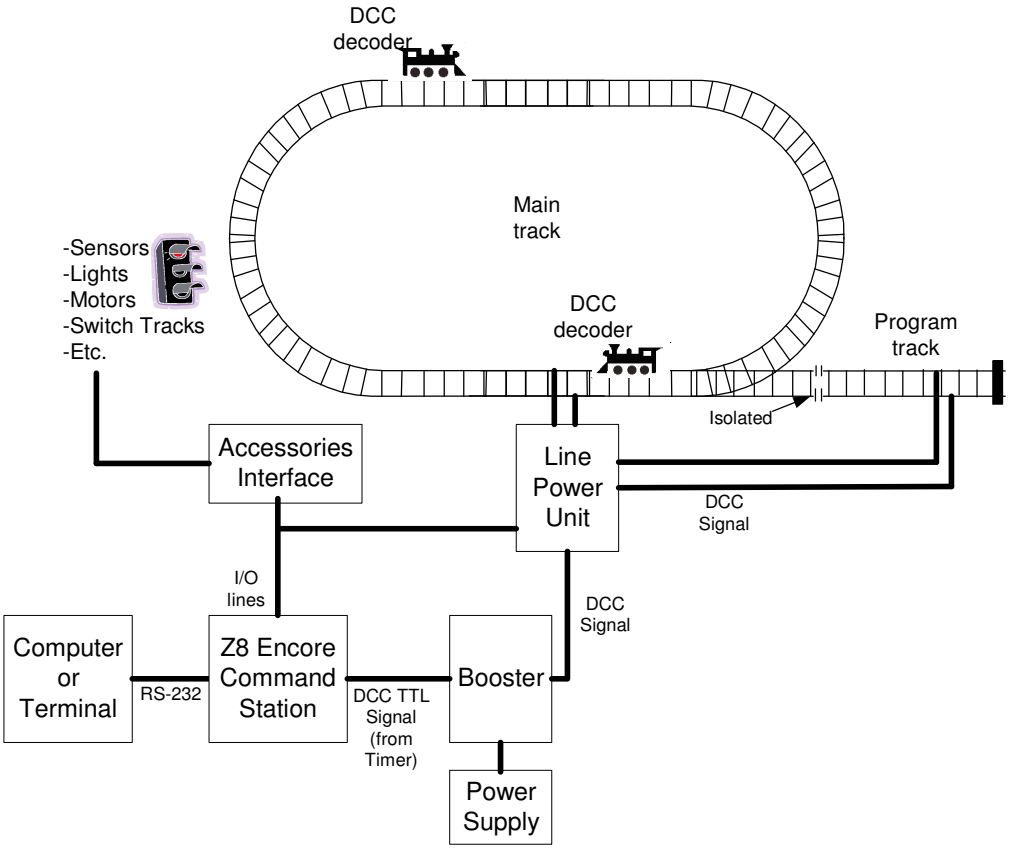
A DCC Command station
Abstract

Project number Z4222

Today's miniature trains have a chip that implement a protocol called DCC. These chips are able to control the motor, lights and sounds of a small locomotive. This provides a high level of realism to this hobby by giving the privilege to the operator to put many locomotives on the same track and control them individually from a command station. The command station is used to send the DCC signals on the tracks. This new way of control increases the popularity of DCC among the community.

The lack of standardization of the manufacturer's accessories and their approach of keeping secret their interfaces has limited the interoperability of similar products. It is important to remark that DCC manufacturers have standardized the communication protocol that run on the rail but not between their peripherals. This limits the possibilities and choices of the hobbyists and prevents them of creating their own input devices. Another fact to mention is the high cost of commercial command station. They are sell around 200-300.

The goal of this project is to build a command station that send DCC signals to all locomotives on the tracks and to control layout accessories. The block diagram of the system is presented at the next figure. This will allow an operator to build a DCC system with a Z8 encore. This system have many advantages over manufactured command station because it's open, low-costs (around 30-40), and scalable. Many of these advantages are provided with the features of the Z8 encore chip. Of course, it will be compatible with the existing DCC decoder found inside locomotive.



value for an input pin and to output a Boolean value on output pin. These pins can be connected to anything the user wish.

Hardware implementation

The Z8 encore development board was used to drive the Z8 chip. I used the power supply circuit for its alimentation and the UART circuit. Jumpers were used to connect to the individuals pins.

The booster module, from figure 3, was built using ideas from the NMRA group. I derived the booster from a test circuit they suggest. The schematic is in figure 5. First, the DCC TTL signal that comes from the Z8 encore is isolated and reproduced by an optocoupler. This protects the Z8 encore from surcharge. The output of the optocoupler is fed to a pair of inverters to get the direct and inversed DCC TTL value. To manipulate the high current load present on the track, a common L298 H-Bridge is used. This component is usually used to control stepper motors. We use it here as a way to switch the direction of current that comes from and external power supply. The L298 can control the direction of a motor. This is exactly what we need to generate DCC. The pair of logic signal from the inverters is used to control the logic functions of L298 to switch the power direction from the power supply. The output of the L298 is passed to a bridge rectifier to protect the circuit from the inductance of the motors when they start.

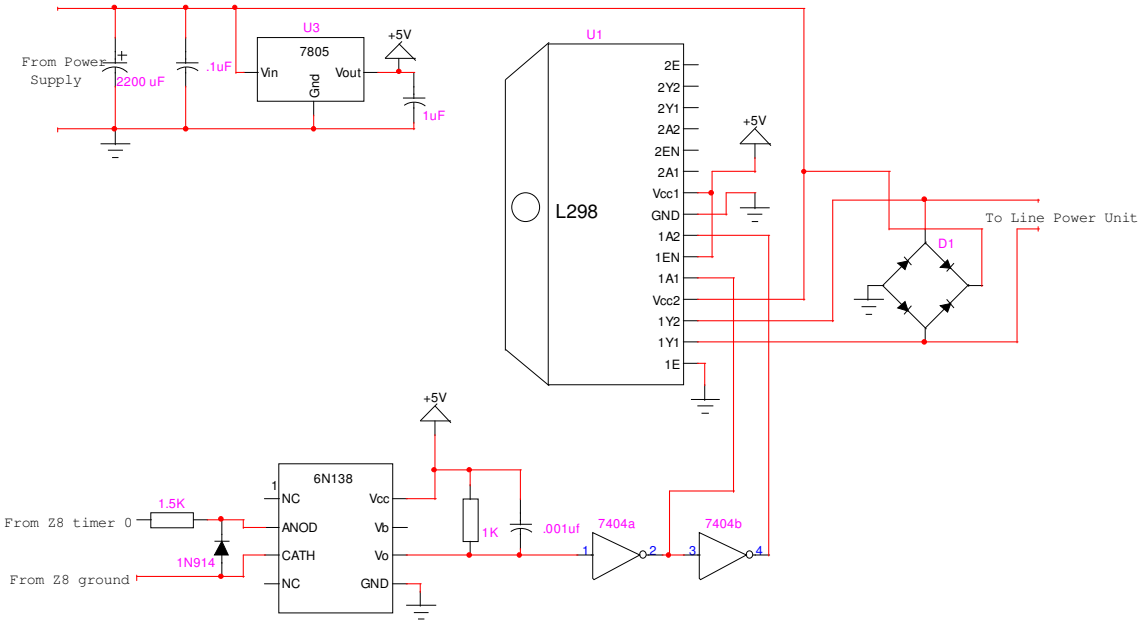


Figure 5 Booster schematic

The line power unit is represented at the figure 6. The program pin PA2 from the Z8 encore pass trough a small accessory module to drive the program relay. If this relay is enabled and the main relay is disabled, the DCC signal from the booster is sent to the

program track only. It's important to note that the program track is isolated from the main track by plastic joint. A resistance on the current path is used to protect the decoders during the program phase, as specified by the DCC specification.

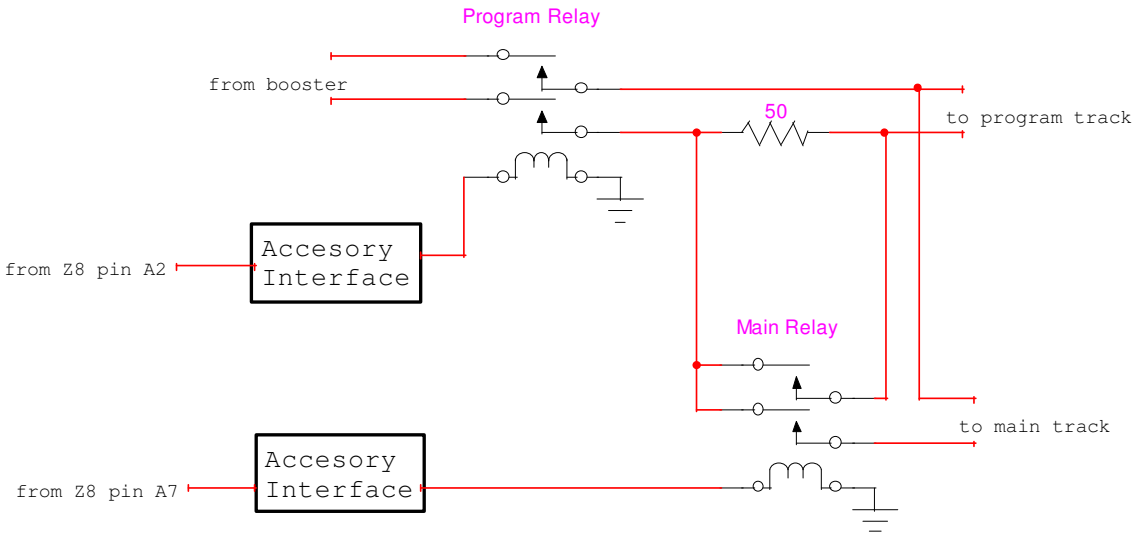


Figure 6 Line power unit schematic

The system can be set in normal operation when the main line relay is enabled with the pin PA7 while the program line relay is keep enabled,. The resistance is shorted by the relay contacts and all tracks receive the DCC signal from the booster.

The accessory interface schematic is showed at figure 7. This interface is used by the "line power unit" module and could be used by any pins to drive user's accessories. A classic connection in cascade of 2 transistors is used. Unfortunately, there is no common accessories interface for input. This depends on the situation. It could be done with a simple switch or it may need a complex interface to transform received signals.

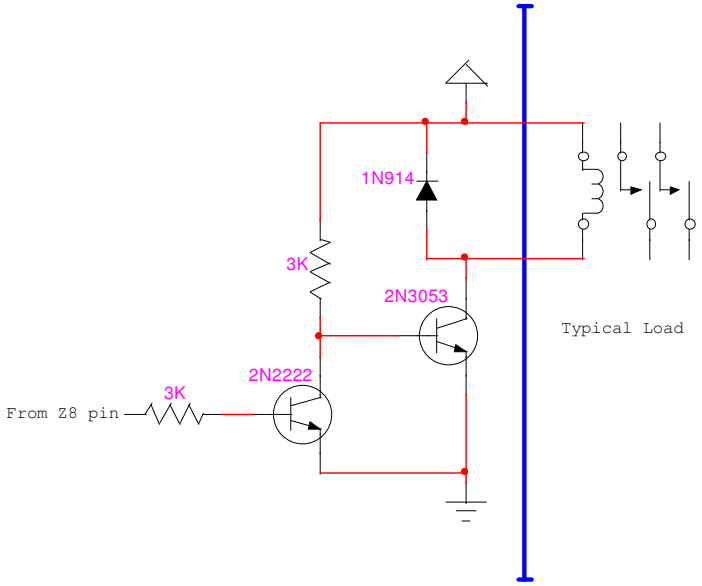


Figure 7 Typical output accessory interface schematic

Pictures of the system

Here are some pictures of the system. We can see the different modules as we explained in the previous sections.