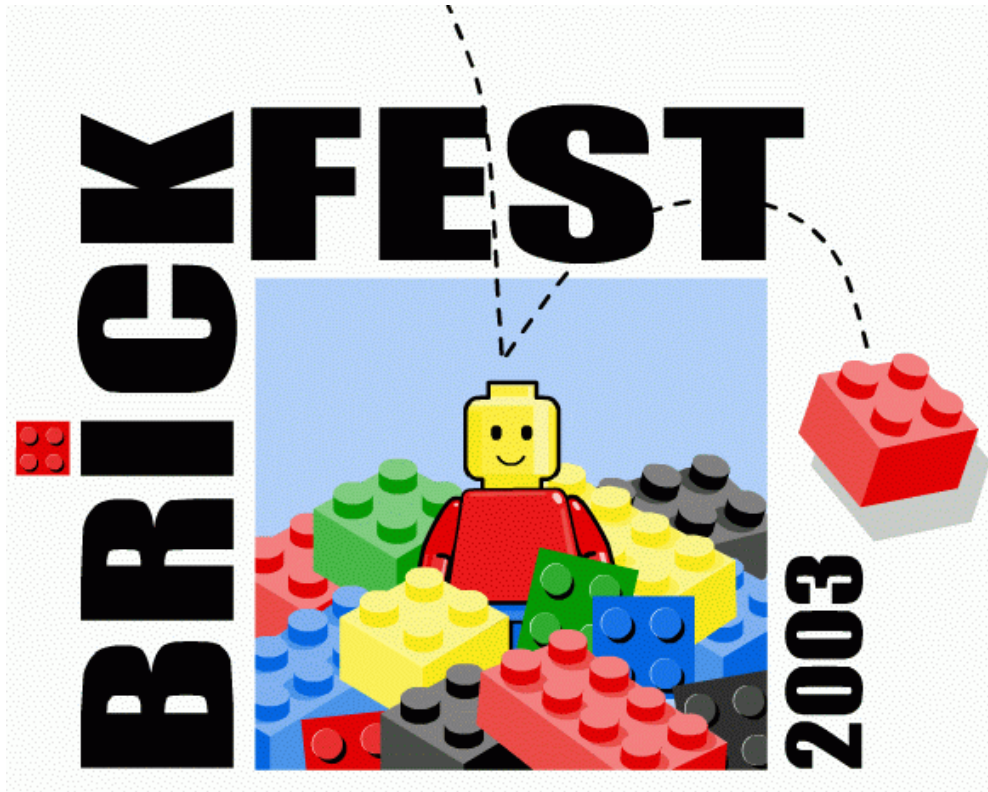




Introduction to LDCC



BrickFest 2003

DCC Track

Presented by:
Tom Cook

Presentation:
Mark Riley

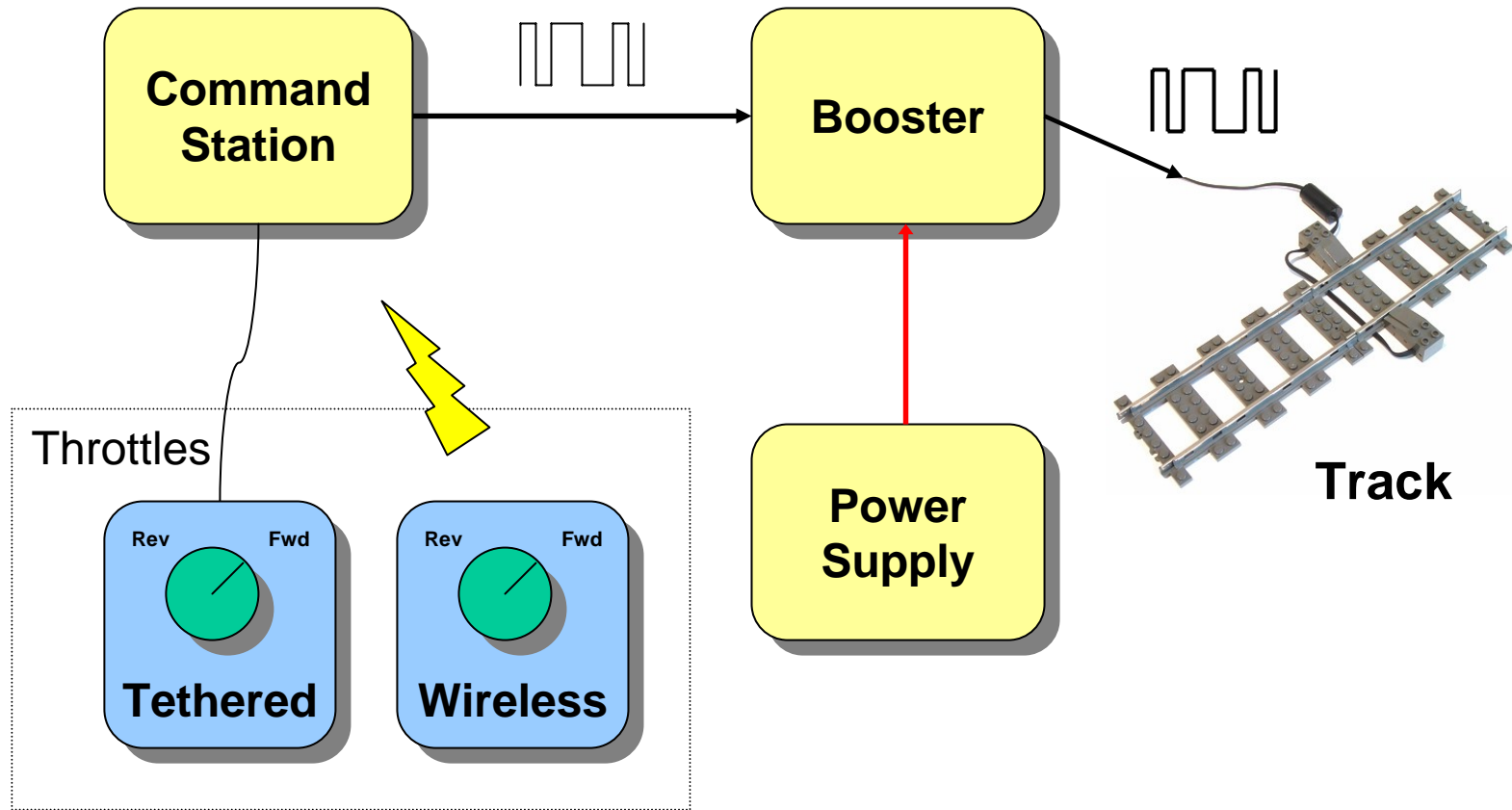
Introducing DCC

- Digital Command Control (DCC)
- Sends electrical signals and power over model railroad tracks to control DCC equipped locomotives and accessories
- Standard of the National Model Railroad Association (NMRA)

DCC Pros/Cons

- Multiple independently controllable trains on same track
- Headlight full brightness, even when stopped or moving slowly
- Forward throttle moves locomotive forward regardless of orientation on track
- 128 speed steps
- DCC decoder must be installed in train motor
- Higher cost
- Lots to learn

DCC Block Diagram



Introducing LDCC

- New firmware for RCX integrates these functions:
 - Command Station
 - Booster
 - Power Supply
- RCX remote:
 - Wireless Throttle





What You Need

- RCX 1.0 with power input jack
- AC Adaptor (the train AC adaptor is fine)
- RCX remote control (or equivalent)
- (1x) 2x8 Electrical plate or
(2x) 9V Electrical wires
- Train motor w/DCC decoder
- Acknowledgement circuit (optional)



LDCC Step-By-Step

- Install DCC decoders in train motors
- Wire RCX to track
- Download firmware
- Configure decoder addresses
- Run trains & have fun!

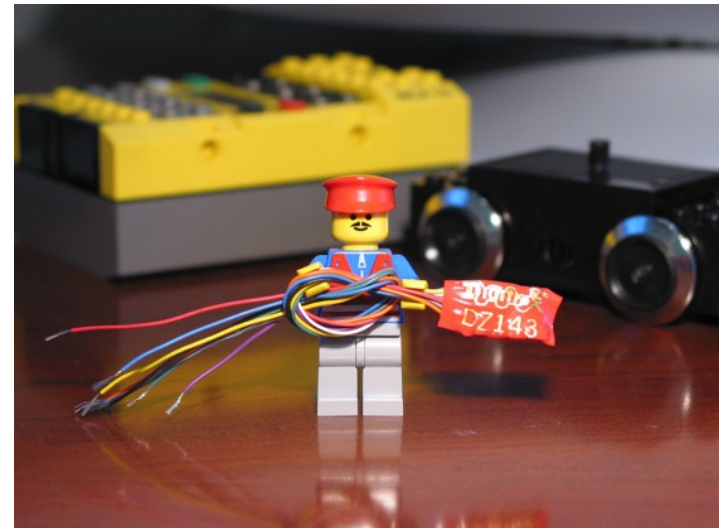


Decoder Installation Overview

- Purchase “DCC Ready” train motors online
 - See lugnet.market.buy-sell-trade
 - ~\$60 US
- Purchase decoder and install yourself
 - See Tom Cook’s L-Gauge Page
 - Train motor (~\$20 on BrickLink)
 - Decoder (\$20-\$30)

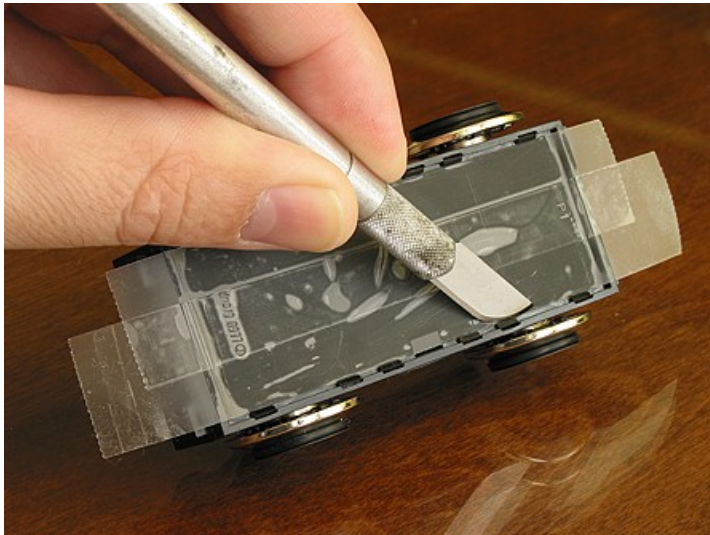
Decoder Brands & Models

- Decoders successfully installed:
 - Digitrax DN121
 - Digitrax DZ143
 - Digitrax DN140 (discontinued)
 - Digitrax DN142
 - Lenz LE0511W
 - MRC AD330
- Other likely candidates:
 - TCS M1



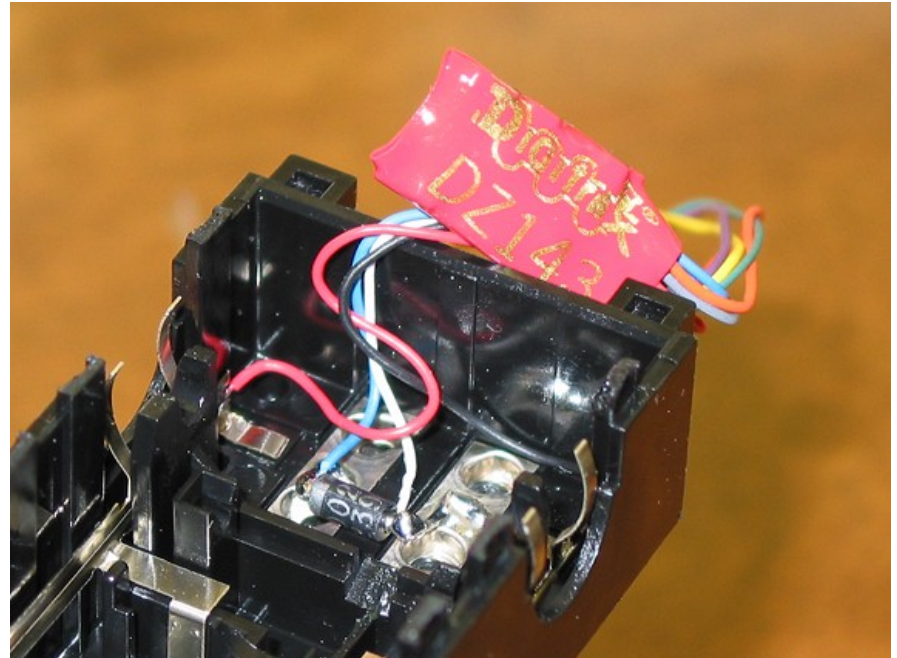
Decoder Install Overview I

- Remove tabs that secure bottom cover



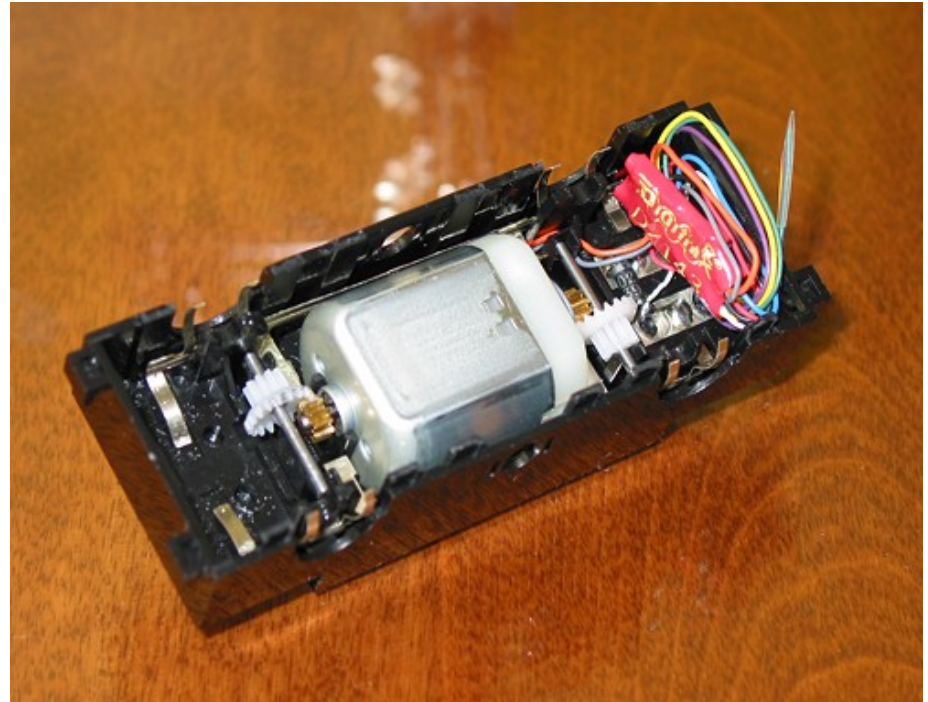
Decoder Install Overview II

- Clip (or insulate) rail pickups from headlight connector
- Blue & white leads go to headlight connector (diode is optional)
- Red & black leads go to rail pickups



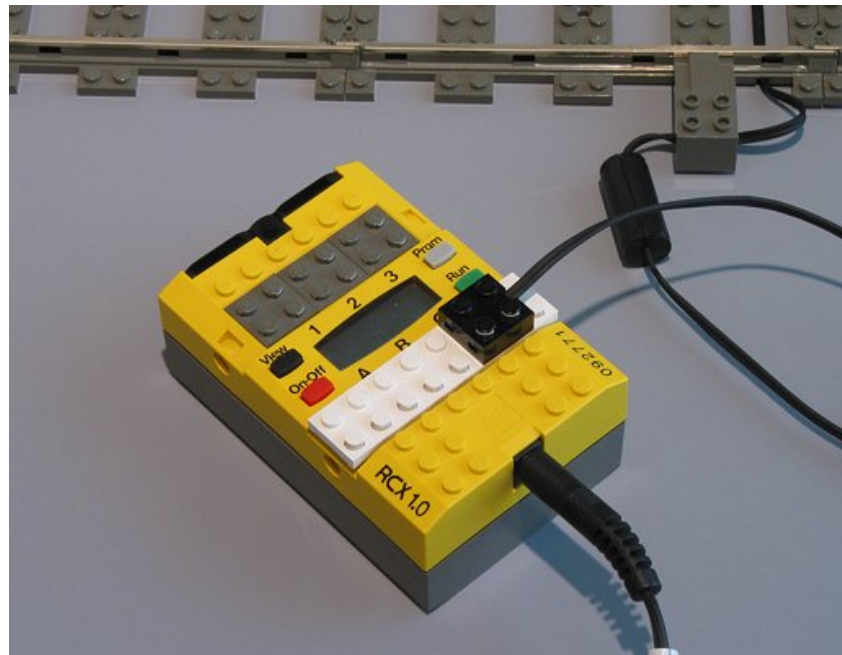
Decoder Install Overview III

- Orange & gray leads go to motor
- Coil (or clip) extra function leads



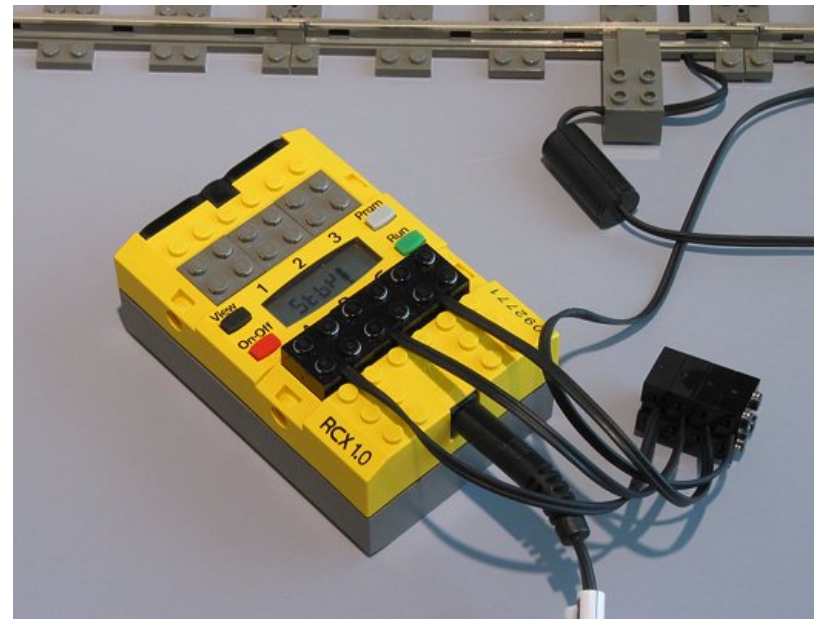
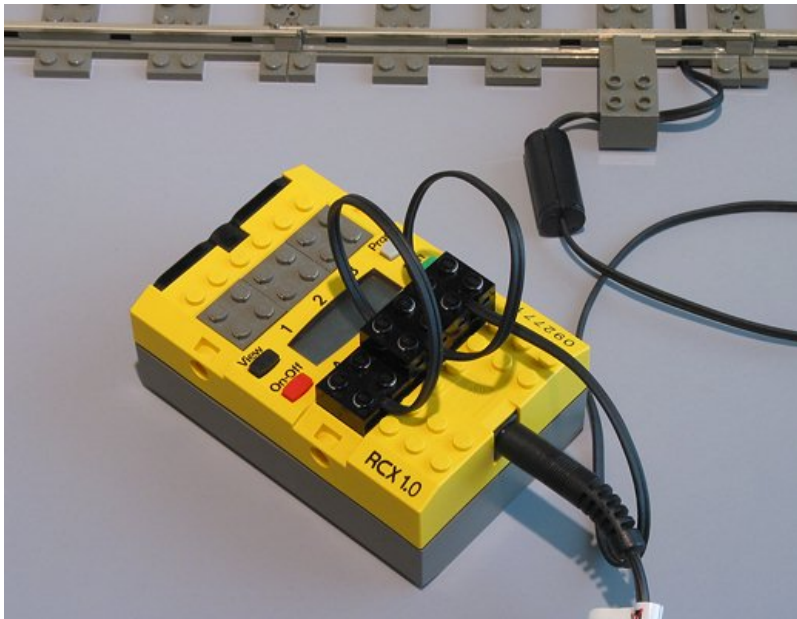
RCX Wiring I

- Outputs of RCX connected in parallel to increase power
 - 2x8 Electrical Plate
 - Track Connector



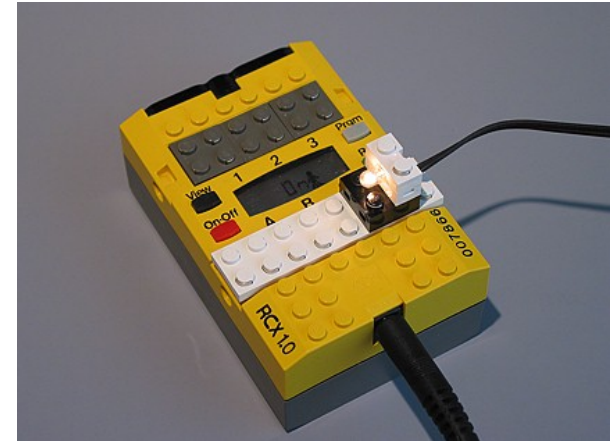
RCX Wiring II

- Alternate methods to connect outputs in parallel
 - (2x) or (3x) 9V Electrical Wires
 - Track Connector



RCX Wiring III

- Add lamp brick to track connector lead
 - Indicates when track is live
 - On in Run mode
 - Off in Stand-By mode
 - Can alert when “shorts” occur



- Add extra track connector leads to remote sections of track if “droop” noticed



LDCC Firmware

- LDCC replaces standard RCX firmware
- Available from LDCC Home Page:
<http://home.surewest.net/markril/lego/dcc/index.html>
- Get beta version 1.05 for latest features



Download Firmware

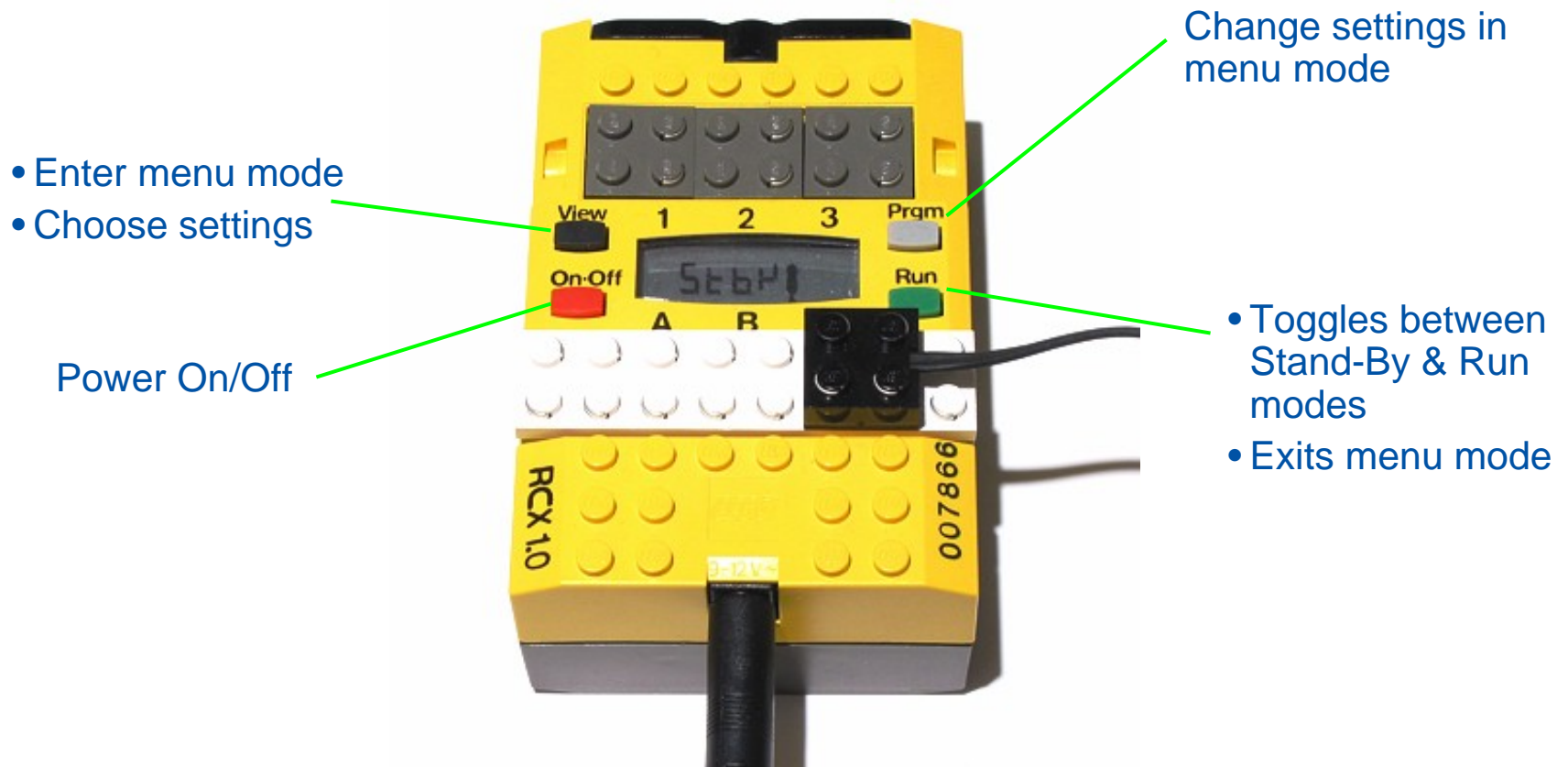
- Use batteries in RCX to retain firmware
- Use any of these firmware downloaders:
 - ScriptEd (from Mindstorms SDK 2.5)
 - NQC
 - BrickCC
 - firmctl3 (from BrickOS)



Stand-By & Run Modes

- Stand-By Mode
 - LDCC starts in Stand-By Mode
 - No power to track
 - Useful for:
 - “Panic stop”
 - Changing track wiring
- Run Mode
 - Track is live
 - Lamp brick will light (if installed)
 - Locos can be stopped or moving

RCX Buttons



9 Locos...

- LDCC can control 9 different locomotives at a time (i.e. Loco #1, #2, etc...)
- Normally each Loco controls the decoder with the same address:

Loco	#1	#2	#3	...	#9
Decoder address	1	2	3	...	9



...And 127 Addresses

- However, you can assign any of 127 decoder addresses to the 9 Locos:

Loco	#1	#2	#3	...	#9
Decoder address	23	2	55	...	9

RCX Remote Control

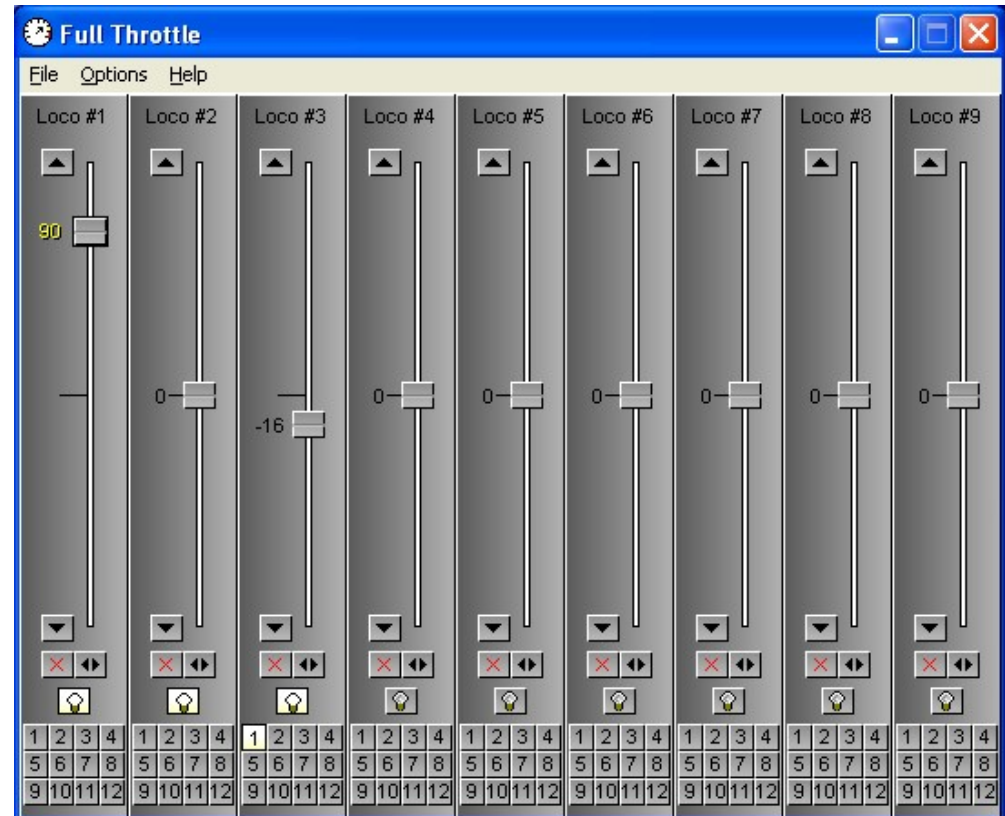
- Press both arrow keys at same time to stop
- Remote normally controls Locos #1-3
- SHIFT+2 to control Locos #4-6
- SHIFT+3 to control Locos #7-9



Full Throttle

By Christopher Phillips

- For Microsoft Windows®
- Uses LDCC IR Protocol
- Serial or USB IR tower
- Control all nine locomotives at once



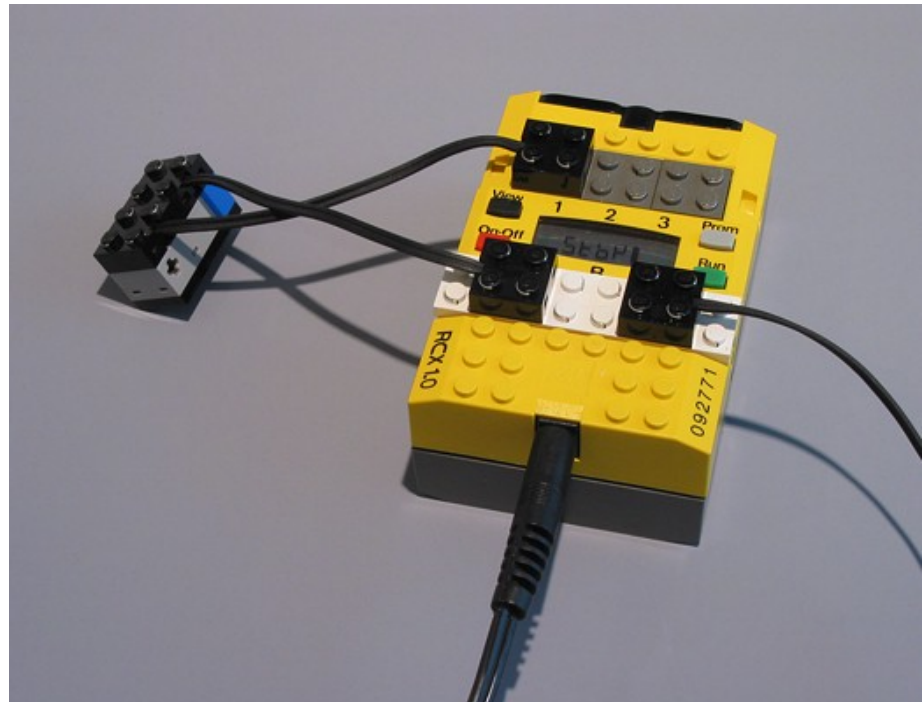
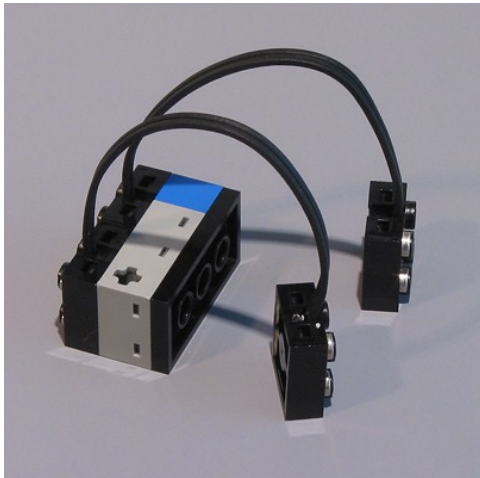


Configuration Variables

- CVs change behavior of decoder
- Settings are retained (even without power)
- Typical settings:
 - Decoder address (1 to 127)
 - Which direction is forward
 - Speed steps (14, 28 or 128 steps)
 - Acceleration & deceleration
 - Speed response curves
 - Headlight effects
- See your decoder manual for which CVs control what functions
- Acknowledgement circuit required to read back CV values
 - Not needed if only setting values

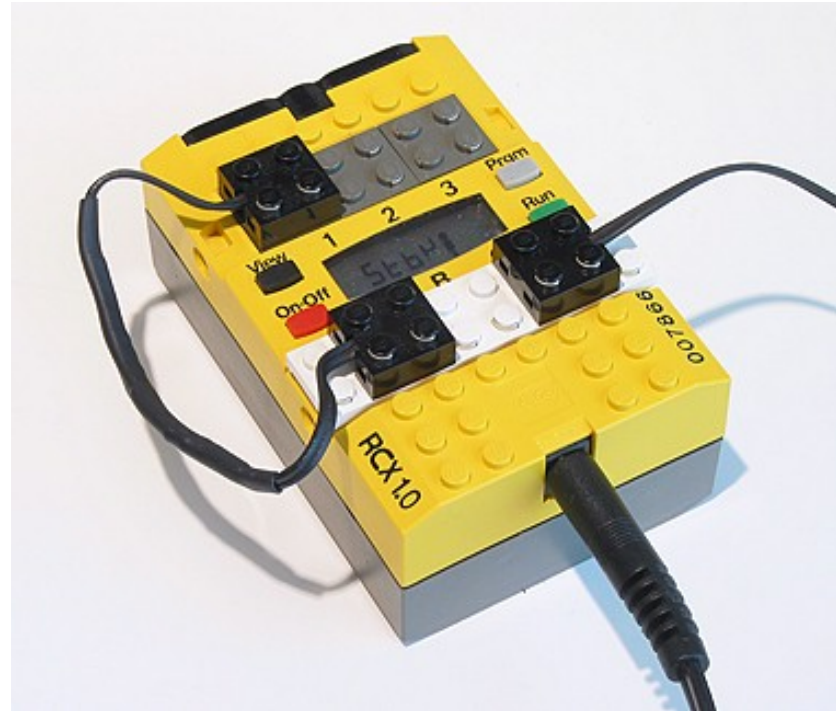
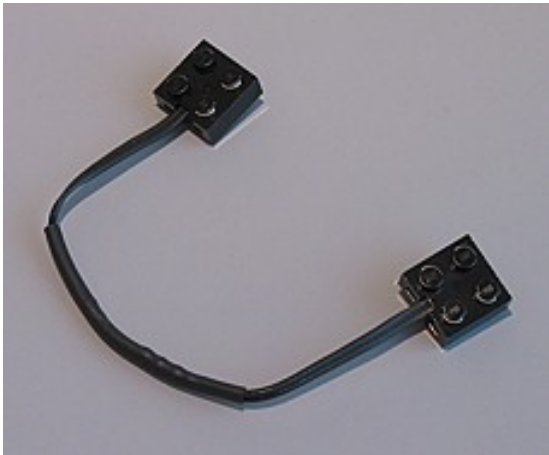
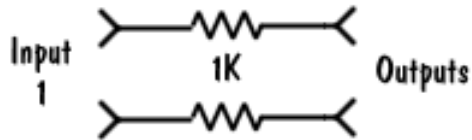
Acknowledgement Circuit I

- 100% Lego Version
 - 9V Electrical Wire (2x)
 - Touch Sensor
 - 1x2 Brick
 - 2x4 Plate



Acknowledgement Circuit II

- Two 1K resistors
- Electrical Wire



Programming Modes

- Decoders support one or more of these programming modes (in order of preference):
 - Direct Mode
 - Paged Mode
 - Physical Mode
- See decoder manual for which modes are supported by your decoder



Change Decoder Address

- Default decoder address is 3 from the factory
- CV #1 is decoder address
- Only one train motor on track at a time when programming

Speed Steps

- All modern decoders support 128 speed steps
- Older decoders may only support 14 or 28 speed steps
 - In this case, LDCC and decoder must both be set to same setting (either 14 or 28 steps)



Online Resources

- Mark Riley's LDCC Page
<http://home.surewest.net/markril/lego/dcc/index.html>
- Tom Cook's DCC Page (Decoder Installation)
<http://www.lgauge.com/trains/dcc/dcc.htm>
- Firmware Downloaders
 - LEGO Mindstorms SDK 2.5
<http://mindstorms.lego.com/sdk2point5/default.asp>
 - NQC (by Dave Baum)
<http://www.baumfamily.org/nqc/>
 - Bricx Command Center 3.3 (by John Hansen)
<http://members.aol.com/johnbinder/bricxcc.htm>
 - Firmdl3 (from BrickOS)
<http://sourceforge.net/projects/brickos/>
- Chris Phillips' Full Throttle
http://www.drvegetable.com/download_throttle.html