

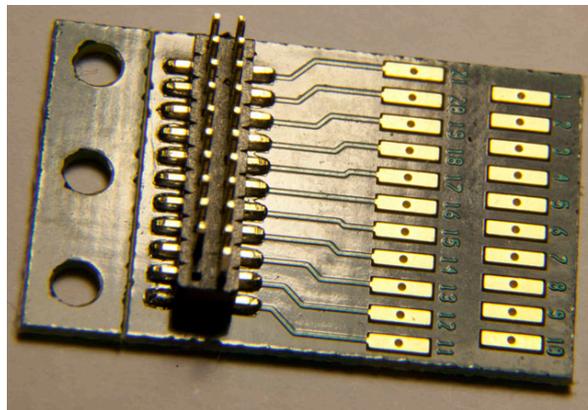
# ESU 21MTC adapter board amplified Aux 3 & Aux 4 modification

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Please note, this modification requires soldering skill at board level and soldering SMD components. It also involves modifying circuit boards. This modification will also void your warranty on the adapter board and any damage to a decoder will also not be covered under warranty. All responsibility for this modification resides with the person making the modification.

While ESU decoders are amongst the best on the market, some models do have some limitations. While the Lokpilot V4 21MTC and the LokSound Select 21MTC decoders have 6 function outputs in total, only 4 of these outputs are amplified (able to drive loads directly) with the remaining 2 being logical (only supplying a control signal). This is due to the fact the the ESU decoders conform to the NEM (MOROP) Standards with Aux 3 & Aux 4 specified as logical outputs. The NMRA (American) Standards however doesn't specify this and as such there are American decoders available with all 6 functions amplified for use through the 21MTC interface. Therefor it is advisable to check with the decoder manufacturer to see if the modification is of any benefit.

With modern models featuring more and more lighting and other circuits to control, having access to all 6 outputs directly can be beneficial. ESU offers two 21MTC adapter boards, their first one (#51967) is a nice and compact design but lacks the amplification circuit whereas their second one (#51968) includes it. This comes with a compromise, as the 21MTC Adapter Board 2 is of a larger form factor and is designed as a direct replacement board for some European models.



ESU 21MTC Adapter Board as supplied

Items required:

ESU 21MTC Adapter Board (#51967)

1x SOT-23 NPN surface mount transistor (BC817-25 element14 p/n 108-1224)

1x 1K $\Omega$  0603 surface mount resistor (CRCW06031K00JNEA element14 p/n 165-2851)

Black 32 gauge decoder wire

Suitable resistors and transistors are available from <http://au.element14.com>

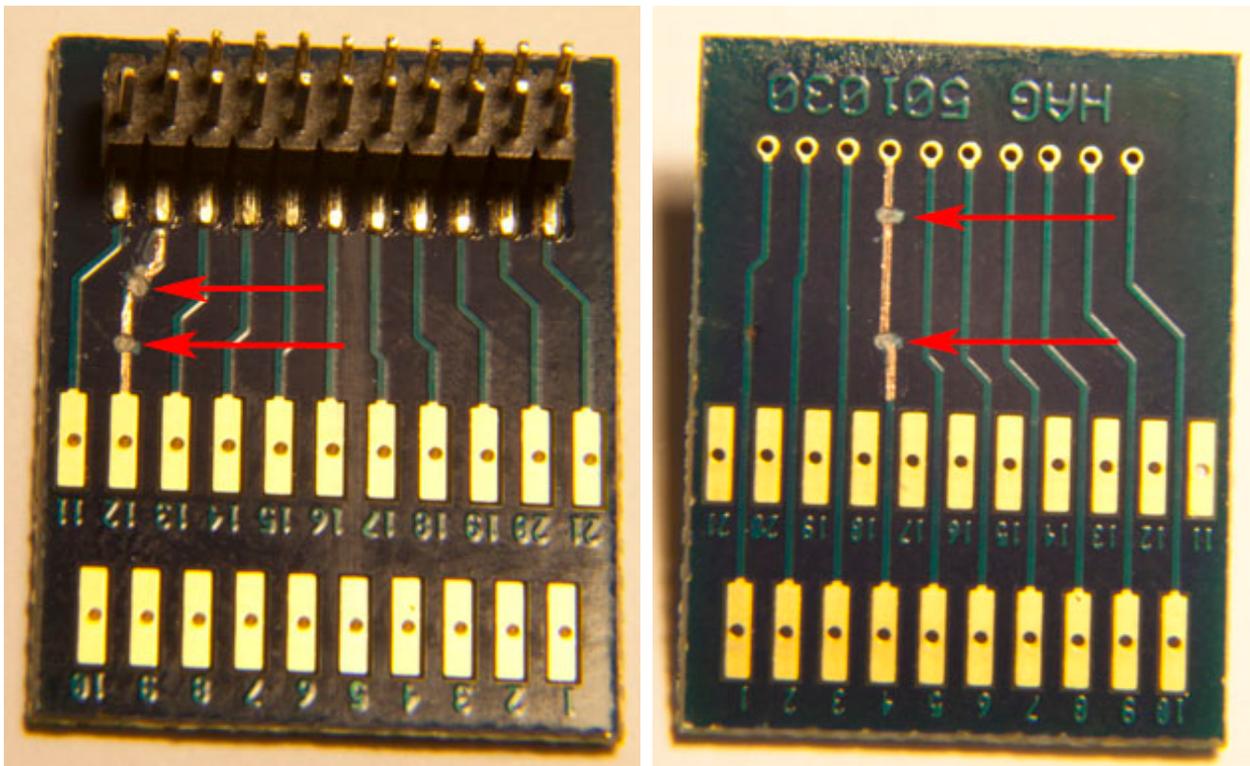
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To modify the adapter board to amplify Aux 3 & Aux 4, we must cut into the appropriate traces on the circuit board. Each trace must be cut in two spots to allow the insertion of the 1K $\Omega$  resistor to buffer the the transistor and the second for the transistor itself.

The first task is to carefully remove the silk screen protection layer over the trace. This is easily achieved by using the tip of a sharp hobby knife to scrape the silk screen off. On the top of the board, you need to scrap the trace that leads to the pad labelled '12' as this is the pad for Aux 3. On the bottom of the board, you need to scrape the silk screen of the trace that leads to pad '4' as this is the pad for Aux 4.

Once the traces have been scraped clean, you need to cut both traces. This is best achieved by using a 1-2mm drill bit in a pin vice to lightly drill the trace away. You don't need to drill very deep, just enough to cut through the trace.



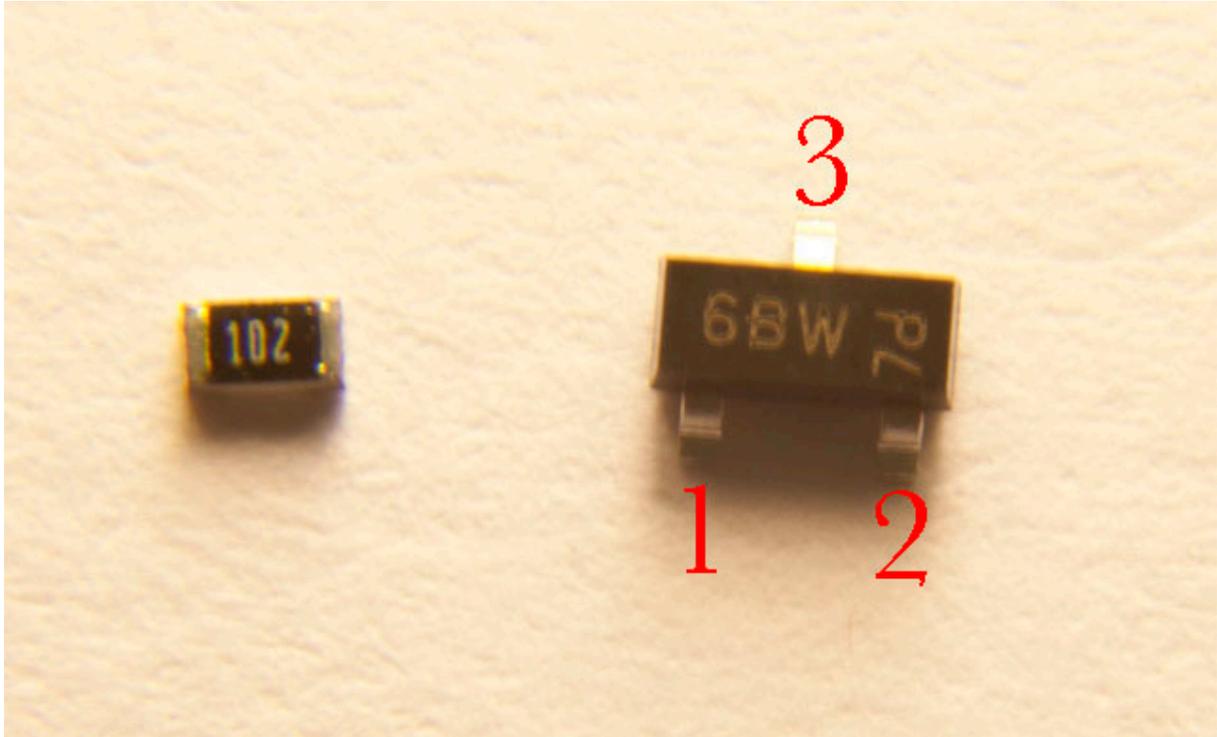
Top (left) and bottom (right) of the 21MTC Adapter Board showing the traces scraped clean and cut

Once you have scraped and cut the traces, lightly tin them with just enough solder to cover the bare copper trace to protect them and to allow mounting of the surface mount components.

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Next you need to get hold of the surface components, this is easier said than done, due to their small size and place them in the appropriate position on the Adapter Board and solder them into place.



1K $\Omega$  resistor (left) and BC817-25 transistor (right) showing the pin numbering as such:  
1. BASE 2. EMITTER 3. COLLECTOR

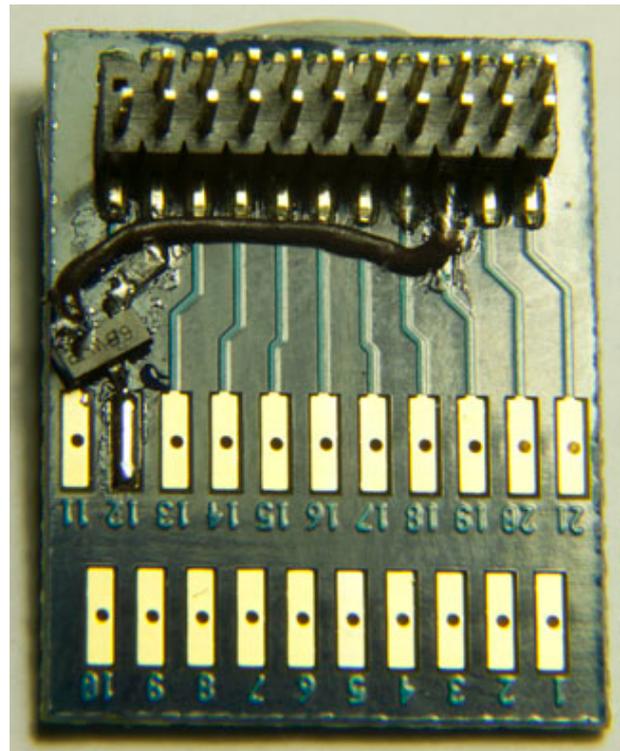
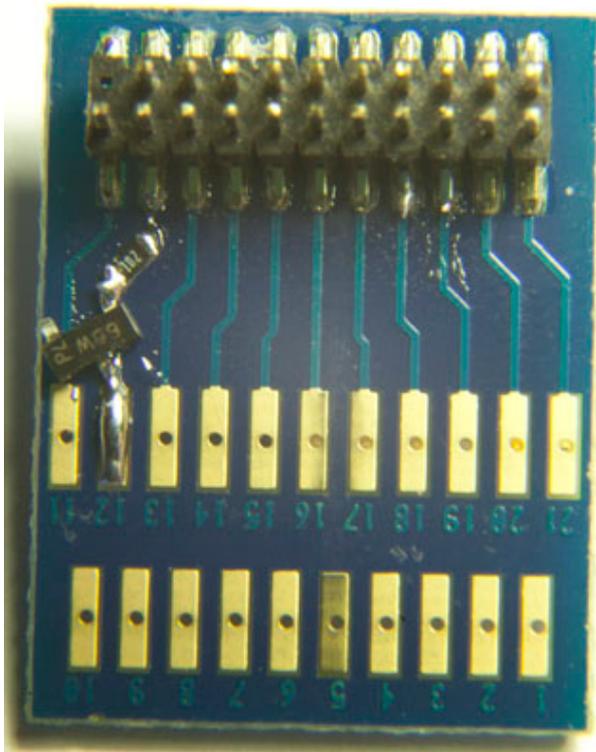
A transistor works like an electronic switch and in the case of an NPN transistor, the emitter is the output and the collector being the input, with the base acting as the switch. When a positive voltage is applied to the base, the transistor turns on allowing current to flow from the collector to the emitter.

In the case of a DCC decoder, they supply a constant positive voltage to the device being controlled and switch the negative on and off via a transistor to control the device, which in most cases is a light in the form of an LED (Light Emitting Diode) or globe. So by cutting the control trace and inserting a transistor and re-routing the output directly to the negative power supply, it allows direct control of the output.

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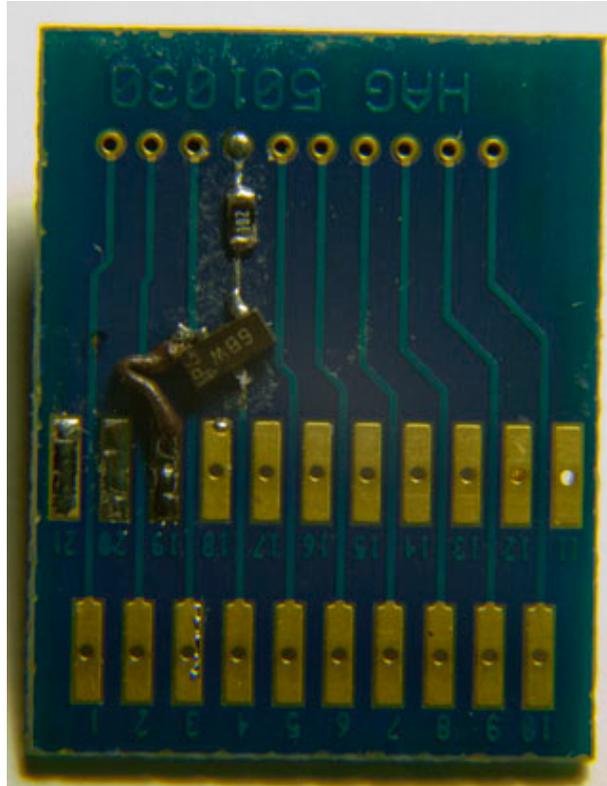
Once the resistor and the transistor are soldered onto the Adapter Board by pins 1 and 3, gently bend pin 2 up away from the board to allow soldering of the 32 gauge decoder wire to it. On the bottom, this wire can be soldered directly to pad '19'. On the top, you can either solder to directly to pad '19' but to allow space to solder a negative wire to the Adapter Board, you can solder the wire onto the bottom leg of the matching pin on the 21MTC plug.



The top of the 21MTC Adapter Board showing resistor and transistor mounting positions (left) and decoder wire forming the negative link (right)

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Bottom of the 21MTC showing the mounting positions of the resistor and transistor as well as the decoder wire for the negative link

Once you have finished and verified all the components and connections are correct, mount the adapter board and wire it into your locomotive and then plug your decoder onto the Adapter Board. Finally program the decoder to use your functions of choice to control the Aux 3 and Aux 4.