



Electric Locomotive Operation Manual

**for QSI Quantum System™ Analog & DCC
Q1a Sound Decoder Equipped Locomotives**



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Basic Analog Operation

QSI recommends 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 lights will turn 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.

Horn

Blow the authentic Electric locomotive Horn for short or long blasts – you control the duration.

- While the locomotive is **moving**, flip the direction switch to turn on the Horn.
- Flip the direction switch back to shut off the Horn.

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

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 Horn hoot instead of the Bell. If you try to do a very short Horn 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

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 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-Start¹). The Electric Motor sounds will rev up with locomotive speed and with labored sounds proportional 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 8).

- As you slow the locomotive down by reducing the throttle to a little below V-start, the Electric Motors rev and labored sounds volume decreases, while Squealing Brake sounds occur as the electric locomotive comes to a slow stop².

Advanced Horn Operation

Doppler Effect

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

- While the locomotive is moving toward the observer, flip the direction switch to turn on the Horn.
- Wait at least one second while the Horn is blowing.
- Just before the locomotive passes in front of the observer, flip the direction switch back and forth quickly so the Horn 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 Horn, or continue with long or short Horn operations. When you are finished blowing the Horn, 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 Horn

Prototype engineers would often “play” their horns by controlling the flow of compressed air. In particular, engineers often had a signature sound associated with how they ended their horn sequences. Some Quantum System sound sets have special Horn 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 Horn.

- Flip the direction switch to blow the Horn for at least one second.
- The normal way to end the Horn is to flip the direction switch back. To do the special Horn 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.

Strobing Ditch Lights

For safety reasons, prototype engineers will often strobe the Ditch Lights while the Horn is blowing, particularly at grade crossings.

- While the locomotive is moving Forward, flip the direction switch to turn on the Horn.

Ditch Lights (if so equipped) will start alternating from side to side and continue for five seconds³ after you turn off the Horn.

¹ 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.

² 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 skph).

Automatic Features

Quantum features⁴ are automatically controlled as a function of the directional state of the locomotive as described in the table below.

Feature	Forward	Neutral from Forward	Reverse	Neutral from Reverse
Headlight	Bright	Dim	Dim	Dim
Reverse Light	Dim ⁵	Dim	Bright	Dim
Mars Light	Strobing	Steady On	Steady On	Steady On
Ditch Lights	On	Off	Off	Off
Number Board Lights	On	On	On	On
Marker Lights	On	On	On	On
Cab Lights	Off after 15 seconds	On after 10 seconds.	Off after 15 seconds	On after 10 seconds.
Vents & Cooling Fans	On after 10 seconds	Off after 10 seconds	On after 10 seconds	Off after 10 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**⁶. The Headlight and optional Ditch Lights will turn off and the 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. After ten seconds the Electric Traction Motor Cooling Fans shut off if they were on when you entered Neutral. Optional Cab Lights come on 10 seconds after entering Neutral.
- After the Air Pumps start, you can use the direction switch to blow the Horn 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 Horn 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,
2. Leave the locomotive in Neutral, flip the direction switch (the Horn will come on) and then turn up the throttle. When the locomotive starts to move in the opposite direction, the Horn 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 Horn will hoot two more times for a total of three hoots⁷.

Note: To prevent the first Horn hoot from being too long, do not delay in turning up the throttle after you have flipped the direction switch.

³ The hold time for strobing Ditch Lights after the horn button is released can be set using CV 55.84.5. The setting of this CV applies to both Analog and DCC operation.

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 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.

⁷ 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 Electric Model Specification sheet for horn sequences used on your model.

Train Load

You can set your electric locomotive to have any of 16 different Load levels, which represent added inertia from rolling stock (see Analog Programming, Option 2 on page 8). The higher the Load setting, the greater the inertia effect during acceleration and deceleration. As you increase track voltage, the motor is provided an increasing portion of that voltage which, depending on the Load setting, will gradually accelerate the locomotive realistically until it reaches full speed. Level 0 is the default, which is no Load.

Under STC, the level 0 Load setting will allow your locomotive to accelerate or stop as quickly as the internal flywheels will allow. Under RTC, level 0 will add no additional Load to the Intrinsic Inertia already provided by RTC. For any Load setting from 1-15, your electric locomotive will take longer to change speed under either STC or RTC. At level 1, it will take approximately 15 seconds more to achieve full speed at max throttle⁸; at level 15, it will take over 3 ½ minutes to achieve full speed. In addition, at higher Load settings, your locomotive will decelerate more slowly as you decrease your throttle.

Sound-of-Power™

Your electric locomotive will produce heavy labored Electric Traction Motor sound effects under RTC or under STC (as long as you have selected any of the Load settings from level 1 to 15). Under acceleration, the Electric Traction Motor sounds will be more labored until the locomotive has achieved its final speed where it will then produce standard sounds appropriate to its throttle setting. Under deceleration, the Electric Motor sounds are less labored until it achieves its final speed where it will again produce standard Electric Motor 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. These Helper locomotives can be part of the head-end consist or as mid-train helpers or as pushers at the end of the train. Helper locomotives behave differently than the train's lead locomotive. Their horns and bells are usually not operated, and their lighting options are different or not used at all.

When you make up your train using more than one locomotive, 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 8.

Normal and Reversed Direction

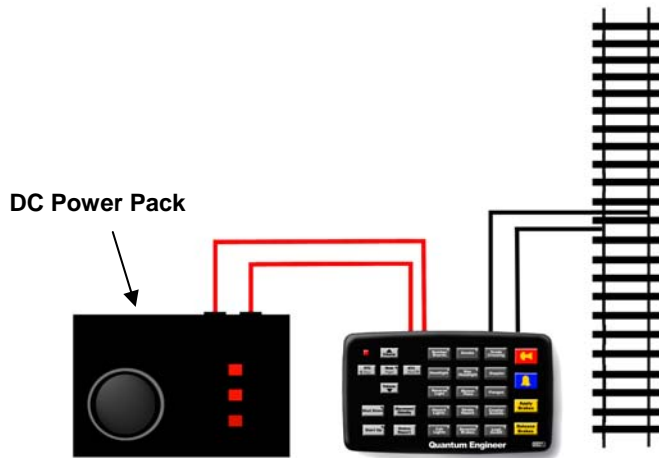
Quantum also allows you to reverse the directional sense of your locomotive. This is normally not an issue with DC two-rail trains since all locomotives will go in the same direction whether they are facing forwards or backwards. However, certain features like Directional Lighting depend on the directional sense. For instance, if you program your locomotive to be an End-Helper for your consist, its Reverse Light (rear Headlight) operates only when the locomotive is moving in Reverse and the Headlight is disabled. This arrangement is ideal for providing a Reverse Light for the consist. However, if this electric locomotive is facing backwards at the end of a consist, the Reverse Light faces forward and will be lit when the consist is moving Forward and there will be no Reverse Light for the consist. The "Direction" program option feature will ensure that this End Helper's backward facing front Headlight will come on only when the consist is backing up and the forward facing Reverse Light (rear Headlight) will not light at all. 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 8.

Additional Analog Operation Features Available with the Quantum Engineer™ Controller

Your Quantum Electric locomotive is equipped with QSI's 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 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 Technology, you are not able to independently operate multiple trains on the same powered track section at different speeds at the same time.

⁸ Some unloaded power packs produce excessive voltage at max throttle and will activate the Quantum high-voltage circuit breaker. When this happens, your locomotive will stop and emit a series of hoots until the power is reduced to a lower voltage (see Troubleshooting, pages 22-23).

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 red wires go to the variable DC output from the power pack and two black wires go to the track. Place Quantum Engineer beside your power pack or mount it directly on most popular power packs as shown below. All features on the power pack remain the same including throttle and reverse switch control. See our web site at <http://www.qsindustries.com/> for further information.



Wiring Quantum Engineer is Simple.
Figure 1



Figure 2

Programming and Sound Control with Quantum Engineer: Figure 3 shows the Star Pad key section of the Quantum Engineer, which controls both sound and programming. During normal operation, the **Volume ▲** and **Volume ▼** keys control the system volume and the **Mute** key toggles the sound between normal and a low volume level. In addition, the **STC** and **RTC** keys allow you to easily select between Standard Throttle Control and Regulated Throttle Control.

Or you can enter Programming Mode by pressing and holding the **Prgm** key while you turn on the power. The Red power light will blink and your locomotive directional lights will blink to indicate you have entered programming. Press the **Next** key to advance from one Programming Option to the next. The locomotive will speak out which Option you have selected. The **Prev** key allows you to move backwards through Program Options. Once you have selected an Option, use the **Volume ▲** or **Volume ▼** keys to program that option.



Figure 3

For instance, if you wanted to change the Whistle volume independently or other sounds, enter programming with the Prgm key, and press and hold the **Next** key until you hear the locomotive count up to thirteen “13” and responds with the verbal message “Whistle Volume”. Press the **Volume ▲** key to increase the Whistle volume or press the **Volume ▼** to decrease the Whistle volume. As you press the volume up or down keys, you will hear the Whistle hoot at each new volume setting. You can now move to other options by pressing the **Next** or **Prev** key. For instance, if you pressed the **Next** Key, you would advance to the next option, “14” where the locomotive would announce “Bell Volume”. You can now use the **Volume ▲** or **Volume ▼** to change the Bell volume and hear the Bell sound at each new volume setting. To leave programming, simply shut off the track power. See the table on page 8 for additional listings of Programming Options.

Analog Programming

The Electric 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 switch⁹.

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. Mid Helper has Horn, Bell and all lights disabled ¹² . 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	"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 Horn, 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 Electric 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 Bell¹³ 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.

⁹ Programming is even simpler using a Quantum Engineer Controller (see previous section on page 7).

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.

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 again¹⁴. 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 switch¹⁵. 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 volume¹⁶.

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 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”.

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.

- 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 over¹⁷ and then chose a slightly higher throttle setting.
- At the end of the process, the locomotive will stop moving and the Horn 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.

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

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 Horn 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.qsindustries.com>.

¹⁷ See section above: 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.

DCC Operation

These steps will allow you to start operating your Quantum equipped electric 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 key¹⁹ to hear the locomotive Start Up sounds. The Directional Lighting System ((Front Headlight, Reverse Light (Rear Headlight), optional Mars Light and optional Ditch Lights²⁰)) will be on. The Cab Lights and Number Board Lights will turn on. The Cab Lights will shut off automatically after ten seconds.
4. Increase the throttle to leave Neutral and start the locomotive moving. The locomotive will start out slowly due to special Quantum Inertial Control™ that resists rapid increases or decreases in speed. 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 sounds²¹.

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 and Ditch Lights on/off	Directional Head, Reverse, Mars and Ditch Lights on/off
F1	Bell on/off (if assigned ²²)	Bell on/off (if assigned)
F2	Horn or horn with Doppler Effect (see below)	Horn
F3	Coupler Crash/Coupler Fire	Coupler Arm or Coupler Fire
F4	Automatic Cooling Fans on/off	Automatic Cooling Fans on/off
F5	Dynamic or Regenerative Brake feature on/off	Dynamic Brake function on/off (in "Disconnect" only) ²³
F6	Initiate Doppler Effect	Start Up
F7	Squealing Brake/Flanges and Air Brakes	Brake Set - Long Air Let-off
F8	Audio Mute on/off	Audio Mute on/off
F9	Heavy Load on/off	Disconnect/Standby/Shut Down
F10	Locomotive's Speed Report.	Status Report
F11	Number Board or Marker Lights on/off	Number Board or Marker Lights on/off
F12	Automatic Cab Lights on/off	Automatic 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.

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 prototype did not have a bell, the bell feature is disabled. Instead a simple feedback ding is assigned to F1.

²³ Dynamic or Regenerative Brakes have no sound effect in Neutral or Disconnect. They are included here for consistency with other Quantum equipped locomotives.

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	Function Key	Forward	Neutral from Forward	Reverse	Neutral from Reverse
Headlight	F0 or FL	Bright	Dim ²⁴	Dim	Dim
Reverse Light	F0 or FL	Dim ²⁵	Dim	Bright	Dim
Mars Light	F0 or FL	Strobing	Steady On	Steady On	Steady On
Ditch Lights	F0 or FL	On	Off	Off	Off
Number Board Lights	F11	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.
Vents & Cooling Fans	F4	On after 20 seconds.	Off after 10 seconds.	On After 20 seconds.	Off after 10 seconds.

When an indicated function key enables an “automatic” light feature, the associated lights operate according to the states shown in the table. For instance, enabling the Automatic Ditch Lights in Neutral will not cause the Ditch Lights to turn on since their automatic behavior would have them off in that directional state; however, if you then entered Forward, the Ditch Lights would turn on. When an indicated function key disables an “automatic” feature, all lights will be off. For instance, disabling “Automatic Ditch Lights” will immediately shut off any operating Ditch Lights 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: Not all features may be available in your locomotive model. In particular, Number Board Lights and Marker Lights have not been offered for the same model. F11 is assigned to the feature that is available.

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.

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 electric locomotive will produce additional labored Electric Motor sounds under acceleration and lighter Electric Motor 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.

Horn and Bell Buttons (F2, F1)

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

- Pressing the F2 key and releasing it will cause the horn command to come on and stay on, until you press F2 again.
- Pressing the horn button will send the horn 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.

Note: If your locomotive is equipped with Ditch Lights, they will automatically strobe from one light to the other when the Horn is being blown and will continue for five seconds after the horn signal has stopped²⁶.

Note: Since the prototype horn uses compressed air, you will hear the Air Pump sounds turn on after the Horn is operated.

²⁴ 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 The hold time for strobing Ditch Lights after the horn button is released can be set in CV 55.84.5.

Doppler Operation (F6)

With DCC, you can trigger the Doppler Effect by quickly interrupting the horn 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 Horn and/or Bell by pressing and releasing their function keys²⁷.
- Press F6 to hear the Doppler shift. A few seconds after the horn button is turned off with the F2 key the Electric locomotive sounds return to normal²⁸.

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 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 settings²⁹. 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.
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.
- Press the F7 key again to stop the air release. The train will continue to slow at the last braking value.
- 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.

Note: If you continue to release air (for over 24 seconds total), all the pressure will be released and brakes will be on full; you will hear no further air release sounds.

- 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 Long Air Let-off sound simulates setting the brakes. However, no braking effect is activated³⁰.

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 automatically changing direction, the loco will accelerate back to its original speed.

²⁷ If you do not turn on either Horn or Bell, the Doppler Shift will still occur, but will be less dramatic.

²⁸ If the Bell was on, it will shut off prior to sounds returning to normal. If you do not have the Bell feature, but the Bell State is on, it will turn off prior to locomotive sounds returning to normal.

²⁹ CV 4 and CV 24 determine the deceleration rate. Applying the brakes increases the deceleration rate temporarily.

³⁰ If the brakes are set in Neutral, turning up the throttle automatically releases the brakes.

Three Stages of Electric 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 key³¹.

Stage One: Disconnect

- Double press the F9 key in Neutral to enter Disconnect. You will hear a Long Air Let-off.
- 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.

If you double press the F9 key in Neutral, the motor drive will be disconnected. Once you hear the Long Air Let-off, the DCC throttle can be moved up and down without the electric locomotive moving. All Function Keys are active in Disconnect.

Stage Two: Standby

- Double press the F9 key while in Disconnect to enter Standby. You will hear a Long Air Let-off. The Directional Lighting and optional Ditch Lights or Mars Light will shut down. The motor will remain disconnected, while the Air Pumps, automatic Cooling Fan operation, Number Board Lights and Cab Lights will continue to operate. In Standby, the locomotive will not respond to throttle or function keys³². 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. Although certain lights and sounds are active, the locomotive will not respond to accidentally changing the throttle setting or pressing the function keys.

Stage Three: Total Shut Down

- Double press the F9 in Standby to enter Total Shut Down. You will hear a Long Air Let-off.
- To leave Total Shut Down, double press the F6 key.

The Air Pumps will turn off, followed by the Number Boards (if so equipped), Marker Lights and the sounds of the Cooling Fans shutting off, the louvers closing, 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. In Total Shut Down, the locomotive will not respond to throttle or function keys. The two exceptions are the F6 Start Up Function Key (described below) and the F10 Status Key (described below).

Note: 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; that is, the locomotive will still be "off line" when power is reapplied for the next operating session, irrespective of whether this next session is Analog (conventional DC) or DCC.

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 the locomotive returns to normal operation.

Dynamic or Regenerative Brakes (F5)

Prototype electric locomotives can have dynamic or regenerative brakes or neither. In all cases, the Dynamic Brake function has been included to make the Quantum electric locomotive consistent with other Quantum equipped locomotives.

- Pressing the F5 key in Forward or Reverse will set the Traction Motor Sound-of-Power to the lowest setting. If the model has Dynamic Brakes, the resistor grid Cooling Fan will come on. If the model has Regenerative Brakes, Traction Motor Cooling Fans will come on (if so equipped). If neither type of brake is included, there will be no additional sounds.
- Pressing the F5 key in Neutral will have no Dynamic or Regenerative Brake effect.

Dynamic or Regenerative Brake feature automatically turns off when entering or leaving Neutral, when locomotive speed drops below 7 smph (11 skph)³³, or when the throttle is turned up. Dynamic or Regenerative Brake feature cannot be turned on in Forward or Reverse unless the locomotive speed is over 8 smph (13 skph).

See Dynamic and Regenerative Brake Sound Description under *Quantum System Sounds* on pages 19-20.

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

³¹ 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.

³² Pressing a function key will only produce a Short Air Let-off.

³³ Dynamic Brakes on prototype locomotives are less effective and are seldom used at low speeds.

Start Up (F6)

If your Quantum equipped electric locomotive is in any stage of Shut Down, you can return your locomotive to normal operation by double pressing³⁴ 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 electric 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 electric locomotive will produce a Long Air Let-off, Directional Lighting will turn on (if previously 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 Electric locomotive will produce a Long Air Let-off, you will hear the engineer's door opening and closing, and see Cab Lights come on (if so equipped), Number Boards and Colored Marker Lights (if so equipped) come on, and Directional Lighting turn on (if previously on). These actions are followed by the sounds of vents opening, the Air Pumps starting up, 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 is shut off if Status F10 key is pressed to allow clear audio reporting (see Status below).

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 an electric locomotive's laboring Sound-of-Power effects. When you approach a grade under Heavy Load, increase the throttle and hear the locomotive's traction motors 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, (Disconnect, Standby or Shut Down).
- Press the F10 key in Forward or Reverse; the locomotive will verbally report the locomotive's speed in scale miles per hour (smph) or in scale kilometers per hour (skph)³⁵.

³⁴ 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.

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.

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 Horn, Bell, Doppler Shift, Squealing Brake and Neutral sounds are described in detail on pages 19-20, in the *Quantum System Sounds* section of this manual.

35 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.

DCC Programming

Most DCC command stations currently available will program Quantum equipped locomotives in Service Mode³⁶ 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 DCC³⁷. To change volume in Service or Ops Mode, do the following:

- Set CV 49 to 0.³⁸
- 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 63 (50%). 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 Mute Volume level will be the smaller of the Mute Volume setting or one-half the current System Volume. In other words, the Mute Volume will never be more than one half of the System Volume.

Enable/Disable Horn Triggered Doppler Shift (CV 51.2)

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

Changing Individual Sound Volumes (CV 52.X³⁹)

To change the volume of individual sounds listed in the table below do the following⁴⁰:

- 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	Electric Motor
16	Air Pump
19	Vents and Cooling Fans
21	Long Air Let-off
22	Short Air Let-off
24	Squealing Brakes/Flanges
34	Coupler Sounds
37	Air Brake Sounds

See your *Electric Model Specifications* sheet for Individual Sound Volume default settings.

36 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 22-23.

37 System Volume changes in DCC also apply to Analog and vice versa.

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

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

40 Setting any Individual Sound Volumes in DCC will also apply to Analog and vice-versa.

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 Bell⁴¹” 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 all⁴² 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 113⁴³. 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 *Electric 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 CV 17 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 CV 18 spoken out (“CV 56.129.18 = X”).⁴⁴
- Set CV 29, bit 5 to ‘1’ (or set CV 29 to 38⁴⁵) 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; to enable, set CV 62 to 1. Default is “Enabled”.

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 4) 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.

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 Bell Volume, which is CV 52.8, set CV 49 to 8 and set CV 64 to 52. You will hear, “CV five two point eight 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).

⁴⁶ This option is not affected by CV 62 (Disable/Enable Verbal Announcements).

Quantum System Sounds⁴⁷

Traction Motor Whine: Although both Diesels and Electric locomotives have Traction Motors, Electric locomotives do not have loud diesel motors drowning out the sounds of the Traction Motors. You will hear the Traction Motors when the Electric Locomotive starts out, especially if the Cooling Fan volume is turned down to a lower value. Like the prototype, the Quantum Traction Motor Whine pitch increases and decreases with the speed of the locomotive. It is not affected by track voltage.

Traction Motor Cooling Fans: The Electric Traction Motors get quite hot from the enormous current supplied to their circuits. All Electric locomotives have powerful Cooling Fans that can create so much draft that the access panel doors cannot be opened when the Cooling Fans are operating at full power. It is not surprising that these fans can easily be heard in idling and operating locomotives. You will also hear the sounds of louvers opening before the fans start. When Cooling Fans shut down, you will hear the louvers close.

Extended Start Up and Shut Down: It takes time to startup or shutdown a prototype locomotive. To model this, the Quantum system uses additional sound records of the engineer entering and leaving the cab, vents opening and closing, lights turning on or off at different times along with the sounds of the Electric Air Pumps starting up or shutting down. *DCC and QARC only.*

Air Pumps: When a locomotive is sitting still, the pumps come on in a steady beat to replace the air lost from brake air releases and from air-operated appliances. Once the pressure is up, the pumps only turn on occasionally to maintain the pressure. Air Pumps are electrically operated and are quite noticeable if Cooling Fans are turned off. In Forward, you will hear the Air Pumps come on soon after the Horn is operated to maintain the air pressure.

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.

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 Electric locomotive model as braking is continually increased. The longer the air is released, the quicker the Electric 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.*

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

Regenerative or Dynamic Brakes: Prototype electric traction motors can act as motors or generators depending on whether they are using power or generating power. When they are generating power, they are hard to turn and can act as brakes. Under dynamic brakes, the power generated from the traction motors is dissipated as heat in large resistor grids, usually located on the top of the locomotive. High volume fans are used to keep the resistor grids from overheating. In regenerative braking, the power from the traction motors is sent back into the electrical distribution system through the overhead wires. In this case, resistor grids and their cooling fans are not required and less power is dissipated in the locomotive. In fact, the power generated from a moving train under regenerative braking is used by other locomotives on the distribution system that are requiring power. If no such locomotives are present, the power is feedback through the substations into the commercial power grid, which allows the railroad to deduct the power generated from their electrical bill. If the commercial power company does not allow power to be supplied to its power grid from the railroad, then dynamic brakes might be employed instead.

When Dynamic or Regenerative Brakes are turned on in a Quantum equipped electric locomotive, the Electric Motor Sound-of-Power drops to its lowest setting and Traction Motor Cooling Fans turn on and Fans for the resistor grid also come on (if dynamic brakes are used). Since dynamic or regenerative brakes are relatively ineffective at low speeds, the Dynamic or Regenerative Brake sounds on the model will shut off automatically below 8 smph (13 skph). *DCC and QARC only.*

Horn: The Quantum System uses authentic locomotive sounds, whenever possible. All Quantum Horns are engineered by QSI sound experts to give you the most authentic effects. If you blow the Horn briefly, you will produce a realistic short Horn sound or “hoot”. Some Quantum Sound sets have special Horn Endings, which can be “played” by tapping the horn button immediately after finishing horn operation.

Alternate Horn: Some electric locomotives had two horns, such as a country horn and city horn. If both horns are available for your model, Standard/Alternate Horn Selection can be assigned to a function key (see CV 53) or selected and operated directly from Quantum Engineer. *DCC and QARC only.*

Bell: North American Electric locomotives and Diesel locomotives, as well as larger Steam locomotives usually have pneumatically operated mechanical bells. Small Steam locomotives often have hand-pulled bells. During turn-on in Neutral, you will hear the pneumatic clapper gain greater throw with each stroke until it finally strikes the Bell. During shutdown in Neutral, you will hear a Short Air Let-off followed by the Bell sound fade out.

⁴⁷ Not all features are included on every Electric. Consult your Electric Model Specifications sheet for a list of features and sounds that apply to your particular locomotive model.

Doppler Run-by: The locomotive 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 Horn is no longer being blown, the Bell shuts off automatically and locomotive sounds return to normal.

Coupler: To give you the most authentic coupler sounds, QSI has 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.*

Squealing Brakes/Flanges: When a train enters a curve, the flanges on the wheels ride up on the inside of the rail and 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.*

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://qsindustries.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 electric locomotive 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 electric locomotive as shown in the *Electric 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 locomotive's roof as shown in the *Electric 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 roof of the locomotive⁴⁹ (perpendicular to the track) 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 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.
- Located the jumper as shown in the *Electric 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 and Analog values.

⁴⁸ Tony's Train Exchange; 1-800-978-3472; <http://www.tonystrains.com>.

⁴⁹ The wand does not need to touch the body. It can be held a reasonable distance from the roof area to prevent possibly marring the painted surface.

Locomotives with Magnetic Reed Switches

- Locate the reed switch area as shown in the *Electric 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 high⁵⁰, 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 hoots. This built in safety feature protects Quantum electronics and the electric motor from excessive voltage⁵¹.

- 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.

⁵⁰ The High Voltage Circuit Breaker is set to trip at 21.5 peak volts.

⁵¹ 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.

Sounds & Features Common to Analog & DCC	Analog Features	DCC Features
<p>Horn or hoot Bell with turn off and turn on effects (if so equipped) Electric Motor Whine 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</p>	<p>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 QUANTUM ENGINEER™* 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 Heavy Load Fan on/off toggle Verbal Status Reports Grade Crossing Horn Signal Alternate Horn Selection Audio Mute System Volume Control RTC/STC Throttle Mode Select Fast Programming plus Additional Features</p>	<p>F0 or FL light control F1-F12 Function Keys 14/28/126 speed steps s 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 Selection 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</p>

...ures. With QARC technology, you can operate features that are otherwise available only in DCC plus features that are not yet available in DCC. QARC controllers are inexpensive accessories that employ the QARC system.

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