Steam Locomotive
Operation Manual
for Quantum Sound™ Analog & DCC
Manual Version 4.1
For Quantum Software Version 7

This product not recommended for children under 14 years of age.

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Basic Analog Operation

We recommend that you get used to operating and having fun with your new sound-equipped locomotive before exploring its more advanced features or programming options. Read through this section and be up and running with your new Quantum equipped locomotive in less than five minutes.

Running the Locomotive

Use an HO power pack with a standard direction switch. Set the switch to run your locomotive forward.

Turn the throttle up slowly until you hear the Quantum

System™ come on. You will hear Start Up sounds and the steam Dynamo revving up as the headlight turns on.

Continue to turn up the throttle voltage until the locomotive starts to move in Forward. The Directional Lighting will turn on. The locomotive will start out slowly due to special Quantum Inertial Control™ that resists rapid increases or decreases in speed.

To stop the locomotive, bring the throttle down (but not so low that the sounds quit) and wait until locomotive slows to a standstill on its own.

Reversing the Locomotive

This simple operation is exactly the same as with standard locomotives.

Bring the locomotive to a stop and turn the power all the way off.

Flip the direction switch and reapply power to go in the opposite direction. Directional Lighting will change.

Whistle

Blow the authentic Steam locomotive Whistle for short or long blasts – you control the duration.

While the locomotive is **moving**, flip the direction switch to turn on the Whistle.

Flip the direction switch back to shut off the Whistle.

The locomotive will not change direction when you blow the Whistle.

Note: If you use a reversing-throttle that changes continuously from forward-to-off-to-reverse or if you flip the direction switch too slowly from one position to the other, you can momentarily lose track power as the switch is being moved through its center position.

Bell (available on all U.S. and other selected models)

You can turn on the Bell (if enabled) and leave it on while you operate other functions on the locomotive.

Turn the Bell **on** with a **Quick** flip-and-back operation of the direction switch.

Turn the Bell **off** with a second **Quick** flip-and-back operation of the direction switch.

Note: The Bell will stay on until you do another **Quick** flip-and-back operation of the direction switch to turn it off or if you interrupt the track power.

Note: If you do a **Slow** flip-and-back operation, you will get a short Whistle hoot instead of the Bell. If you try to do a very short Whistle blast using a **Quick** operation, you will activate the Bell instead.

Note: If you have trouble doing the Quick flip-and-back operation, try holding the power pack in place with your other hand to keep the unit from slipping.

Note: If your locomotive does not have a prototypical bell enabled, the feature will still be present. You will hear a single feedback ding when you turn the bell feature on and a double-ding when you turn the bell feature off.

Advanced Analog Features[1]

Starting the Locomotive

Unlike standard HO locomotives that start at very low track voltages, Quantum equipped locomotives require a minimum of about five volts to operate the electronics. Also, the response to the throttle is realistically much slower, just like a prototype locomotive.

Turn the throttle up slowly until you hear the Quantum

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System™ come on with a Long Air Let-off sound. Continue to turn up the throttle voltage until the locomotive just starts to move in Forward (this voltage is called V-Start[2]). Steam exhaust (Chuffing) and optional Cylinder Cocks will sound in sync with the motion of the drive wheels. Labored steam exhaust sounds are produced in proportion to the locomotive's acceleration and Load setting.

Locomotive Inertia Effects

Your new locomotive is pre-programmed at the factory to use Regulated Throttle Control (RTC) in Analog operation. A model locomotive under RTC operates as though it has the mass and inertia of a prototype locomotive. As a result, your locomotive will resist starting up too quickly if at rest and will resist changes in speed once moving. It takes a little practice to learn to move the throttle and wait until the locomotive responds. If you prefer that your locomotive respond almost immediately to the throttle, reprogram it to use Standard Throttle Control (STC), which has no Inertial Control (see Example 1 under Analog Programming, page 11).

As you slow the locomotive down by reducing the throttle to a little below V-start, the Steam Chuff labored sound volume decreases, while Squealing Brake sounds occur as the Steam locomotive comes to a slow stop[3].

If you leave your Steam locomotive in Neutral for at least 25 seconds and then slowly turn up the throttle, the locomotive plays Cylinder Cocks sounds as it starts moving. The Cylinder Cocks sounds automatically terminate after 16 repetitions or when the locomotive reaches a speed greater than 12 smph.

Advanced Whistle Operation

Doppler Effect

This sound effect changes the pitch and volume of the Whistle, Bell and other steam sounds as the locomotive passes by.

While the locomotive is moving toward the observer, flip the direction switch to turn on the Whistle.

Wait at least one second while the Whistle is blowing.

Just before the locomotive passes in front of the observer, flip the direction switch back and forth quickly so the Whistle does not shut off. You will hear the Doppler Effect as the locomotive passes by.

Either flip the direction switch back to shut off the Whistle, or continue with long or short Whistle operations. When you are finished blowing the Whistle, the locomotive sounds will automatically return to normal after a few seconds. If the Bell was on, it will shut off just before the sounds return to normal.

Note: The faster the locomotive is moving, the greater the Doppler shift. Below 15 smph (24 skph), there is no Doppler shift.

Playing the Whistle

Prototype engineers would often "play" their whistles by controlling the flow of compressed air. In particular, engineers often had a signature sound associated with how they ended their whistle sequences. Some Quantum System sound sets have special Whistle Endings that can be activated using the direction switch to produce a unique sound effect similar to that of a prototype engineer's "playing" the Whistle.

Flip the direction switch to blow the Whistle for at least one second.

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The normal way to end the Whistle is to flip the direction switch back. To do the special Whistle Ending, add an immediate **Quick** flip-and-back operation.

Note: If you wait too long to do the **Quick** Flip-and-Back operation, the Bell might turn on instead.

Automatic Features

Quantum features[4] are automatically controlled as a function of the directional state of the locomotive as described in the table below.

Feature	Forward	Neutral from Forw.	Reverse	Neutral from Rev.
Headlight	Bright	Dim	Dim	Dim
Rear Tender Light	Dim[5]	Dim	Bright	Dim
Mars Light	Strobing	Steady On	Steady On	Steady On
Number Board Lts.	On	On	On	On
Marker Lights	On	On	On	On
Cab Lights	Off after 10 seconds	On after 10 seconds	Off after 10 seconds	On after 10 seconds
Steam Blower	Off after 10 seconds	On after 10 seconds	Off after 10 seconds	On after 10 seconds
Cylinder Cocks[6]	If armed, plays for 16 times, or until speed greater than 12 smph	Arms after 25 seconds	If armed, plays for 16 times, or until speed greater than 12 smph	Arms after 25 seconds

Note: If your locomotive has a Mars Light, the Headlight will be off instead of "Dim" in all states except Forward where it will be Bright.

Neutral

In Neutral, the locomotive will continue to make prototypical sounds appropriate to its resting state.

Enter Neutral by **turning the throttle down below V-Start but not off and wait for the locomotive to stop**[7]. The Headlight will dim and optional Mars Light switches to steady-on. The Reverse Light will turn off when entering Neutral.

You will hear a Short Air Let-off when the locomotive stops moving and enters Neutral, a Long Air Let-off about three seconds later, followed by Air Pumps and other background sounds which come on after 5 to 10 seconds. After the Air Pumps start, you can use the direction switch to blow the whistle or turn on or off the Bell (if enabled).

Changing the Locomotive's Direction without Turning off the Sound

You can use the power pack's direction switch while the locomotive is in Neutral to change the locomotive's direction.

Put the locomotive in Neutral by bringing the throttle down below V-start and waiting for the locomotive to stop.

Flip the direction switch after you hear the Short Air Let-off but before you hear the Long Air Let-off followed by Air Pump sounds turning on. During this short time (3 seconds) the Whistle will not blow when you flip the direction switch.

Turn up the throttle anytime thereafter to operate the locomotive in the opposite direction.

If you have waited until the Air Pumps start in Neutral and now wish to change direction, you can either:

1. Reduce the throttle to off, change the direction switch and turn the throttle back up to repower the locomotive, Or:

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2. Leave the locomotive in Neutral, flip the direction switch (the Whistle will come on) and then turn up the throttle.

Note: When the locomotive starts to move in the opposite direction, the Whistle will stop automatically and then hoot one more time if the direction is Forward for a total of two hoots. Or if the direction is Reverse, the Whistle will hoot two more times for a total of three hoots[8]. To prevent the first Whistle hoot from being too long, do not delay in turning up the throttle after you have flipped the direction switch.

Train Load

You can set your Steam locomotive to have any of 16 different Load levels, which represent added inertia from rolling stock (see Analog Programming, Option 2 on page 11). The higher the Load setting, the greater the inertia effect during acceleration and deceleration. Level 0 is the default, which is no Load.

Sound-of-Power™

During acceleration, the steam locomotive will produce labored Chuffing (based on Load setting) until the locomotive has achieved its final speed where it will then produce standard sounds appropriate to its throttle setting. If starting up after an extended period in Neutral, you will first hear the sounds of Cylinder Cocks venting steam and water from the steam chest. Under deceleration, the Chuffing sounds are less labored until the locomotive achieves its final speed where it will again produce standard sounds appropriate to its throttle setting.

Helpers

Prototype Helpers are locomotives that are used to provide extra power and/or braking for a heavily loaded train. The Quantum System allows you to easily program how

each locomotive will behave by selecting between a Lead locomotive, Mid Helper, End Helper, or Pusher. Each type of Helper locomotive has different lights and sounds enabled or disabled, as described in the table under Option 3, in Analog Programming, page 11.

Normal and Reversed Direction

Quantum also allows you to reverse the directional sense of your locomotive. This is normally not an issue with DC two-rail trains since all locomotives will go in the same direction whether they are facing forwards or backwards. However, certain features like Directional Lighting do depend on the directional sense. When making up a train with different Helper types, it is recommended that you also change the directional sense of any Helper that is intended to be operated backwards within the consist. See "Option 4 Direction", Analog Programming, page 11.

Additional Analog Operation Features Available with the Quantum Engineer™ Controller

Your Quantum diesel locomotive is equipped with QARC™ (Quantum Analog Remote Control) Technology. QARC Technology uses special remote control signals to operate various Quantum System features without the need for complicated and expensive digital systems. With QARC technology, you can operate features that are otherwise available only in Digital Command Control (DCC), plus some new features that are not yet available in DCC. QARC will allow you to: 1) turn on or off individual lights, 2) shut down and start up locomotives, 3) make up consists easily, 4) simplify Analog programming, 5) set System Volume or Mute while train is operating, 6) trigger Coupler Crash sounds, 7) operate prototype-like Air Brakes, 8) turn on Dynamic

Brakes, 9) activate Status or Speed Reports, 10) arm steam Cylinder Cocks, and operate many other features. The QARC System makes Analog operation more fun and more prototypical than DCC by eliminating the need to configure function keys. Every button on the QARC controller does exactly what it is labeled to do. The only major difference between QARC and DCC is that, with QARC, you are not able to independently operate multiple trains on the same powered track section at different speeds at the same time.

The QARC controller, called Quantum Engineer, can be added to your existing Analog DC power pack in less than five minutes. Wiring is simple: two wires go the variable DC output from the power pack and two wires go to the track. All features on the power pack remain the same including throttle and reverse switch control. See our web site at http://www.broadway-limited.com for further information.

Analog Programming

The Steam 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[9].

Program Option #'s (POP's[10])	Option Name (Default Value)	Message when Entering Option	Option Description
1	System Volume[11] (16, Max)	"Volume equals X"	Sets System volume (17 levels) where level 16 is maximum volume 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[12]. Mid Helper has Whistle, Bell and all lights disabled. End Helper has Whistle, Bell and all lights disabled except Reverse Light. Pusher has Reverse Light on all the time as train warning light. Whistle, Bell and all other lights are disabled.

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4	Direction (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"	After next **Quick** or **Slow** Operation, Bell rings followed by "Reset" to indicate the locomotive has returned to factory default condition.
12	About	Model number	Each **Quick** or **Slow** Operation provides progressive information about Quantum Model Number, Software Version, and Software Release Date.
13-49			Additional Programming Options are used to set volumes for the different sounds such as Whistle, Bell, etc. See the Analog Reference Manual, 4.0.

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 Steam Model Specification Sheet included with your locomotive.

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[13] with a **Quick** flip-and-back operation.
>
> 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.

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 and 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

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start again[14]. Once you reach the last Program Option, it 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[15]. Upon entering a Program Option, you will hear the current 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 current volume level setting). After a moment, you will hear the sound playing at its current volume[16].

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 and 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 current 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 Leaving 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 current 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)

This will determine 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. After the "Enter Programming" followed by "Option One - System Volume" announcement of 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 "one-zero" by moving the direction switch back. You will hear "Throttle Mode".

Use a **Slow** or **Quick** operation 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** operation 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 throttle 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 will determine the voltage (and throttle position) at which the locomotive will leave Neutral and start moving.

Enter Programming after powering up your locomotive by

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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 moving the direction switch back. You will hear "V-Start".
Use a **Slow** or **Quick** operation of the direction switch to enter this option. You will hear "V-Start equals X" where "X" is the track voltage value currently set for leaving Neutral.
Use a **Slow** or **Quick** operation 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** operation of the direction switch to start the V-Start voltage setting procedure. The locomotive will move at a slow speed and the Bell will ring continually 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[17] and then choose a slightly higher throttle setting.
At the end of the process, the locomotive will stop moving and the whistle will hoot, 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 V-Max by moving the direction switch and waiting for the next Programming Option to be announced.

<u>Example 3: Setting V-Max (Program Option # 9)</u>

V-Max is set in the same manner as V-Start except after entering this Program Option, you will hear "Set throttle to V-Max" which is the throttle position where you want the full track voltage to be applied to the motor (usually about 80% of full throttle)[18]. Then do a **Quick** or **Slow** operation to start the V-Max setting procedure. Like V-Start, the bell will ring continually until the voltage is set followed by a whistle hoot to indicate the procedure is finished. Setting V-Max is much quicker than V-Start.
Note: During the V-Max setting, the locomotive will not move as it does under V-Start.

For more information, download the Quantum Analog Reference Manual (Ver 4) from http://www.broadway-limited.com

DCC Operation

These steps will allow you to start operating your Quantum equipped steam locomotive immediately using any DCC system that is compatible with the applicable NMRA DCC specifications.

1. Select locomotive number 3.
2. Set your DCC controller to 128 (preferable) or 28 (acceptable) speed step range.
3. Start your locomotive immediately by pressing the F6 DCC function key[19] to hear the locomotive Start Up sounds. The Directional Lighting System (Front Headlight, Rear Tender Light, optional Mars Light[20]) will be on.
4. Increase the throttle to leave Neutral. Steam Exhaust

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(Chuffing) and optional Cylinder Cocks will sound in sync with the motion of the drive wheels. Labored Steam Exhaust sounds are produced in proportion to the locomotive's acceleration and Load setting.

5. When you reduce the throttle to zero, you will hear a Short Air Let-off when the locomotive stops moving indicating that it has entered Neutral; a Long Air Let-off will occur about one second later, followed by Air Pumps and other background sounds[21].

The direction of your locomotive will change when you press the direction key on your DCC throttle.

Locomotive Inertia Effects

Your new locomotive is pre-programmed at the factory to use Regulated Throttle Control (RTC) in DCC operation. A model locomotive under RTC operates as though it has the mass and inertia of a prototype locomotive. As a result, your locomotive will resist starting up too quickly if at rest and will resist changes in speed once moving. It takes a little practice to learn to move the throttle slowly and wait until the locomotive responds. If you prefer that your locomotive respond almost immediately to the throttle, it may be reprogrammed to use Standard Throttle Control (STC) in CV 56.4.

Function Keys

The following table lists features that have been pre-assigned to your DCC function keys. Operation of these keys can be different in the Neutral state (locomotive stopped) and the Motive states (locomotive moving in Forward or Reverse). After you have selected your locomotive, simply press any of the function keys listed below to produce the described effects.

Function Key*	Forward and Reverse	Neutral
F0 or FL or Headlight	Directional Head, Reverse, Mars on/off	Directional Head, Reverse, Mars on/off
F1	Bell on/off (if assigned[22])	Bell on/off (if assigned)
F2	Whistle or Whistle with Doppler Effect (see below)	Whistle
F3	Coupler Crash/Coupler Fire	Coupler Arm or Coupler Fire
F4	Automatic Blower Hiss on/off	Automatic Blower Hiss on/off
F5	Dynamic Brake function on/off	Dynamic Brake function on/off (in "Disconnect" only)
F6	Initiate Doppler Effect	Start Up
F7	Squealing Brake/Flanges and Air Brakes	Cylinder Cocks Arm
F8	Audio Mute on/off	Audio Mute on/off
F9	Very Heavy Load on/off	Disconnect/Standby/Shut Down
F10	Locomotive's Speed Report	Status Report
F11	Alternate Whistle selection/number board or marker lights on/off	Alternate Whistle selection/number board or marker lights on/off
F12	Cab Lights on/off	Cab Lights on/off

* Quantum supports the new NMRA 0-12 function key standard; the old 0-8 standard is not supported.

If you have a DCC command station that supports only the older 0 to 8 function key standard, you will have no way to initiate Shut Down in Neutral with these pre-assigned feature-to-function key mappings. There is an interim solution to this

problem; Swap the features assigned to the F7 and F9 outputs in Neutral by doing the following:

    1. Set CV49 to 9, set CV50 to 1, and set CV53 to 145. Now F7 in Neutral controls Shut Down.

    2. Set CV49 to 11, set CV50 to 1, and set CV53 to 9. Now F9 in Neutral controls Long Air Let-off.

Automatic Features

Automatic Quantum Features depend on the directional state of the locomotive. Automatic Control can be enabled or disabled by their indicated function keys. The state of each Automatic feature in each direction is shown in the table below.

Feature[23]	Function Key	Forward	Neutral from Forward	Reverse	Neutral from Reverse
Headlight	F0 or FL	Bright	Dim[24]	Dim	Dim
Rear Tender Light	F0 or FL	Dim[25]	Dim	Bright	Dim
Mars Light	F0 or FL	Strobing	Steady On	Steady On	Steady On
Number Board Lts.	F0 or FL	On	On	On	On
Marker Lights	F11	On	On	On	On
Cab Lights	F12	Off after 15 seconds	On after 10 seconds	Off after 15 seconds	On after 10 seconds
Blowers	F4	Off after 10 seconds	On after 10 seconds	Off after 10 seconds	On after 10 seconds

Cylinder Cocks[26]	F7	If armed, plays Cocks for 16 times or until speed exceeds 12 smph	Cylinder Cocks armed after 25 seconds	If armed, plays Cocks for 16 times or until speed exceeds 12 smph	Cylinder Cocks armed after 25 seconds

When an indicated function key enables an "automatic" feature, it operates according to the states shown in the table. For instance, enabling the Automatic Mars Light in Neutral will not cause the Mars Light to strobe since their automatic behavior would have them at a steady-on setting in that directional state; however, it you then entered Forward, the Mars Light would begin to strobe. When an indicated function key disables an "automatic" feature, that feature is off. For instance, disabling "Automatic Mars Light" will immediately shut off the Mars Light in any direction and they will not turn on again until the automatic feature is enabled.

Note: Use CV 55 to change the behavior of lights from what is described in the above table.

Note: Lights and other features can be assigned to function keys and configured to different kinds of operation and initial conditions in CV 53 (Output Feature Assignment) and CV 55 (QSI Feature Configuration). See the Quantum DCC Reference manual, version 4.

Note: Cylinder Cocks can also be armed in Neutral with either the F7 key or the F6 Start-up key without having to wait for the 25 second time-out period.

Coupler and Coupler Crash Sounds (F3)

There are two ways to use the F3 key.

As your locomotive is about to couple up to a string of cars, press the F3 key to trigger the crashing sound of locomotive coupling.

Use the F3 key again as the locomotive moves out to trigger the same sound as the slack is taken up in the cars.

Use the F3 key in Neutral to produce uncoupling sounds as you disconnect cars over uncoupler magnets. Press the F3 key once to produce the sound of the lift bar and coupling pin being raised. This first press also arms the uncoupling sound effect. Press the F3 key again while moving or in Neutral to trigger the sound of the coupler knuckle opening and air-lines parting.

Sound-of-Power™

If CV 3, or CV 23 and CV 4, or CV 24 has been set to non-zero positive values, your steam locomotive will produce additional labored Chuffing sounds under acceleration and lighter Chuffing sounds under deceleration. The level of labored sounds is proportional to the values for these four CV's, and how much the throttle is increased or decreased.

Note: When starting out after an extended period in Neutral (over 25 seconds), the Cylinder Cocks will vent 16 times or until speed exceeds 12 smph.

Whistle and Bell Buttons (F2, F1)

Some DCC controllers have separate whistle and bell buttons along with function keys assigned to whistle and bell operation. The bell is usually assigned to F1 and the whistle is usually assigned to F2. The F2 key behaves differently than using the whistle button.

Pressing the F2 key and releasing it will cause the whistle command to come on and stay on, until you press F2 again. Pressing the whistle button will send the whistle command only as long as you hold the button down.

Pressing the F1 key and releasing it will cause the Bell to come

on and stay on, until you press F1 again. There is no difference in operation between the bell button and its corresponding function key.

Doppler Operation (F6)

With DCC, you can trigger the Doppler Effect by quickly interrupting the whistle signal in the same way as described under Analog Operation. Or, you can use the function key (F6) assigned to the Doppler Effect.

Start the Whistle and/or Bell by pressing and releasing their function keys.
Press F6 to hear the Doppler shift. A few seconds after the whistle button is turned off with the F2 key the steam locomotive sounds return to normal.

Note: If you do not turn on either Whistle or Bell, the Doppler shift will still occur but will be less dramatic.
Note: If the Bell was on, it will shut off prior to sounds returning to normal.

Squealing Brake and Flange Sounds (F7)

Quantum provides automatic Squealing Brakes as a locomotive slows to a stop. The operator can also control squealing sounds for continuous and variable brake sounds for protracted stops or to simulate the sounds of squealing wheel flanges on curved track.

To enable Automatic Squealing Brakes operate the locomotive over 40 smph (64 skph). Squealing brakes sounds will then sound automatically when the speed is reduced to less than 20 smph (32 skph).
Pressing the F7 key when the locomotive is moving at any speed will manually activate Squealing Brake sounds, and repeated pressings while the Squealing Brake sounds are

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occurring will continue the sounds uninterrupted.

Note: If you slow the locomotive too quickly, the brake sounds will terminate abruptly when the locomotive stops and enters Neutral.
Note: If you lower your throttle to speed step 0 on a moving locomotive, the F7 key will apply Air Brakes to slow the locomotive. See next section.

Air Brakes (F7)

If you have selected any non-zero deceleration inertia or momentum value in CV 4 and/or CV 24, the F7 key can be used to apply Air Brakes to stop the locomotive more quickly than it would normally stop from the inertia settings[27]. To use Air Brakes:

Turn the throttle down to speed step 0 on a moving locomotive; this enables the F7 key to act as a brake.
Press the F7 key. Hear a brief brake squeal sound and air being released from the brake lines continually. The longer the air is released the greater the braking action.
Press the F7 key again to stop the air release. The train will continue to slow at the last braking value.

> **Note:** F7 will apply brakes when set to 1 and stop the air release when set to 0. Depending on the initial setting for F7 when you turn your throttle down to speed step zero, you may need to press the F7 key twice to first apply brakes.

If you want to apply more braking, press the F7 key again to release more air. When you reach the desired amount of braking, press F7 again to stop the air release.
Turn up the throttle to any value above 0 to release the brakes; this action resets the locomotive's deceleration to a value determined by the sum of CV 4 and CV 24.
If the locomotive is in Neutral when the F7 key is pressed,

the Cylinder Cocks will arm[28].

Note: If the throttle is set to any speed step except 0, Air Brakes are not enabled; instead the F7 key will now manually activate Squealing Brake/Flange sounds but will not affect the locomotive's deceleration.

Note: If the direction state is changed while moving, F7 is enabled to act as a brake without the need to reduce the throttle to speed step 0. After stopping and changing direction, the locomotive will accelerate back to its original speed.

Three Stages of Diesel Locomotive Shut Down:

1. Disconnect, 2. Standby, 3. Total Shut Down (F9)

Locomotive Shut Down has three distinct stages that you can control. Each stage is entered by double pressing the F9 key[29].

Stage One: Disconnect

Double press the F9 key in Neutral to enter Disconnect. The motor drive will be disabled. Once you hear the Long Air Let-off afer entering Disconnect, which represents the locomotive's reverse lever being placed in the neutral position, the throttle can be moved up and down without the steam locomotive moving. Instead, you will hear the sound of steam gradually being vented through the throttle. All Function Keys are active in Disconnect.

To leave 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, the next stage of Shut Down.

Note: There is no effect on the throttle Sound-of-Power from Dynamic Brakes being on in Disconnect as there is in diesel locomotives.

Stage Two: Standby

Double press the F9 key while in Disconnect to enter Standby. You will hear a Long Air Let-off followed by a special "Idle"

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state where Directional Lighting and optional Ditch Lights or Mars Light will shut down.

Note: The motor will remain disconnected, while the Blowers shut down; Automatic Number Board Lights and Cab Lights will continue to operate. In Standby, the locomotive will not respond to throttle or function keys[30]. The three exceptions are the F6 Start Up Key, the F8 Mute Key (described below) and the F10 Status Key (described below).

To leave Standby, either double press the F6 Start Up Key, as described in the Start Up section, or double press the F9 key again to reach the final stage of Shut Down: Total Shut Down.

Note: Standby is ideal for leaving your locomotive running on a siding. Besides hearing occasional Air Pump sounds, the locomotive will not respond to accidentally changing the throttle setting or pressing the function keys.

Stage Three: Total Shut Down
Total Shut Down allows the operator to take the locomotive "off line" (turn off sounds, lights, ignore throttle settings and function commands) independent of the operating session: the locomotive will still be "off line" when power is reapplied for the next operating session, 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 later by the sounds of Pop-Off operating for about ten seconds followed by hiss that gradually trails off to silence. The Number Boards (if so equipped) will turn off and finally, the Cab Lights (if so equipped) will turn off.

Note: In Total Shut Down, the locomotive will not respond to throttle or function keys. The two exceptions are the F6 Start Up Key (described below) and the F10 Status Key (described below).

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

Dynamic Brakes (F5)

Prototype steam locomotives do not have dynamic brakes. However, the Dynamic Brake function has been included to make the Quantum steam locomotive consistent with other Quantum equipped locomotives in consists.

Pressing the F5 key in Forward or Reverse will reduce steam exhaust Sound-of-Power to the lowest setting allowing the steam labored sounds to be consistent[31] with other locomotives that do have Dynamic Brake sounds in multiple unit consists.

Pressing the F5 key in Neutral in "Disconnect" will have no Dynamic Brake effect.

Dynamic Brakes automatically turn off when entering or leaving Neutral, when locomotive speed drops below 7 smph (11 skph)[32], or when the throttle is turned up. Dynamic Brakes cannot be turned on in Forward or Reverse unless the locomotive speed is over 8 smph (13 skph).

Note: In contrast to Air Brakes (F7), Dynamic Brakes do not increase the deceleration rate specified by CV 4 and CV 24.

Start Up (F6)

If your Quantum equipped steam locomotive is in any stage of Shut Down, you can return it to normal operation by double

pressing[33] the F6 key. Start Up will be different for each stage of Shut Down, but all will start up with a Long Air Let-off and will enter normal operation.

Start Up from Disconnect: If you double press the F6 key in Disconnect, the steam locomotive will produce a Long Air Let-off, and the locomotive will enter normal operation.

Start Up from Standby: If you double press the F6 key in Standby, the steam locomotive will produce a Long Air Let-off, Directional Lighting will turn on, and the locomotive will enter normal operation.

Start Up from Total Shut Down: If you double press the F6 key in Total Shut Down, the steam locomotive will produce a Long Air Let-off, the Dynamo revs up and the Directional Lighting turns on, Cab Lights come on (if so equipped), Number Boards come on (if so equipped), followed by Air Pumps starting up, the steam Blower turning on and the locomotive entering normal operation.

Note: During the Start Up procedure, none of the DCC function keys are active. However, if the throttle is turned up from zero during any of the above Start Up procedures, the Start Up procedure will abort and the locomotive will enter normal operation.

Mute (F8)

The Quantum System allows you to reduce the System Volume to a lower level or increase it back to its original setting using the F8 function key. This capability is useful when you need to reduce the sound to engage in a conversation or to answer the phone. If you have many trains operating at once, you can reduce the volume on all those that are running in the background of the layout and increase the volume of the closest locomotive. The Mute feature changes the sound gradually over a second or two, which allows the sound to increase or decrease realistically as the locomotive approaches or recedes from the observer.

Press the F8 key in Neutral or Forward/Reverse to gradually decrease or increase the locomotive's volume.

Note: Mute state is not maintained if power is turned off and then turned back on; the locomotive will return to full system volume setting.
Note: Mute Volume can be programmed in CV 51.1.

Heavy Load (F9)

Heavy Load is applied while the train is moving; it maintains the train at a steady speed while allowing you to have control over the sound effects of a working locomotive. Under Heavy Load, changing the throttle will have little affect on the locomotive's speed. Instead you use the throttle to control a steam locomotive's laboring Sound-of-Power effects. When you approach a grade under Heavy Load, increase the throttle and hear the locomotive work hard with heavy laboring sounds. When the locomotive goes down a grade, reduce the throttle to diminish the locomotive's laboring sounds. You control how hard the locomotive works by how much the throttle is increased or decreased from its initial position (where Heavy Load was turned on).

Press F9 and hear one short hoot when Heavy Load is turned on
Press F9 and hear two short hoots when Heavy Load is turned off.

You can apply Heavy Load as soon as you start moving or wait until you are up to speed.

Note: Return the throttle to its initial setting (where Heavy Load was turned on) to avoid acceleration or deceleration when Heavy Load is turned off.
Note: Heavy Load can only be turned on or off in Forward or Reverse. If turned on, it will remain on in Neutral. If you want it off when you start out from Neutral, immediately do so when the throttle is turned up.
Note: Heavy Load is automatically turned off when track power is

turned off.

Note: Heavy Load represents a train that would take over ten minutes to accelerate to full speed or to bring to a complete stop. It is independent of any inertia (or momentum) values set in CV3, 4, 23, or 24. .

Note: Under RTC and Heavy Load, grades, voltage changes, tight curves or other real loading effects, will have little effect on the speed of the train. Under STC and Heavy Load, grades, loading, etc. will affect the train speed as it moves around the layout.

Status (F10)

The Quantum System provides verbal information about the locomotive's current operating state when the locomotive is in Neutral or the locomotive's current speed in scale miles per hour when the locomotive is moving.

Press the F10 key in Neutral; the locomotive will verbally report its currently enabled long or short DCC address followed by its consist ID (if it has one), followed by its Shut Down state, if any (Disconnect, Standby or Shut Down). Press the F10 key when moving; the locomotive will verbally report the locomotive's speed in scale miles per hour (smph) or in scale kilometers per hour (skph)[34].

Note: When Status Report (or Verbal Speedometer Readout) is activated, the locomotive's sounds will reduce to one half their current volume settings during the verbal report. Locomotive sounds return to normal volume when the report has ended.

Note: In a consist, all locomotives will simultaneously report their status when the F10 key is pressed unless disabled in CV 22.

Note: Status in Forward and Reverse can be configured to also report the Back EMF value and/or motor Pulse Width Modulation (PWM) value. See CV 55, QSI Feature Configuration in the Quantum DCC Reference Manual, version 4.

Horn (F11)

Some prototype steam locomotives had both a steam whistle and an air horn. The whistles worked best in areas where it was necessary for the sound to carry a long way, while the horn was more useful in the city or foggy areas where it was easier to tell the location of the locomotive by its higher pitched sound.
Note: The feedback hoots can be disabled/enabled in CV 51.2

Function Key Operation in Neutral

Some function keys used in Forward and Reverse will have different effects when used in Neutral:

> The F7 key produces Squealing Brake Sounds or applies brakes for a moving locomotive but produces a Long Air Let-off in Neutral.
> Pressing F6 results in Doppler shift for a moving locomotive but activates Start Up in Neutral.
> Pressing F9 turns on/off the Heavy Load feature in a moving locomotive but activates Shut Down in Neutral.

Note: The Whistle, Bell, Doppler Shift, Squealing Brake and Neutral sounds are described in detail on page 37, in the Quantum System Sounds section of this manual.

DCC Programming

Most DCC command stations currently available will program Quantum equipped locomotives in Service Mode[35] on a programming track or Operations (Ops) Mode on the main track. In Service Mode, your locomotive (if queried) will report back CV values to your command station. In Ops Mode, reports are verbal

using the locomotive sound system.

Changing the System Volume Electronically in CV 51.0

You can change the volume either manually (as described in the Special Operation and Troubleshooting section) or electronically using QSI CV 51.0 in DCC. To change volume in Service or Ops Mode, do the following:

> Set CV 49 to 0.[36]
> Enter the System Volume in CV 51. The System Volume can be set to any value between 0 (no sound) and 127 (100%). The default System Volume is 127.

Note: When you change the System Volume in Ops Mode, you will immediately notice the change in volume.
Note: System Volume changes in DCC also apply to Analog and vice-versa.

Changing the Mute Volume Electronically in CV 51.1

To change the Mute Volume in Service or Ops Mode, do the following:

> Set CV 49 to 1.
> Enter the Mute Volume in CV 51. The Mute Volume can be set to any value between 0 (no sound) and 127(100%). The default Mute Volume is 0.

Note: When you change the Mute Volume in Ops Mode, and the locomotive is muted, you will immediately notice the change in Volume.
Note: The effective Mute Volume level will be the smaller of the Mute Volume setting or one-half the current System Volume. In other words, the effective Mute Volume will never be more than one half of the System Volume.

Enable/Disable Whistle Triggered Doppler Shift (CV 51.2)

Set CV 49 to 2.
Set CV 51, bit 0 to 0 to disable Whistle Triggered Doppler; set to 1

to enable Whistle Triggered Doppler.

Changing Individual Sound Volumes (CV 52.X [37])

To change the volume of individual sounds listed in the table below do the following[38].

> 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 11 except for Blower Hiss, which is typically set at 8.

Primary Index entered into CV 49	Individual Sound
0	Whistle
8	Bell
10	Chuff 1 (steam exhaust)
11	Chuff 2[39]
15	Cylinder Cocks
16	Pump 1[40]
17	Pump 2
19	Blower (hiss)
21	Long Air Let-off
22	Short Air Let-off
24	Squealing Brakes/Flanges
26	Dynamo
29	Boiler Pop-off
30	Boiler Blow Down
31	Water Injector
34	Coupler Sounds
37	Air Brake Sounds

Bell Type Selection (CV 55.3.1)

Your Quantum System may have more than one type of Bell sound. To select different Bell sounds,

> Set CV 49 to 3.
> Set CV 50 to 1.
> Set CV 55 to a number from 0 to n to select Bell type. The default is 1; "Feedback Bell[41]" selection is 0 (used for locos where the prototypes did not have bells).

Note: To determine the number of Bell types, n, set CV 49 to 3, set CV 50 to 0, and set CV 64 to 55 to hear verbal response in Ops Mode.
Note: If you set "n" at a higher value than the number of available Bells, Quantum will select the "Feedback Bell", type "0".

Standard Throttle Control and Regulated Throttle Control Options (CV 56.4)

Set CV 49 to 4.
Set CV 56 to 0 for Standard Throttle Control; 1 for Regulated Throttle Control. The default is 1.

> **Note:** CV 2, CV3, CV4, CV 5 and speed tables apply to both Standard and Regulated Throttle Control**.**

Reset all[42] CV's to Factory Default Values (CV 56.128.255)

Note: This does not affect Analog settings, except for volumes.
Set CV 49 to 128.
Set CV 50 to 255.
Set CV 56 to 113[43]. In Ops mode, you will hear "Reset" when reset is completed.

Special Procedure for Short or Extended Address Programming (CV 56.129)

If you cannot program your Short or Extended ID number in Service Mode and your DCC command station prevents you from setting either of these addresses in Ops Mode (using CV 1, or

CV 17 and CV 18) use the following alternative procedures to program your locomotive's ID's.

Alternate Procedure for Entering Short (Primary) Address in CV 56.129.1 in Ops Mode

Set CV 49 to 129.
Set CV 50 to 1.
Set CV 56 to your Short Address (1 or 2 digits). Hear the address spoken back ("CV 1 = X").
If necessary, set CV 29, bit 5 to '0' (or set CV 29 to 6 which is factory default) to enable your new Primary Address.

Procedure for Entering Long (Extended) Address in CV 56.129.17 in Ops Mode

Determine the value of CV 17 and CV 18 for your Extended Address from the ID Table in your Steam Model Specification Sheet or follow instructions in CV 17 and CV 18 in the Quantum DCC Reference Manual (Version 4) to calculate a different ID number.
Set CV 49 to 129.
Set CV 50 to 17.
Set CV 56 to the value of CV 17 from the table. Hear the value of CV17 spoken out ("CV 56.129.17 = X").
Set CV 50 to 18.
Set CV 56 to the value of CV 18 from the table. Hear the value of CV18 spoken out ("CV 56.129.18 = X").[44]
If necessary, set CV 29, bit 5 to '1' (or set CV 29 to 38[45]) to allow operation with your new Extended Address.

Disable/Enable Verbal Announcements (CV 62)

In Ops Mode, the Quantum System will automatically speak out the value of the CV that you enter.
To disable, set CV 62 to 0 (no verbal response); to enable, set CV

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62 to 1 (hear "CV 62 equals 1"). Default is "Enabled".

CV Inquiry with Verbal Feedback in Ops Mode (CV 64)[46]

To inquire about the current value of any CV through Verbal Feedback in Ops Mode:

> Set CV 64 to the CV you wish to query. Hear the verbal message "CV 'X' equals 'Y'", where 'X' is the CV number and 'Y' is the value.

Note: If the CV has a Primary Index such as QSI CV nn.pp (where nn is the CV number and pp is the Primary Index), set CV 49 to pp before you set CV 64 to nn. For example, if you want to inquire about the Diesel Motor Volume, which is CV 52.10, set CV 49 to 10 and set CV 64 to 52. You will hear, "CV five two point one zero equals 'Y' (where 'Y' is the current volume setting). If the CV has both a Primary and Secondary Index, such as CV nn.pp. ss where ss is the Secondary Index, set CV 50 to ss in addition to setting CV 49 to pp before you set CV 64 to nn. .

Note: If you enter either '17' or '18' in CV 64, you will hear the full one to four digit Extended Address ID number spoken out.

Note: Disabling Verbal Announcements (CV 62) will not disable CV Inquiry (CV 64).

Quantum System Sounds[47]

Steam Chuff: The familiar steam chuff comes from steam exhausted from the steam chest through the smoke stack, which creates a powerful draft to feed the fire. Quantum Chuffing produces four distinct Chuff sounds per drive wheel set, a rhythm recognized by all steam fans.

Articulated Chuff: Articulated or Duplex steam locomotives have two sets of steam Chuff sounds that will go gradually in and out of synchrony. Most articulated locomotives had less weight over the front engine, which resulted in more slippage, causing the two engines to run at slightly different speeds.

Cylinder Cocks: When a steam locomotive sits idle for an extended period of time, water condenses and collects in the steam chest. Since water is not compressible and can damage the cylinder valves, the engineer must open special cocks on the steam cylinders to allow the water to be ejected as the piston moves. As the locomotive moves out, clouds of steam and water are propelled out on either side of the locomotive in such a flurry that it sometimes obscures the wheels and valve gear of the engine. Hear the sounds of Cylinder Cocks on the model as the locomotive starts out after it has been idle in Neutral for at least 25 seconds. The Cylinder Cock sounds are synchronized to the Chuff and shorten in duration as the loco's speed is increased. After the locomotive has reached 12 smph or 16 Cylinder Cock sounds have occurred, the Cylinder Cock sounds will slowly terminate as the last of the water is expelled and the engineer shuts off the cylinder cocks valves.

Whistle: The Quantum System uses authentic locomotive sounds whenever possible. If you blow the Whistle briefly, you will produce a realistic short Whistle sound or "hoot". Some locomotive models have special Whistle Endings, which can be "played" by tapping the horn button immediately after finishing Whistle operation.

Horn: Steam locomotives sometimes had both a whistle and a horn. If the Horn is available on your model, it can be selected

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with the Alternate Horn Selection key, F11. The Quantum System uses authentic locomotive sounds, whenever possible. If you blow the Horn briefly, you will produce a realistic short Horn sound or "hoot". Some Quantum Sound sets have special Horn Ending, which can be "played" by tapping the horn button immediately after finishing horn operation. **DCC only.**

Bell: Steam locomotives can have either a pull bell or pneumatically operated mechanical bell. With pull bells you will hear a different sound as the bell swings forward and backward producing the familiar ding-dong effect. Pneumatic bells produce a very repetitive ring and often at a much faster ring rate than a pull bell. During turn-on in Neutral, you will hear the pneumatic clapper gain greater throw with each stroke until it finally strikes the Bell. During shut down in Neutral, you will hear the Bell sound fade out for either pneumatic or pull Bells.

Doppler Run-by: The locomotives sounds get louder as the train approaches, then immediately drop to a much lower pitch and lower volume as the train passes by. With a little practice, you can activate the Doppler Effect exactly when and where you want. Doppler pitch change is based on the speed of the locomotive, so the sounds change more dramatically when the locomotive is running faster. After the Doppler shift has occurred and the Whistle is no longer being blown, the Bell shuts off automatically and locomotive sounds return to normal.

Air Brakes: When prototype train brakes are applied, air is released from the brake lines to reduce the pressure. The more the pressure is reduced, the greater the braking. You will hear a continual air release sound from the steam locomotive model as braking is continually increased. The longer the air is released,

the quicker the steam locomotive model will slow down. Once all the pressure is released, the locomotive will continue at maximum braking, which can still require a long stopping distance depending on your Load settings. **DCC and QARC only.**

Blower or Steam Locomotive Hiss: On a moving locomotive, the steam from the steam chest venting through the smoke-stack draws air through the fire box, keeping the fire healthy. When the locomotive is sitting still, blowers are often turned on to vent steam through the smoke stack to maintain the draft. Blowers were often turned off soon after the locomotive started out. The Steam Blower sound on steam locomotives will turn on gradually followed by a continual steam hiss. The turning on and off of steam Blower Sounds is automatic and depends on the direction state.

Air Pumps: When a locomotive is sitting still, the pumps come on at a steady beat to replace the air lost from the brake air release and from pneumatically operated appliances. Once the pressure is up, the pumps only operate occasionally to maintain the pressure. Large steam locomotives may have more than one pump operating independently.

Appliance Air Release: Compressed air is used on locomotives for operating various appliances. You will hear either a Short Air Let-off or Long Air Let-off at various times.

Brake Squeal: You can hear the brakes squeal on prototype locomotives when they are moving slowly. This sound can become quite loud when the wheels are just about to stop turning. Listen for automatic Squealing Brake sounds at slow speeds and the final distinctive squealing sounds as the Quantum equipped

steam locomotive slows to a stop.

Coupler: To give you the most authentic coupler sounds, we have identified three distinct types of coupler activity. The first is when the coupler is Armed, where you hear the clanking sound of the coupler lift bar and coupler pin raising. The next is Firing the coupler, where you hear the opening of the coupler and the hiss of the air-lines parting. The third sound occurs when the locomotive couples up to its load of cars, and you hear the Coupler Crash as all of the cars bunch together from the impact. **DCC and QARC only.**

Flanges: When a train enters a curve, the flanges on the wheels ride up on the inside of the rail and usually squeal. Recreate this squealing effect by pressing and releasing the Squealing Brake/Flanges DCC function key or QARC Analog button quickly and repeatedly as necessary. **DCC and QARC only.**

Steam Pop-off: If there is too much steam pressure in the boiler, special pop-off valves, or safeties, on top of the locomotive release the excess pressure in a fury of hissing steam that often will blow for 30' or more above the locomotive. This happens most often when the locomotive is sitting still, since the fire continues to build up steam that is not used. The Quantum Pop Off sound comes on for random lengths at random times in Neutral.

Steam Water Injector: The water used to make steam is replaced by water injectors at high pressure, to overcome the elevated pressure in the boiler. The sound of rushing water and steam hiss ends with a distinctive valve shut off. This sound comes on for random lengths of time and occurs randomly when the locomotive is in Neutral.

Steam Boiler Blow Down: As water evaporates, minerals and other residues settle to the bottom of the boiler. The fireman opens a valve to vent this material through a large pipe under the side of the cab onto the ground. Quantum's Blow Down sound occurs at random in Neutral for varying lengths of time.

Locomotive Shut Down (Extended): A long Air Let-off will first occur followed by the steam Dynamo revving down and the Directional lights shutting off. The Air Pumps will turn off, followed by the sounds of Pop Off operating for about ten seconds and finally the Blower Hiss will shut off. **Controllable only with QARC Analog or DCC.**

Locomotive Start Up (Extended): The Dynamo will rev up while the Headlight comes on gradually, then the Cab Lights (if available) will turn on, followed by the Air Pumps, the steam Blower will turn on and then the locomotive will enter normal operation. **Controllable only with QARC Analog or DCC.**

Special Operation and Troubleshooting

For a full description, see the Troubleshooting section in the Quantum DCC Reference Manual (Ver 4) and Quantum Analog Reference Manual (Ver 4) at http://broadway-limited.com.

DCC Program Track Operation

This 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 locomotive can be programmed in Ops Mode. You can also purchase from Tony's Train Exchange®[48], a simple, inexpensive power booster (PowerPak™ by DCC Specialties) that will allow you to program on the program track with any DCC command station.

Manual Controls

Quantum equipped locomotives include special manual controls to adjust the sound volume or reset the locomotive to factory default values. Early Quantum Systems used removable jumpers and turn pots, which required removable panels or hatches or complete removal of the plastic body to expose the circuit board controls. Later models used a special reed switch located directly under the plastic diesel roof that could be activated by a Magnetic Wand without having to disassemble the locomotive.

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

Locomotives with Jumpers and Turn Pots

Locate the Manual Volume Control (potentiometer) on the roof of your tender as shown in the Steam Model Specification Sheet that was included with your model.

Use a small screwdriver to turn the potentiometer clockwise to increase volume or turn it counterclockwise to decrease the volume.

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 potentiometer.

Locomotives with Magnetic Reed Switches

Locate the reed switch area on the tender's roof as shown in the Steam Model Specifications sheet that is included with your model.

Power up the locomotive and leave in Neutral.

Place the enclosed Magnetic Wand over the reed switch area on the top of the tender[49] (perpendicular to the track) and wait as you hear the volume increase or decrease in incremental amounts as the Whistle hoots about every second. Move the wand away and again place it over the reed area 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 case 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.

Locomotives with Jumpers and Turn Pots

Turn off the power.

Locate the jumper as shown in the Steam Model Specification sheet that was included with your model.

Remove the jumper by pulling it up.

Reapply power; after a few seconds you hear the word "Reset".

Turn power off, reinstall the jumper. The locomotive has now been returned to original factory defaults for all DCC

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and Analog values.

Locomotives with Magnetic Reed Switches

Locate the reed switch area as shown in the Steam Model Specifications sheet that came with the locomotive.
Turn off the power.
Place the Magnetic Wand over the reed switch area and apply power and leave the wand there until you hear the word "Reset". Your locomotive is now reset to original factory defaults including all DCC and Analog values.

High Voltage Circuit Breaker (Analog and DCC)

Your Quantum equipped locomotive is designed to operate on normal HO track voltage supplied by most HO power packs. If track voltage gets too high[50], 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 Whistle hoots. This built in safety feature protects Quantum electronics and the electric motor from excessive voltage[51].

To restart your locomotive, reduce the track voltage until the hooting stops and the motors re-engage.

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 case 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.

Make sure the locomotive has not been Muted with the DCC F8 key or Quantum Engineer Mute Key.

Check to see if your Manual Volume Control or Programmed Digital Volume has been turned all the way down.

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 in Analog or use the Magnetic Wand in Analog, which both selects and starts the locomotive.

Note: The Magnetic Wand will not start your locomotive in DCC if it is in a Shut Down state. To start in DCC, you must first select the locomotive with its ID number and then use the F6 key. It will take a couple of seconds after you double press the F6 key before you will hear the pump sounds start.
Note: It does not make any 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 to factory default values as described above.

Upgrading to New Sounds and Features

The Q1a Upgrade Chip contains software that will allow it to reprogram itself using a PC and the QSI Programmer module, which in turn is wired to a program track. Using this method, the Q1a chip can be upgraded to new software, enhanced with new features, and new or different sounds. New software and sound sets will be available through the QSI website at **http://www.qsindustries.com**. Refer to the operating instructions and documentation supplied with the Quantum Programmer.

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Notes from Quantum Steam Locomotive Operator's Manual

[1]   Not all features described below may be included in your locomotive model.

[2]   It is useful to mark where V-Start is on your throttle. V-Start can also be reprogrammed to different values for different power packs.

[3]   Squealing Brakes occur if the locomotive exceeds 40 scale

miles per hour (64 scale kilometers/hour) and then slows down to below 20 smph (32 smph).

[4] Not all features, or dim light capability, may be available in your particular locomotive model.

[5] Most Quantum 1 and Q1a Reverse Lights cannot be dimmed; they only have bright and off settings. In these cases, "Dim" is equivalent to "Off".

[6] Cylinder Cocks arming after Start up and/or after 25 seconds in Neutral can be set using CV 51.2. The settings in this CV apply to both Analog and DCC operation.

[7] If Regulated Throttle Control is enabled it is important to wait until the locomotive stops on its own. The locomotive's electronic Inertial Control will keep it moving even though you have reduced the throttle far enough below V-Start to stop the locomotive. In your attempt to stop the locomotive, do not try to reduce the throttle so far that all sounds turn off.

[8] Standard US prototype railroad signaling is two hoots before starting in forward and three hoots before starting in reverse. Other countries have different signaling. Check your Diesel Model Specifications Sheet for horn sequences used on your model.

[9] Programming is even simpler using a Quantum Engineer Controller (see page 11).

[10] POP is short for "Program Option".

[11] You can set volume with the Manual Volume Control or with Programming or both.

[12] Some lights that are not controlled by the Quantum System may remain on.

[13] If your locomotive does not have a prototype Bell enabled, a single feedback ding indicates you have entered the Bell state and a double-ding indicates you have left the Bell state.

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[14]   If you have a Quantum Engineer, you can move both back and forth through Program Options.

[15]   If you have a Quantum Engineer, Quick and Slow operations are done with specific program buttons.

[16]   Setting any volume in Analog will also apply to DCC and vice-versa.

[17]   See section: Moving on to Other Program Options or Leaving Programming.

[18]   V-Max should not be set too low when using RTC. For most MRC™ power packs, the best choice for V-Max is about 1.5 volts below the highest throttle setting as determined by the Quantum built-in Voltmeter

[19]   It does not need to be F6; any function or speed command will activate the locomotive. It is only when a locomotive is in Shut Down that an F6 command is necessary.

[20]   The lighting features available depend on the locomotive model.

[21]   Neutral sounds also include steam Pop-off, Water Injector, and Blow Down that turn on and off randomly.

[22]   If the protoype did not have a bell, no bell feature is assigned to F1. No other feature is assigned in its place.

[23]   Not all features may be available in your locomotive model.

[26]   If your locomotive has a Mars Light, the Headlight will be off (instead of "Dim") in all states except Forward where it will be Bright.

[25]   Most Quantum 1 and Q1a Reverse Lights cannot be dimmed; they only have bright and off settings. In these cases, "Dim" is equivalent to "Off".

[26]   Cylinder Cocks arming after Start Up and/or after 25 seconds in Neutral can be enabled/disabled in DCC using CV 51.2, which

applies to both Analog and DCC operation.

[27] CV4 and CV24 determine the deceleration rate. Applying the brakes increases the deceleration rate temporarily

[28] If the optional Cylinder Cocks feature is not included in your model, the F7 key will produce a long Air Let-off.

[29] Double pressing is defined as two F9 commands sent within two seconds. Note that the F9 key may have to be pressed three times, due to the DCC command station and locomotive having different initial states for F9. Double pressing ensures that Shut Down stages are not entered or exited accidentally.

[30] Pressing a function key will only produce a Short Air Let-off.

[31] It would be inconsistent for a steam locomotive to be working at full Sound-of-Power while Dynamic Brakes are being applied to other locomotives within the same consist.

[32] Dynamic Brakes on prototype locomotives are less effective and are seldom used at low speeds.

[33] Double pressing is defined as two F6 commands sent within two seconds. Note that the F6 key may have to be pressed three times, due to the DCC command station and locomotive having different initial states for F6. Double pressing ensures that Start Up is not entered accidentally.

[34] Scale speed report can be programmed to announce in smph or skph under DCC in CV 56.0, which will apply to both DC Analog and DCC Operation.

[35] If your DCC command station will not program in Service Mode, check with the command station manufacturer; some companies will give you a free upgrade. Also, see Special Operation and Troubleshooting on page 42.

[36] In Ops Mode, you will hear the value spoken out when changing the value of a CV.

[37] 'X' refers to the value in column 1 of the table, the Primary

Index number that will be entered into CV 49.

[38] Setting any individual sound volumes in DCC will also apply to Analog and vice-versa.

[39] Volume setting for Chuff 1 and Chuff 2 will also apply to Analog. However, since there is only one setting for Chuff Volume in Analog, pOP 26 will change the volume level of Chuff 1, which will also apply to Chuff 2. When returning to DCC, both Chuff Volumes will be at the same value as set in Analog.

[40] Volume setting for Pump 1 and Pump 2 will also apply to Analog. However, since there is only one setting for Pump Volume in Analog, POP 26 will chnage the volume level of Pump 1, which will also apply to Pump 2. When returning to DCC, both Pump Volumes will be at the same value as set in Analog.

[41] Feedback Bells produce a single light "ding" when turning the bell on and a double "ding" when shutting the bell off. This bell type is suitable for locos that are not intended to have bells but need a bell sound to indicated that the bell state is on or off.

[42] Consult the Quantum DCC Reference Manual (Version 3) to learn how to reset different groups of CV's.

[43] "113" is QSI's Manufacturer's ID Number assigned by the NMRA.

[44] If you want to verify your extended address, set CV 64 to 17 (or 18) to hear the full address spoken out.

[45] Entering "38" leaves the other configuration settings in CV 29 at factory default, but changes the ID to Extended Address type.
[46] This option is not affected by CV 62 (Disable/Enable

Verbal Announcements).

[47] Not all features are included on every Steam locomotive.

[43] QARC™ or Quantum Analog Remote Control™ uses special signals under Analog control to operate different

Quantum features. With QARC, you can operate features that are currently available only in DCC in addition to features that are not yet available in DCC.

[44] Tony's Train Exchange; 1-800-978-3472; http://www.tonystrains.com.

[45] The wand does not need to touch the body of the engine.

[46] The High Voltage Circuit Breaker is set to trip at 21.5 peak volts

[47] The High-Voltage Circuit Breaker will sometimes activate if the Load (inertia or momentum) feature is used and the throttle is turned up too quickly to full power.

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Sounds & Features Common to Analog & DCC	Analog Features	DCC Features
Whistle or hoot Bell with turn off and turn on effects (if so equipped) Diesel Motor Low Idle Sounds Diesel Turbo (if so equipped) Automatic Cooling Fans Doppler Shift Brake or Flange Squeal Neutral Sounds Long Air Release Short Air Release Air Pumps Sound of Power™ Neutral State (Idle) Directional Lighting Bright/Dim Headlight Reverse Light (optional) Ditch Lights (optional) Mars Light (optional) Number Board Lights (optional) Cab Lights (optional) Constant Brightness Lighting. Regulated Throttle Control™ Standard Throttle Control Downloadable Sound Sets and Software via QSI Programmer Module. Manual Volume Control Reset to Factory Default	System Volume Programming Individual Sound Volume Control Helper Type: (Normal) Normal loco, Lead Loco, Mid Helper, End Helper. Pusher. Direction: Normal/Reversed DC Power Pack Programming V-Max V-Start Select or Deselect locomotive with Magnetic Wand **QSI QARC™ Operation**** (with QSI QARC Controllers™) Air Brakes Flanges Dynamic Brakes Locomotive ID's. Consist ID's. Coupler Sounds Quick or Extended Start Up Disconnect Standby Quick or Extended Shut Down Explicit Lighting Control Controllable Flange Squeal Load on/off toggle Very Heavy Load Fan on/off toggle Verbal Status Reports Grade Crossing Whistle Signal Alternate Whistle Selection Audio Mute System Volume Control RTC/STC Throttle Mode Select Fast Programming plus Additional Features	F0 or FL light control F1-F12 Function Keys 14/28/126 speed steps Coupler Sounds Air Brakes Dynamic Brakes **Programming Modes Supported:** Address Mode, Register Mode, Service Mode, Direct Mode, Ops Mode Long Form & Ops Mode Short Form **NMRA CV's supported:** 1-5, 7-8,17-25,29,33-46,66-95 **QSI CV's supported:** 49 Primary Index 50 Secondary Index 51 Sound Control 51.0 System Volume 51.1 Mute Volume 51.2 Doppler 52 Individual Sound Volume Controls 53 Function Output Mapping 55 Feature Configuration 55.3 Bell 55.70,73 Headlight/Reverse Light 55.76 Mars Light 55.84 Ditch Lights & Strobe Hold Time 55.100 Number Board Lights 55.104,106 Marker Lights 55.116,118 Cab Lights 55.136,137,138 Multiple Lights 55.178 Status 56 QSI Configuration 56.4 RCT/STC Throttle Mode Select 56.5 Minimum BEMF 56.18-21 Motor PID Control Parameters 62 Auto CV Verbal Feedback 64 CV Inquiry Verbal Readout

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