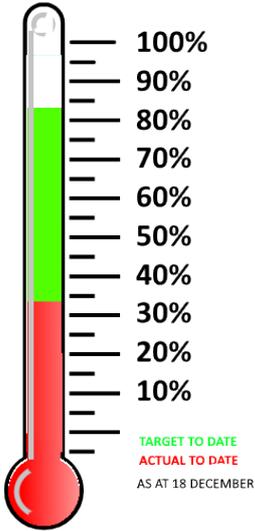


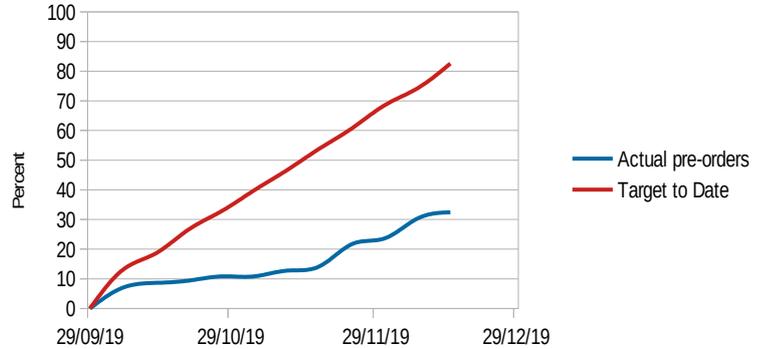


New Product Pre-Orders Update



As reported in the last Club Protocab newsletter, the level of pre-orders to date is well below our required target which closes at the end of this month. The level of new pre-orders has understandably slowed down since the project was launched and we have passed the 30% mark, but we're nearly at the end of December (already!). We're

forecasting that we will reach the 35% level, and on that basis that should not be able to go forward with the new products in their entirety. In that case, all the Owners who have paid a pre-order deposit will receive their money back into their account in the first week of January. We discussed this with a number of Owners at Warley and on the telephone since. Needless to say, everyone



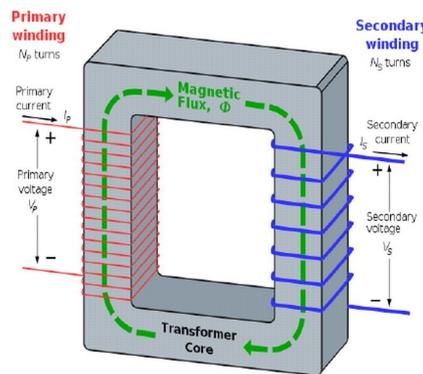
expressed disappointment, but we were surprised at the number of Owners who were seriously concerned that we might not be able to get these new products to them and asked - even begged - us not to give up.
Continued on page 2

The 9650 Wireless Induction Charging System (WICU)

Since the first design of Protocab back in 2009, it has always been the aim to enable the operator to charge the locomotive's internal battery without needing to touch the locomotive or remove it from the track. Further, it was the intention that the full sized prototype would be the benchmark for the Protocab system and this meant that charging through the track and wheels was not prototypical, although a clearly practical compromise, which is also proving to be a very popular option at pre-order. Wireless induction has been around since the 1800s, when *Nikola Tesla* first demonstrated the principle. But to provide a system which is both reliable and affordable has only recently become feasible.

current is *induced* in that coil which can then be passed along wires connected to it. It's not a new phenomenon in model railways either. Almost every model railway layout uses a similar principle in its transformers.

mains voltage. Even though there is a metal block inside both coils, it is effectively providing a barrier between the dangerous mains voltage and the safer workable output voltage because both coils are insulated from the core. Notably, the induction in a transformer can only take place because the current is *alternating* between positive and negative through the zero position, as opposed to the *direct* current which goes zero to either positive or negative. The transformer uses an iron coil to transmit the magnetic field. We use another principle of magnetism, that is that it is effective through air. So, we have a *primary* coil that we feed with a current and a *secondary* coil which we place in the locomotive. We position the secondary over the primary (which has a current passing through it) and a charging current will flow into the secondary and into the battery charger.

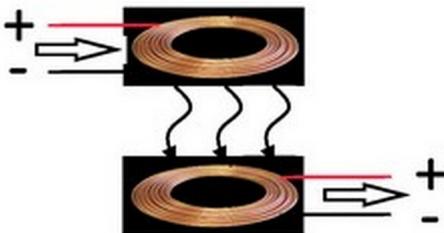


The Application of Computer Programming in Transformer Design - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/A-simple-transformer-circuit_fig1_273508310 [accessed 23 Dec, 2019]

The mains current is fed into a coil (which is usually wrapped around an iron core to intensify the magnetic field and to provide a path for the magnetic flux to a secondary coil wrapped around the same iron core). If there are, say, 1,000 windings of the copper in the 'primary' coil and 100 in the 'secondary' coil, the voltage that emerges from the secondary coil will be (1000/100) one tenth of the

But where to place the two coils?
The greater the distance between the two coils, the less current will pass across the gap between the coils, lengthening the recharging duration. An ideal separation is between 1mm - 2mm, although the larger the coil the greater the current that can be passed, but unlike the transformer where the two coils can
Continued next page

Current induction- how does it work?



Tesla showed that if you pass an electrical current through a coil, it will create a magnetic resonance so that when a similar coil is within the magnetic field, a

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have different numbers of coil windings, the primary and secondary coils for our use must be identical.

The logical place to put the primary coil is between the rails of the track, with the secondary under the locomotive. However, this is not as easy as it may sound.

The first issue is fitting a coil between the rails of OO track. At 16.5mm between the rails, and the back to back dimension of the wheels 14mm, means that a 12mm diameter coil will be a tight fit and leave very little room for sideplay in the wheelsets. However, it is likely that a locomotive will approach the coil slowly, so sideplay might not be an issue. There isn't a problem with shorting between the wheels, it is more the potential for damage to the primary coil.

A similar 12mm coil then needs to be fitted close to the lowest point of the locomotive, but bear in mind that it needs to be above rail head level. At the optimum separation distance, this requires the primary coil to be about 1mm above rail height and the coil on the locomotive to be around 2 - 3mm above the rail head level.

This is usually fine for a diesel locomotive, where the coil can be located under the fuel tank (as in the photo), but where to place the coil on a steam locomotive?

We have experimented with placing the coil between the wheels of the tender and, painted black, it is fairly unobtrusive. We have also considered placing the receiver under the cab roof or even on the side of the tender and

having the transmitter coil very close to the top or side of the loco. However, there are as many variations inside of cab roof and tender as there are locomotives, so these are unlikely to be workable solutions. A visitor to the stand at Warley came up with the idea of placing the coil under the ashpan which sounds like a very good idea and one we will try by experiment shortly. If you already use the 9601 Plug Charging Unit, you will know how long to expect a full battery charge to take, typically three to four hours from empty. Charging an empty battery with the 9650 WICU system will take longer, probably twice as long. But, remember that the lithium-ion battery does not display the 'memory' that previous batteries have experienced. (When you recharged a partially charged battery, the charge would only go as far as the previous level so reducing the available charge from a usable battery.). This means that you recharge a partially charged lithium-ion battery, so 'topping up' the battery is feasible. It has to be said that even lithium batteries will show a memory effect over time, but it is very small compared to, say, nickel cadmium batteries and by that time, the battery will probably be at the end of its usable life. We would, however, recommend that you discharge the loco battery from time to time, running the loco until the battery no longer supplies power to the motor and then recharge it completely. Lithium ion batteries like this 'cycling' discharge occasionally, as it helps to preserve battery life.

The use of the 9650 WICU system is, therefore, ideal for the sort of usage that typical model railway layouts provide. Start from the fiddle yard or siding, run to the station, run round the train and run back to the fiddle yard - position over the WICU transmitter and the battery starts charging until the next run cycle. If that isn't enough in a typical running session, install another WICU transmitter at the station!

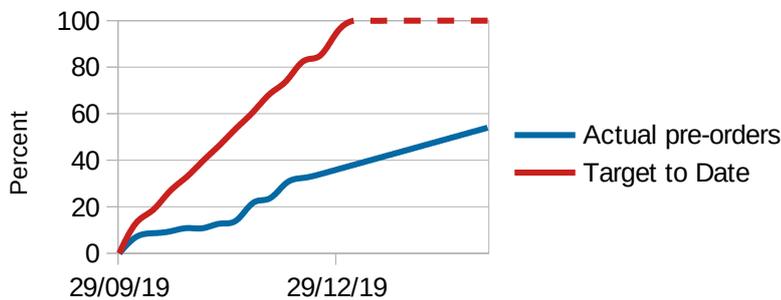
There are two parts of the initial 9650 WICU system:

- the 9650-1201TX Transmitter (with the primary coil, 12mm to enable installation in a OO track - other coil sizes will become available in due course). This unit comprises a main board into which a microUSB cable is plugged to provide the charging current for the primary coil, as well as the management system circuitry described below. There is also a pair of solder points so that you can solder the two wires supplying the charging current, on the basis that it is likely that the main board will be permanently fixed in place under or over the baseboard. The coil is a plug attachment to the main board, but again, the leads from the coil can be soldered in place on the main board.
- The 9956 USB type A to microUSB cable can be used for the charging socket, but at *Continued on page 4*

New Product Pre-Orders Update

from front page

Well, we certainly don't intend to do that, but it may take longer to achieve our aim of delivering the new quality products to you. Several Owners suggested that we keep the pre-order phase open beyond the end of the year until we have achieved the target.



This chart extrapolates where we are now at the same rate of take-up to where we need to be. You can see that this suggests that we pass the 50% target towards the end of February. At that point, we will seriously consider going ahead with the project, with the expectation of further sales for the product in

the short period beyond. We should consider the possibility that the take-up will slow down, particularly after Christmas when discretionary spend tends to be put aside. We'll review that option as we get to the end of the year, and there are other options that have been suggested. We have been asked why there is an end date anyway, and our response is that we don't like to hang on to Owners' money if there is little chance as yet of fulfilling the reason for them making the deposit. But we are

very grateful and touched by the enormous support and encouragement we have received from everyone.

In this last Club Protocab newsletter before Christmas, we continue our descriptions of the new products in detail with the Wireless Induction Charging System which is proving to be very popular with our pre-order Owners. But there are caveats....! Lastly, in this newsletter, we'll cover the new battery range.

If we don't mention it later, let's close this introduction by wishing you a very Happy festive season and a chance to get into the modelling room for extended operations!

STOP PRESS: As of today (23 December) our actual pre-order percentage has risen to 34.5%

The Club Protocab newsletter is sent free of charge to anyone who has consented to have their personal data stored on Acc+Ess Ltd's secure server and can apply to unsubscribe at any time.

1901 series Protocab batteries

Before describing the new batteries in plan, a question we are sometimes asked is whether you have to use the Protocab batteries or whether you can use your own batteries. Apart from the convenience to you of being able to buy everything required to install and control you battery powered locomotives, there are important safety considerations that decided us to offer the batteries as part of the total system.

It is not unheard of for lithium batteries to catch fire and even explode, but with the correct build of battery, including effective protection circuits to prevent over charging and over discharging, and strong casing to withstand 'normal' usage, we can mitigate those risks as far as we practically can. That there are billions of lithium ion batteries in use and around a billion produced every year should indicate that they are inherently safe unless badly produced and/or mismanaged by the users.

Protocab batteries in the 190x ranges deliver between 3 and 4.2Volts, they are fitted with the appropriate connector for the socket on the 05xx LCUs and have been tested with the 0502 LCU to comply with EMC regulations. Moreover, the charge management circuits on the 05xx LCUs and 96xx charging units are designed solely for use with lithium ion batteries.

Note that when we purchase Protocab batteries, we insist with the suppliers that they are safety certificated, usually to UL1642/2054, UL62133 and, for transportation, UN38.3. Restrictions apply when sending lithium batteries through the post and one requirement is that the batteries are certified to these standards. These comprehensive safety tests include compressing and dropping tests (an excellent summary of these tests is at <https://www.metlabs.com/battery/top-3-standards-for-lithium-battery-safety-testing>). A battery being sold without at least these certificates - AND you can assure yourself of their authenticity! - should be avoided.

Naturally, a user guide is provided with every battery we sell which provides you with guidance on the installation and use of Protocab batteries.

With such a vast variety of locomotives in many scales, a small range of batteries will not fit all circumstances. Equally, it is important that a lithium battery in not stressed by a motor trying to pull too much current from the battery, so the system of connectors and the safety devices on the LCUs aim to prevent this happening. We will try to expand the range of batteries to cover different circumstances and the first expansion after the existing three (1902-902030,

1902-653040 and 1902-902944) is to introduce the 1901 series of *cylindrical* form batteries. The 1902-series are flat form which limits their use in steam outline models.

The 1901-series addresses this. These are all single cell so are interchangeable with any of the LCUs except the 0554 for which a special connector option is fitted to the battery.

The first batteries in the 1901 series have been chosen for their availability, being commonly used in many applications. The three batteries are:

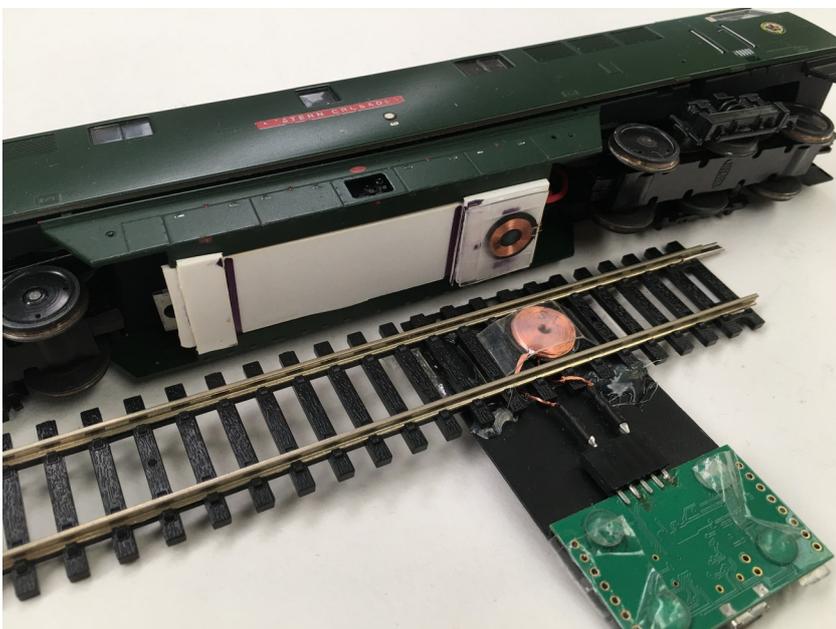
Protocab cat. no. 1901-1044, 10mm diameter, 44mm long, delivering 300mAh at 3.7Volts

1901-1450, 14mm diameter, 50mm long, 1050mAh at 3.7V

1901-1865, 18mm diameter, 65mm diameter, 2200mAh at 3.7V

In experimentation, the 1901-1044 is fine for many 4mm locomotives, particularly tender locos, although somewhat too long for certain tank locos. We are trying to source a fourth battery in this series, which will be 10mm diameter and 28mm long, delivering 200mAh at 3.7V. We will let you have further details as we receive them.

We have specified 75mm cables for all batteries so that any losses in the cabling are minimal.



The arrangement of the prototype demonstration for the 9650 WICU system, recently shown at Scaleforum and Warley. The 'Western' diesel has the coil beneath the fuel tank. The 12mm primary coil is between the rails of a OO track. It is attached to an experimental development board. The production board will have a different configuration.

Why are the Starter Sets unavailable?

If you were planning to adopt Protocab recently, we're sorry to say that the 0001 Starter Sets have been out of stock. There are three components of the Starter Sets that are currently out of stock, most notably the 0502 Locomotive Control Units, which are also key components in the Locomotive Sets.

We have received a small batch of 0502 so the Locomotive Sets are once again available. However, we need to order a number of components for the 0201 Direct Controller, depending on the outcome of the pre-orders for the new products.

The product plan for 2020 will be determined early in January and we plan to have the full product range available as soon as possible.

We will update the shop of protocab.com and through this newsletter.

Meanwhile, we continue to support all our Owners as usual.

The 9650 Wireless Induction Charging System (WICU)

continued from page 2

- 1.8m long, this may need to be enhanced with additional length options, if experience demands it.
- the 9651-1501RX Receiver (with the secondary coil, also 12mm). This unit comprises a circuit board and the coil. The circuit board is likely to be 25mm long and 15mm wide and can be installed anywhere in the locomotive, close enough for the three cables of the 9949 assembly to connect the board to the LCU and close enough to be able to connect the coil to the board. The coil will be delivered with a connector fitted which will be plugged into the relevant socket on the circuit board. The coil will have a self-adhesive pad underneath which will enable it to be fitted to a suitable point under the locomotive. The unit will include the 9949 3-wire cable assembly to attach the board to the LCU.

Having outlined how the wireless induction charging system works, there are some factors to consider. The first is that the external power to the 9650-1201TX Transmitter is switched on at the beginning of the running session and remains powered until the session ends, so it is powered throughout. Only when a WICU receiver coil is positioned over the transmitter coil will the charging process commence (and only then if the loco is in Ready, not in Drive mode). The two circuits (in the transmitter and receiver) carry out an authenticating 'handshake'

to prove that this is a legitimate connection. Otherwise you might, for example, drop a coin across the track and without this authentication, the transmitter might heat up the coin by passing current through it! This is not an Acc+Ess development - it is standard on all wireless induction charging systems that comply with the Qi (pronounced 'chee') international standard on which the system is based and incorporated on the processors we are using on the transmitter and receiver boards.

With the 9651-1201RX connected to one of the new 0554 or 0505 LCUs, and these adopted to the new 0241 Touch Controller, this controller screen will display an indicator when the two coils are in alignment. There is also an optional indicator LED on the 9650-1501TX board that will illuminate when the two coils are in alignment. This option is delivered disabled, but can be enabled by soldering a small piece of wire over a pair of solder pads to create a circuit.

The 0241 in the above configuration also shows the progress of the charging process which it does irrespective of which charging method is used (but only if the battery is connected to the 0554 or 0505 LCUs - the 0502 doesn't support sending charging data back to the controller).

In case of a possible over-current situation, there are detectors on both the transmitter and receiver boards to cut off the current when the limit is reached. If using the 9901 Mains Adaptor to power the 9650-1501TX transmitter, the current delivered is 500mA. Even if

the largest Protocab battery is attached to the 9651-1201RX receiver, so it would be capable of pulling much more current during recharging, the receiver will limit the current to 500mA. (There is presently experimentation going on whether we need to provide a current limiting option on the receiver so that the smallest Protocab batteries are not stressed by being delivered too high a charging current. So far, this does not seem to be an issue, but our concern is that it might shorten the battery life. We will report further, although this will be resolved before we go into production.) One question that has been asked by several Owners and Club members is whether the 9650-1501TX and the 9651-1201RX have to be matched to each other. The answer is 'no'! So you can have one transmitter and several receivers, several transmitters and one receiver (yes, really!) or several transmitters and several receivers. Each transmitter will recognise each receiver, so you can even take your locos to your Protocab-fitted Club layout and charge your locos on their transmitters. If you are the only Protocab member in the DC or DCC-faithful club (for the moment anyway!), you could try to ask them to install a 9650-1501TX somewhere in the track, just for you! But since most club sessions I have attended only last a couple of hours, you won't need to recharge your battery while you are there, usually. The issue for the future is whether we implement differential primary and secondary coil sizes. We'll report further.

In the next Newsletter, the last before the New Year (when the pre-order phase closes) will be a bumper edition covering the 0241 Touch Controller! There is much to cover so be prepared for the alternative activity! Mind you, whether it is lucid depends on how much we have had over the Christmas period! Have a good one yourself.

A Very Happy Christmas to all Club Protocab members!



Best wishes from the Acc+Ess team, from left to right, Alex, Tony, Nick Percebois (our French associate) and Dan!
Cheers, everyone!