Lionel® Gas Turbine Locomotive Operation Manual

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

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Introduction

The Lionel Gas Turbine model has two modes of operation, Diesel and Turbine Mode. Diesel operation of the prototype provided only limited power to maneuver the gigantic locomotive in the Yard for servicing and was not used in moving fright. The top speed under diesel mode was about 25 mph. The Quantum system was designed to also limit the speed to about 25 smph in Diesel Mode. When the full 4,500 house power was required for mainline operation, the powerful Gas Turbine was fired up which is also true of the model.

Because the prototype Gas Turbine required considerable time to bring the turbine on-the-line or to shut it down, the operation of the transitions between Diesel and Turbine Mode for the Quantum equipped model is compressed in time. In the case of shutting down the turbine, the twenty-minute sequence is reduced to a little less than a minute. In addition, there are some conflicting reports about the turbine sound itself. Some witnesses report that the Big Blow, as it was commonly called, only had a deafening whoosh sound and no turbine whine at all. In some of the tapes we heard, there appeared to be a slight turbine whine, especially at idle. Some maintained that there was a whine sound distinctly heard as the turbine was revved up before ignition. We have left it to the operator to decide how the Gas Turbine should sound. We have included both a Whoosh sound and Turbine Whine on separate sound channels, which can have their volumes adjusted independently. We have set the defaults of the Turbine Whine to be easily heard during the start up and shut down sequence. However, on the main, the Whoosh clearly dominates especially during Sound-of-Power™ periods.

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 and the Mars Light will start strobing. The locomotive will start out slowly due to special Quantum Inertial Control™ that resists rapid increases or decreases in speed[1].
- 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 gas turbine 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

You can turn on the Bell 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.

Switching between Turbine Mode and Diesel Mode

See the next section, Advanced Analog Features, to learn how to operate the Gas Turbine in Turbine Mode.

1 Because of the limited power of the Cummings diesel, top speed for a prototype in Diesel mode was less than 25 mph. Quantum operation under Regulated Throttle Control (RTC) will also limit the top speed to 25 smph (see Regulated Throttle Control on Page 5)

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-Start[2]). The Diesel Motor sounds will rev up 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 Standard Throttle Control (STC), which has no Inertial Control (see Example 1 under Analog Programming, page 7).

- As you continue to turn up the throttle under RTC, the locomotive will reach a maximum speed of 25 smph while in Diesel Mode which properly models the limited speed of the prototype gas turbine while under diesel power
- As you slow the locomotive down by reducing the throttle to a little below V-start, the Diesel Motor rev or Turbine Whine and labored sounds volume decreases as the gas turbine locomotive comes to a slow stop[3].

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 [4]. The Headlight and Ditch Lights will turn off and the optional Mars Light switches to steady. 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 the Air Pumps start, you can use the direction switch to blow the Horn or turn on or off the Bell.
- If the gas turbine locomotive is in Diesel Mode and left in Neutral From Reverse for 30 seconds, a special Low Idle state marked by subdued throbbing motor sounds will automatically come on. The gas turbine locomotive will return to normal Diesel Motor sounds when throttle is turned up.

Note: If it is in Turbine Mode, there is no special Low Idle sound in Neutral.

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:

- Reduce the throttle to off, change the direction switch and turn the throttle back up to repower the locomotive or,
- Leave the locomotive in Neutral, flip the direction switch (the Horn will come on) and then turn up the throttle.

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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 only occur if the locomotive exceeds 40 scale-miles per hour (64 scale kilometers/hour) and then slows down to below 20 smph (32 skph), which requires Turbine Mode operation.

4 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.

Note: 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 hoots[5]. 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.

Changing between Diesel and Gas Turbine Mode

Diesel Mode to Turbine Mode: The Gas Turbine locomotive comes from the factory in Diesel Mode. Because of the limited power from the diesel motor in the prototype, the model will be limited to 25 smph in Diesel Mode under RTC. To achieve full power from your model for mainline operation, you will need to change to Turbine Mode. To change from Diesel Mode to Turbine Mode:

- Put the locomotive in Neutral.
- Use a flip-and-back operation of the reverse switch four times to produce four short horn hoots in Neutral.

The locomotive will go through a complex Turbine start up scenario as depicted in the graph in Quantum Gas Turbine Sounds on pages 24. At the start of the transition to Turbine Mode, the Mars Light will change from Dim to Off. When the transition scenario is completed, the Mars light will change from Off to steady on.

Turbine Mode to Diesel Mode: The prototype Gas Turbine locomotive was quite inefficient for yard operation at slow speeds. Once the locomotive entered the yard, the turbine was shut down and the locomotive was moved about using the small auxiliary 250 hp Cummings diesel. Under RTC, the model will be limited to 25 smph in Diesel Mode. To change from Turbine Mode to Diesel Mode:

- Put the locomotive in Neutral.
- Use a flip-and-back operation of the reverse switch four times to produce four short horn hoots in Neutral.

The prototype diesel was used to power the turbine blades and slow it down slowly to prevent heat damage. At the start of the transition to Diesel Mode, the Mars Light will change from Steady to Off. When the transition scenario is completed, the Mars light will change from Off to steady on. The locomotive will go through a complex Turbine Shut Down scenario as depicted in Quantum Gas Turbine Sounds on page 25.

Notes: The following is a list of operational issues when changing between Diesel and Turbine Mode:

- After the Turbine Whoosh starts reducing, the Diesel Motor will continue at maximum RPM for 36 seconds to model the Turbine cool down process.
- Cooling Fans and vent opening sounds only occur in Diesel Mode.
- Mars Light, Air Pumps, Cooling Fans and other Neutral Sounds will be suspended during transition from Turbine Mode to Diesel Mode or from Diesel Mode to Turbine Mode, like the prototype.
- If the locomotive is in Turbine Mode or Diesel Mode when power is shut off, the locomotive will power up in the same Mode when power is reapplied.
- If locomotive is at any point in transition from Turbine to Diesel Mode, it will power up in full Diesel Mode when power is reapplied with standard rapid diesel start up sounds.
- If locomotive is in Turbine Mode or in transition from Diesel to Turbine Mode when power is shut off, Turbine sounds will sequence through rapid turn-on operation instead of artificially and abruptly producing full Turbine sounds when power is reapplied.
- If the locomotive is in any point in the transition from Diesel Mode to Turbine Mode, and the throttle is turned up to leave Neutral, the locomotive will terminate Diesel/Turbine transition and rapidly enter full Turbine operation in Turbine Mode.
- If the locomotive is at any point in the transition from Turbine Mode to Diesel Mode, and the throttle is turned up to leave Neutral, the locomotive will terminate Turbine/Diesel transition and enter Diesel Mode.
- A power cycle or a Software Reset (such as POP 11, see page 9) in Analog or DCC will not change from Diesel Mode to Turbine Mode or from Turbine Mode to Diesel Mode. A Hardware Reset using the jumper will always return the locomotive to Diesel Mode.
- It is disallowed to move back and forth between Turbine and Diesel Mode when the locomotive is in transition between either Mode. The transition process must be completed before another transition can be initiated.
- Transition from Diesel to Turbine Mode or transition from Turbine to Diesel Mode will only happen in Neutral. The coded horn (four short horn hoots) will not have any affect on changing modes in Forward or Reverse.

5 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 Locomotive Model Specification sheet for horn sequences used on your model.

- If the locomotive was in Turbine Mode prior to Total Shut Down using a Quantum Engineer, the locomotive will start up and stay in Diesel Mode when Start Up is activated. To return to Turbine Mode the transition from Diesel to Turbine Mode must be activated.
- If you are in Turbine Mode, you will be able to hear the long Air Let-off after entering Neutral but you may not be able to hear the Air Pumps over the sound of the Turbine.

Doppler Effect

This sound effect changes the pitch and volume of the Horn, Bell and other gas turbine 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.

Automatic Features

Quantum features 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	Off	Off	Off
Reverse Light	Off	Off	Bright	Off
Mars Light	Strobing	Steady On	Steady On	Steady On
Number Board Lights	On	On	On	On
Vents & Cooling Fans	Off	On at random times	Off.	On at random times
Diesel Low Idle	Off	Off	On after 30 seconds	Off

Note: Reverse Light operation applies simultaneously to both the Locomotive and the Tender Reverse Lights. These lamps are wired together when the tender is plugged in and are not under separate Quantum control.

Train Load

You can set your gas turbine locomotive to have any of 16 different Load levels, which represent added inertia from rolling stock (see Analog Programming, Option 2 on page 6). 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, in either Diesel or Turbine Mode, the locomotive will produce heavy labored sounds (based on Load setting) until the locomotive has achieved its final speed where it will then produce standard sounds appropriate to its throttle setting. Under deceleration in Diesel Mode, the Diesel Motor sounds are less labored until it achieves its final speed where it will again produce standard Diesel Motor sounds appropriate to its throttle setting.

Note: Turbine Whine and Whoosh will change with the throttle only slightly over the entire throttle range during normal operation in Forward or Reverse since the turbine was often run near full RMP at all times. Although the change in Turbine sound is not as dramatic as change in diesel RPM's or volume, it is nevertheless quite noticeable.

Helpers

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 6.

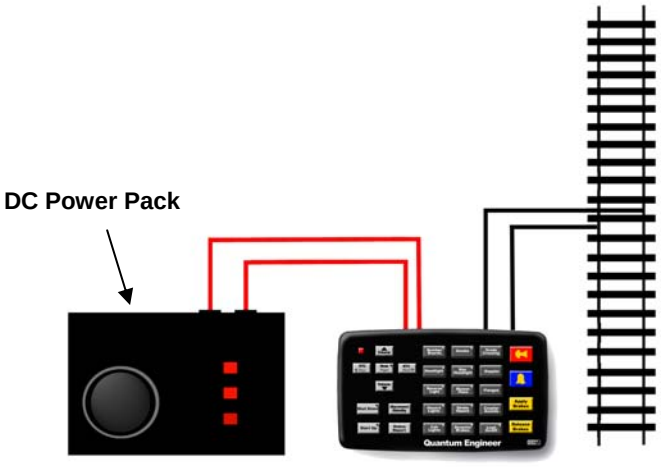
Normal and Reversed Direction

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 or diesel Low Idle 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 6.

Additional Analog Operation Features Available with the Quantum Engineer™ Controller

Your Quantum gas turbine 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, 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 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

Analog Programming

The Gas Turbine 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.

Program Option #'s (POP's[6])	Option Name (Default Value)	Message[7] when Entering Option	Option Description
1	System Volume[8] (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[9]. 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 where locomotive will leave Neutral. (See Example below)
9	V-Max (12v)	"V-Max equals X"	Sets track voltage where full 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 a hoot to indicate the locomotive is returned to factory default condition.
12	About	e.g. "500; 0; 7.0.14; 5/20/2006"	Each **Quick** or **Slow** Operation provides progressive information about Quantum Model Number (500), Sound Set (0), Software Version (7.0.14), and Software Release Date (5/20/2006).
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 in the Analog Reference Manual, 4.0..

Entering Programming

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

1. Apply power and turn up the throttle to hear the sound system come on.
2. Within five seconds of powering up, turn on the Bell with a **Quick** flip-and-back operation.
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.

6 **POP** is short for "**P**rogram **Op**tion".

7 The verbal programming responses (such as "Enter Programming" etc.) have a minimum volume setting to provide programming information even when the system volume is turned all the way off.

8 You can set volume with the Manual Volume Control or with Programming or both. The Manual Volume Control will determine the range of volume control under Programming; that is, if you turn the Manual Volume Control down to say, 50%, you will not be able to increase the volume above the 50% value using Programming.

9 Gas Turbine Number Board Lights are not controlled by the Quantum System and will remain on when track is powered.

Scrolling through the Program Options

- After entering Programming, you will hear an announcement of the first Program Option, "Option 1 - System Volume".
- To access other Program Options, simply flip the direction switch to the opposite position and leave it there. Listen as each option number is announced in order.
- When you hear the Option Number you want, flip the direction switch back and leave it there. After you stop at an option you will hear the option number and name announced. When you are scrolling through and stopping at Program Options, **you are not making any changes**. To make changes you must actually **enter** the Program Option.

Note: If you accidentally go to a higher option number other than the one you wanted, simply turn the power off, re-enter Programming and start again[10]. 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[11]. 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[12].

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".

10 If you have a Quantum Engineer, you can move both back and forth through Program Options.
11 If you have a Quantum Engineer, **Quick** and **Slow** operations are done with specific program buttons.
12 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 over[13] 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)[14]. 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.

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.

13 See section above: Moving on to Other Program Options or Leaving Programming.
14 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 verbal Voltmeter.

DCC Operation

Introduction

The Gas Turbine will initially start and operate as a standard diesel locomotive except that the speed is limited to 25 smph to model the lower power of the prototype locomotive when operated with the small 250 hp Cummings diesel.

These steps will allow you to start operating your Quantum equipped gas turbine 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[15] to hear the diesel Start Up sounds. Number Board Lights will be on and Directional Lighting System (Headlight, Locomotive Reverse Light and Tender Reverse Light, Mars Light) will be on. Use the FL or F0 key to turn on/off the Directional Lighting System.
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 sounds[16].

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.

Note: Under RTC, in Diesel Mode, the locomotive will only travel up to 25 smph [17]; any speed setting above 25 smph in Diesel Mode will not increase speed but will cause the motor sounds to be more labored.

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

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 and Mars Lights on/off**	Directional Head, Reverse and Mars Lights on/off
F1	Bell on/off	Bell on/off
F2	Horn or horn with Doppler Effect (see below)	Horn on/off
F3	Coupler Crash/Coupler Fire	Coupler Arm or Coupler Fire
F4	Cooling Fans on/off	Cooling Fans 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	Toggle Diesel or Gas Turbine modes
F8	Audio Mute on/off	Audio Mute on/off

**Directional Headlight, Reverse and Mars Lights are assigned to Multiple Lights #1.

15 It does not need to be F6; any function or throttle command for a locomotive that is not in Shut Down will activate the locomotive.
16 Neutral sounds also include Cooling Fans with Vents opening and closing that turn on and off randomly.
17 Because of the limited power of the Cummings diesel, top speed for a prototype in Diesel mode was less than 25 mph. Quantum operation under Regulated Throttle Control (RTC) will also limit the top speed to 25 smph (see Regulated Throttle Control on Page 5)

Function Key*	Forward and Reverse	Neutral
F9	Heavy Load on/off	Disconnect/Standby/Shut Down
F10	Locomotive's Speed Report.	Status Report
F11	Multiple Lights[18] 2	Multiple Lights 2
F12	Multiple Lights 3	Multiple Lights 3

* 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 F4 and F9 outputs in Neutral by doing the following:

Set CV49 to 6, set CV50 to 1, and set CV53 to 145. Now F4 in Neutral controls Shut Down.

Set CV49 to 11, set CV50 to 1, and set CV53 to 8. Now F9 in Neutral controls Diesel Cooling Fans.

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	Off	Off	Off
Reverse Lights	F0 or FL	Off	Off	Bright	Off
Mars Light	F0 or FL	Strobing	Steady On	Steady On	Steady On
Number Board Lights		On	On	On	On
Marker Lights		On	On	On	On
Vents & Cooling Fans	F4	Off	On at Random Times	Off.	On at Random Times

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 Reverse Lights in Forward will not cause the Reverse Lights to turn on since their automatic behavior would have them off in that directional state; however, it you then entered Reverse, the Automatic Reverse Lights would turn on. When an indicated function key disables an "automatic" feature, all lights will be off. For instance, disabling "Automatic Reverse Lights" will immediately shut off any operating Reverse Lights and they will not turn on again until the automatic feature is enabled.

Note: Reverse Light operation applies simultaneously to both the Locomotive Rear and the Tender Reverse Lights. These lamps are wired together when the tender is plugged in and are not under separate Quantum control.

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.

Changing From Diesel Mode to Turbine Mode

The Gas Turbine locomotive comes from the factory in Diesel Mode. Because of the limited power from the diesel motor in the prototype, the model will be limited to 25 smph or less in Diesel Mode. To achieve full power from your model for mainline operation, you will need to change to Turbine Mode. There are two ways to do this.

- Press the horn button four times to produce four short horn hoots in Neutral.
- Press the F7 key in Neutral.

The locomotive will go through a complex Turbine Start Up scenario as depicted in the graph below. At the start of the transition to Turbine Mode, the Mars Light will change from Dim to Off. When the transition scenario is completed, the Mars light will change from Off back to Dim.

Note: Turbine fire is a distinctive sound that sounds like a giant gas furnace being ignited.

Changing from Turbine to Diesel Mode (F7)

There are two ways to return to Diesel Mode from Turbine Mode.

- Press the horn button four times to produce four short horn hoots in Neutral.
- Press the F7 key in Neutral.

[18] No lights are currently assigned to Multiple Lights #2 or #3 features and hence F11 and F12 will have no affect. See CV 55 in DCC Reference Manual, Version 4, for more information on Multiple Lights.

The locomotive will go through a complex Turbine shut down scenario as depicted in the graph below. At the start of the transition to Diesel Mode, the Mars Light will change from Dim to Off. When the transition scenario is completed, the Mars light will change from Off back to Dim.

Notes: The following is a list of operational issues when changing between Diesel and Turbine Mode:

- F7 must be set to "1" in Neutral to activate transitions between diesel to turbine or turbine to diesel. If F7 is already set to 1, set to 0 and then set to 1.
- After the Turbine whoosh starts reducing, the Diesel locomotive will continue at maximum RPM for 36 seconds to model the Turbine cool down process.
- Cooling fans and vent opening sounds only occur in Diesel Mode.
- Mars Light, Air Pumps, Cooling Fans and other Neutral Sounds will be suspended during transition from Turbine Mode to Diesel Mode or from Diesel Mode to Turbine Mode, like the prototype.
- If locomotive is in Turbine Mode or Diesel Mode when power is shut off, the engine will power up in the same Mode when power is reapplied.
- If locomotive is at any point in transition from Turbine to Diesel Mode, it will power up in full Diesel Mode when power is reapplied with standard rapid diesel start up sounds.
- If locomotive is in Turbine Mode or in transition from Diesel to Turbine Mode when power is shut off, Turbine sounds will sequence through rapid turn on operation instead of artificially and abruptly producing full Turbine sounds when power is reapplied.
- If the locomotive is in any point in the transition from Diesel Mode to Turbine Mode, and the throttle is turned up to leave Neutral, the locomotive will terminate Diesel/Turbine transition and rapidly enter full Turbine operation in Turbine Mode.
- If the locomotive is at any point in the transition from Turbine Mode to Diesel Mode, and the throttle is turned up to leave Neutral, locomotive will terminate Turbine/Diesel transition and enter Diesel Mode.
- A power cycle or a Software Reset (such as POP 11) in Analog or DCC <u>will not</u> change from Diesel Mode to Turbine Mode or from Turbine Mode to Diesel Mode. A Hardware Reset using the jumper will always return the locomotive to Diesel Mode.
- It is disallowed to move back and forth between Turbine and Diesel Mode when the locomotive is in transition between either Mode. The transition process must be completed before another transition can be initiated.
- Transition from Diesel to Turbine Mode or transition from Turbine to Diesel Mode will only happen in Neutral. Neither the Turbine/Diesel transition by a coded horn (four short horn hoots) or the F7 key will have any affect on changing modes in Forward or Reverse.
- If the locomotive was in Turbine Mode, it will return to Diesel Mode prior to any shutdown operation (F9). The locomotive will start up and stay in Diesel Mode when Start Up (F6) is activated after any shutdown operation. To return to Turbine Mode the transition from Diesel to Turbine Mode must be activated.
- The coded horn Turbine/Diesel Mode toggle can be disabled in DCC in CV 52.2 bit 1. Enable =1 (default) and Disable =0.

Sound-of-Power™

Your Gas Turbine locomotive will produce labored sounds under acceleration and lighter sounds under deceleration but only if CV 3, or CV 23 and CV 4, or CV 24 are set to non-zero positive values. The level of labored sounds is proportional to the values for these four CV's, and how much the throttle is increased or decreased. Labored sounds will be heard in either Diesel or Turbine Mode.

Diesel Motor RPM: Quantum has eight motor throttle "notches" found on most prototype diesel locomotives. As you increase the throttle, you will hear the RPM's increase for every increase in ten speed steps (at 128 speed step setting). Idle is considered Notch 1 and occurs for speed step 0. Notch 2 ranges from 1 to 10, Notch 3 from 11 to 20, Notch 4 from 21 to 30, etc. If your controller has an option to increment or decrement your throttle set setting by ten speed steps, it is very easy and predicable to set your notch value.

Turbine Whine and Whoosh will change with the throttle only slightly over the entire throttle range since the turbine was often run near full RMP at all times. Although the changes in Turbine sound are not as dramatic as changes in diesel RPM's or volume, they are nevertheless quite noticeable.

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 engine 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.

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

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 keys.
- Press F6 to hear the Doppler shift. A few seconds after the horn button is turned off with the F2 key the locomotive sounds return to normal.

Note: If you do not turn on either Horn 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 brake squeal 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 settings [19]. 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 to1 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.

19 CV4 and CV24 determine the deceleration rate. Applying the brakes increases the deceleration rate temporarily.

- 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.

Note: If the locomotive is in Neutral, F7 does not activate Air Brakes; instead F7 affects transition from Diesel to Turbine Mode or Turbine Mode to Diesel.
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.

Three Stages of Gas Turbine 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[20].

Stage One: Disconnect

- Double press the F9 key in Neutral to enter Disconnect. You will hear a Long Air Let-off. The motor drive will be disabled. If the locomotive was in Turbine Mode, it will return to Diesel Mode. The DCC throttle can be moved up and down without the locomotive moving. As the throttle is moved up or down, you will hear the Diesel Motor rev up and down in proportion to the throttle setting.
- 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: In Disconnect, you can also turn on the Dynamic Brakes (see description of Dynamic Brakes below) to create Sound–of-Power as the throttle is moved up and down. Engineers on prototype diesels use dynamic brakes to load the motor-generator to test its output efficiency while the locomotive remains stationary.

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 "Low Idle" sound. The Directional Lighting and optional Ditch Lights or Mars Light will shut down.

  Note: The motor will remain disconnected, while the Air Pumps, automatic Cooling Fan operation, Number Board Lights and Marker Lights will continue to operate. In Standby, the locomotive will not respond to throttle or function keys[21]. The three exceptions are the F6 Start Up Key, the F8 Mute Key and the F10 Status Key.
- 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 the Low Idle diesel motor 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 by the sounds of the Cooling Fans shutting off, the louvers closing, the Diesel Motor shutting down. A few seconds later you will hear the engineer's door open and then shut.

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

Start Up (F6)

If Gas Turbine locomotive is in any stage of Shut Down, you can return it to normal operation by double pressing[22] 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 Diesel Mode operation.

Start Up from Disconnect: If you double press the F6 key in Disconnect, the locomotive will produce a Long Air Let-off, Dynamic Brakes will shut off (if on) and the locomotive will enter normal Diesel Mode operation.

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20 Double pressing ensures that Shut Down stages are not entered or exited accidentally. 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.

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

22 Double pressing ensures that Start Up is not entered accidentally. 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.

Start Up from Standby: If you double press the F6 key in Standby, the locomotive will produce a Long Air Let-off, Directional Lighting will turn on, the Diesel Motor sound will change from the special Low Idle to regular Idle, and the locomotive will enter normal Diesel Mode operation.

Start Up from Total Shut Down: If you double press the F6 key in Total Shut Down, the locomotive will produce a Long Air Let-off, you will hear the engineer's door opening and closing, and see the Mars Light will turn on steady. These actions are followed by the sounds of vents opening, the Diesel Motor starting up, the Air Pumps starting up, followed by a Long Air Let-off and the locomotive entering normal Diesel Mode 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.

Dynamic Brakes (F5)

The prototype Gas Turbine locomotive has dynamic brakes that cause the train to slow down by using the traction motors in generator (rather than motor) mode. This method of braking dissipates the energy of a moving train by converting it to electrical power, which is then applied to a large air-cooled resistor load in the locomotive.

- Pressing the F5 key in Forward or Reverse will set the locomotive Diesel Motor or Turbine sound to idle at the lowest Sound of Power setting and turn on the powerful Dynamic Brake cooling fans.
- Pressing the F5 key in Neutral and Disconnect (see Shut Down above), will turn on the Dynamic Brake Fans while Diesel Motor sounds remain at idle.

Dynamic Brakes automatically turn off when entering or leaving Neutral, when locomotive speed drops below 7 smph (11 skph)[23], or when the throttle is turned up. Dynamic Brakes cannot be turned on in Forward or Reverse unless the locomotive is traveling 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.
Note: Dynamic Brakes sounds will be barely audible over the Turbine roar in Turbine Mode.
Note: Mute Volume can be programmed in CV 51.1.

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 diesel's notch, turbine whine and laboring Sound-of-Power effects. When you approach a grade under Heavy Load, increase the throttle and hear the locomotive rev up with heavy laboring sounds. When the locomotive goes down a grade, reduce the throttle to hear the locomotive's rev drop with light laboring sounds. You control which notch or the change in revs and labored sounds 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. .

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

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 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)[24].

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 for a moving locomotive but produces Diesel/Turbine transitions in Neutral.
- Pressing F6 results in Doppler shift for a moving locomotive but activates Start Up in Neutral.
- Pressing F9 enables Heavy Load in a moving locomotive but activates Shut Down in Neutral.

24 Scale speed report can be programmed to announce in smph or skph 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 Mode[25] 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.[26]
- 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 System Volume can be set to any value between 0 (no sound) and 63 (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 Mute 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 Doppler Shift from Whistle Signal Interrupt and Enable/Disable Turbine/Diesel Transition from Coded Horn (CV 51.2)

- Set CV 49 to 2.
- Set CV 51 to the value indicated in the table below. An "X" in the table indicates that the feature will be enabled. The default is 3 (both features are enabled).

Doppler from Horn Signal	Turbine Transition from Coded Horn	Decimal Value	Binary Value	Hex Value
		0	00000000	00
X		1	00000001	01
	X	2	00000010	02
X	X	**3**	**00000011**	**03**

Changing Individual Sound Volumes (CV 52.PI [27])

To change the volume of individual sounds listed in the table on the next page do the following:

- Set CV 49 to the Primary Index for the individual sound from the table below.
- Enter Volume level in CV 52 as follows: "0" = No sound, "1 – 15" = Sets volume from the lowest value at "1", the highest volume at "15". The volume levels are in 2db increments.

25 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 25.
26 In Ops Mode, you will hear the value spoken out when changing the value of a CV.
27 'PI' refers to the value in column 1 of the table, which is the Primary Index that is entered into CV 49.

Individual Sound Volumes for CV52.PI

Primary Index entered into CV 49	Sound	Default
0	Horn	11
8	Bell	11
10	Diesel Motor	11
13	Turbine Whoosh	11
15	Turbine Whine	11
16	Air Pump	11
19	Diesel Motor Cooling Fans and Vents	11
21	Long Air Let-off	11
22	Short Air Let-off	11
24	Squealing Brakes	11
28	Dynamic Brakes	11
34	Coupler Sounds	11
37	Air Brakes	11

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[28]" 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 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 [29]. 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 = XX").
- If necessary, set CV 29, bit 5 to '0' (or set CV 29 to 6 which is factory default[30]) to enable your new Primary Address.

28 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.
29 "113" is QSI's Manufacturer's ID Number assigned by the NMRA.
30 See Table on Page 22 for additional options for CV29 with bit 5 set to "0".

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 on the next page or follow instructions under CV 17 and CV 18 in the *Quantum DCC Reference Manual (Version 3)* 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").[31]
- If necessary, set CV 29, bit 5 to '1' (or set CV 29 to 38 [32]) to allow operation with your new Extended Address.

Gas Turbine Extended Address values for CV 17 and CV 18 for Different Cab Numbers.

Loco Cab Number	CV 17 (Dec)	CV 18 (Dec)	CV 17 (Hex)	CV 18 (Hex)	CV 17 (Binary)	CV 18 (Binary)
61	192	61	C0	3D	11000000	00111101
64	192	64	C0	40	11000000	01000000
66	192	66	C0	42	11000000	01000010
71	192	71	C0	47	11000000	01000111
73	192	73	C0	49	11000000	01001001
75	192	75	C0	4B	11000000	01001011

Note: When you select your locomotive with a two digit ID as an extended address, you may need to enter leading zeros to distinguish it from a Primary (short) ID on some command stations (e.g. 0062 instead of 62).

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

CV Inquiry with Verbal Feedback in Ops Mode (CV 64)[33]

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 n.PI (where n is the CV number and PI is the Primary Index), set CV 49 to PI before you set CV 64 to n. 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 n.PI.SI where SI is the Secondary Index, set CV 50 to SI in addition to setting CV 49 to PI before you set CV 64 to n. .

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) <u>will not</u> disable CV Inquiry (CV 64).

31 If you want to verify your extended address, set CV 64 to 17 (or 18) to hear the full address spoken out.
32 Entering "38" leaves the other configuration settings in CV 29 at factory default, but changes the ID to Extended Address type. Also see table on next page for other choices.
33 This option is not affected by CV 62 (Disable/Enable Verbal Announcements).

Common NMRA Configuration Values (CV 29)

Each bit in CV 29 controls some basic operational setting for DCC decoders, including Extended Addressing, Speed Table Enable, Power Source Conversion, Lighting Operation, Locomotive Direction, and others. Quantum default for CV 29 is 6.

The following table provides some of the more common values for CV 29 for the features indicated.

Extended Addressing	Speed Tables	Power Conversion	28/128 Speed Steps	Reversed Direction	Decimal Value	Binary Value	Hex Value
			X		2	00000010	2
		X	**X**		**6**	**00000110**	**6**
	X		X		18	00010010	12
	X	X	X		22	00010110	16
X			X		34	00100010	22
X		X	X		38	00100110	26
X	X		X		50	00110010	32
X	X	X	X		54	00110110	36
			X	X	3	00000011	3
		X	X	X	7	00000111	7
	X		X	X	19	00010011	13
	X	X	X	X	23	00010111	17
X			X	X	35	00100011	23
X		X	X	X	39	00100111	27
X	X		X	X	51	00110011	33
X	X	X	X	X	55	00110111	37

For more information, download the *Quantum DCC Reference Manual (Version 3)* from http://www.qsindustries.com.

Quantum Gas Turbine Sounds

Diesel Motor Rev: The diesel used in the prototype was a Cummings 250 horsepower motor. In Diesel Mode under RTC, the Gas Turbine top speed is limited to 25 smph. Quantum allows the Diesel Motor to be operated over eight notches corresponding to the throttle notches used on most prototype diesels. As the throttle is turned up, the Diesel Motor RPM will increase in fixed increments until the maximum RPM occurs at notch 8. All eight notches are evenly distributed between 0 and the maximum speed step.

Turbine Whoosh: The U.P. Gas Turbine produced an almost deafening roar that seemed to drown out all but the horn. It was sometimes referred to as "The Big Blow" since its dominant sound was that of furiously rushing exhaust gas. We have modeled this effect by synthesizing this sound in the Quantum system until it sounded exactly like the prototype gas turbine. We have coupled this effect to our Sound of Power™ concept to provide labored Turbine Whoosh when the locomotive is under load.

Turbine Whine: Some witnesses to the prototype gas turbine maintain there was no turbine whine, such as the sound that a jet airplane would make. However, other witnesses say that there was a discernable whine as the turbine was revving up that could still be barely heard at idle. We have included a separate whine sound in the Quantum System, which can easily be heard during the transition from diesel to turbine sounds, and which is almost buried in the Turbine Whoosh sound when the turbine is "on the line".

Low Idle: Low Idle is used on prototype locomotives to maintain a warm and ready locomotive with a minimum of fuel consumption. The special Low Idle sound has a lower base throb and is less harsh than the normal idle.

Vents and Cooling Fans: The Cummings diesel motor and generator enclosed in the Gas Turbine cab need ventilation to stay cool. All diesel locomotives have powerful cooling fans on the roof to draw outside air through louvers on the sides of the locomotive. When cooling fans start, you will also hear the sounds of louvers opening. When cooling fans shut down, you will hear the louvers close after the fans have quit.

Air Pumps: When a locomotive is sitting still, the pumps come on in a steady beat to replace the air lost from the brake air release or any other air operated appliances. Once the pressure is up, the pumps only turn on occasionally to maintain the pressure. Air Pumps are operated directly from the Diesel Motor or from two electric motors when the turbine is "on the line". Air pumps are quite noticeable when turned on in a non-moving locomotive in Diesel Mode. You will also 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 diesel locomotive model as braking is continually increased. The longer the air is released, the quicker the gas turbine 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 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 gas turbine locomotive slows to a stop.

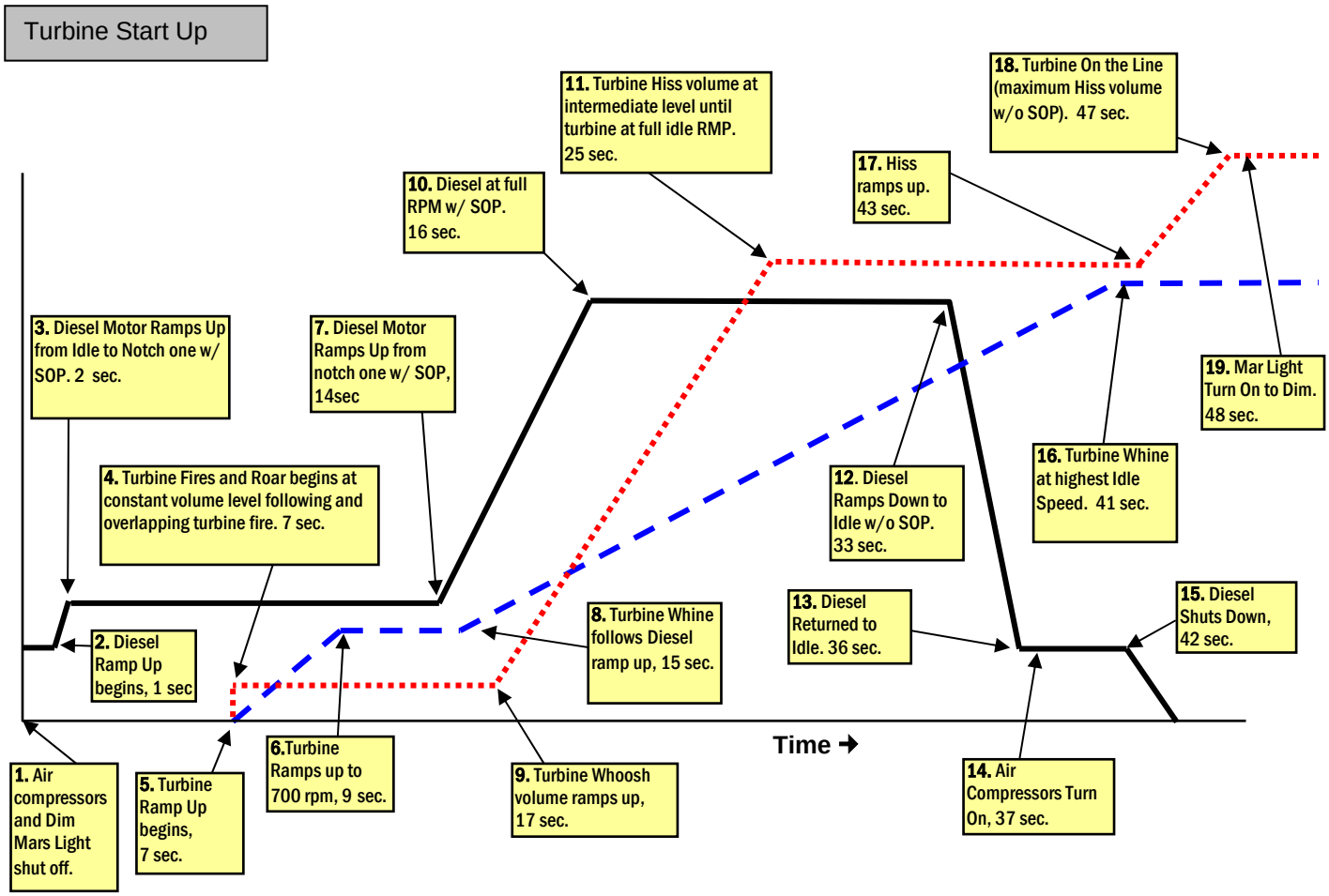
Dynamic Brakes: Electric motors can act as motors or generators depending on whether they are using power or generating power. When used as generators, the traction motors are disconnected from taking power from the locomotive's prime mover, and instead are connected to large resistor grids in the roof. By increasing the resistive load on the traction motors, the traction motors become harder to turn and act as brakes for the locomotive. The electric power generated by turning the traction motors is dissipated as heat by the resistor grid. These resistor arrays get quite hot and require cooling. When Dynamic Brakes are turned on under Diesel Mode operation, the Diesel Motor sound drops to notch 1 and the Dynamic Brake cooling fan sounds come on. Under Turbine operation, the Turbine sound will drop it its lowest Sound of Power setting but since the Turbine Whoosh stays relatively constant and loud, it may be difficult to hear the Dynamic Brake sounds. Since dynamic brakes are relatively ineffective a low speeds, the Dynamic Brakes will shut off automatically below 8 smph (13 skph). ***DCC and QARC only.***

Quick Locomotive Start Up. If the locomotive is in Diesel Mode, the Diesel Motor will start quickly when the gas turbine is powered up or addressed. If the locomotive is in Turbine Mode, it will quickly enter Turbine Mode when operated. Extended turn-on effects occur if locomotive is started from Total Shutdown.

Air Horns: The horn used for the Gas Turbine is a single chime horn usually found on early F units. Some commercial videotapes of the Gas Turbine have dubbed a multi-chime horn in for sound effects and do not represent the actual locomotive horn. In addition, the Gas Turbine horn includes a special short horn blast. If you blow the horn briefly, you will produce a realistic short horn sound or "hoot".

Bells: Diesels and electric locomotives and larger steam locomotives usually have pneumatically operated mechanical bells and so does the gas turbine. Pneumatic bells can be as distinctive as pull bells. They are characterized by their tone, clapper rep rate and their location on the locomotive. In addition, it often takes time to get the clapper up to speed on the prototype or to shut down. When the Quantum bell is turned on in Neutral, you will hear the wheezy sound of the pneumatic clapper starting up before the bell starts to ring and you will hear the bell fade out with soft rings along with the Short Air Let-off sound associated with turning this appliance off.

Transition from Diesel to Turbine and Ignition: Starting the gas turbine was a complex procedure which required considerable time for the turbine to be at full power. We have shortened the amount of time to start the turbine in the model but preserved much of the important procedures necessary to bring the turbine "on the line". This includes first ramping up the diesel locomotive one notch to start the turbine rotating to the point where it would fire. The firing of the gas turbine model sounds a bit like lighting a large industrial gas furnace. At this point the turbine starts revving up with its distinctive whine coupled with a low level Whoosh. The diesel is then revved up further followed by the turbine whine and whoosh increasing up to the point where the diesel disconnects and returns to idle. Shortly after this, the turbine is ramped up to full power where the Whoosh or roar now dominates the Turbine Whine. The complete Turbine Start-Up procedure is shown in the block diagram below. (SOP in blocks means Sound Of Power™)



There are three operations shown:

The solid black lines show the volume and RPM operation of the Diesel Motor.

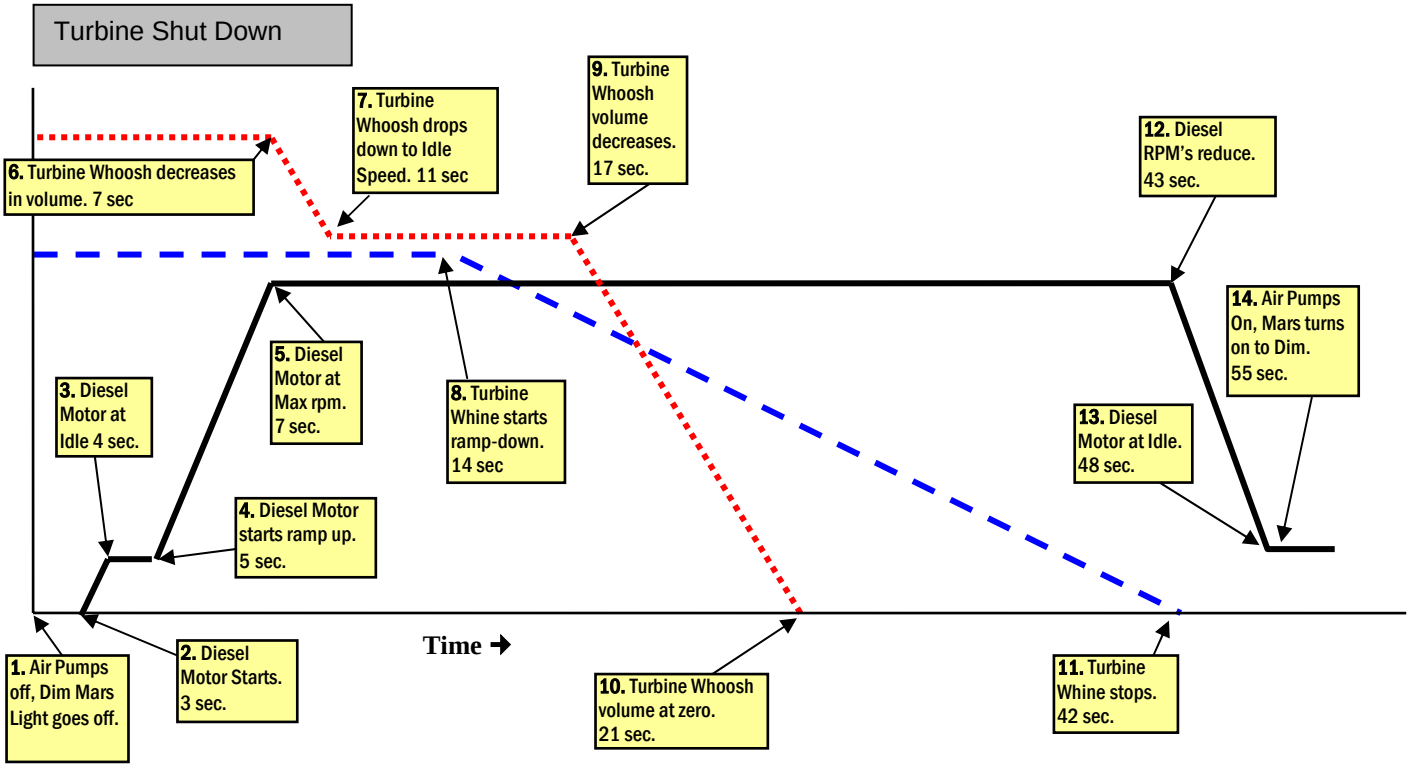
The dotted blue line with large dashes shows the volume and RPM of the Turbine Whine.

The dotted red line with small dashes shows the volume of the Turbine Whoosh.

The yellow boxes indicate major events in the transition to Turbine Mode. The timing shown in each box indicates the number of seconds since the transition command was sent to start Turbine Mode.

Note: Turbine fire is a distinctive sound that sounds like a giant gas furnace being ignited.

Transition from Turbine to Diesel: Turning off the turbine was almost as complex as turning it on. The diesel is first ramped up to engage the turbine at full RPM. The turbine is dropped down to idle and the turbine throttle is reduced to zero. The Diesel Motor is maintained a full power to allow the turbine to cool over about 40 seconds; during this period, the Turbine Whoosh is first reduced to off while the Turbine Whine is gradually reduced to zero. After the turbine is completely shut down, the Diesel Motor returns to idle. The complete Turbine Start-Up procedure is shown in the block diagram below.



Doppler Run-by: On prototype 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 change the pitch to occur 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.

Flanges or Extended Brakes: When a train enters a curve, the flanges on the wheels tend to ride up on the inside of the rail and squeal. Recreate this squealing effect by pressing and releasing the Brake Sound function key button quickly and repeatedly as necessary. Or for slow stops, use the same function key to produce long protracted squealing brake sounds.

Dynamic Brakes: Electric motors can act as motors or generators depending on whether they are using power or generating power. When used as generators, the traction motors are disconnected from taking power from the locomotive's prime mover, and instead are connected to large resistor grids in the roof. By increasing the resistive load on the traction motors, the traction motors become harder to turn and act as brakes for the locomotive. The electric power generated by turning the traction motors is dissipated as heat by the resistor grid. These resistor arrays get quite hot and require cooling. When Dynamic Brakes are turned on under Diesel operation, the Diesel Motor sound drops to notch 1 and the Dynamic Brake cooling fan sounds come on. Under Turbine operation, the Turbine sound will drop to its lowest Sound of Power setting but since the Turbine Whoosh stays relatively constant and loud, it may be difficult to hear the Dynamic Brake sounds. Since dynamic brakes are relatively ineffective a low speeds, the Dynamic Brakes will shut off automatically below 8 smph.

Coupler Sounds: 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 will 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 with 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.

Locomotive Shut Down (Extended): The air pumps will turn off, as well as directional lighting, followed by the sounds of the cooling fans shutting off, the louvers closing, the Diesel Motors shutting down and finally, the engineer's door opening and closing.

Locomotive Start Up (Extended): The engineers door will open and close, followed by vents opening, the Diesel Motor starting up, the air pumps starting up, and the locomotive entering normal operation.

Special Operation and Troubleshooting

For a full description, see the Troubleshooting section in the Quantum DCC Reference Manual (Version 4) and Quantum Analog DC Reference Manual (Version 4) at www.qsindustries.com.

With some Command Stations, using the horn button to activate the Horn, and, while this button is held down, activating the F6 Doppler key, will cause the Horn to shut off instead of causing a Doppler shift effect.

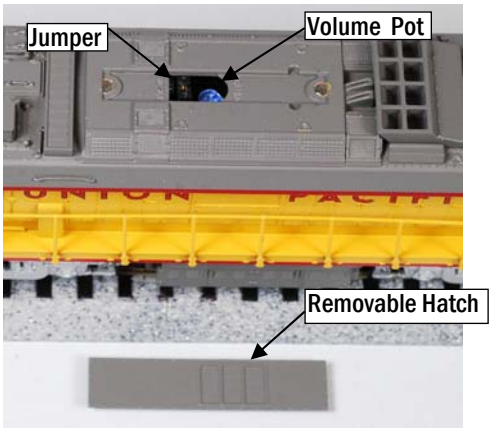
We have experienced intermittent and independent horn signal interruption with some DCC command stations, causing unexpected Doppler shifts. If this happens frequently, you can disable the Horn Triggered Doppler (CV 51.2).

Manual Volume Adjustment (Analog and DCC)

To adjust the volume by hand:

- Locate the removable hatch on the top of your Lionel Gas Turbine locomotive and remove it using you fingernail. It is located in the center of the roof and is held in place magnetically. Manual Volume Control (blue potentiometer) is located towards the front with the Reset Jumper directly behind.
- 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.



Using the Quantum Reset Jumper to Return 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.

- Turn off the power.
- Use small needle nose pliers to pull the jumper up and out.
- Reapply power; after a few seconds you hear three Horn hoots in quick succession.
- Turn power off, reinstall the jumper. The locomotive has now been returned to original factory defaults for all DCC and Analog values.

Program Track Operation (DCC)

Your locomotive conforms to NMRA standards for program track operation. However, the Quantum System requires more current to operate than standard DCC decoders and may not respond to the limited program track power from some 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®[34], a simple, inexpensive power booster (PowerPak™ by DCC Specialties) that will allow you to program on the program track with any DCC command station.

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 for 15 seconds 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 F8 key.
- Check to see if your volume potentiometer or digital sound has been turned all the way down.
- You may have shut your locomotive down in DCC using the F9 key, **which will also shut it down in Analog**. Go back to DCC operation and start your locomotive with the F6 key. Once started, you can return to DC or DCC operation.
- If the above methods do not start your locomotive, use the jumper to reset your locomotive to factory default values as described above.

34 Tony's Train Exchange; 1-800-978-3427; www.tonystrains.com.

Sounds & Features Common to Analog & DCC	Analog Features	DCC Features
Horn or hoot Bell with shut down and turn on Effects Diesel Motor Low Idle Sounds Gas Turbine Transition between Diesel/Turbine 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/Off Headlight Reverse Light Tender Lights Mars Light Number Board Lights Constant Brightness Lighting. Regulated Throttle Control™ Standard Throttle Control Downloadable Sound Sets and Software via QSI Programmer Module. Manual Volume Control with Volume Pot Reset to Factory Default with Jumper	System Volume Programming Individual Sound Volume Control Helper Type: (Normal) Normal loco, Lead Loco, Mid Helper, End Helper. Direction: Normal/Reversed DC Power Pack Programming V-Max (12v) V-Start (8.5v) **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	F0 or FL light control F1-F12 Function Keys 14/28/126 speed steps (28/126) 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

*** Quantum Analog Remote Control (QARC) Technology allows commands to be sent to locomotives under Analog control to operate different Quantum features. 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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