At QSI Solutions we pride ourselves on our unequaled Customer support. If you need help please call 800-671-0641

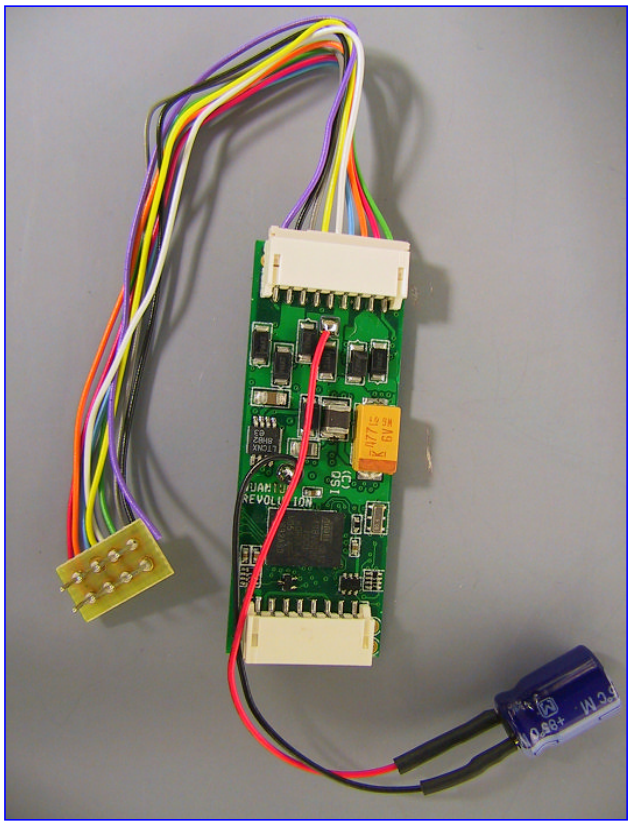
Quantum Revolution-U

Universal, PnP Format, Advanced DCC Sound and Power Decoder!

User Operations Manual, Revolution-U

Software ID		
☐ Other	☐ Steam	☐ Diesel 1st

				–			



By: Josh Shedaker, with contributions from Don Fiehmann

Rev 05/19/09

"U.S. Reissue Patent Number RE38,660".

Quick Start

1. If before you familiarize yourself with the operations manual, you want to test, explore and appreciate the great sound and performance features offered in the QSI, Quantum Revolution, then please review the information listed below!
2. Observe Anti-Static Precautions!
3. Insure your test area is free of metal debris from sanding, filing, drilling etc is clean and well lighted!
4. Familiarize yourself with the decoders DC/DCC Inputs, motor outputs and lighting outputs.
5. Connecting these incorrectly will most likely let the smoke out. See: Pg-7
6. Test the decoder before installing, DO NOT ATTEMPT TO PROGRAM NOW!
7. Use a decoder tester if you have one, if not you can use alligator clips to make the necessary connections. This should be done with care to avoid possible inadvertent contact of the alligator clips to each other that may short the decoder. Use tape to keep the wires/connections from moving.
8. You can use a 12v-16v bulb to simulate the motor. Its intensity will vary according to your throttle speed setting. Make sure your test speaker is 8 ohm.
9. After you are sure all your connections are correct and will not short connect your test set up to either an HO, (10v-14v), DC or DCC Power Unit.
10. In DC you will need to increase the throttle to about 7v to fire up the sounds, etc
11. In DCC, select ADD=3, the factory default, and advance the throttle and the decoder will function.
12. Test all lighting functions you may have connected.
13. After you verified the decoder is operating properly then program as you wish!

At QSI Solutions we pride ourselves on our unequaled Customer support. If you need help please call 800-671-0641

Special Precautions

1. Do not use too much heat when soldering. A 15 to 25 watt iron is ideal.
2. Never touch the speaker or motor wires together
3. There are no in additional resistors required when using 12-16 v bulbs
4. If you remove and re-install the capacitor observe the correct polarity. Red is (+).

Quantum Revolution-U User Operations Manual, Table Of Contents

1:Viva la Revolution!

Congratulations; you are now the delighted owner of the Quantum Revolution, the most advanced sound decoder on this planet. With this decoder you will have access to 8-channel, high fidelity sound, as well as the most sophisticated motor drive and lighting effects ever combined into one unit. The addition of the **Quantum Programmer** (MSRP $99.95) makes the Revolution the most *easily customized* sound decoder available – *period*! Follow the procedures outlined in the following, and you'll soon discover that this decoder is simply, well… *Revolutionary*!

For a long time, those of us in the model railroad "sound world" were stuck with whatever horn, whistle, air pump, chuff and bell the manufacturer decided was suitable. As a result, most of us at one time or another, thought something like: "Well, I really like the exhaust sound, but man, that horn is terrible." The **QSI Revolution** obsoletes ALL such limitations. Simply tell us what you want when you order your decoder, and we'll program it for you before we ship it! Further, with the Quantum Programmer, you can add or change whatever sounds (and more) you want, whenever you want. So read on – and join the *Revolution*!

1a: Revolution Features and Specifications

1: 8-Channel Sound – enabling multiple sounds to play at one time.

2: 6-Lighting Outputs, with many programmable settings including:
- Headlight/Tail Light
- Fire Box Flicker
- Front and Rear Mars Light
- Front and Rear Ditch Light
- Front and Rear Number Board Light
- Cab Light

Exclusive: All lighting outputs support 256 intensity levels for "Revolutionary" brightness control!

3: Motor Control: RTC (Regulated Throttle Control/BEMF) – for supreme low speed performance, smooth acceleration, braking, and incomparable power sharing between the locomotives in consists. (Have you ever dared to try and prototypically consist…a helper at the rear of a train? RTC makes it possible.)

4: Load-responsive exhaust sounds, unmatched "Sound of Power," SOP

5: Verbal CV, speed, scale MPH, and status reporting.

6: Sound-of-Power (see section **4a** for a full description of this feature) for even more control over the exhaust sounds.

7: Dual-mode operation – designed to run on DC or DCC.

8: Advanced Analog™**:** All sound features available in DCC are available in DC using the **Quantum Engineer** add-on controller, (sold separately), to your DC power pack.

9: All Quantum 2 products, Q2, can be upgraded with new sounds and software from the QSI Solutions website using the **Quantum Programmer™** (sold separately). This keeps your revolutionary sound **system perpetually up-to-date with new features, improvements, and sounds. You might say we've obsoleted… obsolescence!**

10: Simple installation. Two, distinct decoder formats means most locomotives will be adaptable to accept the following decoders:

Revolution-A: For all locomotives that have an Atlas or Kato style board, and

Revolution-U: For standard wired-style decoders w/wo an 8-pin NMRA plug and a 9-pin, JST header.

Automatic Features

The following QSI features are automatically controlled as a function of the directional of the locomotive!

Feature	*Forward*	*Neutral From Forward*	*Reverse*	*Neutral From Reverse*
Headlight	Bright	Dim	Dim	Dim
Rear Tender Lt.	Dim	Dim	Bright	Dim
Mars Light	Strobing	Steady On	Steady On	Steady On
Ditch Lt.	On	Off	Off	Off
Num. Board. Lt.	On	On	On	On
Marker Lights	On	On	On	On
Cab Lights	Off After 10 Secs.	On After 10 Secs.	Off After 10 Secs	On After 10 Secs.
Steam Blower	Off After 10 Secs.	On After 10 Secs.	Off After 10 secs.	On After 10 Secs.
Cylinder Cocks	If Armed, Plays 16 times or until speeds greater than 12 smph.	Arms after 25 secs.	If Armed, Plays 16 times or until speeds greater than 12 smph.	Arms after 25 Secs.
Vents & Cooling Fans	Off	On at random times	Off	On at random times

1b: Quantum Revolution Specifications

Dimensions: Revolution-A, 0.99" x 2.86", **Revolution-U,** 2.13" x 0.69"
Maximum Peak Voltage: 25v
Steady State Current: 1.3 Amps
Stall Current (1 sec): 2+ Amps
Speaker Load: 8/16 ohm or two, 8- ohm speakers in series (Not parallel)
Audio Amplifier: Advanced D Style Format (2 watts)
Light Outputs: 6 with 256 Intensity levels ea.
Function Current: 100ma

2: Installation Overview

As model railroaders, we understand the need for instant gratification when we get a new locomotive or decoder. We ask you to defer this for a moment or two while we go over some installation specifics. These days, most manufacturers produce DCC-ready locomotives – meaning that DCC installation is oftentimes literally a snap (which is the case with the **Revolution A**)! However, before you highball into your installation, there are a few things you should do beforehand that will make things a lot easier in the long run.

1: Read this ENTIRE manual! (We know – yuk!)
2: Remember that decoders are *static-sensitive* devices. *Always* discharge any static electricity you may have built up by *touching a grounded pipe or a piece of sheet metal* ***before*** *beginning your installation.*
3: Make sure you have a clean, well lighted area consisting of a non-conductive surface on which to perform your installation.
4 Never do installation work with power applied to the decoder. This can burn up the decoder. We all love engines that smoke – but this is the wrong way to get it!
5: Never touch your speaker output leads together.
6: Never touch your motor output leads together.
7: Never exceed the designated output ratings specified in section 1B.
8: Work carefully, take your time and have fun. (What may be frustrating tonight, probably won't be tomorrow.)

2a: Preparing Your Locomotive; Pre-Install Precautions

We've already covered a few of the things that you don't want to do when installing your decoder. Now let's look at some things you *do* want to do to get your locomotive ready to roll.

1st: Isolate the motor. This is one of the most critical aspects of any DCC decoder installation, regardless of make or model. You MUST make sure your motor no longer receives ANY power directly from the track. In other words, if you can find pick-up wires going directly from one side of your wheels/trucks to the motor terminals, you'll want to disconnect them where they connect to the motor *not from the trucks*. Disconnecting them will keep the DCC from "backfeeding" into the decoder and burning it up (see Step 5 of Section 2 regarding "smoke"!).
Note that on certain locomotives the motor draws power directly from 2 sides of a split frame, which the motor is enclosed inside. Isolating this type of motor can be more difficult, and can require insulation of the inner parts of the frame. If you have any doubt about the type of motor set-up you have, please contact QSI Solutions for clarification before proceeding with the installation.
Most modern models already have the motor isolated. If the locomotive instructions say anything about it being "DCC Ready," then your model already has the motor isolated.

2nd: Trace your wires. By identifying which wire goes where, you'll make things a lot easier. We recommend you devise some method of marking the wires once you have them traced out. That way, when you want to reconnect that headlight, you won't be left sitting there, looking at a bundle of wires, thinking uhhhhhhh.....

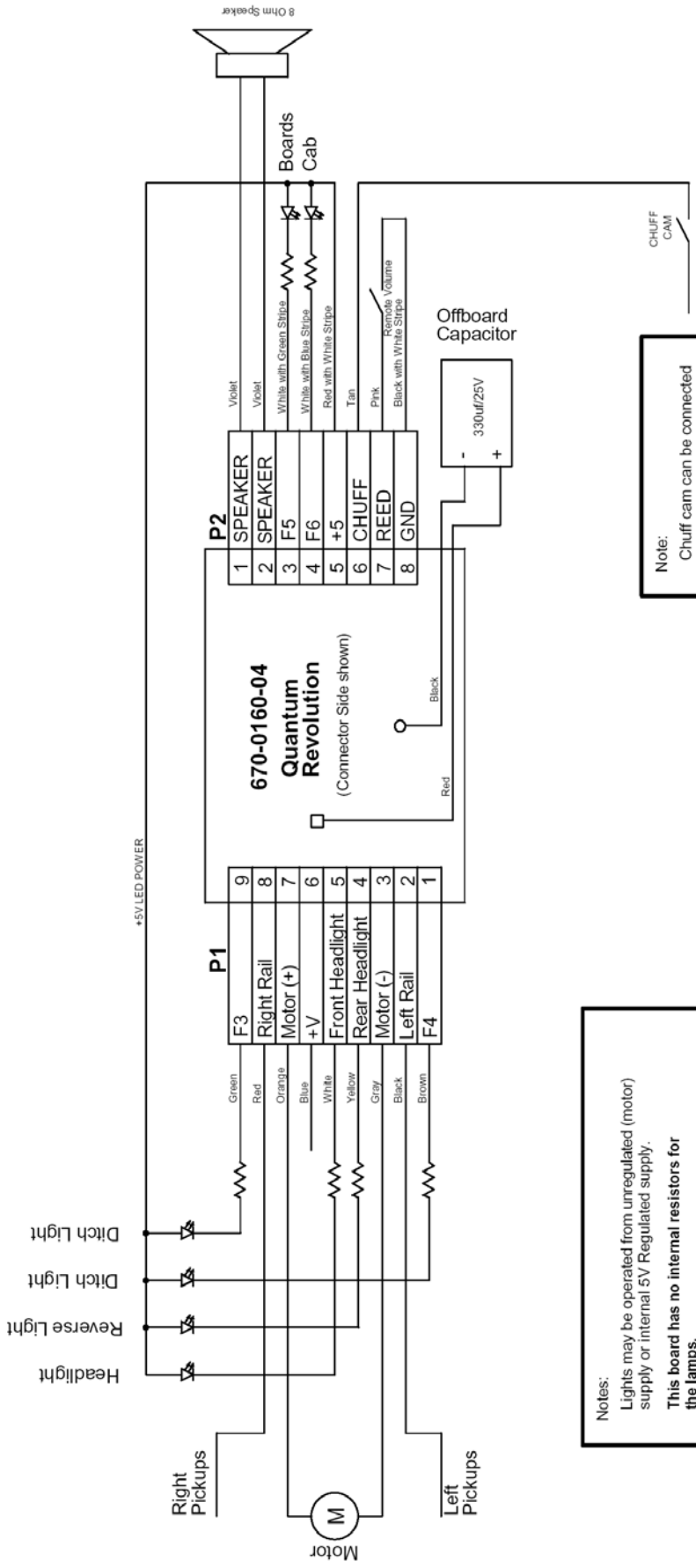
2b: Pre-Installation loco modifications

Now that you've isolated your motor and traced your wires, it is time to figure out where to put that speaker. In steam locomotives, this is often pretty easy since most tenders are reasonably open inside. In diesels, it tends to be a bit more difficult. We'll outline a couple ideas and let you decide.

2c: Speaker Selection

Since we've talked about *where* you're going to put the speaker, let's take a step back and talk about which speaker you're going to use. QSI offers a plethora of new speakers with varying frequency responses – which means you now have many options. We recommend you experiment, so that you can decide how much modification you're willing to do to accommodate a particular speaker. Hint: Be sure to use some type of baffle (enclosure) with your speakers. You can either use one of the available speaker enclosures, or with appropriate "sealing," the body shell itself. If you're unsure about what kind of speaker you're going to need, feel free to call QSI Solutions for recommendations.
Next, make the final decision on where you'll put your speaker(s). Some locomotives have a cover on the fuel tank that, when removed, reveals a weight that can also be removed. This is actually one of the better configurations, because it accommodates the largest speaker. Another option includes: removing weight from the top of the frame and broadcasting the sound out, quite prototypically, through the exhaust fan grills. The last (and possibly most common) configuration is to remove any cab detailing and locate your speaker in the remaining open space.

2d: Installing and Wiring Your Decoder



Note:
Chuff cam can be connected to eiter track, +5. GND or Power, depending upon the individual installation.

For isolated cams, connect switch between GND and CHUFF

P2	Function	Color Code	Comments
1	Speaker	Violet	Any Polarity
2	Speaker	Violet	Any Polarity
3	F5	White w/ Green Stripe	# Board Default
4	F6	White w/ Blue Stripe	Cab Light Default
5	+5 V	Red w/ White Stripe	+ 5 V Common
6	Chuff	Tan	See Special Notes
7	Reed	Pink	To GND for Reset
8	Ground	Black w/White Stripe	

Notes:
Lights may be operated from unregulated (motor) supply or internal 5V Regulated supply.

This board has no internal resistors for the lamps.

Maximum total load for 5V supply is 150ma.

Speaker impedence must be 8 ohms or greater.

Continuous track current must not exceed 1.25A
Peak track current must not exceed 2.0A

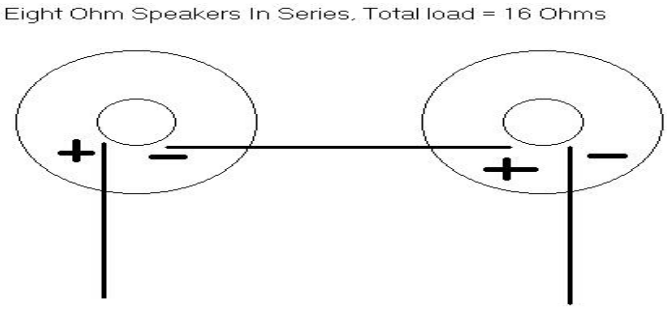
P1	Function	Color Code	Comments
9	F3	Green	
8	Right Rail	Red	
7	Motor +	Orange	
6	+ V	Blue	(Track Volts) – 1.5v=V
5	Front Light	White	
4	Rear Light	Yellow	
3	Motor (-)	Gray	
2	Left Rail	Black	
1	F4	Brown	

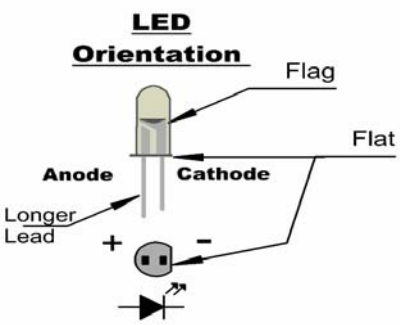
If you've followed our instructions so far, you should already know what this section covers because you've already read the entire manual, right? That being the case, you should also have accomplished the following:

1: You've verified that your motor is isolated
2: You've traced your wires so you know where they all go
3: You've figured out a location for your speaker
4: You've performed any modifications necessary to fit the selected speaker into said location

Now, take a moment to study the diagram below, as it will be referred to often in the coming paragraphs.

The Quantum Revolution U is equipped with an 8-pin NMRA plug, which will allow you to plug it in to most "DCC Ready" locomotives without much modification. If you accidentally reverse the connection of the 8-pin plug the only thing that will happen is the locomotive will run in the opposite direction of what your handheld says. It is also equipped with a 9-pin JST connector that enables it to be quickly plugged into Athearn "Ready to Roll" models and Mantua classics series using the 9 pin "quick plug" assembly. While it is possible to plug the 9-pin connector in backwards you would have to really force it. If you look closely at the side of the plug assembly you'll notice that it has locating notches that show you the correct direction to plug it in. In most cases simply plugging the decoder in is all you'll need to do to get it running. You will need to solder the speaker wires to the speaker. If you are only using one speaker then polarity is a non-issue. The Revolution is perfectly happy driving two 8, ohm speakers wired in series like the diagram below.





From Decoder+ Speaker Wire **To Decoder – Speaker Wire**

For those of you not working with a plug and play locomotive we'll go through wire by wire. Examine the diagram on the previous page for visual reference.

P1 (Connector, 9 Pin JST Format)

Green: Is for the extra light function tied to F3 for diesels this is programmed for the left ditch light. On steam decoders this is set up for a firebox flicker. The other lead from the light attached to this will go to the common

Red: Connects to the right hand rail pick-up wires coming from the trucks
Orange: Connects to the + Motor Wire

Blue: Is the 12v common for this decoder. If using an 8 pin plug this will be the common that is connected to the plug itself. This common is good for use with 12-16v bulbs. If using 1.5v bulbs or LED's we recommend that you use the +5 common from **P2** as this will give you a lower voltage output and therefore require less resistance when using low voltage lights. If using this as your common simply connect one lead from you light to this wire (or the anode of an LED) and the other to the appropriate function.

White: Connects to one wire for the headlight or the Cathode of an LED (see diagram below)
Yellow: Connects to one wire for the reverse light or the Cathode of an LED (see below)
Gray: Connects to the – Motor Wire

Black: Connects to the left hand rail pick-up wires coming from the trucks

Brown: Is for the extra function tied to F4 for diesels this is programmed for the right ditch light. On steam decoders this is set up for a Mars light

P2 (Connector 8 Pin JST Format)
Violet: Speaker wires, see below.

White /Green Striped: Is for the extra light function tied to F5 for diesels this is programmed for a Mars light. On steam decoders this is for Classification/Marker lights

White /Blue Striped: Is for the extra light function tied to F6 for steam and diesels this is programmed to a Cab light

Red White Striped: Is the 5v common for this decoder. If using LED's or low voltage (1.5v) bulbs you will use this common as less resistance will be required than with the blue 12v

Tan: This is for connecting a chuff cam sensor. This is not a required installation step but some users still like to use these kinds of sensors. If you are using this feature you will also need to set CV56 to a value of 16 to enable cam synchronized chuff.

Pink: This wire forms one part of the reed switch connection. The other wire from the reed switch will go to the ground wire.

Black/ White Striped: Is the ground wire. This is only used to form the other end of the reed switch connection or when using and isolated cam.

Okay, we're getting close to being done now the outermost Violet wire is the – speaker wire while the one immediately next to it is the + speaker wire. Connect these to the terminals on your speakers and install your speaker into the location you've prepared for it. (These outputs may be connected to *either* speaker terminal if they're not marked.)
Put the shell back on, and put your loco on the track. (If you have a program track, check to be sure there are no short circuits after the shell is installed.) The moment you issue any sort of command (be it applying DC track voltage or issuing a function command on your DCC system) you should hear your newly-equipped locomotive thunder to life. Congratulations! You've done it! That wasn't nearly as hard as you thought it was going to be was it?

3: Programming Your New Decoder

Now that you've got it installed, let's take a look at programming some of the CVs in your decoder. This section is primarily for DCC users – but you can also do it DC; it just requires some different steps. First we'll cover DCC programming, then programming with a DC power pack.

If you get into trouble you can reset the decoder by entering the following CV's in the order listed. **THIS WILL NOT AFFECT THE SOUNDS LOADED IN THE DECODER!**

CV 49 = 128
CV 50 = 255
CV 56 = 113

The decoder will speak the word "RESET" when the last CV is entered (if done on the mainline) OR when power is next applied (if done on the program track)

QSI's: Exclusive Decoder Talk Back Feature:

All QSI Decoders have a unique, exclusive "Talk Back Feature" when using OPS-Mode Programming. These decoders actually "Talk Back" to the user via the decoders Verbal Announcement feature to tell the user the values of programmed CV's.
CV62 governs the exclusive "Talk Back".
This can be extremely handy as it confirms that the decoder has not only acknowledged the information, but taken it as well. . Especially when programming indexed CV's as the decoder will speak back the entire 3 decimal value when programming is complete. (example: if you program CV 56.18.1 the decoder will say "CV Five Six point one eight point one equals xxx)
This works well with most DCC Systems but there is a **notable exception with NCE**

N.C.E. has an auto-programming feature in Ops Mode for setting a long address. When you enter a new long address into an N.C.E. system it does three things: Programs CV17, programs CV18 and programs CV29. The problem is that the "Talk Back" tries to acknowledge the change made in CV17 and in doing so interrupts the N.C.E. systems information flow causing the address programming to fail. For NCE, in order to have these automatic address programming features work correctly you need to turn off the verbal read back by setting CV62 to a value of 0. Or conversely, you can also program CV17, CV18 and CV29 individually, (not use the NCE auto feature) and maintain the "Talk Back" feature without programming interference. If you are just programming single CV's at a time then the talk back feature may remain enabled.

3a: Basic Operational CVs

Programming of all CVs in this decoder is performed according to the instructions provided with your DCC system.
It should be noted that due to the relatively high in-rush current required to run this decoder, most systems require
It to be programmed on the main line (or in "Ops Mode"). If that's a problem with your particular DCC system, you can purchase a program track booster called the PowerPax from DCC Specialties that will remedy the problem.

NOTE: These CV's are grouped so that similar CV's are together.

CV#	*CV NAME*	*DEFAULT*	*RANGE*
1	**Primary Address**	**3**	**1-127**
17	**Extended Address Lower Byte**	**192**	*
18	**Extended Address Upper Byte**	**0**	*
29	**Configuration Data #1**	**6**	**0-55**
2	**Vstart (start voltage)**	**8**	**0-255**
5	**Vhigh (top speed)**	**1**	**0-255**
3	**Acceleration Rate (momentum)**	**0**	**0-255**
4	**Deceleration Rate (momentum)**	**0**	**0-255**
51	**Master Volume**	**127**	**0-127**
52	**Horn Volume**	**11**	**0-15**
62	**Verbal Announcement "Talk Back Feature"**	**1 (ON)**	**0-1 0(Off)**

***= Special Range; See Below**

CVs Explained

QSI CV#'s

QSI uses several unique CV's in their decoders. These have up to 3 parts.

Example: CV 55.70.1

1. 55 is the CV Number (think of this as a room in a house)
2. 70 is the Primary Index (think of this as a closet in the room)
3. 1 is the Secondary Index (think of this as a shelf in the closet)

To set QSI CV's

1. Set CV49 to the Primary index value
2. Set CV50 to the Secondary Index value (If no Secondary Index is shown set CV 50 to 0)
3. Now set the CV# to whatever value gives you the feature desired.

CV: 1 Primary Address: If you're going to use a short address (between 1 and 127) you can simply enter that address as the value of CV1.

CV: 17/18 Extended Address: CVs 17 and 18 are known as a "paired" CV, meaning that the two CVs *together* hold one piece of information. If your DCC system does not compute the values of CV17/18 for you, here is a way to compute the values, by using a different value in each CV to "build" the address you want. To determine the values that are placed into these CVs use the following equation.

A. Start with the locomotive address , divide it by 256 Sample *4449 ÷ 256 = 17.379*
B. Take the whole number (17) and add 192. Sample *17 + 192 = 209*
C. Program the value (209) in step B is into CV17.
D. Multiply the whole number (17)from step A by 256. Sample *17 X 256 = 4352*
E. Subtract the loco address from the computed value in step D. Sample *4449 − 4352= 97*
F. Program the value (97) in step E is into CV18. (Some system may require a 0 to be placed in front of numbers less than 100. That would make the 97 a 097.)
G. To activate 4 digit addressing a value of 32 (bit 5) needs to be added to CV-29.

Wasn't that fun? Here's a simpler way to determine these values.

CV:29, Configuration Data 1: CV29 controls 4 things at one time. First, it controls which speed table is accessible in the decoder (i.e., 14, or 28/128 speed steps). Second, it determines whether or not your locomotive will still run in analog mode (analog mode conv.). Third, it tells the locomotive which direction is its "normal" travel direction. Lastly, it determines whether your loco will accept a 2 or 4 digit address. For the specific value to enter use the reference chart below.

CV:2, V Start: This CV dictates the amount of voltage that is applied to the motor when the throttle is first increased. The higher the value you more voltage will be applied when you first crack the throttle. If your loco stutters at low speeds increasing CV2 will often remedy the problem.

CV:5, V High: This CV dictates the top speed that the locomotive can reach. The higher the value in this CV the lower the top speed.

CV29 Look-Up Table

CV Value for CV29: Hex or	Dec	Speed Step / Speed Table	Analog Mode	Normal Direction	2/4 Digit Add
X00 HEX	0	14	Off	Forward	2
X01	1	14	Off	Reverse	2
X02	2	28/128	Off	Forward	2
X03	3	28/128	Off	Reverse	2
X04	4	14	On	Forward	2
X05	5	14	On	Reverse	2
X06	6	28/128	On	Forward	2
X07	7	28/128	On	Reverse	2
X10	16	14 Speed Table	Off	Forward	2
X11	17	14 Speed Table	Off	Reverse	2
X12	18	28/128 Speed Table	Off	Forward	2
X13	19	28/128 Speed Table	Off	Reverse	2
X14	20	14 Speed Table	On	Forward	2
X15	21	14 Speed Table	On	Reverse	2
X16	22	28/128 Speed Table	On	Forward	2
X17	23	28/128 Speed Table	On	Reverse	2
X20	32	14	Off	Forward	4
X21	33	14	Off	Reverse	4
X22	34	28/128	Off	Forward	4
X23	35	28/128	Off	Reverse	4
X24	36	14	On	Forward	4
X25	37	14	On	Reverse	4
X26	38	28/128	On	Forward	4
X27	39	28/128	On	Reverse	4
X30	48	14 Speed Table	Off	Forward	4
X31	49	14 Speed Table	Off	Reverse	4
X32	50	28/128 Speed Table	Off	Forward	4
X33	51	28/128 Speed Table	Off	Reverse	4
X34	52	14 Speed Table	On	Forward	4
X35	53	14 Speed Table	On	Reverse	4
X36	54	28/128 Speed Table	On	Forward	4
X37	55	28/128 Speed Table	On	Reverse	4

Commonly Used CV's and Values

Individual Sound Vol. CV's	CV	CV50	CV49	CV52	Effect
Horn Volume	52	X	0	0-15	0= Minimum Volume. 15= Maximum Volume
Bell Volume	52.8	X	8	0-15	0= Minimum Volume, 15= Maximum Volume
Motor Volume	52.10	X	10	0-15	0= Minimum Volume, 15= Maximum Volume
Turbo Volume	52.14	X	14	0-15	0= Minimum Volume, 15= Maximum Volume
Air Pump Volume	52.16	X	16	0-15	0= Minimum Volume, 15= Maximum Volume
Cooling Fan Volume	52.19	X	19	0-15	0= Minimum Volume, 15= Maximum Volume
Long Air Let-off Volume	52.21	X	21	0-15	0= Minimum Volume, 15= Maximum Volume
Short Air Let-off Volume	52.22	X	22	0-15	0= Minimum Volume, 15= Maximum Volume
Squealing Brakes Volume	52.24	X	24	0-15	0= Minimum Volume, 15= Maximum Volume
Generator Volume	52.26	X	26	0-15	0= Minimum Volume, 15= Maximum Volume
Dynamic Brake Fan Volume	52.28	X	28	0-15	0= Minimum Volume, 15= Maximum Volume
Coupler Volume	52.34	X	34	0-15	0= Minimum Volume, 15= Maximum Volume
Air Brakes Volume	52.37	X	37	0-15	0= Minimum Volume, 15= Maximum Volume
Alternate Horn Volume	52.40	X	40	0-15	0= Minimum Volume, 15= Maximum Volume
User Sound Effect Volume	52.46	X	46	0-15	0= Minimum Volume, 15= Maximum Volume
Quantum Configuration CV's	**CV**	**CV50**	**CV49**	**CV52**	**Effect**
System Configuration	56.0.0	0	0	0-1	0= Sound Off at Powerup 1= Sound on at Powerup
Throttle Mode (STC and RTC)	56.4.0	0	4	0-1	0= Stand.Throttle Control 1= Regul. Throttle Control
R.T.C Minimum BEMF	56.5.0	0	5	0-31	0= NO BEMF for RTC, 31=ALL BEMF for RTC
Quantum PID CV's	**CV**	**CV50**	**CV49**	**CV52**	**Effect**
Very Low Speed Proportional Gain	56.18.0	0	18	0-255	Special See Section 5C
Very Low Speed Integral Gain	56.18.1	1	18	0-2	Special See Section 5C
Very Low Speed Differential Gain	56.18.2	2	18	0-255	Special See Section 5C
Low Speed Proportional Gain	56.19.0	0	19	0-255	Special See Section 5C
Low Speed Integral Gain	56.19.1	1	19	0-2	Special See Section 5C
Low Speed Differential Gain	56.19.2	2	19	0-255	Special See Section 5C
Medium Speed Proportional Gain	56.20.0	0	20	0-255	Special See Section 5C
Medium Speed Integral Gain	56.20.1	1	20	0-2	Special See Section 5C
Medium Speed Differential Gain	56.20.2	2	20	0-255	Special See Section 5C
High Speed Proportional Gain	56.21.0	0	21	0-255	Special See Section 5C
High Speed Integral Gain	56.21.1	1	21	0-2	Special See Section 5C
High Speed Differential Gain	56.21.2	2	21	0-255	Special See Section 5C

Programming Indexed QSI CV's

Important QSI CV's are listed above. The programming of the values listed needs to be done in a specific order using CV's 49 and 50. When you see an indexed value like CV56.18.1 you actually need to change up to three CV's to modify the information contained within the CV. If there are 3 decimal places (like in the example above) then you must program CV50 first, then CV49 second and then which ever Master CV you're trying to change third. For simplicity this has been color coded above. You will program the GREEN VALUE FIRST, where applicable the RED VALUE SECOND, and the BLUE VALUE LAS

3b: Analog Programming

PART OF THE METHOD OF RESETING AND WORKING WITH THIS UNIT IS ANALOG MODE IS THROUGH A MAGNETIC REED SWITCH WHICH IS AN OPTIONAL PART. IF YOU FEEL YOU NEED THIS PART PLEASE NOTIFY YOUR DEALER.

Value for CV29 Hex	Dec	Speed Step / Speed Table	Analog Mode	Normal Direction	2/4 Digit Add
X00	0	14	Off	Forward	2
X01	1	14	Off	Reverse	2
X02	2	28/128	Off	Forward	2
X03	3	28/128	Off	Reverse	2
X04	4	14	On	Forward	2
X05	5	14	On	Reverse	2
X06	6	28/128	On	Forward	2
X07	7	28/128	On	Reverse	2
X10	16	14 Speed Table	Off	Forward	2
X11	17	14 Speed Table	Off	Reverse	2
X12	18	28/128 Speed Table	Off	Forward	2
X13	19	28/128 Speed Table	Off	Reverse	2
X14	20	14 Speed Table	On	Forward	2
X15	21	14 Speed Table	On	Reverse	2
X16	22	28/128 Speed Table	On	Forward	2
X17	23	28/128 Speed Table	On	Reverse	2
X20	32	14	Off	Forward	4
X21	33	14	Off	Reverse	4
X22	34	28/128	Off	Forward	4
X23	35	28/128	Off	Reverse	4
X24	36	14	On	Foward	4
X25	37	14	On	Reverse	4
X26	38	28/128	On	Forward	4
X27	39	28/128	On	Reverse	4
X30	48	14 Speed Table	Off	Forward	4
X31	49	14 Speed Table	Off	Reverse	4
X32	50	28/128 Speed Table	Off	Forward	4
X33	51	28/128 Speed Table	Off	Reverse	4
X34	52	14 Speed Table	On	Forward	4
X35	53	14 Speed Table	On	Reverse	4
X36	54	28/128 Speed Table	On	Forward	4
X37	55	28/128 Speed Table	On	Reverse	4

Your locomotive can be programmed using a standard power pack. All advanced operations are easily programmed using your standard HO power pack. After entering programming (described below), the various features are selected and operated by using the direction switch. Where "X" is the current value of the Program Option. Defaults are shown in parenthesis along with the option name; defaults for volume levels are listed on the Diesel Model Specification sheet included with your locomotive.

Program Option #'s (POP's)	*Option Name (Default Value)*	*Message When Entering Option*	*Option Description*
1	**System Volume (16, Max)**	**"Volume equals X"**	**Sets System volume (17 level) where level 16 is max and level 0 is off.**
2	**Load (0, No Load)**	**"Load equals X"**	**Selects the starting and stopping inertia for both Regulated Throttle Control (RTC) and Standard Throttle Control (STC). Level 0 (no load), Level 1-15, increasing Load with acceleration to full speed from 15 seconds to 210 seconds in RTC and from 3 seconds to 45 seconds in STC.**
3	**Helper (Normal)**	**"Helper Equals" "Normal" "Lead" "Mid" "End" "Pusher"**	**Selects Normal, Lead, Mid, End, or Pusher Helper in consists. Normal Locomotive has all sounds and lights enabled. Lead locomotive has all sounds enabled and Reverse Light disabled. Mid Helper has Horn, Bell and all lights disabled11. End Helper has Horn, Bell and all lights disabled except Reverse Light. Pusher has Reverse Light on all the time as train warning light. Horn, Bell and all other lights are disabled.**
4	**Directional (Normal)**	**"Direction Equals X"**	**Selects if the features associated with the locomotive's direction are "Normal" or"Reversed".**
5-7	**Reserved**	**"Reserved"**	
8	**V-Start (8.5v)**	**"V-Start Equals X"**	**Sets track voltage at which locomotive will leave Neutral. (See Example below)**
9	**V-Max (12v)**	**"V-Max Equals X"**	**Sets track voltage at which full track power is applied to motor.**
10	**Throttle Mode (RTC)**	**"Mode Equals X"**	**Selects between Regulated Throttle Control (RTC) and Standard Throttle Control (STC)**
11	**Programming Reset**	**"Warning-about to reset"**	**Selects between Regulated Throttle Control (RTC) and Standard Throttle Control (STC).**
12	**About**	**"Model Number"**	**Each Quick or Slow Operation provides progressive information about Quantum Model Number, Software Version, and Software Release Date.**

Entering Programming

Use this simple sequence to enter Programming using the direction switch.

1. Apply power and turn up the throttle to hear the sound system come on.
2. Within five seconds of powering up, turn on the Bell with a Quick Flip-and-Back operation of the direction switch.
3. Within three seconds of the Bell turning on, turn off the bell with a second Quick Flip-and Back operation
4. Within three seconds, turn the Bell back on again with a third Quick flip-and-back operation.

NOTE: If you delay too long after power has been first applied, the opportunity to enter Programming will "time out," and you will need to start again by shutting off, and reapplying track power.

Once you perform the three bell operations after applying power, the bell will shut off automatically, you will hear "Enter Programming," and the headlight and reverse light will flash alternately off and on.

Scrolling through the Program Options

After entering Programming, you will hear an announcement of the first Program Option, "Option 1 - System Volume".

To access other Program Options, simply flip the direction switch to the opposite position and leave it there. Listen as each option number is announced in order.

When you hear the Option Number you want, flip the direction switch back and leave it there. After you stop at an option you will hear the option number and name announced. When you are scrolling through and stopping at Program Options, **you are not making any changes**. To make changes you must actually **enter** the Program Option.

Note: If you accidentally go to a higher option number other than the one you wanted, simply turn the power off, re-enter Programming and start again.

Once you reach the last Program Option, the decoder will continue to announce the last option number.

Entering a Program Option and Making Changes

After the verbal announcement of a Program Option, you can enter that option by performing a **Slow** or **Quick** Flip-and-Back operation of the direction switch. Upon entering a Program Option, you will hear the present setting for that option. For unused Program Options, you will hear "Reserved". For any volume option, you will hear "Volume equals X" (where "X" is its present volume setting). After a moment, you will hear the sound at its present volume.

Note: It is easy to distinguish between doing a **Quick** and **Slow** operation. When you flip the direction switch to do a **Slow** operation, wait until you hear a low level "hiss" sound from the locomotive; then immediately flip the direction switch back. To do a **Quick** operation, make sure you flip the direction switch back before you hear the "hiss" sound.

Note: Entering a Program Option does not change the settings for that option; it only provides information about its present value. After entering the Program Option, additional **Slow** or **Quick** flip-and-back operations will program new settings as described in the above table. For all level adjustments, a **Quick** operation will decrease one level, while a **Slow** operation will increase one level.

Note: Since "System Volume" is the first Program Option, you can use **Quick** or **Slow** operations immediately after entering Programming to change the System Volume.

Moving on to Other Program Options or Exiting Programming

Flip the direction switch at anytime to the opposite position, and leave it there. The Quantum System will first return to and announce the present Program Option, and then automatically advance on to higher options.Exit Programming anytime you want by turning the power off, and then back on again.

Example 1: Setting Throttle Mode (Program Option # 10)

Program Option #10 determines whether your locomotive uses Regulated Throttle Control (RTC) or Standard Throttle Control (STC).
Enter Programming after powering up your locomotive by turning the Bell on, then off and then on as described above.12 of 28 After the “Enter Programming” and “Option One - System Volume” announcement of the first Program Option, flip the direction switch and leave it there. You will hear “Option 1, 2, 3 … etc.” Stop when you hear “one-zero” by moving the direction switch back. You will hear “Throttle Mode”.Use a **Slow** or **Quick** flip of the direction switch to enter this option. If the throttle mode is at its default value (RTC), you will hear “Mode equals Regulated;” otherwise, you will hear “Mode equals Standard.”Use a **Slow** or **Quick** flip of the direction switch to change the Throttle Mode. Repeated **Slow** or **Quick** operations will cause the throttle mode to alternate between its two possible values “Regulated” or “Standard”.
Once you have selected the Throttle Mode you wish to use, turn the power off. When you power up again, your locomotive will be using the Throttle Mode that you have just selected.

Example 2: Setting V-Start (Program Option # 8)

This option determines the voltage (and throttle position) at which the locomotive will leave Neutral and begin moving.
Enter Programming after powering up your locomotive by turning the Bell on, then off and then on - as described above.
After the “Enter Programming” announcement followed by “Option One - System Volume” announcement for the first Program Option, flip the direction switch and leave it there. You will hear the announcement “Option 1, 2, 3 … etc.”. Stop when you hear the number “8” by flipping the direction switch back. You will hear “V-Start”.
Use a **Slow** or **Quick** flip of the direction switch to enter this option. You will hear “V-Start equals X” in which“X” is the track voltage value presently set for leaving Neutral.
Use a **Slow** or **Quick** flip of the direction switch to activate this option. Hear the message “Set throttle to V-Start.” After three seconds, the voltage will be announced. If you move the throttle, the new track voltage value is announced a few seconds later. Once throttle is set, use a **Slow** or **Quick** flip of the direction switch to begin the V-Start voltage setting procedure. The locomotive will move at a slow speed and the bell will ring continuously for about 25 seconds, indicating the correct value is being calculated. If you chose a very low voltage setting, be patient. If the locomotive does not move during this procedure, return to the beginning of this option or start over and choose a slightly higher throttle setting. At the end of the process, the locomotive will stop moving and the Horn will blow, signifying the end of the operation, and you will hear the message “V-Start = X” where “X” is the new setting.
To leave Programming, turn the throttle off, and then power up for normal locomotive operation. Or continue to the next option (V-Max) by moving the direction switch and waiting for the next Programming Option to be announced.

Example 3: Setting V-Max (Program Option # 9)

V-Max is set in the same manner as V-Start except upon entering this Program Option, you will hear “Set throttle to V-Max” which is the throttle position at which you want full track voltage to be applied to the motor (usually about 80% of full throttle). Then do a **Quick** or **Slow** operation to start the V-Max setting procedure. Like V-Start, the bell will ring continuously until the voltage is set followed by a horn blast to indicate the procedure has been accomplished. Setting V-Max is much faster than V-Start!

CV	Individual Sound	Range
52	Horn Volume	0-15
52.8	Bell Volume	0-15
52.1	Motor Volume	0-15
52.13	Turbine Whoosh Vol.*	0-15
52.14	Turbo Volume	0-15
52.15	Turbine Whine Vol.*	0-15
52.16	Air Pump Volume	0-15
52.19	Cooling Fan Volume	0-15
52.21	Long Air Let-Off Vol.	0-15
52.22	Short Air Let-Off Vol.	0-15
52.24	Brake Squeal Vol.	0-15
52.26	Generator Volume**	0-15
52.28	Dynamic Brake Vol.	0-15
52.34	Coupler Volume	0-15
52.37	Air Brakes Volume	0-15
52.4	Alternate Horn Vol.	0-15

3C: Individual Sound Volume

Thanks to it's 8 sound channels, the Quantum Revolution allows for a great amount of user control over individual sound volume. The CVs to change these individual volumes are listed in the chart below:

*= Turbine Models Only
**= Non-Turbo Charged Models Only

Changing individual Sound Volumes (CV52)

X’ refers to the value in column 1 of the table, the Primary Index number that will be entered into CV 49.

To change the volume of individual sounds listed in the table below do the following:

Set CV 49 to the Primary Index for the individual sound from the table below.

Enter Volume level in CV 52 as follows: “0” = No sound, “1 – 15” sets volume from the lowest level at “1” to the highest at “15”, with volume levels at 2db increments. Defaults are typically set to 11.

Primary Index entered into CV 49	Individual Sound
0	Horn
8	Bell
10	Diesel Motor
14	Turbo
16	Air Pump
19	Vents and Cooling Fans
21	Long Air Let-off
22	Short Air Let-off
24	Squealing Brakes/Flanges
28	Dynamic Brakes
34	Coupler Sounds
37	Air Brake Sounds

4: Revolutionary Operations:

We've covered all the particulars, now lets have some fun. Again, since this decoder is full featured in both DC and DCC we'll split this into two sections again. First the DCC:
With your locomotive on the track, call up the address on your DCC hand-held (which will be address 3 if you haven't already changed it). Upon entering the address you should hear the locomotive hiss briefly followed by the sound of the prime mover starting up. Depending on your system , you may need to issue a function command to start it up. From here when you toggle function 0 (or push the headlight button) the lights will come on.

Now, give the horn a toot and roll your throttle up. The loco will begin to accelerate according to any momentum programming you did earlier. As the locomotive accelerates listen to the notching, notice that just previous to the notch up you can hear the motor quiet down a bit before it ramps up through the notch. This will continue until you reach either top speed or (where applicable) the transition (essentially shifting gears) where you will hear another couple notches.

Now let's slow down and pull into the station or freight yard. As you slow you'll hear the brakes engage and start squealing, when you reach stop you'll hear the cylinders bleed off the last bit of pressure with a quick hiss.

With DC the process is essentially the same except in order to play the horn and the bell you'll need to throw the direction switch back and forth, not quite as much control but the fun is still there and more so than ever before).

There is another DC sound control option we haven't discussed yet. *Atlas* makes a product called the **Quantum Engineer,** which is a sound control device connects directly to the two track output wires. It provides a 28, button interface with i*ndividual controls for all the sounds within the decoder, as well as buttons to apply and release the brakes*. (If using the Quantum Engineer you should consult the manual for proper operation procedures). Like we said: the most advanced sound control on the planet!

4a: Functions and Features Explained

First we'll go through function by function and discuss the uses of each of the basic functions. Please keep in mind that the following applies exclusively to DCC users.

F1: Toggles Bell On or Off
F2: Toggles Horn On or Off (also toggles alternate horn after triggered using F11)
F3: Plays Coupler sounds. The first time you push the button the couplers will clank as they join together. The Second time you push the button you'll hear the pressure release and the pins bang apart.
F4: Toggles Cooling Fans On or Off
F5: Toggles Dynamic Brakes On or Off

F6: When in neutral it plays start-up sounds. When moving in forward or reverse triggers the Doppler effects causing the all locomotive sounds to “Doppler down”. This can be especially fun at the end of a grade crossing, or when used in conjunction with other sound effects.
F7: In neutral plays long air let off. When in forward Or reverse it plays the flange,brake, squeal sound. On Turbine decoders, in neutral double tap F7 to engage the Turbine sound.
F8: Mute.
F9: In neutral puts loco in standby/disconnect mode. When moving activates the Sound Of Power function, when sound of power is activated you'll hear the horn hoot once. As you throttle up the loco will sound as though it's under a very heavy load. Concisely, if you throttle down you'll hear the motor ramp down like it's coasting. Neither of these functions will effect speed until **F9** is pressed again when you will hear a double whistle hoot or horn blast indicating that Sound Of Power has been turned off.
F10: Status Report. In neutral the loco will read back the address and any mode that it may be in (e.g., standby/disconnect). When moving, **F10** acts as a speedometer giving a verbal read back of the scale miles per hour.
F11: Toggles between the primary and secondary horn. After pressing **F11** once **F2** will control the secondary horn normally.
F12: Toggles extra light function on or off.

The Quantum Revolution also allows for changes in the “mapping” of these functions. Maping is the ability to change which button on your handheld controls what function.

Sound of Power

When a diesel locomotive starts to pull a heavy load, the engineer opens the throttle causing the engine to rev up before the train even starts moving. In steam engines the chuff gets louder as the engineer opens the throttle. As a train reaches its set speed, the sound level drops. When the throttle is cut back, the sound level cuts back. A diesel engine should drop to an idle. These are all possible with the **Sound of Power** feature.Sound of Power works by comparing the speed set by the DCC command to the speed of the locomotive. The greater the difference between the two, the higher the volume. Keeping that in mind, it should be noted that putting a value in the momentum CVs, (CVs 3 and 4) will make the effect more pronounced.

Checking out the Sound of Power First increase the throttle on your DCC system. When the desired speed is reached push **F9** you will hear the horn blast once and the volume increase. As you adjust the throttle you'll notice the sound of the locomotive change dependent on the direction of throttle change. I.E. If you increase the throttle you'll hear the sound get louder like the locomotive is under a load, if you decrease the throttle you'll hear the locomotive quiet down and go to idle as if it's going down a hill and no longer struggling. When finished using this feature simply press **F9** again and you'll hear a double horn blast and the locomotive will go to whatever speed step the throttle is set to when Sound Of Power was disengaged.

Braking

You can get even more control over speed by braking with **F7**. As the engine is coasting, with speed **set to zero, F7** will act as a brake with the added sound of the brake squeal. When you press **F7** you will also hear an air release. The longer you press, the faster the braking. This feature requires values to be set in CV3 and CV4. If you don't have momentum in the locomotive when you drop the throttle to 0 and your loco will stop immediately negating the usefulness of the brake. Set CV3 and CV4 to some value. We like CV4 set to half of CV3's value. So for starters, try about 50 in CV3 and 25 in CV4. You can program this on the main or "Ops mode". This adds to the fun of switching. Be sure and try the braking feature you'll enjoy the challenge of running an engine more like the prototype.

The Doppler Effect

Sound waves move at the speed of sound. As a train approaches its speed vs the speed of its *sound* causes its sound wave to compress, which in turn, causes the *pitch* of its sound to seemingly increase. When the engine passes by, the opposite happens and its sound waves are stretched and the pitch of its sound drops. The greater the speed, the greater the shift in sound frequencies as the engine passes by.

Checking out the Doppler Feature

Model locomotives do not move fast enough to create such a shift in sound frequency. To achieve this the Doppler feature needs to be triggered as the locomotive passes. There are two ways to trigger the Doppler feature. First, with the whistle blowing for *longer than a second*, quickly release the whistle/horn key and then reapply. This quick drop out of the whistle signal will trigger a drop in the sound frequency, simulating the Doppler effect.

The second way is to use **F6** key. **F6** is used for startup when the engine is stopped, when the locomotive is moving **F6** is used to trigger the Doppler effect. The change in sound is impressive as the engine passes - sounds like the real thing! The faster the speed, the more pronounced is the effect.

Grade Crossing

Engineers use specific signals on the horn/whistle to communicate various actions (forward, reverse all stop etc.) one of the universally recognized signals is the grade crossing, used whenever a train is approaching an active roadway. Several other decoder manufacturers have included this signal in the past. But all were fairly limited in realism because they lacked a method for changes in signal timing. QSI has remedied this by including a provision in the Quantum Upgrade software that provides very fine control of the timing. (If you do not own a Quantum Programmer see your local dealer.)

Checking out the Grade Crossing Unlike other functions the grade crossing does not come set to a default function key. You'll have to change a couple CVs to use this fun effect. We recommend that you assign this to **F3** because the coupler clank sound is one most people can live without. In order to assign the grade crossing to **F3** set CV50 to a value of 0, CV49 to a value of 5 and then change CV53 to 154. Now, while moving, you should be able to simply press **F3** and hear the classic *long, long, short, long.* Horn/whistle signal. For a real treat, while the last long horn blast is playing hit **F6** and listen to the way the Doppler effect really ties the grade crossing together! Now, go to your programmer and "fine tune" this fine tune! Or, read the following and program it with your DCC system.

Disconnect/Standby/Shutdown

Locomotive Shut Down has three distinct user-controllable stages. Each stage is entered by double-pressing F9 key.

Stage One: Disconnect

To enter "Disconnect," double-press the F9 key in Neutral (neutral=speed step 0). You will hear a long air release. The motor drive will be disabled. The DCC throttle can be opened or closed without the locomotive moving As the throttle is opened or closed, you will hear the motor rev up and down in response to the throttle. Note that all Function Keys are active in Disconnect. To exit Disconnect, either double-press the F6 Start Up key as described in the Start Up section, or double-press the F9 key again to reach Standby, which is the second stage of the Shut Down mode.

> **Note:** In Disconnect, you can also turn the Dynamic Brakes on (see Dynamic Brakes below) to create Sound–of-Power as the throttle is opened and closed. Prototype engineers use dynamic brakes to load and test the motor generator's output efficiency while the locomotive remains stationary,.

Stage Two: Standby

To enter "Standby," double-press the F9 key while in Disconnect, and you will hear a long air release,-followed by a distinctive "low idle" sound. The directional lighting and optional ditch lights or mars light will also shut down.

Note: In Standby, the motor will remain disconnected, while the air pumps, automatic cooling fans, number board lights and cab lights will continue to operate. Also in Standby, the locomotive will not respond to throttle or function keys with the following exceptions: The F6 Start Up Key, the F8 Mute Key (described below) and the F10 Status Key (also described below).
To exit Standby, either double-press the F6 Start Up Key (as described in the Start Up section), or double-press the F9 key again to access Total Shut Down, the final stage of Shut Down.

Note: Standby is ideal for leaving your locomotive running on a siding. In addition to hearing the sound of the diesel at low idle, the locomotive will not respond to accidental changes in throttle settings or function keys.

Stage Three: Total Shut Down

Total Shut Down allows you to take the locomotive "off line" (turn off sounds and lights, ignore throttle settings and function commands) independent of the operating session. Note that the locomotive will still be "off-line" when power is next reapplied, regardless of whether the next session is analog (conventional DC), or DCC.

Double press the F9 in Standby to enter Total Shut Down. You will hear a Long Air Let-off. The Air Pumps will turn off, followed by the Number Boards (if so equipped) and the sounds of the Cooling Fans shutting off, the louvers closing, the Diesel Motor shutting down and finally, the Cab Lights (if so equipped) turning off. A few seconds later you will hear the engineer's door open and then shut.

Note: In Total Shut Down, the locomotive will not respond to the throttle – nor will it respond to function keys except for the F6 Start Up Key (described below) and the F10 Status Key (also described below). 17 of 28

To exit Total Shut Down, double-press the F6 key.

Note: If power is turned off at any stage of Shut Down (Disconnect, Standby or Total Shut Down) or during a Shut Down procedure, the locomotive will remember the last Shut Down stage it was at during power down, and the locomotive will power up in the same stage.

However, if Start Up is initiated during any of the above Shut Down procedures, the Shut Down is aborted, and the locomotive will return to normal operation.

Start Up

You can return your Quantum Revolution-equipped diesel locomotive to normal operation during any stage of Shut Down by double-pressing the F6 key. Start Up will be different for each stage of Shut Down, but enter normal each will start up with a long air release, and will operation.

Start Up from Disconnect: Double-press the F6 key in *Disconnect*, and the diesel locomotive will produce a long air release, the dynamic brakes will shut off and the locomotive will enter normal operation.

Start Up from Standby: Double-press the F6 key in Standby, and your diesel will produce a long air release, directional lighting will turn on, the diesel motor sound will change from special low Idle to regular Idle, and the locomotive will enter normal operation.

Start Up from Total Shut Down:

Double-press the F6 key in Total Shut Down, and the locomotive will produce a long air release, you will hear the cab door opening and closing, and if so equipped, you'll see the cab lights and number boards come on and the directional lighting turn on (if it was on previously). These actions are followed by the sounds of vents opening, the diesel motor starting up, the air pumps starting up and the locomotive's entering normal operation.

Note: During the Start Up procedure, no DCC function keys are active. However, in the event the throttle is advanced beyond zero during any of the above Start Up procedures, the Start Up procedure will abort and the locomotive will enter normal operation.

5: Fine Tuning Your Performance:

The Revolution offers many ways to fine-tune your locomotive for truly revolutionary motor response. This is accomplished through Regulated Throttle Control, Back EMF and what are referred to in the DCC industry as PIDs. The next section explains what each of these do and how to use them to *really* tune your locomotive for prototypical operation.

Smooth Starts using QSI Decoders.

Some locos tend to jump when they start moving. This can be lessened or eliminated by one of the following.

Make sure the loco is in Regulated Throttle Control (RTC)
Increase the value in CV2 Vstart. Increase this value by a value of 10 until the loco starts moving at speed step 1 or 2. If it moves too fast then back it off by 5 until the ideal setting is reached.
If CV2 doesn't fix the problem, increase the value in CV56.5 (RTC Min. BEMF).
If the problem still persists then try increasing the values in the PID Parameters, CV56.18.0 (PGain) and CV56.18.2 (DGain)
Any setting here will also work when the loco is running on DC as well.

5a: Back EMF (Back Electro-Motive Force) Explained:

One of the better ways to explain BEMF is to compare it to the way an electric motor functions. For example, if you apply power to a motor, the shaft turns. Conversely, if you turn the motor shaft, the motor will generate power, or in our case, produce a voltage. Similarly, when a decoder applies power to a motor, it begins to rotate. However, the decoder applies power in pulses. As a result, there is a time between pulses when no voltage is applied to the motor. During this time the decoder can "read" the voltage produced by the motor. If the motor slows, the BEMF voltage drops, if speed increases, the voltage also increases. This is how a BEMF decoder can determine the speed of the motor, sense any change in motor speed, and respond accordingly to provide realistic load-related variations in speed as trains ascend and descend grades, for example.

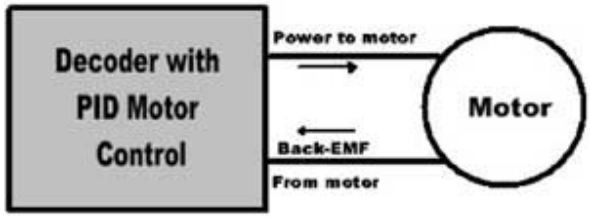
5b: Regulated Throttle Control (RTC) Explained:

Regulated Throttle Control (RTC) adds realistic momentum to your train operations. Although it has been available in *analog* from QSI, it has not been available in DCC until now. RTC uses Back EMF to simulate the massive inertial characteristics of prototype operations. An RTC-controlled locomotive will move through such "obstacles" as tight turnouts, raised track joints, etc., with little change in speed – and will easily maintain speeds of less than 1 scale mile per hour! However, if the locomotive encounters a long uphill grade, it will slowly reduce speed just as does the prototype. Similarly, when a downhill grade is encountered, it will slowly increase in speed like the prototype.
Unlike Speed Control, which is a feature used by many older decoders. RTC is a true, comprehensive throttle control system, and is controlled by the same CV's that control speed curves, including (CV2, CV3, CV4, CV5, CV23 and CV24, and all CVs related to the speed curve.

The best news: since RTC-controlled locos slowly adjust their speed based on load, locomotives in consists tend to share power equally. This makes advanced (and truly prototypical) consisting extremely easy since the locomotives can actually "talk" to each other. Put that helper in the middle of the train, or that pusher at the end – where they belong!

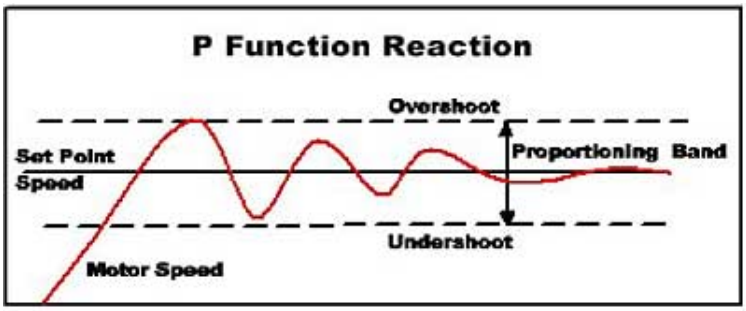
5c: PID (Proportional Integral Derivative) Control Explained:

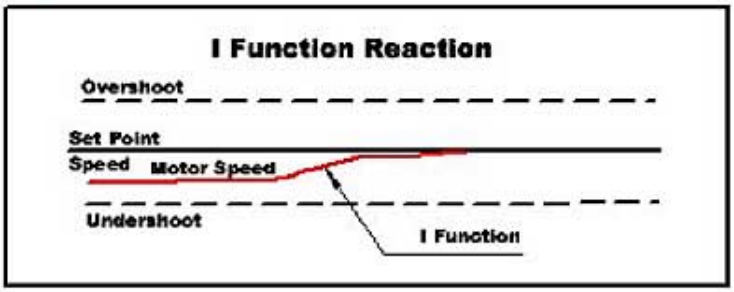
The PID control process is a little like a three ring circus. Each of its three components play a part in the control process. To oversimplify, think of PID as a black box with the output as the power to the motor and the input as the BACK-EMF from the motor.
We "tune" for smoothest operation by changing the CV values associated with PID parameters. But first, a little more tech-talk:

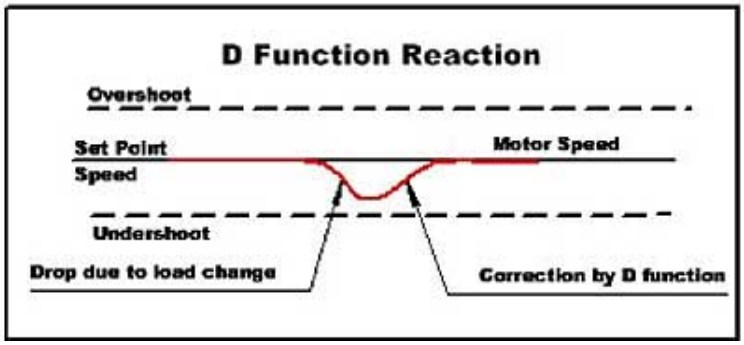


The PID control process To get a picture of how the PID process works, first consider that speed needs to be controlled. To do this, we send a speed-setting command to the decoder. This speed-setting command initiates the PID process and is called the "set

point." In response, our decoder sends power to the motor, which starts to turn. At the same time, the decoder reads the Back-EMF signal to determine how fast the motor is turning. Once the motor nears the speed of the set point, the PID process begins to function. The manner in which the individual PID components interact is briefly described below.







The Proportional component: The "P" part of the process stands for "Proportional," which in essence, establishes a "speed band" parameter around our set point. This "proportional band" tolerates some speeds above and below the speed entered as the set point. It is somewhat akin to the way a thermostat controls furnace temperature in a house. The furnace continues to produce heat until its "set point" (thermostat setting) is reached. After this, some heat production (called overshoot) continues even after the thermostat turns the furnace off. Most thermostats then wait until the temperature drops about 2 degrees below the set point (called undershoot) before the furnace is again turned on. Its "proportional band" is between the two levels. The proportional component in PID works in a similar manner.

Integral component: The "I" part of the process stands for "Integral" action, which controls the difference between the set point and the center of the proportional band. This may not be the same due to system imbalance. The Integral action senses and tries to correct the difference between the set point and the decoder's "center point."

The Derivative component: The "D" part of the process is "Derivative" action, which looks for any change in motor speed. When it senses a change, this function tries to correct it. Such a change could be triggered by a locomotive starting up a grade with a string of cars whose increased load has caused the motor to slow. The derivative component "sees" this change and applies a correction. Such a slow-down could also be caused by a bind in the mechanism or a tight spot in the track. Note that some decoders use only the **P** and **I** (PI) functions and not the **D**. The Revolution, on the other hand, is weighted toward utilization of the **P** and **D** components. Most of the decoders that use PID utilize a single set of values for the functions that are used over the total speed range. The Revolution, on the other hand, has four sets of PID values, between which it alternates depending on speed-step settings.

PID and locomotive control (QUANTUM PROGRAMMER REQUIRED)

Note that the only way we have of checking the effects of any PID modifications – for which the Quantum Programmer is required – is by observing the reaction of the locomotive following each adjustment. There is no "standard" for the values used in these CVs, nor is there a standard way to set the CVs. For the most part, determining their optimum values is a matter of trial and error. Fortunately, the Revolution comes with a fairly universal PID structure.

NOTE: We do not list the CV's required to change these parameters because they are absolutely locomotive-specific. If you are interested in changing these parameters you should purchase a Quantum Programmer and consult the included CV Manager software manual for more specific information.

Setting CV Values (Quantum Programmer Required)

For best results, use "service mode" within the CV Manager software to change these CVs. Doing so makes it much easier to immediately see your results. Note that if the value in any of the (motor control??) CVs is set too low, the locomotive will be "under-corrected." If set too high (over-corrected), your prime-mover may react jerkily to speed changes. To tune a CV, keep increasing its value until the locomotive's reaction becomes unstable or jerky. Then change the CV setting back to the value that was stable. A procedure like this is used to set the CVs used for motorcontrol and only motor control.

6: Customizing Sounds Using The Quantum Programmer:

One of the primary advantages of the Quantum Revolution is its ease of customization. Using the Quantum Programmer (sold separately) you can change the individual volumes and characteristics of all sounds with ease. We'll cover the two most important parts of it here.

6a: Changing The Software Set:

Using the Q2 Upgrade software, you can make any locomotive sound like any other locomotive. In fact you can easily put a RS-2 sound into a 4-8-4 Steam Locomotive! While ridiculous, this shows how flexible your new decoder is! This is also a big part of what makes this decoder truly revolutionary. Since you can infinitely upgrade the software, if down the road we come up with a new sound that you can't live without, all you need do is download it from the internet, and program it into your locomotive with the Quantum Programmer. Your locomotives need never again be out of date. As we said, we've tried to make obsolescence obsolete.

7: Special Operation and Troubleshooting

For most complete information, see the "Troubleshooting" sections (listings?) in the Quantum DCC Reference Manual (Ver. 4) and Quantum Analog Reference Manual (Ver. 4) at http://www.qsisolutions.com.

PART OF THE METHOD OF RESETING AND WORKING WITH THIS UNIT IN ANALOG MODE IS THROUGH A MAGNETIC REED SWITCH WHICH IS AN OPTIONAL PART. IF YOU FEEL YOU NEED THIS PART PLEASE NOTIFY YOUR DEALER.

DCC Program Track Operation

Your locomotive conforms to NMRA standards for program track operation. However, the Quantum System requires more current to operate than standard DCC decoders and may not respond to the limited program track power from some DCC command stations. If you are unable to program in Service Mode on your program track, all CV's in your Revolution-equipped locomotive can be programmed in Ops Mode. Note also that Tony's Train Exchange® offers a simple, inexpensive power booster (PowerPax™ by DCC Specialties) that will once again enable you to program on the program track with any DCC command station.

Manual Controls

There is an optional reed switch which is used to control sound volume or reset the locomotive to factory default values. If you desire this part please contact your dealer.

To adjust the volume by hand: (Analog and DCC)

Note: Volume can also be adjusted digitally using the programming methods described in the programming sections of this manual. However, if you turn the volume down using the Manual Volume Control, you will not be able to increase the volume using programming above the level set by the reed switch.

Using Magnetic Reed Switches:

Locate the reed switch on the decoder
Power up the locomotive and leave it in Neutral.
Place the enclosed Magnetic Wand over the reed switch on the decoder and wait as you hear the volume increase or decrease in incremental amounts as the Horn hoots about every second. Move the wand away and again place it over the reed switch to change the direction (louder or softer) of the volume. Remove the wand when you reach the desired volume level
Note: System Volume can also be adjusted digitally using the programming methods described in the Analog and DCC programming sections of this manual.

To Reset Your Locomotive to Factory Default Values (Analog and DCC)

In the event your locomotive's sound and control system misbehaves – and turning the power off and back on does not return it to normal operation – you can reset your locomotive to original factory values. This is done one of three ways. You can set the following CVs in the order as shown:
CV49=128,CV50=255,CV56=113
After entering the last value turn the power off and then on again and hear the word "Reset".
If you have a reed switch installed; locate the reed switch on the decoder, and turn off the power. Place the Magnetic Wand over the reed switch area, apply power and leave the wand in place until you hear the word "Reset". Your locomotive is now reset to original factory defaults If you don't have a reed switch installed; locate the Pink wire (marked Reed in our diagram on pg: 7) and the Black wire with a white stripe and simply touch the ends together as you apply power as per the instructions above. The loco should speak the word "Reset" when the process is complete.

High Voltage Circuit Breaker (Analog and DCC)

Your Revolution equipped locomotive is designed to operate on the normal HO track voltage supplied by most HO power packs. If track voltage gets too high, the motor drive circuit will automatically shut down and the locomotive will coast to a stop. The Quantum System will alert you to the problem through a continuous series of Horn blasts. This built-in safety feature protects Quantum Revolution electronics and the electric motor from excessive voltage.
To restart your locomotive, reduce the track voltage until the horn blasts stop and the motor re-engages.

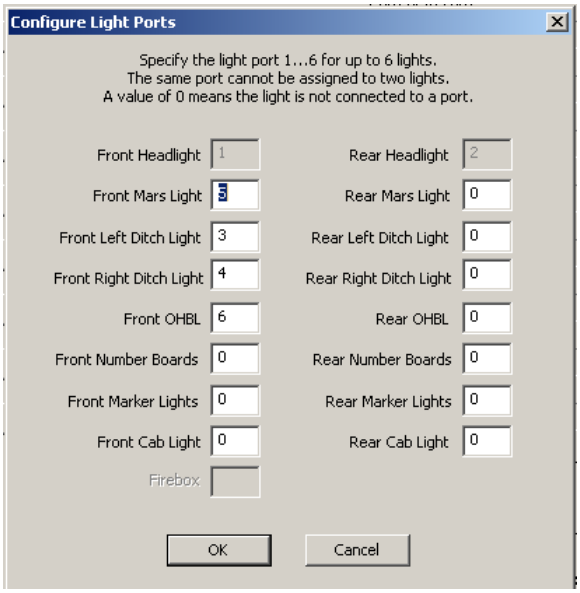
Note: Later Quantum-equipped locomotives use a different motor control design, which will operate at higher voltage.

Reasons why your locomotive is silent or will not start (Analog and DCC)

In the event your locomotive remains silent after power up, and turning the power off and back on does not return it to normal operation, try the following suggestions to bring your locomotive back to normal sound operation.
1. Make sure the locomotive has not been Muted with the DCC F8 key or Quantum Engineer Mute Key
2. Check to see if your Manual Volume Control or Programmed Digital Volume has been turned down.
3. You may have shut down your locomotive in DCC using the F9 key, or in Analog using the Quantum Engineer Shut Down key. Use the F6 key in DCC, or the Quantum Engineer Start Up key or Magnetic Wand in Analog, which both selects and starts the locomotive.
Important: The Magnetic Wand will not start your locomotive in DCC if it is in a "Shut Down" state (mode?). To start in DCC, you must first select the locomotive with its ID number and then use (double-press?) the F6 key. Note also that it will take a couple of seconds after you double press the F6 key before you will hear the pump sounds start.
Note: It makes no difference whether you start your locomotive in DCC or DC. Once started, you can return to either DC or DCC operation.
If the above methods do not start your locomotive, use the magnetic wand to reset your locomotive.

Options: Using 12v, (1.5v, 15ma. Lamps) and LEDS for the Quantum Revolution-U

The Quantum Revolution-U has the ability to have all 6 lighting outputs directly operate 1.5v, 15ma bulbs and LEDS with minimal resistance needed. Use the 5 V Common, the Red and White striped **+5** wire coming from connector **P2** (see page 7) in place of the blue **+V** coming from connector **P1.** You can also utilize a combination of the two, if your loco has 12v head and reverse lights use the **+V**. If you've added grain of wheat 1.5v bulbs for ditch lights use the **+5** wire and a 220 Ohm, 1/8 Watt resistor in line with the function side of the circuit.



Configuring Light Ports on Quantum Revolution-A

The Quantum Revolution-A sound decoder has 6 Light ports or outputs. These are numbered 1-6 and must be configured for the following features using Q2Upgrade and then downloading the configured firmware to the locomotive using the Quantum Programmer. Default Diesel settings (after 7-28-08) are shone below. Ports 1 and 2 are reserved for the Front and Rear Headlights. Ports 3 – 6 can be configured for any other feature. Note that each port can only have one feature assigned to it and can only be changed using Q2Upgrade and then downloading the configured firmware to the locomotive using the Quantum Programmer.

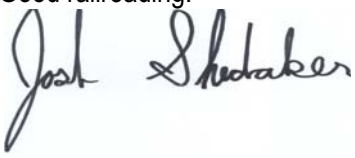
Example: CV 55.70.1

1) Set CV 49 to 70
2) Set CV 50 to 1
3) Set CV 55 to 6

This will make the Front Headlight Bright when the loco is moving Forward, Dim when it is moving Forward and stops, Off in Reverse, and OFF when it is going in reverse and comes to a stop.

If you have made it this far… congratulations? Most importantly, thank you for choosing the Quantum Revolution. To realize its full potential, we strongly recommend you consider the Quantum Programmer, and gain access to the ever-expanding sound and control possibilities the Revolution offers. And of course, for additional information and technical support, please feel free to contact us at any time.

Good railroading!



Josh Shedaker

Special thanks to Don Fiehmann, QSI and Budd Shedaker for their contributions and editting.

Quantum Revolution complete DCC Reference Manual:
http://qsisolutions.com/pdf/quantumdccrefmanual_4_3_0.pdf

Revolution-U: Common CV's to Specialize Lighting Output

Front Headlight (Port 1)

CV 55.70.0 Initial State

0 = OFF
1 = Automatic Control
2 = ON
3 = Dim

CV 55.70.1 Automatic Configuration

86 = Bright in FWD, Dim in NFF, DIM in REV, Dim in NFR

2 = Bright in FWD, OFF in NFF, OFF in REV, OFF in NFR

Rear Headlight (Port 2)

CV 55.73.0 Initial State

0 = OFF
1 = Automatic Control
2 = ON
3 = Dim

CV 55.73.1 Automatic Configuration

101 = Bright in REV, Dim in NFR, Dim, FWD, Dim in NFF

32 = Bright in REV, OFF in NFR, OFF in FWD, OFF in NFF

Front Ditch Lights (Port 3=Left) (Port 4=Right) Both work together.

CV 55.84.0 Initial State

1 = Automatic Control
2 = ON
3 = Dim

CV 55.84.1 Automatic FWD

0 = OFF
1 = Dim
2 = Bright
3 = Strobe
4 = OFF (Strobe with horn)
5 = Dim (Strobe with horn)
6 = Bright (Strobe with horn)

CV 55.84.2 Neutral From FWD

0 = OFF
1 = Dim
2 = Bright
3 = Strobe
4 = OFF (Strobe with horn)
5 = Dim (Strobe with horn)
6 = Bright (Strobe with horn)

CV 55.84.3 Automatic REV

0 = OFF
1 = Dim
2 = Bright
3 = Strobe
4 = OFF (Strobe with horn)
5 = Dim (Strobe with horn)
6 = Bright (Strobe with horn

CV 55.84.4 Neutral From REV

0 = OFF
1 = Dim
2 = Bright
3 = Strobe
4 = OFF (Strobe with horn)

CV 55.76.0 Initial State

1 = Automatic Control
2 = ON
3 = Dim

CV 55.76.1 Automatic FWD

0 = OFF
1 = Dim
2 = Bright
3 = Strobe

CV 55.76.2 Automatic Neutral From FWD

0 = OFF
1 = Dim
2 = Bright
3 = Strobe
5 = Dim (Strobe with horn)
6 = Bright (Strobe with horn)

Mars Light (Port 5)

CV 55.76.3 Automatic REV

0 = OFF
1 = Dim
2 = Bright
3 = Strobe

CV 55.76.4 Automatic Neutral From REV

0 = OFF
1 = Dim
2 = Bright
3 = Strobe

Overhead Beacon (Port 6) Works with F12 button

CV 55.92.0 Initial State

0 = OFF
2 = Blinking Light
18 = Rotating Beacon
34 = Strobe Light

Addendum Notes:

Kato's(10-15-08)
Kato locomotives require the new revision of download files from QSI with the revised PID parameters, 1050-0v7-25-3 that supports the new PID and allows changing the PID. Otherwise, they have mid-speed surging.

Proper Chuff Sounds for Articulated Locomotives.

Articulated locomotives fall into 2 general categories, Simple and Compound. You can tell which one you have by looking at the size of the steam cylinders on you loco.

Simple Articulated locomotives use high-pressure steam in both the front and rear cylinders. Both sets of cylinders will be the same size. These locos will have a separate exhaust sound (Chuff) for each set of cylinders. Many times this will be a double chuff or 8 chuffs per driver revolution that will go in and out of synchronization.

Compound Articulated locomotives or Mallets use high-pressure steam in the rear set of cylinders, which in turn exhaust into low-pressure front cylinders. The front cylinders on a compound articulated will be about twice the size of the rear cylinders. The front cylinders exhaust out the stack. Since only the front cylinders exhaust out the stack, Compound Articulated's sound more like a conventional steam locomotive with 4 chuffs per driver revolution.

Some modern Compound Articulated's were able to start heavy trains by using high-pressure steam in both sets of cylinders for short periods. This would result in a double chuff similar to a simple articulated. The difference being that because of the greater size of the low-pressure cylinders, the second set of chuffs could be far louder than the first. These locos would only run this way long enough to get the train moving then they would return to normal compound operation.

Both the QSI G Scale and the Revolution series decoders offer an articulated sound firmware set to duplicate the way these locomotives sounded. 4000 series for G Scale and 4050 for the revolution series.

These sound files have two different chuffs. Both with independent volume control so you can duplicate any of these articulated sounds. Try the following.

Simple articulated
Set CV52.10 (Chuff) and 52.11 (Chuff2) at the same value to get the prototypical double chuff.

Compound Articulated (normal operation)
Set CV52.10 (Chuff) to the level you want and set CV52.11 (Chuff2) to 0 so there is the prototypical 4 chuffs per rev.

Compound Articulated (Starting)
Set CV52.10 (Chuff) to the level you want and set CV52.11 (Chuff2) to a higher value so there is the prototypical 8 chuffs per rev with the second chuff considerably louder. After the train is moving reset CV 52.11 to 0 to get the normal sound of a compound articulated

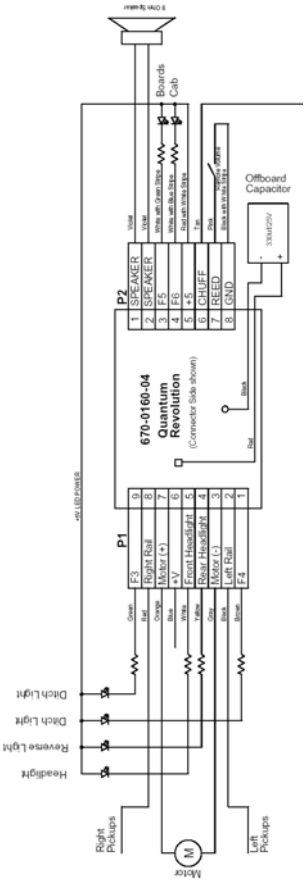
Software ID

Diesel ☐ Steam ☐ Other ☐

Quantum Revolution-U

Advanced DCC Sound and Power Decoder, Generic Format

- Advanced, Co-Processor Technology, 24 Bits, 8 Channels. Low Power design that allows mounting almost anywhere.
- Higher Audio output for crisp, clear, high fidelity sounds.
- Additional memory provides for more sounds and control
- Better Motor Performance under marginal power.
- Super, Smooth low/mid speed performance under RTC.
- Steam versions of the board also support a chuff CAM.
- Lighting: 6 light outputs, all with 256 intensity levels
- User Calibration of BEMF vs. Scale MPH for Scale MPH readouts.
- User Calibration of Chuff rate for low range speeds.
- User Configurable Brakes and Grade Crossing sounds.
- Magnetic Wand for volume control/reset or by programming.
- Doppler Effect by key control of horn/whistle function.
- Programmable Grade Crossing Effect!
- Sound of Power by Throttle Control and loading effects.
- Complete Sound file downloading Supports Cut & Paste or editing of sound records: Horn/Whistle, Alternate Horn/Whistle, Bell, Diesel Motor, Chuff, Dynamic Brakes, Fans, Steam Generator, Pump, Cooling Fan/Vents.
- Compatible with all DCC Systems.



The Magnetic Reed Switch is not installed on this unit.
Caution: Observe ESD Handling Practices!

Maximum Peak Voltage: 25v
Steady State Current: 1.3 Amp
Stall Current: (1 sec): 2+ Amps
Speaker Load: 8/16 ohm or 2, 8 ohm in Series
Audio Amplifier: Advanced D Style Format 2 Watts

Guaranty: This Decoder is Unconditionally Guaranteed for 2 yrs.

QSI Solutions c/o American Hobby Distributors, 57 River Road, Suite 1023, Essex Junction, VT 05452, Toll-free (800) 671-0641 Fax 802-878-5550, e-mail info@qsisolutions.com