SIEMENS

USER'S HANDBOOK

LOCOMOTIVE FUEL OPTIMIZER (LFO), Q2863

July 2010 (Revised June 2014)

DOCUMENT NO. OBE-00-10-03
VERSION A.1

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PRINTED IN U.S.A.

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⚠ WARNING

WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. WARNINGS ALWAYS TAKE PRECEDENCE OVER NOTES, CAUTIONS, AND ALL OTHER INFORMATION.

⚠ CAUTION

CAUTION

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NOTE

NOTE

Generally used to highlight certain information relating to the topic under discussion.

If there are any questions, contact Siemens Industry Inc., Rail Automation Application Engineering.

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REVISION HISTORY

Rev.	Date	Author	Description
A	10/2010	DLW	Initial release
A.1	06/2014	TP	Change to Siemens Branding

1.0 INTRODUCTION

The Siemens Locomotive Fuel Optimizer (LFO), part number Q2863, is a device designed for application to North American specification diesel-electric locomotives that controls the engine speed on individual locomotives in a consist. By controlling the individual engine speeds, the most fuel efficient configuration of the locomotive consist is attained.

Maximum locomotive fuel efficiency in multiple unit operation is achieved without locomotive crew intervention. LFO equipped locomotives calculate the most efficient operation of the consist in each throttle notch. As throttle notches are selected on the lead locomotive, the most fuel efficient combination of individual locomotive throttle notches is selected by the LFO for the trailing locomotives.

1.1 HARDWARE

The LFO is housed in a rugged steel enclosure with a hinged lid. Holes are provided in the mounting base to allow secure attachment within the locomotive. All interfaces to the locomotive wiring are accomplished through circular Mil Spec connectors located on one face of the LFO. All programming is accomplished via DIP switches located beneath the enclosure cover.

1.2 SPECIFICATIONS

Operating voltage	74 VDC supplied from locomotive wiring harness via pins A, B, D and E of the Q9298 cable
Operating Temperature Range	-40 °F to +185 °F (-40 °C to +85 °C)
Internal Event Recorder Memory Capacity	1 Meg
Baud rate	19200
Data bits	8
Start bits	1
Stop bits	1
Parity	None
Dimensions	5.4 inches high (13.7 cm) 12.0 inches long (30.5 cm) 12.2 inches wide (31.0 cm)
Weight	14 pounds, 12.5 ounces (6.7 kg)

2.0 OPERATIONAL OVERVIEW

2.1 INTRA-CONSIST COMMUNICATION

For the LFO to optimize fuel consumption in a consist, there must be two or more LFO-equipped locomotives. LFO equipped locomotives in consist communicate with each other via a carrier signal superimposed on the Forward (8T) and Reverse (9T) locomotive analog (+74 VDC) trainline. When the Multiple Unit (MU) cable is interconnected between locomotives, the physical communication path is established.

Once communication is established, a local communication network is created with one LFO unit assuming the “supervisory” or “system master” role. The supervisory LFO then performs two optimization routines to determine the optimum engine speed for each locomotive in the consist based on the throttle position requested by the locomotive engineer, and sends this information to the other LFO equipped locomotives. No intervention by the locomotive engineer/train crew is required.

The following example shows the results for three GE “Dash-9” locomotives in consist under LFO control.

Notch	Loco1	Loco2	Loco3	Burn Rate (g/hr)	OPT Rate (g/hr)	% Difference
1	1	1	1	23.4	23.4	0
2	2	2	2	46.2	46.2	0
3	Idle	1	6	163.8	155.7	-5.0
4	Idle	3	7	236.7	229.6	-3.0
5	Idle	5	8	326.1	323.3	-0.9
6	2	7	8	421.5	409.6	-2.8
7	4	8	8	514.8	501.3	-2.6
8	8	8	8	381.6	381.6	0

For notches 3 through 7 in this example, the engine speeds of each locomotive are selected by the LFO to provide equivalent tractive effort (horsepower) in the consist, but with decreased fuel consumption. More than 40 EMD and GE locomotives are currently supported by the LFO.

As LFO-equipped locomotives are added to or subtracted from the consist, the optimum engine speed for each locomotive is recalculated by the supervisory LFO and then sent to the other LFO-equipped locomotives in consist. This process cannot be controlled by the locomotive engineer, providing an additional fuel savings opportunity in conjunction with other technologies currently being deployed in the rail industry.

2.2 “SUPERVISORY” OR “SYSTEM MASTER” LFO DETERMINATION

The LFO unit with the highest serial number (newest LFO unit) automatically assumes the role of “Supervisory” or “System Master” LFO. All other LFOs in the consist report to the supervisory LFO via the carrier signal superimposed on the trainline. **The supervisory LFO need not be installed in the lead locomotive.**

2.3 LOCOMOTIVE SPEED

The LFO can accommodate speed inputs from a standard 20/60 pole axle drive, a wide range of armature speed probe applications and a radar signal commonly found on EMD locomotives. The speed signal is communicated from each LFO equipped locomotive to the other LFO equipped locomotives in consist. Failure of a speed input on one locomotive will not prevent the system from becoming active.

Below a speed threshold (currently set at 15 MPH), the LFO will not change the engine speeds for each LFO-equipped locomotive in the consist. The system is active only above the threshold which can be adjusted by the factory.

2.4 THROTTLE VALUE CONTROL

Internal to the LFO unit, a series of five (5) microprocessor controlled relays are used to control the generator field and throttle valves on each locomotive in the consist. As a safety feature, the relays are powered by the generator field signal coming from the locomotive trainline. If a command to load is not present, the LFO cannot change the engine speed and the locomotive will follow the trainline throttle requested by the lead locomotive.

2.5 DYNAMIC BRAKE OPERATION

Regardless of train speed, when the engineer places the locomotive control handle in dynamic brake (DB), the LFO-equipped locomotive engine speeds will revert to trainline/local throttle control.

2.6 MAXIMUM NUMBER OF LOCOMOTIVES UNDER LFO CONTROL

The railroad may include as many locomotives in consist as required. However, the LFO supports up to a maximum of six LFO-equipped locomotives in consist. Locomotive types may be mixed in the consist.

2.7 NON-LFO EQUIPPED LOCOMOTIVES IN CONSIST

Non-LFO-equipped locomotives in consist will follow the throttle notch setting requested by the locomotive engineer. However, fuel savings will be reduced as fewer locomotives in the consist will have the capability for optimization.

2.8 LFO PROGRAMMING AND CONSIST MANAGEMENT

During installation, a series of 16 DIP switches on the LFO are configured to identify the locomotive model and the type of speed input. The locomotive model information is transmitted to the supervisory LFO when it is identified as a locomotive that has been added to the consist. The supervisory LFO then re-calculates the optimum throttle settings for a given trainline throttle request for all locomotives in the consist and transmits the information to each LFO-equipped locomotive.

The 16-position DIP switch is located under the LFO cover. Please refer to Section 4, PROGRAMMING, for proper switch settings.

3.0 INSTALLATION

3.1 LOCATION

Depending on the locomotive model, the LFO is typically installed in the nose of the locomotive or in the high voltage cabinet behind the cab. Mounting holes are provided in the base plate for this purpose.

NOTE

NOTE

The LFO must be connected to the locomotive wiring harness at terminal blocks using the Q9267 and Q9298 cables supplied with the unit. Ensure that LFO mounting location is within cable reach of the terminal blocks.

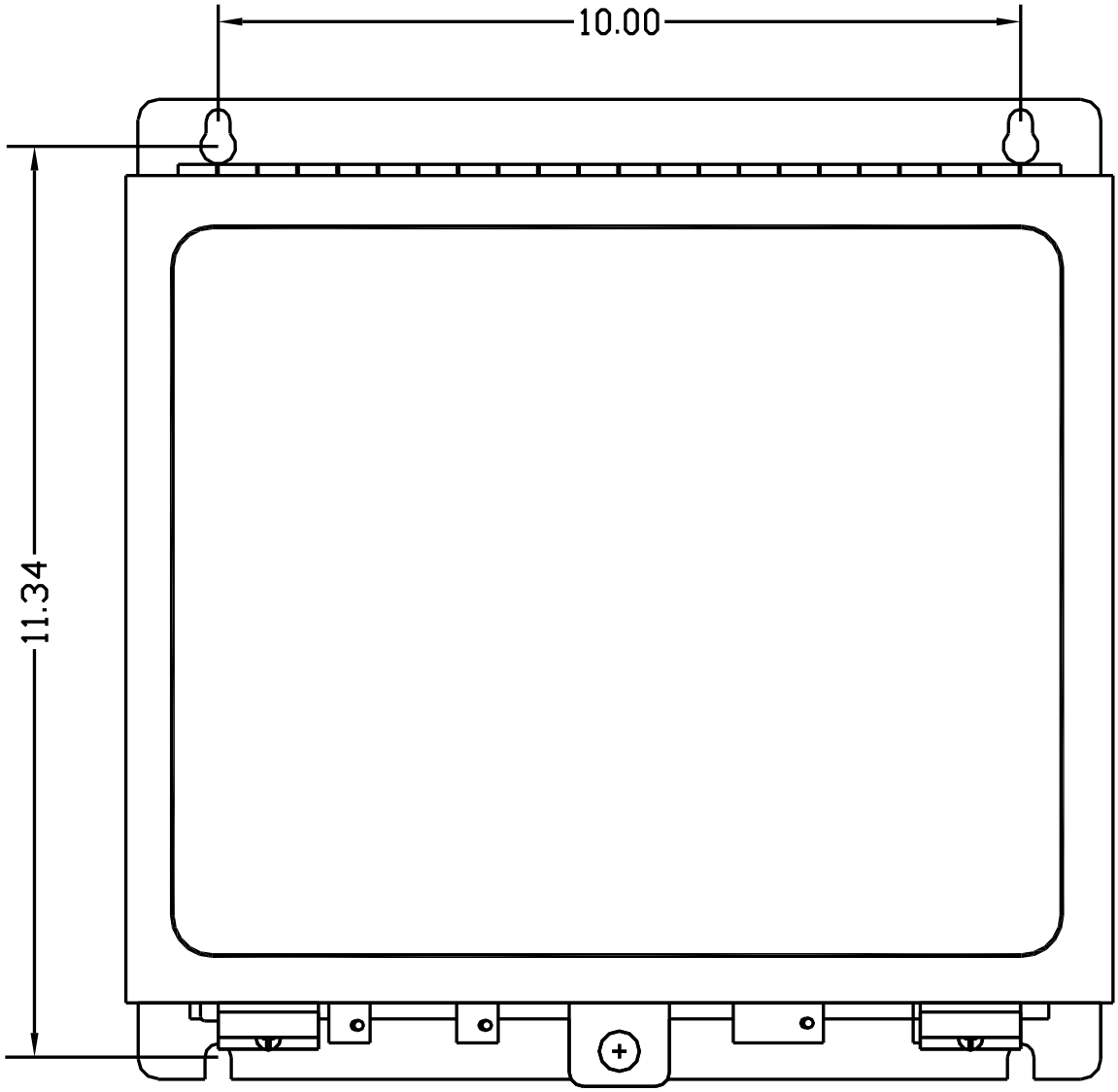


Figure 1. LFO Mounting Hole Dimensions

If the Q2864 Cab Indication panel is used, install it in a visible location in the cab adjacent to the throttle. The Q2864 panel is available in both vertical and horizontal-mount configurations. A minimum of 2 ½ inches of space is required behind the Cab Indication panel for component clearance. Use the supplied Q9354 cable to connect the panel to the locomotive wiring harness (see Figure 4 and Table 1).

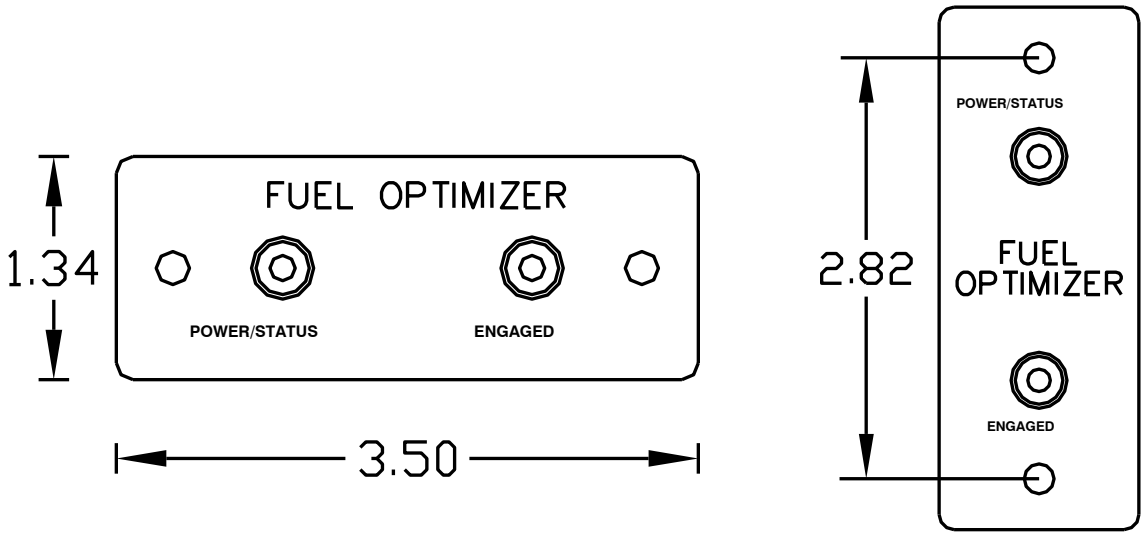


Figure 2. Cab Indication Panel, Q2864

3.2 CABLE CONNECTIONS

To interface the LFO to the locomotive wiring harness, use the Q9267 and Q9298 cable assemblies supplied with the unit. Connect the cables to the LFO in the locations indicated below. Connections to the locomotive wiring harness are indicated on Figure 4 and listed in Table 2 and Table 3. Connector sizes are different to prevent the Q9267 and Q9298 cables from being attached to the wrong LFO connector.

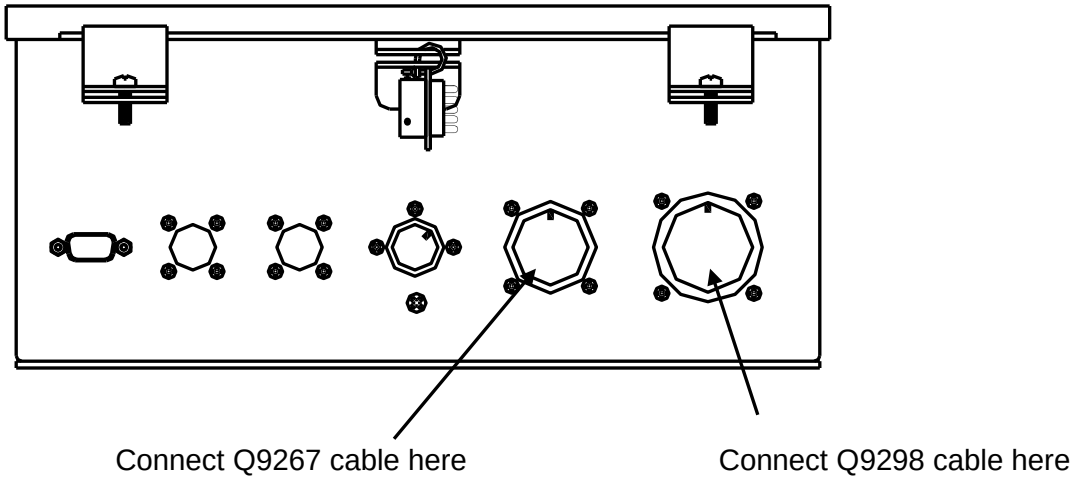


Figure 3. LFO Cable Interface Locations

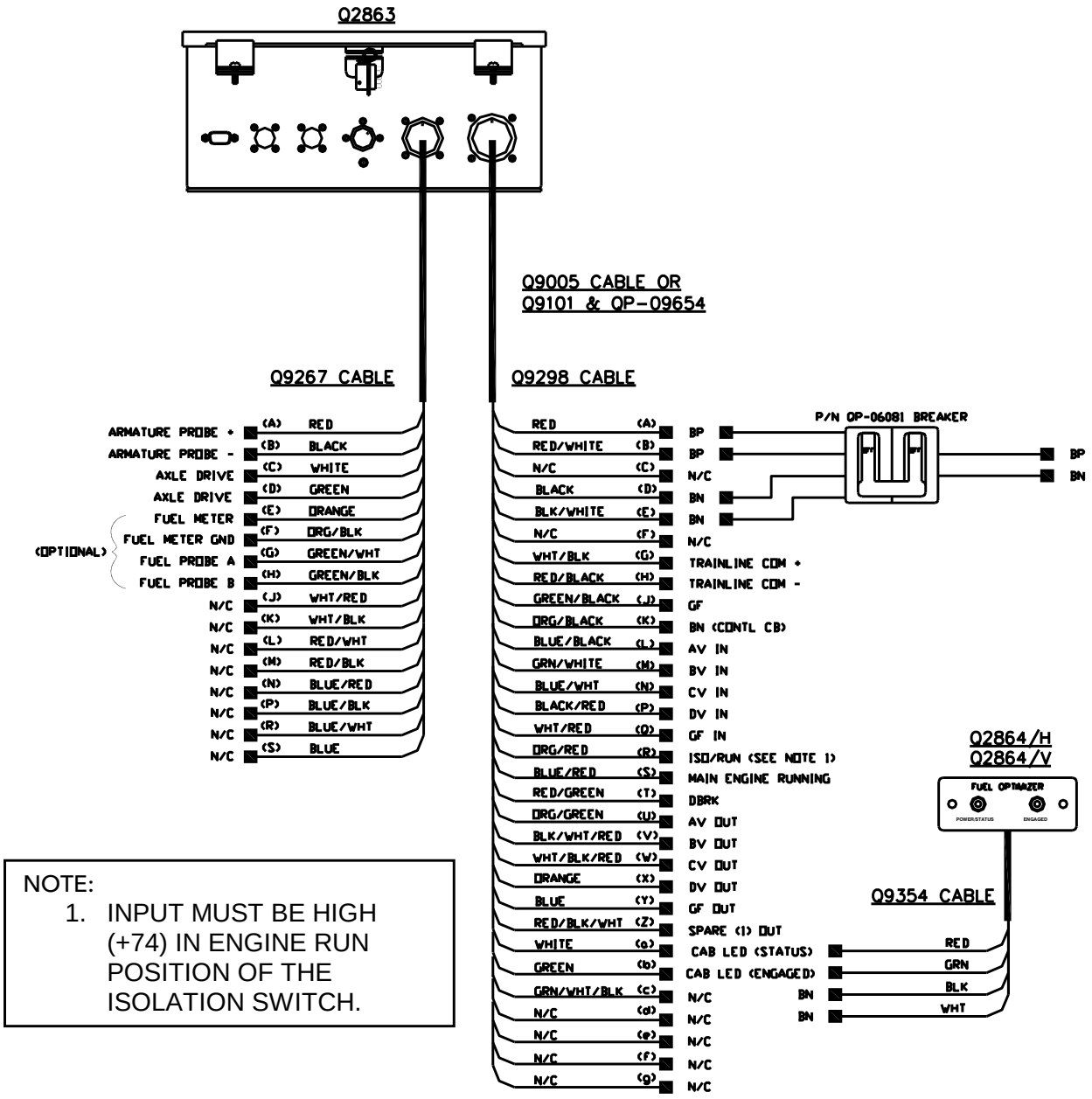


Figure 4. LFO Interface Cable Wiring Diagram

Table 1. Cable Q9354 Connections to Locomotive Wiring Harness

Wire Color	Locomotive Wiring Harness Signal
RED	CAB LED (STATUS)
GREEN	CAB LED (ENGAGED)
BLACK	BN
WHITE	BN

Table 2. Cable Q9267 Connections to Locomotive Wiring Harness

Cable Pin	Wire Color	Locomotive Wiring Harness Signal	Notes
A	RED	ARMATURE PROBE +	
B	BLACK	ARMATURE PROBE -	
C	WHITE	AXLE DRIVE	
D	GREEN	AXLE DRIVE	
E	ORANGE	FUEL METER	OPTIONAL
F	ORG/BLK	FUEL METER GND.	OPTIONAL
G	GRN/WHT	FUEL PROBE A	OPTIONAL
H	GRN/BLK	FUEL PROBE B	OPTIONAL
J	WHT/RED	N/C	
K	WHT/BLK	N/C	
L	RED/WHT	N/C	
M	RED/BLK	N/C	
N	BLUE/RED	N/C	
P	BLUE/BLK	N/C	
R	BLUE/WHT	N/C	
S	BLUE	N/C	

Table 3. Cable Q9298 Connections to Locomotive Wiring Harness

Cable Pin	Wire Color	Locomotive Wiring Harness Signal	Notes
A	RED	BP	
B	RED/WHT	BP	
C	N/C	N/C	
D	BLACK	BN	
E	BLK/WHT	BN	
F	N/C	N/C	
G	WHT/BLK	TRAINLINE COM +	
H	RED/BLK	TRAINLINE COM -	
J	GRN/BLK	GF	
K	ORG/BLK	BN (CONTL CB)	
L	BLUE/BLK	AV IN	
M	GRN/WHT	BV IN	
N	BLUE/WHT	CV IN	
P	BLK/RED	DV IN	
Q	WHT/RED	GF IN	
R	ORG/RED	ISO/RUN	(SEE NOTE 1 IN FIGURE 4)
S	BLUE/RED	MAIN ENGINE RUNNING	
T	RED/GRN	DBRK	
U	ORG/GRN	AV OUT	
V	BLK/WHT/RED	BV OUT	
W	WHT/BLK/RED	CV OUT	
X	ORANGE	DV OUT	
Y	BLUE	GF OUT	
Z	RED/BLK/WHT	SPARE (1) OUT	
a	WHITE	CAB LED (STATUS)	
b	GREEN	CAB LED (ENGAGED)	
c	GRN/WHT/BLK	N/C	
d	N/C	N/C	
e	N/C	N/C	
f	N/C	N/C	
g	N/C	N/C	

4.0 LFO PROGRAMMING

4.1 PROGRAMMING USER INTERFACE

Field programming of the LFO consists of setting the 16-position DIP switch located under the LFO cover. Each LFO used in the consist must be programmed for the locomotive in which it is installed.

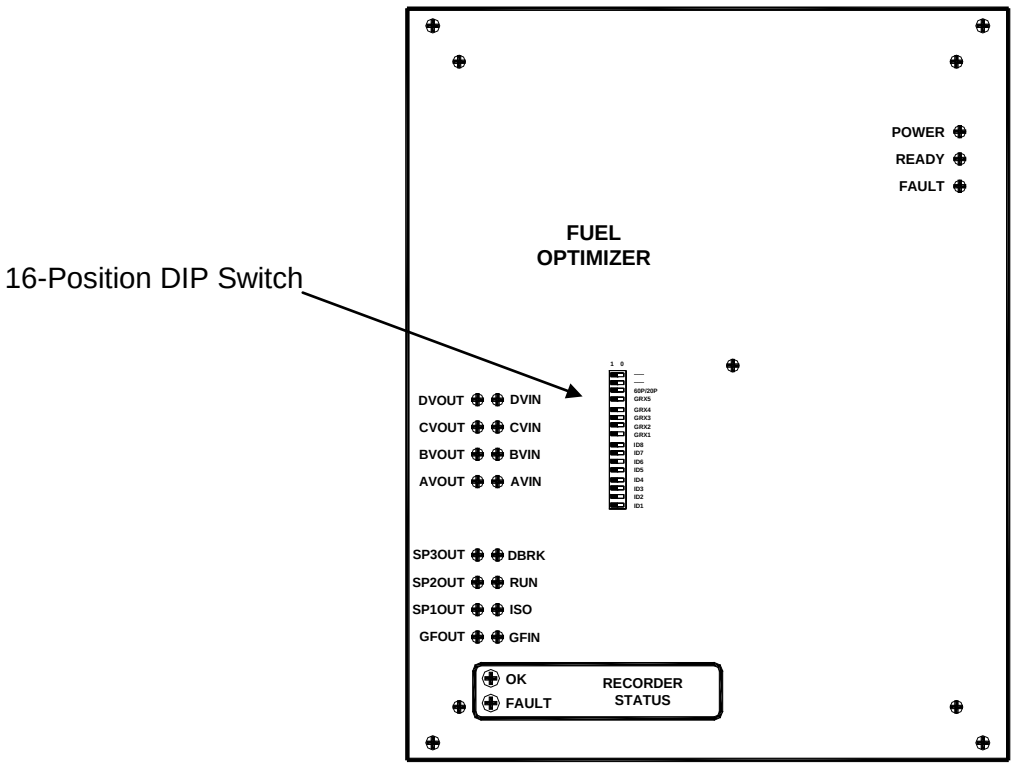


Figure 5. LFO Front Panel (Located Under Cover)

4.1.1 16 Position DIP Switch

Each switch segment in the 16-position DIP switch has two positions, 1 and 0. The 1 position is to the left as indicated in Figure 6. Note that the top two switch segments are not currently used for LFO programming.

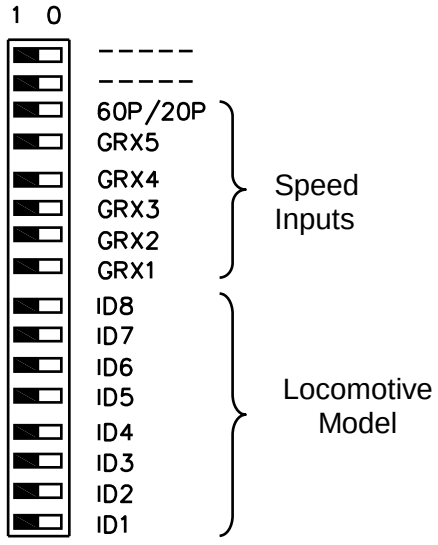


Figure 6. 16 Position DIP Switch

4.1.2 Programming Speed Inputs

The next six positions on the DIP switch are used to program the speed inputs to the LFO. The input programming combinations are shown in Table 4 (traction motor or armature probes only) and Table 5 (axle drive and radar only).

Table 4. Traction Motor/Armature Probe Input Programming

Gear Ratio	Pulses per Armature Rev.	Switch Segment Label					
		GRX1	GRX2	GRX3	GRX4	GRX5	60P/20P
61/16	29	0	1	0	0	1	0
61/16	60	1	1	1	0	0	1
61/16	192	1	1	0	1	1	1
62/15	29	1	0	0	0	1	0
62/15	60	0	1	1	0	0	1
62/15	192	0	1	0	1	1	1
70/17	29	1	1	0	0	1	0
70/17	60	0	0	0	1	0	1
70/17	192	0	0	1	1	1	1
74/18	29	1	0	1	0	0	0
74/18	60	1	0	0	1	1	0
74/18	192	0	1	1	1	0	1
74/29	29	1	0	1	1	0	0
74/29	60	0	1	0	0	0	1
74/29	192	0	1	1	0	1	1
77/26	29	0	0	1	0	0	0
77/26	60	0	0	0	1	1	0
77/26	192	1	0	1	1	0	1
79/24	29	0	0	0	0	1	0
79/24	60	1	0	1	0	0	1
79/24	192	1	0	0	1	1	1
80/23	29	0	1	1	1	0	0
80/23	60	1	1	0	0	0	1
80/23	192	1	1	1	0	1	1
81/22	29	0	1	1	0	0	0
81/22	60	0	1	0	1	1	0
81/22	192	1	1	1	1	0	1
82/21	29	1	1	1	0	0	0
82/21	60	1	1	0	1	1	0
82/21	192	0	0	0	0	1	1
83/18	29	0	0	1	0	1	0
83/18	60	1	0	0	1	0	1
83/18	192	1	0	1	1	1	1
83/20	29	0	1	0	0	0	0
83/20	60	0	1	1	0	1	0
83/20	192	1	1	0	1	0	1
87/16	29	1	0	0	0	0	0
87/16	60	1	0	1	0	1	0
87/16	192	0	1	0	1	0	1
90/19	29	1	1	0	0	0	0
90/19	60	1	1	1	0	1	0

Gear Ratio	Pulses per Armature Rev.	Switch Segment Label					
		GRX1	GRX2	GRX3	GRX4	GRX5	60P/20P
90/19	192	0	0	1	1	0	1
90/21	29	0	0	1	1	0	0
90/21	60	1	0	0	0	0	1
90/21	192	1	0	1	0	1	1
91/20	29	1	1	0	1	0	0
91/20	60	1	1	1	1	1	0
91/20	192	0	0	1	0	1	1
93/18	29	0	0	0	1	0	0
93/18	60	0	0	1	1	1	0
93/18	192	1	0	0	0	1	1
93/19	29	0	1	0	1	0	0
93/19	60	0	1	1	1	1	0
93/19	192	1	1	0	0	1	1
94/17	29	1	0	0	1	0	0
94/17	60	1	0	1	1	1	0
94/17	192	0	1	0	0	1	1
94/18	29	1	1	1	1	0	0
94/18	60	0	0	1	0	0	1
94/18	192	0	0	0	1	1	1

GRX = Gear Ratio

Table 5. Axle Drive/Radar Input Programming

Poles	Switch Segment Label					
	GRX1	GRX2	GRX3	GRX4	GRX5	60P/20P
20	0	0	0	0	0	0
60	0	0	0	0	0	1
RADAR	1	1	1	1	1	1

4.1.3 Programming Locomotive Model

The last eight switch positions (ID1 – ID8) are for programming the locomotive model. Refer to Table 6 for proper programming combinations.

NOTE

NOTE

Any locomotive model configuration not listed in Table 6 is not defined and will yield a fault condition.

Table 6. Locomotive Model Programming

Switch Segment label								Locomotive Model
ID1	ID2	ID3	ID4	ID5	ID6	ID7	ID8	
0	0	0	0	0	0	0	0	B23-7
1	0	0	0	0	0	0	0	B30-7A
0	1	0	0	0	0	0	0	B32-8
1	1	0	0	0	0	0	0	B36-7
0	0	1	0	0	0	0	0	B40-8
1	0	1	0	0	0	0	0	C30-7 (1977)
0	1	1	0	0	0	0	0	C30-7 (1980)
1	1	1	0	0	0	0	0	C30-7 (1981)
0	0	0	1	0	0	0	0	C30-7A
1	0	0	1	0	0	0	0	C36-7 (1980)
0	1	0	1	0	0	0	0	C36-7 (1982)
1	1	0	1	0	0	0	0	C36-7 (1983)
0	0	1	1	0	0	0	0	C39-8 (1983)
1	0	1	1	0	0	0	0	C39-8 (1987)
0	1	1	1	0	0	0	0	C40-8-EFI
1	1	1	1	0	0	0	0	C40-8 (1989)
0	0	0	0	1	0	0	0	C44-9 (DEC 1993)
1	0	0	0	1	0	0	0	C44-9 (SEPT 1993)
0	1	0	0	1	0	0	0	C44AC
1	1	0	0	1	0	0	0	C60AC
0	0	1	0	1	0	0	0	GP30
1	0	1	0	1	0	0	0	GP35
0	1	1	0	1	0	0	0	GP38
1	1	1	0	1	0	0	0	GP40
0	0	0	1	1	0	0	0	GP50
1	0	0	1	1	0	0	0	GP7
0	1	0	1	1	0	0	0	GP9
1	1	0	1	1	0	0	0	SD38
0	0	1	1	1	0	0	0	SD40
1	0	1	1	1	0	0	0	SD45
0	1	1	1	1	0	0	0	SD50
1	1	1	1	1	0	0	0	SD60
0	0	0	0	0	1	0	0	SD60
1	0	0	0	0	1	0	0	SD7
0	1	0	0	0	1	0	0	SD70ACE
1	1	0	0	0	1	0	0	SD70M-2
0	0	1	0	0	1	0	0	SD70MAC
1	0	1	0	0	1	0	0	SD9
0	1	1	0	0	1	0	0	GEVO

4.2 SETUP VERIFICATION USING THE 83000 SOFTWARE

4.2.1 Connecting the PC to the LFO

After the Q2863 LFO is installed in the locomotive and programmed using the 16-position DIP switch, the setup can be verified using the 83000 software running on a laptop PC. Connect the PC to the LFO as indicated in Figure 7 using the Q9101 adapter (supplied with LFO) and a standard RS232 serial cable.

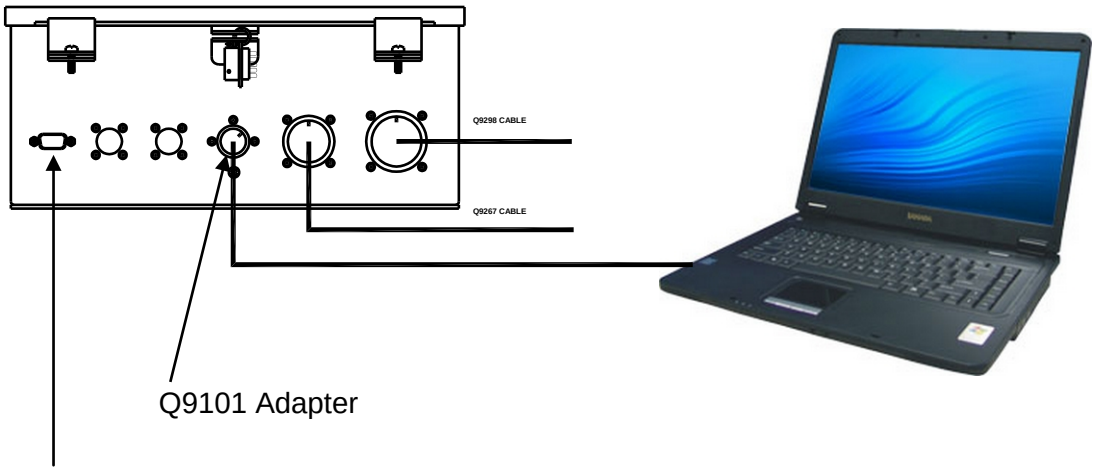


Figure 7. Laptop Computer Connection to LFO

4.2.2 Starting the 83000 Application

Launch the 83000 software by double-clicking the desktop icon or by selecting the application from the All Programs list.

4.2.3 Locomotive Verification

After the Q2863 status is indicated as “READY” (No fault condition), use the 83000 program to verify the locomotive settings.

1. Click the **OK** button on the 83000 display to connect to the Q2863.
2. Click the **Verifier is OFF** button to verify the locomotive model, gear ratio and sensor pulses or poles settings.

5.0 ANALYZING FUEL CONSUMPTION DATA

The LFO is designed to control the locomotive's throttle valves independently of the requested throttle notch. All throttle valve activity is recorded by the internal Event Recorder. When conducting an analysis of a trip, it is necessary to have data downloads from each of the LFO-equipped locomotives in the consist in order to accurately account for the fuel savings. Use the QDP Desktop Playback software to acquire the data downloads and perform the analysis.

5.1 DATA COLLECTION

The following download procedure must be performed for each LFO in the consist.

Equipment required: Computer with QDP Desktop Playback software installed
Q9101 download adapter
Standard RS232 serial cable

NOTE: QDP software part number is 16370

1. Connect the computer to the Q2863 LFO via the RS232 cable and the Q9101 download adapter as shown below.

2. Start the QDP software.

   IMPORTANT: Note the location that the files will be saved. The default location for the Desktop Playback program is C:\QEI\Data.

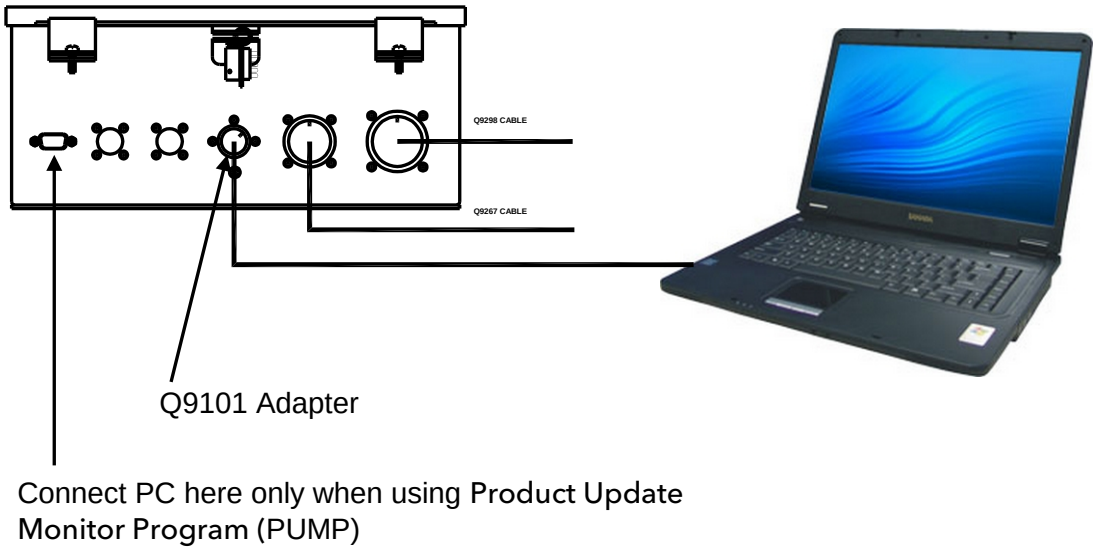


Figure 8. Laptop Computer Connection to LFO

5.2 DATA ANALYSIS

1. Open the QDP software.

2. Select **File** from the menu bar, then select **Open a Disk File** from the menu. The Open File Dialog will appear mapped to the default directory. Select the desired file for viewing and analysis.

QDP with a Data File Open

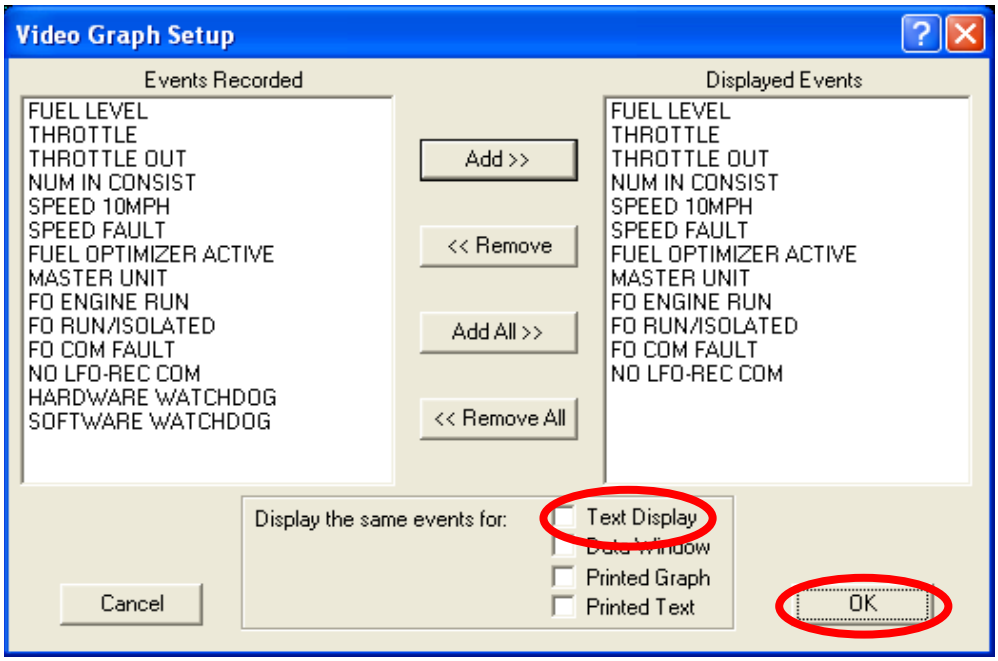
3. Press the keyboard F10 button to display the QDP Data Window on the left side of the QDP screen. The Data Window identifies the date, time, and throttle information for the data entry at the cursor position.

QDP Data Window Displayed (Graph View)

4. Select **Setup** from the menu bar, then select **Video Graph Screen Setup** from the menu.

5. On the Video Graph Setup screen, click the **Remove All** button.

6. Select **THROTTLE** and **TL THROTTLE** in the Events Record list. Click the **Add** button to copy the selection to the Displayed Events list.



Video Graph Setup (Events Displayed)

7. In the lower center of the screen select the **Text Display** check box.

8. Select the **OK** button.

9. On the QDP Data Window, move the cursor to the beginning of the data segment to be analyzed. If may be necessary to zoom in to view the starting point accurately. This can be done by using any of the following methods:

   - Select the **View** option from the menu then select **Zoom** or **Max Zoom**.
   - Press F3 repeatedly, incrementally zooming in each time.
   - Press F5 for Max Zoom.
   - Use QDP Data Window in graph view.

10. After the cursor is placed, set the first tag for analysis by selecting **Tags** from the menu bar, then select the **Place Tag 1** option, or use the keyboard shortcut **ALT** + **1**.

NOTE

NOTE

The color of the text will change after the tag has been set.

11. Move the cursor to the end of the analysis segment.

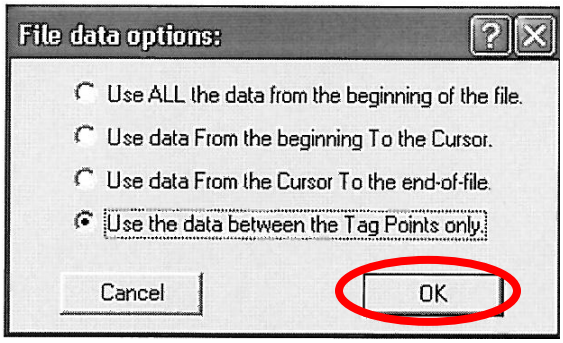
NOTE

NOTE

For longer run times it is recommended to zoom out first, then as the desired end time comes within view zoom back in.

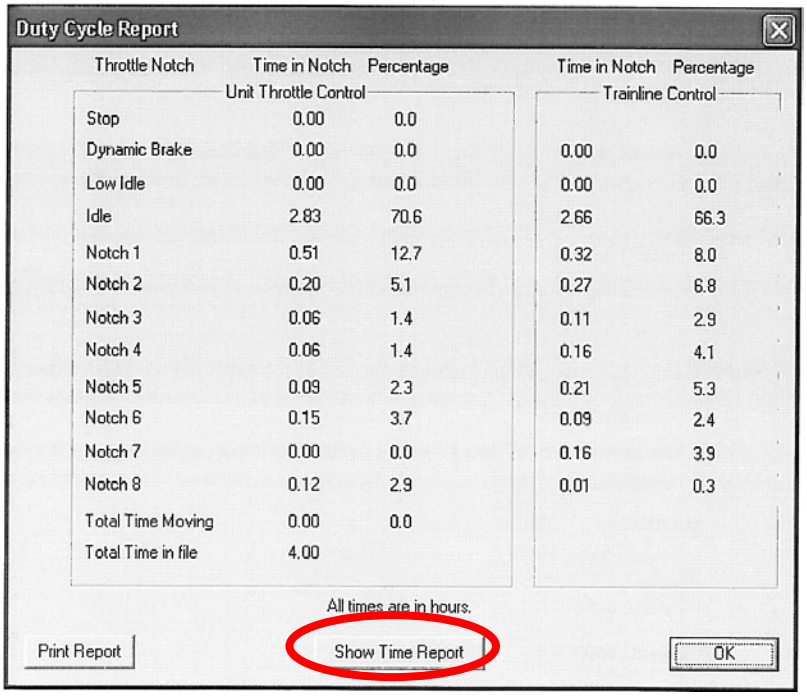
12. Place the second tag at the desired location by either selecting from the menu as before (**Tags** > **Place Tag 2)**, or the keyboard shortcut **ALT** + **2**.

13. Select **Analyze** from the menu bar, then the **Duty Cycle** option. The following dialog box will appear. For analyses over a particular period the fourth option should be selected, **Use the data between the Tag Points only**. Then click **OK**.



File Data Options Dialog Box

14. The Duty Cycle Report dialog box will appear indicating the times per throttle notch as a percentage. The Unit Throttle Control data reflects the Fuel Optimizer's control and the Trainline Control data reflects the throttle position requested by the engineer.



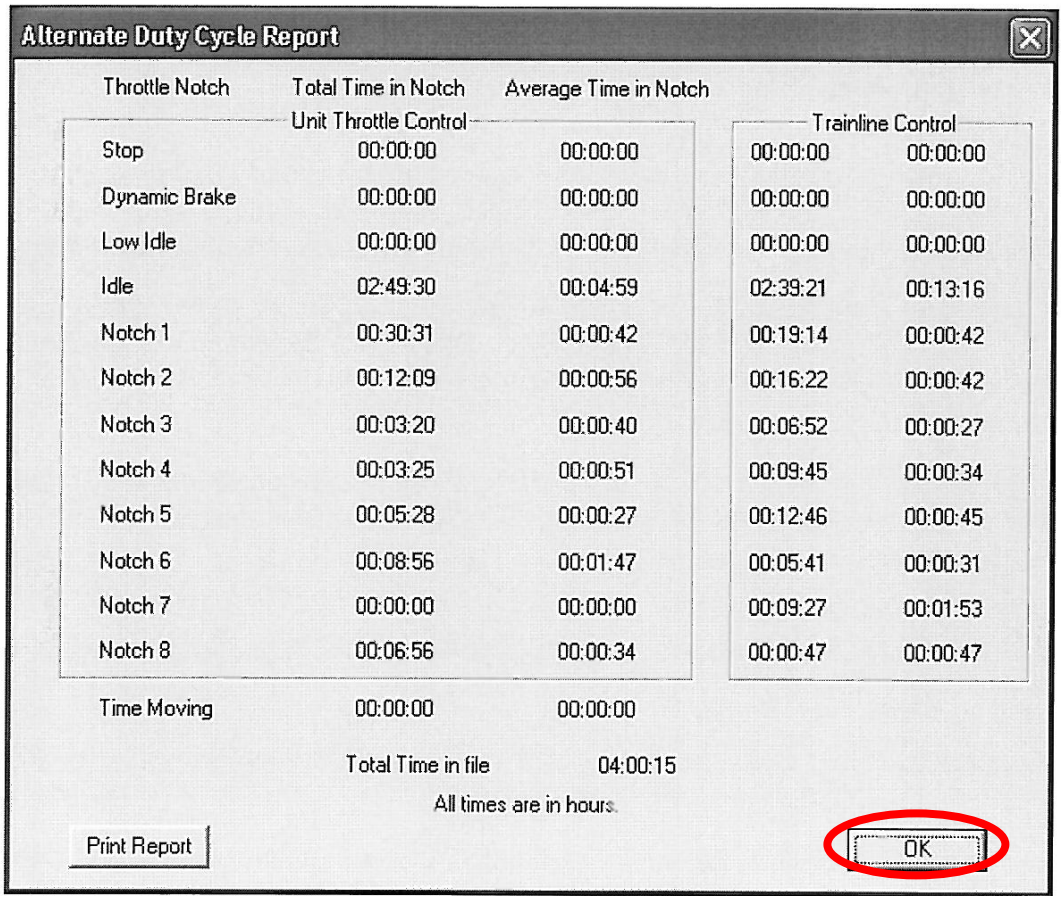
Duty Cycle Report Dialog Box

15. Click the **Show Time Report** button and the Alternate Duty Cycle Report screen is displayed. This screen lists the reported duty cycles in units of time (HH:MM:SS). The first column per group reflects the overall time per throttle notch, and the second column per group reflects the average time per notch. The **Total Time in file** value indicated at the bottom of this dialog box is the overall time in the analysis period.

NOTE

NOTE

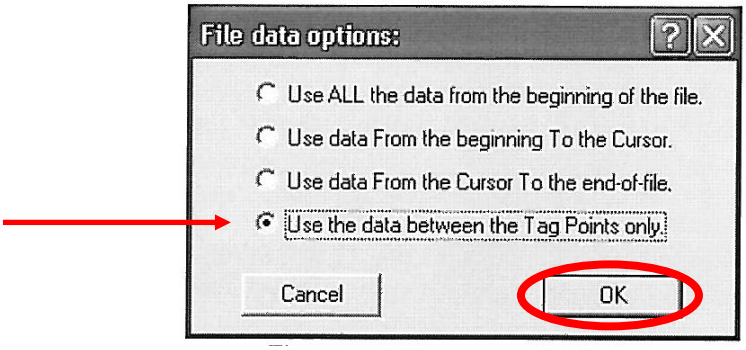
This **Total Time in file** value will be beneficial when comparing multiple files. Since the recorder will have latency of events and will not have identical operating times, it may be necessary to skew start/stop times to match the overall run times as well as events.



Alternate Duty Cycle Report Dialog Box

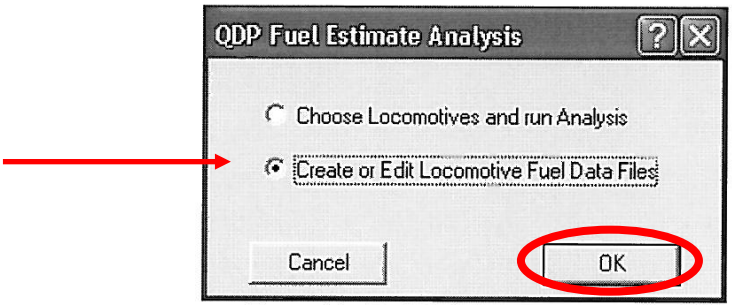
Click **OK** to close the dialog box.

16. Select **Analyze** from the menu bar then select the **Fuel Estimate** option. The **Fuel data options** dialog box will appear again. For analysis over a particular period the fourth option should be selected, **Use the data between the Tag Points only**. Then click **OK**.



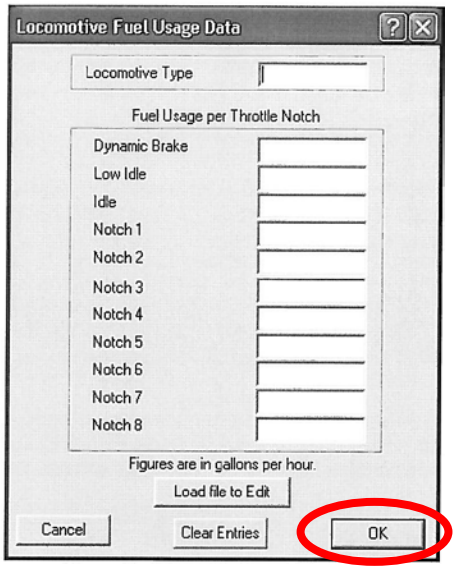
File Data Options Dialog Box

17. For first time analysis on a locomotive model, it will be necessary to setup the fuel tables for the locomotive. This is done by selecting the **Create or Edit Locomotive Fuel Data Files** option from the QDP Fuel Estimate Analysis dialog box. Then click **OK**.



Fuel Estimate Analysis dialog

The Locomotive Fuel Usage Data dialog box will appear in which the fuel values per throttle notch can be entered and saved.



Locomotive Fuel Usage Dialog Box

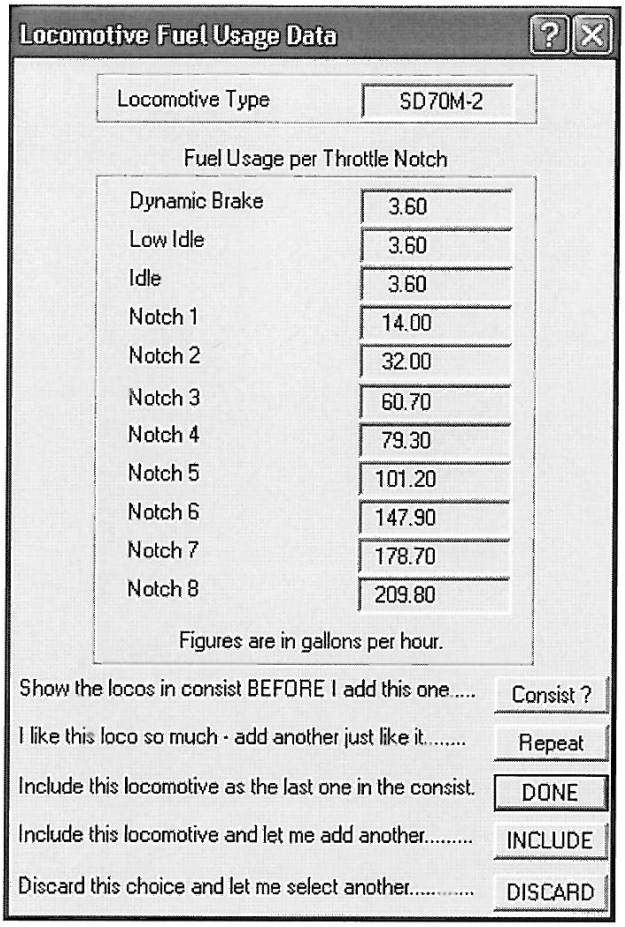
18. After successfully entering each value, including Dynamic Brake and Low Idle (either 0 or the idle value will suffice), click **OK** to continue.

NOTE

NOTE

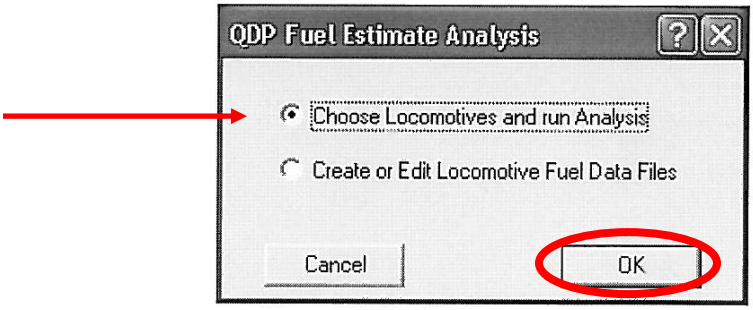
These values should be in gallons per hour. Embedded application revision B (the current version at the time of this writing) and earlier are set for tenths of a gallon per hour and will appear similar to the example below.

.



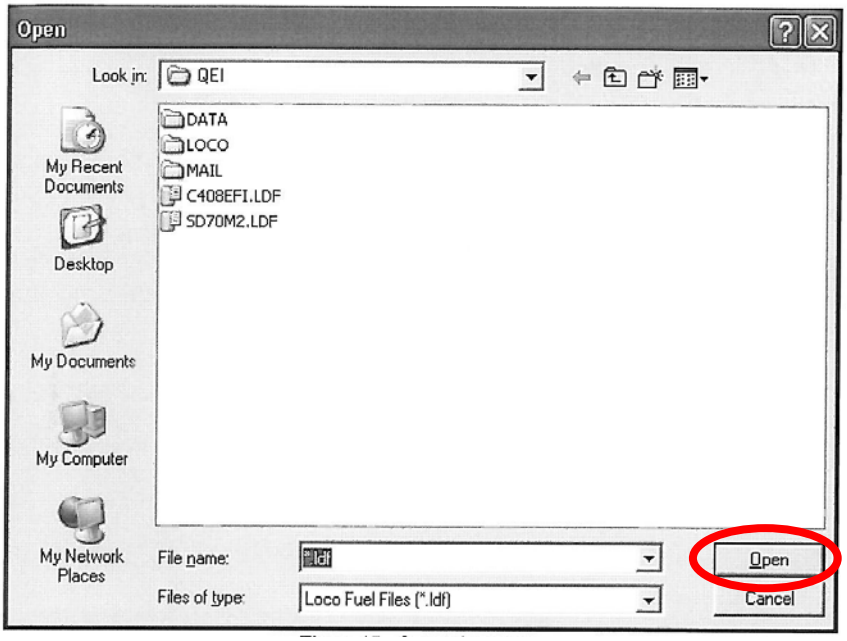
Fuel Usage Data

19. The QDP Fuel Estimate Analysis dialog box will reappear. This time select the **Choose Locomotives and run Analysis** option, then click **OK** to continue.



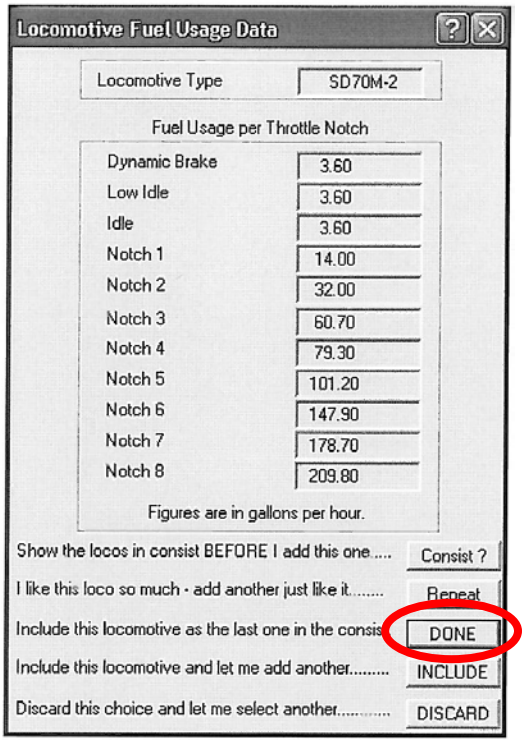
Fuel Estimate Analysis Dialog Box

20. The Open File dialog box will appear. Select the appropriate locomotive fuel file (*.ldf), then click the **Open** button.



Open File Dialog Box

21. The QDP software will display the Locomotive Fuel Usage Data window. Select the **DONE** button to continue.



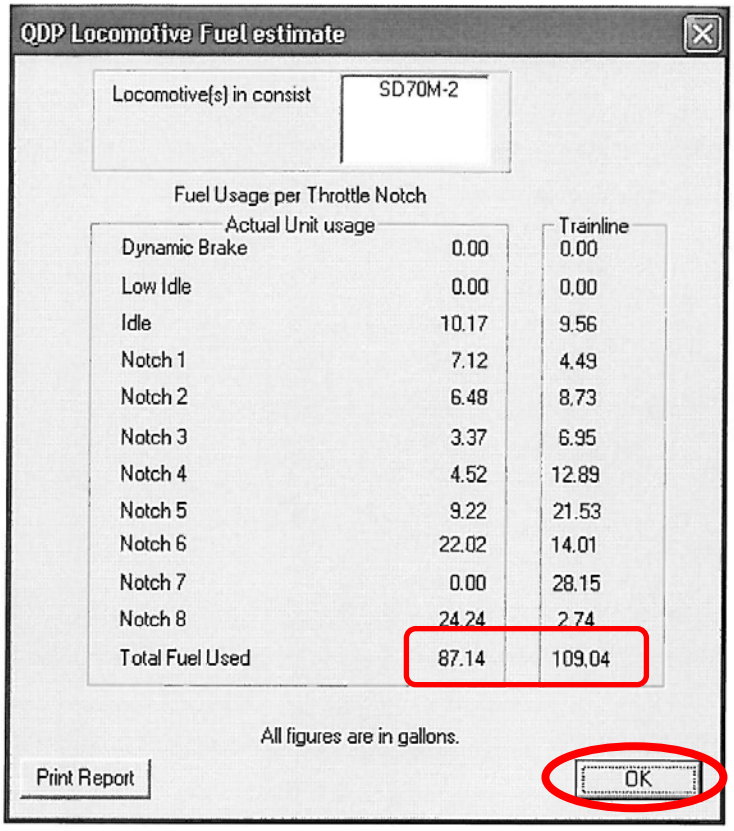
Locomotive Fuel Usage Data Dialog Box

A summary of fuel usage will be displayed based on the Actual Unit usage (Fuel Optimized values) and the Trainline usage per throttle notch (what the locomotive would have burned without having the Fuel Optimizer installed).

NOTE

NOTE

The example shown in the following figure depicts a locomotive that burned less fuel with the fuel optimizer installed than it would have without the fuel optimizer. When analyzing a multiple unit consist, it is possible for some units to burn more fuel with the fuel optimizer installed, but the final collection of data will show an overall fuel savings.



Locomotive Fuel Estimate Dialog Box

In the figure above: **Actual Unit usage** = Fuel Optimizer used
Trainline = no Fuel Optimizer used

22. Make note of the **Total Fuel Used** values for both the Actual Unit usage and the Trainline. Click **OK** to continue.

23. Repeat for all other locomotives in consist.

24. A summary of fuel savings can be presented for the consist in terms of overall fuel usage. The Fuel Optimizer savings can be calculated as follows:

    a) Find the sum of the **Actual Unit Usage Total Fuel Used** values for all LFO-equipped locomotives in consist (= Total Actual Usage).

    b) Find the sum of the **Trainline Total Fuel Used** values for all LFO-equipped locomotives in consist (= Total Trainline Usage).

    c) Calculate the percent of fuel savings:

$$\frac{\textbf{Total Actual Usage -Total Trainline usage}}{\textbf{Total Trainline Usage}} \textbf{ X 100\%}$$

    The negative result is the percentage of fuel savings.

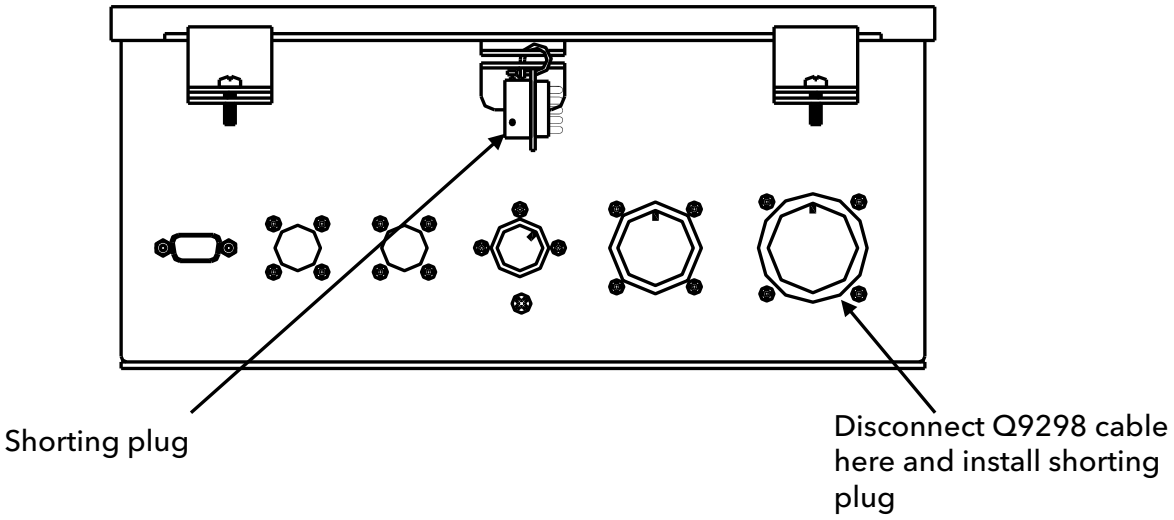
6.0 MAINTENANCE AND TROUBLESHOOTING

6.1 MAINTENANCE

No routine maintenance is required and there are no field replaceable components on the LFO.

6.2 TAKING THE LFO OUT OF SERVICE

To take an LFO out-of-service, disconnect the Q9298 cable from the LFO connector. Install the supplied shorting plug on the LFO connector in place of the Q9298 cable. With the shorting plug installed the locomotive will follow the train line controls.



6.3 APPLICATION SOFTWARE UPDATES

If it becomes necessary to upload new application software to the LFO CPU, use the Siemens Product Update Monitor Program (PUMP) for this task. The upload process is provided below.

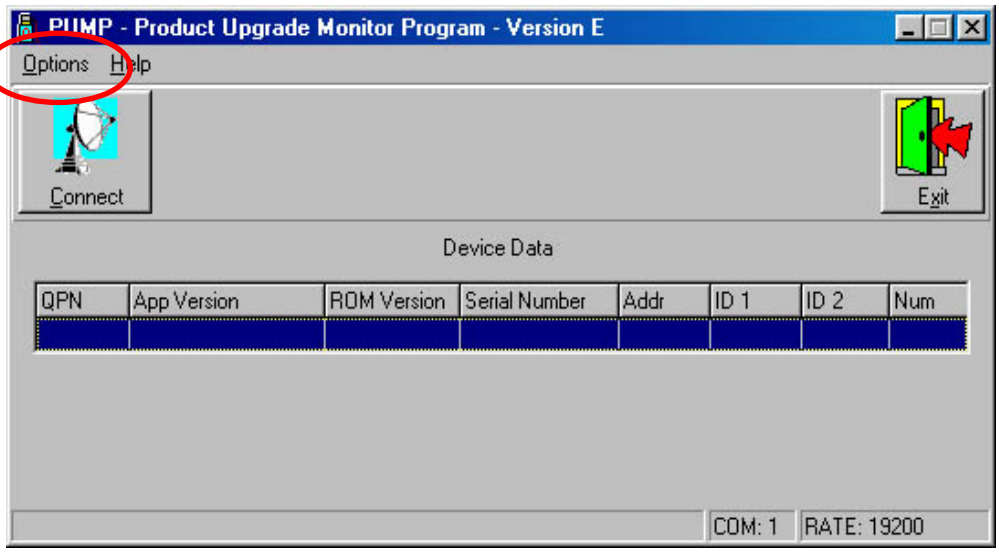
6.3.1 Program Installation

The PUMP program is installed on a laptop PC by running the SETUP.EXE program found on the software CD. Insert the disk into the CD drive. The InstallShield® installation program will initialize the installation process and provide prompts regarding the installation progress.

InstallShield® is a registered trademark of Macrovision Corporation

6.3.2 Initial Program Configuration

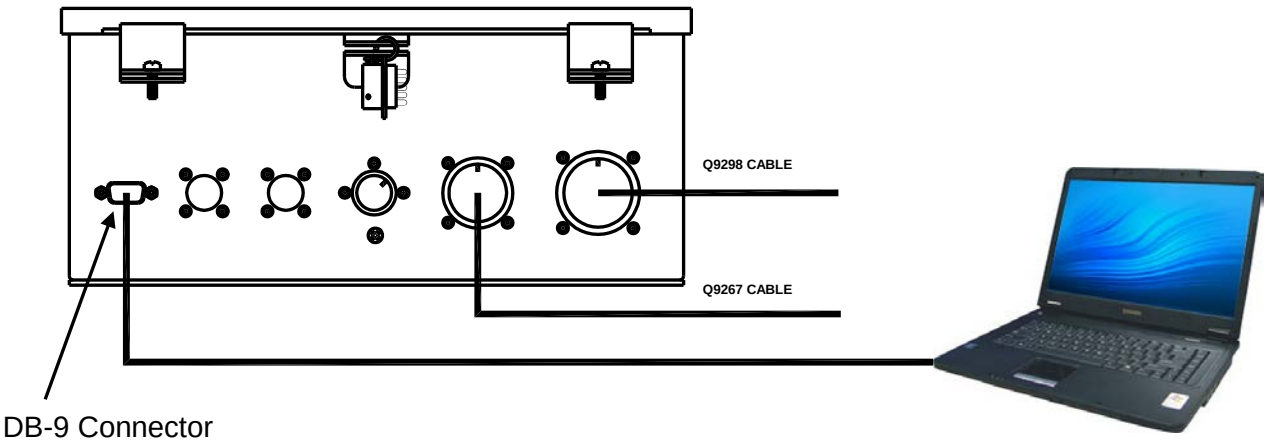
1. Start the PUMP program. The initial screen will appear as shown below.



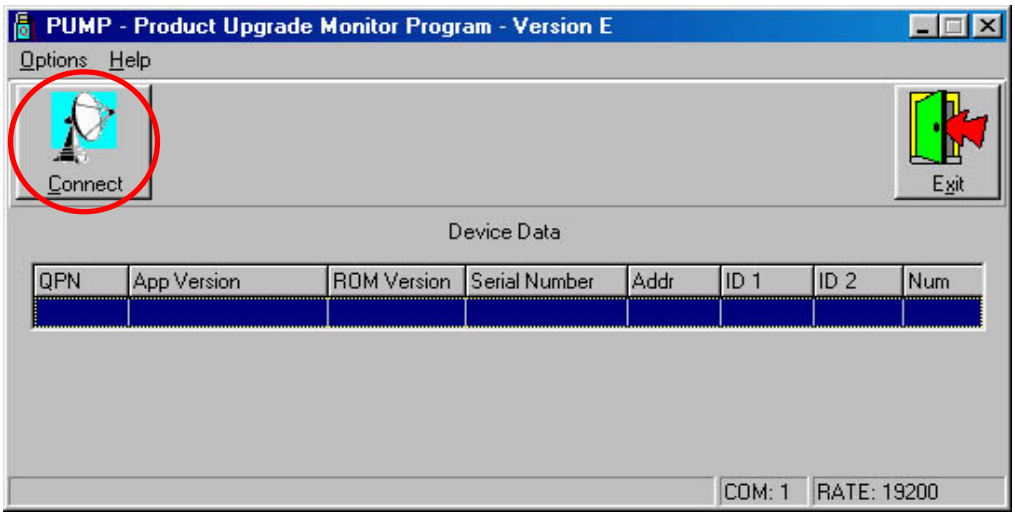
2. The first time the program is run, use the **Options** menu choice and select *Communications Setup*. Configure the software parameters as follows:
   - COM Port will depend upon the computer configuration – usually set to COM1.
   - baud rate = 19,200
   - The program should also be configured to *Connect to* **1** *Device*.

6.3.3 Uploading New Application Program

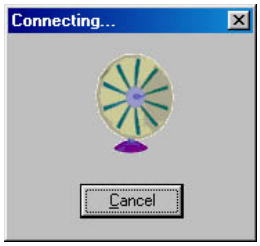
1. Connect a serial cable between the PC com port and the DB-9 connector on the Q2863.



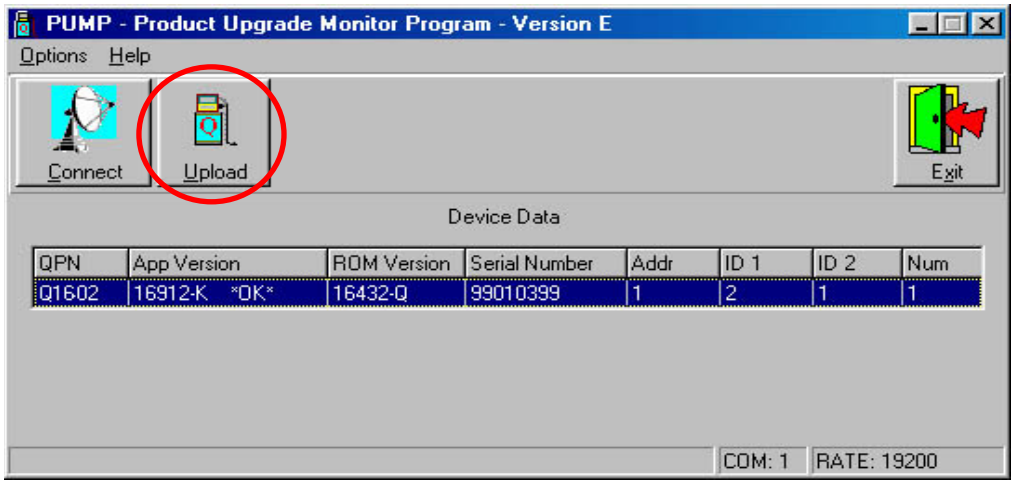
2. After the LFO has powered up and established normal operation, click the **Connect** button on the PUMP screen.



The dialog box shown below will appear while the program is attempting to connect to the LFO.

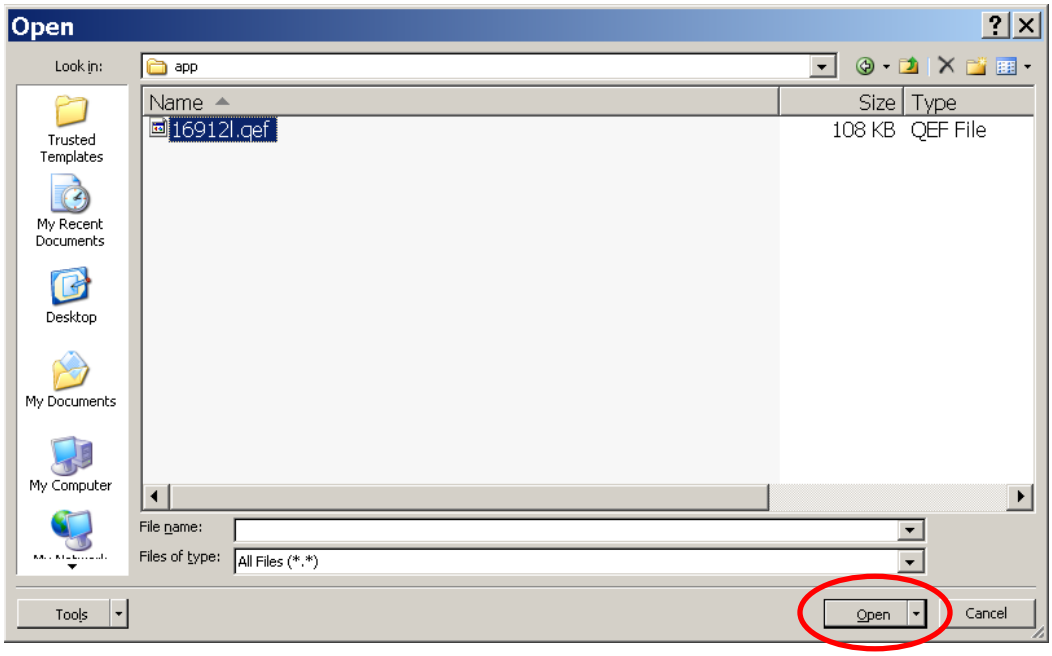


3. Once communication is established, the PUMP program will display LFO data similar to the data shown in the figure below. The **Upload** button should also be displayed on the PUMP screen.



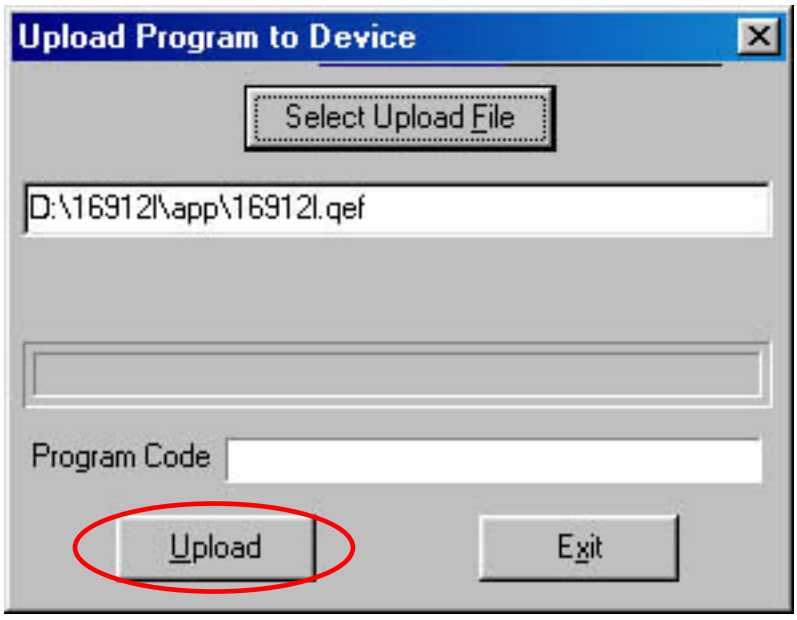
4. To upload the new application, click on the **Upload** button.

5. A standard Windows® file load dialog will appear. Select the application file supplied by Siemens and click the **Open** button.

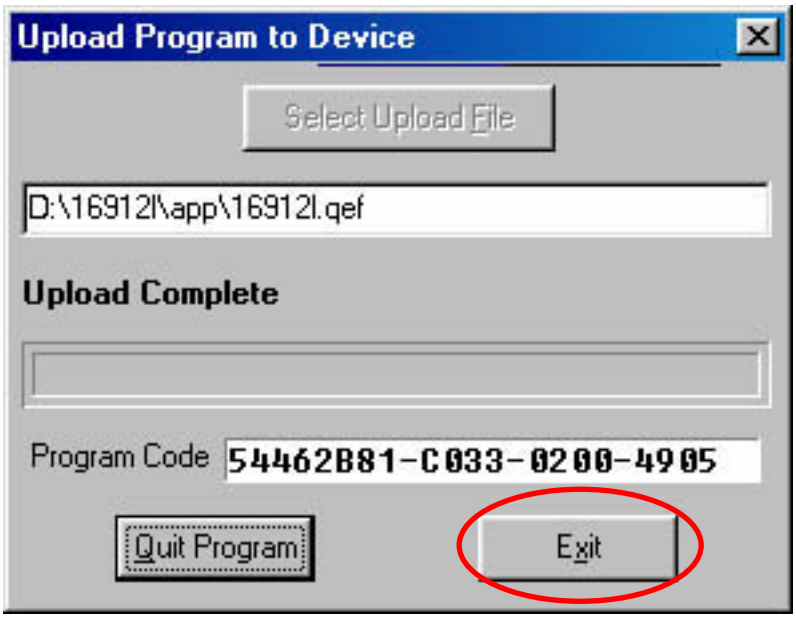


Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

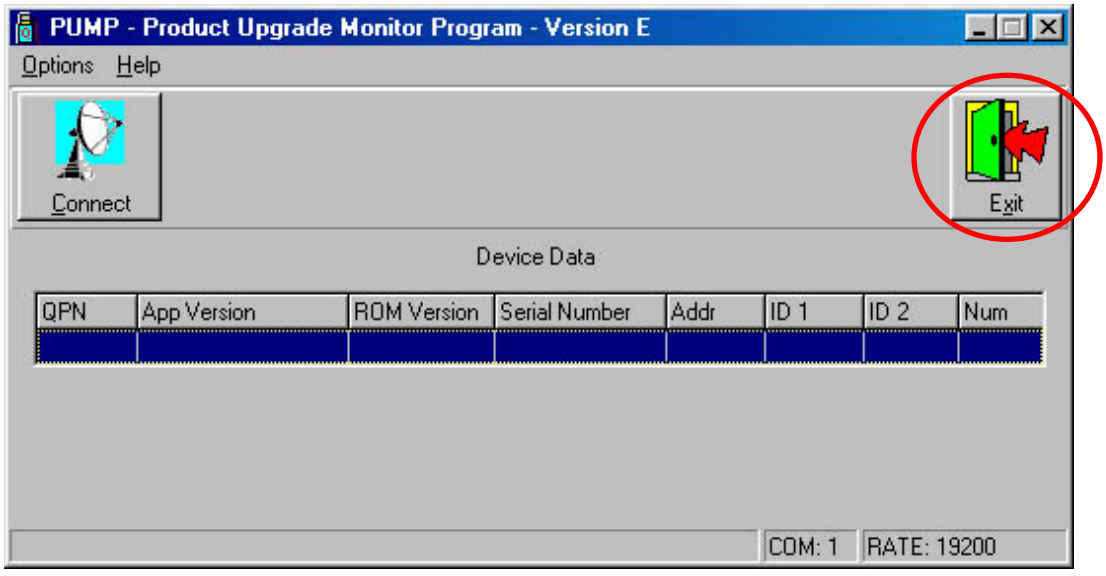
6. The dialog box shown below will appear displaying the selected file.



7. Click the **Upload** button to begin the application update. The PUMP program will upload the application. When the upload is complete a dialog box similar to the following is displayed.



8. Click the **Exit** button on the Upload Program to Device dialog box.



9. Click the **Exit** button the main PUMP screen to exit the PUMP application.

6.4 TROUBLESHOOTING

Field troubleshooting begins by observing the LEDs on the LFO front panel during operation to determine if a problem with the LFO or the external wiring exists. LED indications are described below.

LED Nomenclature	LED State	Indication
POWER	On	Train battery is supplied to LFO
	Off	Train battery not supplied to LFO – check wiring connections at terminal blocks and that connector XX on front of LFO is seated completely
READY	On	LFO is operational and ready to control throttles
	Off	LFO is not operational
FAULT	On	LFO internal fault or external wiring error (invalid throttle valve combination, etc.) (See Note 1)
	Off	No fault detected
AVOUT - DVOUT	On	Optimized output to throttle valve A through D present for local locomotive
AVIN - DVIN	On	Throttle valve A through D status present from trainline for local locomotive
SP1OUT	On	Spare 1 output active
SP2OUT	On	Power/Status
SP3OUT	On	LFO Engaged
GFOUT	On	Generator Field output is active
DBRK	On	Locomotive throttle in dynamic brake
RUN	On	Main engine run is active
ISO	On	Isolation is active
GFIN	On	Generator Field input is active
OK (RECORDER STATUS)	On	Internal event recorder operating properly
FAULT (RECORDER STATUS)	On	Internal event recorder fault detected (See note 2)

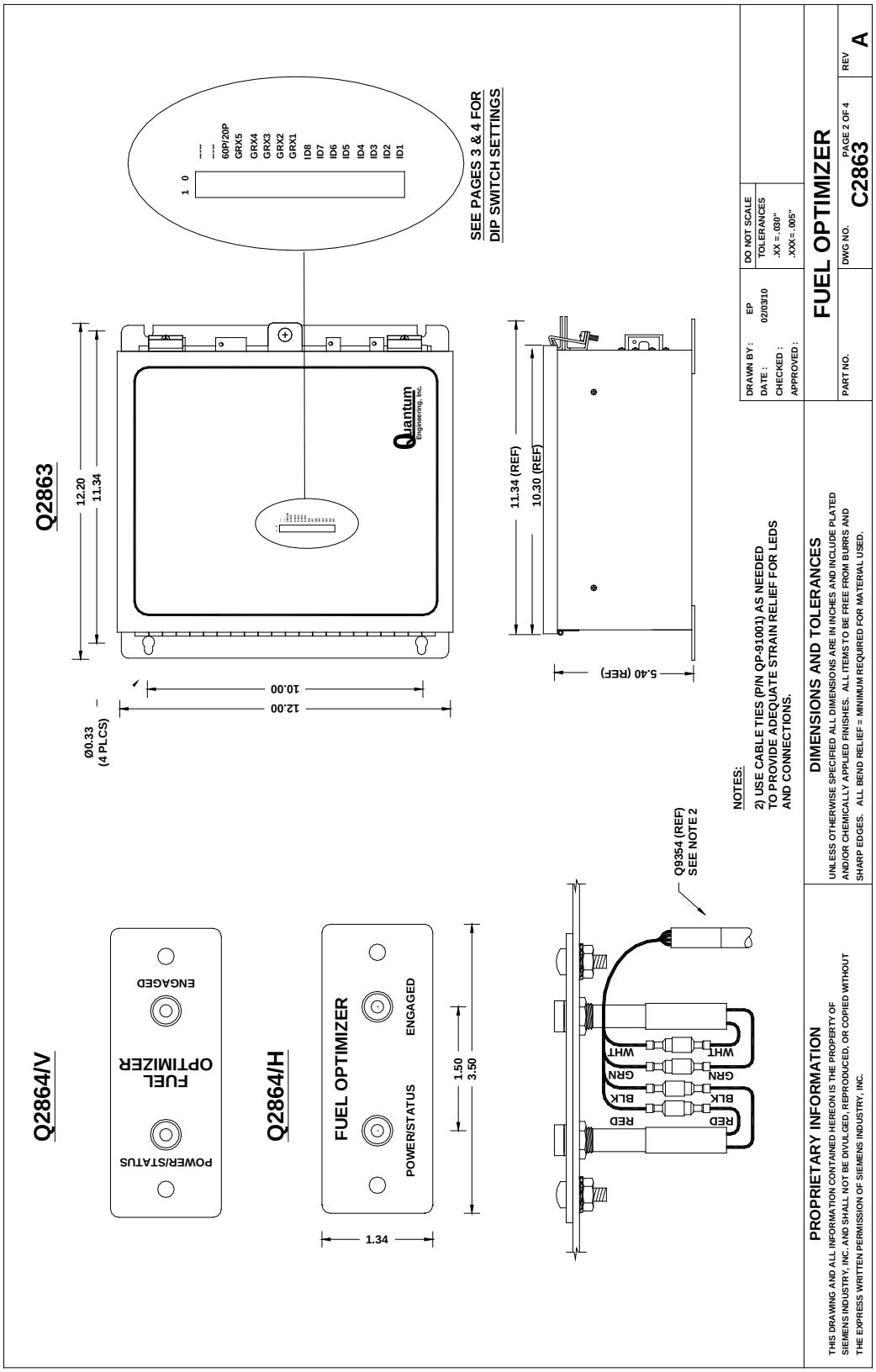
Notes:

1. Connect a laptop computer to the LFO DB-9 connector and use the 83082 program to identify the specific fault.
2. Connect a laptop computer to the round recorder port on the LFO using a Q9101 adapter and a serial cable and then use the QRST (Recorder Service Toolkit) application to troubleshoot.

7.0 DRAWINGS

The following lists all applicable drawings and their corresponding revision levels for the Siemens Q2863 Locomotive Fuel Optimizer. These drawings are included in this manual.

Drawing	Description	Revision
C2863	Assembly – Fuel Optimizer Q2863	A


Q2863
12.20
11.34
Ø0.33
(4 PLCS)
10.00
12.00
Quantum
Engineering, Inc.
1 0
60P/20P
GRX5
GRX4
GRX3
GRX2
GRX1
ID8
ID7
ID6
ID5
ID4
ID3
ID2
ID1
SEE PAGES 3 & 4 FOR
DIP SWITCH SETTINGS
11.34 (REF)
10.30 (REF)
5.40 (REF)
Q2864/V
FUEL
OPTIMIZER
POWER/STATUS
ENGAGED
Q2864/H
FUEL OPTIMIZER
POWER/STATUS
ENGAGED
1.50
3.50
1.34
Q9354 (REF)
SEE NOTE 2
RED
BLK
GRN
WHT
NOTES:
2) USE CABLE TIES (P/N QP-91001) AS NEEDED
TO PROVIDE ADEQUATE STRAIN RELIEF FOR LEDS
AND CONNECTIONS.
DRAWN BY : EP
DATE : 02/03/10
CHECKED :
APPROVED :
DO NOT SCALE
TOLERANCES
.XX = .030"
.XXX = .005"
FUEL OPTIMIZER
PART NO.
DWG NO. C2863
PAGE 2 OF 4
REV A
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