Ride on Railways Ltd.

iDrive Motor Controller Guide.



This guidance applies to controllers only supplied by Ride on Railways. Other companies will have programmed the unit up differently and may use different wiring options.

If you are having issues with the motor controller, please read this guide fully before deciding the controller is at fault. Most issues are wiring related and can be sorted quite quickly at no cost.

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Specification PG Drives Technology iDrive 180

- Progressive Regenerative Braking
- Supply Voltage: 24Vdc
- Operating Voltage: 16-30Vdc
- PWM Frequency: 20kHz ± 1%
- Output Current: 180A continuous)
- Power Connections: M6 screw terminals (bolts supplied)
- Control Connector: 14-way Molex Mini-Fit, Jr (supplied)
- Moisture Resistance: Electronics to IPx5
- Operating Temperature: -25°C to +50°C
- 3 Auxiliary protected 24v outputs (max 3amp) –
- Wiring loom 16/0.2mm wire
- Potentiometer 4K7V or 5K ohm.
- Low voltage battery protection cut out – 22.8v.

24v outputs -

Aux 1 - Reverse traction applied (optional plug and lead)
Aux 2 - Continuous - spare leads on loom
Aux 3 - Traction applied (not wired on standard loom)

Limit switch - top speed 60%

INTRODUCTION

The iDrive is one of the best value and most durable commercial motor controllers on the market.

We programme them to work with a single potentiometer for speed control and a switch for reverse.

The three wires to the potentiometer and two to the reversing switch are sacrosanct. Keep these wires uncomplicated. We do not recommend connecting any accessories to them.

Acceleration and deceleration have been programmed to be responsive with little lag between turning the speed knob and motors reacting. This keeps you in full control. If you want slow acceleration turn the speed knob up slowly.

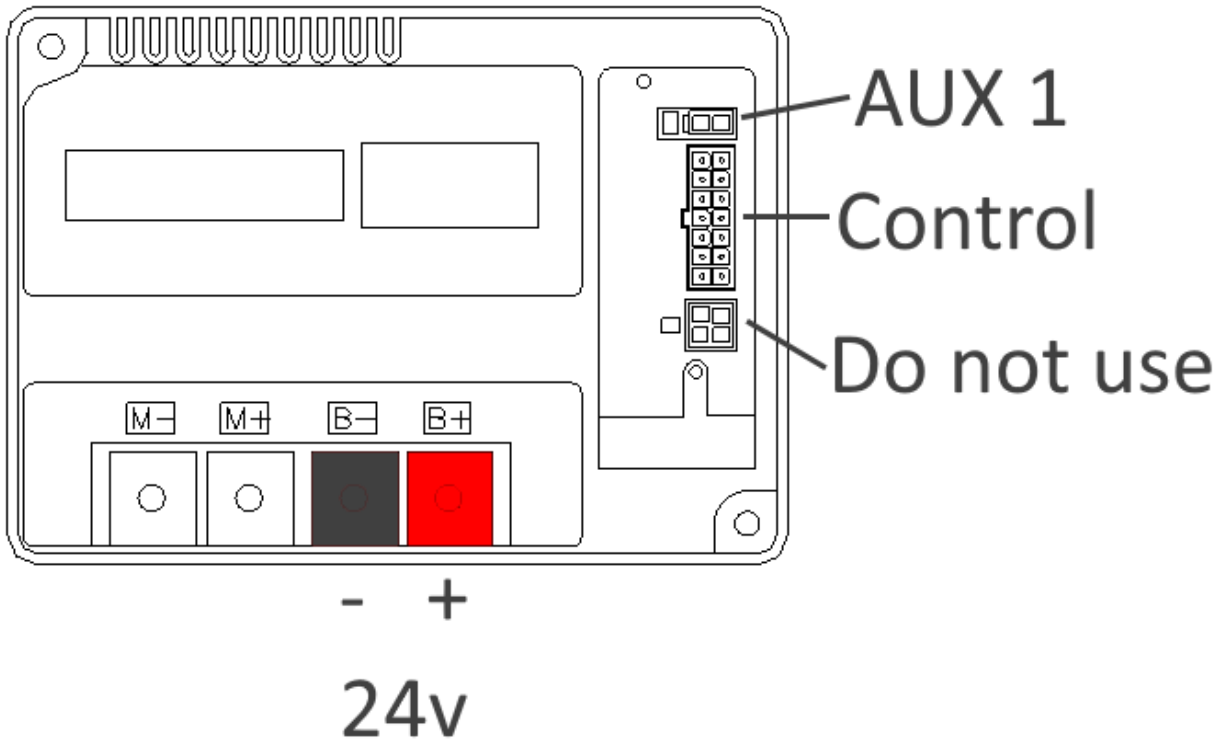
Regenerative braking is progressive so the faster you turn the speed down the more aggressive the braking will be.

It is important to ensure batteries cannot become disconnected while regenerative braking is used. The controller needs the batteries to soak up the power generated. Avoid underrated fuse breakers that can trip out too easily. Do not tow a vehicle at speed with the ignition off and batteries isolated.

IMPORTANT

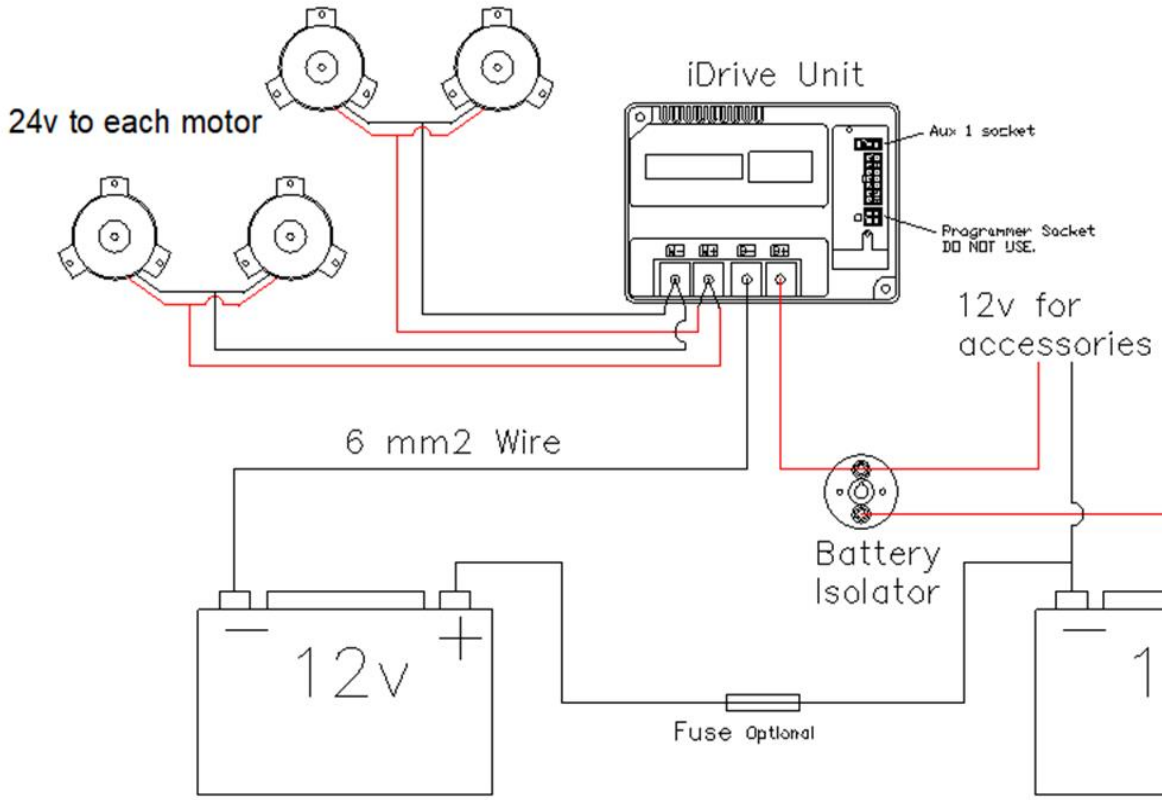
The unit is not voltage polarity protected. If you connect the battery supply wrong way round or to the motor terminals it will destroy the unit. This is not covered under any warranty.

We recommend cable ties on battery leads so it is impossible to connect the battery up incorrectly.



From experience – it is easy to be distracted and connect a battery wrong way round. Make sure it is not possible to do this. The pop noise it makes is an expensive one.

iDrive Unit Motor Wiring



GOOD PRACTICE

- Do not run power cables across battery tops
- Keep battery and motor cables open and vented. Try not to wrap them in bundles.
- 4 motor engines use 6mm2 cable for battery and motor runs. On 8 motor engines use10mm2 for the battery runs.
- Tie battery cables to chassis in a manner which means they cannot be connected to the wrong terminals.
- If using 12v from one battery regularly charge batteries separately if using a 24v charger
- Try to keep + & - cables together to avoid generating induction fields. If possible run control cabling away from power cables.

On some locos the orange(+) and black (-) motor wires may have to be connected to different polarities to get the motors to run in the same direction.

12v Motors on 24v

Motor manufacturers tend to design and use a standard chassis and bearings for a whole range of different motors with varying rpm's. A motor stated as 12v 3300 rpm could be exactly the same as one labeled as 24v 6600 rpm. By running on 24v you reduce the current draw and work the motor more efficiently. If a loco is running at 6 mph then the motors will be running at 3300rpm and drawing half the current they would be if on 12v with the benefit of more speed and power available should you want to go faster.

By over speeding the motors you also get through the more inefficient lower rpm's quicker when accelerating.

SOUND SYTEMS
It is becoming increasingly popular to have the latest sound system on a loco.
We would recommend using the motor output for any synchronising of the sound as against tapping in to the control side.
STRAY VOLTAGES FROM SOUND BOARDS HAVE BEEN KNOWN TO CAUSE RUNAWAY TRAINS.

RIDE ON RAILWAYS LTD

Power Cables

You will be surprised by how much current a locomotive can draw when accelerating away with a loaded train.

5” gauge locomotive – easily pull 120amps peak

7 ¼” gauge large locomotive – up to 180 amps peak

Cable Sizing

Cable Size	Continuous Current (enclosed)	Open Wires	Peak – Short bursts
6.0 mm^2	40A	60A	120A
10 mm^2	60A	90A	180A

Consideration needs to be made to whether you are drawing high current continuously or for short bursts. Really not necessary to put in huge cables if you are not pulling large loads on demanding tracks. Power cable should be in the open to allow for any heat to dissipate.

Use multicore flexible cable – not single solid core. Use power crimps for higher loads. Simple coloured crimps usually max out at 60 amps.

Fuses

We do not use fuses on main power cables. This theoretically can lead to the risk of cables melting in a high current short. Solution – ensure you don’t short the cables. Zip tie battery leads down so you cannot physically connect the battery wrong way round.

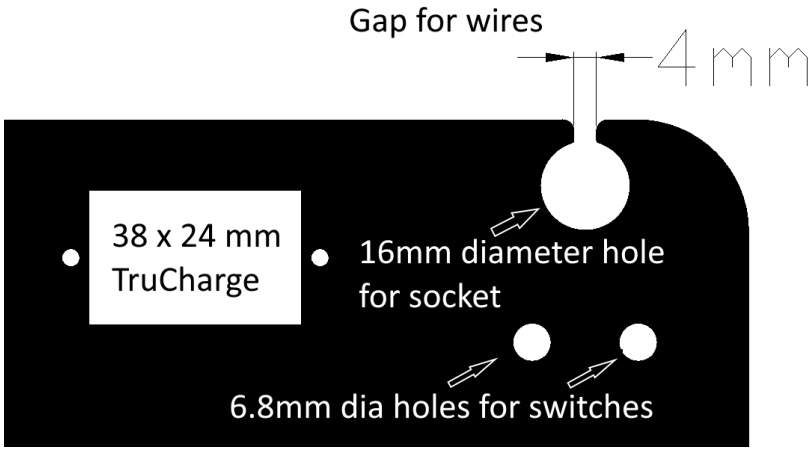
- Fuses/breakers are highly unlikely to protect a motor controller.
- For regenerative braking the batteries must be connected to absorb the power.
- Mains breakers are not designed for high DC low voltage loads.

Scenario

You pull away from the station with a heavy load. In doing so after a few seconds the fuse blows. The train goes in to regenerative mode. Motors generate current. With the controller not having access to the batteries it cannot divert the power safely. Some controllers have a failsafe to stop runaway vehicles and will sacrifice themselves to apply braking. Others go open circuit – no braking.

Similar situation. Fully charged batteries starting at the top of a long downhill line. Loco goes straight in to regenerative braking but batteries are unable to absorb the power. Result loss of braking.

Mounting the Socket and Switches



The 8 pin socket has the locking nut on the back. To mount slide the nut back over the wires. Slide the wires through the gap in the panel and bring the nut back up on to the socket.

This allows for use of standard looms that can easily be replaced.



For those not using Ride on Railways models we have previously supplied socket mounting plates.

You can cut/unsolder the wires to mount the socket but the slot solution allows for use of standard wiring looms.

RoR Handset



Our handsets are made in house using custom uk made 8 core flexible lead.

The Deadman's button uses a low pressure microswitch. We do not recommend bypassing this as it does ensure power is cut when the handset is put down or dropped.

The Deadman's button will avoid a runaway train.

8 wires are the lowest practicable number – keep it simple and safe. Accessory switches for example sound and lights, should be mounted on the loco.

From experience – I have seen several runaway trains due to lack of a deadman's feature and repaired several locos with burnt out motors where power was left applied whilst stationary.

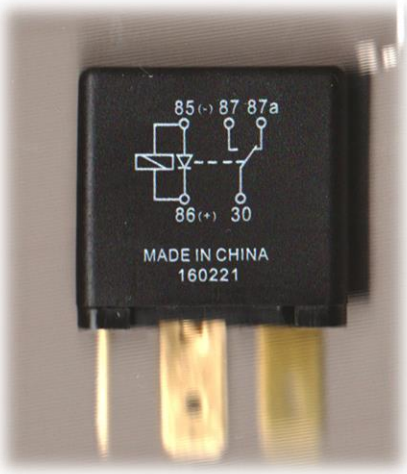
WARNING

STRAY VOLTAGE SPIKES

Stray voltage spikes can be generated by items such as horns and relays. These can affect/kill the iDrive and Truecharge meter. They can also knock out led lighting, so a loco with failed, flickering or un uneven brightness LED's could have issues.

To stop these, it is recommended to take/use the following precautions –

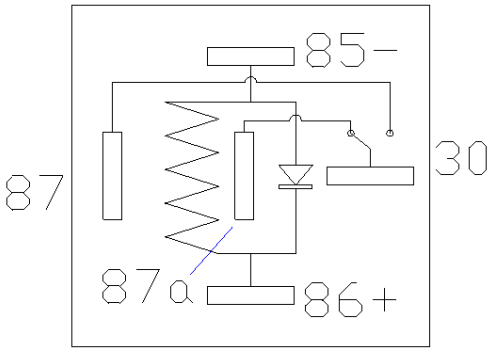
- If feasible take horn power supply back to the battery terminal. Essential for the negative wire.
- Use a suppression diode across **horns** and **relays**. This will neutralise any spike.



Left –

A relay with a suppression diode built in. This clearly shows how you can fit a diode over the coil terminals. This allows a spike on the negative to return to the positive terminal. White bar goes to the positive terminal.





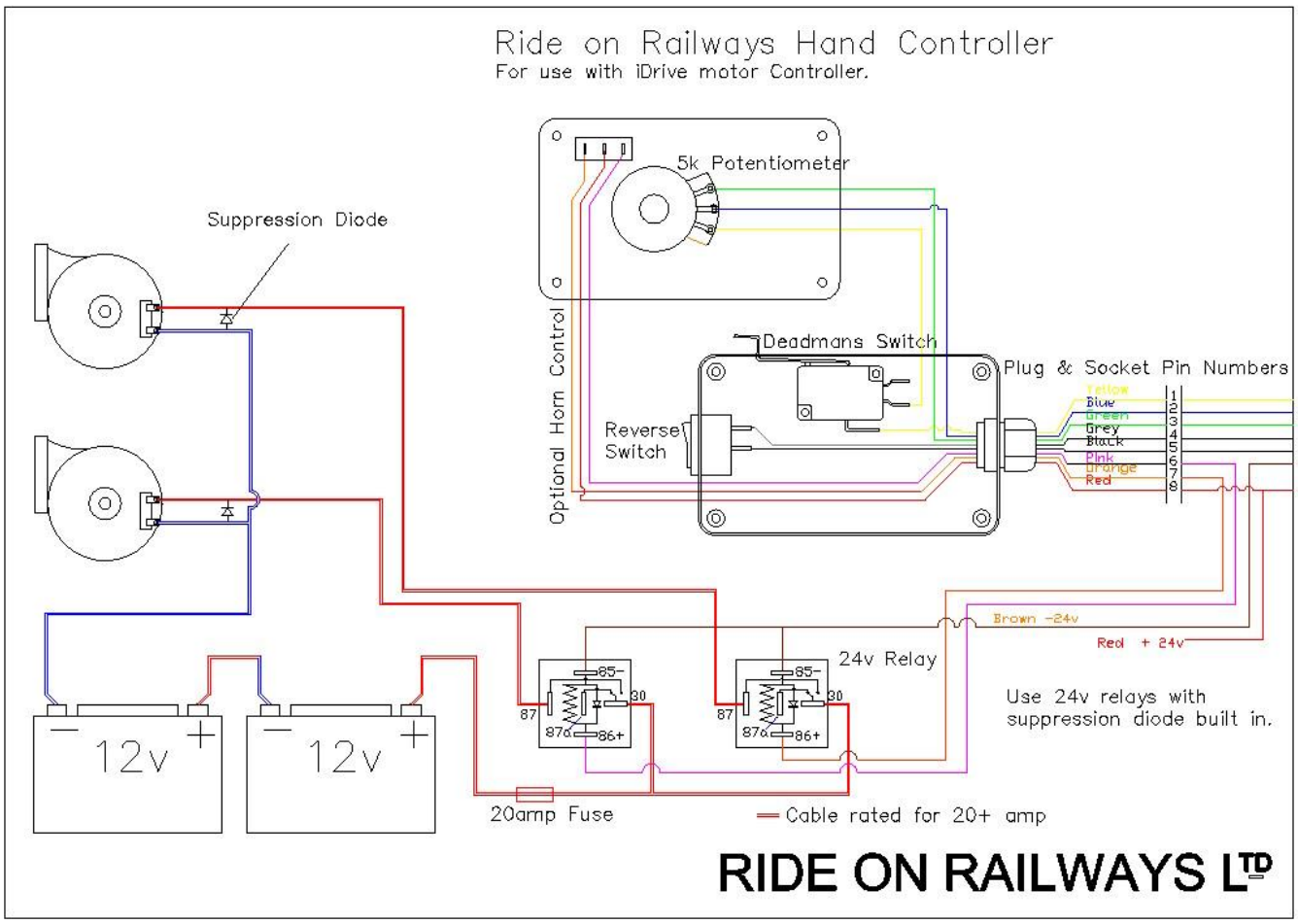
Left

Terminals on a standard 5 pin power relay.
85 Negative coil
86 Positive coil

30 Common
87a Normally closed
87 Normally open

From experience - a diode of a few pennies across pins 85 and 86, can save you many hundreds of pounds. An expensive set of car horns damaged an iDrive, TrueCharge meter and the programming leads. It also took out several LED marker lights – which was a sign of issues that I did not appreciate at the time.

Wiring of Horns



Some dos and don’ts of horns

- Do not draw 12v from a single battery as it will unbalance battery sets. Use 24v horns, relays, lights and accessories.
- For 12v accessories use voltage dropper.
- Put in diodes to stop voltage spikes.
- Use relays of 20+ amps on power cables.
- Do not power a car/air horn direct through a switch.
- Do not use horns continuously/excessively long blasts without upgrading wires to allow for this.

IDrive Controller - Fault Finding

IMPORTANT

The iDrive and Truecharge meters are sensitive to reverse voltages. If you have connected the battery wrong way round or to the motor terminals, it is likely you have killed the iDrive beyond repair.

TRUECHARGE METER



The Truecharge meter is not only a basic voltage meter but can also report back potentional faults. It does this by flashing numbers of LEDS.

If the leds are scrolling up and down on start up, this indicates that the pot/speed knob was not at zero on start up. Return to zero to clear fault.

FLASHING LEDS -

1 Bar	The battery needs charging or there is a bad connection to the battery. Check the connections to the battery. If the connections are good, try charging the battery.
2 Bar	There is a bad connection to the motor. Check all connections between the motor and the controller.
3 Bar	The motor has a short circuit to a battery connection. Contact your service agent.
4 Bar	Not used.
5 Bar	Not used.
6 Bar	The controller is being inhibited from driving.
7 Bar	A throttle fault is indicated. Make sure that the throttle is in the rest position before switching on the machine.
8 Bar	A controller fault is indicated. Make sure that all connections are secure.
9 Bar	The parking brakes have a bad connection. Check the parking brake and motor connections. Make sure the controller connections are secure.
10 Bar	An excessive voltage has been applied to the controller. This is usually caused by a poor battery connection. Check the battery connections.

If the Truecharge meter is not working –

- Check wiring to the unit
- Could be a sign of stray voltage spikes. See previous page before using idrive to make sure the meter didn't stop working due to a voltage spike.

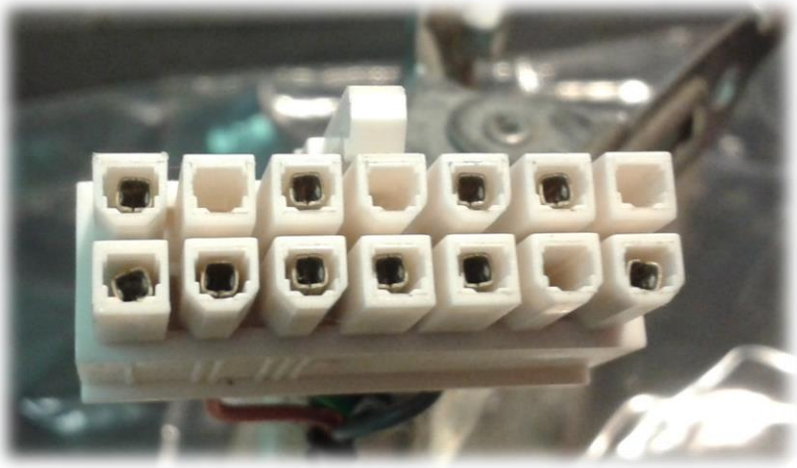
From experience – TrueCharge meters have onboard electronics to change between voltages so it can be used on different set ups not just 24v. Turning ignition off and on can calibrate the unit. If it shows greens but drops to red when power applied it may be that batteries are at end of life.

WIRING CHECKS

Please follow a couple of basic checks before deciding the controller unit is at fault.

14 pin Molex plug

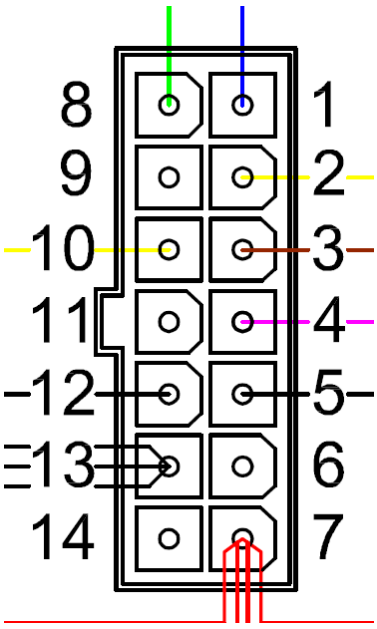
Check all the pins are pushed fully home – as per the picture to the right. If any are not use a small screwdriver or scribe to push them home.



Resistance/continuity testing – for broken wires/connections.

A few simple checks with a multi-meter can help identify broken wires or bad connections.

Unplug the 14 pin plug from the iDrive, plug in the handset and on the 20k range check the following. Put an elastic band around the Deadman's button to keep it applied.



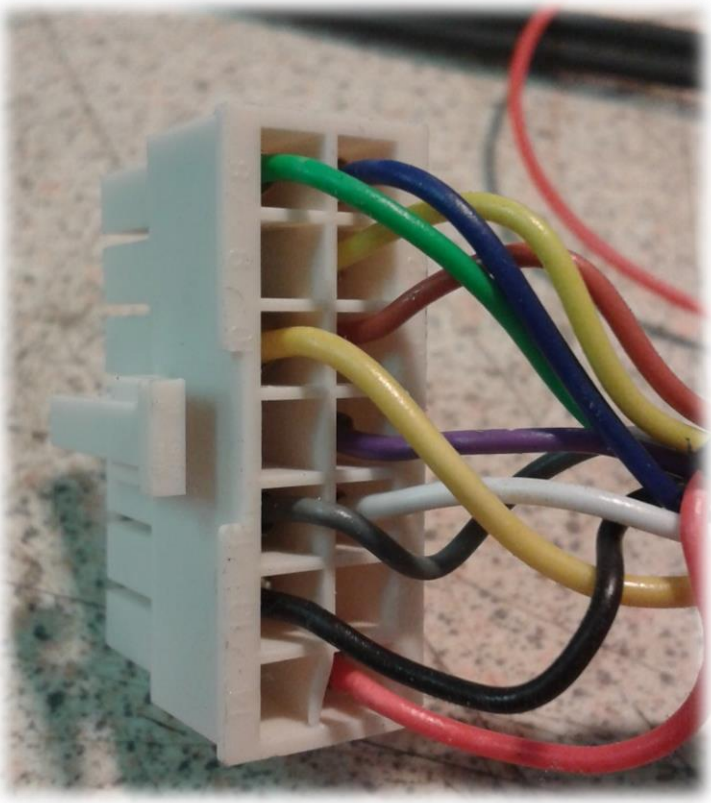
Switching/turning should see meter change. If it does not then it may indicate a broken wire. Test with switches in both positions.
Pins
5 & 7 – ignition Switch – Display 1 and 0.00
13 & 4 – speed Switch – Display 1 and 0.00
13 & 12 – reverse switch – Display 1 and 0.00

1 & 2 + 1 & 8 – Turn speed control knob – Value should go between 0 & 5K
TruCharge Meter
If it does not work unplug 4 pin plug and test wires back to pins 7, 13 & 10

Horn Switch
Pin 7 and output wires or terminals in handset. – Display changes between 1 and 0.00

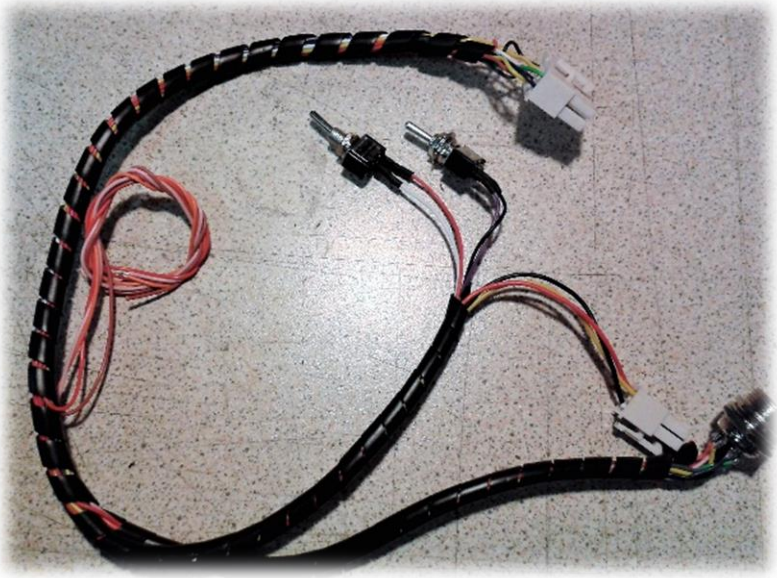
Correct Wiring

There are wiring diagrams on the website but check the wire colours are correct against the picture on the right.



Wiring Loom

Check all the solder connection on switches and sockets. Gentle flex to make sure connection is solid.



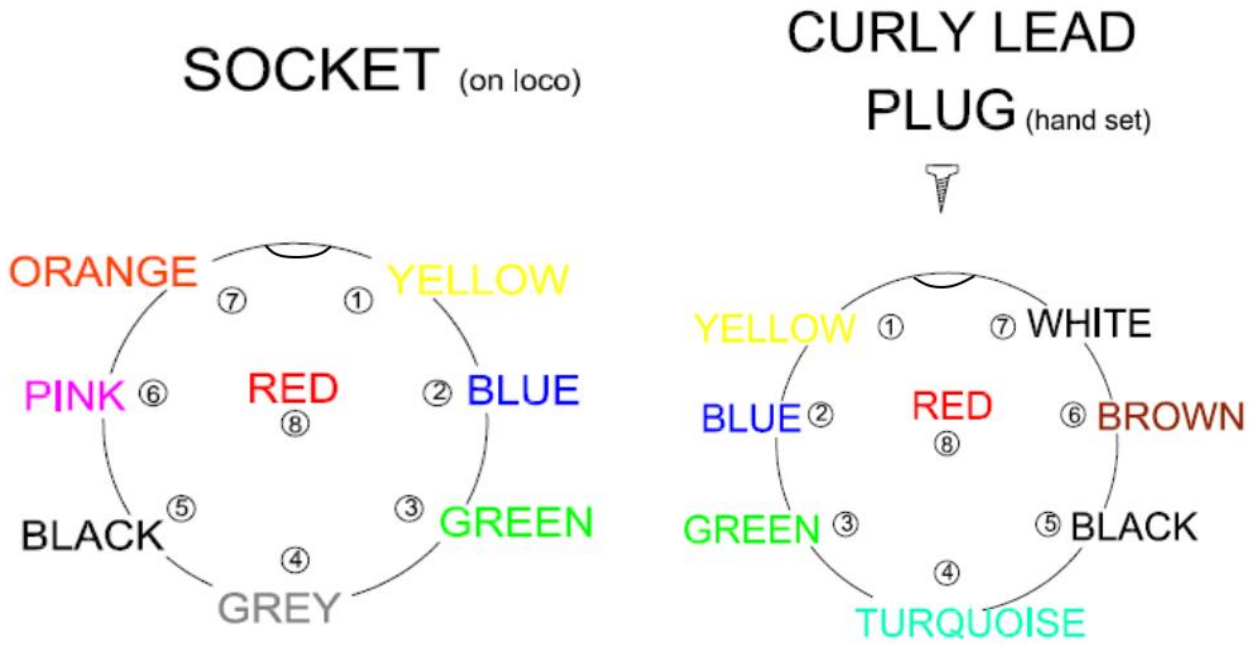
Curly Handset Lead

While wire breakages are rare, it cannot be ruled out. Failures are likely to occur where excessive or constant strain has been applied. High probability areas will be –

- Broken solder joins in back of plug.
- Broken wire at cable glands – plug or handset end.

If the wire is identified as broken at the cable gland area, the lead can be stripped back and fresh wire used. If you need to use the curly area of the lead, clamp the other end in a vice and pull tight. Use a heat gun to the last couple of curls to get them to straighten out. Allow to cool before taking pressure off.

Metal 8 pin Plug and Sockets

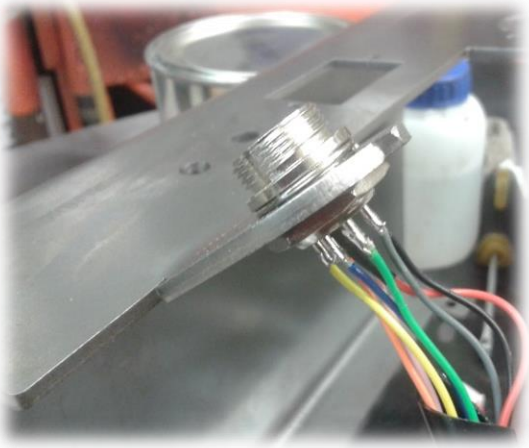


View from **rear** of plug/socket.

PLUG
Check there are 8 metal sleeves in the end holes of the plastic. Also check that they are clean and free from dirt.

Remove the two small screws on the cable clamp. Remove the small screw from the casing then turn the black section anticlockwise 1/8th of turn and gently pull forward. Check all the solder terminals.



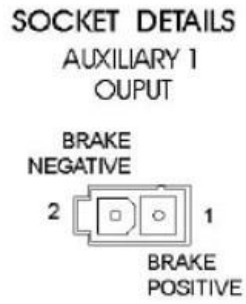


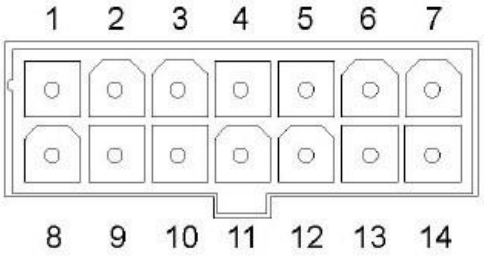
SOCKET
Carry out similar check on the socket ensuring all 8 pins are present and straight. Peel back any insulation tape to expose the soldered pins. Check all joints carefully.

Remember to cover pins before switching back on. A few turns with a quality insulation tape will do the job.

If you cannot still find any issues feel free to return them to us for testing. We have test boxes which should pick up any issues. We only charge postage for this.

Idrive Pins





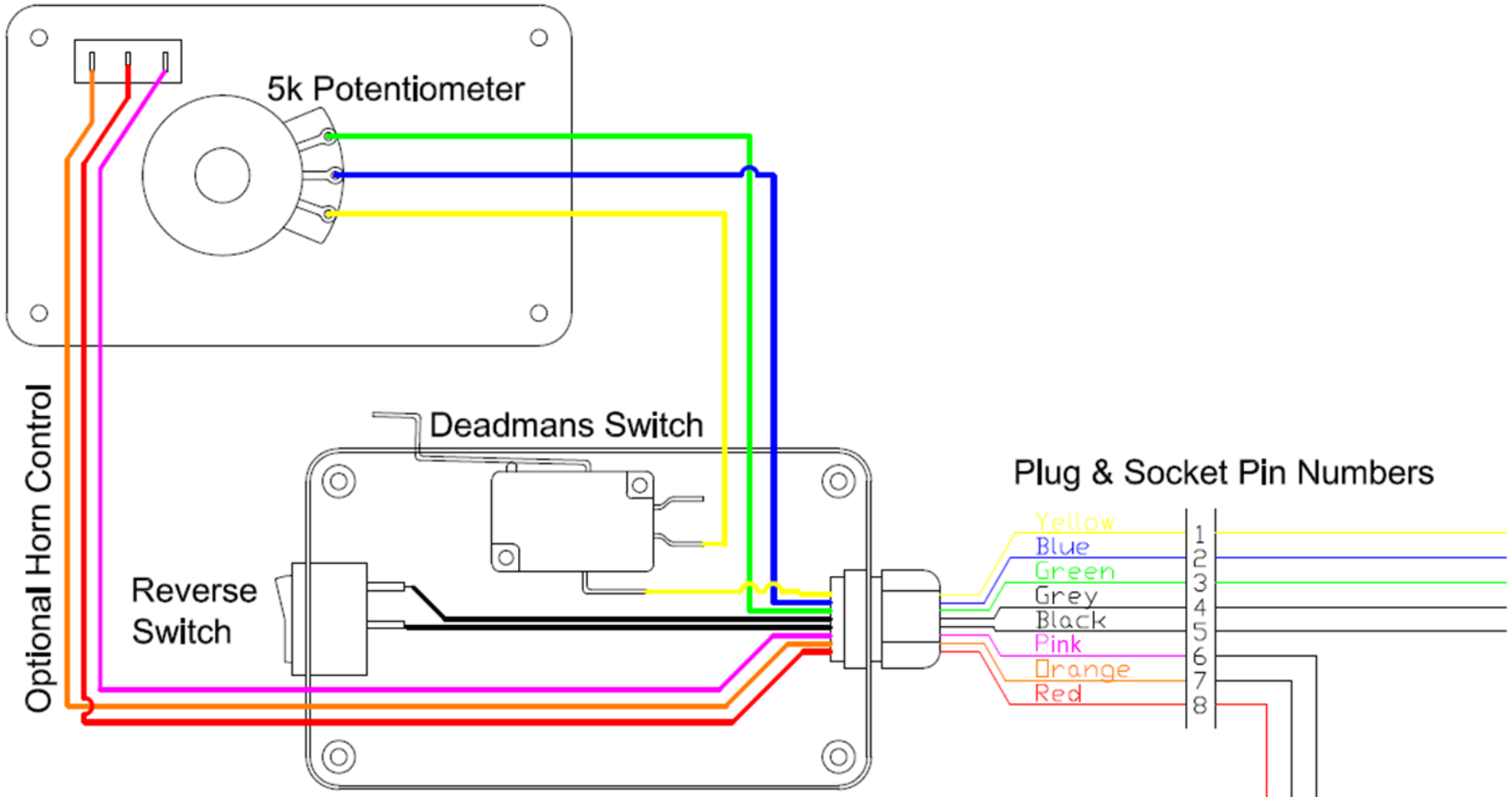
Pin Number	Description
1	Throttle Wiper
2	Throttle High Reference
3	Auxiliary 2 Output
4	Slow/Fast Switch
5	On/Off Switch
6	Inhibit 1 / Forward Direction Switch*
7	Fused B+ Supply
8	Throttle Low Reference
9	Speed Limiting Potentiometer Wiper / Belly Button Input
10	Status Indicator
11	Auxiliary 3 Output
12	Reverse Switch / Auxiliary 3 Input / Reverse Direction Switch*
13	0V
14	Inhibit 2 / Tiller Switch* + 13 = Deadmans

From experience. While we have to change colours of wires, we have always used the same pin numbers on our handsets and sockets. This means our oldest iDrive handsets will still work with our newest looms unlike other suppliers.

We use CB microphone plugs and sockets because they are tough and durable. Never use soft plastic DIN plugs as they can be bent and short out pins. Very dangerous.

Ride on Railways iDrive Handset

View from rear of face plate

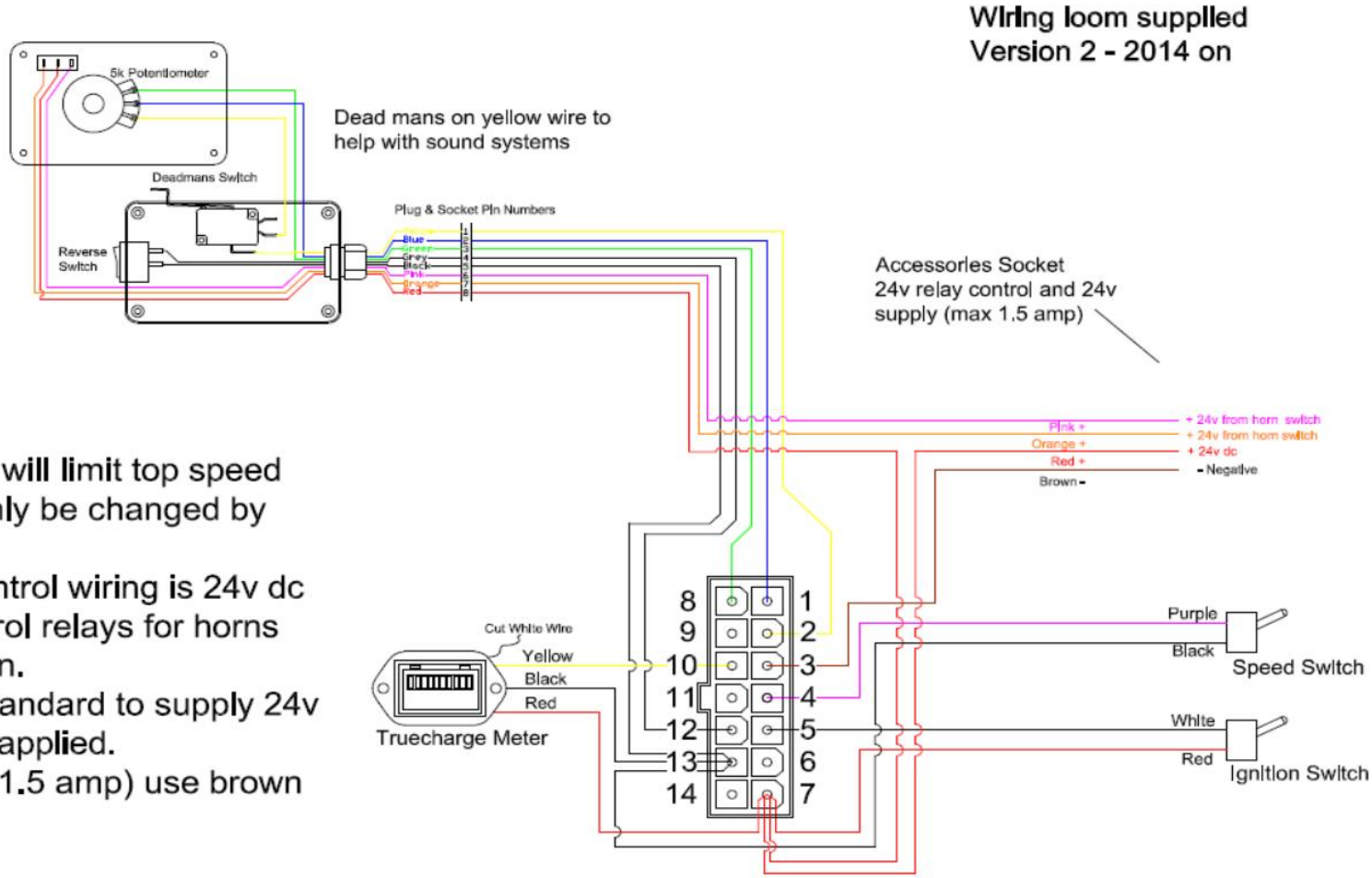


Curly Flex -

Pin 4 (grey) - Turquoise
Pin 6 (Pink) - White
Pin 7 (Orange) - Brown

Optional Horn Control Wires

RIDE ON RAILWAYS LTD iDrive & Locomotive Wiring

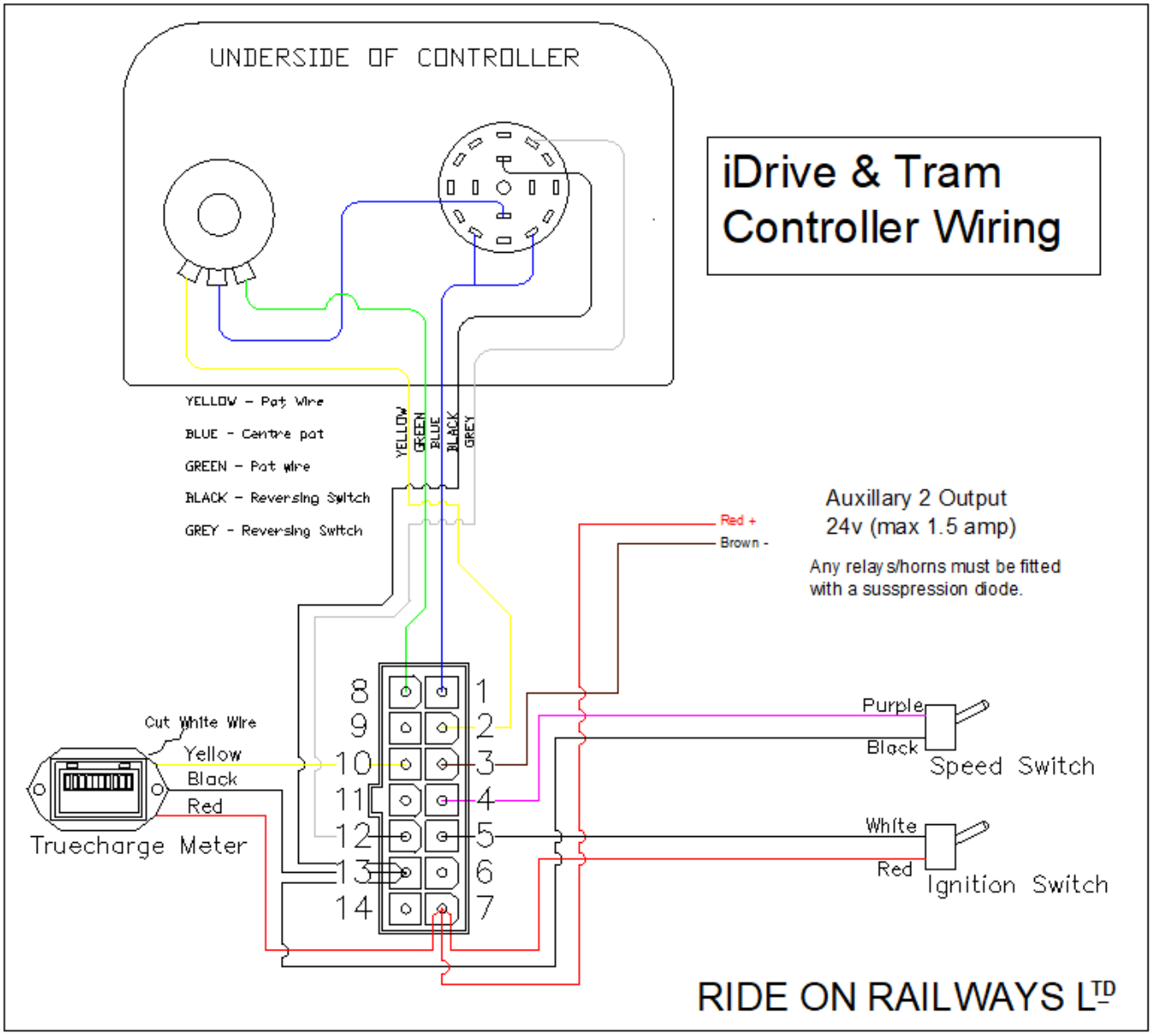


NOTES

1. Character switch will limit top speed to 60%. This can only be changed by RoR.
2. Optional horn control wiring is 24v dc supply. Use to control relays for horns not direct connection.
3. Aux 1 is set as standard to supply 24v dc when reverse is applied.
4. For 24v dc (max 1.5 amp) use brown and red wires.

CJF Tram Controller

The CJF tram controller can be hard wired in to the iDrive or put on a plug as an alternative to one of our handsets. Recommended to use wire colours as below to help with identification.



Lead Acid Batteries



- **Do not run the batteries below their stated 50% capacity**.

- Charger amperage should not exceed 15% of the amp hour capacity of the battery – i.e a 110ah battery should have a max amperage charge of 12 amps.

- Plug the charger in at any opportunity you can. Even on running days, plug it in when in the station area. Doing so will prolong the life of batteries and should see you get in excess of the 50 running days you may otherwise achieve.

- Always use a high-quality multistage charger that is designed to charge the batteries and switch to top up/trickle charge mode once charged. There shouldn't be any issues with leaving a loco on charge full time. If the batteries are known to be fully charged, then it can be unplugged and just topped up before running.

- The iDrive unit has been programmed to protect the batteries from being excessively drained. If it detects the voltage dropping below **22.8v** for more than **20** seconds, it will inhibit drive and flash up 1 red led on the truecharge meter. Do not continue to use batteries which continually trips the unit out with low voltage.

- Single flashing LED can also indicate bad battery connection.

- Wet cell batteries should always have the lead plates covered in electrolyte. If exposed, then top up with distilled/ deionised water. Only top up when fully charged. Low electrolyte can allow the build-up of hydrogen gas and the high risk of an explosion.

- Batteries will generally lose 2-3% charge a month when left.

- Do not leave an unplugged battery charger connected to batteries for long periods of time. Nearly all chargers draw a slight current that over a long period can drag he batteries down.

LiFePO4 batteries - £1800

These are at time of writing are not a viable alternative. 3-4 x the cost and have limited current draw meaning that for an Earll loco you would require at least 6 batteries. As this would be bespoke use the risk of fire is greatly increased over mass produced products.
Claims of 1000 cycles/10 year are dubious at best.

Current price for Hankook lead acid 110ah batteries are £100 each. They are also fully recyclable.

24 Volt Lead Acid Battery State of Charge	
Level	Voltage
100%	26.00 Volts
90%	25.55 Volts
80%	25.00 Volts
70%	24.60 Volts
60%	24.30 Volts
50%	24.10 Volts
40%	23.90 Volts
30%	23.62 Volts
20%	23.32 Volts
10%	23.02 Volts
0%	21.00 Volts

LEFT - Rough guide of the correlation between voltage and capacity. Settled voltage.

END OF LIFE

Anything after 50 full charge cycles is a bonus. If when put under load the voltage drops quickly but recovers when power stopped, it could be a sign the batteries are at the end of their life.

The iDrive has an onboard system log that we can read when docked with the computer. We do not charge for checking iDrives but need to charge for postage.

If you need help please do get in touch.

Paul Middleton

07757 321851

Email paul@rideonrailways.co.uk