CONTROLMASTER®
SMART AUTOMATION & CONTROL TECHNOLOGY BY RCT

SERVICE MANUAL

P9929 – REMOTE SYSTEM (LINE-OF-SIGHT) TO SUIT CATERPILLAR D10T DOZER SERIAL NUMBERS RJG02946 AND UP

www.rct-global.com

LEGAL NOTICE

1. You acknowledge that this document is protected under copyright law and Remote Control Technologies Pty Ltd or its related bodies corporate ("**RCT**") owns the copyright in this document or otherwise have permission or licence from the relevant owner to use certain specific works.
2. You must not make any changes, amendments, variations, alterations or modifications to the document.
3. You must not reproduce this document in any form or by any means, or to make copies of this document without RCT's prior written consent.
4. The contents in this document constitute confidential information of RCT. You must not circulate, distribute or otherwise allow the document to be available in the public domain, or to disclose or share the document with any third party, without RCT's prior written consent.
5. RCT provides the document to you on an "*as is*" basis. RCT is not required to provide any updates to this version of the document. RCT may make any change, amendment or modification to the contents in this document without notice to you.
6. RCT takes a best endeavour basis to ensure that the contents in this document are accurate, complete and reliable. RCT does not warrant that the document will continue to be reliable, relevant, accurate or complete due to RCT's continuous efforts in product development, innovation and technology.
7. Any trademarks used in this document belongs to RCT or is used under a licence. The trademarks are not to be used for any purposes, without RCT's prior written consent.
8. Any illustrations used in this document are for illustration purposes only. Illustrations are intended as aids to facilitate your understanding of the subject matter or issue.
9. RCT disclaims all liability, loss or damage that you suffer as a result of your reliance on this document.
10. By your conduct of using or reading this document, you agree to and accept the terms in this notice.

Contents

ControlMaster® Remote Control Solutions comply with Australian Standards AS/NZS 4240

Table of Figures

1

Safety Precautions

⚠ Safe Operating Distance

By definition, ‘safe operating distance’ means:

> *The minimum distance between the operator and the machine beyond which the hazards associated with functioning are acceptable.*

Australian Standard AS/NZS 4240.2:2009 Remote control systems for mining equipment – Operation and maintenance for underground metalliferous mining states, ‘The remote operator work location should be designed in such a manner that ensures the remote equipment cannot come into contact with the operator under any circumstances’.

AS/NZS 4240.1:2009 A4, ‘Safe Operating Practices’ paragraph 2 states that “The safety of mine workers shall be paramount in the application of remote control mining machines, with Safe Working Practices and **Safe Operating Distances** being determined by **risk assessment**”.

The two main areas for consideration are:

1. Machine operating area
2. Safe operating distance

Factors to consider when determining the machine operating area are:

- Factoring the maximum highest gear selection in both forward and reverse that the machine will be used on remote control. Refer to the manufacturers specifications to verify the top speed attainable.
- Determining braking distance required to bring the machine to a complete stop from that speed and conducting brake distance testing with the machine loaded/unloaded.
- Consider and allow for machine articulation and implement/tool movements.
- Account for working environment i.e. working on inclines/declines, surface conditions that may affect machine motion, traction and braking.
- Tramming movements.

Factors to consider when determining the safe operating distance are:

- Determine the operational area that the machine will be used in whilst on remote control; factor in the use of barriers and their effectiveness.
- Proximity of safety zones i.e. cuddies, physical barriers, safety barriers.
- Ensure full and clear visibility of machine operational area.
- Placement of Automation Centre (Teleremote mining only).

Australian Standard AS/NZS 4360 Risk Management may be used as a guide to assist in determining the safe operating distance for remote control operations.

When determining machine braking distance under remote control, the following factors should be considered when conducting tests and determining outcomes from the results.

Normal Remote Operation

- Operator reaction time.
- Remote control/machine electromechanical reaction time.
- Machine brake condition/wear.
- Hydraulic oil temperature/condition/viscosity.
- Environmental conditions.
- Any other factor that may affect braking distance.

Forced Shutdown

Under forced shutdown, the machine’s braking distance may be extended.

Examples of forced shutdown are as follows:

- Barrier violation.
- Emergency stop/remote shutdown button.
- Transmitter low battery power.
- Transmitter tilt switch.
- Transmitter to machine communications lost.
- Any other forced shutdown condition.

⚠ Important Safety Notice

Remote controls must be used from a safe operating distance outside the machine’s operating area. Operating a remote controlled machine within this distance can be dangerous and could result in serious or fatal injuries.

Attention! Become alert. Your safety is involved.

2

Transmitter

Transmitter Specifications

Complies with Standard:	AS/NZS 4240:2009
Guidance Ready;	ControlMaster® Guidance enables
Unit NET Weight (with Battery):	3.96 kg
Operating Voltage:	12 Vdc to 16 Vdc
Current @ 16 V without Radio:	150 mA
Current @ 16 V with Radio:	240 mA
Current @ 16 V with Radio & Teleremote Station:	560 mA
Operating Angle:	Tx will operate until tilted 45° (North, South, East or West)
Power Inlet Plug:	Bayonet Cannon 6-pin: A: +12 Vdc B: 0 V Gnd C: Barrier sense D: Battery charger sense E: +12 Vdc F: 0 V Gnd
Battery Voltage:	16 V (fully charged)
Battery Capacity:	6140 mAh
Battery Type:	8-cell lithium-ion
Battery Dimensions:	L = 148 mm | W = 80 mm | H = 30 mm
Battery Operation:	16 hours transmitting time
Battery Low Voltage Warnings:	Low battery warning @ 13.5 Vdc Critical low battery warning @ 13 Vdc Battery low shutdown @ 12 Vdc
Battery Charge Time:	~3 hours
Processor Type:	MC9S08DZ128
Processor On Board Memory:	4 MB on-board memory
Processor Baud Rate:	38400
Display:	LCD graphical 240 x 320 pixels
Display Overall Dimensions:	L = 15 mm | W = 84 mm | H = 52 mm
Display Viewing Angle:	180° viewing angle
Display Current Draw:	130 mA
Front Switch Type:	Eaton IP67
Side Switch Type:	Pushbutton IP67
Communication Supported:	Serial CAN J1939
Radio Types Supported:	RFI-480, RFI-433, AC4790, TDL2-433
Radio Baud:	All radios are 9600 baud
Transmit Power:	RFI-480 @ 350 mW (software adjustable) RFI-433 @ 10 mW AC4790 @ 1000 mW (software adjustable)
Radio Current Draw:	RFI-480 @ 25 dBm – 90 mA RFI-433 @ 14 dBm – 90 mA AC4790 @ 20 dBm – 40 mA
Line-of-Sight Operating Distance:	RFI-480 @ max power : 450 metres RFI-433 @ max power : 450 metres TDL2-433 @ max power : 100 metres AC4790 @ max power : 250 metres

Receive Sensitivity:	RFI-480: -108 dBm RFI-433: -108 dBm AC4790: -99 dBm
Aerial Type:	Patch antenna tuned (470–490 MHz for RFI-480 & 915-928 MHz for AC4790 433 MHz)
Communications Failure Time:	Max 1000 ms from loss of data
Operating Temperature:	−15 °C to +65 °C at 95% RH
Software Startup Delay:	@ 5 seconds
Standard Inputs:	8 x analogue 24 x digital to processor 4 x digital from joystick
Matching Pair Integrity:	1 to 9999 identity codes (software selectable)
Disparity Checking:	Disparity checking on joysticks and park brake and start
Joysticks:	Hall effect joystick (dual sensors)
Firmware:	Upgradable using PC
Operator Chair Interface:	CAN base network (J1939) Cannon bayonet type 6-pin A: +12 Vdc B: 0 V Gnd C: CAN high D: CAN low E: Detect F: Local Teleremote
Dimensions:	L: 385 mm | W: 200 mm | H: 215 mm (from the base to the top of the joystick)
Switch Processor Common Supply Rail Voltage:	~5 Vdc
System Volt Measurement at Components (Without Teleremote Station):	Voltage @ battery : 15.99 Vdc Voltage @ Switch processor : 15.83 Vdc Voltage @ S08 (main) processor : 15.78 Vdc Voltage @ Radio : 15.73 Vdc Voltage @ CAN header of S08 (main) processor : 15.75 Vdc Voltage @ CAN plug on battery interface PCB : 15.73 Vdc Voltage @ Teleremote chair base : 15.71 Vdc Total system voltage drop : 280 mV
System Volt Measurement at Components (With Teleremote Station):	Voltage @ battery : 15.99 Vdc Voltage @ Switch processor : 15.68 Vdc Voltage @ S08 (main) processor : 15.52 Vdc Voltage @ Radio : 15.41 Vdc Voltage @ CAN header of S08 (main) processor : 15.40 Vdc Voltage @ CAN plug on battery interface PCB : 15.35 Vdc Voltage @ Teleremote chair base (TX) : 15.33 Vdc Voltage @ Teleremote chair base (Chair) : 15.24 Vdc Voltage @ Teleremote chair regulator : 15.17 Vdc Total system voltage drop : 820 mV
Movement Joystick Voltages (Centre to Full Range):	Forward voltage : 2.5 – 4.5 Vdc Reverse voltage : 2.5 – 0.5 Vdc Left voltage : 2.5 – 4.5 Vdc Right voltage : 2.5 – 0.5 Vdc
Implement Joystick Voltages (Centre to Full Range):	Raise voltage : 2.5 – 0.5 Vdc Lower voltage : 2.5 – 4.5 Vdc Curl voltage : 2.5 – 4.5 Vdc Dump voltage : 2.5 – 0.5 Vdc
Joystick Disparity Error Message:	Greater than 13.5%

Switch and Joystick Input Pin Assignment

Transmitter Left Side Switch Inputs

Pin No.	Header	Wire Colour	Description
1	(CN8)	Red	Switch Common
2	(CN8)	Green	Raise Rpm / Slow Winch Speed
3	(CN8)	Blue	Spare/Override
4	(CN8)	Yellow	Camera Select
5	(CN8)	Not Used	Not Used

Transmitter Right Side Switch Inputs

Pin No.	Header	Wire Colour	Description
1	(CN7)	Red	Switch Common
2	(CN7)	Green	Lower Rpm / Ladder Down / GPS Grade Enable
3	(CN7)	Blue	Gear Up
4	(CN7)	Yellow	Gear Down
5	(CN7)	Not Used	Not Used

Transmitter Emergency Stop Switch Inputs

Pin No.	Header	Wire Colour	Description
1	(CN3)	Not Used	Not Used
2	(CN3)	Not Used	Not Used
3	(CN3)	Not Used	Not Used
4	(CN3)	Not Used	Not Used
5	(CN3)	Red	Switch In
6	(CN3)	Red	Switch Out
7	(CN3)	Not Used	Not Used
8	(CN3)	Not Used	Not Used

Left Joystick Inputs

Pin No.	Header	Wire Colour	Description
1	(CN6)	Red	5 V Supply
2	(CN6)	Black	0 V Gnd
3	(CN6)	White	Left / Right 1
4	(CN6)	Yellow	Left / Right 2
5	(CN6)	Orange	Forward / Reverse 1
6	(CN6)	Blue	Forward / Reverse 2
7	(CN6)	Grey	Raise Rpm Top Switch
8	(CN6)	Brown	Lower Rpm Lower Switch

Right Joystick Inputs

Pin No.	Header	Wire Colour	Description
1	(CN5)	Red	5 V Supply
2	(CN5)	Black	0 V Gnd
3	(CN5)	White	Blade Tilt Left / Right 1
4	(CN5)	Yellow	Blade Tilt Left / Right 2
5	(CN5)	Orange	Blade Lower / Raise 1
6	(CN5)	Blue	Blade Lower / Raise 2
7	(CN5)	Grey	Rip Select / Blade Float / Upper Switch
8	(CN5)	Brown	Pitch Select Lower Switch

Joysticks (General)

The left and the right joysticks supply proportional values from the transmitter to the receiver. If an open or short circuit occurs with the joysticks, the transmitter will send a null state (centre joystick position) for that function and will indicate the failure on the transmitter display.

The joysticks are configured to have a dead band of 20% travel around the centre position before any control is activated. When a joystick is moved beyond the dead band, the transmitter supplies proportional values to the receiver with a resolution that reflects the angle of the joystick.

By moving the tramming or implement joysticks with the park brake released, the receiver scales its output values between the minimum and maximum set points to the respective proportional control. These values are calibrated using the machines OEM sensors (refer to the *Setup and Calibration* section).

The tramming forward and reverse functions both drive the proportional decelerator output. They also drive the forward and reverse digital outputs.

A second Hall Effect sensor is located on each axis of the joystick shaft to provide confirmation of the direction of movement at the joystick.

Selectable Options

Service Menu: Watchdog Trigger

There are eleven watchdogs in the ATX2200 Dozer system; monitoring communications between the various devices in the system. These watchdogs form an essential part of the safety system and must be tested as part of any software upgrade. The watchdogs are triggered from the RCT Configuration Utility.

Watchdog Types

No.	Type	Description
1	CMT COMMS	This trigger interrupts the watchdog update sent from the transmitter to the receiver.
2	CMR COMMS	This trigger interrupts the watchdog update sent from the receiver to the transmitter.
3	CMT HARDWARE	This trigger interrupts the transmitter processor watchdog update.
4	CMR HARDWARE	This trigger interrupts the receiver processor watchdog update.
5	JCAN 1 CAN	This trigger interrupts the receive CAN watchdog from the left joystick.
6	JCAN 2 CAN	This trigger interrupts the receive CAN watchdog from the right joystick.
7	PENDANT CAN	This trigger interrupts the watchdog from the transmitter processor to the transmitter I/O PCB.
8	CAN SIGNAL 1TX	This trigger interrupts the watchdog from the receiver processor to the logic CAN module 1 I/O PCB.
9	CAN SIGNAL 2 TX	This trigger interrupts the watchdog from the receiver processor to the logic CAN module 2 I/O PCB.
10	CAN SIGNAL 1 RX	This trigger interrupts the watchdog from the logic CAN module 1 I/O PCB to the receiver processor.
11	CAN SIGNAL 2 RX	This trigger interrupts the watchdog from the logic CAN module 2 I/O PCB to the receiver processor.

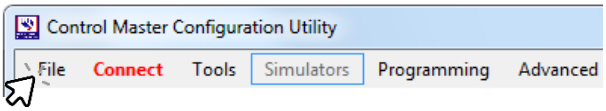
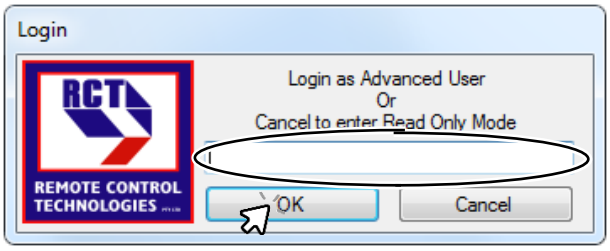
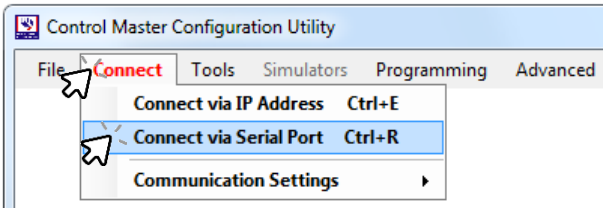
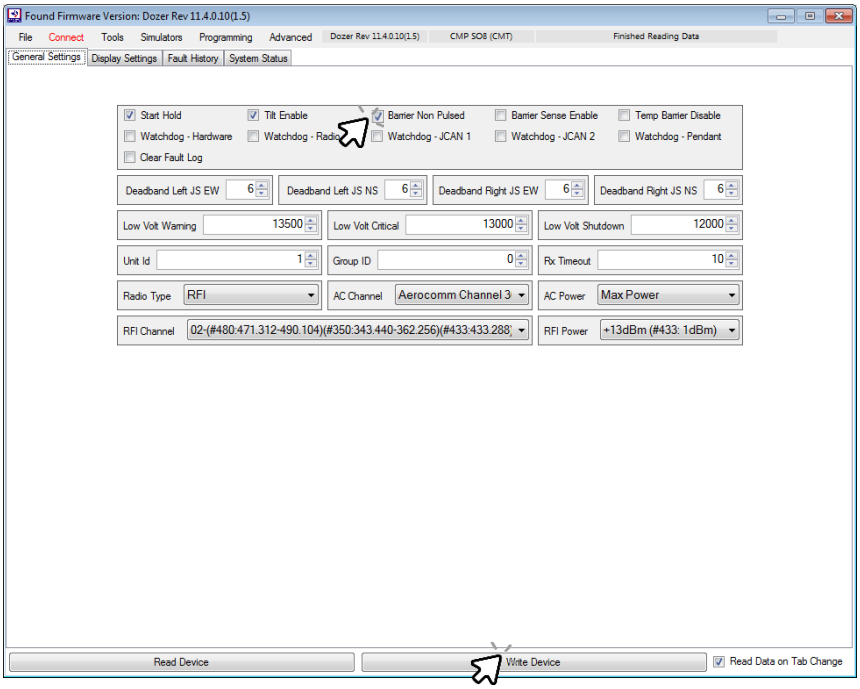
Barrier Non Pulsed

This is a customer-specific setting. When this feature is selected, the barrier input into the transmitter requires a constant steady signal of up to 24 V to allow normal operation of the transmitter. Any interruption of this signal will result in the message, 'BARRIER BREAK' being displayed at the transmitter LCD.

When this feature is not selected, the barrier input into the transmitter requires a pulsed 8 Hz signal of up to 24 V to allow normal operation of the transmitter. Any interruption of this signal will result in the message, 'BARRIER BREAK' being displayed at the transmitter LCD.

The default setting for the barrier input is pulsed barrier input.

To access the **Barrier Non Pulsed** option:

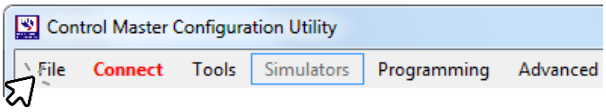
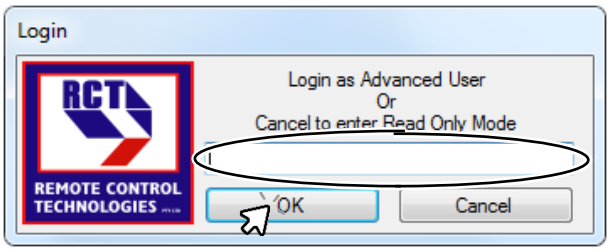
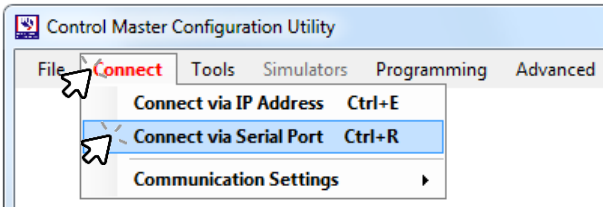
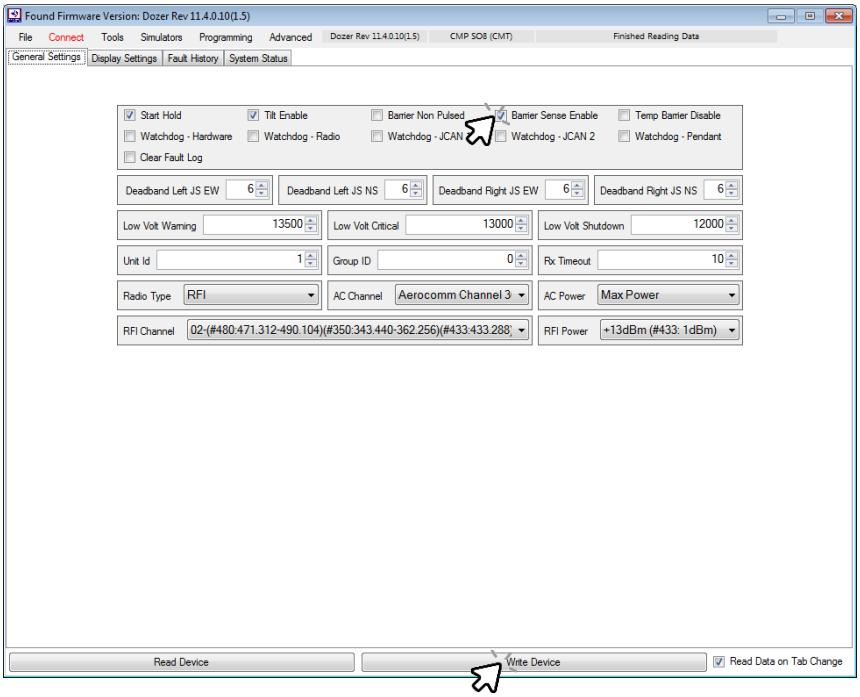
1.	Connect the PowerMaster lead (3314) to the Cannon base located at the base of the transmitter.	
2.	Connect the PowerMaster lead to a serial port on the computer.	
3.	Start the RCT configuration utility.	
4.	Click **File**, and then click **Advanced login**.	
5.	When the login box appears, type in the password. Click **OK**.	
6.	Click Connect, and then click **Connect via Serial Port**.	
7.	Select or deselect the **Barrier Non Pulsed** checkbox, and then click **Write Device**.	

Barrier Sense Enabled

When this feature is selected, the barrier break error message is enabled. This selection will require a barrier to be plugged into the transmitter when the Automation Centre is connected. This option is de-selectable in the RCT configuration utility.

The default setting is for barrier enable to be selected.

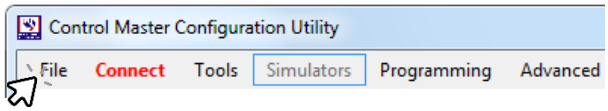
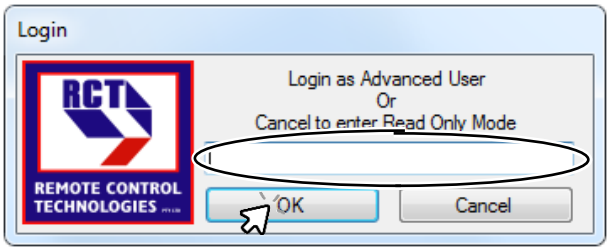
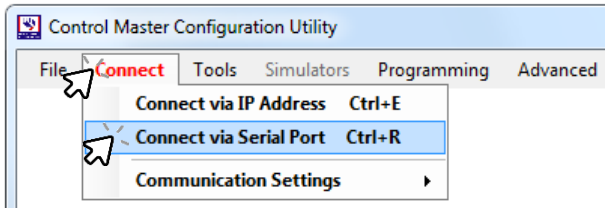
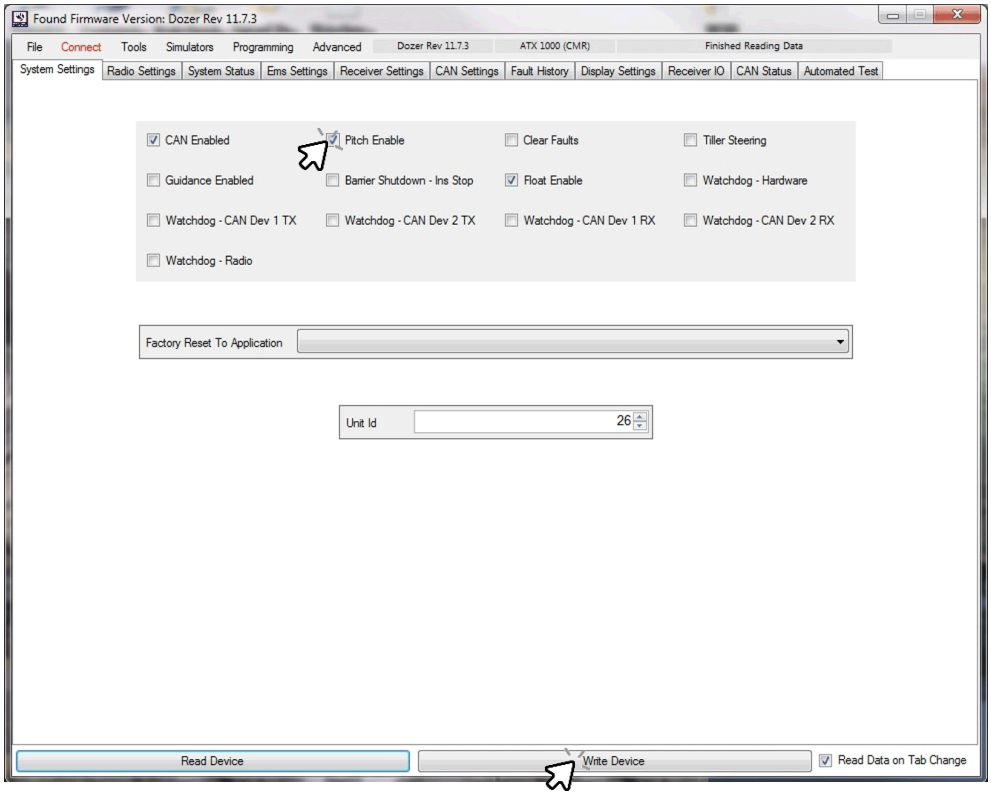
To access the **Barrier Sense Enable** option:

1.	Connect the PowerMaster lead (3314) to the Cannon base located at the base of the transmitter.	
2.	Connect the PowerMaster lead to a serial port on the computer.	
3.	Start the RCT configuration utility.	
4.	Click **File**, and then click **Advanced login**.	
5.	When the login box appears, type in the password. Click **OK**.	
6.	Click Connect, and then click **Connect via Serial Port**.	
7.	Select or deselect the **Barrier Sense Enable** checkbox, and then click **Write Device**.	

Enable Tilt Blade Control

When this feature is selected, operators can alter the position of the tip and tilt of the dozer blade. This option can be selected in the RCT configuration utility.

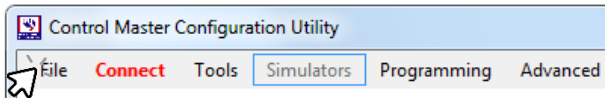
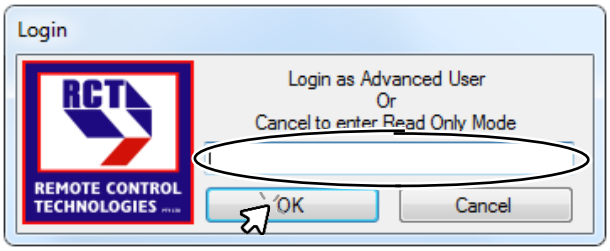
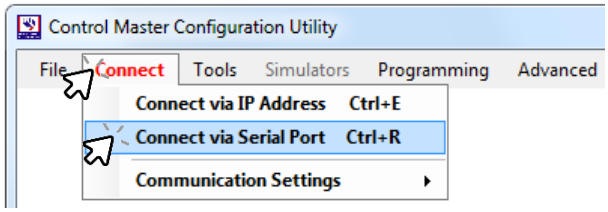
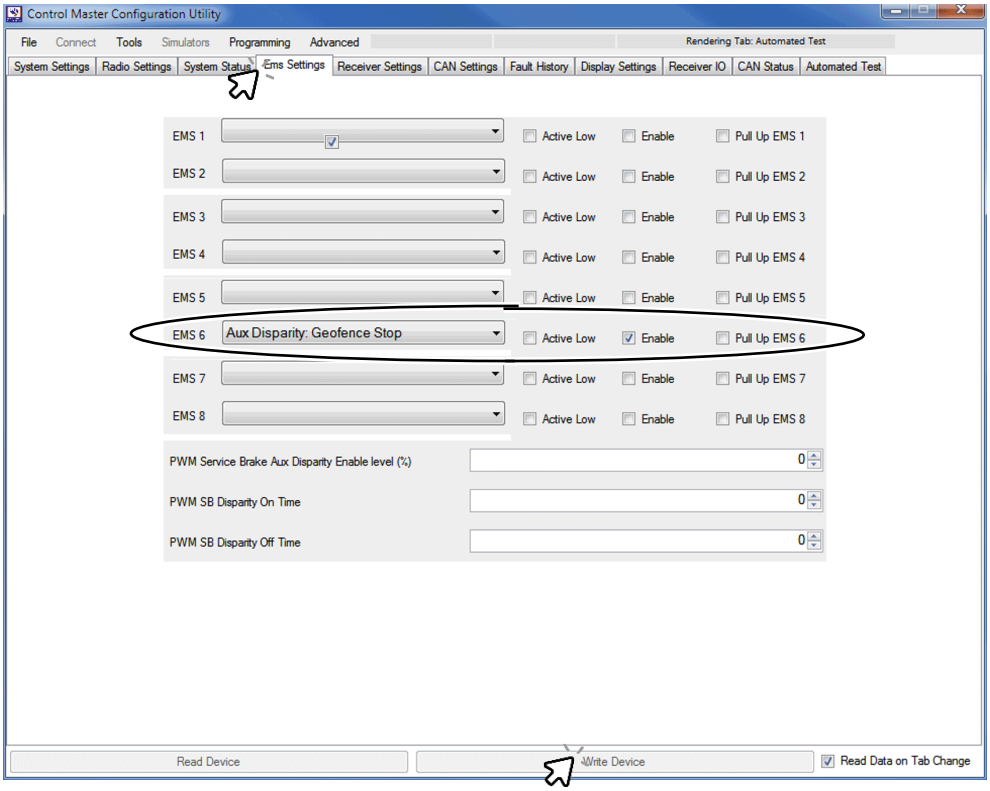
To access the **Tilt Enable** option:

1.	Connect the PowerMaster lead (3314) to the Cannon base located at the base of the transmitter.	
2.	Connect the PowerMaster lead to a serial port on the computer.	
3.	Start the RCT configuration utility.	
4.	Click **File**, and then click **Advanced login**.	
5.	When the login box appears, type in the password. Click **OK**.	
6.	Click Connect, and then click Connect via Serial Port.	
7.	Select or deselect the **Pitch Enable** checkbox, and then click **Write Device**.	

Enable Geofence Stop

When this feature is selected, vehicles fitted with a compatible Trimble Geofence System can wire in the Geofence to stop the vehicle if the Geofence boundary is crossed. Operators can use the override function to move the vehicle back into a safe location. This option can be selected in the RCT configuration utility.

To enable/disable the **Geofence Stop** option:

1.	Connect the PowerMaster lead (3314) to the Cannon base located at the base of the transmitter.	
2.	Connect the PowerMaster lead to a serial port on the computer.	
3.	Start the RCT configuration utility.	
4.	Click **File**, and then click **Advanced login**.	
5.	When the login box appears, type in the password. Click **OK**.	
6.	Click Connect, and then click **Connect via Serial Port**.	
7.	Click the **EMS Settings** tab. In the **EMS 6** list box, select **Aux Disparity: Geofence Stop**, and then select the **Enable** checkbox. Check the settings, and then select **Write Device**. To disable the geofence setting, make sure the **Enable** checkbox is not selected. 

3

Transmitter Battery Charger

Overview

The ControlMaster® Battery Charger, part number 11777, has been designed to provide a simple and compact charging source for lithium-ion batteries to suit the ControlMaster® ATX transmitters.

The battery charger works by using an AC adaptor, reducing the mains voltage ac power source to 24 volts dc. The dc voltage is supplied to the charger module which supplies a suitable voltage and current source to charge the 16-volt lithium-ion battery.

Safety Instructions

Correct Use

- This charger is only intended for use with the ATX battery (part number 10710). The charger is not designed to charge any other battery.
- The charger is designed for use in a dry and protected environment at temperatures of 0 to +50 °C, indoor use only.

General Safety Instructions

- Connect the charger only to a correctly installed socket. The voltage must correspond to the one specified on the rating plate of the charger.
- Ensure that the mains cable is not damaged and keep it away from sharp edges, humidity, heat or oil.
- Do not connect the charger if the mains cable is damaged. A damaged mains cable must be replaced immediately. Contact the RCT sales team for a replacement cable.
- Place the mains cable safely and out of the way to prevent it from becoming a tripping hazard.
- Remove plug from mains if the charger is not in use.

Special Safety Instructions

- Disconnect the battery and remove input power from the charger immediately if the charger becomes hot.
- Do not cover the charger as it could overheat and thus be damaged.
- Prior to installation, maintenance or repair, disconnect the charger from mains power.
- Do not allow water, moisture or foreign objects into the charger.
- Do not expose the charger to strong sunlight for a prolonged period of time.
- Allow the charger or battery to cool down before reconnecting.
- Always disconnect from the power source when not in use.

Electronic Specifications

CHARGER	**Part number:**	11777
	Stock code:	67000-549
INPUT	**Ac voltage range:**	90–264 Vac 50/60 Hz
	Dc voltage range:	24 Vdc
	Efficiency:	75% minimum full load at rated input
	Max input power:	100 W
OUTPUT	**Constant current (CC) mode:**	At beginning of charging, 2.0 Adc (Av) constant charging current to charge the pack until the pack voltage reaches to 16.8 V (+1%, −3%).
	Constant voltage (CV) mode:	The output will keep 16.8 V constant through the end of charging.
	Max output power:	35 W ± 5%
	Battery fully charged condition:	Terminate current ≦ 200 ± 10 mA Initial battery voltage > 16.8 ± 0.5 V
	Efficiency:	≧ 90%
ENVIRONMENT	**Operating temperature and humidity range:**	0 ~ 50 °C / 20 ~ 90% RH
	Storage temperature and humidity range:	−20 ~ 85 °C / 20 ~ 90% RH
CERTIFICATES	**Safety:**	EMI
MECHANICAL	**Weight:**	Approximately 2.21 kg
	Dimensions:	Length: 200 | Depth:175 | Height: 100 mm

Note

The ac mains plug supplied with the battery charger is only suitable for use in Australia, New Zealand, China and Argentina.

Figure 1 Example of Australian two-prong and three-prong ac mains plugs and socket

For other countries, ensure suitable approved adaptors are used.

Features

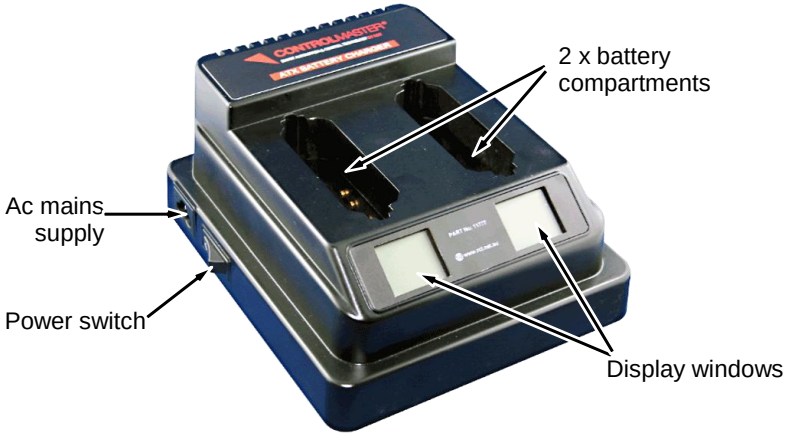
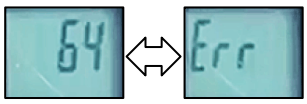


Figure 2 Battery Charger, part number 11777

Operation

1. Check that the battery charger is switched off.
2. Ensure the mains cable is plugged into the side of the charger.
3. Plug the mains cable into a suitable outlet and turn the outlet on.
4. Insert the batteries into the battery charger.
5. Switch the charger on. The LCD will scroll through following displays.
   a.  Battery state of charge in percentage (displays for two seconds).
   b.  Remaining charge time in minutes (displays for 10 seconds).
6. When the battery is fully charged, the display will show  .

For units built after June 2020, the following function will also be present.

Battery Condition	Description	Display	Recommended Action
■ Battery charged to 100% of its current maximum capacity, **AND** ■ Total capacity of the battery is below 65% of the design capacity.	The display will alternate between showing the total capacity and an error message.	 Alternating display	Replace the battery

Compliance

The particular standards that we presently comply with, relating to the battery charger, include:

- CE
- RCM (formerly C-tick)
- FCC
- **IEC60335-1:2013-12** – Household and similar electrical appliances – Safety – Part 1: General requirements
- I**EC60335-2-29:2004-12 –** Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers

Electrical Warnings

⚠ Warning – Danger of Serious or Fatal Injury

1. Before use, read the manual completely.
2. Turn the power switch to the OFF position before connecting or disconnecting the battery.
3. Never touch the unit when your hands are wet.
4. Never operate the unit if foreign materials such as metallic objects, water, or other debris have fallen inside. Contact RCT for check and repair.
5. Never allow foreign objects to touch the battery connector terminals.
6. Never block the vents on either side of the enclosure.
7. Never operate the unit when damaged in any way.
8. Never connect to a non-rechargeable battery—may cause a leakage or an explosion.
9. This unit is designed to charge the ATX2200 Transmitter 16 V Lithium-Ion battery (part number 10710) **ONLY.** Do **NOT** use to charge any other type.
10. This unit is for indoor use only.
11. Place the unit in an area that allows air circulation.

4

Receiver

Receiver Specifications

Complies with Standard:	AS/NZS 4240:2009
Operating Voltage:	6.5 Vdc to 32 Vdc
Current @ 12 V:	750 mA
Communication Supported:	9600 baud
Radio Types Supported:	Modbus proprietary 38400 RFI-480 @ 350 mW AC4790 @ 1000 mW RFI-433 @ 10mW TDL2-433 @ 10 mW
Transmit Power:	Adjustable
Receive Sensitivity:	@ −95 dBm
Aerial Type:	BNC
Communications Failure Time:	Max 1000 ms from loss of data
Operating Temperature:	0 °C to 60 °C at 95% RH
Software Start-up Delay:	@ 15 seconds
Standard Outputs ON/OFF:	12 x 2000 mA pulling high
Standard Outputs Proportional:	8 x 2000 mA positive (+) pulse width modulated
Standard Inputs:	8 x analogue (EMS inputs) 8 x digital (EMS inputs)
Matching Pair Integrity:	1 to 9999 identity codes (software selectable) displayed on power up
Dimensions:	Length: 300 mm | Width: 200 mm | Height: 110 mm
Diagnostics:	LCD
System Reaction Time:	Average 87 ms
Communications Error Check:	CRC-16; three consecutive data strings before registration of system failure
Watch Dog 1:	CMR hardware Reset by failed application program Operating system to reset if timer not updated within 0.5 second
Watch Dog 2:	Chair CAN CMT monitors this register to ensure data from the Chair joysticks is current CMT shuts down on communication failure if the data is not current after one second
Watch Dog 3:	CAN Signal module left joystick Processor resets one second after application fails to update
Watch Dog 4:	CAN signal module right joystick Processor resets one second after application fails to update
Watch Dog 5:	Radio communications watch dog register sent to CMR by the CMT CMR monitors this register to ensure data from the CMT is current CMR shuts down on communication failure if the data is not current after one second

Receiver External Layout (684p)

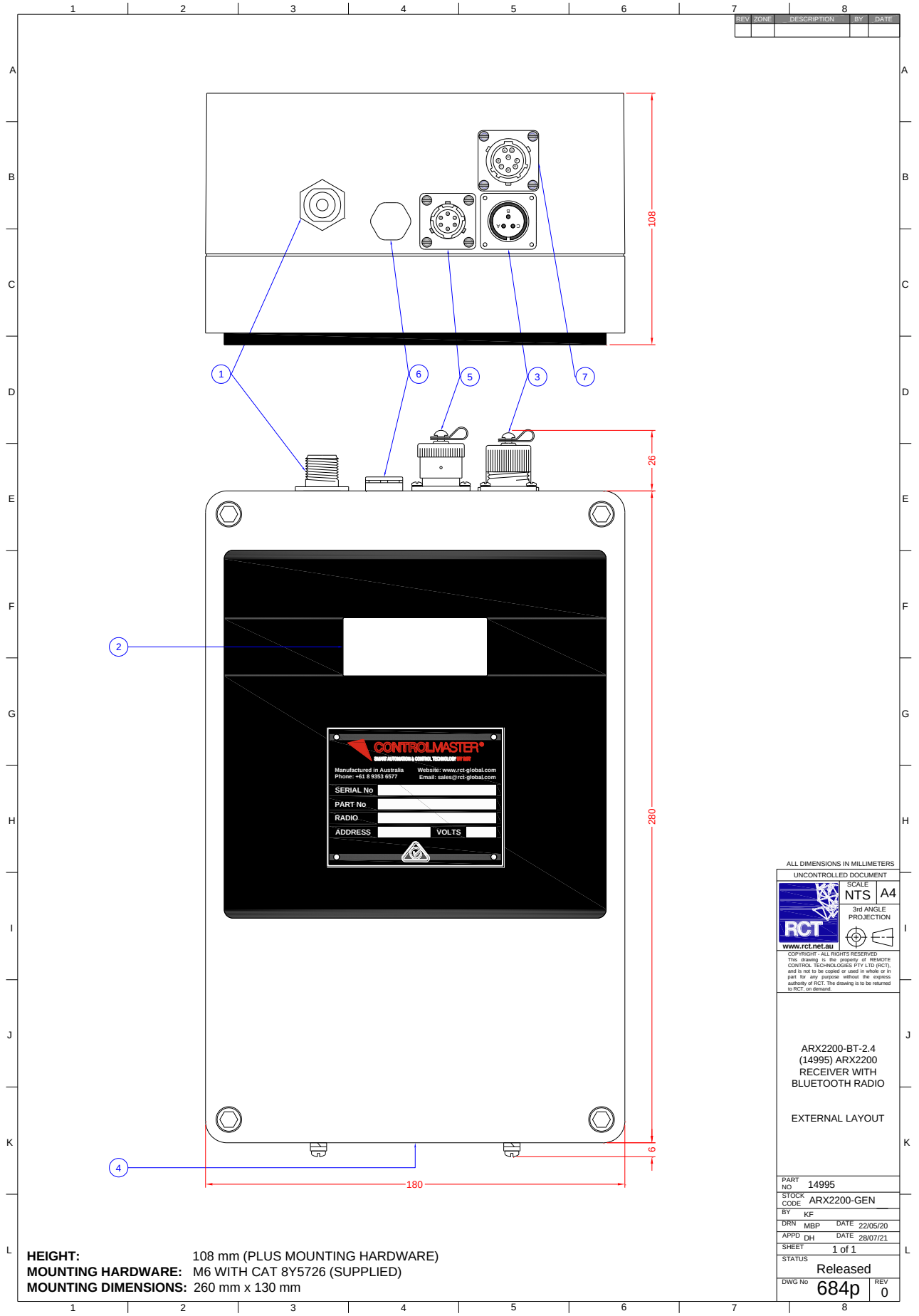
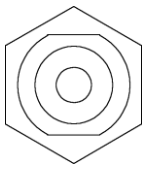
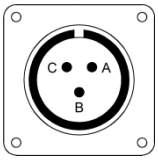
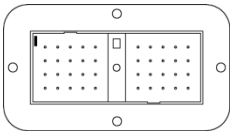
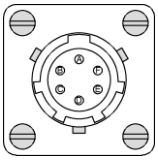
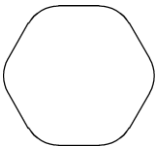
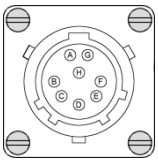


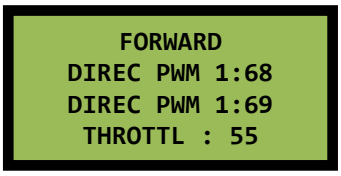
Figure 3 Drawing 684p – Receiver external layout

Receiver Operational Features

No.	Connection	Description
1		**Aerial Connector** The aerial connector provides the communications link at the receiver.
2		**LCD Display** The LCD provides set up, diagnostic and operational information. The receiver system ID number is shown on power-up.
3		**3-Pin Modbus Cannon Base Connector** The 3-pin Modbus Cannon base is used for configuring and monitoring the software using the RCT configuration utility.
4		**Deutsch Logic Plug** The Deutsch logic plug contains the wiring required to remotely control the machine.
5		**6-Socket Ethernet Cannon Base Connector** The Ethernet 6-socket Cannon base is used for uploading new software and to communicate over an Ethernet connection.
6		**Pressure Vent** The pressure vent is used to equalise pressure and reduce condensation.
7		**8-Pin Bayonet Connector** The 8-pin bayonet connector is used for connection to the 4 x CAN channels internal of the receiver.

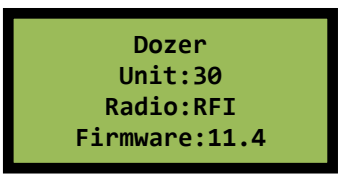
Output Display

The LCD located on the front of the receiver shows the outputs being driven to the machine logics. The most recent output is displayed at the top line. The proportional outputs are displayed as a duty cycle percentage and the digital outputs are displayed as text.



Software Revision Number and Product Series Number

When the receiver is first switched on, the LCD will show the ControlMaster® remote product series number and the software revision number. The software version will depend on the chosen application as displayed on screen.



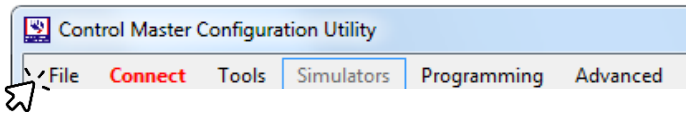
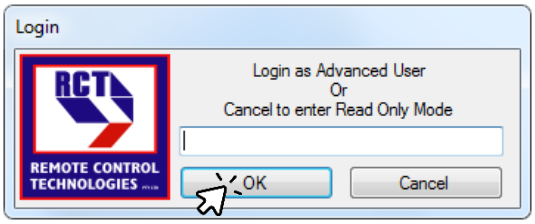
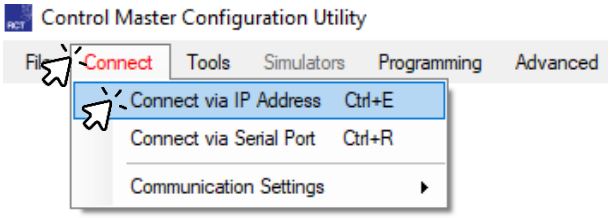
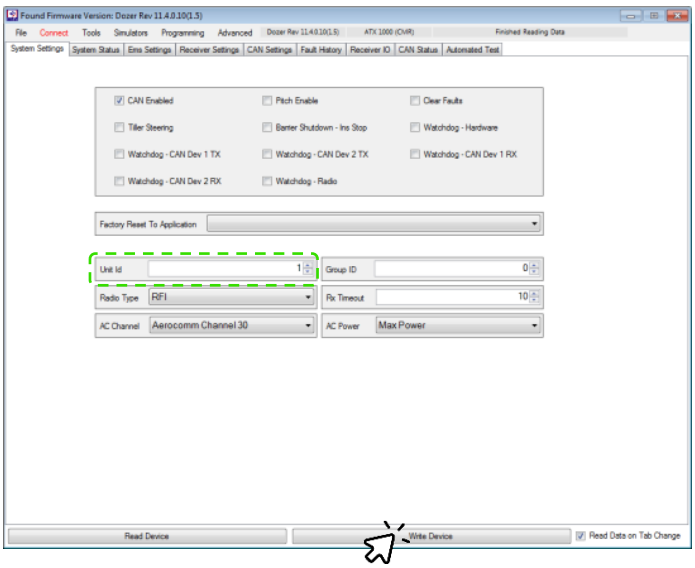
Unit Identification Number

Each receiver/transmitter set is assigned a unique unit identification number. This number is set at the factory. The radio type installed will also be shown briefly on power up.

Changing the Unit Identification Number of the Receiver

Setting the Receiver Unit ID Number

For the transmitter and receiver to communicate with each other, both must be set to the same Unit ID number. The range of numbers can be between 0 and 9999, although the Unit ID number should be the same as the remote serial number located on the side of the receiver and beneath the battery of the transmitter. If required, the Unit ID of the receiver may be changed with the ControlMaster® Configuration Utility. The ControlMaster® Programming Lead (8809) is required to link the computer to the receiver. You will be required to change the IP address of the computer to one that the receiver can communicate with (e.g. 192.168.0.125 with a subnet of 255.255.255.0). Refer to the section titled '*Enabling the Laptop to Communicate with the CM2200 Receiver*' on page 65.

1.	Connect the ControlMaster® Programming Lead (8809) to the Cannon base located on the side of the receiver.	
2.	Connect the ControlMaster® Programming lead (8809) to the Ethernet port on the computer.	
3.	Ensure the receiver is powered on.	
4.	Launch the ControlMaster® Configuration Utility.	
5.	Click **File**, and then click **Advanced login**.	
6.	When the login box appears, type in the password. Click **OK**.	
7.	Click **Connect**, and then click **Connect via IP Address**.	
8.	In the **Unit ID** field, click the up or down arrows to increase or decrease the Unit ID number until the required number is reached	
9.	Click **Write Device** at the bottom of the window to save the setting.	

Receiver Input/Output Tables

Digital Outputs

Pin	Function	Type
1	Start Engine	DO(2)
2	Engine Run	DO(1)
3	Front Lights	DO(4)
4	Park Brake	DO(3)
5	Rear Lights	DO(5)
11	Instant Shutdown (where required)	DO(11)
12	Horn	DO(8)
13	Reverse	DO(9)
14	Fire Suppression	DO(6)
15	Camera Select	DO(7)

Pin	Function	Type
21	Forward	DO(10)
22	Raise RPM	DO(13)
23	Blade Tip (NC)	DO(12)
24	Lower RPM	DO(14)
25	Decelerator Select	DO(16)
32	Service Brake Limit Switch	DO(19)
33	Upshift	DO(17)
34	Downshift	DO(18)
35	Override	DO(15)

PWM Outputs

Pin	Function	Type
26	Not Used	PO(1)
27	Not Used	PO(2)
28	Not Used	PO(3)
29	Not Used	PO(4)

Pin	Function	Type
30	Not Used	PO(5)
40	Not Used	PO(6)
39	Decelerator	PO(7)
38	Not Used	PO(8)

EMS Inputs

Note

The EMS settings are machine specific; this is a generic example of one typical setup. The EMS options will be configured from factory to suit the particular dozer model.

Pin	Function	Type
19	Action Alarm (Stop Engine)	DIN (3)
9	Fuel Level (NC)	AN (1)
17	Forward Auxiliary Disparity	DIN (6)
18	Ladder Stowed	DIN (5)

Pin	Function	Type
20	Action Lamp (Check Engine)	DIN (4)
10	Machine Park Brake Input	AN (2)
6	Reverse Auxiliary Disparity	DIN (7)
7	Second Gear	DIN (8)

Power/Ground

Pin	Function	Type
8	Ground	
37	Ground	
31	Processor Drive	

Pin	Function	Type
36	FET Drive	VFDRV
16	PWM Drive (PWM 7, 8, 5, 6, 1 to 4)	VPWM

Note

(NC) = Not Connected

CAN Interface Module External Layout (528g)

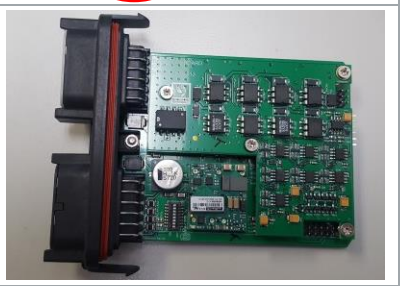
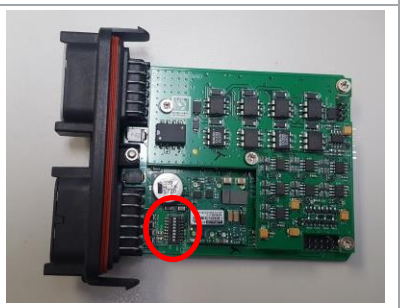
Figure 4 Drawing 528g – CAN interface module external layout

CAN Interface Module Specifications

Complies with Standard:	AS/NZS 4240:2009
Operating Voltage:	10 Vdc to 32 Vdc
Communication Supported:	AN J1939/RS232 (default: CAN)
Operating Temperature:	0 °C to 60 °C (at 95% relative humidity)
Standard Outputs ON/OFF:	2 x 2000 mA pulling high
Standard Outputs Proportional:	8 x 200 mA PWM/analogue 0 to 5 V outputs
Standard Inputs:	8 x PWM/analogue 0 to 5 V inputs
ID Selection Switches:	2 x DIP Switches (internal 7 & 8, 4 ID selections)
Dimensions:	Length: 133 mm, Width: 119 mm, Height: 39 mm
Diagnostics:	Tri-colour LED: ■ Flash through all colours at startup ■ 1 Hz flash red = shutdown state ■ 1 Hz flash green = running state ■ 2.5 Hz flash red = disparity shutdown state
Configuration:	Via ATX2200 or RCT Configuration Utility

Replacing a CAN Module

In the event of a CAN module failure, the remote receiver and the remote interface will need to be removed to allow access to the CAN modules. Unplug and remove the damaged module. Before fitting the new module, the address switches inside the module will need to be set. Follow the instructions to set the correct address for the location that the module will be installed.

1.	Open up the unit by prying the two tabs on the side with a screw driver to expose the PCB assemblies.	
2.	Remove the plug and PCB assembly from the housing.	
3.	Locate the DIP switch assembly on the front of the PCB.	

4.	Using a fine tip screwdriver set the DIP switches to the correct combination.	
5.	Refit the plug and PCB assembly into the housing. Push firmly to ensure that the two side clips are correctly engaged.	

CAN Module I/O Table Connector A (CAN Module 1)

Pin	Signal	Description
1	Battery Supply	8 to 32 Vdc
2	Input 1	Up Shift/Down Shift / Bi-Directional Shift (Not Connected)
3	Input 2	Direction (FNR) Sensor 2 Signal (Not Connected)
4	Input 3	Left Hand Steering Sensor 1 (Left Paddle)
5	Input 4	Right Hand Steering Sensor 2 (Right Paddle)
6	Input 5	Steering Sensor 3/Rpm Dial (Not Connected)
7	Output 5	Steering Sensor 3/ Rpm Dial (Not Connected)
8	Output 4	Right Hand Steering Sensor Signal 2 (Right Paddle)
9	Output 3	Left Hand Steering Sensor Signal 1 (Left Paddle)
10	Output 2	Direction (FNR) Sensor 2 (Not Connected)
11	Output 1	Up Shift/Down Shift / Bi-Directional Shift (Not Connected)
12	Ground	0V Chassis

CAN Module I/O Table Connector B (CAN Module 1)

Pin	Signal	Description
1	Input 6	Direction (FNR) Sensor 1 (Not Connected)
2	Input 7	Service Brake Pedal Position Sensor (Not Connected)
3	Input 8	Second Gear Sense
4	Output 9	Ladder Raise
5	Digital Return 1	Powertrain Earth Return
6	CAN −	CAN Data J1939
7	CAN +	CAN Data J1939
8	Digital Return 2	Powertrain Earth Return
9	Output 10	Ladder Down
10	Output 8	Not Used
11	Output 7	Service Brake Pedal Position Sensor (Not Connected)
12	Output 6	Direction (FNR) Sensor 1 (Not Connected)

CAN Signal Module Addressing

- CAN Module 1 = DIP switch 7 on and 8 off

DIP Switches (1–8)

1. ON = CAN+ connected to PB-7 (mutually exclusive with RS232)
2. ON = CAN – connected to PB-6
3. OFF = RS232 TX connected to PB-6 (mutually exclusive with CAN)
4. OFF = RS232 RX connected to PB-7
5. ON = input 7 normal feed thru to local remote relay
6. ON = input 8 normal feed thru to local remote relay
7. OFF = CPU CAN SEL 0 (PORT A bit 0 = LOW)
8. OFF = CPU CAN SEL 1 (PORT A bit 0 = HI)

CAN Module I/O Table Connector A (CAN Module 2)

Pin	Signal	Description
1	Battery Supply	8 to 32 Vdc
2	Input 1	Blade Tip Forwards/Backwards/Pitch Angle Right/Left
3	Input 2	Blade Tilt Left/Right
4	Input 3	Blade Raise/Lower
5	Input 4	Ripper In/Out Winch Reel In/Out
6	Input 5	Ripper Raise/Lower Winch Brake Apply/Release
7	Output 5	Ripper Raise/Lower Winch Brake Apply/Release
8	Output 4	Ripper In/Out Winch Reel In/Out
9	Output 3	Blade Raise/Lower
10	Output 2	Blade Tilt Left/Right
11	Output 1	Blade Tip Forwards/Backwards/Pitch Angle Right/Left
12	Ground	0 V Chassis

CAN Module I/O Table Connector B (CAN Module 2)

Pin	Signal	Description
1	Input 6	CAN I/O Checking
2	Input 7	Chassis Reference Direction (FNR) Sensor (Not Connected)
3	Input 8	Chassis Reference Service Brake Position SensorNot Connected
4	Output 9	Digital Output (Not Connected)
5	Digital Return 1	Implement Earth Return
6	CAN −	CAN Data J1939
7	CAN +	CAN Data J1939
8	Digital Return 2	Implement Earth Return
9	Output 10	Digital Output (Not Connected)
10	Output 8	Chassis Reference Service Brake Position Sensor (Not Connected)
11	Output 7	Chassis Reference Direction (FNR) Sensor (Not Connected)
12	Output 6	Spare

CAN Signal Module Addressing

- CAN Module 2 = DIP switch 7 off 8 on

DIP Switches (1-8)

1. ON = CAN+ connected to PB-7 (mutually exclusive with RS232)
2. ON = CAN – connected to PB-6
3. OFF = RS232 TX connected to PB-6 (mutually exclusive with CAN)
4. OFF = RS232 RX connected to PB-7
5. ON = input 7 normal feed thru to local remote relay
6. ON = input 8 normal feed thru to local remote relay
7. ON = CPU CAN SEL 0 (PORT A bit 0 = HI)
8. OFF = CPU CAN SEL 1 (PORT A bit 0 = LOW)

CAN Module Warnings

Described below are warnings hard coded into the CAN module I/O inputs which are used to ensure the correct installation of the CAN I/O modules, and that the correct machine configurations are applied when setting up multiple machines. The inputs are configured when the system is designed and cannot be changed.

CAN I/O Mismatch

The CAN I/O Mismatch warning suggests that the modules have been installed incorrectly and are connected to the wrong harnesses. For example; the implement CAN I/O module (address 2) is connected to where the powertrain CAN I/O module (address 1) should be, and vice versa.

This fault can be rectified by swapping the modules.

Machine Selection Incorrect

The Machine Selection Incorrect warning suggests that the machine configuration selected does not match the machine. For example, the machine in question is a different model or serial number range to the configuration that has been written to the receiver.

This fault can be rectified by selecting and writing the correct machine configuration to the receiver.

5

Machine Interface

Interface Internal Layout (684o)

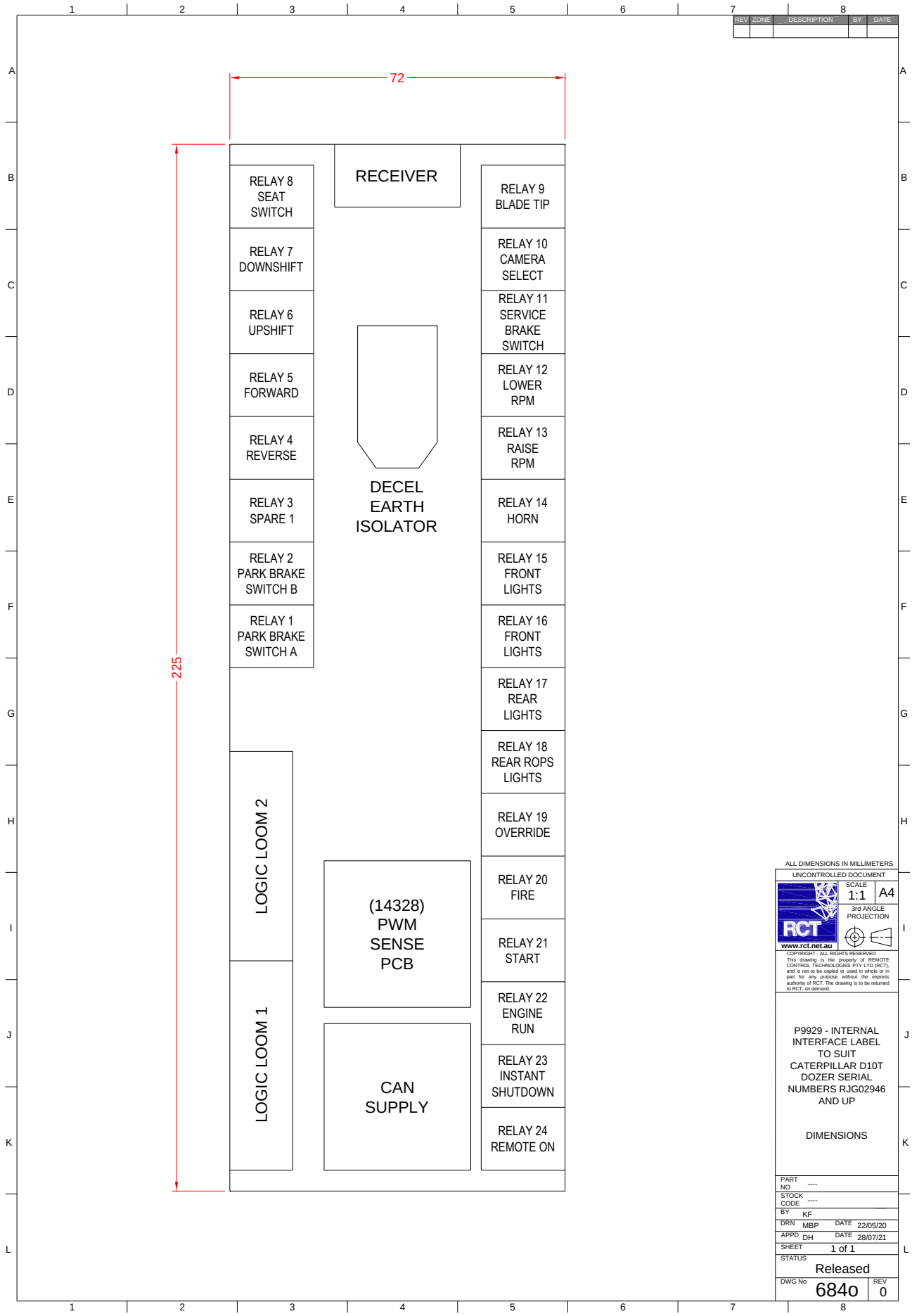


Figure 5 Drawing 684o – Interface internal layout

6

Setup and Calibration

Calibrating the PWM Outputs

Movement of the machine is actuated by hydraulic cylinders and or motors. Control of oil flow to the cylinders/motors is achieved with hydraulic valves. Solenoid coils that convert electrical energy into mechanical motion are fixed to the valves. In some scenarios, The ARX2200, supplies a pulse width modulated signal to the solenoid coils to control the hydraulic valves. In others the CAN I/O Modules supply pulse width modulated signals to the input sensors that manipulate the machines behaviour. Unfortunately, not all input sensors, valves or coils operate with the same characteristics and therefore the response of one machine may be slower or quicker than another.

Generally, the operator compensates for this machine inconsistency by varying the joystick movement to allow smooth control at the machine. However, the degree of control with this approach is limited and often inadequate. Typically, machine movement just becomes too snappy or too slow to respond.

For the dozer logics, there is a number of high and low output PWM circuits. The following is a guide on how to calibrate and set the receiver and CAN module outputs to suit any machine with proportional control.

To complete the calibration process, position the machine in an area that allows for operation on remote control. Pre-start and site-specific checks should be made. Position the machine on a flat and level surface

Setting the PWM Outputs

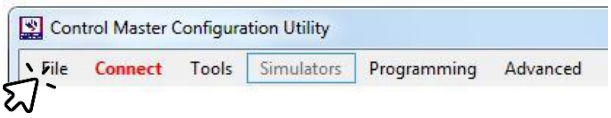
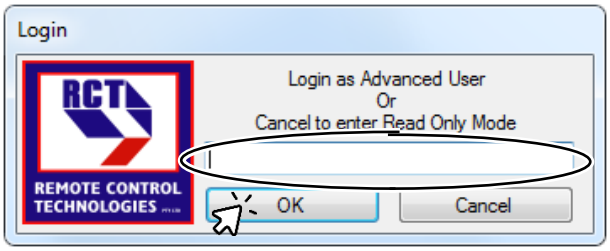
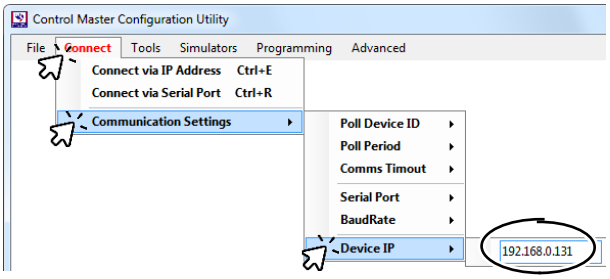
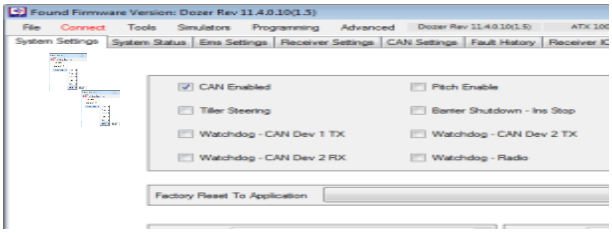
There is no requirement for the machine engine to run while the calibration routines are being set. The machine ignition key should be on, park brake applied and remote control selected.

Each calibration is set by physically moving the individual machine control implements and setting the minimum and maximum set points. The PWM settings provided by the machine control implements are read and stored in the receiver. These values can then be manually adjusted if required. The design concept is to duplicate the OEM machines set points to provide suitable proportional control.

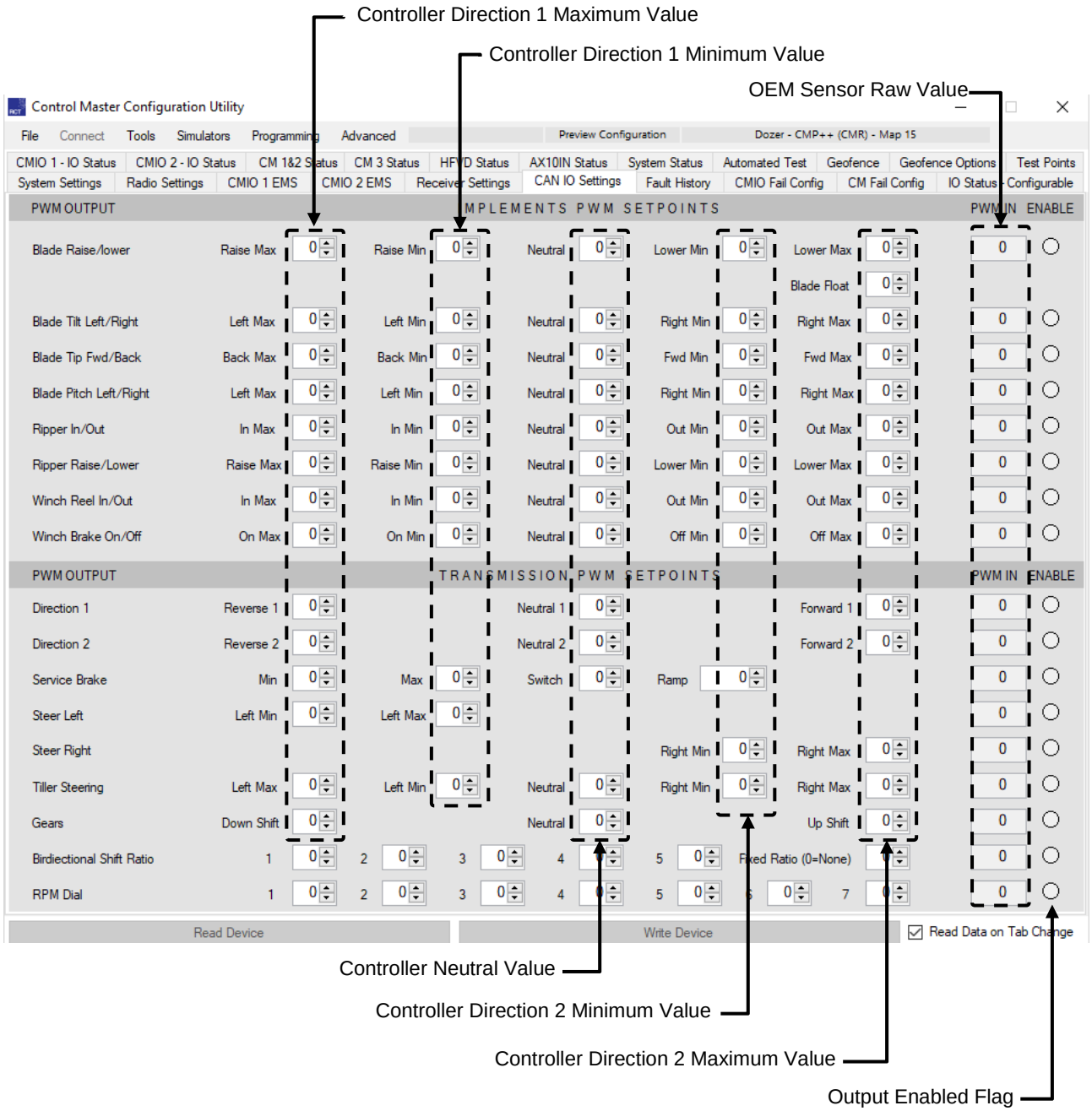
Setting Up Calibration via Config Utility

Using a laptop computer with the latest Config Utility installed, connect to the ARX receiver on the machine.

Logging into the Receiver from the PC

1.	Connect an Ethernet crossover cable (part number 8809) to the CM2200 receiver and the PC.	
2.	Enable the PC to communicate with the receiver.	
3.	Ensure the receiver is powered on.	
4.	Launch the RCT configuration utility application on the PC.	
5.	Click **File** and then click **Advanced Login**.	
6.	When the login window appears, type in the password and click **OK**.	
7.	Click **Connect** and navigate to **Device IP**.	
8.	Change the **Device IP** to match the IP address of the receiver. This should be `192.168.0.131`. **Note**: The IP address is briefly displayed on the receiver LCD at power up.	
9.	Click **Connect** and then click **Connect via IP Address**.	
10.	Click to select the **CAN IO Settings** tab. (Refer to screenshot on the following page.)	

The enabled configured PWM fields are indicated by the ‘Enable” indicator to the right of the window. This determines characteristics specific to the model of dozer, for example, if the dozer model is equipped with a ripper, the red flag will indicate on the Ripper Raise/Lower and/or Ripper In/Out. The winch will NOT be enabled due to the red flag missing. This is determined by the factory defaults. Provided the key is on and the engine is off and remote control is selected, the value may be read in via movement of the OEM controls.



Set the Machine’s Upshift Set Point

1. With the sensor at its neutral position, input the sensors neutral value into neutral field
2. The default value for this position is around 50 percent.
3. Push the upshift switch, or push the thumb wheel toward the upshift direction.
4. The OEM sensor input value will be provided.
5. Enter this value into the ‘Upshift’ field
6. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Downshift Set Point

1. Push the downshift switch, or push the thumb wheel toward the downshift direction.
2. The OEM sensor input value will be provided.
3. Enter this value into the ‘Downshift’ field
4. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Direction Forward Set Point (FNR 1)

1. With the sensor at its neutral position, input the sensors neutral value into ‘Neutral 1’

2. The default value for this position is around 48 percent.
3. Push the direction switch or rotate the direction handle forward.
4. The OEM sensor input value will be provided.
5. Enter this value into the ‘Forward 1’ field.
6. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Direction Reverse Set Point (FNR 1)

1. Push the direction switch, or rotate the direction handle to the reverse position.
2. The OEM sensor input value will be provided.
3. Enter this value into the ‘Reverse 1’ field
4. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Direction Forward Set Point (FNR 2)

1. With the sensor at its neutral position, input the sensors neutral value into neutral field
2. The default value for this position is around 48 percent.
3. Push the direction switch or rotate the direction handle forward.
4. The OEM sensor input value will be provided.
5. Enter this value into the ‘Forward 2’ field.
6. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Direction Reverse Set Point (FNR 2)

1. Push the direction switch, or rotate the direction handle to the reverse position.
2. The OEM sensor input value will be provided.
3. Enter this value into the ‘Reverse 2’ field
4. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Service Brake Minimum Set Point

1. Brake pedal at rest in neutral (Foot off).
2. Copy the provided sensor value into the service brake ‘Min’ field
3. The Default value for this position is around 25 percent
4. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Service Brake Maximum Set Point

1. Push the brake pedal toward the cab floor as it would be used on manual control.
2. Copy the provided sensor value into the service brake ‘Max’ Field.
3. The default value for this position is around 51 percent
4. To save the selected value, click **Write Device** at the bottom of the window.

Set the Machine’s Service Brake Switch Set Point

1. Connect a multi meter or test lamp to the brake dump limit switch normally open contact.
2. Connect a multi meter to the brake pedal position sensor.
3. Slowly press the brake pedal down until the service brake switch contact closes, then measure the service brake pedal position sensor PWM value.
4. Enter the service brake pedal position sensor switch point percentage into the ‘Switch’ field.
5. To save the selected value, click **Write Device** at the bottom of the window

Set the Machine’s Steering Left (1) Set Points

1. With the steering lever at its neutral position, copy this value into the left hand steering sensor 1 ‘Neutral’ field.
2. Begin pushing the steering lever to the left. When the sensor value changes from the neutral value, copy this into the “Left Min’ field.
3. Follow the steering lever through to its maximum left position. Copy this value into the ‘Left Max’ field.
4. Return the lever to neutral.
5. Begin pulling the lever to the right. When the sensor value changes from the neutral value, copy this into the ‘Right Min’ field.
6. Follow the steering lever through to its maximum right position. Copy this value into the ‘Right Max’ field.
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Steering Right (2) Set Points

1. With the steering lever at its neutral position, copy this value into the right hand steering sensor 2 ‘Neutral’ field.
2. Begin pushing the steering lever to the left. When the sensor value changes from the neutral value, copy this into the “Left Min’ field.

3. Follow the steering lever through to its maximum left position. Copy this value into the ‘Left Max’ field.
4. Return the lever to neutral.
5. Begin pulling the lever to the right. When the sensor value changes from the neutral value, copy this into the ‘Right Min’ field.
6. Follow the steering lever through to its maximum right position. Copy this value into the ‘Right Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Steering (3) Tiller Set Points (where applicable)

1. With the steering lever at its neutral position, copy this value into the tiller steering ‘Neutral’ field.
2. Begin pushing the steering lever to the left. When the sensor value changes from the neutral value, copy this into the “Left Min’ field.
3. Follow the steering lever through to its maximum left position, Copy this value into the ‘Left Max’ field.
4. Return the lever to neutral
5. Begin pulling the lever to the right. When the sensor value changes from the neutral value, copy this into the ‘Right Min’ field.
6. Follow the steering lever through to its maximum right position. Copy this value into the ‘Right Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Blade Raise/Lower Set Points

1. With the blade joystick at its neutral position, input the sensors neutral value in to ‘Blade Raise/Lower’ Neutral field.
2. The default value for this position is around 50 percent.
3. Begin pulling the blade joystick backward to raise the blade. When the value changes from the neutral value to its minimum, copy this value into the ‘Raise Min’ field.
4. Follow the joystick through to the blade raise maximum level. Input this reading into the ‘Raise Max’ field
5. Return the blade joystick to the neutral position
6. Begin pushing the blade joystick to the lower position. When the value changes from the neutral value to its minimum enter this value into the ‘Lower Min’ field.
7. Follow the joystick through to the blade lower maximum position. Enter this value into the ‘Lower Max’ field.
8. Note that blade float must be enabled for the following.
9. Push the blade joystick through its mechanical detent to the Float position.
10. Enter the supplied value into the ‘Blade Float’ Field.
11. To save the selected values, click **Write Device** at the bottom of the window.

Note: Almost every dozer install requires the ‘Blade Lower’ value to be considerably lower as the read in value because the weight of the blade and gravity do not correlate with the ATX and operator chair joysticks well.

Set the Machine’s Blade Tilt Let/Right Set Points

1. With the blade joystick at its neutral position, copy this value into the blade tilt ‘Neutral’ field.
2. Begin pushing the blade joystick to the left. When the sensor value changes from the neutral value, copy this into the “Left Min’ field.
3. Follow the blade joystick through to its maximum left position, Copy this value into the ‘Left Max’ field.
4. Return the lever to neutral
5. Begin pulling the blade joystick to the right. When the sensor value changes from the neutral value, copy this into the ‘Right Min’ field.
6. Follow the blade joystick through to its maximum right position. Copy this value into the ‘Right Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Blade Tip Forward/Back Set Points

1. With the blade joystick at its neutral position, copy this value into the blade tip ‘Neutral’ field.
2. Begin pushing the blade tip thumb roller or thumb wheel in the direction to Tip the blade forward. When the sensor value changes from the neutral value, copy this into the “Fwd Min” field.
3. Follow through to its maximum tip forward position, copy this value into the ‘Fwd Max’ field.
4. Return the lever to neutral
5. Begin pushing the blade tip thumb roller or thumb wheel in the direction to Tip the blade forward. When the sensor value changes from the neutral value, copy this into the ‘Back Min’ field.
6. Follow through to its maximum Tip backward position. Copy this value into the ‘Back Max’ field
   To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Blade Pitch Angle Tilt Set Points (when configured for VPAT)

1. With the blade joystick at its neutral position, copy this value into the blade pitch ‘Neutral’ field.
2. Begin pushing the blade pitch angle thumb roller or thumb wheel in the direction to the left. When the sensor value changes from the neutral value, copy this into the “Left Min” field.
3. Follow through to its maximum left position. Copy this value into the ‘Left Max’ field.
4. Return the lever to neutral

5. Begin pushing the blade pitch angle thumb roller or thumb wheel in the direction to the right. When the sensor value changes from the neutral value, copy this into the “Right Min” field.
6. Follow through to its maximum right position. Copy this value into the ‘Right Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Ripper In/Out Set Points

1. With the ripper control at its neutral position, copy this value into the Ripper In/Out ‘Neutral’ field.
2. Begin moving the ripper control toward the shank in function. When the sensor value changes from the neutral value, copy this into the “In Min’ field.
3. Follow the ripper control through to its maximum shank In position, Copy this value into the ‘In Max’ field.
4. Return the lever to neutral
5. Begin moving the ripper control toward the shank out function. When the sensor value changes from the neutral value, copy this into the ‘Out Min’ field.
6. Follow the ripper control through to its maximum shank out position. Copy this value into the ‘Out Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine’s Ripper Raise/Lower Set Points

1. With the ripper control at its neutral position, copy this value into the ripper raise/lower ‘Neutral’ field.
2. Begin moving the ripper control toward the ripper raise function. When the sensor value changes from the neutral value, copy this into the “Raise Min’ field.
3. Follow the Ripper control through to its maximum raise position, Copy this value into the ‘Raise Max’ field.
4. Return the lever to neutral
5. Begin moving the ripper control toward the ripper lower function. When the sensor value changes from the neutral value, copy this into the ‘Lower Min’ field.
6. Follow the ripper control through to its maximum Ripper Lower position. Copy this value into the ‘Lower Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window..

Set the Machine’s Winch Reel In/Out Set Points (when configured)

1. With the winch control at its neutral position, copy this value into the winch reel in/out ‘Neutral’ field.
2. Begin moving the winch control toward the reel in function. When the sensor value changes from the neutral value, copy this into the “In Min’ field.
3. Follow the winch control through to its maximum reel in position, copy this value into the ‘In Max’ field.
4. Return the lever to neutral
5. Begin moving the winch control toward the reel out function. When the sensor value changes from the neutral value, copy this into the ‘Out Min’ field.
6. Follow the winch control through to its maximum reel out position. Copy this value into the ‘Out Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

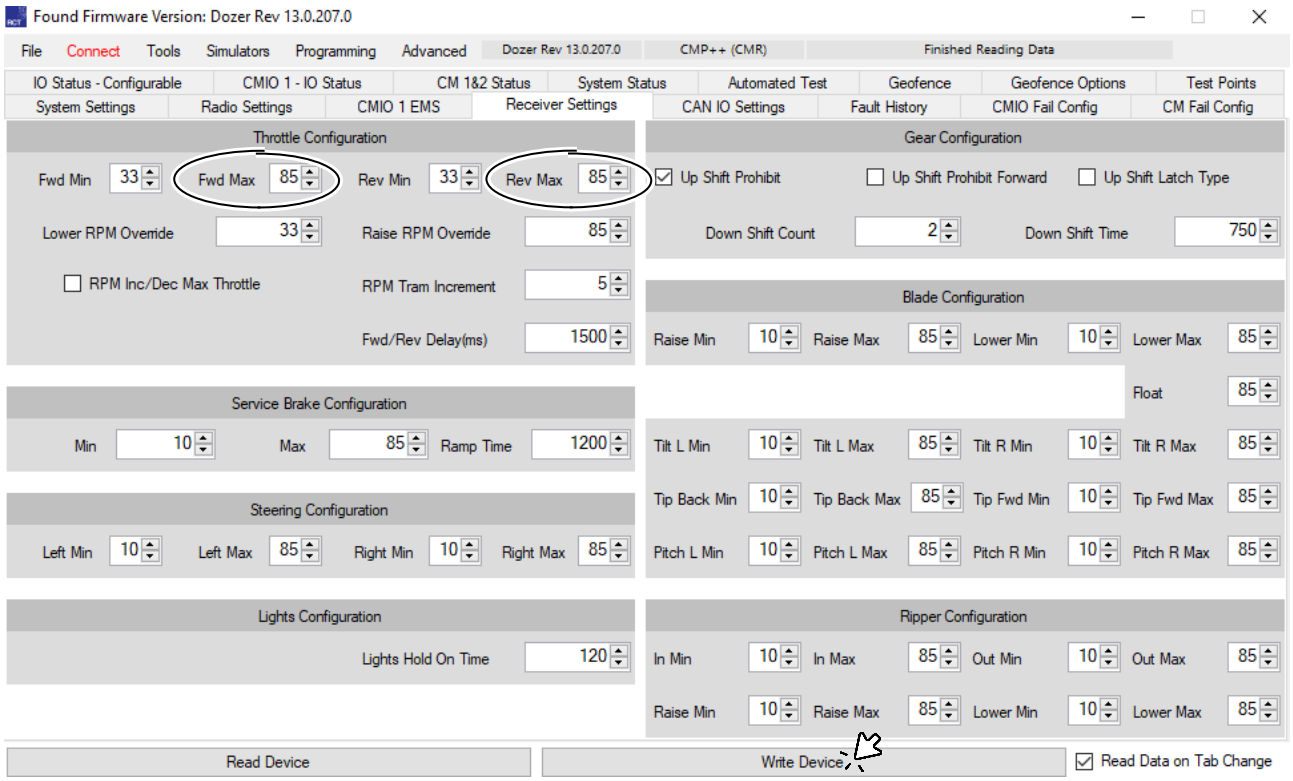
Set the Machine’s Winch Brake Apply/Release Set Points (where configured)

1. With the winch control at its neutral position, copy this value into the Winch brake on/off ‘Neutral’ field.
2. Begin moving the winch control toward the brake apply function. When the sensor value changes from the neutral value, copy this into the “On Min’ field.
3. Follow the winch control through to its maximum brake apply position, copy this value into the ‘On Max’ field.
4. Return the lever to neutral
5. Begin moving the winch control toward the brake release/free spool function. When the sensor value changes from the neutral value, copy this into the ‘Off Min’ field.
6. Follow the winch control through to its maximum brake release/free spool position. Copy this value into the ‘Off Max’ field
7. To save the selected values, click **Write Device** at the bottom of the window.

Set the Machine's Decelerator Minimum and Maximum Set Points

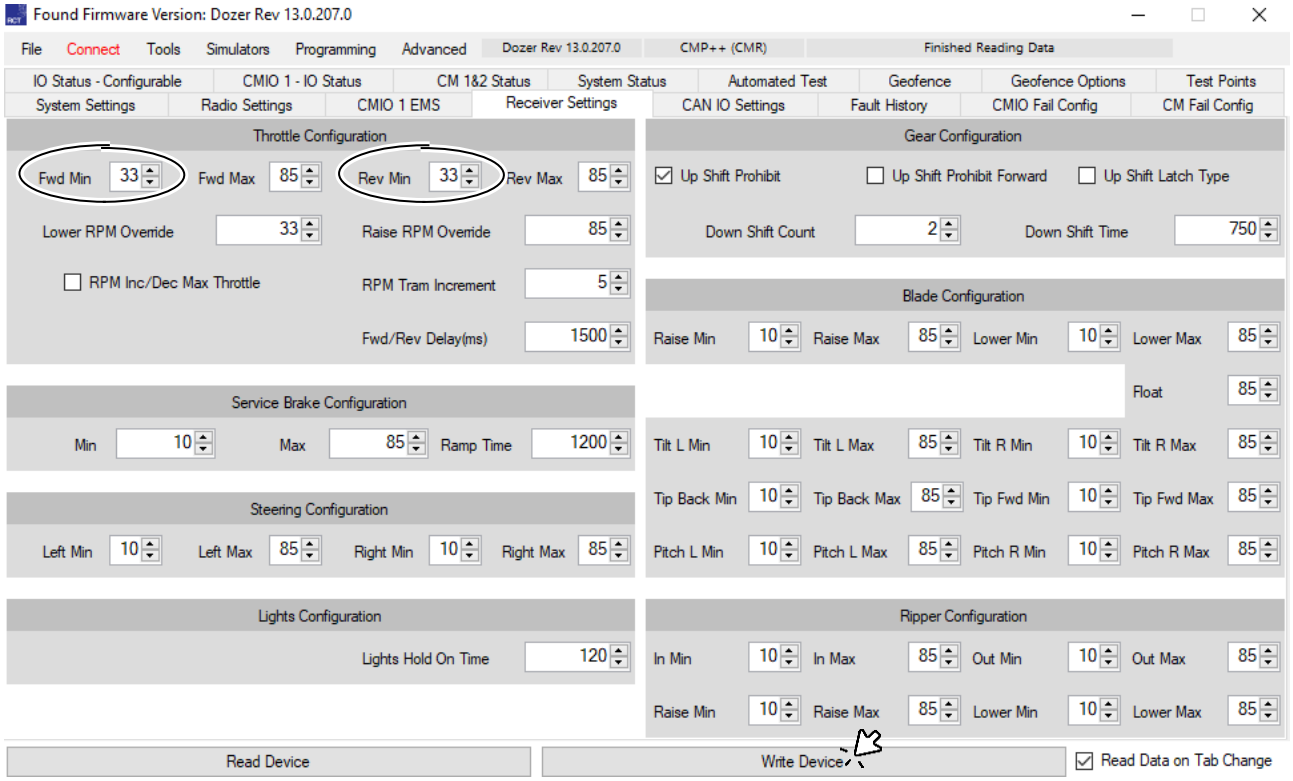
Set the Machine's Decelerator Released Set Point

1. Navigate to the **Receiver Settings** tab.
2. Use an oscilloscope to back-probe the decelerator pedal connector between the signal wire and earth.
3. Measure the waveform displayed on the scope.
4. Place the measured percentage in BOTH Max fields.
5. Click **Write Device**.



Set the Machine's Decelerator Applied Set Point

1. Actuate the decelerator pedal to the end of its travel.
2. Measure the signal output waveform.
3. Place the measured percentage into BOTH Min fields.
4. Click **Write Device**.

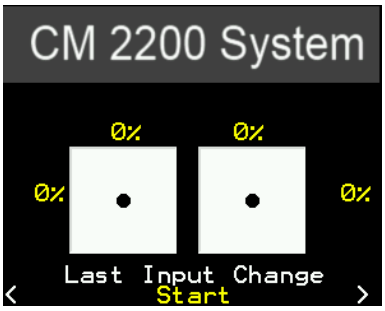
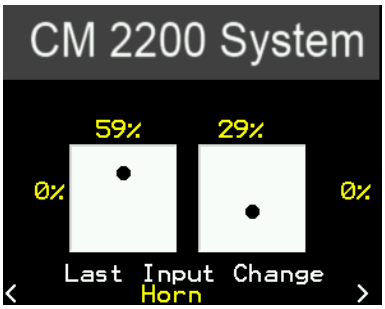
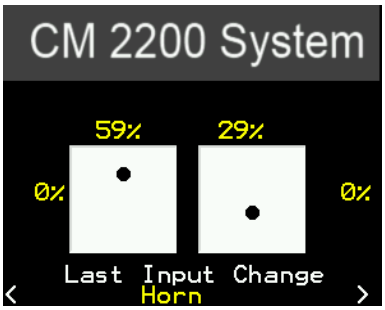


Diagnostic Mode

In diagnostic mode, the transmitter joysticks and switches can be tested and displayed without transmitting the states to the receiver. No communication is required between the transmitter and the receiver for this test.

Additionally, diagnostic mode is used to recall the logged fault codes from the receiver.

Joystick Display

1.	To initiate diagnostic mode, turn the transmitter off; press and hold the horn or camera select switch, then turn the unit on. Keep holding the horn switch or camera select switch on until the first text is displayed on the screen. The transmitter will display the joystick status screen.	
2.	The above screen indicates the status when the joysticks are centred and no switches or buttons are pushed. The left half of the screen displays the left joystick and the right half displays the right joystick. The percentages and messages below change depending on the movement of the joysticks or buttons. For example, if the left joystick is north 33% and west 18% with the top button pressed and the right joystick south 32% and east 11% the screen will display as shown at right.	
3.	The lower message displays information about the last input change i.e., it will display the input most recently pressed or switched. For example, if the horn switch is held on, the screen will display as shown at right.	

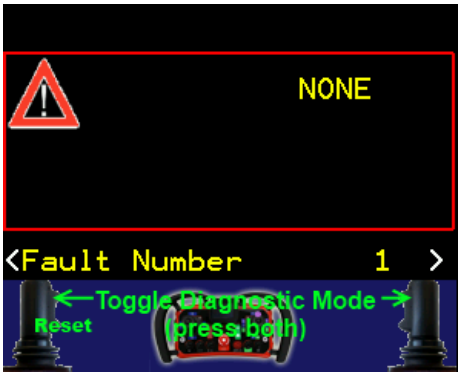
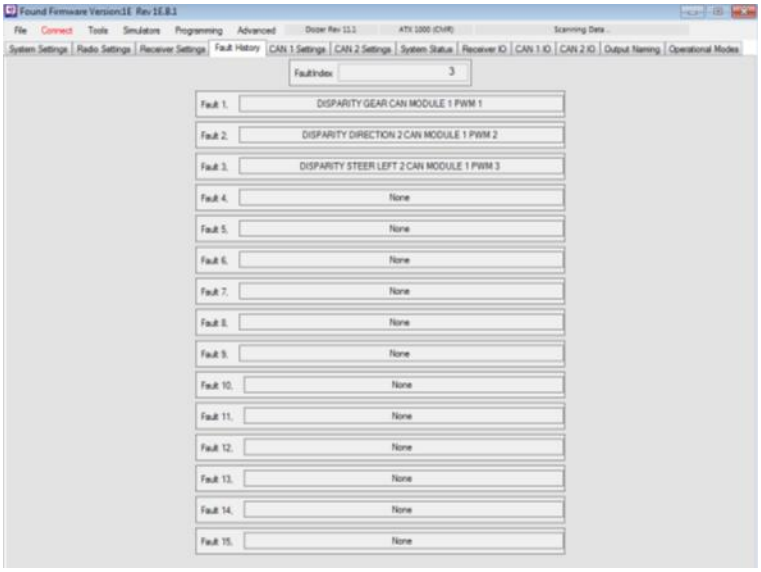
Fault Log Mode

System faults are logged in both the transmitter and receiver. The faults can be retrieved from either the transmitter or receiver using the RCT Configuration Utility.

To view the faults generated from both units, enter the fault log mode as described below.

To gain access to the Fault Log mode, enter Diagnostic Mode and then press the top front buttons on both joysticks simultaneously.

To recall the faults move the left joystick right or left to toggle through the faults.

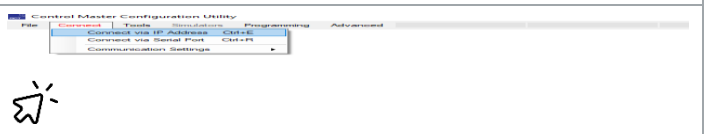
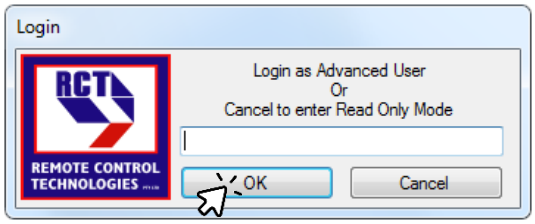
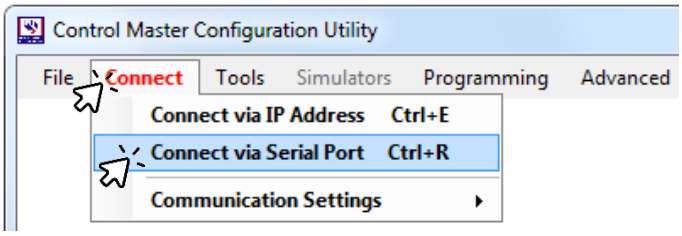
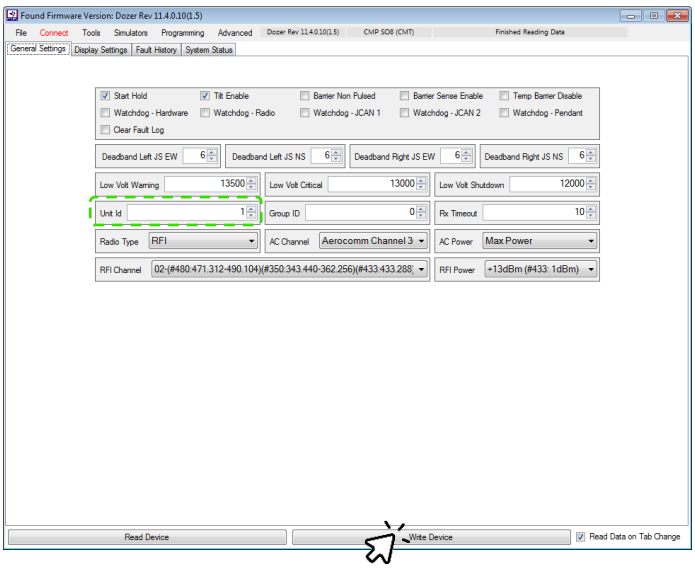
1.	To reset the fault log, press the left joystick front lower button.	
	The following table lists examples of each type of fault code display and a more detailed explanation.	
2.	With the joysticks centred, press the top buttons on both joysticks at the same time to return to diagnostic mode.	
3.	To return the transmitter to normal operating mode the transmitter must be turned off then on again.	

Changing the Unit Identification number for the Transmitter

Setting the Transmitter Unit ID Number

For the transmitter and receiver to communicate with each other, both must be set to the same unit identification number. The range of numbers can be set between 0 and 9999. Preferably, the unit identification number should be the same as the remote serial number located on the side of either the transmitter or receiver.

To change the unit identification number in the transmitter:

1.	Connect the PowerMaster lead (3314) to the Cannon base located at the base of the transmitter.	
2.	Connect the PowerMaster lead to a serial port on the computer.	
3.	Ensure the transmitter is powered on.	
4.	Launch the ControlMaster® Configuration Utility.	
5.	Click **File**, and then click **Advanced login**.	
6.	When the login box appears, type in the password. Click **OK**.	
7.	Click **Connect**, and then click **Connect via Serial Port**.	
8.	In the **Unit ID** field, click the up or down arrows to increase or decrease the Unit ID number until the required number is reached.	
9.	Click **Write Device** at the bottom of the window to save the setting.	

7

Diagrams

Interface Internal Wiring (575r)

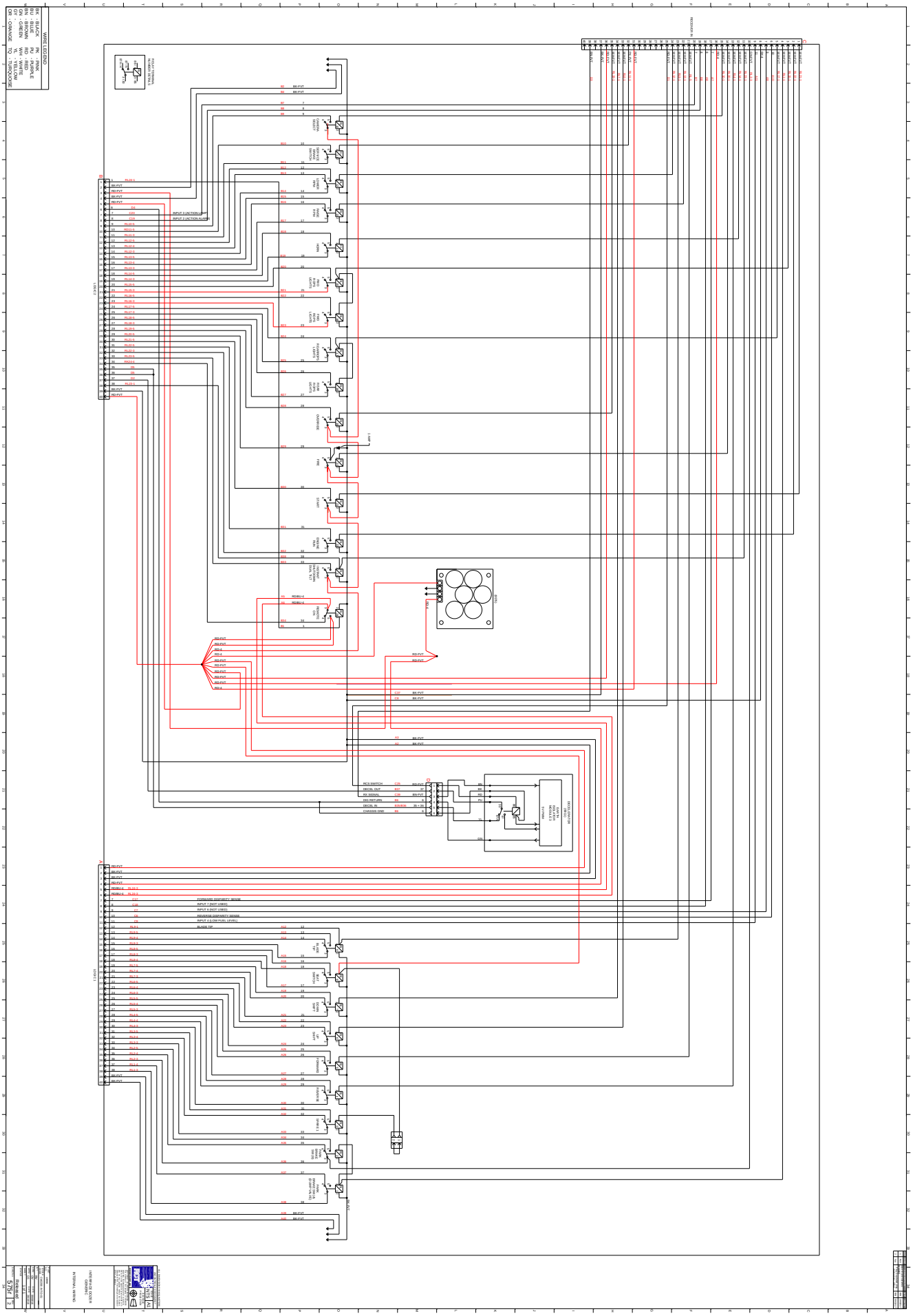


Figure 6 Drawing 575r – Interface internal wiring

Notes

Logic Loom 1 Loom Configuration (683t)

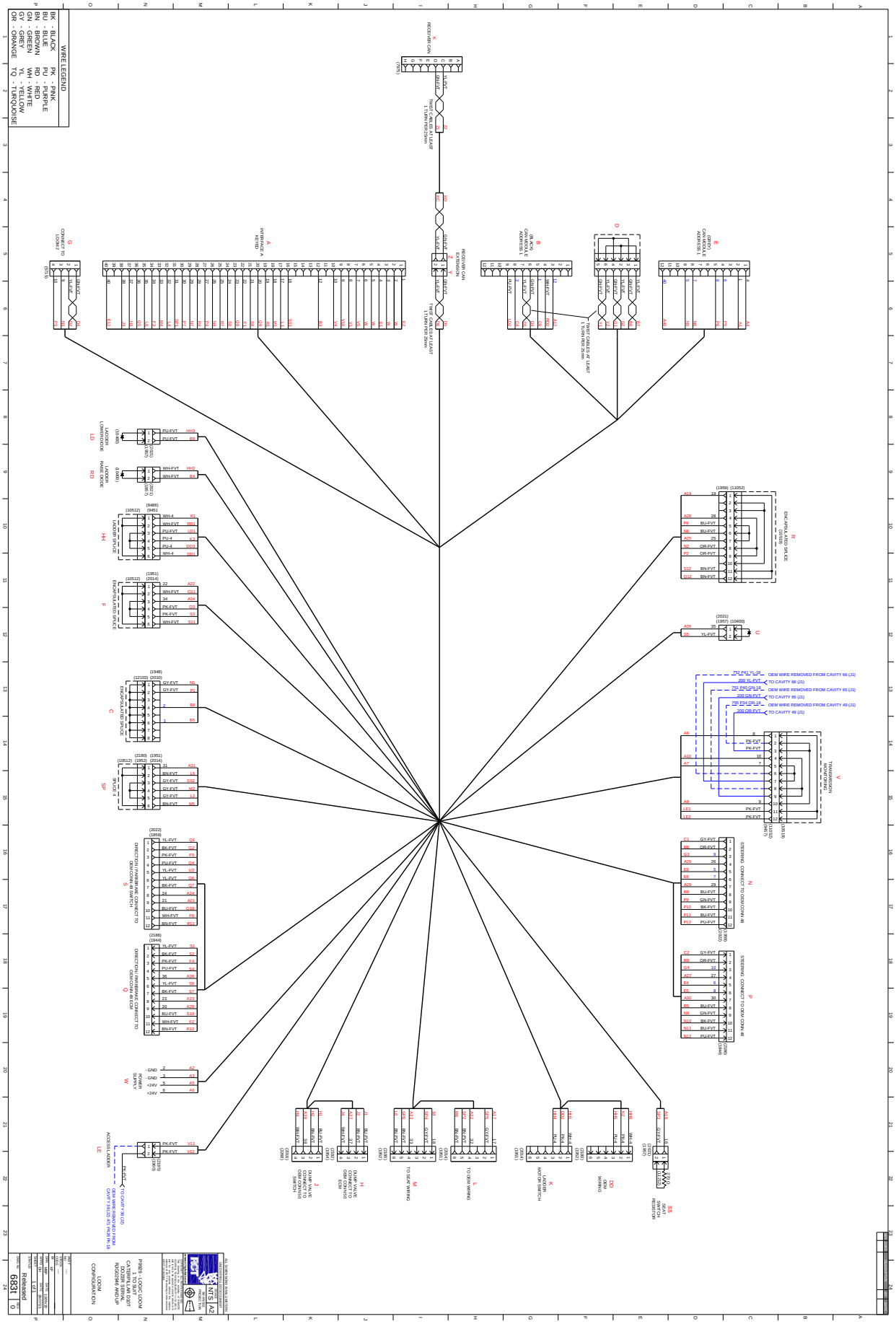


Figure 7 Drawing 683t – Logic loom 1 loom configuration

Notes

Logic Loom 2 Loom Configuration (683n)

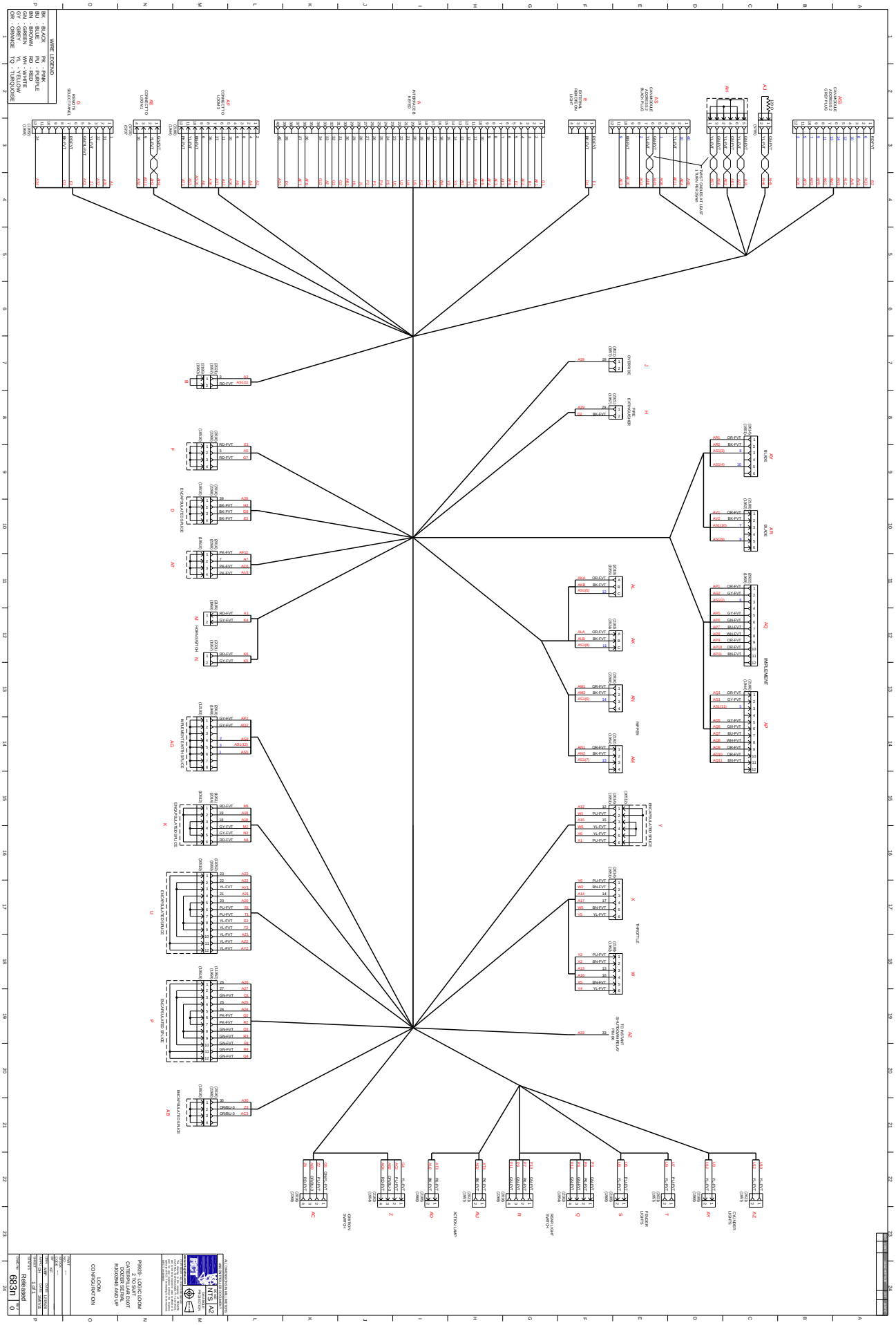


Figure 8 Drawing 683n – Logic loom 2 loom configuration

Notes

Logic Loom 3 Loom Configuration (683m)

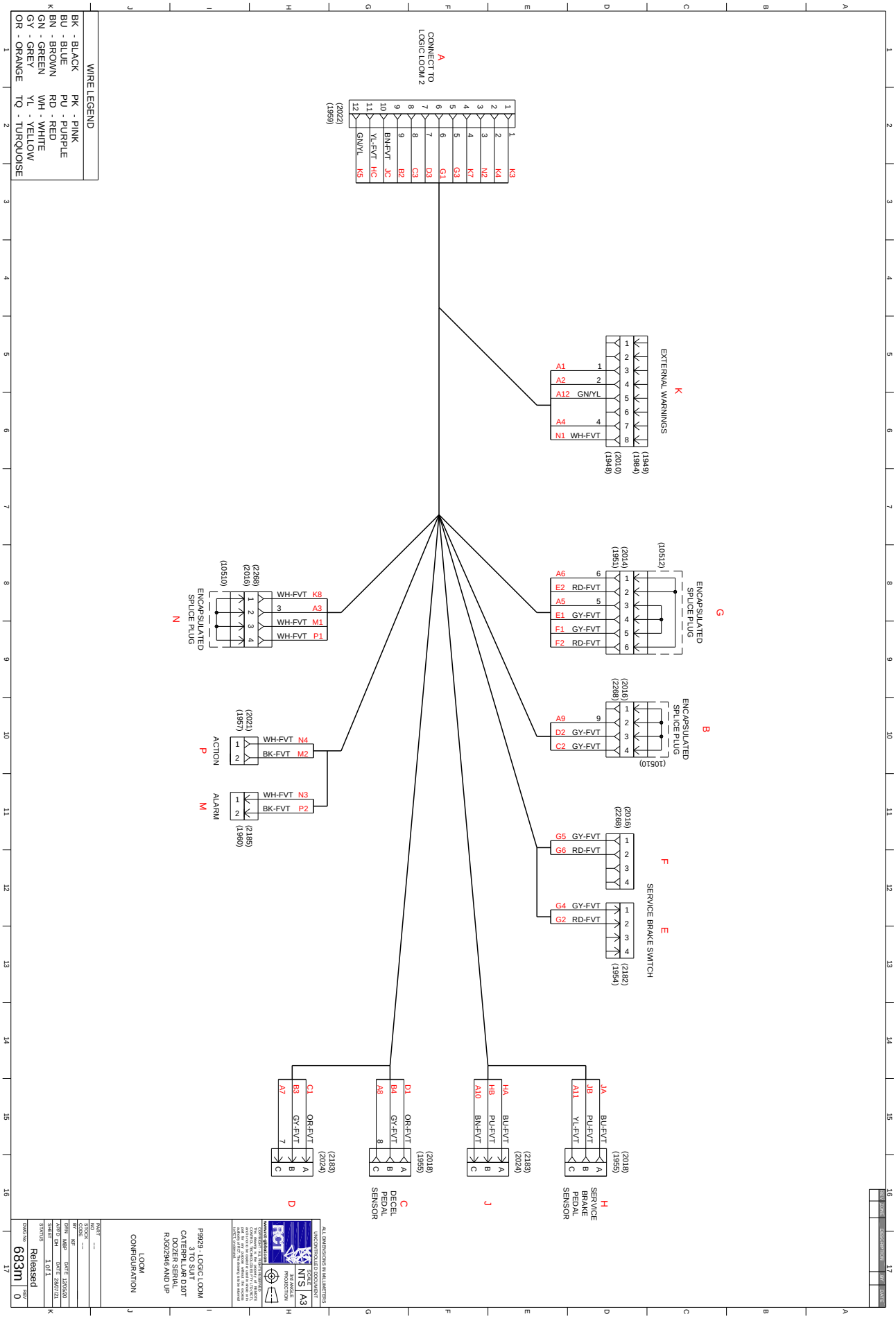


Figure 9 Drawing 683m – Logic loom 3 loom configuration

Notes

Receiver to Interface Loom (538v)

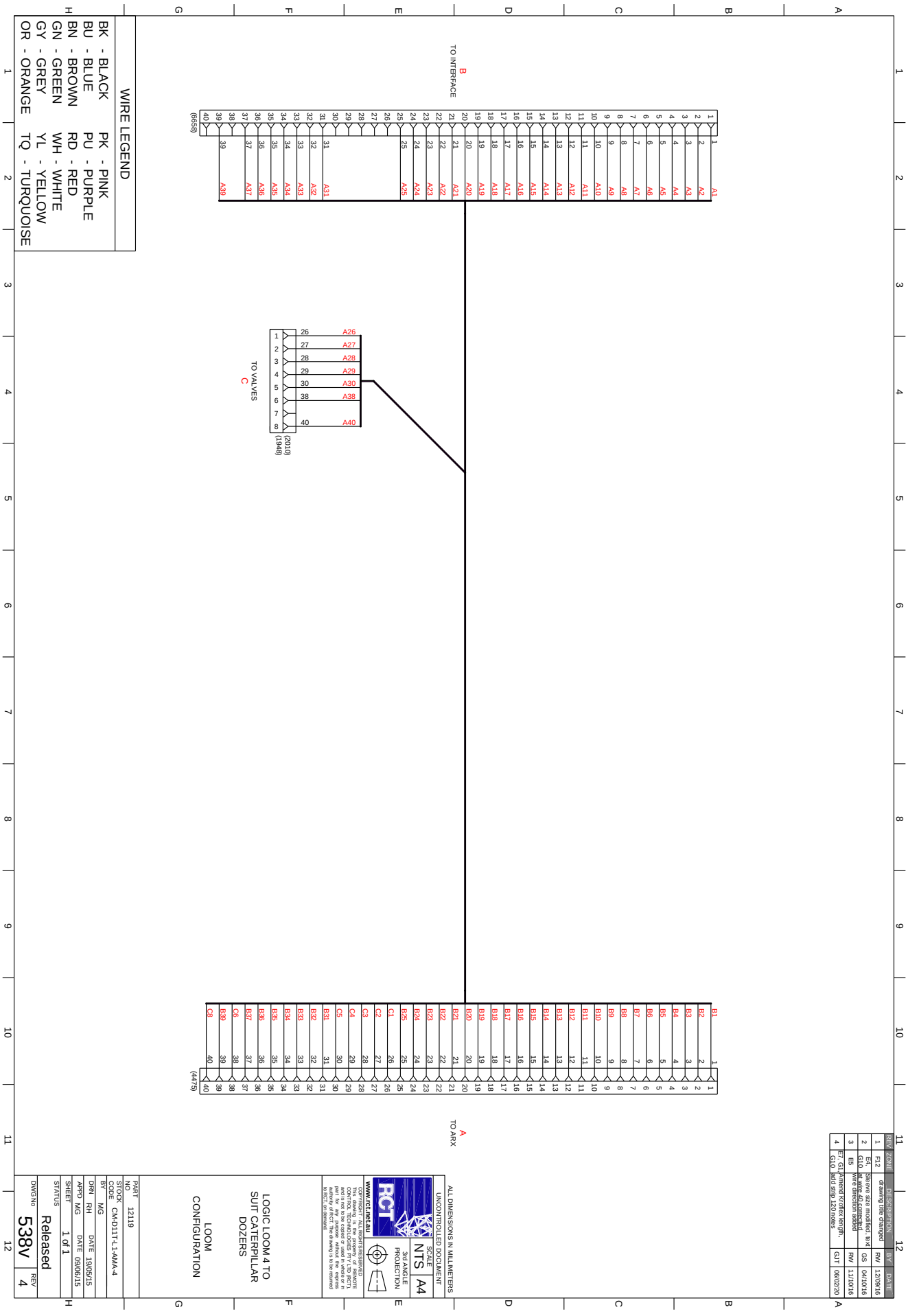


Figure 10 Drawing 538v – Receiver to interface loom

Notes

Complete Electrical Schematic (679j)

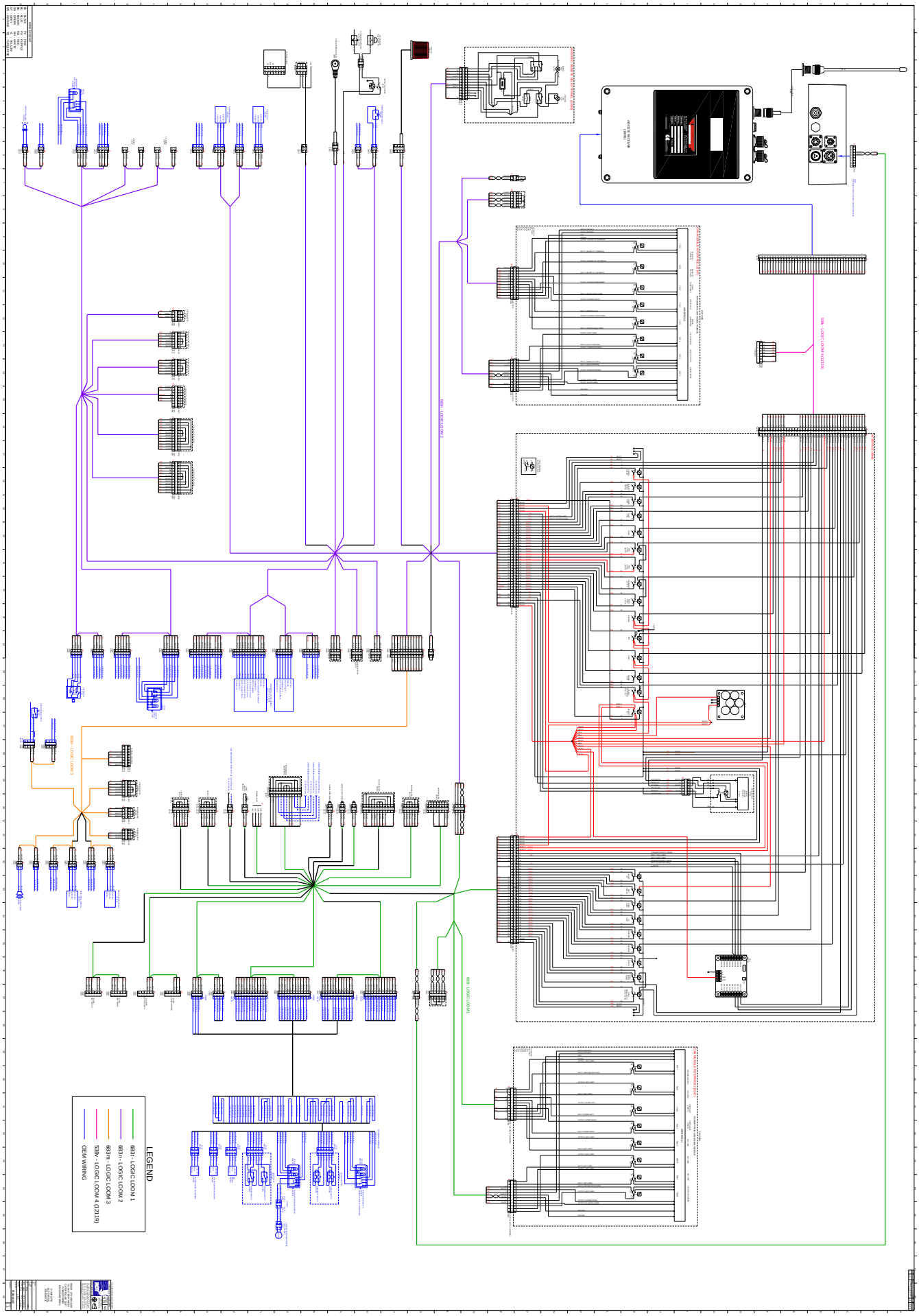


Figure 11 Drawing 679j – Complete electrical schematic

Notes

8

Disparity Checking

Basic Operation Information

The ControlMaster® ATX2200 transmitter incorporates disparity checking as standard. The transmitter joysticks contain two Hall Effect sensors for each axis.

These sensors provide analogue signals into the central processing unit (CPU). The CPU continually compares both sensors from each axis to ensure that the values are within a set range.

If the values are out of specification, the transmitter will be shut down. The receiver outputs are switched off, putting the machine in a safe mode with the engine switched off. The screen will display which joystick and axis has the disparity with instructions on how to reset the alarm. For example, if the disparity was on the left joystick North/South axis, the following error will be displayed.

Reset Receiver and Restart Operations

To reset the receiver and restart operations, the park brake must be applied then released. However, the system will only reset if no function is active; this requires switches (except lights) to be in their off state and the joysticks to be centred. If this is not the case the transmitter screen will display the reason for no reset.

For example, if the right joystick is not centred, the following screen will be displayed:

Once all the reset conditions are met, the park brake must be applied, and then released. The system lockout and the disparity are then reset. During the reset, the following will be displayed:

Use this same process to reset any alarm condition that causes a shutdown. If the alarm condition still exists, the first alternate screens will be redisplayed.

The joysticks are also monitored for CAN communications failure. When this fault occurs, a shutdown is activated; the receiver outputs are switched off putting the machine in a safe mode with the engine switched off. The screen will display which joystick has the failure alternately with instructions on how to reset the alarm. For example, if the CAN failure is at the right joystick the following screen will display:

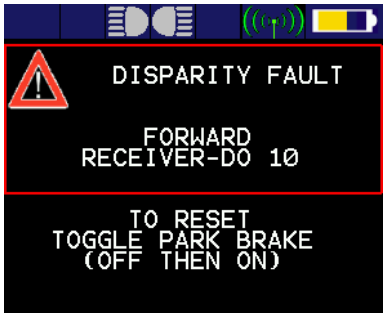
The system requires resetting as described above in joystick disparity.

Disparity Checking

The park brake switch circuitry includes disparity checking. This provides two park brake inputs which are mutually exclusive. Therefore, if one input is high then the other input must be low or vice versa. If both inputs are at the same level then the message **PARK BRAKE SWITCH FAIL** is displayed and the system is shut down requiring a reset as described previously in joystick disparity.

The receiver ControlMaster® Input/output (CMIO) boards have built-in disparity checking. The system checks the input signal received and compares it to the output signal. It achieves this by gathering the following information:

- Commands from the transmitter to the receiver, including joystick information
- Internal information from the receiver itself, including the state of communications, operating mode, signal status from the PWM and FET outputs.



If a disparity exists between the information sent from the transmitter and what is provided by the receiver outputs, the receiver outputs are switched off putting the machine in a safe mode with the engine switched off and the park brake applied. The individual fault message is displayed at the transmitter on the LCD alternately with instructions on how to reset the alarm. For example, if a disparity error exists on the forward tram output, the following screen will be displayed:

Note

To assist with troubleshooting, the display includes the disparity error code. The system requires resetting as described above in joystick disparity by first releasing, and then applying, the park brake.

Common Causes of Disparity Faults

The most common cause of disparity faults is poorly maintained plug connections. The ingress of moisture into the cannon plugs that connect to the remote receiver and the remote interface will cause voltage to track between the pins. This voltage, although not always very large, is enough to be seen by the disparity card as an output activated when not requested and will cause the subsequent shutdown of the remote receiver. Ensuring these plugs are kept tight and clean is very important as to ensure the continued operation of the ATX/ARX2200 remote set. Any damage to the lead between the receiver and the interface will also be a likely cause of disparity faults.

System Errors and Alarms

System Errors

On-board System Protection

The ARX2200 dozer receiver contains a number of systems designed to protect the on-board components.

System errors are caused by internal or external faults. When this happens, the system places the machine into a safe state. When the receiver detects system errors, it switches off its outputs and places the machine into a safe mode with the engine switched off.

The individual alarm message is displayed at the transmitter on the LCD screen alternately with instructions on how to reset the alarm. To reset the receiver, apply then release the park brake switch on the transmitter, as described in the joystick disparity error reset procedure previously.

The following tables list all system errors and the message that will be displayed on transmitter LCD screen.

Error Messages

Displayed Message	Description
CAN 2 COMMS FAILURE	The receiver has lost CAN communications with the CAN modules.
MACHINE PARK BRAKE RELEASED	As described.
CAN 2 W-DOG FAILURE	CAN module 2 has a failed watchdog.
AUX DISPARITY FORWARD	Machine has moved forward when not requested or has not moved forward when requested.
AUX DISPARITY REVERSE	Machine has moved reverse when not requested or has not moved in reverse when requested.

Reset Required Alarms

There are several alarms that are critical enough to shut down the system and require the park brake toggle to reset. Most of these are explained in detail in the transmitter operations sections where relevant, such as system lockout on power up.

When these alarms occur, the receiver outputs switch off and places the machine into a safe mode with the engine switched off. The individual alarm message is displayed at the transmitter on the LCD screen alternately with instructions on how to reset the alarm. For example, if the fire suppression system is activated, the screen on the right will be displayed:

To reset the receiver, apply then release the park brake switch on the transmitter, as described in the joystick disparity error reset procedure above.

The following table lists all alarms requiring system reset and the message that will be displayed on the transmitter LCD screen.

Displayed Message	Description
PARK BRAKE SWITCH FAIL	The dual mutually exclusive inputs from the park brake switch are the same (both on or both off) indicating switch failure.
TX TILTED SHUTDOWN	Transmitter tilted more than 45 degrees in any direction for more than one second.
FIRE SUPPRESSION ACTIVATED	Fire suppression system has been activated.
CMT LOW BATTERY SHUTDOWN XX.XV	If the battery voltage level falls below 12 volts, the system is shut down and radio transmission is turned off. The display shows the shutdown message with current battery voltage (XX.XV) alternately with a reset message stating a new battery is required. Park brake toggle will not reset this fault. The transmitter must be powered down; battery replaced and powered up to reset this fault.
BARRIER BREAK	When the external laser barrier is broken all joystick actions including joystick buttons are disabled.
SYSTEM LOCKOUT	The system is locked out on power up and after recovery from communications failure.
ADVANCED SETUP LOCKOUT	Advanced setup is locked out on power up and after recovery from communications failure in advanced setup mode.

Auto Reset Alarms

There are several alarms that provide a warning, but are not serious enough to shut down and lockout the system. These alarms auto-reset when the alarm condition is removed. Many of these alarms have no impact on the receiver outputs.

- The tilt alarm becomes a reset required shutdown alarm if it persists for longer than one second.
- The communications failure alarm becomes a reset required shutdown alarm if it persists for longer than one second.

When an alarm occurs, the individual alarm message is displayed at the transmitter on the LCD screen.

The following tables list all auto resetting alarms and the message that will be displayed on the transmitter LCD screen.

Displayed Message	Description
LO BATTERY XX.XV	The battery voltage supplying the transmitter is below 13.4 volts. The alarm will continue to display until the battery voltage is above 13.6 volts or the alarm is superseded by a more serious battery alarm.
CRITICAL XX.XV	The battery voltage supplying the transmitter is below 13 volts. The alarm will continue to display until the battery voltage is above 13.1 volts or the alarm is superseded by a more serious battery alarm (shut down).
NO COMMS FROM CMT	Transmitter to receiver communications failure—system lockout if longer than one second.
TX TILTED	Transmitter tilted more than 45 degrees in any direction—system lockout if longer than one second (lights remain on).
CHECK ENGINE	Action lamp is active.
STOP ENGINE	Action alarm is active.

9

Software

Compatibility Index

the ATX2200 transmitter and ARX2200 receiver are first powered up, the receiver firmware revision numbers will be requested by the transmitter as part of the normal communications protocol and checked against the firmware version of the transmitter. If the revisions are not identical or the transmitter does not successfully communicate with the receiver within six seconds, the transmitter will stop attempting to communicate and remain powered on in a shutdown state, that is, not transmitting. An alarm message, 'CMR INCOMPATIBLE OR UNAVAILABLE' is displayed on the transmitter LCD display.

To enable the transmitter to re-attempt to communicate with the receiver, the power must be cycled at the transmitter.

Note

The transmitter and receiver must successfully communicate with each other within the first six seconds of the transmitter being powered on or the communications will be shut down at the transmitter.

In addition, once successful communications have been established, the transmitter will continually check the software revision of the receiver. Any loss of communications will only display an alarm message 'WARNING NO COMS WITH CMR' at the transmitter LCD display.

If the communication between the transmitter and receiver is successful and the revision numbers are incompatible, the following message;

'CMR INCOMPATIBLE REV DIFFERENT'
'----TO RESET---- CYCLE CMT POWER'

will be displayed at the transmitter and communication will stop. The firmware will have to be updated to ensure compatibility and the power at the transmitter will have to be cycled.

The compatibility index (CI) is used to ensure the software installed in the transmitter and the receiver are compatible.

Software Upgrades

The ControlMaster® ARX2200 Receiver and ATX2200 Transmitter have a single processor located in each unit. Application software upgrades occur at both the transmitter and receiver, and each processor contains a different file.

The RCT configuration utility is used to upgrade files in the transmitter and a web browser is used to upgrade the files in the receiver.

The following information explains how to upgrade files in both the transmitter and receiver.

Note

Only authorised and trained RCT service technicians may conduct software modifications and upgrades

Enabling the Laptop to Communicate with the CM2200 Receiver

This is a quick start guide to help get communications between the PC and the CM2200 receiver.

Before you can access the receiver you need to ensure that your PC and receiver are both using compatible IP addresses.

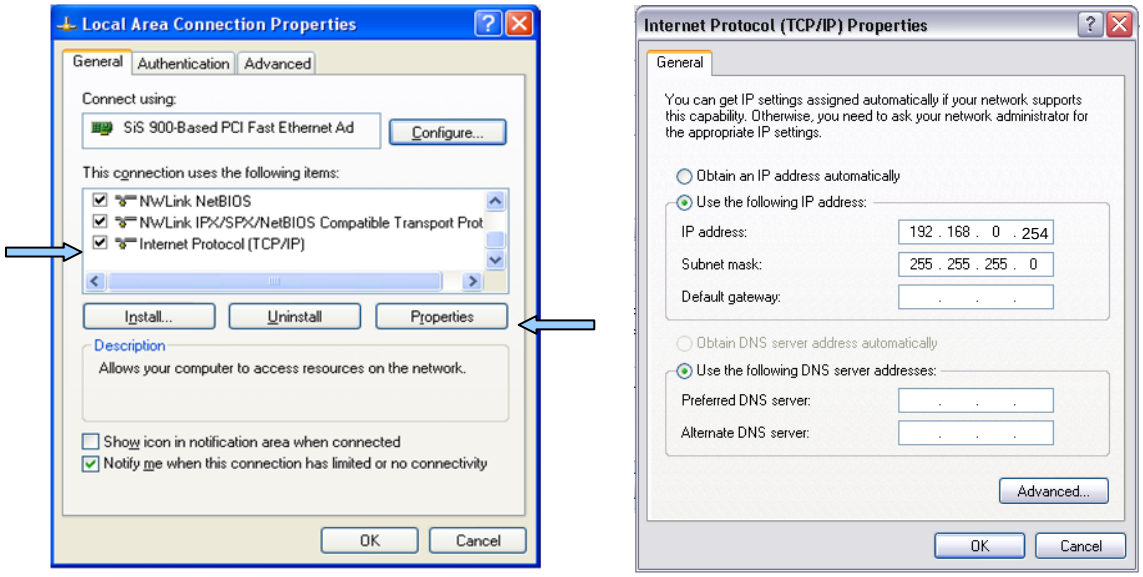
Production-built receivers will leave the factory configured with a default IP address (192.168.0.131).

If the IP address of your PC does not have a similar address (first three *octets* the same) i.e. (*192.168.0*) then it will not communicate with the receiver that is using the factory-set address.

Determine the IP Address of the PC

This can be found via the control panel, as described below:

1. Click the Windows **Start** menu.
2. Click **Control Panel**.
3. Click **Network Connections**.
4. Double-click **Local Area Network Connection**.
5. Click **Properties**.
6. Scroll down and click **Internet Protocol (TCP/IP).**
7. Click the **Properties** tab.
8. Take note of **ALL** the existing settings as you will need to change back to these once you have finished with the Guidance system.
9. Click **Use the Following IP address** as shown on the below right screenshot.
10. Enter the IP address as shown on the right screenshot.
11. Enter the subnet mask as shown on the right screenshot.
12. Click **OK**.



Upgrading Software in the CM2200 Receiver – Programming the Receiver

Programming the receiver processor with the latest software version using CMP++.

Equipment required

- Security Screw Tool (for removing the cover of the RX if required)
- CM2200 Programming Lead (6 pin bayonet plug to Ethernet connector)
- Power Supply (+24 volts)
- CM2200 Test Unit (required to power up the receiver)

Programming the CM2200RX is more involved than programming the ATX2200.

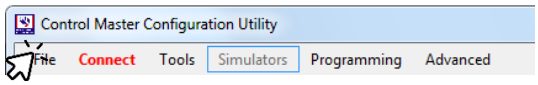
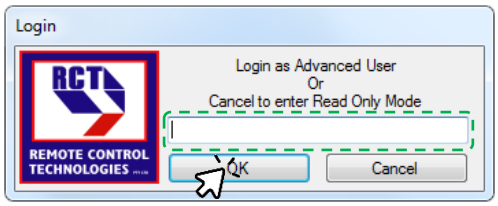
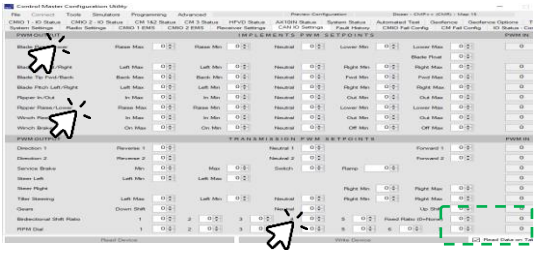
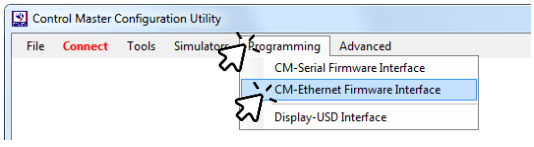
- Connect the test unit to the receiver via the lead connected to the test unit.
- Connect the 24 V power supply to the test unit.

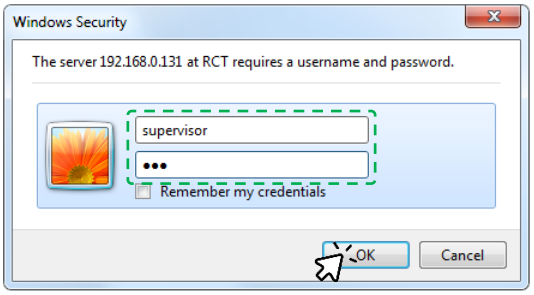
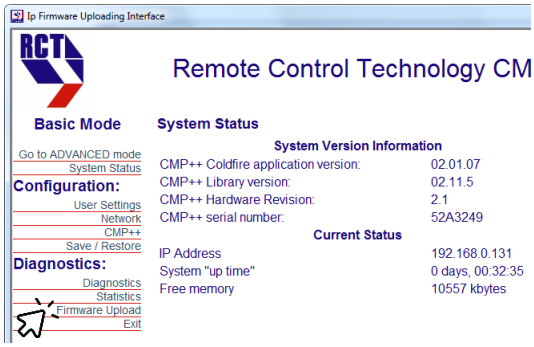
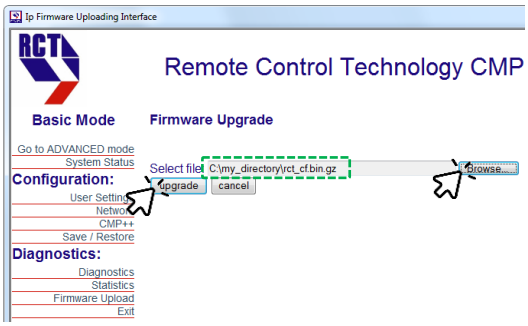
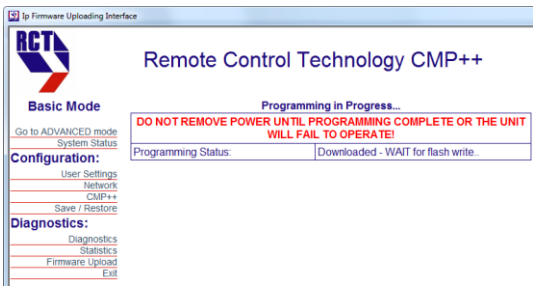
Download the latest (required) version of the CM2200 software to the desktop: This may be provided on portable storage such as a CD or thumb drive (memory stick) or from the R drive within RCT.

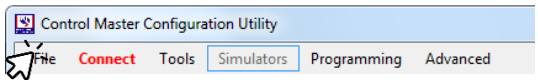
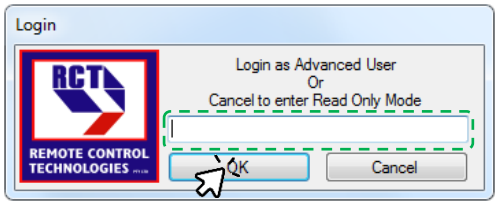
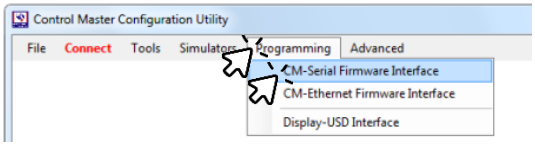
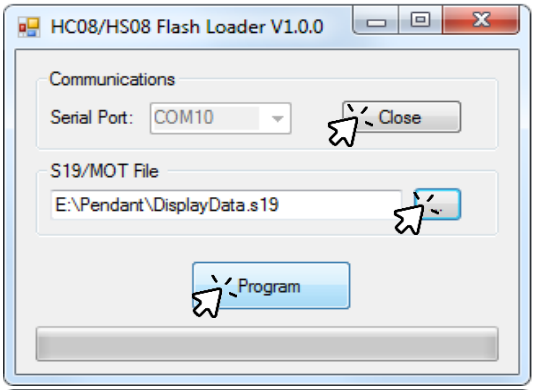
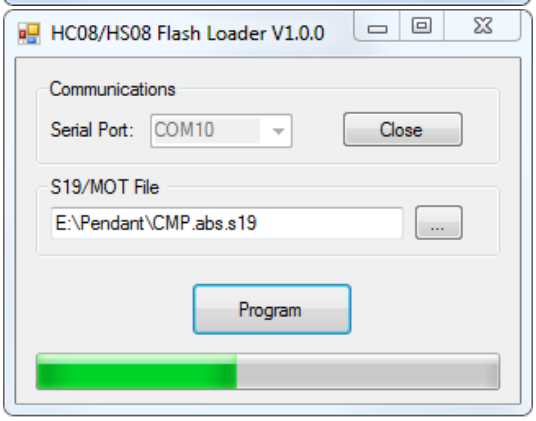
`R:\Shared\FTP\Production Software\Control Master\CM2200 Software\ATX2200 CM2200\CMR`

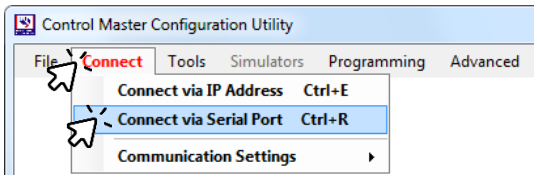
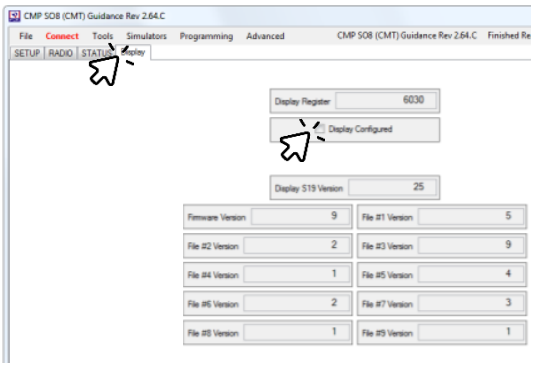
With the latest (required) version on your desktop you will need to disconnect the network cable from your Ethernet port on your laptop and plug in a CM2200 Programming Lead going between the Ethernet port on your laptop to the programming port on the CM2200RX.

Logging into the Receiver from the PC

1.	Connect an Ethernet crossover cable to the CM2200 receiver and the laptop (use part number 8809).	
2.	Enable the PC to communicate with the receiver (see previous page).	
3.	Ensure the receiver is powered on.	
4.	Launch the **RCT Configuration Utility** application on the laptop.	
5.	Click **File**, and then click **Advanced login**.	
6.	When the login box appears, type in the password. (Contact the service department at RCT.) Then, click **OK**.	
7.	Click **Connect**, then click **Communication Settings**, and finally, click **Device IP**. Change the **Device IP** to match the IP address of the receiver which should be `192.168.0.131.` **Note** The IP address is briefly displayed on the receiver LCD at power up.	
8.	Click **Programming**, then click **CM-Ethernet Firmware Interface**	

9.	Click **Log in** and the Windows security window requesting a user name and password will appear.	
10.	Enter the user name and password: ■ User name: **`supervisor`** ■ Password: **`cmp`** Click **OK**.	
11.	When the System Status screen appears, click **Firmware Upload**.	
12.	When the Firmware Upgrade screen appears, click **Browse** and locate the firmware file which has a **`.bin.gz`** extension. Select the firmware file and click **upgrade**.	
13.	Programming will begin. DO NOT REMOVE POWER TO THE RECEIVER	
14.	When completed, restart the receiver. **Note** Do not power off the unit or unplug the crossover cable during the upgrade proves, as this may corrupt the program.	

	For the ATX2200-TG connect the Control Master® Programming lead (3314) to the cannon base located on the transmitter.	
2.	Connect the Control Master® Programming Lead (3314) to the serial port on the laptop.	
3.	For the ATX2200-LS open up the transmitter and connect the programming lead (5708) to HD3 on the processor board. Set the switch to the up position.	
4.	Connect the programming lead (5708) to the serial port on the laptop	
5.	Start the RCT configuration utility.	
6.	Ensure the transmitter is powered on.	
7.	Click **File**, and then click **Advanced login**.	
8.	When the login box appears, type in the password. Then, click **OK**.	
9.	Click **Programming**; and then click **CM Serial Firmware Interface**.	
10.	When the **UHC08/HS08 Flash Loader** dialog box appears, click the **Open/Close** button to enable communications.	
11.	Click the **'…'** button and locate the new transmitter file. The filename should start with **`CMR_Rev`**.	
12.	Click **Program**.	

13.	Once programming is complete, click the '…' button and locate the second file. The filename should start with **`CMTD_Rev.`**	
14.	Click **Program**.	
15.	Cycle the power to the transmitter.	
16.	When the transmitter has booted up, click **Connect**, and then click **Connect via Serial Port**.	
17.	Click the **Display** tab, and then select the **Display Configured** checkbox.	
18.	Click **Write Device**, then cycle power to the transmitter.	

10

Regulations and Standards

Regulations and Standards Compliance

RCT has an obligation as a manufacturer to comply with the relevant legislation and standards upheld by Federal and State Acts and Regulations and the Australian Communications and Media Authority.

The particular standards that we presently comply with, relating to the ATX2200 Transmitter, include:

- **AS/NZS 4240.1:2009** – Remote Controls for mining equipment.
- **CISPR 22:2006** – Class A procedures – Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
- **EN 62209-1:2006** – Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices. Human models, instrumentation, and procedures. Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)**.**
- **EN 62209-2:2010** – Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices. Human models, instrumentation, and procedures. Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).

Additionally, when fitted with the RFI-433 radio module:

- **ETSI EN 301 489-1 V1.9.2 (2011-09)/ETSI EN 301 489-3 V1.6.1 (2013-08)** – Testing to Section 8.2 (Radiated Emissions).
- **ETSI EN 301 489-1 V1.9.2 (2011-09)/ETSI EN 301 489-3 V1.6.1 (2013-08)** – Testing to Section 8.3 (Conducted Emissions from DC Power Port).
- **ETSI EN 301 489-1 V1.9.2 (2011-09)/ETSI EN 301 489-3 V1.6.1 (2013-08)** – Testing to EN 61000-4-2:2008 (Electrostatic Discharge). Testing to EN 61000-4-3:2008 (RF Electromagnetic Field Immunity). Testing to EN 61000-4-6:2008 (RF Common Mode Immunity). Testing to ISO 7637-2:2011 (Vehicular Transients and Surges).
- **ETSI EN 300 220-1 V2.4.1 (2012-05)/ ETSI EN 300 220-3 V1.1.1 (2000-09)** – Testing to Section 5.4 (Transmitter Under Extreme Test Conditions). Testing to Section 7.2 (Transmitter Average Power). Testing to Section 7.8 (Transmitter Spurious Emissions). Testing to Section 8.6 (Receiver Spurious Emissions).

Additionally, when fitted with the RFI-480 radio module:

- **AS/NZS 4268:2008** – Radio equipment and systems—Short range devices—Limits and methods of measurement.

Additionally, when fitted with the Laird AC4790 radio module:

- **FCC PART 15.247** – Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
- **AS/NZS 4268:2008** - Radio equipment and systems—Short range devices—Limits and methods of measurement.

The transmitting device (radio) has been tested in accordance with all the necessary requirements of the standard by an independent, authorised testing facility. All testing, calibrations and measurements covered by the test report have been performed in accordance with National Association of Testing Authorities (NATA) requirements, which include the requirements of ISO IEC 17025 and are traceable to national standards of measurement.

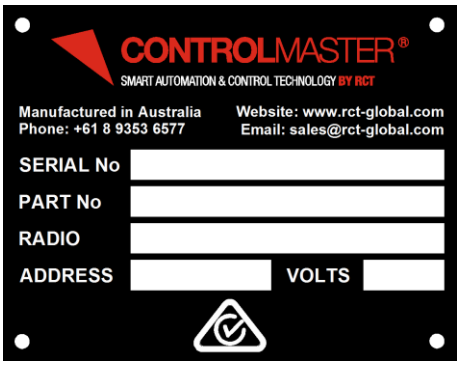
In accordance with ACMA requirements, RCT has compiled compliance records for Control Master® Remote Controls CM2200 series, fitted with the following radio brand/models;

- **RFI-433**
- **RFI-480**
- **LAIRD/AEROCOMM**

In accordance with the R&TTE Directive, 1999/5/EC, RCT possesses compliance declarations for the following radio brand/models:

- **LAIRD/AEROCOMM**

Product Labelling

1.	All products that have been assessed, tested and conformance confirmed are labelled in accordance with the ACMA requirements. The regulatory compliance mark (RCM) is used to clearly identify a conformant product.	
2.	ControlMaster® CM2200 Series Remote sets fitted with RFI-480 or Laird radios are fitted with an identification label that incorporates the RCM. This product is intended for the Region 3 market. **Serial No.** Identifies the TX and RX as a matched pair **Volts** Confirms system voltage **Part No.** Part number of unit for reordering **Radio** Frequency identifier **Address** Matching pair integrity	
3.	ControlMaster® CM2200 Series Remote sets are fitted with an identification label that incorporates the RCM and the CE logo. This product is intended for the Region 1 market.	
4.	ControlMaster® CM2200 Series Remote sets fitted with RFI-480 radios, intended for underground use only or Laird radios for above ground applications, intended for Region 2 market are fitted with an identification label that incorporates the FCC declaration of compliance.	

⚠ Important Information

The requirements of the standard should be read in conjunction with the applicable Federal and State laws, acts and regulations. The standard does not take precedence over these.

11

Region Specific Remote Systems (Radios and Frequencies)

Radio Types

The following are the types of RF transceivers/modules used in CM2200 remotes.

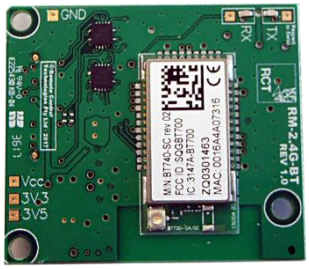
Radio Manufacturer	Model/Frequency	Notes
RFInnovations Pty Ltd	RFI-350 UHF 330 – 365 MHz	Used in region 3 – Single frequency (programmable) type radio used for surface remotes sold in Indonesia.
RFInnovations Pty Ltd	RFI-480 UHF 470 – 492 MHz	Used in region 2 and 3 – Single frequency (programmable) type radio used for underground remotes sold in Australia, U.S. and Indonesia. Also used for surface Teleremote in Australia.
RFInnovations Pty Ltd	RFI-433 UHF 433.925 – 434.565 MHz	Used in region 3 – 15 channels available in the LIPD band. Used for surface LOS and Teleremote applications. No licence required.
Laird Technologies	AC4790-200M-02 (Formerly Aerocomm) UHF 915 – 928 MHz	Used in region 2 & 3 – U.S./ Australian compliant radio that uses spread spectrum. Used for surface remotes only.
Laird Technologies	RM-2.4G-BT UHF 2.40 – 2.480 GHz	Used in all regions – Single frequency type radio fixed @ 2.4 GHz. Used for Line-of-Sight remotes.

RF Innovations RFI-350 Radio

RF Innovations RFI-480 Radio

RF Innovations RFI-433 Radio

Laird Technologies AC4790-200M-02 Radio



Laird Technologies RM-2.4G-BT Radio

Figure 12 Radio types

Region Specific Remote Systems Defined

As per the International Telecommunications Union standard, the world is divided into three regions of radio spectrum allocations. Generally, countries observe the rules of frequency allocation based on the region they occupy, but there are exceptions. Different frequencies are used within the different regions for different purposes. For example, the ISM* band in Australia is 915-928 MHz, in the US it is 902-928 MHz and in Europe 433-434 MHz.

As the ControlMaster® 2200 series remote control systems are sold into each of the regions, they are required to be configured to match the requirements for operation within each region. Different radio modules are installed to suit these requirements.

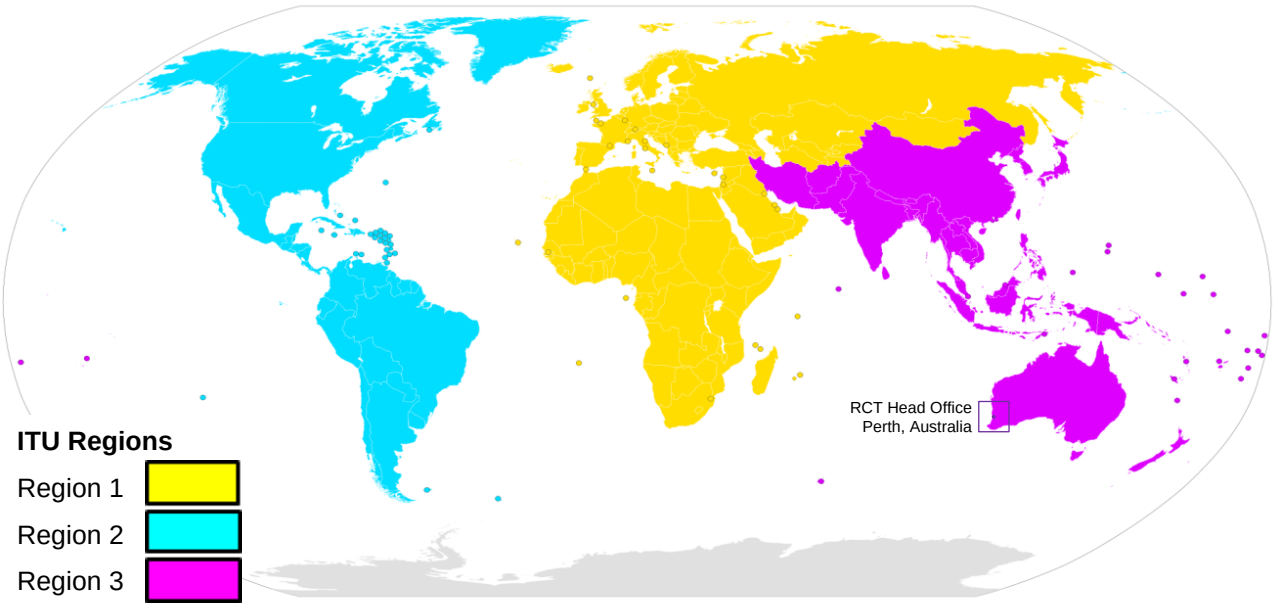


Figure 13 World map showing radio spectrum allocation regions

⚠ Important Information

The requirements of the standard should be read in conjunction with the applicable federal and state laws, acts and regulations. The standard does not take precedence over these.

* ISM – Industrial, Scientific & Medical

Countries Included

Country	Region	Radio Type	Surface (MHz)	Underground (MHz)
Botswana	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Ghana	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Morocco	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Mozambique	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Namibia	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
South Africa	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Tanzania	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Zambia	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Kazakhstan	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Mongolia	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Turkey	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Russian Federation	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Armenia	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Belgium	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Norway	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Sweden	1	Surface – RFI-433	433.050–434.790	433.050-434.790 Docking station required
Canada	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Guatemala	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Mexico	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
United States	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Brazil	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Chile	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Colombia	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Peru	2	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required
Indonesia	3	Surface – RFI-433 U/G – RFI-480	433.050–434.790	470-492 Docking station required
New Zealand	3	Surface – RFI-433 U/G – RFI-480	433.050–434.790	470-492 Docking station required
Papua New Guinea	3	Surface – RFI-433 U/G – RFI-480	433.050–434.790	470-492 Docking station required
New Caledonia	3	Surface – RFI-433 U/G – RFI-480	433.050–434.790	470-492 Docking station required
Bolivia	3	Surface – Aerocomm U/G – RFI-480	915–928	470-492 Docking station required

12

Parts List

Part No.	Description	Quantity: Suggested Spares
14829	Camera Loom 8 meters	1*
12596	Remote Select Box	1*
12147	CAN Module – Power Train	1*
12147	CAN Module – Implements	1*
12192	ARX2200 Receiver fitted with Bluetooth Radio (Part No 15408) x 1	-
10166	ATX2200 Transmitter fitted with Bluetooth Radio (Part No 14392) x 1	-

* denotes critical spares

13

Glossary

Glossary

Active PoE	See Power over Ethernet (PoE).
Area Access Control (AAC)	Provides the interface between the work area and the Automation Centre.
Articulated vehicle	A vehicle which has a permanent or semi-permanent pivot joint in its construction.
Articulation sensor	A sensor that measures the vehicle's angle of articulation.
AusProTec®	The specialised electrical equipment product brand of RCT.
AutoDig	An RCT product feature that enables the machine to position itself for a dig, and complete the dig with no interaction from the operator.
AutoDump	An RCT product feature that enables the operator to train the machine to automatically complete the dumping cycle.
Automation Centre	A ControlMaster® product that is a full operator station including an operator chair, controls, displays, and network equipment (RCT product name).
AutoNav	An RCT product feature that enables machines to operate between multiple dump and dig points.
Commissioning	The process of assuring that a remote control system was designed, installed, tested, and operated according to the operational requirements of the client.
Control	See Multi-Machine Control.
Controller Area Network (CAN)	A robust vehicle bus standard designed to allow microcontrollers and devices to communicate with each other's applications without a host computer. Also known as CANbus.
ControlMaster®	The Automation and control technology product brand of RCT.
Dash	Instrument cluster of a machine or vehicle.
Dependent Guidance	The machine has been set to Guidance operation; however, it requires input from the operator using the tramming joystick to enable tramming.
DigAssist	An RCT product feature that assists the operator with the digging cycle giving them a visual overview and providing them with key machine information.
Disparity	Not equal or not similar. In an RCT or ControlMaster context, when a particular remote function commanded state is compared to the actual state.
EarthTrack®	The mining information systems product brand of RCT.
E-Stop	Emergency stop—a safety mechanism used to shut off machinery in an emergency, when it cannot be shut down in the usual manner.
G-Dash	Electronic instrument cluster that provides the operator with machine operational information.
GeoFence	A virtual fence or perimeter around a physical location.
Grep	ControlMaster® Guidance Re-player software, commonly referred to as Grep, is used to playback the machine movements through the operating area showing proximity to walls, articulation, ground speed and all other parameters logged.
Guidance	A method of controlling a machine where the operator is only required to provide a forward or reverse input, and a right or left input in areas where there is a decision required (RCT product name).
Human Machine Interface (HMI)	A user or operator interface that connects the human or operator to a machine, system or device.
Independent Guidance	Once the machine has been trained, it will tram itself without input from the operator along the loaded and unloaded paths.
Interface	Machine-specific component(s) that allow a standard ControlMaster® Remote Control system to be installed on any machine make or type.
Laser Guard	A machine containment system that acts as a barrier, preventing machines from leaving the remote operating area, or personnel entering the area (RCT product name).
Line-of-Sight	A method of controlling a machine where the remote control operator relies on a visual 'line-of-sight' of the machine (RCT product name).
Loaded path	The tramming run from the stope back to the stockpile.
Loom	An electrical wiring loom or harness.

Machine Enrolment	The process of enrolling a machine to a dedicated work area.
Mag base antenna	An antenna that has a strong magnetic base for secure attachment to the machine.
Manual control	The method by which an operator controls a machine without using a remote control system, that is, by sitting in the machine and using the OEM controls.
Muirhead®	The machine and personnel protection product brand of RCT.
Multi-Fleet Select (MFS)	Enables operators to select between multiple machines of more than one machine type from one Automation Centre, operating only one machine at a time (RCT product name).
Multi-Machine Control (MMC)	Enables operators to select between multiple machines from one Automation Centre, with multiple machines operating at the same time (RCT product name).
Multi-Machine Select (MMS)	Enables operators to select between multiple machines from one Automation Centre, operating only one machine at a time (RCT product name).
Pan-tilt-zoom (PTZ)	A PTZ camera is one that is capable of remote directional and zoom control.
Park brake	A braking mechanism used to keep the vehicle securely motionless when parked.
Passive PoE	See Power over Ethernet (PoE).
Point-to-point	See Independent Guidance.
Power over Ethernet (PoE)	Technology that allows a single Ethernet cable to carry both power and data and can be active or passive. Active PoE will negotiate with connected equipment to determine whether it can receive electrical power and also the proper voltage, preventing any electrical damage to the connected equipment. Passive PoE is 'always on' in terms of the electrical supply and non-PoE devices may be damaged if connected.
Pulse Width Modulation (PWM)	A method of reducing the average power delivered by an electrical signal by effectively breaking it up into discrete parts. It is a method used in ControlMaster® products to control some proportional outputs.
RCT Bridge	A device that allows digital communications to be integrated into an existing analogue mine network or communications system.
RCT Connect	Communications system that provides 2.4 GHz Wi-Fi coverage throughout the areas of the mine that it is deployed in, typically a Teleremote load haul dump (LHD) production area.
Receiver	A device used to receive control signals sent from the transmitter and control the machine via the on-machine remote interface(s).
Remote Component Enclosure (RCE)	An enclosure with a hinged lid that safely and securely houses critical ControlMaster® machine components.
Remote Control	The method by which an operator controls a machine while not being present in the operator's seat.
Risk assessment	A thorough look at your workplace or situation to identify those things, situations, processes, etc. that may cause harm, particularly to people.
Safe operating distance	The minimum distance between the operator and the machine beyond which the hazards associated with operating machines are acceptable.
Select	See Multi-machine Select.
Service brake	A vehicle brake, usually foot-operated, that is used in normal operation to slow the vehicle.
SmarTrack®	The industrial fleet management product brand of RCT.
Teleremote	A method of controlling a machine where display screens show video images captured by cameras mounted on the machine.
Tramming	The action of driving a machine in a forward or reverse direction.
Transmitter	A device used to send control signals to the receiver on the machine.
Uninterruptable power supply (UPS)	A self-contained battery backup device.
Unloaded path	The tramming run from the stockpile to the stope.
Vision	The video or live footage that is captured by cameras mounted on the machine or equipment and streamed to the operator.
Waypoint	Start and stop points for Independent Guidance runs.
Work area	The area where remote-controlled machines will be operating.

14

Warranty

Warranty

Please see the RCT standard warranty, available on our website - www.rct-global.com.

Revision History

Rev	Date	By	Details of change
1.0	28/07/2021	OP	Initial document approval.

Discover more: www.**rct-global**.com

sales@rct-global.com

AUSTRALIA:	+61 (0) 8 9353 6577
AFRICA:	+27 (0) 83 292 4246
CANADA:	+1 705 590 4001
RUSSIA / CIS:	+7 (910) 411 11-74
SOUTH AMERICA:	+56 3 5229 9409
USA:	+1 801 938 9214

CONTROLMASTER® SMART AUTOMATION & CONTROL TECHNOLOGY BY RCT
MUIRHEAD® SMART PROTECTION SYSTEMS BY RCT
EARTHTRACK® SMART INFORMATION SYSTEMS BY RCT
AUSPROTEC™ SMART SPECIALISED ELECTRICAL EQUIPMENT BY RCT
SMARTRACK® SMART FLEET CONTROL BY RCT