Manufactured in the United Kingdom

CE RoHS

Genesis Car

1N00-501 user manual

Your serial number is:

Please quote this number when ordering parts or seeking telephone assistance.

Company information

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This product is manufactured in the European Economic Area and is manufactured to comply with all relevant legislation.

Do not dispose of this product in landfill. Contact Tornado International Ltd for information regarding disposal in compliance with 2012/19/EU.

RoHS This product and all constituent components to the best of our knowledge complies with 2011/65/EU.

Conventions used in this manual

For clarity the following conventions are used in this manual:

Paragraph Heading	Meaning
Tip!	Information which will assist in the operation of the product
Note!	Information which is important for the correct operation of the product.
Caution!	Information which is **VITAL** to avoid **injury** to persons or damage to the product.
Warning!	Information which is **VITAL** to avoid **serious injury** to personnel or the public.

Please take note of the information in shaded areas. If you have any questions with regard to the correct installation or operation of the product please contact Tornado International Ltd.

Important – please read this!

This manual is provided in good faith and is believed to be accurate. Because Tornado International have no control over the manner in which the product is used, users should satisfy themselves that any information or instruction contained in this manual is appropriate for the conditions under which the product is being installed and operated.

In the interest of product development, Tornado International reserves the right to alter or modify the product as necessary.

Introduction

Thank you for purchasing this quality product from Tornado International Ltd. It will give you many years of trouble free service and if used in a suitable site will provide consistent profits.

Please read and understand this manual before using the equipment.

This manual contains the following sections;

1.00 Installation guide **Page 5**
This section will guide you through the installation process.

2.00 Operating procedures **Page 16**
Directions for daily operation of the equipment.

3.00 Detailed overview of the system **Page 17**
Here you will find detailed information about each part of the system with hints and cautions about the correct operation of the equipment.

4.00 Periodic service **Page 47**
Little is required in the way of periodic service. However time spent in following these procedures will pay dividends in improved reliability and service life.

5.00 Fault finding **Page 49**
Should any faults arise during operation, consult this section to help diagnose problems.

This manual is for a car set operating on a loop aerial system at a frequency of 120KHz. Your set may use a different system or frequency. Please contact Tornado quoting your serial number if you are unsure about aspects of the installation or operation of your system.

1.00 Installation guide

1.01 On delivery

Before opening crates

1. Check the number of crates delivered agrees with the number on the shipping documents.
2. Inspect the crates for damage. If any damage is visible note the crate number, and the position and extent of the damage. If the crates are not to be opened immediately, the shipping company should be notified as soon as possible. If the crates are to be opened at this time, wait until the product is inspected for damage.
3. The crates should be moved to a position close to the operating area before opening.
4. The crates should be opened carefully, the contents removed and the quantities checked against the shipping notes. A product identification chart can be found at Appendix A (page 51). If any damage was noted on the outside of the crates, the product next to the damage should be inspected carefully. Any damage should be notified to the shipping company as soon as the product is unpacked. Any shortage should be notified to Tornado International Ltd. in writing (letter, fax or e-mail) as soon as possible and in any event not later than 5 days after receipt.

Before installation

All equipment designed to operate off mains voltage supply (100V to 240V) is supplied with a connecting plug where available. Ensure that the required number of plugs and sockets are available before starting the installation.

Caution!
Check that the supply voltage matches the voltage setting on the front of the PSU and Charger cases. (see 1.04 Dia. 1 and 1.05 Dia. 1)

Tools & items required;

Small flat screwdriver
Medium flat screwdriver
Medium cross point screwdriver
Power drill
8mm drill bit
51mm hole cutter
10mm socket and ratchet
Socket set or adjustable spanner
Staple gun or 3mm cable clips
7mm cable clips
10 of each coin/token/currency note used

(These are not supplied with the unit)

1.02 Setting out the equipment:

1. Before starting the installation place the consoles on the floor in the position they are to be mounted. The consoles may be mounted either indoors or outside. Console number "1" should be on the left with the consoles running in numerical order to the right.
2. Place the power supply unit (PSU) in the position it will be used.

Caution!
The PSU must be mounted in such a position that the public do not have access to it.

3. Place the chargers in the position they will be used. Air vents at the top and bottom of the case provide cooling. It is important that the chargers are positioned so that there is an uninterrupted flow of cool air over the vents.

Caution!
The chargers must be mounted indoors and in such a position that the public do not have access to them. They must be protected from water.

4. Check that the PSU and charger mains cables will reach the electric supply sockets.
5. Lay out the 24V PSU cable and check that it is long enough to reach from the master console to the PSU.

Note!
The PSU cable must not be lengthened without consulting Tornado International Ltd.

Tip!
The master console can be identified by an additional door to the right of the coin acceptor door. It is usually numbers 3/4 or 5/6. It is the console with the transmitter inside.

6. If you have more than one console open the console door (the key is in the spares pack) and locate the console cable coiled up inside. Check that the cables from all additional consoles reach the console connection sockets inside the master console.

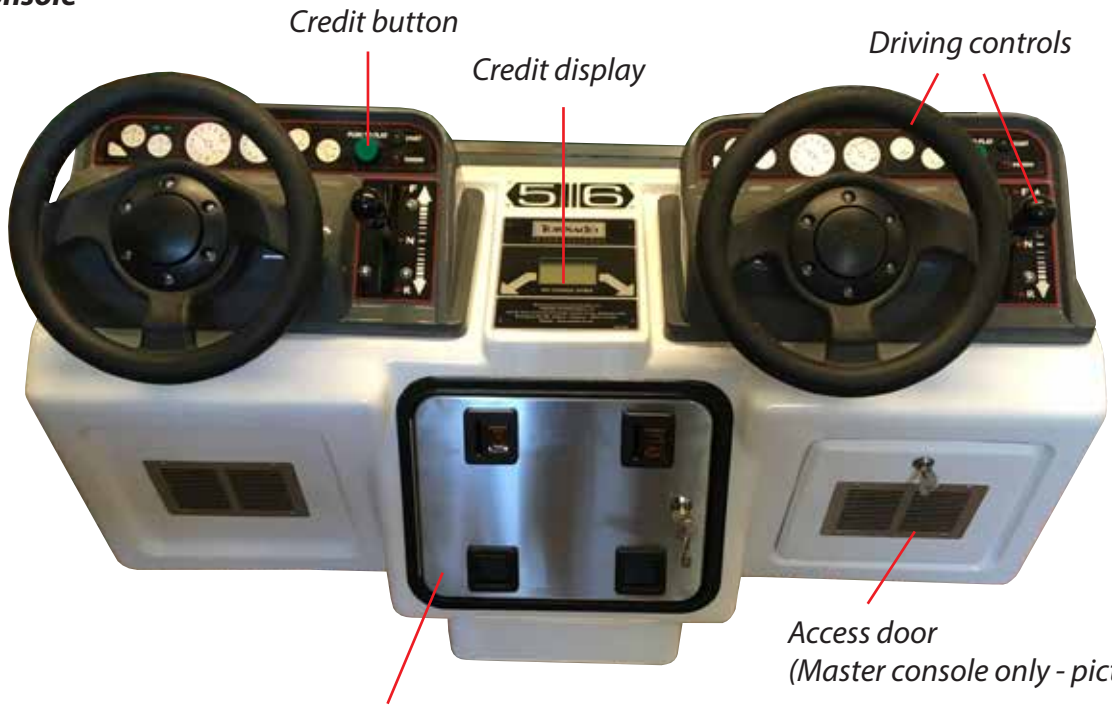
Note!
The console cables must not be lengthened without consulting Tornado International Ltd.

When you have satisfied yourself that all of the units are suitably positioned the installation can begin.

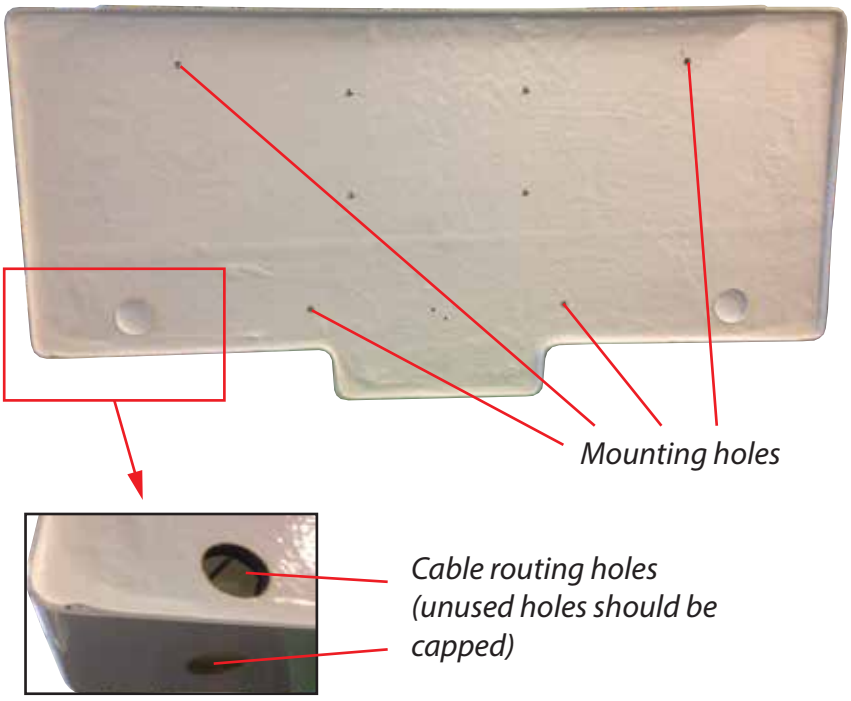
1.03 Consoles

The consoles are usually mounted on a fence or low wall. The lip (See Dia. 3) at the top of the console serves to locate the console on the top of the wall or fence and assists in the mounting process. The lip may be removed if required by marking a line along the top of the console and cutting along the line with a hacksaw. There are 4 mounting holes in the back of the console and large cable holes on the back and underside of the console to route the console connection cables. (See Dia. 2)

Dia. 1 - Console



Dia. 2 - Console rear



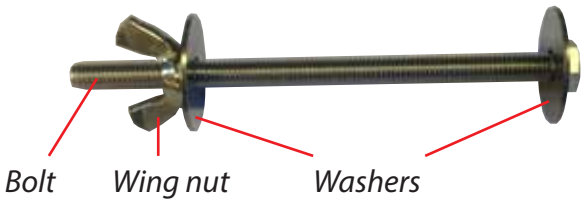
Dia. 3 - Lip removal (if required)

Caution!
Whenever possible use the predrilled mounting holes in the rear of the console (See Dia. 2). If this is not possible, alternative holes may be drilled in the back of the console only after checking that there are no items or electronics inside the console in the area to be drilled. Any damage caused by not following this instruction is the responsibility of the installer.

Mounting the consoles

1. With the coin acceptor door open the console should be placed in the chosen position on the wall or fence to which it is to be fixed.
2. The position of the mounting holes (and cable holes if required) should be marked on the wall or fence using a scribe or pencil from inside the console.
3. The console can then be removed and using an 8mm drill bit, the four mounting holes can be drilled in the wall or fence. Any required cable holes can then be drilled in the wall or fence, using a 51mm hole saw.
4. Locate the console mounting bolts in the spares pack and position the bolts with one washer under the head through the wall or fence from the model operating side.
5. Prepare four washers and wing nuts. With a helper holding the bolts in place, lift the console into position and locate it onto the mounting bolts. Fit a washer and wing nut to each bolt and tighten securely.
6. Repeat for each console.

Dia. 4 - Console mounting bolt



1.04 Power supply unit (PSU)

Dia. 1 - The PSU

Dia. 2 - PSU back plate

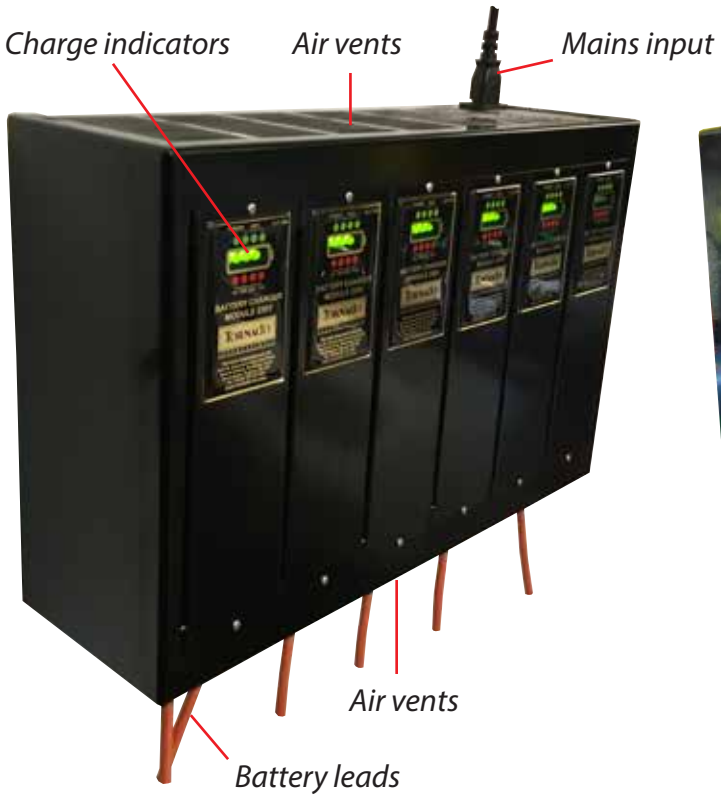
The PSU can either be placed on a shelf or hung on a wall using the slots on the back plate (see Dia. 2). To wall mount the PSU, use the lugs on the PSU backplate as a template and a draw the two drilling locations on the wall. Drill the holes and insert the rawl plugs and screws provided in the spares pack (1F00-001 - Charger & PSU fixings) the create the mounts.

Locate it in close proximity to a wall outlet, but **do not plug it in yet.**

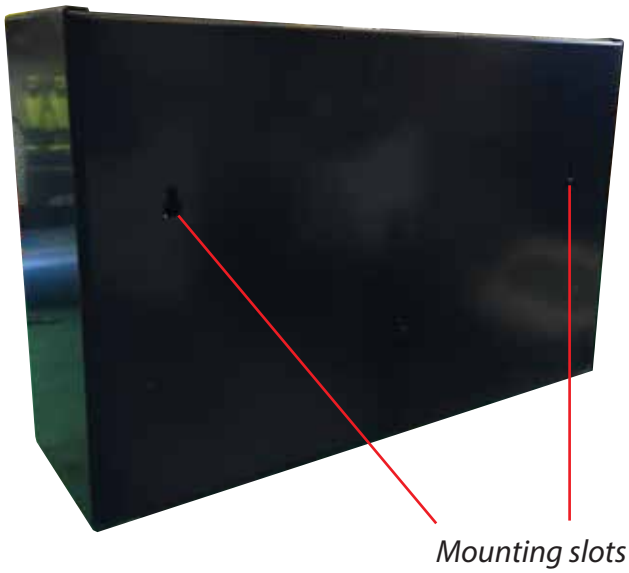
Caution!
The PSU must be mounted in such a position that the public do not have access to it.

1.05 Chargers

Dia. 1 - The charger case



Dia. 2 - Case mounting slots



The chargers must be mounted on a wall using the slots in the rear of the case (see Dia. 2). Draw a 325mm horizontal line on the wall on which you want to mount the charger case and drill a hole at each end. Use the rawl plugs and screws provided in the spares pack (1F00-001 - Charger & PSU fixings) to create the mounts.

Air vents at the top and bottom of the case provide cooling. It is important that the chargers are positioned so that there is an uninterrupted flow of cool air over the vents.

Caution!
The chargers must be mounted indoors and in such a position that the public do not have access to them. They must be protected from water.

The chargers should now be connected to the electric supply. The batteries are fully charged when the unit is dispatched from the factory, however if the unit has been in transit for some time it might be prudent to charge the batteries whilst the rest of the installation is carried out. See the section "3.20 Battery charger" for how to charge the batteries.

1.06 Routing the console cables

Dia. 1 – The transmitter motherboard showing the master console connection sockets (Inside the access door of the master console)

Each console has a grey cable coiled inside the console on the side nearest the master console. Each of these has to be routed out of the console and into the master console. The cables should be supported using 8mm cable clips every 30cm.

1. Open the coin acceptor door and locate the console cable.
2. Uncoil the cable and feed the plug out of the console using one of the large holes in the back or bottom as required.
3. Route the cable to the master console and fit the plug into the correct numbered socket on the transmitter motherboard (See Dia. 1) (The socket numbers are on the transmitter motherboard cover). Do not fix the cables in position at this time.
4. Repeat the routing for all console cables. It should be noted that the cable for the master console is fitted at the factory. All of the console cables are the same length so some surplus will remain for consoles close to the master console.
5. Leaving a small loop of cable in the master console, fix the cables in position starting at the master console and working toward the standard console(s).
6. Coil up any excess cable and place it inside the standard console to one side, ensuring that the coil of cable does not interfere with the operation of any of the console controls.
7. Repeat the cable fixing for any other consoles.

Note!
When you have finished connecting all of the supplied consoles check to ensure all of the master console connection sockets have either a console connected or a dummy plug installed.

1.07 Routing the PSU cable:
The PSU cable has to be routed from the PSU to the master console. This cable carries the 24V ac produced by the PSU to the consoles.

Note!
The PSU cable must not be lengthened without consulting Tornado International Ltd.

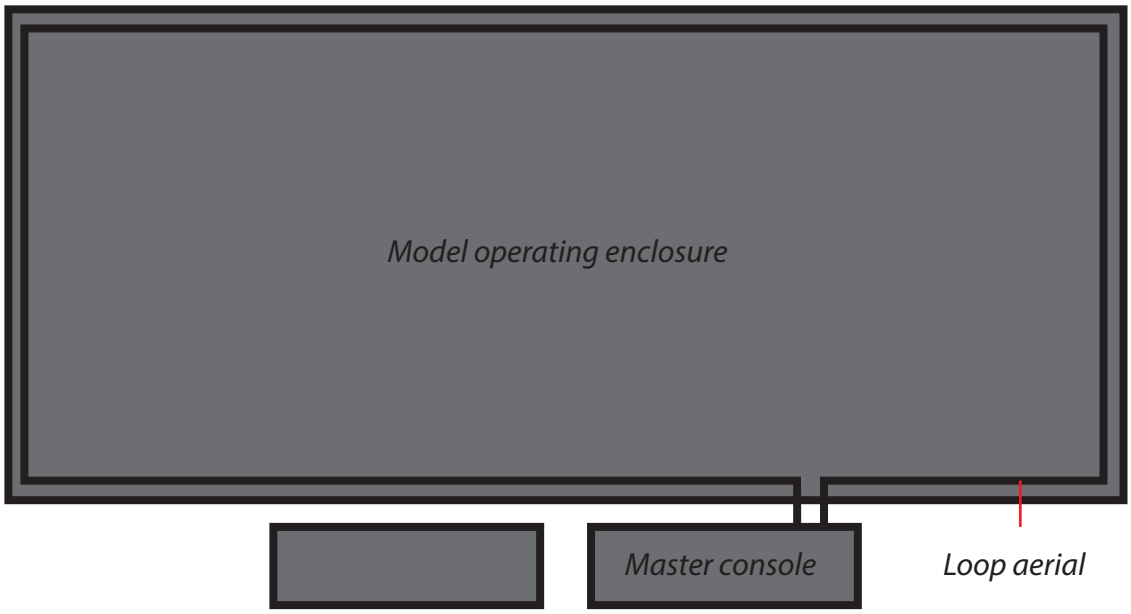
1. Route the cable from the PSU to the master console.
2. Plug the PSU cable into the 24V socket in the master console. (See 1.06 Dia. 1)
3. Starting at the master console fix the cable in place using 8mm cable clips.
4. Coil any excess cable next to the PSU.

Do not plug the PSU in to the mains outlet at this time.

1.08 The loop: (If you don't have a loop system please ignore this section)
The loop is the aerial used by the transmitter (TX) to send the control signal to the models. We use a loop type aerial because it concentrates the available transmitter power into the operating area for better interference rejection. The loop wire will be found with the spares pack. If required, any wire of at least the same cross sectional area can be used.

The loop wire forms a complete loop starting at the loop plug in the master console (See 1.06 Dia. 1), running around the perimeter of the model operating enclosure and ending back at the loop plug in the master console (See Dia. 1).

Dia. 1 – The loop aerial



1. Locate the loop wire and leaving 3m excess, attach the wire to the enclosure wall at a convenient point below the master console. The loop wire may be run on the outside of the enclosure wall or on the inside.
2. Fix the wire around the enclosure using staples or cable clips every 300mm. Choose a position and height that does not cause the models to rub against the wire, and is not easily seen by the public.
3. The wire should be run around the area to finish at the point you started. Leave 3m and cut the wire. The remaining wire should be retained for any future use.
4. Route the two lengths of wire to the loop socket in the master console and cut them to a convenient length so that they reach within 200mm of the socket (See 1.06 Dia. 1).
5. Strip back around 5mm of insulation from both ends of the wire to expose the bare wire underneath.
6. Locate the loop plug in the spares pack (2 are supplied). Loosen the screws of the empty contacts, insert the ends of the loop wire and tighten the screws to secure them and make the contact. It does not matter which wire goes to which contact (See Dia. 3).

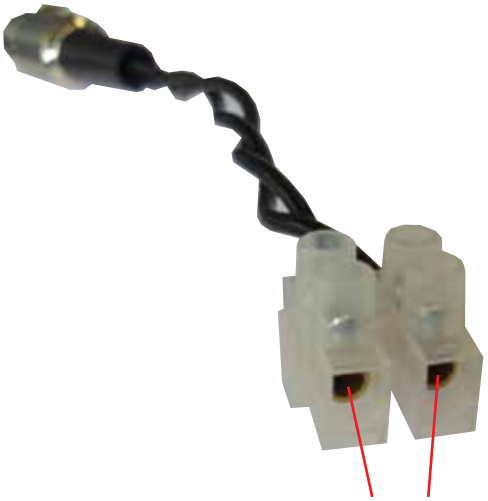
Note!
Double check that the screws are in contact with the bare sections of wire and not the insulation.

7. Fit the loop plug (see Dia. 2) into the loop socket on the loop output board. The loop output board is attached to the transmitter motherboard, found in the master console (See 1.06 Dia. 1).

Dia. 2 – Loop plug

To transmitter motherboard

Dia. 3 - Connector block



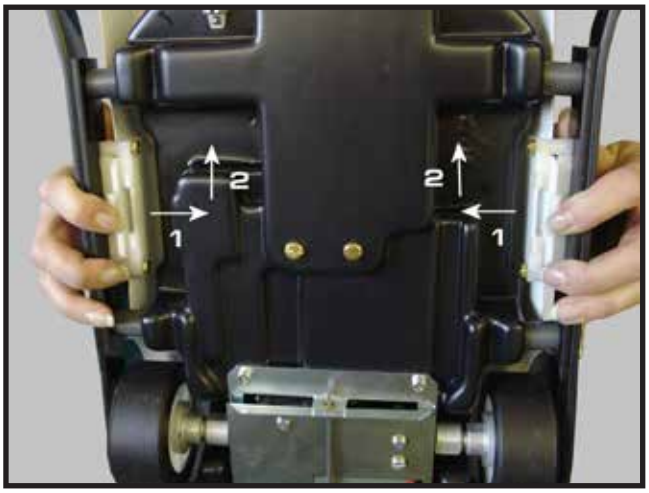
Insert loop wire ends here. It does not matter which wire goes to which contact

1.09 The models:

The models should be handled with care. They are designed to be as robust as possible within the constraints of their size.

Dia. 1 - The model

Dia. 2 - The body catch



1. Carefully unpack the models and place them near their driving positions.

2. Remove the body by holding the model in the position shown in Dia. 2. Using your fore finger first, push the clips toward the center of the car (1) and then up and off (2). The body catches will release and the body can then be lifted off the model.

Tip!
To preserve the appearance of the body, never stack them on top of each other and always place them on the ground or shelves the correct way up.

Do not connect the battery to the model at this time.

1.10 Power up & testing

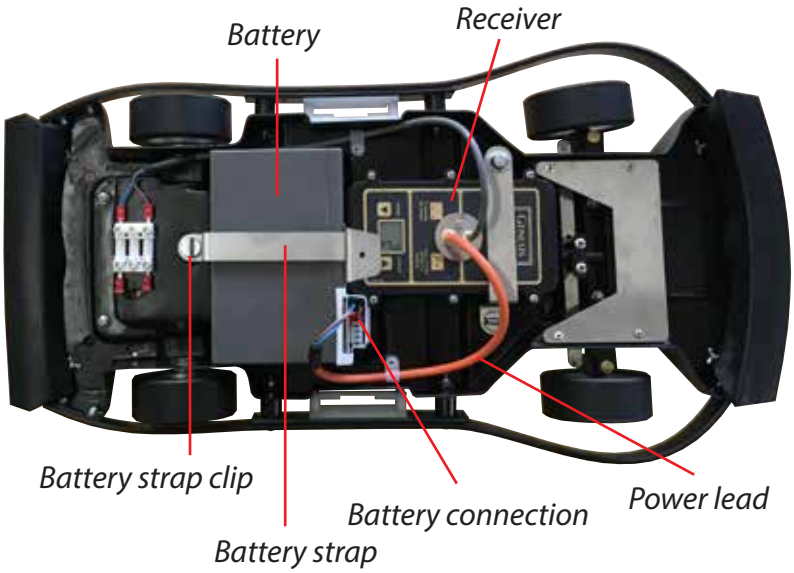
All of the stages described in sections 1.01 to 1.09 should be completed before these instructions are followed. The power to the unit will be turned on and the primary functions of the unit will be tested manually. This will allow the unit to be entered into service. The test procedures will duplicate some of the tests carried out at the factory prior to shipment. All aspects of every unit's operation are tested as the last stage of production.

If you encounter any problems please check to ensure you have carried out the installation correctly. If you still have a problem please make a note of the exact nature of the fault, all of the symptoms and the serial number of the unit, then telephone the Tornado International Ltd technical helpline.

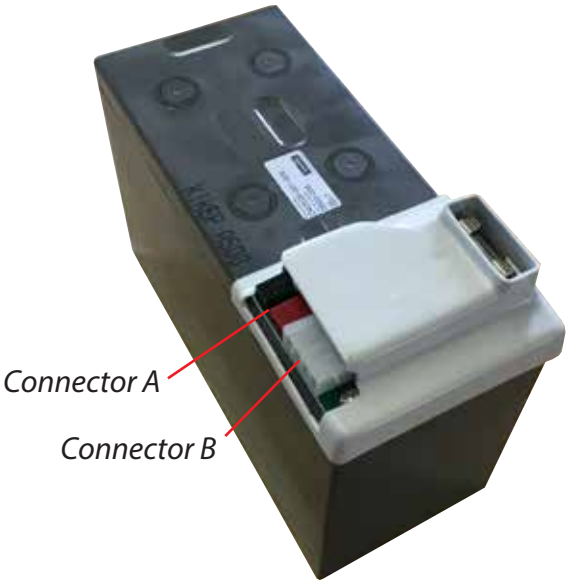
Dia. 1 - Driving controls

1. Turn on the PSU by plugging it in to a wall outlet.
2. Check the lights on the loop output board. There should be a solid green light to indicate that the loop is tuned. (See 1.06 Dia. 1). Customers with previous experience of Tornado equipment will be familiar with "tuning the loop". This is now not required as a manual operation and is carried out automatically. If a solid green light is not shown please contact Tornado service department for assistance.
3. Check that the red finish lights on all of the consoles are turned on. (see Dia. 1)
4. Calibrate the forward/reverse sticks on each playing position by pushing them fully forward and fully backward.
5. Turn the playtime control on the master timer to maximum (fully clockwise). (See 1.06 Dia. 1)
6. Observing the credit displays introduce enough coins/tokens to purchase one play. The counters should show 1 credit and the green credit button should flash. (see Dia. 1) Repeat for each playing position.
7. Press the green credit button. The credit button should stop flashing and remain on constantly, the red finish light should turn off and the green play light should come on. (see Dia. 1) Repeat for each playing position.
8. At the end of the set time a sounder will be heard, the green play light will turn off and the red finish light should turn on.

Dia. 2 - Car interior



Dia. 3 - Car battery



9. In the cars, twist the battery strap clip to release the battery strap, then unhook it. Insert a battery into beach car then refit the battery strap and push down on the clip to secure it. Attach the power lead from the receiver to the battery connection (See Dia. 2) .

Caution!
As the battery is connected, lift the rear of the model far enough to remove the front and rear wheels from the ground. This will allow the steering to move and the drive wheels to briefly rotate.

Caution!
The batteries and receivers supplied with this set are designed to use the battery connector labeled A (see Dia. 3). **Do not remove the cover from connector B.**

10. Again introduce enough coins/tokens to purchase one play into playing position 1. The counter should show 1 credit and the green credit button should flash. Press the green credit button to trigger the game. Check that the red finish light has turned off and the green play light is on.
11. Place model number 1 in the play area. Move the forward/reverse stick fully forward and backward and back to neutral. Now move the forward/reverse stick to forward again. The model should move forward.

Caution!
Moving the stick fully foward and backward and back to neutral is a necessary calibration step that needs to be repeated after every system power off / on.

Turn left and right to check that the model responds correctly. Repeat for reverse. At the end of the play period the green play light will turn off, the red finish light will turn on and control will be removed from the playing position.
12. Repeat the test for each model.

The unit is now ready for use.

2.00 Operating procedures

To ensure this product remains in good working order these instructions should be followed daily.

2.01 Opening instructions

1. Remove the console covers; visually check the consoles for any damage.
2. Turn the power supply on and check that the red lights are illuminated on each playing position.
3. Calibrate the forward/reverse sticks on each playing position by pushing them fully forward and fully backward.

Note!
The power supply must always be turned on before the batteries are connected to the models.

3. Check the charge indicator LEDs on the battery chargers. All four should be illuminated green when the battery is fully charged.
4. Remove the batteries from the chargers and insert the spare batteries if they are not fully charged.
5. With the car near to the operating area, insert the battery into the car and refit the battery retaining strap. Keeping the wheels clear of the ground, connect the battery to the receiver. The drive wheel and steering servo will operate briefly.
6. Attach the car body and lock it into position. Ensure it is the correct number for the receiver.
7. Carefully place the car inside the operating area.
8. Repeat operations 5 to 7 for each model.
9. Coin and test each playing position in turn to ensure the console and car operate correctly.

The unit is now ready for use.

2.02 Closing instructions

1. Whilst the car is still inside the playing area, remove the body and disconnect the battery.

Caution!
It is vital that the battery is disconnected whilst the car is in the playing area. If the car is placed on a table or work surface with the battery connected it is possible that the car could drive off the surface and fall to the floor. Damage caused in such a way is not covered by the guarantee.

2. Take the car to the charging/storage area and remove the battery from the car.
3. Invert the chassis and gently shake it to remove any accumulated dust and grit.
4. Using polish and a cloth thoroughly clean the body.
5. Place the chassis and body in their storage position.

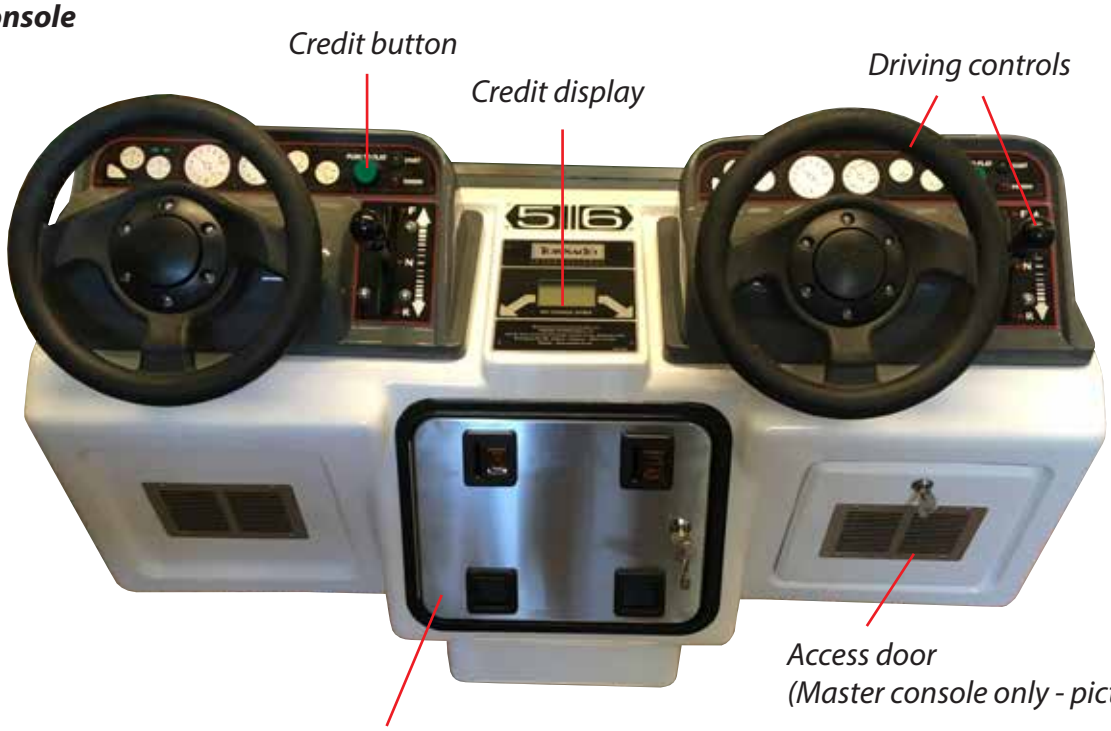
Note!
The bodies should be stored either on the chassis or singularly. To avoid damage to the tops they should not be stored stacked on top of each other or on their roofs.

6. Repeat operations 1 to 5 for each model.
7. Turn off the power supply and check that all of the lights on the consoles are off.
8. Open the cash doors (remove the pad locks if fitted) and remove the cash.
9. Lock the cash doors and thoroughly clean and polish the consoles and playing positions. Place the covers over the consoles.
10. Place the used batteries in the charger.

3.00 Detailed overview of the system

3.01 Consoles

Dia. 1 - Console

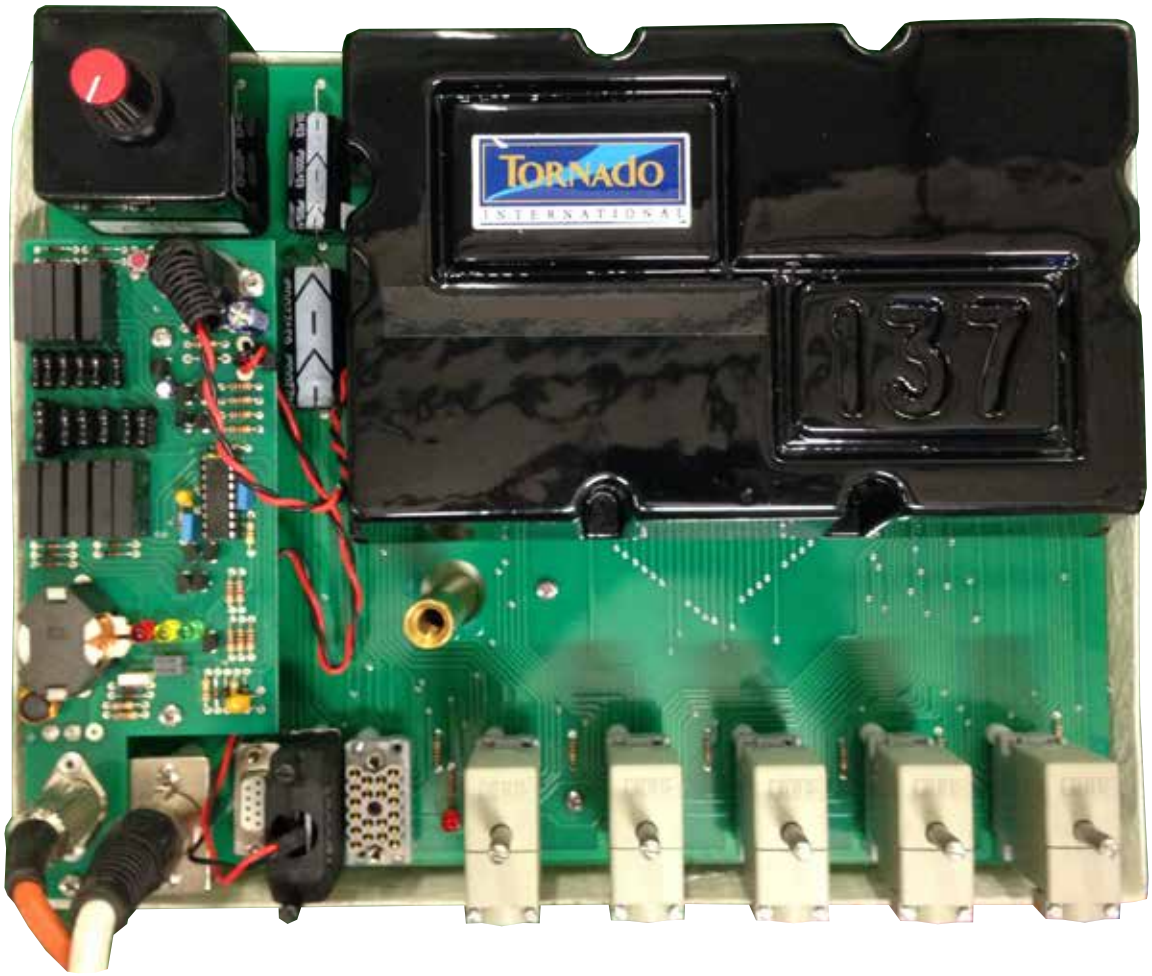


The consoles are made from glass fibre with a blockboard reinforcing for the back wall. Regular application of a quality polish will reduce the harmful effects of sunlight. The console should be thoroughly cleaned at the end of the operating period and before any soiling is allowed to dry. Never use any abrasive cleaner on the console. Housed in every console are the following components;

Driving controls
Coin acceptors
Credit display
Console motherboard
Cash box
Slave timer

The master console can be identified by the provision of an additional door to the right of the coin acceptor door. It is usually console number 5/6. This door allows access to the transmitter motherboard.

Dia. 2 - Transmitter motherboard



Attached to the transmitter motherboard are the following components;

The transmitter
The loop output board (if a loop system is specified)
The master timer
Console motherboard connection
Dummy plugs (on any setup with fewer than 12 positions)

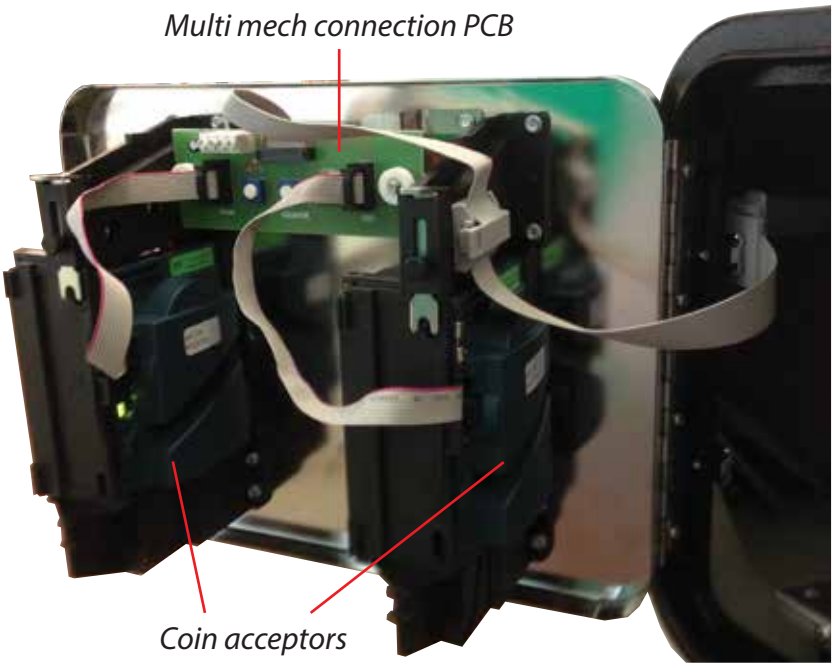
To access the components on the transmitter motherboard, remove the magnetically attached lid by pulling it away from the main assembly and removing through the cash door.

The consoles are provided with covers, which should be used over night and if it rains heavily during the day. A canopy over the consoles is advised to allow your customers to use the attraction during inclement weather or provide shade if the equipment is sited in sunny climates.

The coin acceptor doors and the transmitter access door are all fitted with radial pin tumbler locks. They all open with the same key. Provision is made for the use of your own padlock to secure the cash box if required.

3.02 Coin acceptors

Dia. 1 - Coin acceptors



Microcoin electronic coin acceptors are fitted to the unit. These can be reprogrammed and can accept multiple coins and or tokens. Please contact the service department for details. There are no user serviceable parts in the coin acceptors. They should be returned to Tornado for service.

3.03 Credit display

Dia. 1 - Credit display & credit button

The credit display is mounted between the driving controls and serves both play positions.

As soon as one or more credits are available the green play button will flash. Credits are given when enough coins, tokens or notes are inserted, or upon the use of a swipe card.

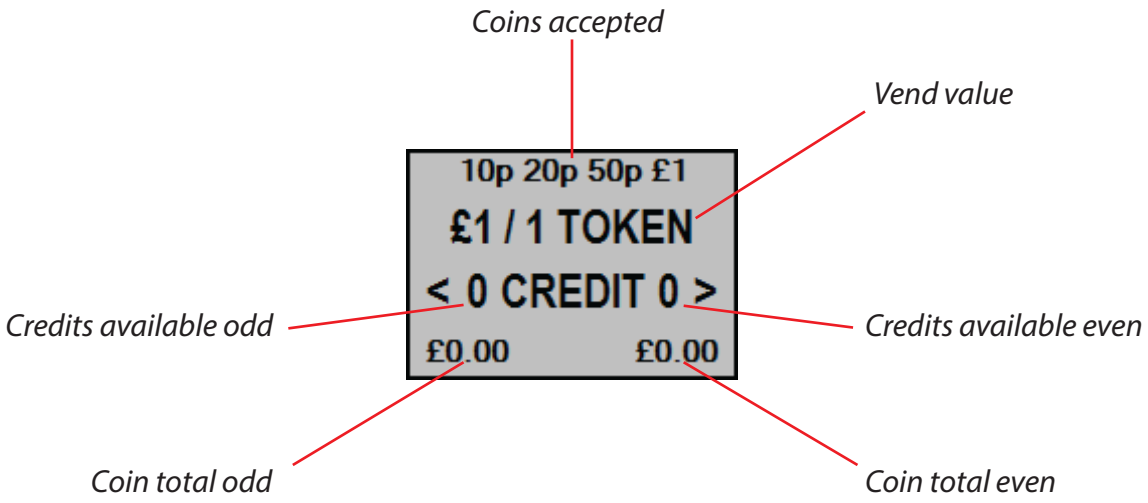
When the play button is pressed one credit will be removed from the total, the play button will be illuminated and a signal will be sent to the slave timer to start the game. Whilst the game is in play, pressing the green play button has no effect. At the end of the game the green play button will flash if more credits are available.

Any over payment which does not reach the next vend price is stored and added to the next payment. For example, if the vend price is 75p and a customer inserts 100p one credit will be displayed and 25p stored. The excess payment is kept in store until either some more money is inserted or the unit is turned off. No change is given.

Note!
Removing power from the system when credits are available will result in the credits being lost.

Credit dispay main screen

Dia. 1 - Main screen



Coins accepted:
The coins accepted by the electronic multimech can be displayed on the credit display main screen for customer information. These coins displayed can be programmed into the credit display by the operator but does not change any settings in the electronic multimech. If coins need to be omitted or added to the electronic multimech it will have to be reprogrammed.

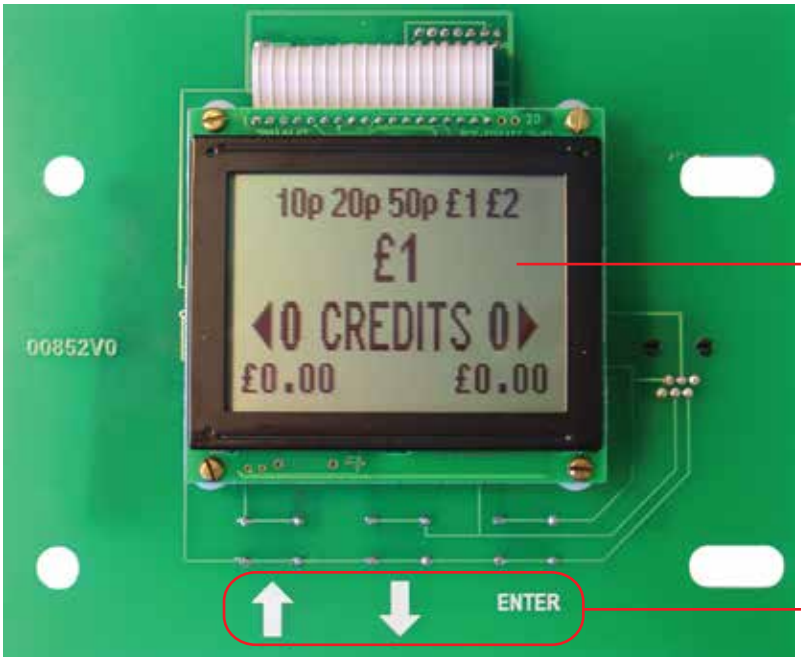
Vend value:
The vend value is the cost of 1 credit and is displayed on the credit display main screen for customer information. This can be programmed by the operator for coin, token, notes and swipe card operation and will change the vend value without the need to reprogram the electronic multimech.

Credits available odd / even:
The credits available is the number of plays a customer has accumulated. When a game is not in play and there are credits available the display will flash. When a game is in play the credits available will not flash.

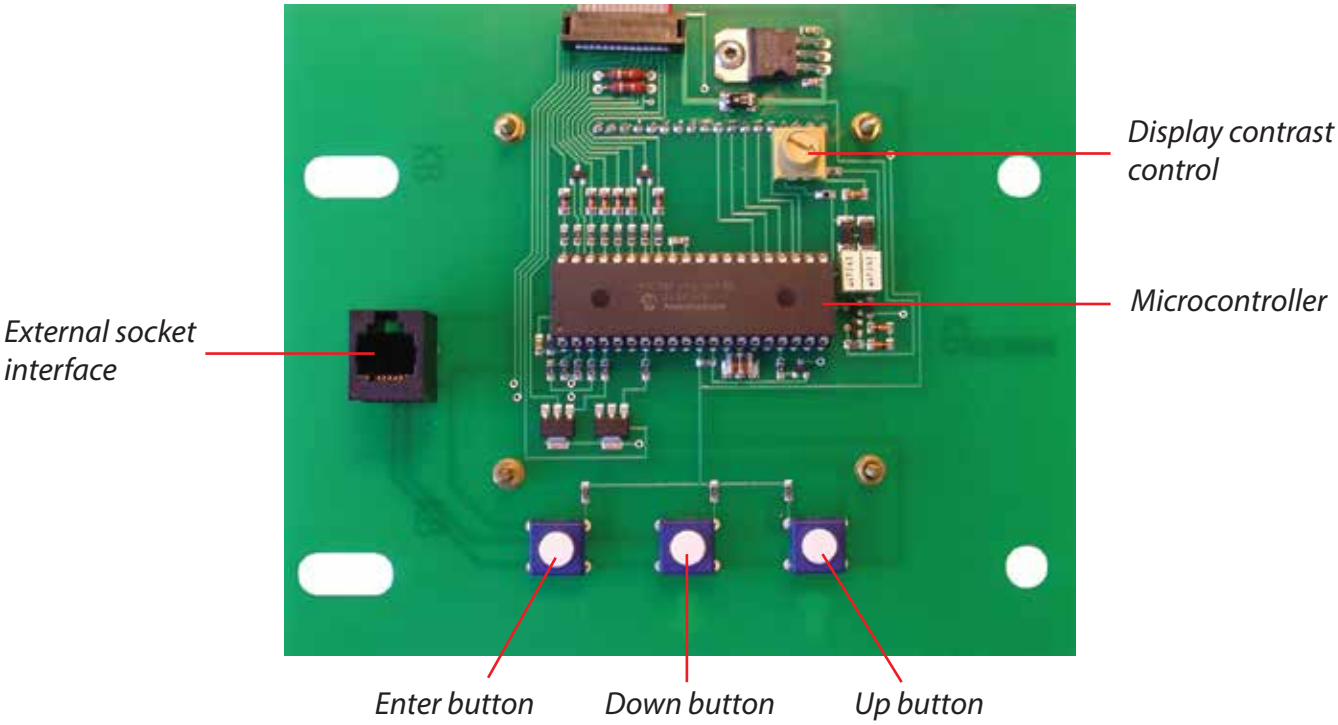
Coin total odd / even:
The coin total is the value of the coins passed through the electronic multimech by the customer. When the coin total reaches the vend value a credit is incremented and the coin total is deducted by the vend value.

QL credit display

Dia. 2 - Front



Dia. 3 - Rear

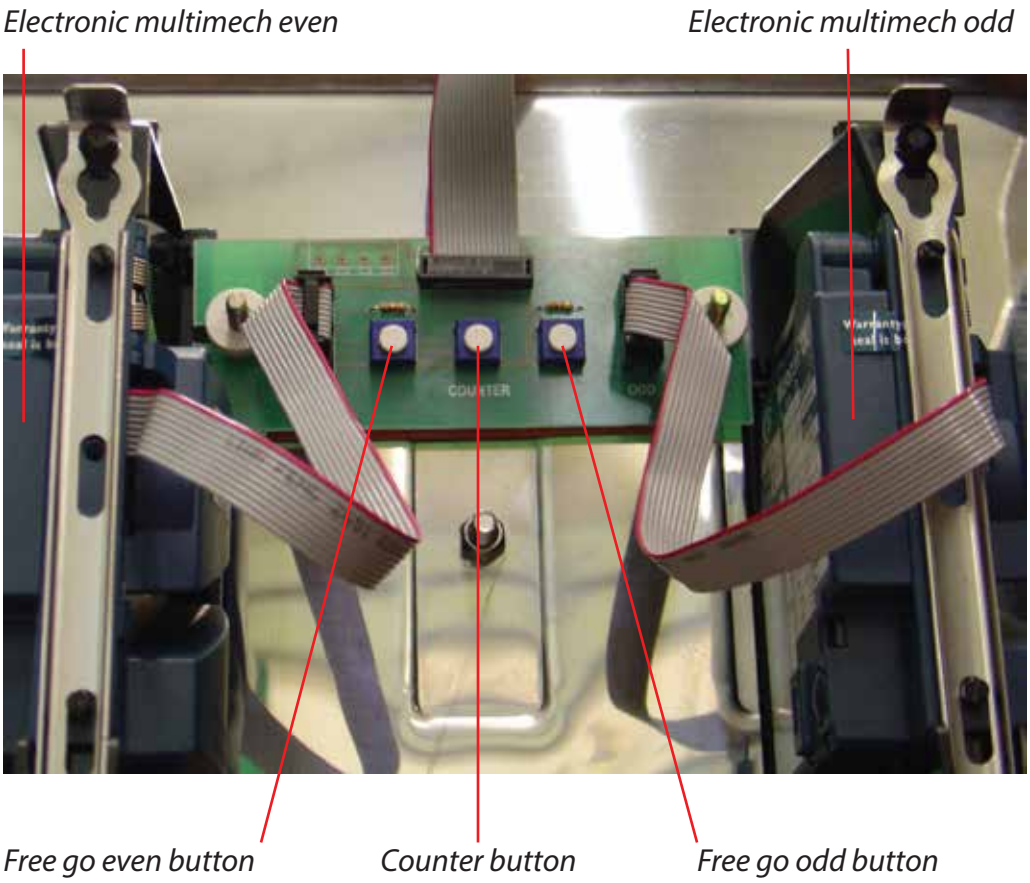


Menu control buttons:
The menu control buttons are located at the rear of the credit display (see Dia. 3). Their functions correspond with the labels on the front of the board (see Dia. 2) The features and settings of the credit display can be accessed with these buttons through a menu system. The buttons are located at the rear of the credit display and can be accessed without the need to remove it from its mountings.

Display contrast control:
The intensity of the display can be adjusted to make the screen characters darker or lighter (see Dia. 2). In extreme high temperature the display may darken and can be adjusted by turning the finger adjustable contrast control potentiometer.

Multimech interface board

Dia. 4 - Interface board



Free go odd / even:
The operator may increase the credits available by pressing the free go buttons (see Dia. 4). For every press of the button 1 credit is incremented on the corresponding counter.

Counters:
The counters can be accessed by pressing the counter button on the console door (see Dia. 4). If the counter button is pressed once the cash counter is displayed. If the counter button is pressed twice the free go counter is displayed. To exit the counter mode press the counter button until the main screen is displayed. If the display is left in counter mode for 25 seconds it will automatically revert to the main screen.

Note!
Although each digital coin counter counts the coins for its own acceptor, the cash box serves two acceptors and is not separated.

Adjusting coin vend price

The coin vend price is the value of 1 credit in currency and will give the customer 1 play. When a coin vend price is selected it will be displayed on the main credit display screen informing the customer of the value of 1 credit. The coin vend price can be adjusted by the operator without the need to reprogram the multi-mechs.

Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

Using the UP & DOWN buttons on the credit display select the VEND MENU. When the VEND MENU has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the COIN VEND menu. When COIN VEND has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the ADJUST VEND menu. When ADJUST VEND has been selected press the ENTER button to take you to the next menu screen.

Use the UP & DOWN buttons to select the new coin vend price. To disable the coin vend price select a value of zero. When the new coin vend price has been selected press the ENTER button to exit this menu screen.

To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

Adjusting token vend

The token vend is the value of 1 credit in tokens and will give the customer 1 play. When a token vend price is selected it will be displayed on the main credit display screen informing the customer of the value of 1 credit. The token vend can be adjusted by the operator without the need to reprogram the multimechs.

Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

Using the UP & DOWN buttons on the credit display select the VEND MENU. When the VEND MENU has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the TOKEN VEND menu. When TOKEN VEND has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the ADJUST VEND menu. When ADJUST VEND has been selected press the ENTER button to take you to the next menu screen.

Use the UP & DOWN buttons to select the new token vend value. Select OFF if the token vend feature is not to be used. When the new vend price has been selected press the ENTER button to take exit this menu screen.

To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

Adjusting swipe vend

The swipe vend is the value of 1 credit in card swipes and will give the customer 1 play. When swipe vend is selected it will be displayed on the main credit display screen informing the customer of the value of 1 credit. The swipe vend cannot be used in conjunction with the coin vend or token vend.

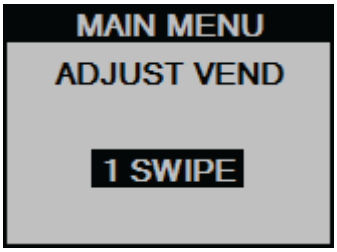
Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

Using the UP & DOWN buttons on the credit display select the VEND MENU. When the VEND MENU has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the SWIPE VEND menu. When SWIPE VEND has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the ADJUST VEND menu. When ADJUST VEND has been selected press the ENTER button to take you to the next menu screen.

Use the UP & DOWN buttons to select the new swipe card vend value. Select OFF if the swipe card vend feature is not used. When the new swipe card value has been selected press the ENTER button to exit this menu screen.



To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

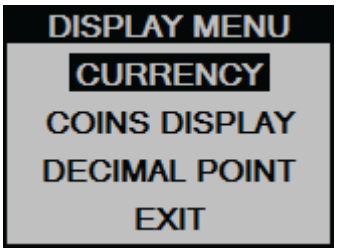
Adjusting currency

The currency symbol used by the credit display can be changed to suit the country of use. Changing the currency symbol does not change any of the vend price settings.

Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

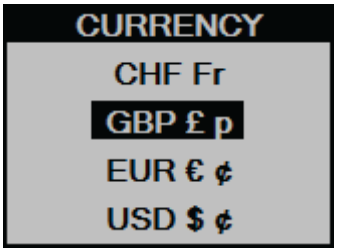
Using the UP & DOWN buttons on the credit display select the DISPLAY MENU. When the DISPLAY MENU has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the CURRENCY menu. When the CURRENCY menu has been selected press the ENTER button to take you to the next menu screen.



Using the UP & DOWN buttons on the credit display select the displayed currency. When the displayed currency has been selected press the ENTER button to take you to the next menu screen.

Use the UP & DOWN buttons to scroll through the available currencies. Select the required currency. When the new currency has been selected press the ENTER button to exit this menu screen.



To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

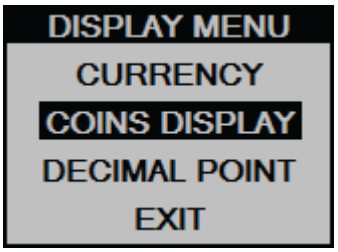
Adjusting coins displayed

The coins accepted by the credit display can be displayed on the main credit display screen. These settings do not adjust the multimech configuration and may need to be independently programmed.

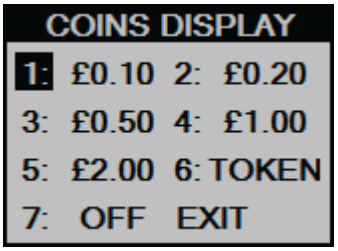
Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

Using the UP & DOWN buttons on the credit display select the DISPLAY MENU. When the DISPLAY MENU has been selected press the ENTER button to take you to the next menu screen.

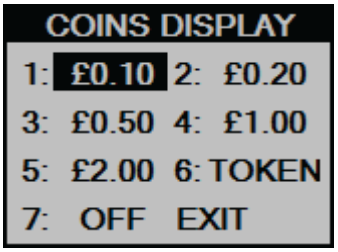
Using the UP & DOWN buttons on the credit display select the COINS DISPLAY menu. When the COINS DISPLAY menu has been selected press the ENTER button to take you to the next menu screen.



Using the UP & DOWN buttons on the credit display select the number of the coin to be adjusted. When it has been selected press the ENTER button to adjust its value.



Use the UP & DOWN buttons to adjust the value of the coin to be displayed. When the required coin has been modified press the ENTER button to exit this menu screen. Repeat this operation until all the coins have been adjusted.



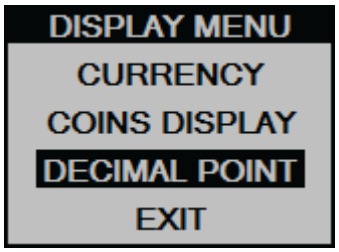
To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

Adjusting decimal point
Not all currencies have a decimal point and may need it to be disabled.

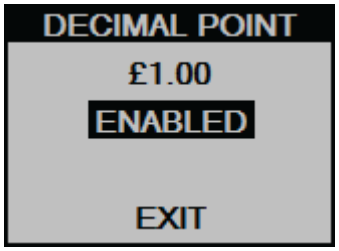
Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

Using the UP & DOWN buttons on the credit display select the DISPLAY MENU. When the DISPLAY MENU has been selected press the ENTER button to take you to the next menu screen.

Using the UP & DOWN buttons on the credit display select the DECIMAL POINT menu. When the DECIMAL POINT menu has been selected press the ENTER button to take you to the next menu screen.



Using the UP & DOWN buttons on the credit display select the ENABLED / DISABLED menu. Press the ENTER button to toggle the decimal point.



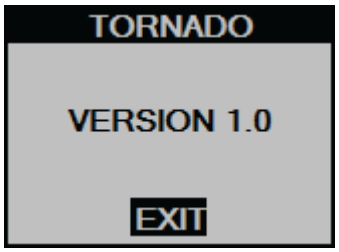
To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

Version number
The version number of the software programmed into the credit display microcontroller can be viewed.

Press the ENTER button on the credit display to access the MAIN MENU screen on the display.

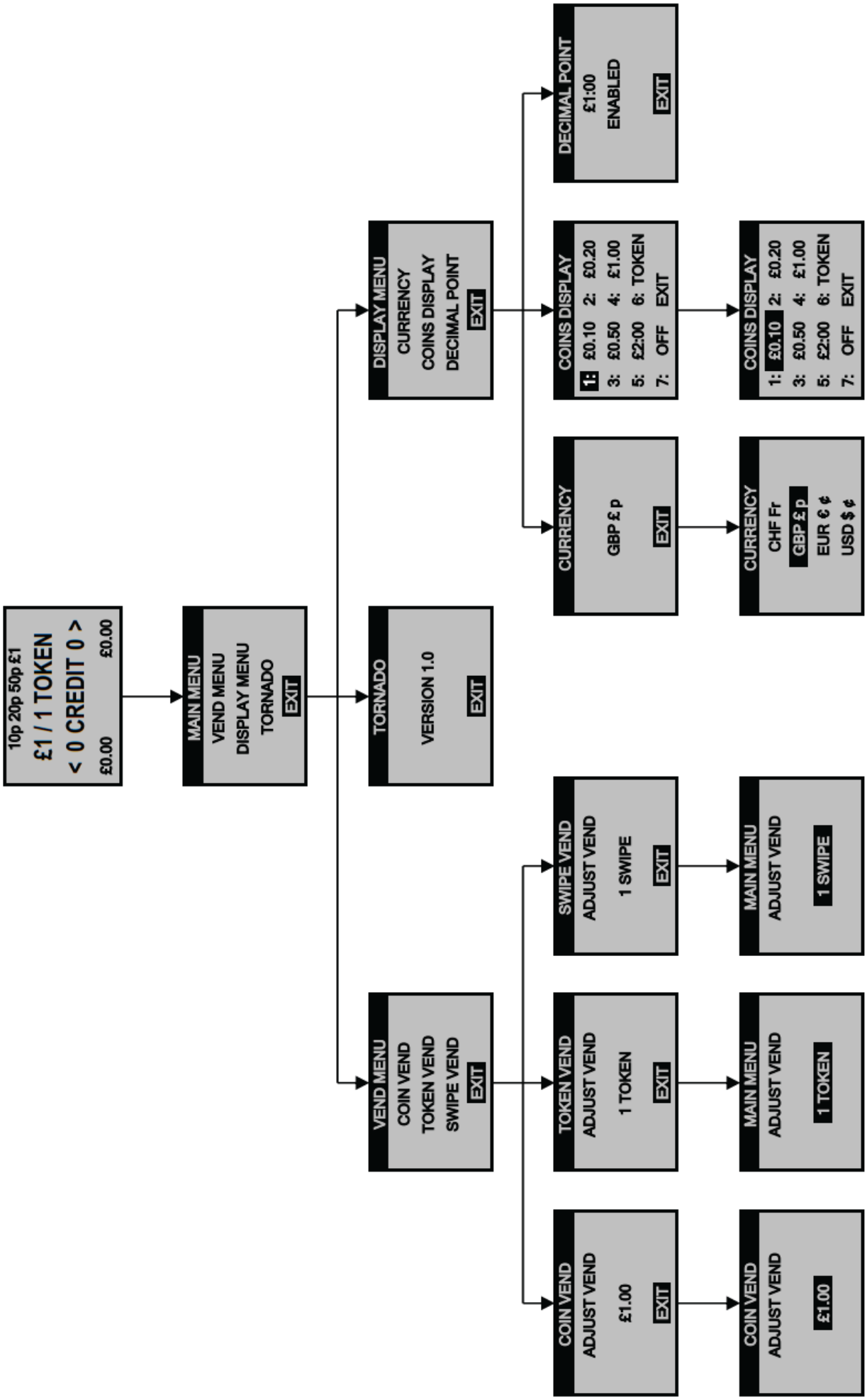
Using the UP & DOWN buttons on the credit display select the TORNADO menu. When the TORNADO menu has been selected press the ENTER button to take you to the next menu screen.

The screen will now show the version number of the software programmed into the onboard microcontroller.



To exit the menu screens or to go to another menu screen select EXIT using the UP & DOWN buttons on the credit display.

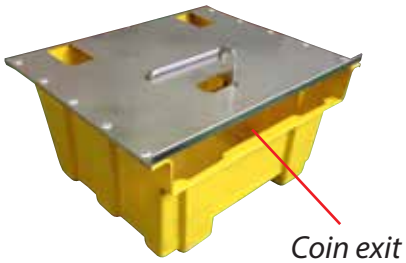
Menu path


10p 20p 50p £1
£1 / 1 TOKEN
< 0 CREDIT 0 >
£0.00
£0.00
MAIN MENU
VEND MENU
DISPLAY MENU
TORNADO
EXIT
VEND MENU
COIN VEND
TOKEN VEND
SWIPE VEND
EXIT
COIN VEND
ADJUST VEND
£1.00
EXIT
COIN VEND
ADJUST VEND
£1.00
TOKEN VEND
ADJUST VEND
1 TOKEN
EXIT
MAIN MENU
ADJUST VEND
1 TOKEN
SWIPE VEND
ADJUST VEND
1 SWIPE
EXIT
MAIN MENU
ADJUST VEND
1 SWIPE
TORNADO
VERSION 1.0
EXIT
DISPLAY MENU
CURRENCY
COINS DISPLAY
DECIMAL POINT
EXIT
CURRENCY
GBP £ p
EXIT
CURRENCY
CHF Fr
GBP £ p
EUR € ¢
USD $ ¢
COINS DISPLAY
1: £0.10 2: £0.20
3: £0.50 4: £1.00
5: £2:00 6: TOKEN
7: OFF EXIT
COINS DISPLAY
1: £0.10 2: £0.20
3: £0.50 4: £1.00
5: £2:00 6: TOKEN
7: OFF EXIT
DECIMAL POINT
£1:00
ENABLED
EXIT

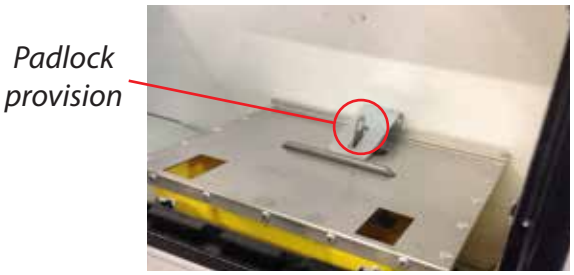
3.04 Cash box

Dia. 1 - Box front

Dia. 2 - Box rear



Dia. 3 - Locking



The cash box is mounted in the centre of the console behind the coin acceptor door. There is provision to fit your own padlock for added security. The cash box is removed from the console by opening the coin acceptor door, removing the padlock if fitted and lifting out using the handle.

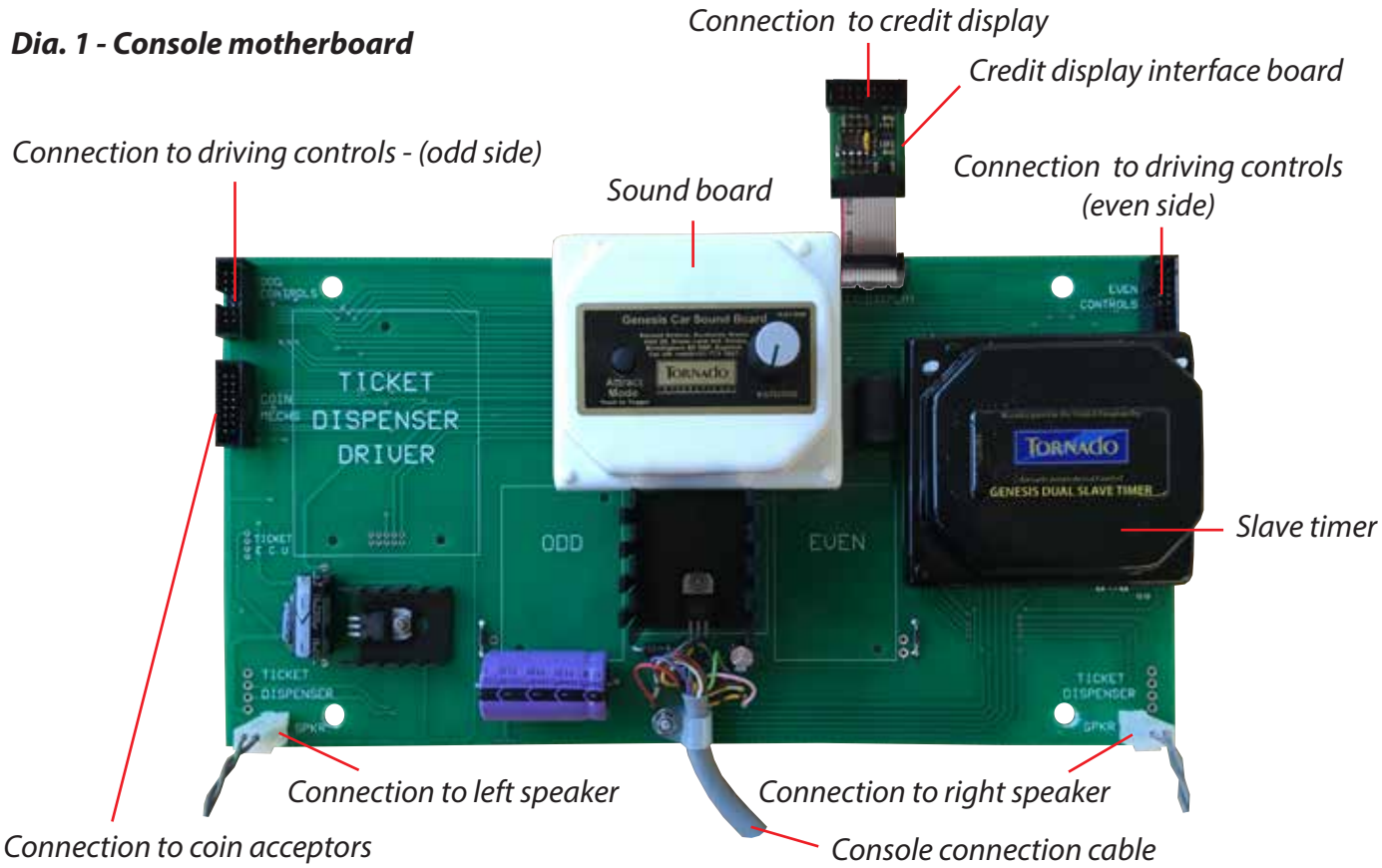
Caution!
Care should be taken to avoid damage to the console motherboard or coin acceptors when removing or replacing the cash box.

The coins can be poured out of the cash box into a suitable container by use of the slot in the rear of the box.

Caution!
When replacing the cash box, ensure it is correctly located before closing the coin acceptor door.

3.05 Console motherboard

Dia. 1 - Console motherboard



The console motherboard is mounted in the centre of the console and is accessed by opening the coin acceptor door. It is the distribution centre for the console and has the following parts mounted on it;

Slave timer
Sound board

And connections for the following;

Console connecting cable
Driving controls
Credit display interface board
Coin acceptors
Speakers

The credit display interface board connects directly to the credit display.

3.06 Sound board

Dia. 1 - Sound board

The sound board is mounted on the console motherboard. One board provides the sound for two playing positions. The sound is produced via a speaker mounted under each playing position. The sound board has two modes, attract and normal. Each mode is selected by pushing the attract mode button. Each push will toggle the mode. The sound board will remember the last mode set on powerup. When set to normal mode the unit is silent when the playing position is not in use. During play the sound produced is dependant on the position of the forward/reverse control as follows:

Forward:	The engine accelerates and changes up through the gearbox finally reaching a constant high speed.
Neutral:	The engine idles.
Reverse:	The engine accelerates to a modest speed.

When set to attract mode the sound of an engine at idle will be produced when the playing position is not being used. As soon as the playing position is in use, operation is the same as normal mode. The volume for both speakers is controlled by the volume control. Turning the control clockwise will increase the sound level.

3.07 Slave timer

The slave timer (see 3.05 Dia. 1) is mounted on the console motherboard. Each slave timer serves two playing positions. It is essentially two timers in one case. The slave timer performs the following functions;

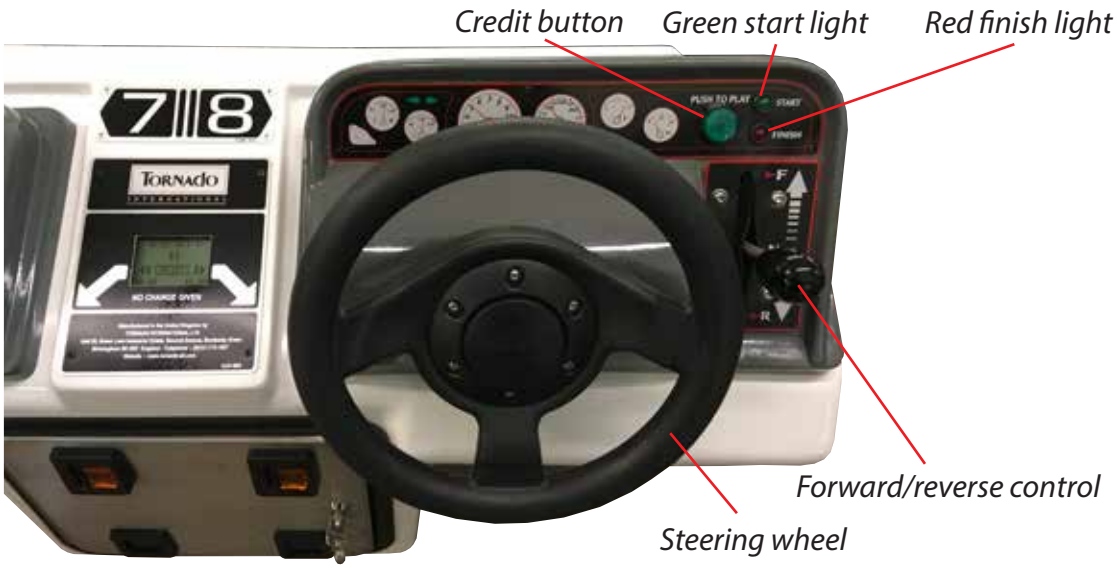
Receives the signal from the credit display to start the game.
Turns the red stop light off and the green start light on.
Transfers model control from internal fixed resistors to the driving controls
Counts the timing pulses generated by the master timer and distributed by the console connecting cable.

When it has received the required number of pulses, control is removed from the driving controls, the end of go sounder is operated, the lights are reversed and a signal is sent to the credit display.

Note!
If the unit is switched off during play, the game will be lost.

3.08 Driving controls

Dia. 1 - Controls



The driving controls are mounted on top of the console and comprise of a control for each function of the model. Each car uses two channels of the transmitter for its operation, one for steering and one for forward or reverse. All of the controls effect the operation of the model by altering the resistance across one or more channels of the transmitter.

Caution!
For correct operation of the model it is vital that the receiver and drive motor in the chassis are connected correctly with the correct polarity.

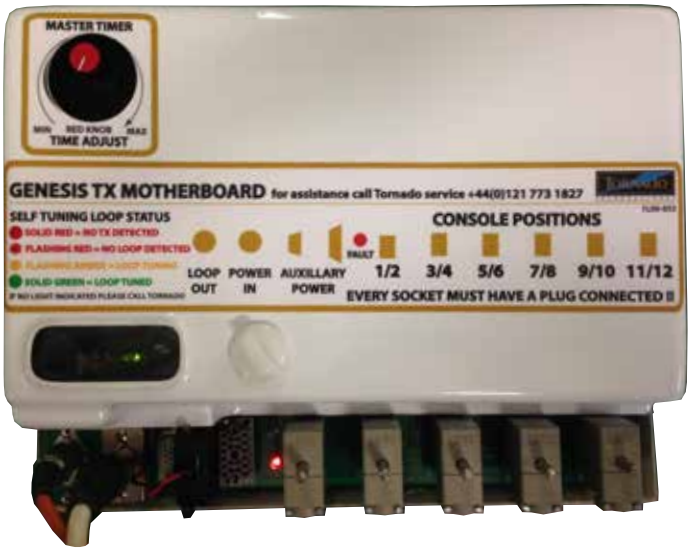
With the steering wheel in the centre position (and the console in the play state) moving the forward/reverse control from neutral to the forward position alters the speed of the drive motor from crawl to full speed in the direction selected. The car will move faster the further the control is moved from neutral.

If the steering wheel is turned to the left or right, the steering servo (a small motor and gearbox mounted inside the receiver case) will turn the steering wheels in the desired direction. The angle of the front wheels on the car is proportional to the position of the playing position steering wheel. This precision of control is called proportional control and gives your customer the most easily controlled model in the industry.

3.09 Transmitter motherboard

Dia. 1 - Transmitter motherboard

Dia. 2 - Transmitter motherboard with case



The transmitter motherboard is housed in the master console behind a plastic cover. It is accessed by opening the door under the driving controls and removing the cover through the coin acceptor door. Mounted on the transmitter motherboard are the following components;

The transmitter
The loop output board (if a loop system is specified)
The master timer
The console connection sockets & LED fault indicator
24 volt power supply (PSU) cable socket
Diagnostic socket
Accessory socket

3.10 Transmitter (TX)

The TX (3.09 Dia. 1) runs all of the time that the system is turned on. The transmitter repeatedly broadcasts frames of information. Each frame consists of one long sync pulse followed by 48 shorter pulses. Each of the shorter pulses' lengths is determined by the position of the driving controls (or fixed resistors in the slave timer if the model is not in use).

One pulse is transmitted for each channel and four channels are allocated for each model. Only two channels are used, the other two are available for future product development. All channels are transmitted even if your particular set has less than 12 models.

Note!
If your set has less than 12 models it is essential that shorting plugs are fitted to all unused console sockets on the transmitter motherboard. The red "fault" LED will light if any socket is empty.

The signal produced by the transmitter is fed to the loop output board to be matched to the length of the loop wire. The transmitter is a mature and reliable design. It is often tempting to assume the TX is the culprit during fault finding, but experience shows this is rarely the case.

Caution!
Always turn the power off at the power supply before removing the transmitter. Failure to do so will lead to serious damage to the transmitter.

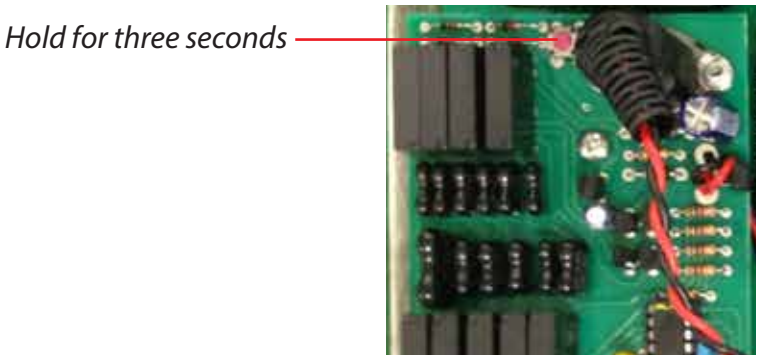
Note!
If you operate more than one type of Tornado equipment, you may have transmitters for the other equipment which look very similar. All items supplied in the spares pack should only be used with the equipment for which they were supplied.

3.11 Loop output board (If you don't have a loop system please ignore this section)

The loop output board (see 3.09 Dia. 1) is located next to the transmitter, on the transmitter motherboard. To operate efficiently all transmitters have to have an aerial which is of a specific length. (Or equal divisions of that length). Normally the manufacturer determines the length during development and makes the aerial accordingly.

In the case of our equipment however, the length of the aerial is determined by the perimeter of the model area. Clearly there is a conflict of requirements and this is overcome by the use of the loop output board. This assembly matches the length of loop wire (the aerial) to the transmitter. This is achieved by changing the capacitance of the circuit. The procedure of matching the length of the loop wire to the transmitter is called "tuning the loop" and is an automatic operation. If the size of the operating area is changed or if the loop wire is changed the loop output board will automatically change its settings. However if instructed by Tornado there is a manual reset button for the tuning board located as shown below.

Dia. 1 - Reset button



Caution!
Operating the system with the loop partially or incorrectly tuned will lead to poor model performance and damage to the transmitter and receivers.

3.12 Tuning the loop (If you don't have a loop system please ignore this section)

Manual tuning is not required as the unit is supplied with a self tuning loop output board. Status LEDs on the loop output board (see 3.09 Dia. 1) are visible through a window on the TX Motherboard case (see 3.09 Dia. 2). A solid green light indicates the loop is tuned and functioning correctly, flashing amber indicates the loop is tuning, flashing red indicates no loop is detected and solid red indicates no transmitter is detected.

3.13 The master timer

The master timer (see 3.09 Dia. 1) is mounted on the transmitter motherboard. It produces a constant stream of pulses whilst the unit is turned on.

The gap between the pulses is controlled by the knob mounted on the front of the unit. The slave timer (mounted in each console) counts a fixed number of pulses to determine when to end the game. By varying the gap between pulses the time taken to send (and therefore count) a given number of pulses also varies. In this way the length of the game is altered.

Rotating the knob fully anti-clockwise sets the shortest time and clockwise the longest. Changing the setting during play will lead to a proportional change in that (or those) games. The pulses are distributed to the slave timers via the console connection cables. If the pulses are not sent (or do not arrive) the slave timer will not end the game.

3.14 The console connection sockets

These are mounted along the bottom of the transmitter motherboard (see 3.09 Dia. 1). They are numbered to correspond with the console numbers.

Note!
If your set has less than 12 models it is essential that shorting plugs are fitted to all unused console sockets on the transmitter motherboard. The red "fault" LED will light if any socket is empty.

3.15 24V power socket

This is mounted at the bottom of the transmitter motherboard (3.09 Dia. 1). It is the connection for the power supply lead. The power is distributed to the rest of the system via the console cables.

3.16 Diagnostic socket

This is provided for the use of Tornado service engineers. Do not connect to this socket.

3.17 Accessory socket

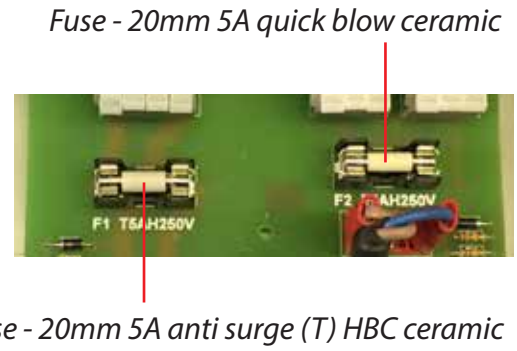
This is provided for the attachment of Tornado accessories. Instructions will be provided with the accessory.

3.18 Power supply unit (PSU)

Dia. 1 - PSU with lid

Dia. 2 - PSU without lid

Dia. 3 - Fuses



The power supply converts local mains voltage (100-120v or 220-240v AC) to 24V AC. This is to ensure the safety of the players. Two fuses are located inside the case - one is exposed and the other beneath the transformer cover. Use the power switch at the wall outlet to turn the PSU on or off.

Warning!
Disconnect the mains supply before removing the cover.

Warning!
Only use the power supply supplied by Tornado for this equipment. Using another PSU can cause personal injury or damage to the equipment.

Caution!
Always replace the power supply fuses with one of identical type and rating.

Caution!
Ingress of water will lead to severe damage to the power supply. Always ensure the lid is secured.

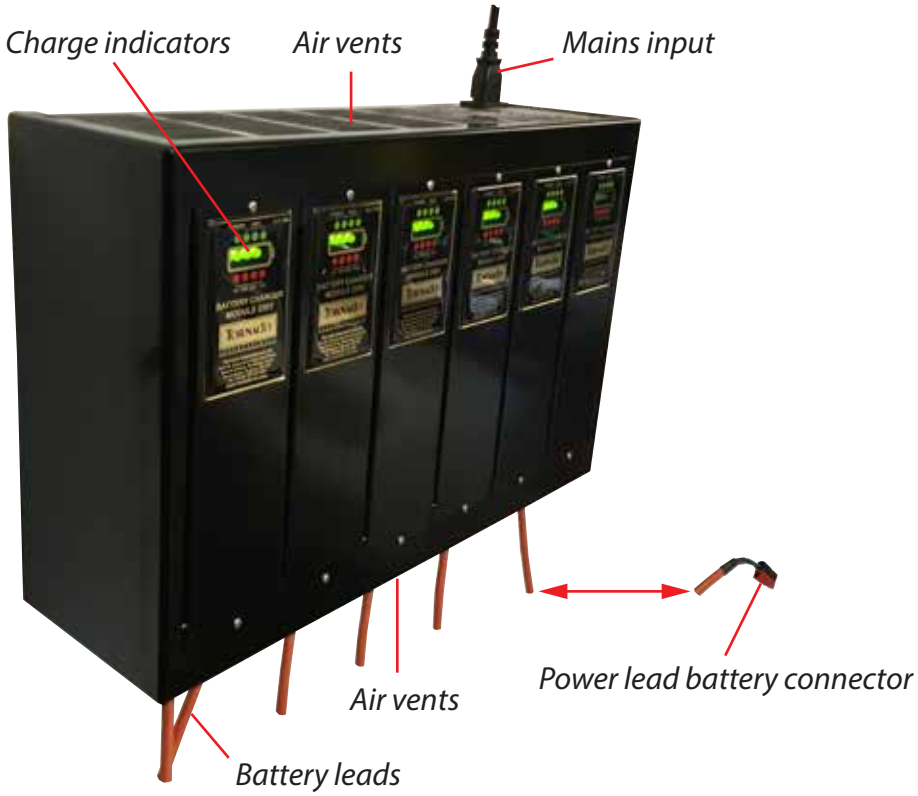
3.19 The power supply lead

The PSU lead is used to connect the power supply to the transmitter motherboard in the master console. The plug must be fully inserted into the socket on the transmitter motherboard and the catch checked to ensure it is correctly latched. A damaged power supply lead should be replaced.

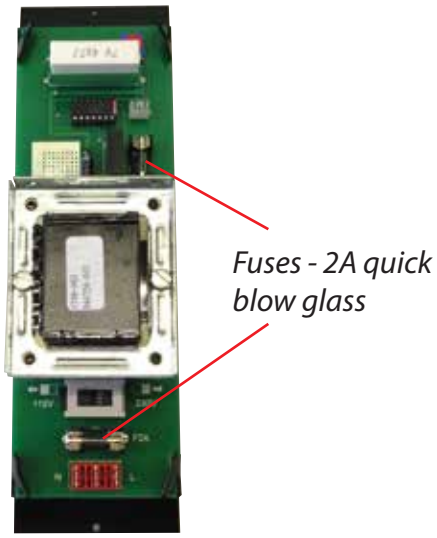
Caution!
The power supply lead must not be lengthened without reference to the Tornado technical department.

3.20 Battery charger

Dia. 1 - Charger case



Dia. 2 - Charger module rear



The battery charger consists of an outer case to which up to six charger modules can be fitted. The case houses the modules and distributes power to them. There are cooling vents at the top and bottom.

Caution!
Risk of fire. It is important to ensure there is sufficient ventilation to provide an adequate flow of cooling air through the vents.

The battery chargers are designed to be wall mounted. A suitable shelf of sufficient strength to hold the batteries should be provided under the chargers within reach of the battery cables. To allow for correct ventilation, the shelf should not be closer to the bottom of the charger than 150mm.

The chargers are fully automatic and require no setting by the operator.

To improve reliability the charger modules are fully independent. Each module has two fuses. To access them undo the screws at the top and bottom of the module, pull the module from the case and disconnect the leads.

Warning!
Disconnect the mains supply before removing the module.

Caution!
Risk of fire. Always replace the charger module fuses with one of identical type and rating.

Dia. 3 - Awaiting a battery

Dia. 4 - Charging

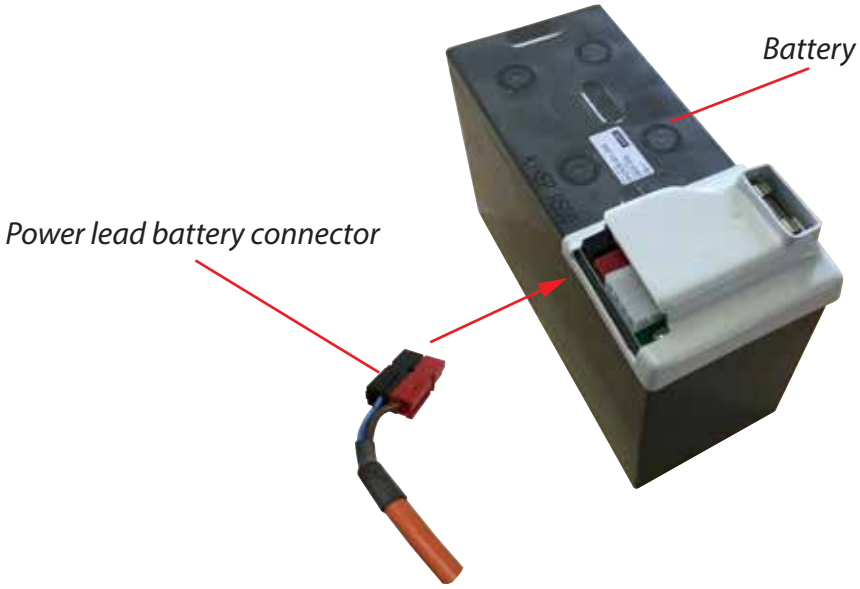
Dia. 5 - Fully charged

Each module has four LEDs to indicate the level of charge in the connected battery. One red light indicates no charge, and each subsequent red light is equal to 25% of charge. When all lights turn green the battery is fully charged. When no battery is inserted a single green LED shows the charger is receiving power and is ready to charge a battery.

Tip!
Before disconnecting the batteries from the charger or when placing the batteries on charge, always check the charge level. This ensures that the batteries are ready for service or are connected to the charger as required.

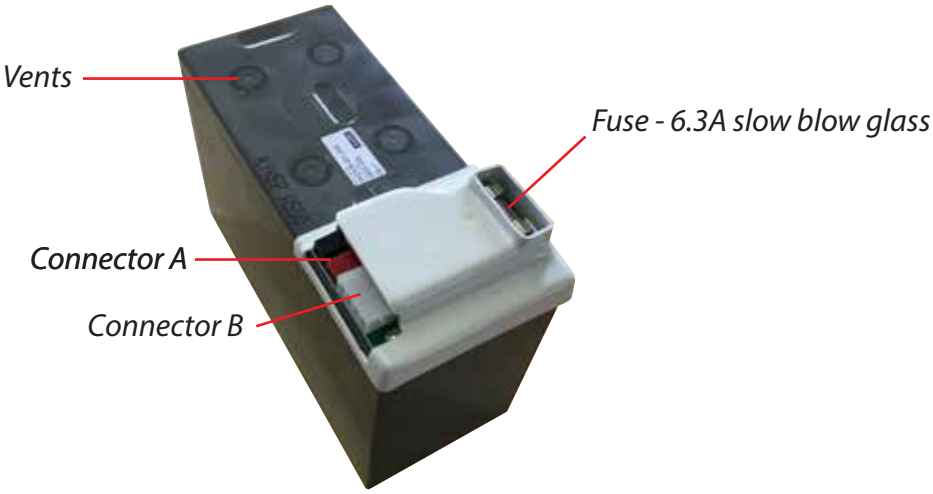
When connecting the batteries to the charger take care to correctly align the two halves of the red and black connectors (see 3.20 Dia. 6). Do not force the connectors together and never disconnect them by pulling on the cables. It is not necessary to switch off the charger when connecting or disconnecting the batteries.

Dia. 6 - Connecting the battery



3.21 Batteries

Dia. 1 - Battery



The batteries are of the sealed lead acid type. Please read the following information before use.

Warning!
Risk of fire. The batteries are capable of producing very high currents for a considerable time. Never place the batteries in a position which might allow the terminals to be shorted by a conducting material.

Warning!
Risk of fire. The protection fuse must only be replaced with a fuse of identical type and rating.

Warning!
Risk of personal injury. The batteries contain lead and a gel which contains sulphuric acid. Never use a battery with a damaged case.

Caution!
A damaged battery must be treated with care. Handle only with protective clothing. Dispose of in accordance with local laws.

Caution!
The battery vents must not be removed for any reason. The battery is maintenance free and water must not be added. Removal of the vents or the addition of water to the cells will invalidate the warranty.

If your set is fitted with red and black battery connectors to the chargers and receivers (connector A in the above diagram) **do not remove the white cover over connector B.**

Always treat a battery with respect. Not only is it expensive, it is vital to the correct operation and therefore profitability of the equipment. It should be considered as an energy store and like any concentration of energy it is only safe when used correctly. A battery should only be used for its intended purpose. It should never be used as a doorstop or support block etc. Staff should be given training to recognise and deal with a damaged battery.

There are two batteries supplied with each model, allowing one to be used whilst the other is on charge.

Tip!
Before use, separate the batteries into two sets. On the end opposite the connectors, label one set "A" and the other "B". Then number both sets 1 to 12 (or however many models are in your set). Always use set A or set B together and place the battery in the model and charger with the same number.

There are two advantages to this system. If the batteries need to be changed during the operating day it is easy to see which batteries have been changed. Additionally if there is a battery problem the possible culprit is narrowed to one battery, one car and one charger.

Always keep the battery contacts clean. The next section deals with charging the batteries and the associated subject of battery life.

It must be understood that batteries are an expendable item and in this respect are similar to the tyres and brakes on your car. They will benefit from correct use and be permanently damaged by misuse or inappropriate charging regimes. There are three areas where you can have a direct effect on the overall life of the battery. These are: charging, use and storage.

Before we examine the factors relating to battery life, this vital fact must be appreciated - **every rechargeable battery leaves the manufacturer with a finite life!**

This life is usually expressed in terms of charge/discharge cycles. Each time a battery is charged and discharged a part of the battery life is used up and cannot be replaced.

Charging
It is vital to use a quality charger. The Tornado charger supplied with your unit has been tested by the battery manufacturer and is approved by them for use with the dry-fit batteries supplied. Do not charge the batteries with any other charger and do not use the Tornado chargers on other batteries.

The batteries should be charged at the end of each operating period even if the unit has only had a little use. Repeated under charging will lead to reduced battery capacity and premature failure. With this in mind it is important to charge the battery fully after each use and this will normally be achieved by overnight charging.

Incomplete charging can be diagnosed by charger LEDs which aren't green at the start of the operating period and a gradual and progressive reduction of the batteries' capacity, as evidenced by a reduction in the number of games the batteries achieve. If these symptoms are accompanied by late closing and early opening times then steps must be taken to avoid the premature failure of the batteries due to undercharging.

Always monitor the models' performance and change the batteries if the models' speed is visibly reduced. Place the used batteries on charge immediately. The charging regime you use will depend on your specific site and pattern of use. However the goal is the same, to ensure that the batteries are fully charged before the next time they are used. As a rule the most discharged set of batteries should be charged overnight. During the operating season there should always be one set of batteries in the charger.

Use

When fitting and removing the batteries handle them with care. Avoid dropping them into the model or onto the floor. Dropping the battery will cause the plates to deform with the result that some cells will become useless.

Do not allow the model to be used with discharged batteries. Customer satisfaction will be reduced as will the battery life. Change the battery or remove the model from service as soon as the car's speed is visibly reduced. Do not part charge and re-use the batteries as this will lead to premature failure.

Storage

If the unit is to be removed from service the correct storage of the batteries is vital. As soon as the batteries are removed from service they should be charged for 24hours. They should then be stored in a FROST-FREE place and be charged for 24 hours for each month of storage.

Caution!
Failure to follow these instructions will result in permanent damage to the batteries.

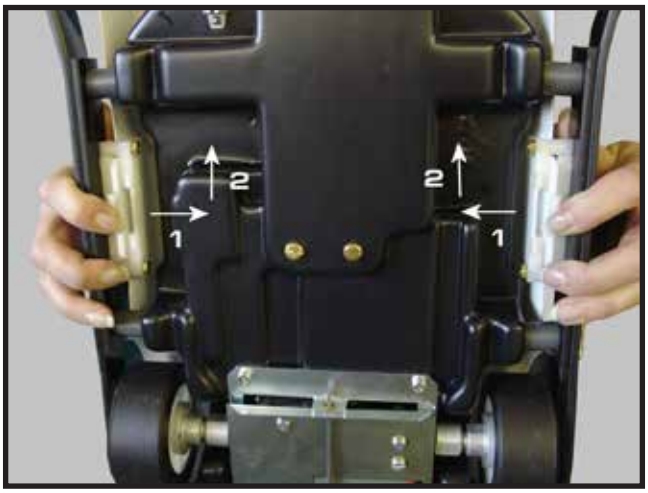
Summary
1. Only use the chargers supplied.
2. Charge the batteries at the end of each operating period.
3. Do not allow repeated undercharging.
4. Remove batteries from service before they are completely discharged and recharge immediately.
5. Charge for 24 hours before storage and recharge for 24 hours for each month of storage.
6. Store in a FROST-FREE place.
7. Handle the batteries with care.
8. Keep the terminals clean.
9. Do not remove the vents, or add water to the cells.

The batteries are expensive. It pays to look after them!

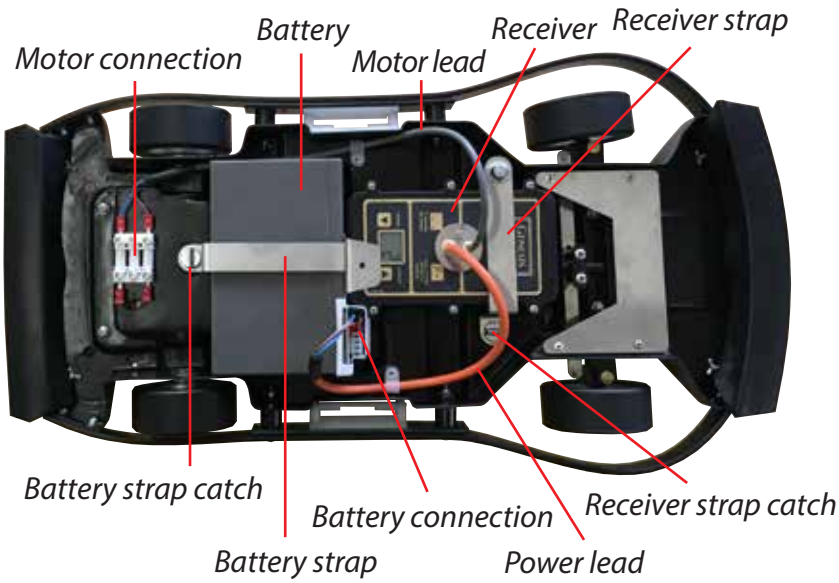
3.22 The models

Dia. 1 - The model

Dia. 2 - The body catch



Dia. 3 - Car interior



The model car chassis are moulded from polypropylene. It is very tough and is largely unaffected by temperature fluctuations. The bodies are produced from UV stabilised PVC.

Regular application of a quality polish will reduce the harmful effects of sunlight. The car should be thoroughly cleaned as soon as it is removed from the playing area and before any soiling is allowed to dry. Never use any abrasive cleaner on the car.

The body is removed by holding the chassis as in Dia. 2 above, placing your fingers on the release tabs (1 in the diagram) and then pushing the tabs inward and upward (2 in the diagram). The body will spring off the chassis.

Note!
Ensure the body does not fall to the floor after its removal. To avoid scratches and damage to the graphics, do not store by stacking the bodies on top of each other.

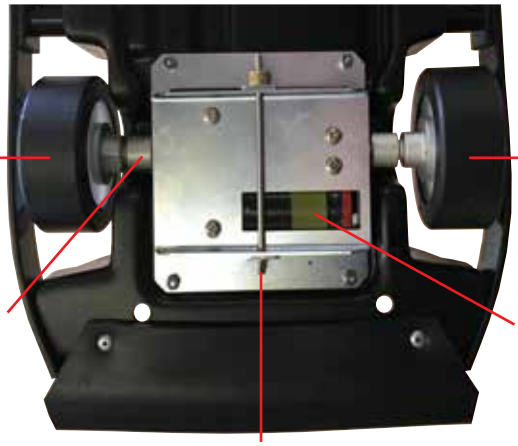
Note!
Do not unclip the body from just one side and then twist the body to one side to gain access to the chassis. This will cause premature failure of the body which is not covered by the guarantee.

The model contains the following components;

The drive motor and gearbox.
The receiver
The battery

3.23 The drive motor & gearbox

Dia. 1 - Motor & gearbox assembly



The car is propelled by a custom designed motor and gearbox. The motor is of the ironless core rotor type. This type of motor is very efficient, using very little current for a given output. All of the shafts and gears in the gearbox are carried on ball races. These features give the model exceptional running time on a battery charge.

Only one of the rear wheels is driven, the other being carried on a ball raced lay shaft. This arrangement reduces drag when cornering which again reduces battery drain. Reduced current consumption prolongs battery life and therefore reduces the management time required by the attraction.

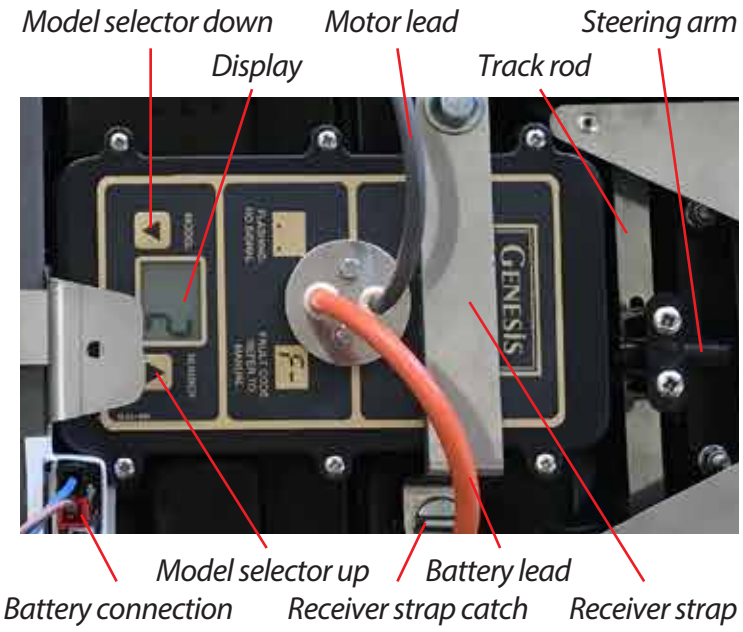
The whole gearbox is carried on a pivoting plate to keep the drive wheel in contact with the ground. The rear wheels are retained by a locknut and collet system. This provides secure mounting for the wheels whilst being easy to remove without damage to the axles for service.

3.24 The receiver (RX)

The receiver is mounted in the front of the car. For increased reliability it is produced using surface mount components on an automatic production line. It is housed in a custom designed water resistant case.

Its function is to receive the signal from the transmitter, interpret the signal and control the movement of the car via the drive motor and steering servo. It does this by inspecting each frame of information sent by the transmitter. Each frame starts with a long synchronisation pulse. The receiver sees this and starts counting the control pulses.

Dia. 1 - Receiver in situ



There is one control pulse for each channel, and four channels allocated to each model. It counts the control pulses ignoring them until it arrives at the pulses for the model it is controlling. It then switches the drive motor and steering servo according to the length of the relevant pulses. Genesis cars do not use the other two pulses allocated to each model so the receiver ignores them.

The receiver then shuts down until the next sync pulse is received when the procedure is repeated. This happens 15 times every second.

Mounted on the top of the receiver are the model selector buttons and a display. During use the display will show the number of the model the receiver is set to control, or fault codes if a fault has been detected. It will also indicate if the receiver is not receiving a signal from the transmitter by showing two flashing dots at the bottom of the display.

The receiver can be set to operate any model by pressing the up or down model selector buttons during use. The display will roll round when it reaches 1 or 12. On powerup the display will show the receiver type followed by the number the receiver was last set to.

Due to its modular design and custom designed case the receiver may be repaired in the field by competent technicians.

Note!
To comply with the terms of the guarantee any part or assembly which requires repair or replacement must be returned to Tornado International Ltd. without being opened or disassembled. The guarantee period is 1 year from the date of shipment.

The fault codes are as follows;

F1 - Servo motor overcurrent trip,
F2 - Drive motor overcurrent trip,
F3 - Servo motor short circuit trip,
F4 - Drive motor short circuit trip,
Lb - Low battery

To change the receiver proceed as follows;
(Please refer to 3.22 Dia. 3 and 3.24 Dia. 1)

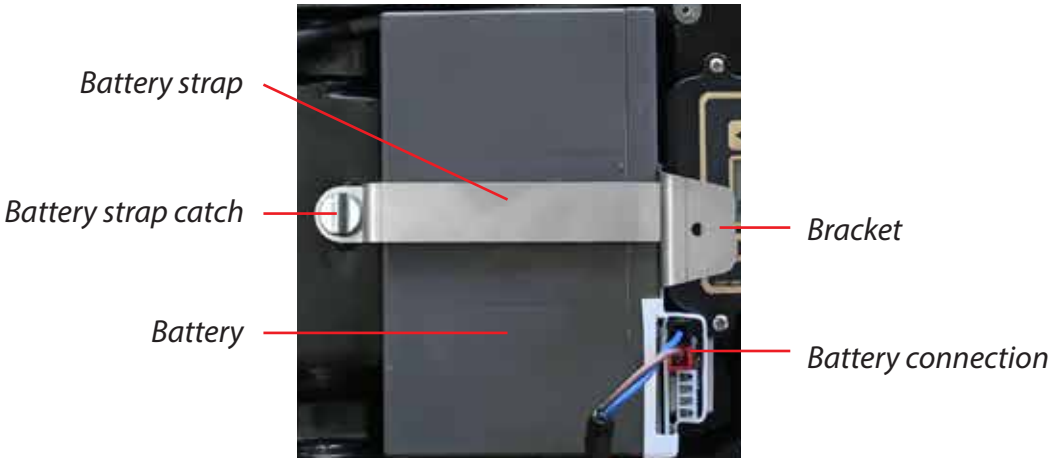
1. Release the retaining strap catch by rotating the catch in either direction one quarter of a turn. Rotate the retaining strap away from the receiver case.
2. Disconnect the battery lead from the battery. Release the battery lead from it's retaining clip.
3. Using a small flat screwdriver, undo the retaining screws on the motor connector over the gearbox and disconnect the motor lead. Release the motor lead from it's retaining clip.
4. Lift the rear of the receiver and remove it from the chassis.

To replace the receiver reverse the above procedure. Ensure that the steering arm is correctly inserted into the black track rod moulding and that the receiver is set to the correct model number.

3.25 Fitting the battery to the chassis

Tip!
This section contains information regarding the fitting of batteries into the chassis. For information about the batteries themselves and how to charge them see the section 3.21 - Batteries.

Dia. 1 - Battery in situ



To fit the battery into the chassis first remove the battery strap by turning the catch ¼ turn in either direction, lift the strap and unhook it from the metal bracket fitted to the chassis.

Carefully place a fully charged battery into the chassis in the position indicated by the diagram.

Refit the battery strap by inserting the hooked end into the support, hinging the strap down onto the battery and then pushing down on the catch until a click is heard.

Then with the car in the operating area and the wheels clear of the ground connect the battery lead to the battery, being careful to align the connector with the correct socket.

Note!
The battery should not be connected to the receiver unless the car is in the operating area and the consoles turned on.

Caution!
The car must not be placed on an elevated surface (table or work surface) with the battery connected. In the event of an uncommanded movement of the car it could drive off the surface and fall to the ground. This will almost certainly result in severe damage to the car and possible personal injury.

To remove the battery from the car proceed as follows. With the car in the operating area remove the body. Disconnect the battery from the receiver by gently pulling on the connecting plug.

Note!
The battery must not be disconnected by pulling on the cable. This will damage the cable and result in erratic and unreliable operation.

Release the battery strap by turning the catch ¼ turn in either direction, lift and remove the strap from the bracket. Remove the battery from the chassis and place on charge. Lay the strap in the chassis so that it is ready for the next operating period.

4.00 Periodic service

4.01 Daily
Follow the procedures in section 2.00 "Operating procedures".

4.02 Weekly
Inspect the chassis. Check that the wheels rotate freely and that there is no debris around the axles. The rear right hand drive wheel will have the drag of the gearbox when it is turned.

Thoroughly clean all of the cars and consoles taking care to remove any stubborn marks which daily cleaning has missed.

4.03 Monthly
Clean the battery contacts and lightly lubricate them with petroleum jelly.

Using light machine oil, lightly lubricate all of the locks and coin acceptor door hinges.

4.04 Annually
Check the coin path through the coin acceptors and clean if required.

Caution!
Do not immerse the coin acceptors in any fluid. Clean only the coin path using a cotton bud and a mild solvent.

Inspect the vents on the battery charger case. Ensure that they are clean and there is no restriction to the flow of cooling air.

Inspect the power supply, console connecting cables and loop wire for any damage.

Check all fasteners on the console and cars and tighten or replace as necessary.

Check all the tyres on the cars and replace if the tyre is worn beyond the bevel

4.05 To Remove from Service
1. Follow the "Operating procedures – closing instructions".
2. In all cases perform all weekly and monthly maintenance checks.
3. Perform the annual maintenance check if appropriate.
4. It is preferable to dismount the consoles for prolonged storage. If this is not possible fit the console covers making sure that they will not be dislodged by wind. Exposed locations may require additional covering to ensure adequate protection.
5. If the consoles are dismounted protect the loop plug by applying a coat of spray preservative oil and wrapping a plastic bag around the plug. Secure with insulation tape.
6. If the power supply lead cannot be removed, (It might be routed underground) apply a coat of spray preservative oil to the exposed plug and wrap a plastic bag around it. Secure with insulation tape.
7. As soon as the batteries are removed from service they should be charged for 24hours. After charging remove the batteries from the charger and unplug the charger. The batteries should then be stored in a FROST-FREE place and be charged for 24hours each month of storage.

Caution!
Failure to follow these instructions will result in permanent damage to the batteries.

4.06 To return to service

1. Charge all of the batteries for 24 hours.
2. If the consoles were dismounted, remount them. Take care not to damage any of the internal components or looms.
3. Route the console connecting leads to the master console and connect the plugs to their numbered sockets.
4. Inspect the loop wire and plug. Reconnect the plug to the socket on the loop output board.
5. Inspect the power supply lead and reconnect the lead to the plug on the transmitter motherboard and the power supply.
6. Turn the power supply on.
7. Check all of the red stop lights are on. Replace any failed bulbs.
8. Check the operation of the coin acceptors by introducing coins. Check that each acceptor takes all of the programmed coins and that the credit display functions correctly.
9. Trigger each playing position in turn by pressing the green play button. Check that the credit counter is reduced by one, and that the red stop light is off and the green go light is on. Allow the playing positions to time out. Note the time and check to see that they all time out.
10. Place a car in the playing area. Insert and connect a fully charged battery. Check that the receiver display is showing the correct model number and then fit the car body.
11. Trigger the playing position and drive the model. Repeat for each car.
12. Turn the power supply off, wait 30 seconds and turn it back on to reset all of the credit displays to zero.
13. Note the new coin counter start numbers.

The unit is now ready to use.

5.00 Fault Finding

Tornado International Ltd. has been manufacturing this type of equipment for over forty years. The result is a well proven product which, by a combination of tried and tested designs and the best of modern technology, offers many years of profitable operation. However all things built by man can fail. This section is intended to guide you through the basics of fault finding on our equipment.

5.01 Foreword

Keep an open mind! When trying to fault find on the equipment look first at the simple things. Has any work been carried out on the equipment recently? Have any changes been made to the equipment? Have there been any unusual occurrences? It is always tempting to suspect the electronics, but it is most often something simple. A corroded connector, a broken or damaged wire or even, dare we say it, misuse by the operator.

The most important aspect of fault finding on the equipment is to observe and WRITE DOWN THE SYMPTOMS. This is true if you are going to fault find yourself and even more important if you are going to telephone Tornado for assistance. In nine cases out of ten, give us concise and full symptoms and we will accurately diagnose the problem. Take time to observe what happens when various actions are taken. When the red console stop light is on, when the green console start light is on. Drive the model and note what happens when driven in all directions and in all parts of the operating area. What happens if the receiver is changed for the spare, or the slave timer is changed? Each set is supplied with a comprehensive spares pack. It has two uses. One, to enable you to continue to operate after a failure and two, to help with fault finding by exchanging known good items for suspect ones.

5.02 Principles

At its simplest, the model is controlled by switching resistors of varying value across the channels controlling the model. If the red console stop light is on (i.e. the position is not in play) these are fixed resistors in the slave timer. When credits are available and the green play button is pressed, relays in the slave timer transfer control to the driving controls. When the forward/reverse control is moved a connected variable resistor alters the length of the transmitted control pulse. This in turn is interpreted by the receiver, which turns on the drive motor in the desired direction. From the above you will see that if the resistance of any of the circuits or wiring connected to the transmitter channels changes, the model will react accordingly.

For example, all of the models are in the playing area with all of the playing positions on stop. (Red light illuminated on the driving controls). All of the cars will be stationary. If we disconnect the console connecting plug for console 1 & 2 we have changed the resistance across the channels for the first two models by presenting an open circuit to the transmitter. (We have also removed power from the console but that is academic for this example). The transmitter interprets this as a resistor change (which it is) and changes the length of the eight affected pulses (4 per model) accordingly. The receiver then turns on the drive motors and moves the steering servos in accordance with the transmitted signal. The cars will run in reverse with the steering turned to the right. If we were to apply a short to the same channels the two cars would run forwards with the steering turned to the left. In summary, resistance controls the models. If the resistance of any channel is changed, intentionally or due to a fault, the model will move accordingly. We can use this movement and its direction to diagnose the possible fault.

There are numerous other systems in use by the equipment, but these are relatively conventional. It is faults in the transmission system which seem to be the most difficult to diagnose for those not familiar with the equipment.

Finally for diagnostic purposes, consider the unit as two separate sections. The console section and the model section. In all cases the first thing to do is to discover whether the problem is in the console or the model section. Be careful as there are a lot of symptoms that are identical for faults in either section. Fortunately there is a relatively simple test. If a fault is observed in the operation of a model, place a charged battery in the spare chassis and set the receiver to the same number as the affected model. Operate the suspect model and observe the good one. If both of the models react in the same manner the fault probably lies at the console end. If the good model reacts normally whilst the suspect model does not, the fault is in the model.

Technical help is available from Tornado International Ltd. during our office hours.

PLEASE HAVE AN ACCURATE AND COMPREHENSIVE LIST OF SYMPTOMS WHEN YOU CALL.

Appendix A

Console

Model (2 per console)

Power supply unit (PSU)

Battery (2 per model)

Battery charger

Receiver