Lionel® Gas Turbine Locomotive Operation Manual

for QSI® Quantum-1 System™ Analog & DCC Sound Decoder Equipped locomotives

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Version 3.0

Basic Analog Operation

Introduction

The Lionel Gas Turbine model has two modes of operation, Diesel and Turbine Mode. Because the prototype Gas Turbine required considerable time to bring the turbine on 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 only had the 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.

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 with the Number Board Lights turning on followed by a Long Air Let-off. The factory default is to have the locomotive start up in Diesel Mode. You will see the Mars light come on steady and will hear Diesel Start Up sounds.

Continue to turn up the throttle voltage until the locomotive starts to move in Forward. The Directional Headlight will come on and optional Mars Light will start strobing. As you turn up the throttle the diesel will rev through all eight notches and the locomotive will power up to full speed operation.[1]

As you slow the locomotive down by gradually reducing the throttle, Squealing Brake sounds occur as the locomotive comes to a stop.

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.

The locomotive's Reverse Lights on both the locomotive and fuel tender will turn on and the Headlight will turn off. The Mars Light will continue strobing.

Horn

Blow the authentic Turbine 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

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.

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. 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. 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.

[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)

Note: When you toggle the Bell off, it will continue ringing briefly with less volume as the pneumatic clapper slows down, just like the prototype.

Switching between Turbine Mode and Diesel Mode

In Analog, we use a coded horn signal to switch between Turbine and Diesel Mode.

Transitioning from Diesel to Turbine Mode:

In Forward, reduce the throttle until the locomotive stops but do not completely shut off the track power. At this point, the headlight will shut off and the Mars light will stop strobing and switch to steady on and you will hear a Short Air Let-off. About three seconds later, you will hear a Long Air Let-off and the Air Pumps will start.

Do four **Slow** flip-and-back operations of the direction switch to blow the horn four times in quick secession. This will start the transition into Turbine Mode. The steady Mars Light will turn off and you will hear the Diesel Motor rev up followed by the Turbine igniting and the Turbine revving up to full power. The entire procedure takes about 48 seconds. The Mars Light will switch back to steady on at the end of the procedure. You are now in Turbine Mode and can proceed to operate your locomotive with the throttle.

Transitioning from Turbine to Diesel Mode:

Reduce the throttle until the locomotive stops but do not completely shut off the track power. At this point, the Headlight will shut off and the Mars light will stop strobing and switch to steady on and you will hear a Short Air Let-off. About three seconds later, you will hear a Long Air Let-off and the Air Pumps will start.

Do four **Slow** flip-and-back operations of the direction switch to blow the Horn four times in quick secession. This will start the transition into Diesel Mode. The steady Mars Light will turn off and you will hear the Diesel Motor start and rev up to full RPM followed by the Turbine Whoosh and Whine decreasing to off. The Diesel Motor will then decrease to idle. The entire procedure takes about 55 seconds. The Mars Light will switch back to steady on at the end of the procedure. You are now in Diesel Mode and can proceed to operate your locomotive with the throttle.

Note: Once the locomotive is in Turbine Mode or Diesel Mode, it will stay in that mode through direction changes and power downs.

Advanced Analog Features

Starting the Locomotive

Most HO DC power packs with a standard reversing switch[2] are suitable for Analog operation. Generally, modern electronic type power packs will provide better performance.

When operated with a standard DC power pack, your Quantum equipped Gas Turbine locomotive behaves quite differently from other locomotives you may have operated. Unlike standard HO locomotives that start at very low track voltages, Quantum equipped locomotives require a minimum amount of voltage to operate the electronics.

Turn the throttle up slowly. The Number Board Lights will turn on first[3]. As the voltage is increased further, you will hear the Quantum System™ come on with a Long Air Let-off sound. The Mars Light will turn on steady and the Headlight will be off (See a table summary of Directional Lighting Operation in the DCC section of this manual). If you are in Diesel Mode, you will hear the motor in the diesel locomotive start up followed immediately by the Air Pumps.

Continue[4] to turn up the throttle voltage until the locomotive starts to move in Forward (this voltage is called V-Start[5]). The Headlight will switch on bright and the optional Mars Light will begin to strobe.

As you slow the locomotive down by gradually reducing the throttle to a little below V-start, the locomotive speed decreases, while Squealing Brake sounds occur as the locomotive comes to a slow stop[6].

Note: If you need to turn your throttle up quite high to start your Gas Turbine locomotive, V-Start can be adjusted for operation with your particular DC power pack (see Analog Programming on pages 9-11). For recommended power packs, consult the *Quantum Analog Reference Manual* (Version 3) available at http://www.qsindustries.com.

Doppler Effect

This sound effect changes the pitch and volume of the Horn, Bell and other diesel 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, there is no Doppler shift.

Neutral

In Neutral, the Gas Turbine 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 locomotive to stop**[7]. The Headlight or Mars Light switches to a steady dim. The and Reverse Light will remain on if entering Neutral From Reverse (NFR).

You will hear a Short Air Let-off when the locomotive stops moving and enters Neutral, and a Long Air Let-off about three seconds later followed by Air Pumps and other background sounds. In addition to the pumps, diesel motor Cooling Fans and Vents will come on at random time intervals in Neutral. After ten seconds the diesel motor Cooling Fans shut off if they were on when you entered Neutral.

If the Gas Turbine locomotive is in Diesel Mode and left in Neutral From Reverse, a special Low Idle state marked by subdued throbbing motor sounds will automatically come on after 30 seconds (see description of Low Idle in the section on Quantum System Sounds on page 24). The Gas Turbine locomotive will return to normal Diesel Motor sounds when the throttle is turned up.

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2 Some electronic power packs do not have a reverse switch. Instead they have a reverse button, which does not cause a rapid change in track polarity to the track and is not suitable for Quantum operation. See the list of suitable power packs in the *Quantum Analog Reference Manual* (Version 3) at http://www.qsindustries.com.

3 Number Board Lights for the Gas Turbine are directly wired to the track power and will be on whenever track power is applied.

4 It is not necessary to wait for the engine Start Up to finish before entering Forward. If you turn up the throttle, the Start Up sounds terminate and the locomotive will immediately go into normal Forward operation.

5 V-Start is set at 8.5 volts. It is important to note where V-Start is located on your throttle control to know where you will enter and leave Neutral (see *Neutral* on Page 4).

6 Squealing Brakes occur if the locomotive exceeds 40 scale-mph (smph) and then slows down to below 20 smph.

7 If Regulated Throttle Control is enabled (see below) it is important to wait until the locomotive stops on its own. The locomotive's electronic inertia 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 go off.

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

After the Air Pumps start, you can also use the direction switch to blow the Horn or turn on or off the Bell[8].

Note: If you are in Turbine Mode, you will be able to hear the long Air Let-off but you may not be able to hear the Air Pumps over the sound of the Turbine.

If you cannot enter Neutral, or have difficulties with any of the operations, you may need to program your locomotive for optimal use with your particular DC power pack (see Analog Programming in next section).

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 wait for the locomotive to stop[9].

Flip the direction switch after you hear the Short Air Let-off but before you hear the Long Air Let-off and the Air Pump sounds turn 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. Turn the power all the way off, change the direction switch and turn the power back on, or,
2. 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.

Standard Throttle Control™ (STC™) and Regulated Throttle Control™ (RTC™)

Quantum locomotives have two types of Analog throttle control available, Standard and Regulated. Both Standard Throttle Control (STC) and Regulated Throttle Control (RTC) will apply more power to the motor as a function of increasing track voltage beginning at the V-Start setting. RTC includes an Inertial Control™ feature that prevents the locomotive from reacting quickly to changes in voltage or minor impediments to motion such as misaligned track joints, tight curves, rough turn-outs, etc. A locomotive under STC may come to an unrealistic halt from a raised track joint or a drop in voltage[10] while the same locomotive under RTC, with its Inertial Control, will continue at the same speed. RTC operates your locomotive as though it has the mass and inertia of a prototype locomotive; your locomotive will resist changes in speed once it is moving and will resist starting up quickly if at rest. You will be able to operate your locomotive at very slow prototypical speeds without having to adjust your throttle voltage continually to maintain speed.

While small obstacles will not affect the locomotives speed under RTC, a continual force will slow your train down, just like the prototype. For instance, if your diesel locomotive encounters an upward grade under RTC, it will eventually slow down. Providing more throttle will slowly accelerate it back to speed. The same locomotive under STC would quickly slow down or stop if it encountered an upward grade.

The type of throttle control also affects how your locomotive decelerates. Under STC, your locomotive will respond quickly to a reduction in track voltage. Under RTC, your locomotive will decelerate slowly as you bring the throttle down. If you bring the throttle down below V-Start, the locomotive will slowly come to a stop. You can however, force a locomotive to slow down rapidly under RTC by bringing the throttle down quickly; this action reduces the power available to the motor inertial control circuit and forces the speed to decrease faster than RTC would normally allow. Once the locomotive slows down and regains normal RTC operation, it will continue to decelerate slowly according to its built-in inertia and Load setting. For instance, if your locomotive was running at top speed and you quickly reduced the track voltage to just below V-Start (where the locomotive would normally be stopped) the locomotive would at first slow down rapidly as you reduced the available power to the motor. After this initial rapid slow down, the locomotive would decelerate at a rate determined by RTC Inertial Control and Load and finally coast to a stop.

STC and RTC are selected under Analog Programming (see next section). The default for the Gas Turbine is STC.

Note: RTC will have different performance with different power packs. In particular, if your power pack operates at voltages in excess of 12 volts[11], you will want to reprogram V-Max (see Analog Programming) to a higher value. Also see the *Quantum Analog Reference Manual (Version 3)* from http://www.qsindustries.com.

Note: The Gas Turbine in Diesel Mode under RTC will initially start and operate as a standard diesel locomotive except that the top speed is limited to 25 smph or less to model the limited speed of the prototype locomotive when operated with the small 250 hp Cummings diesel. You will need to change to Turbine Mode to achieve full power, just like the prototype.

[8] In Neutral, the mechanical Bell feature has a distinctive turn-on effect as the pneumatic clapper gains full motion to strike the bell. The Bell may also have a shut-down effect where each strike becomes less loud as the clapper slows its motion.

[9] On some power packs that have high internal resistance, the track voltage may rise slightly as the locomotive slows down and requires less power to operate. With these power packs, as the locomotive slows, you may need to reduce the throttle a little more to remain below V-Start.

[10] For instance, blowing the Horn takes power and can reduce track voltage substantially and quickly. Under STC at low speeds, blowing the Horn can stop your locomotive. Under RTC blowing the Horn will not cause your locomotive to stop or slow abruptly

[11] Most MRC™ Power Packs have a maximum voltage anywhere from 16 to 20 volts, which is above the recommended NMRA standard of 12 volts.

Note: Always make sure all locomotives in a consist are set to the same Throttle Mode and have the same Load Values[12]. If the Gas Turbine is operating under RTC in a consist, make sure that it is in Turbine Mode, since Diesel Mode has a limited top speed of 25 smph and will fight with other locomotives in a consist at higher speeds.

Train Load

You can set your diesel locomotive to have any of 16 different Load levels, which represent added inertia from rolling stock (see Analog Programming in next section). 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.

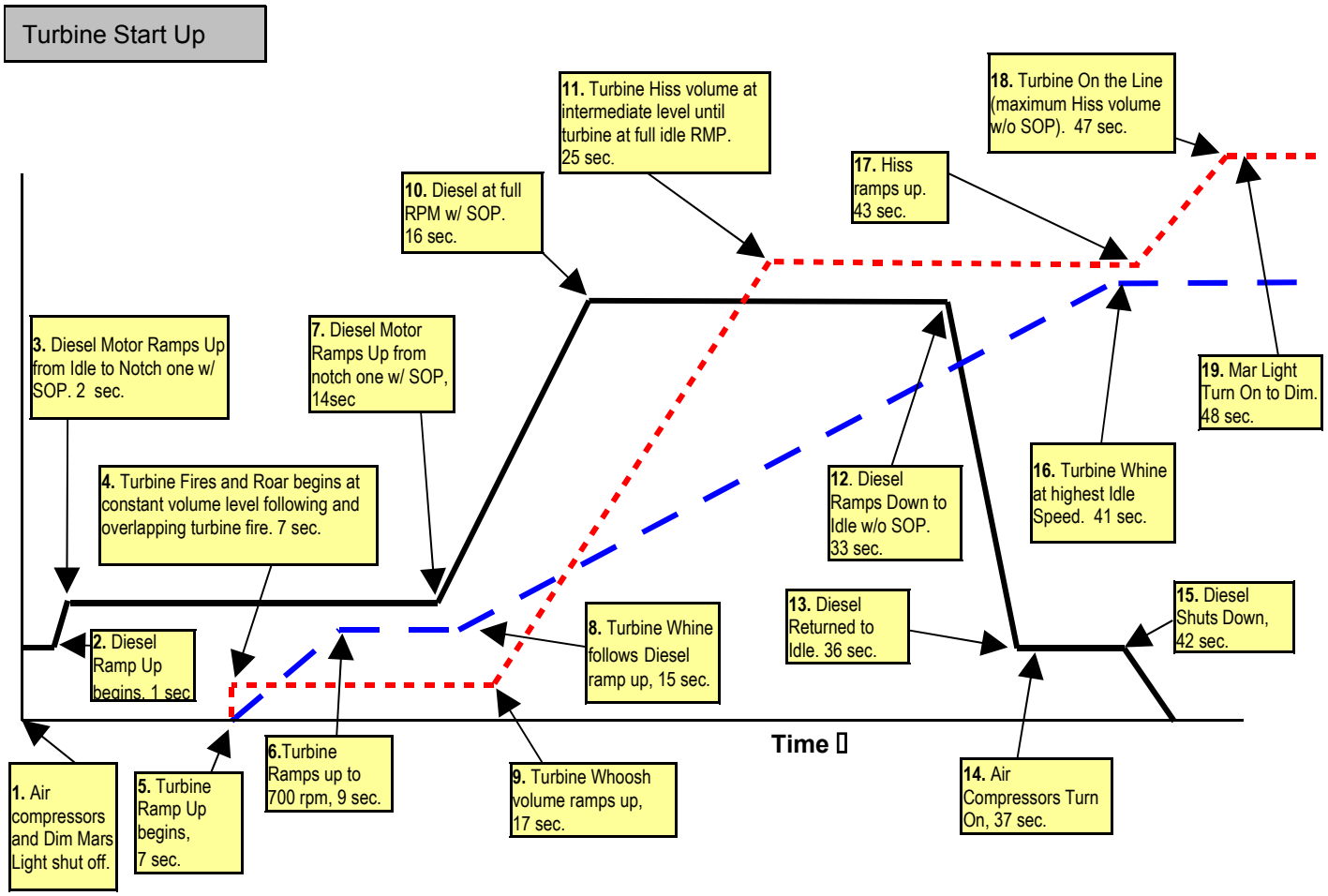
Under STC, the level 0 Load setting will allow your locomotive to accelerate or stop as quickly as the internal flywheels will allow. For any Load setting from 1-15, your Gas Turbine will automatically be under RTC and will take longer to change speed. At level 1, it will take approximately 15 seconds or more to achieve full speed at max throttle; at level 15, it will take over 3 ½ minutes to achieve full speed. In addition, at higher Load settings, your engine will decelerate more slowly as you decrease your throttle.

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 engine 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:

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

The engine 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 to steady on.



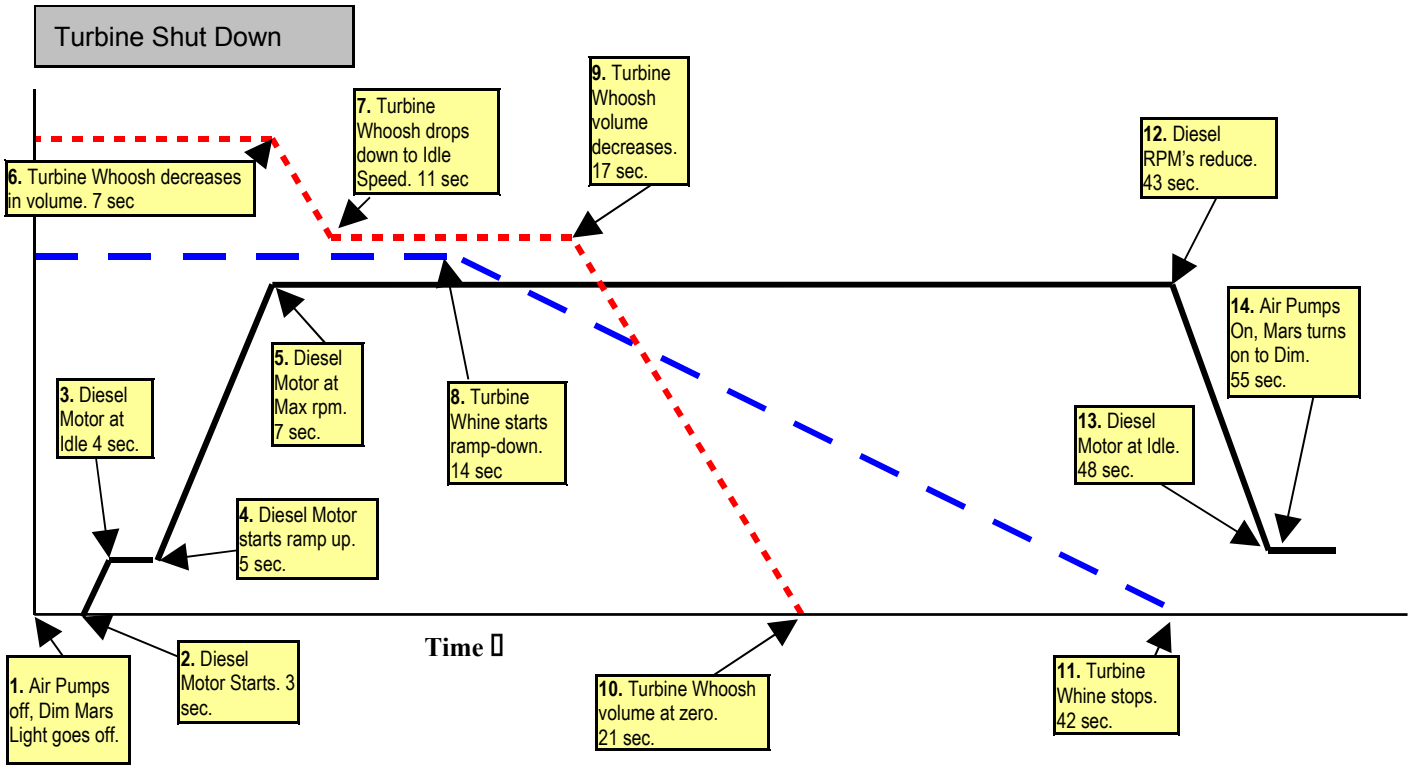
[12] Recent Quantum locomotives use the term "Load" rather than Inertia or Momentum, which better describes the effect.

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.

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:

Press the horn button four times to produce four short Horn Hoots in Neutral.

The locomotive will go through a complex Turbine Shut Down scenario as depicted in the graph below. 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.



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 Software Reset (soft reset) 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.

Sound of Power™

The locomotive will produce Sound-of-Power labored sound effects under RTC if you have selected any of the Load settings from level 1 to 15. Under acceleration, in either Diesel or Turbine Mode, the locomotive 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 locomotive sounds are less labored until it achieves its final speed where it will again produce labored sounds appropriate to its throttle setting.

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

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. Mid-Helper and End-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 from a Normal, Lead locomotive, Mid Helper, End Helper, or Pusher. Each type of locomotive has different lighting and sound characteristics, as described in the table in the next section on Analog Programming.

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[13])	Option Name (Default Value)	Message[14] when Entering Option	Option Description
1	System Volume[15] (16, Max)	"Volume equals X"	Sets System volume (17 levels) where level 16 is maximum volume and level 0 is off.
2	Inertia (0, No Load)	"Load equals X"	Selects the starting and stopping Load. For Level 0 (no Load), Standard Throttle Control (STC) is automatically selected. For Loads from 1-15, Regulated Throttle Control (RTC) is automatically selected. For levels 1-15, Load is increased with acceleration increasing from 15 seconds to 210 seconds.
3	Helper (Normal)	"Helper equals" "Normal", "Lead", "Mid" "End"	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[16]. End Helper has Horn, Bell and all lights disabled except Reverse Light.
4-7	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	Reserved	"Reserved"	
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 (500; 4.4; 02/16/04)	Model number	Each **Quick** or **Slow** Operation provides progressive information about Quantum Model Number, Software Version, and Software Release Date.
13	Horn Volume	"Volume equals X"	Customizes Horn Volume (16 levels). Max is 15.
14	Bell Volume	"Volume equals X"	Customizes Bell Volume (16 levels). Max is 15.
15	Motor Volume	"Volume equals X"	Customizes Diesel Motor Volume. (16 levels). Max is 15.
16	Fan Volume	"Volume equals X"	Customizes Vents and Cooling Fans Volume (16 levels). Max is 15.
17	Reserved	"Reserved"	Customizes Turbo Volume (16 levels). Max is 15.
18	Whoosh Volume (12)	"Volume equals X"	Customizes Turbine Whoosh Volume (16 levels). Max is 15.
19	Whine Volume (8)	"Volume equals X"	Customizes Turbine Whine Volume (16 levels). Max is 15.

Where "X" is the current value of the Program Option. Defaults are shown in parenthesis along with the option name; defaults for volume levels are listed on the Diesel Model Specification sheet included with your locomotive. .

Entering Programming

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

3. Apply power and turn up the throttle to hear the sound system come on.
4. Within five seconds of powering up, turn on the Bell with a **Quick** flip-and-back operation.
5. Within three seconds of the Bell turning on, turn off the bell with a second **Quick** flip-and back operation.
6. 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.

[13] **POP** is short for "**P**rogram **Op**tion".

[14] 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.

[15] 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.

[16] Some lights, such as Number Board Lights, on the Gas Turbine that are not controlled by the Quantum System will remain on.

Scrolling through the Program Options

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

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

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

Note: If you accidentally go to a higher option number other than the one you wanted, simply turn the power off, re-enter Programming and start again or continue up through POP 19 where the Programming Options will start again at POP 1.

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[17]. 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[18].

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 will first return to and announce the current Program Option and then automatically advance to on to higher options.

Exit Programming anytime you want by turning the power off and then back on again.

Example 1: Setting Inertia and Throttle Mode (Program Option # 2)

This will determine whether your locomotive uses Regulated Throttle Control (RTC) or Standard Throttle Control (STC) and will set the Inertia (Load or Momentum) value.

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… etc.". Stop when you hear "two" by moving the direction switch back. You will hear "Inertia".

Use a **Slow** or **Quick** operation of the direction switch to enter this option. If the throttle mode is at its default value (STC), you will hear "Inertia equals 0;" otherwise, you will hear "Inertia equals X." where "X" is the current Inertia level setting.

Use a **Slow** operation of the direction switch to increase the Inertia Setting. At Level 0, there are no inertia effects and the Throttle Mode is set to Standard Throttle Control (STC). At Levels 1-15, the Inertia effects increase and Regulated Throttle Control (RTC) is automatically[19] selected. Use **Quick** operations to reduce the Inertia level.

Once you have selected the Throttle Mode you wish to use, turn the throttle off. When you then power up again, your locomotive will be using the Inertia Value and concurrent Throttle Mode you have just selected.

Note: Set Inertia level to "1" to match the Gas Turbine to current Quantum equipped locomotives that use the factory default settings of RTC and Level 0 Load. This will provide the best operation in consists.

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

This will determine the voltage (and throttle position) where your locomotive will leave Neutral and move out.

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 hear the announcement "Option 1, 2, 3 … etc.". Stop when you hear "eight" by moving the direction switch back. You will hear "V-Start".

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

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

[19] Later Quantum equipped locomotives have a separate Program Option (POP 10) dedicated to selecting Throttle Mode. Load (Inertia) settings remain at POP 2.

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 to leave Neutral.

Use a **Slow** or **Quick** operation of the direction switch to activate this option. Hear the message "Set throttle to V-Start" and after three seconds the voltage will be announced. If you move the throttle, the new track voltage value is announced.

Once throttle is set, use a **Slow** or **Quick** operation of the direction switch to start the procedure. The bell will ring continually, indicating the correct value is being calculated. If you chose a very low setting, be patient. If you do not get a setting within a minute, chose a slightly higher throttle value.

At the end of the process[20], the locomotive will move slightly and stop. 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.

Note: The value of V-Start may decrease from the original voltage reading because the power pack may drop voltage during calibration.
Note: Sometimes it is difficult to see the locomotive move unless you are watching carefully.

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)[21]. 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.

Note: When double heading your Quantum equipped locomotives[22], make sure that both locomotives have similar speed/throttle characteristics by adjusting V-Start and V-Max to prevent them from fighting each other.

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

[20] Later Quantum equipped locomotives use an improved method to set V-Start.

[21] 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.

[22] Do not double-head Quantum equipped locomotives with standard locomotives and then operate the Horn or Bell while locomotives are moving. The standard locomotive will reverse direction and fight with the Quantum equipped locomotive.

DCC Operation

Introduction

Because the Gas Turbine model required considerable time to bring the turbine on-line or to shut it down, the operation of the transitions between diesel and turbine operation is compressed in time. In the case of shutting down the turbine, a 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 only had the 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 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.
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 diesel locomotive immediately using any DCC system that is compatible with the applicable NMRA DCC specifications.

7. Select locomotive number 3.
8. Set your DCC controller to 128 (preferable) or 28 (acceptable) speed step range.
9. Start your locomotive immediately by pressing the F6 DCC function key[23] to hear the diesel Start Up sounds. Number Board Lights will be on and Mars Light will be Dim. Directional Lighting System (Headlight and Reverse Light) will be off. Use the FL or F0 key to turn on the Directional Lighting.
10. Slowly turn up the throttle. Mars Light will strobe. The locomotive default setting is speed control and will maintain the same speed regardless of varying track voltage, grades or other conditions that would normally affect the speed of an HO model locomotive. In addition, the locomotive is pre-calibrated at the factory to move at the speed set by the DCC speed step in scale miles per hour. However, under diesel control, the locomotive will only travel up to 25 smph; any speed setting above 25 smph in Diesel Mode will not increase speed but will cause the motor sounds to be more labored.

When you reduce the throttle to zero, the Gas Turbine will automatically enter Neutral when the locomotive stops. You will hear a Short Air Let-off when the locomotive stops moving and a Long Air Let-off about one second later followed by Air Pumps and other background sounds[24]. The Mars Light will stop pulsing and go Dim and Headlight will go off (if directional lighting had been turned on with the FL key).
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 Lighting on or off	Directional Lighting on or off
F1	Bell on or off	Bell on or off
F2	Horn or horn with Doppler Effect (see below)	Horn on or off
F3	Coupler Crash/Coupler Fire	Coupler Arm or Coupler Fire
F4	Cooling Fans on or off	Cooling Fans on or off
F5	Dynamic Brake function on or off	Dynamic Brake function on or off (only in Disconnect)
F6	Doppler	Start Up
F7	Squealing Brake/Flanges and Air Brakes	Toggle Diesel or Gas Turbine modes
F8	Audio Mute on or off	Audio Mute on or off
F9	Cruise Control on or off (RTC and SC only)	Shut Down (Disconnect, Standby, Total Shut Down)
F10	Short Air Let-off	Short Air Let-off.
F11	Short Air Let-off.	Short Air Let-off.
F12	Mars Light Off/Dim/Pulsing/Off/Dim/Pulsing/etc.	Mars Light Off/Dim/Pulsing/Off/Dim/Pulsing/etc.

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

[23] It does not need to be F6; any function or speed command for a locomotive that is not in Shut Down will activate the locomotive.
[24] Neutral sounds also include Cooling Fans with Vents opening and closing that turn on and off randomly.

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.

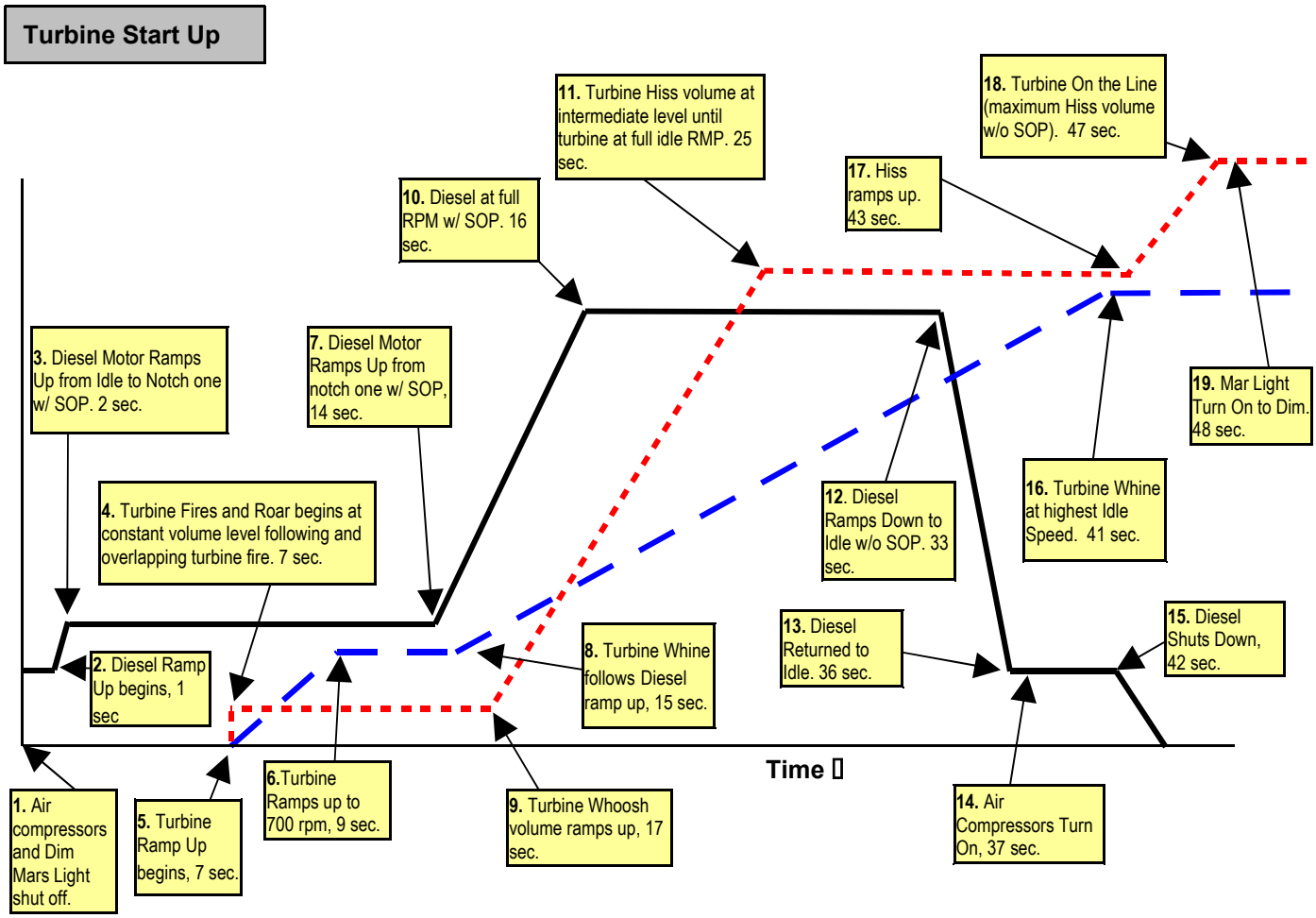
Changing From Diesel Mode to Turbine Mode

The Gas Turbine locomotive comes from the factory in Diesel Mode. Because of the limited power from the diesel engine 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[25].



[25] Mars Light should be in Automatic operation, not "Take Control". See "Automatic Features with "Take Control" "on page 17.

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.

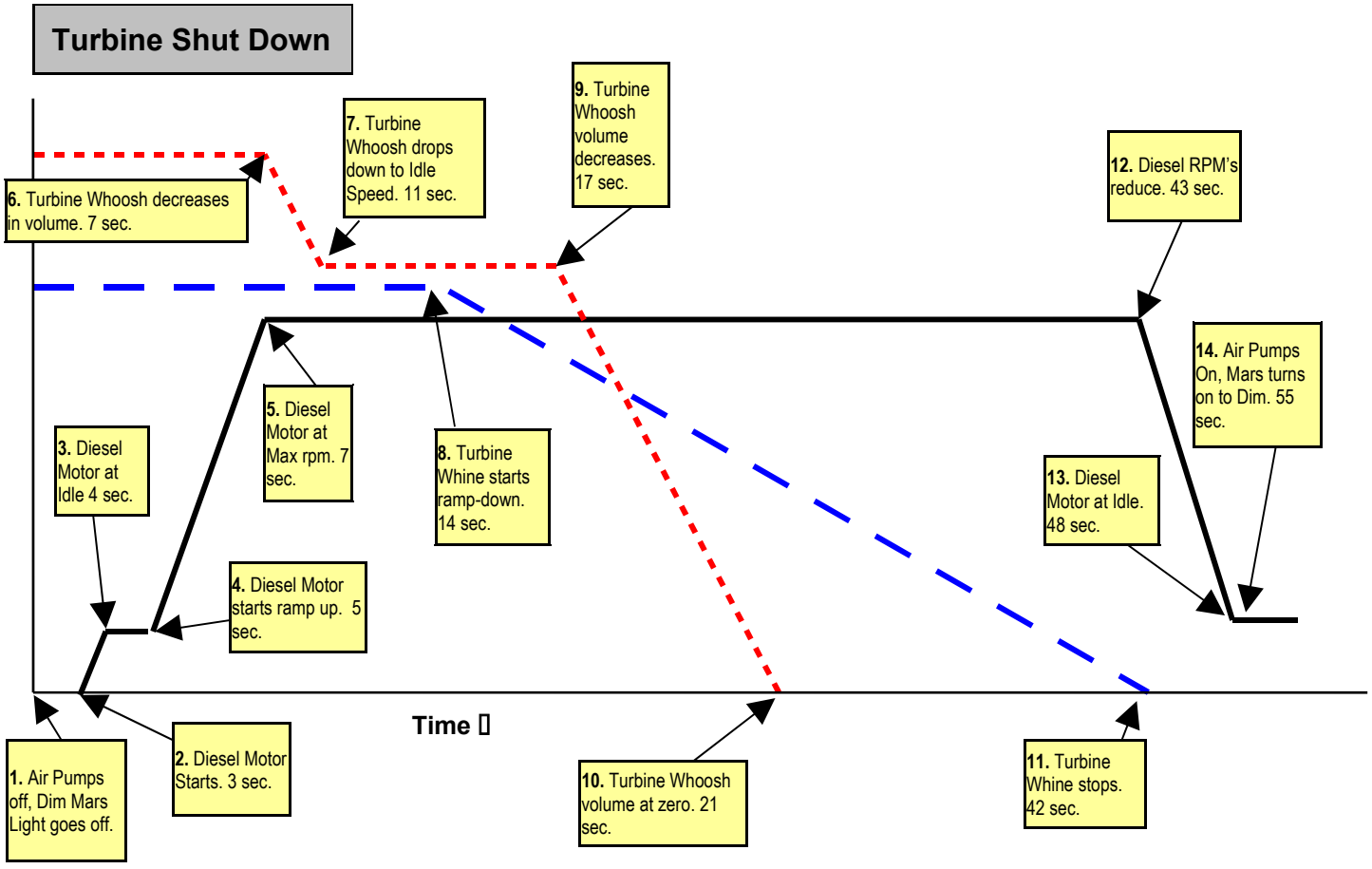
Changing from Turbine to Diesel Mode (F7)

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.

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:

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 Software Reset (soft reset) 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. 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.
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 Diesel Motor throttle "notches" found on most prototype 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.

Directional Lighting Operation (F0 or FL or Headlight)

The FL (or F0, or Headlight) key toggles the Directional Headlight/Reverse[26] on or off.
The defaults for Headlight/Reverse Directional Lights are off. When toggled on, the Directional Lights[27] operate according to the table below.

Directional Lighting Operation in DCC and Analog with Mars Light Option

	Forward	Neutral from Forward	Reverse	Neutral from Reverse
Headlight	On	Off	Off	Off
Reverse Light	Off	Off	On	Off

Note: Number Board lights and Cab light are on whenever track power is applied and are not under the control of the Quantum System.
Note: Both the tender Reverse Light and locomotive Reverse Light will operate whenever locomotive is in Reverse. These lamps are wired together when tender is plugged in and are not under separate Quantum control.

[26] Explicit lighting control features for Headlight, Reverse Light and Mars Light can be assigned to DCC function outputs. (See QSI DCC Reference Manual, version 3)
[27] Quantum uses constant voltage lighting that is independent of track voltage.

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 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 [28].

Pressing the horn button will send the horn command only as long as you are holding 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: The Veranda Gas Turbine uses a single chime horn[29].

Doppler Operation (F6)

With DCC, you can trigger the Doppler Effect by quickly interrupting the horn signal in the same way it is described under Analog operation. Or you can use the function key (F6) dedicated to the Doppler Effect.

Start the Horn and/or Bell by pressing and releasing their function keys[30].

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[31].

Standard Throttle Control, Speed Control and Regulated Throttle Control

There are three ways your locomotive can respond to your throttle.

1. Under **Standard Throttle Control (STC)**, the power to the locomotive is controlled directly by the throttle setting. With STC the speed of the locomotive will change with loading from cars and variations in track voltage.
2. **Speed Control (SC)** uses calibrated internal motor control electronics to maintain the same speed regardless of varying load or track voltage conditions. Under Speed Control, the throttle setting (using 128 speed steps) selects the locomotive's speed in 1 smph (scale miles per hour) increments. If you set the throttle at 35, the model locomotive will go 35 smph on level track or up hill or down hill. If you use 14 or 28 speed steps, you will need to multiple your settings by 9 and 4.5 respectively to compute your scale speed.
3. **Regulated Throttle Control[32] (RTC)** uses a special Inertial Control method to give the locomotive model the feel of a prototype locomotive. It is the preferred method when multiple heading Quantum locomotives together.

Note: All three types of throttle control are available in either Turbine or Diesel Mode.
Note: The 25 smph limit in Diesel Mode is automatically available in SC and RTC but is not available under STC Operation.
The default is "Speed Control". If you prefer, change the setting in CV 56.4 (see next section).

Cruise Control (F9)

Quantum Cruise Control behaves in much the same way as cruise control on a modern automobile.

Press F9 and hear two short toots when Cruise Control is toggled on

Press F9 and hear one short toot when Cruise Control is toggled off.

When Cruise Control is on, the locomotive will continue at its present speed regardless of grades, changes in load, or tight curves. Turning the throttle up or down will not affect locomotive speed, but will cause Sound-of-Power chuffing labor sounds to change in direct proportion to the

[28] Since the prototype horn uses compressed air, you will hear the Air Pump sounds turn on after the Horn is operated.
[29] Some commercial video tapes of the Gas Turbine have dubbed a multi-chime horn in for sound effects and do not represent the actual locomotive horn.
[30] If you do not turn on either Horn or Bell, the Doppler shift will still occur but will be less dramatic.
[31] If the Bell was on, it will shut off prior to sounds returning to normal.
[32] RTC maintains engine speed through minor impediments such as misaligned track joints, rough switches, tight curves, etc, but also allows gradual power equalization when locomotives are used in concert.

throttle's movement from the initial setting (where Cruise Control was turned on). You can increase the laboring motor sounds in Cruise Control as a train climbs a grade or decrease the Sound-of-Power effects as the train moves down the grade.
Return the throttle to its initial setting to avoid acceleration or deceleration when Cruise Control is toggled off.

Note: Cruise Control is only available in Regulated Throttle Control or Speed Control. In Standard Throttle Control, F9 will produce in a Short Air Let-off.
Note: Cruise Control is automatically turned off when the speed step is reduced to zero or track power is turned off.

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.

Squealing Brakes come on automatically when the speed is reduced from high-speed travel (over 35 smph) to less than 10 smph.

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 as long as the locomotive continues moving. See next section.
Note: The Gas Turbine does not have an Air Brake effect using the F7 key that is standard on later Quantum locomotives that actually reduces the speed of the locomotive.

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 mode. This helps dissipate the energy of a moving prototype 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, next page), will turn on the Dynamic Brake Fans while Diesel Motor sounds remain at idle.

The Dynamic Brake function automatically turns off when entering or leaving Neutral, or the speed of the locomotive drops below 7 smph[33], or if the throttle is turned up. The Dynamic Brakes cannot be turned on in Forward or Reverse unless the locomotive is traveling over 8 smph.

Note: 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.

Automatic Features with "Take Control" Operation

The Quantum System allows the operator to take control of certain automatic features by using their associated function key. Once you "Take Control", the features will no longer have automatic operation and you will control their operation and their state with their function key commands. Automatic and Take Control operations are described in the table below.

Gas Turbine Locomotive "Take Control" Operation

	Automatic Operation			**Take Control**	
	Forward	**Reverse**	**Neutral**	**Function Key**	**Operation**
Vents & Cooling Fans	Non-operating	Non-operating	On and off at random times	F4	Toggles Vents/Cooling Fans operation between on or off.
Mars Light	Strobing	Dim	Dim	F12	Mars Light Off/Dim/Pulsing/Off/Dim/Pulsing/etc.

Note: In Neutral, Mars is set at Dim to conform to general Rail Safety regulation Rule 17. In Forward and Reverse, Mars is pulsing.

Take Control of Automatic Cooling Fans with the F4 key to stop Automatic Control and select whether the Cooling Fans are on or off.

Take Control of the Pulsing Mars Light with the F12 key to change the Mars Light state progressively through states of Off, Dim, Pulsing, etc. each time the F12 key is pressed.

Regardless of the state of the automatic fans (on or off), if you press the F4 key, the Cooling Fans will be set to on if the F4 key is "1" and off if the F4 key is "0" and Automatic Control will be disabled. Thereafter, the fans will respond only to the state of the F4 function.
Note: Automatic Control will be restored if the power is shut down and reapplied or if the F6 Start Up key is double pressed in Neutral (see the description of Start Up at the bottom of this page).

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

Note: If Mars Light is under DCC "Take Control" operation, the Mars light will not provide reliable information of the beginning of the Turbine Shut Down operation but will provide information about the beginning of Turbine Start Up operation. Turbine Start Up/Shut Down will reset all "Take Control" features to "Automatic Operation".

Three Stages of Diesel Locomotive Shut Down: 1. Disconnect, 2. Standby, 3. Total Shut Down (F9)

Locomotive Shut Down has three distinct stages that you can control. Each stage is entered by double pressing the F9 key[34]. If the locomotive is in Diesel Mode, any shut down operation will automatically return it in Diesel Mode prior to shut down operation.

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 the next stage of Shut Down: Standby.

If you double press the F9 key in Neutral, the electric motor drive will be disabled. Once you hear the Long Air Let-off, 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.

Note: All function keys are operable in Disconnect.

Note: 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 Mars Light will shut down. The motor will remain disconnected, while the Air Pumps, automatic Cooling Fan operation and Number Board Lights will continue to operate. In Standby, the locomotive will not respond to throttle or function keys. The three exceptions are the F6 Start Up Key, the F8 Mute Key (described below) and the F10 Status Key (described below).

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

Note: Standby is ideal for leaving your locomotive running on a siding. Besides hearing 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

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 sounds of the Cooling Fans shutting off, the louvers closing and the Diesel Motor shutting down. 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 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 locomotive will return to normal 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[35] 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 diesel locomotive will produce a Long Air Let-off, Dynamic Brakes will shut off (if on) and the locomotive will enter normal operation.

Start Up from Standby: If you double press the F6 key in Standby, the diesel locomotive will produce a Long Air Let-off, the Diesel Motor sound will change from the special Low Idle to regular Idle, 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 diesel locomotive will produce a Long Air Let-off, you will hear the engineer's door opening and closing, and see, and the Mars Light will turn on Dim. These actions are followed by the sounds of

[34] 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.

[35] 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.

vents opening, the Diesel Motor starting up, the Air Pumps starting up, followed by a Long Air Let-off and the locomotive entering normal operation.

Note: During the Start Up procedure, none of the DCC function keys are active. 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.

Note: Whenever a Start Up command is sent, regardless of whether the locomotive is in Shut Down or operating normally (in Neutral), the Quantum System will automatically restore all Automatic Control.

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[36].

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 volume setting.

Note: Mute Volume can be programmed in CV 51.1.

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 produces Cruise Control (under RTC and STC) 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 23-24, in the *Quantum System Sounds* section of this manual.

[36] The Gas Turbine Mute feature changes the volume immediately unlike later model Quantum locomotives that changes the sound gradually over a few seconds.

DCC Programming

Most DCC command stations currently available will program Quantum equipped locomotives in Service Mode[37] 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[38]. To change volume in Service or Ops Mode, do the following:

Set CV 49 to 0.[39]

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.

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 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 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.X[40])

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

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

Enter Volume level in CV 52 as follows: "0" = No sound, "1 – 15" = Sets volume from the lowest value at "1", the highest volume at "15". The volume levels are in 2db increments.

[37] 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.

[38] System Volume changes in DCC also apply to Analog and vice-versa.

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

[40] 'X' refers to the value in column 1 of the table, the Primary Index number put into CV 49.

Individual Sound Volumes

Primary Index entered into CV 49	Sound	Default
0	Horn	**11**
8	Bell	**13**
10	Diesel Motor	**7**
13	Turbine Whoosh	**12**
15	Turbine Whine	**8**
16	Air Pump	**10**
19	Diesel Motor Cooling Fans and Vents	**8**
21	Long Air Let-off	**11**
22	Short Air Let-off	**11**
24	Squealing Brakes	**11**
28	Dynamic Brakes	**10**
34	Coupler Sounds	**11**

Standard Throttle Control (STC), Speed Control (SC) and Regulated Throttle Control (RTC) Options (CV 56.4)

Set CV 49 to 4.

Set CV 56 to: 0 for Standard Throttle Control, 1 for Speed Control and 2 for Regulated Throttle Control.

Note: CV 2, CV 5 and speed tables are available for Standard and Regulated Throttle Control[41] but inactive for Speed Control. See DCC Quantum Reference Manual (Version 3).

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

Note: This does not affect Analog settings, except for volumes.

Set CV 49 to 128.

Set CV 50 to 255.

Set CV 56 to 113 [43]. In Ops mode, you will hear 3 hoots 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.

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 *Diesel Model Specification Sheet* or follow instructions in 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. There will be no verbal response.

Set CV 50 to 18.

Set CV 56 to the value of CV 18 from the table. Hear the new full Extended Address spoken out.

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[41] Regardless of the value of CV 2, RTC has a minimum speed of 1 smph at speed step 1.

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

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

Set CV 29, bit 5 to '1' (or set CV 29 to 38 [44]) to allow operation with your new Extended Address.

Loco 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

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[45]; to enable set CV 62 to 1[46]. Default is "Enabled".

CV Inquiry with Verbal Feedback in Ops Mode (CV 64)[47]

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

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

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

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

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.

[44] Entering "38" leaves the other configuration settings in CV 29 at factory default, but changes the ID to Extended Address type.

[45] You will not hear "CV 62 equals 0".

[46] You will hear "CV 62 equals 1".

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

Quantum Gas Turbine Sounds

Diesel Motor Rev: The diesel used in the prototype was a Cummings 250 horsepower motor. Under diesel control in RTC or SC throttle mode, 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 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 turbine. We have coupled this effect to our Sound of Power™ concept to provide labored Turbine Whoosh when the engine is under heavy load.

Turbine Whine: Some witnesses to the prototype Gas Turbine maintain there is 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".

Cooling Fans: The enormous diesel motors and generators 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.

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.

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.

Brakes: You can hear the brake squeal on prototype locomotives when the locomotive is moving slowly and can become particularly loud when the wheels are just about to stop turning. Listen at slow speeds for constant brake squeal sound and the final distinctive squealing sounds as the Gas Turbine slows to a stop.

Quick Engine Start Up. All diesel locomotives have a quick start up and shut down effect when a locomotive is selected. Protracted turn-on effects are available when locomotives are in Total Shut Down (see Controllable Sounds below).

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, as well as larger steam locomotives, usually have pneumatically operated mechanical bells. Diesel bells can be as distinctive as steam bells. They are characterized by their tone, clapper rep rate and their location in 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 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.

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.

Doppler Run-by: The locomotives sounds get louder as the train approaches, then immediately drop to a much lower pitch and lower volume as the train passes by. With a little practice, you can activate the Doppler Effect exactly when and where you want. Doppler pitch change is based on the speed of the locomotive, so the sounds change more dramatically when the locomotive is running faster. After the Doppler shift has occurred and the 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 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.

Coupler Sounds: There are two types of coupler sounds in Quantum depending on the type of operation. When coupling up to rolling stock, hear the sound of a locomotive crashing into and pushing a string of cars. When uncoupling, hear the sound of the lift bar and coupler pin after backing up over a magnet to open the couplers. Hear the knuckle opening and the air brakes parting when moving from the uncoupled cars.

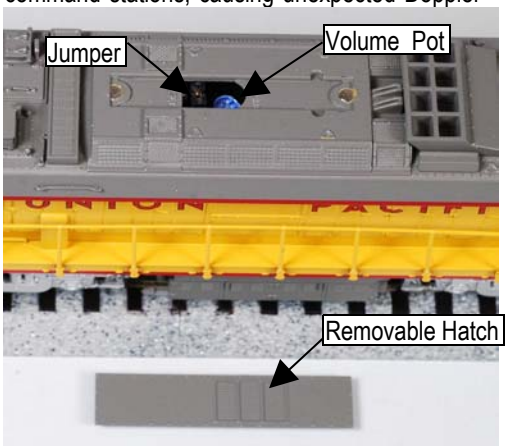
Low Idle: Low Idle is used on prototype locomotives to maintain a warm and ready locomotive with a minimum of fuel consumption. The special Low Idle sound has a lower base throb and is less harsh than the normal idle.

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 3) and Quantum Analog DC Reference Manual (Version 3) 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®[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.

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.

[48] 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 Gas Turbine Motor Transition between Diesel/Turbine Automatic Cooling Fans Doppler Shift Brake 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 Manual Volume Control with Volume Pot Reset to Factory Default with Jumper	System Volume Programming Individual Sound Volume Control Regulated Throttle Control and Locomotive Load Inertia. Helper Type: (Normal) Normal loco, Lead Loco, Mid Helper, End Helper. DC Power Pack Programming V-Max (12v) V-Start (8.5v)	F0 or FL light control F1-F12 Function Keys 14/28/126 speed steps (28) Coupler Sounds 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 Primary Address 2 V-Start 5 V-High 8 QSI MFG's ID Number (113) 3-4,7,17-25,29,33-46,66-95 **QSI CV's supported:** 49 Primary Index 50 Secondary Index 51 Sound Control 51.0 System Volume 51.1 Mute Volume 51.2 Doppler (Enabled) 52 Individual Sound Volume Control 53 Function Output Mapping 56 QSI Configuration 56.4 STC, RTC, SC. 56.128.*n* Reset 56.253 Version Build Information 62 Auto CV Verbal Feedback (enabled) 64 CV Inquiry Verbal Readout

***Settings in parentheses indicate factory default.**

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