EXHIBIT H – User Manual (DRAFT COPY)

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Phoenix

Counter/Classifier

Field Unit Instruction Manual

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Version: 2.12 & 2.21

Revised: 12/22/95

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Changes to the Phoenix Firmware:

This section documents the differences between the various versions of the Phoenix Counter/Classifiers. If you have used a previous version, you can simply refer to the list of changes below to determine what has changed.

Note that some version numbers are skipped. This happens when a new version is created for R&D or testing purposes and is not released generally to our customers. In addition, a version number might be skipped if it simply fixes some minor bug in the firmware.

■ VERSION 1.00

Initial release of firmware (derived from Unicorn Firmware V1.30).

For the sake of brevity, versions 1.01 to 1.49 have been removed.

■ VERSION 1.50

Added code to support the new Power Imp.
Increase size of TAM Code to 12K (to handle autostarting) and reduced allowable system memory to 16K.

■ VERSION 1.52

Made changes to support revised TAM Card Hardware.

■ VERSION 1.53

Extended delay times when initializing modems. This is done to support slower (and less expensive) modems.

■ VERSION 1.54

Added option to turn off modem initialization. All modems are then treated as dumb modems.
Removed the Alt+9 option from the counter key pad to set battery warning and offset voltages. This is now done using TrafMan (Alt+F10 from the main linked screen).

■ VERSION 1.55

Added option to scroll display to see other spacings when monitoring Raw or Binned data (use Right or Left arrows from key pad to see other spacings).
Added support of Daylight Savings Adjustment time (set using TrafMan).
Added sensor info to monitor count data enquire so TrafMan can set piezo levels while monitoring count.

■ VERSION 1.58

Changed default modem initialization (second line) so that the &D1 is changed to &D2.
Fixed bug causing lost data when memory became full.

■ VERSION 1.60

Added Pacing Delay & XON/XOFF Support.
Increased size of Site ID from 10 characters to 15 characters.

■ VERSION 1.61

Fixed timing bug created by version 1.60.

■ VERSION 1.62

Fixed mo dem com mu ni ca tion bugs in clud ing fail ure to rec og nize smart mo dems, fail ure to leave the "Set ting Mo dem" screen, and fail ure to re set the mo dem prop erly.

■ VER SION 1.63

Same as ver sion 1.62 ex cept the letter of the ver sion is now re ported by TrafMan (in stead of just the version num ber). You DO NOT need to up date to ver sion 1.63 if you have ver sion 1.62.
Let ter ver sion "z" has also been cre ated which adds In-Day Times (see Ap pen dix F).

■ VER SION 1.64

Adds in the View Lane To tals func tion to all stor age modes (Raw, Binned, Count, & Sen sor). Note that you can only view these to tals us ing TrafMan.

■ VER SION 2.00

This is a ma jor new re lease of the firm ware which has the fol low ing new fea tures and changes:

- In-Day Times are now part of all ver sions (see sec tion VII).
- Coun ter now con tains a built in se rial num ber which is in cluded with all data files stored (see section I.d.).
- Fixed prob lem with hun dredths of a sec ond value on Raw and Sen sor data.
- Coun ter now sup ports Lane Grouping (see sec tion IV.c.2) for Binned and Count data.
- Coun ter now mon i tors the loop board(s) and if used and col lect ing data will check to in sure that the loops are func tion ing. If they are not, then the are au to mat i cally re started and re tuned. See sec tion I.e. for more in for ma tion.
- You can now set the the Bat tery Warn ing Volt age from the Con fig ure Sys tem Op tion (sec tion IV.h.).
- You can now View Lane To tals from the coun ter key pad (sec tion IV.I.).
- Coun ter now has an op tional Call-Back sys tem which can make the coun ter call you up and warn you when one or more lanes goes down. See sec tion VIII for more in for ma tion.
- Coun ter pro gram code is now bro ken up into three parts: EPROM Code, TAM Code, and RAM Code. These three seperate pro grams work to gether to make the coun ter op er ate. See sec tion I. f. for more in for ma tion on how these three pro grams work.
- The TAM In ter face has been im proved to work with more types of TAM cards and has also become more re li able. A bug has been fixed which al lows you to over write the end of a TAM card.

■ VER SION 2.01

Fixed prob lem when mon i tor ing Raw or Binned data with TraMan, the length of the ve hi cle was shown as "= <x>" in stead of "Length = <x>" (<x> rep re sents the length value).

■ VER SION 2.02

Fixed prob lem when SnMis Stor age Mode was set to Dis abled, the SnMis were still be ing dis played.

■ VER SION 2.03

Fixed bug with con vert ing SnMis #3 to a ve hi cle when in Pres-Axle-Pres mode and the SnMis #3 To Ve hicle op tion is en abled.

■ VER SION 2.04

Fixes a prob lem with Lane Grouping that caused coun ter to stop col lect ing data when group ing was enabled and at least two groups were se lected.

■ VER SION 2.05

Cold Re starting coun ter will now also re set theWhich Loop Boards In stalled value. This al lows the user to re motely re-en able loop boards that have shut down.

■ VER SION 2.08

Changed coun ter so that while load ing new TAM or RAM code all ex ter nal in ter rupts are dis abled. This pre vents any cor rup tion of the TAM or RAM code dur ing up load.
Added code to ini tial ize Piezo Sen si tiv ity lev els on power up. This pre vents the piezos from trip ping dur ing the Self Test due to be ing uninitialized.
Re moved all I/O Wait States to speed up data pro cess ing.
Added com mand to al low set ting of the Day Light Sav ings Time Ad just value with out hav ing to stop col lec-tion first.

■ VER SION 2.10

Fixed bug that oc curred when us ing Pres-Axle-Pres and the SnMis #3 To Ve hi cle op tion. Coun ter will now cor rectly re port the ve hi cle.

■ VER SION 2.12

See 2.21 de scrip tion be low.

■ VER SION 2.20

This is a ma jor re lease of the firm ware. This ver sion in creases the Phoe nix coun ter ca pa bil ity to a full 8 lanes of clas si fi ca tion and 16 lanes of count. Be cause of this, all di rec tional lanes for Raw and Binned data col lec tion are now the ac tual lane num ber + 8 (in stead of + 4). For ex am ple, Lane #1 op po s ite di rec tion traf fic will be stored in Lane #9 (in stead of Lane #5). See sec tion II.b for more in for ma tion on di rec tional traffic.
Other 2.20 Changes:

- Fixed bug that dis played SnMis #25 (or SnMis #/ on coun ter screen) when us ing Pres-Axle-Pres or Axle-Pres-Axle mode with di rec tional traf fic and the cen ter sen sor would be hit with out any other sen sor. Coun ter now cor rectly dis plays a SnMis #0.

■ VER SION 2.21

This ver sion fixes a bug which causes the coun ter to fail dur ing file move ment in heavy traf fic. NOTE: Ver-sion 2.12 is also avail able which has this same fix but with out the other 2.20 changes. You do not need 2.21 if you have 2.12.

I. Introduction

Thank you for purchasing Diamond Traffic Products Phoenix Traffic Classifier Field Unit. You have purchased one of the finest traffic classification counter available today. This manual describes the operation and programming of the Phoenix Field Unit. Please be sure you have read and understood this manual completely before attempting operation.

What is a "Phoenix Field Unit"?

The Phoenix is a data gathering instrument for use in the field. By using the Phoenix and one of several possible combinations of sensors, traffic data and vehicle classification can be recorded and later retrieved. Speed, Length, and Number of Axles are just a few types of data which can be gathered with this use instrument.

For the unit itself, the welded aluminum case is durable, light, and weather resistant. The interior keypad & display are both sealed to prevent moisture from damaging them. In addition, a rubber seal is installed around the lid to further protect the unit from the weather.

The case also contains a lid securing mechanism and aluminum carrying handle. The right side of the case normally contains two or four Airswitches, a Battery Charger/Solar Input plug, and the Serial Interface plug. Optionally, the right side can also be fitted for loops inputs, piezo inputs, and/or a remote input.

Inside the case is the heart of the unit, the microprocessor. Several electronic printed circuit boards contain the microprocessor, backup battery, charger network, memory, and all other support circuitry for the unit. In addition, the case can contain the boards for any options which are customer ordered, such as Loop Detector Boards, Piezo Boards, TAM Memory Card Interface board, and Expanded Memory.

Some Tips to Prolong the Life of Your Phoenix

- Always dry the unit out completely after removing from the field.
- Always push on the dust caps onto unused plugs.
- Keeping the battery fully charged will prolong its service life. Recharge battery every six weeks when not in use.
- Disconnect the serial interface plug if serial communication is not required. This will substantially prolong battery life.
- Avoid placement of unit in drainage ditches or areas prone to flooding.
- Do not attempt service without qualified personnel. The components of the Phoenix are very static sensitive, and boards can be damaged by improper handling. All hardware is covered in the Phoenix Hardware Manual.

I.a. How To Use This Manual

This manual completely describes the use of the Phoenix. The only thing not covered in this manual is programming & retrieving data from the serial port with a PC Computer. This is covered in the TrafMan Software Instruction Manual.

Do I Have To Read The Whole Manual?

Anybody using a Phoenix should read all of Section I,II, and III of this manual. This will familiarize you with the basic equipment provided, what types of data you can collect, and what type of sensors can be used. From that point there are three methods of operation:

Method 1 - To operate the Phoenix entirely from its built in key pad.
All setup and configuration can be done from there. A computer and/or TAM must be used to retrieve the data once it has been collected. If this is the method you want to use, first read section IV.a and IV.b, then read Section V for an example which matches your application. Section VI will describe using the TAM interface, if installed.

Method 2 - To operate the Phoenix only from a computer (using the TrafMan Software).
All setup and configuration can be done from a computer (in addition to retrieving the collected data). If this is the method you want to use, simply refer to the TrafMan Software Manual for more information. Use this field unit manual for clarification and technical information on the Phoenix.

Method 3 - To operate the Phoenix using both a computer and its built in key board.
This is the most common method since you might not be able to always have a computer with you, and be coming familiar with the key pad operation is always useful. We suggest that you first attempt to run the counter using the built in key pad (first read section IV.a and IV.b then follow the examples in section V.) After collecting some data with the Phoenix, move on to using the TrafMan Software to collect your data. From that point, read through the rest of the TrafMan Software Manual for more information on controlling the counter through a computer.
See section VI for a complete description on using the TAM interface, if installed.

I.b. Communication With The Phoenix

Communicating with the Phoenix is done through the built in Key pad/Display, or through the serial port to an IBM PC compatible computer. A communications software package is normally provided for use with the large variety of IBM PC compatible computers available on the market today. This extensive software package (called the TrafMan Software) allows such advanced features as:

- "Pop-Up" windows and "User-Friendly" menus.
- Complete Data base functions with viewing and editing of all collected data.
- XMODEM transfers for data file retrieval, with later file format conversion utilities.
- Data File Printouts with daily and hourly summaries.
- Complete monitoring and configuration.

To learn more about using this program, refer to the TrafMan Software Instruction Manual. Note that Phoenix serial access is not restricted to use with any particular type of computer. Any computer which supports a standard serial communications (RS232) will suffice. The TrafMan Software Disk contains a documentation file for computer programmers for programming from the serial port (`SERIAL.DOC`).

I.c. System Components

To op er ate your Phoe nix coun ter/clas si fier you will need the fol low ing:

- Phoe nix Field Unit In struc tion Man ual.
- TrafMan Soft ware Disk & TrafMan Soft ware In struc tion Man ual.
- A Bat tery Charger or So lar Charging Panel.
- A Se rial In ter face Ca ble.

Op tional Items In clude:

- A Mo dem In ter face Ca ble.
- One or more TrafMan En hance ment Mod ules (such as the TrafPrint En hance ment).
- A Re mote Airswitch Ca ble.
- An In duc tive Loop Ca ble.
- One or more TAM Cards.

Ad di tional Equip ment Re quired To Use The Phoe nix Coun ter:

You must have the fol low ing equip ment to use the Phoe nix. All of this equip ment can be pur chased from Di a-mond Traf fic Prod ucts as well as from sev eral other sources:

- Sensors. You must have the ap pro pri ate type and quan tity of sen sors (Loop, Tube, Piezo, etc.) If us-ing tubes, you will need nails and road tube grips to in stall road tubes.
- A Computer. Ideally, this would be one of the many IBM-PC type com put ers avail able and you could use the TrafMan Soft ware. It is pos si ble to use an other type of com puter, but it will re quire some one with tech ni cal knowl edge and com puter pro gram ming skill for the type of com puter you wish to use.
- A Modem. This is re quired if you plan to in stall the Phoe nix in a per ma nent sta tion where com mu ni ca-tion over a phone line is re quired. There are sev eral mo dems avail able, each with their own ad van-tages and dis ad van tages. You MUST pur chase a Hayes Com pat i ble Mo dem. We also rec om mend a mo dem that is pro gram ma ble (some times called a Smart Mo dem). The Phoe nix will work with most non-pro gram ma ble mo dems as well, but you may not be able to take ad van tage of some fea tures of the coun ter. See Sec tion III.c.1 for more in for ma tion.
  In ad di tion, Ap pen dix A of the TT-Link Soft ware Man ual con tains de tailed in struc tions for us ing a mo-dem with any of Di a mond Traf fic Prod ucts coun ters.

I.d. Features not available from the keypad

The Phoenix has several features which are not available directly from the counter key pad. Some of these features only relate to serial port use and therefore are not needed from the key pad. Other features would require to much internal firmware to access and use from the keypad and therefore are only accessible through the serial port.

The following features are available in the Phoenix but can only be set and/or used from the serial port using the TrafMan software package.

- **Data Retrieval**

  The most important serial counter function, the retrieval of collected data. This is normally done using the TrafMan and/or the Remote software programs. See the appropriate manual for more information.

- **Passwords**

  The counter allows you to enable/disable password access and to set your own password (the default is "PASS").

- **Modem Initialization**

  You can customize the initialization string that is sent to the modem. See appendix A of the TT-Link software manual for more information on modem initialization lines.

- **Daylight Savings Time Adjust**

  You can either manually or automatically have TrafMan set the Phoenix to handle daylight savings time changes. The Phoenix will change the time and adjust data appropriately.

- **TAM Card Reader**

  As described in Section VI, many functions are available when the counter is configured as a TAM Card Reader.

- **Battery Offset Voltage, SnMis #3 To Vehicle, & No Modem Initialization**

  These specialized functions, not commonly used, are all accessible from a special TrafMan Hidden Menu which is called up using the Alt + F10 key from the main counter link screen. The counter must not be collecting data to set these functions.

- **XON/XOFF and Pacing Delay**

  These two specialized modems functions can only be set from TrafMan using the serial port. See appendix A of the TT-Link software manual for more information.

- **In-Day Times**

  In-Day times are specific time periods inside of a 24 hour period in which you want to collect data, and all other times will be excluded. What this basically does is make the counter create a new data file several times during the day. For example, if you selected two In-Day Times of 0600-1200 and 1600-1800, then the counter would create two files per day, each containing data for the appropriate time period. See section VII for more information on In-Day Times.

- **Counter Serial Number**

  The counter now contains a built in firmware serial number, This serial number, usually set by us at the factory, is included with all data files so that which counter collected the data can be easily identified. You can optionally set your own serial number using the Alt + F10 function from the main counter link screen in the TrafMan software.

- **Counter Call-Back**

  The counter has an optional Call-Back function which allows you to program the counter with a phone number for it to call if a lane should go down. After making the call, the counter will connect to a remote PC running the TT-Link Software and then issue a report telling you the Site, Time, Date, and Lane(s) which failed. See section VIII for more information on counter Call-Back.

I.e. Loop Board Monitoring

The counter has a built in function to insure that your loop boards do not fail. Basically, when you use loops for data collection, the counter checks every five minutes to see if any loop activations have occurred. If they have not, then the counter goes to a special function which sends a command to the loop board to see if it is responding. If it isn't, then the loop board is restarted and all loops are retuned for proper operation.

Why, you may ask, should a loop board ever fail? Generally this is caused by one of two things:

- Lightning Strike
  Sometimes if a lightning strike is close enough to the loops in the road a large static charge can be transmitted through the loops into the loop board circuitry. The loop board has several electronic protections against this and it will probably not cause any damage (unless the lightning is very close), it may cause the loop board to lock up or shut down. The loop board monitoring function will detect the loop board failure and will restart the loops between 5 and 10 minutes later.
- Other Electrical Noise
  Similar to a lightning strike, other sources of strong electronic signals can cause the loop board to have problems. For example, a strong C.B. broadcast from an illegal transmitter. The loop boards in your counter are the best available but it is possible for strong electrical interference to cause premature shutdown. Once again, the loop board monitoring function will detect and correct this occurrence.

Chances are you have not ever experienced any problem with your loop boards. The loop board monitoring function has been added into the firmware to make sure you never do.

I.f. Counter Firmware Configuration

Although not essential to know, it will help you understand your traffic counter if you know how the internal programming works inside your counter. If you are not interested in this information feelfree to skip this section.

There are three separate programs which operate inside the Phoenix. The first (and most important one) is the EPROM. This is a physical Integrated Circuit (IC) inside your counter which is programmed by us at the factory and installed in your counter. Whenever you turn the counter on, the microprocessor inside the counter starts running the program contained inside this chip. The very first screen that appears on the display of the counter will show you the name and version number of this EPROM (for example: Phoenix V2.00a).

The EPROM contains all of the really important programming such as the vehicle classification routines and the routines that store data into memory. You may at some time want to perform an upgrade of this EPROM to add new features to your counter or to fix bugs found in the programming of the EPROM. This is done by taking your counter apart, removing the old EPROM, and installing a new EPROM that you get from Diamond.

The second program inside your Phoenix is called the RAM Code. This is an auxiliary program which resides in the changeable memory (called RAM Memory) and is only used when you perform various non-essential tasks such as using the Show Status option or Viewing Lane Totals. The EPROM automatically knows how and when to run this program based upon what options you select.

A copy of the latest RAM Code is always contained in the TrafMan subdirectory on your hard drive of your PC in a file named `RAM.HEX`. Whenever you link to a counter, TrafMan will check to make sure that the version of the RAM Code inside the counter is at least equal to the version of the RAM Code that is contained on disk. If it

is not, then TrafMan automatically upgrades your Phoenix to the latest version. This is much easier than changing EPROMS because it is all done automatically for you without any disassembly.

The third and final program inside your counter is called the TAM Code. This program is only present in machines which have a TAM Card Interface installed. This program is very similar to the RAM Code in that it resides in RAM Memory and can be upgraded by TrafMan whenever you link to the counter. The latest version of the TAM Code is always in your TrafMan directory in a file called `TAM.HEX`.

The TAM Code is used to control all of the functions of the TAM Card Interface. It contains all of the programming to read, write, identify, and erase TAM Cards. It also contains all of the code to turn the counter into a TAM Card Reader (see section VI). A copy of the TAM Code is also contained in the first 12K of every TAM Card. You can instantly update a counters TAM Code by simply plugging in a TAM Card which has the latest version of the TAM Code on it.

The EPROM knows how and when to use the TAM Code. In most cases you will never be aware when you are in the EPROM, RAM Code, or TAM Code. All three programs work together to provide a seamless and fully functioning traffic counter environment.

II. Modes, Sensors, And How To Use Them

This section of the manual discusses the various ways the Phoenix can collect data, and what type of sensors are required to collect each type of data. Please read this section carefully. The Phoenix is a very sophisticated counter/classifier with many options. Reading and understanding this section first will greatly simplify operation later.

II.a. The Four Basic Storage Modes

Before attempting to use your Phoenix, you should first become familiar with the four fundamental modes of operation. The mode that you select determines the type of data that will be collected, and whether the information will be combined with other entries or stored individually.

Raw - This mode will store each individual vehicle in memory as it passes by. The following information about each vehicle can be stored in memory: time, speed, number of axles, spacing between each axle, over all length, and bin classifications.

Binned - This mode is the conventional classifier storage mode. Each vehicle is analyzed and given 5 different bin numbers. Each bin # represents a category the vehicle belongs to. The 5 bins are Axle Class, Speed Class, Length Class, Gap Class, & Headway Class. The parameters for determining what types of vehicles belong to each bin # can be changed by the user, with the most commonly used values being built into the Phoenix. Users specify a time interval, such as every 15 minutes, in which the total number of vehicles for each bin will be stored in memory.

Count - The count mode is one of the simplest modes of operation. It is used when just a vehicle count is desired. When using Tubes or Piezo Sensors, the Phoenix provides the total number of axles detected, optionally divided by two. When using Loops, the Phoenix will give the number of vehicles. Users specify a time interval, such as every hour, in which these total counts will be stored in memory.

Sensor - Sensor mode stores individual sensor pulses into memory with an accurate time stamp. This mode bypasses the Phoenix regular data analysis routines and allows users to get an exact copy of what the counter saw on the roadway. Other software, such as TrafMan, can then be used to analyze this data into other forms as the user requires.

II.b. Sensors and Sensor Modes

The Phoenix supports Road Tube Airswitches, Inductive Loops, Remote Inputs, Piezo Resistive Inputs, and Piezo Electric Inputs. Road Tubes, Remote Inputs, and Piezo Sensors are considered "axle" sensors, since they are activated by individual axles. Inductive Loops are considered "presence" sensors, since they become active by the presence of a vehicle passing over, and become un-active when the vehicle leaves. The Remote input will support any type of sensor which will give a momentary switch closure.

Since there are variations with each sensor (for example, Inductive Loops will have slightly different amounts of inductance), the Phoenix performs automatic tuning of all sensors except for Piezo Electric and Piezo Re-

sistive. These the user must tune during setup using the Phoenix Keypad or a PC Computer and the TrafMan software. See section III.d.3. for more information.

When in Raw storage or Binned storage modes, four types of sensor arrangements (sensor modes) may be selected:

Axle-Axle - Two axle sensors, such as two tubes.

Pres-Pres - Two presence sensors, such as two loops.

Axle-Pres-Axle - Two axle sensors and one presence sensor.

Pres-Axle-Pres - Two presence sensors and one axle sensor.

In Count storage mode, you can select either a Presence Sensor or an Axle Sensor. In Sensor storage mode, you can select either a Presence Sensor, an Axle Sensor, or both.

The way the sensors are divided up among the lanes depends on the storage mode (Raw, Binned, etc.) and the sensor mode (Axle-Axle, Pres-Pres, etc.). Table 1 shows the divisions of the sensors.

Table 1

	Count Storage & Sensor Storage		Raw Storage & Binned Storage	
Lane Number	Axle (Tubes)	Pres (Loops)	Axle (Tubes)	Pres (Loops)
#1	1	1	1 & 2	1 & 2
#2	2	2	3 & 4	3 & 4
#3	3	3	5 & 6	5 & 6
#4	4	4	7 & 8	7 & 8
#5	5	5	n/a	9 & 10
#6	6	6	n/a	11 & 12
#7	7	7	n/a	13 & 14
#8	8	8	n/a	15 & 16
#9	n/a	9	2 & 1 (Directional)	2 & 1 (Directional)
#10	n/a	10	4 & 3 (Directional)	4 & 3 (Directional)
#11	n/a	11	6 & 5 (Directional)	6 & 5 (Directional)
#12	n/a	12	8 & 7 (Directional)	8 & 7 (Directional)
#13	n/a	13	n/a	10 & 9 (Directional)
#14	n/a	14	n/a	12 & 11 (Directional)
#15	n/a	15	n/a	14 & 13 (Directional)
#16	n/a	16	n/a	16 & 15 (Directional)

Sensor and Count modes always use the same lane number as sensor number for input to that lane. Raw and Binned modes will always use two inputs for each lane, with the sensors numbers shown in the table.

Raw and Binned modes are the clas si fi ca tion modes, so they can also take ad van tage of two slightly more com pli cated sen sor modes, “Axle-Pres-Axle” and “Pres-Axle-Pres”. The first and last sen sors, e i ther the two Axle or the two Pres, are AL WAYS the same as shown in Ta ble 1. The dif fer ence co mes in the mid dle sen sor.

To in crease the ca pa bil i ties of the Phoe nix, the mid dle sen sor used co mes from a sen sor not nor mally used with a lane you are con fig ur ing. Ta ble 2 shows the con fig u ra tion for these two modes.

Ta ble 2 - Con fig u ra tion of Three Sen sor Lanes

Mode	Lane 1	Lane 2	Lane 3	Lane 4	Lane 5	Lane 6	Lane 7	Lane 8
Axle Pres Axle	#1 #1 #2	#3 #2 #4	#5 #3 #6	#7 #4 #8	n/a	n/a	n/a	n/a
Pres Axle Pres	#1 #1 #2	#3 #2 #4	#5 #3 #6	#7 #4 #8	#9 #5 #10	#11 #6 #12	#13 #7 #14	#15 #8 #16

NOTE: The Phoe nix cur rently only sup ports 8 Axle Sen sor in puts so you can not en able Axle-Pres-Axle or Axle-Axle modes for lanes 5-8.

Sen sor Con flicts

The sys tem works AS LONG AS THERE IS NEVER ANY CON FLICT BE TWEEN LANES FOR SEN SORS. This can oc cur if you use dif fer ent axle con fig u ra tions on dif fer ent lanes and you are us ing “Axle-Pres-Axle” or “Pres-Axle-Pres” on the higher num bered lane. Still con fus ing? Hang in there, it gets sim pler. Let’s try an ex- ample.

Ex am ple 1: Sup pose you se lected Pres-Pres for lane #1 and Axle-Pres-Axle for lane #2. Ac cord ing to Ta ble 1 (for lane#1) and Ta ble 2 (for lane#2).

Ta ble 3 - Ex am ple 1

Mode	Lane 1	Lane 2
Pres-Pres	Pres 1, Pres 2	————————
Axle-Pres-Axle	————————-	Axle 3, Pres 2, Axle 4

In this case, Pres 2 (un der lined) is spec i fied for BOTH lanes 1 and 2!. This sit u a tion is re ferred to as a SEN- SOR CON FLICT and is au to mat i cally de tected by the soft ware. If a con flict oc curs, the Phoe nix will not al low you to start col lect ing un til the con flict is re solved.

Now, for further example, suppose you chose Axle-Pres-Axle for lane #1 and Pres-Pres for lane #2, according to the same tables.

Table 4 - Example 2		
Mode	Lane 1	Lane 2
Axle-Pres-Axle	Axle 1, Pres 1, Axle 2	————————
Pres-Pres	————————	Pres 3, Pres 4

Now, there is no conflict and the system can operate. When the system does detect a sensor conflict with another lane (and note that the higher number lane will always be the lane in conflict, so lane #1 will never be in conflict since it is the lowest lane number), you will receive an error message and the software will not continue operation.

The Phoenix also contains many advanced sensor analysis routines to improve data accuracy, including examining both sets of axle and presence sensors, the tossing out of too short spacings (for example: eliminating a road tube bounce, which can cause a false count), and the determination of missed axles.

II.c. Raw Storage and Specific Functions

In this mode, a individual record is kept for each vehicle encountered. Any combination of one to eight lanes (depending on how many and what type of sensor input boards are installed) can be enabled. If any lane is configured for directional mode (the ability to classify traffic in either direction), an additional lane of traffic data is created. For example, if lane #1 is enabled and is configured in directional mode, the counter would create lane #9 for vehicles traveling in the opposite direction on lane #1.

Physical Lane	Opposite Direction Lane
Lane #1	Lane #9
Lane #2	Lane #10
Lane #3	Lane #11
Lane #4	Lane #12
Lane #5	Lane #13
Lane #6	Lane #14
Lane #7	Lane #15
Lane #8	Lane #16

Note that the directional lane is not an actual separate lane - it is the same physical lane but simply traffic moving in the opposite direction. It is recommended that the directional option be used whenever the possibility of two-way traffic exists, such as a one-lane road or an area on a two-lane highway where there is much passing of slower vehicles, thereby using the oncoming lane.

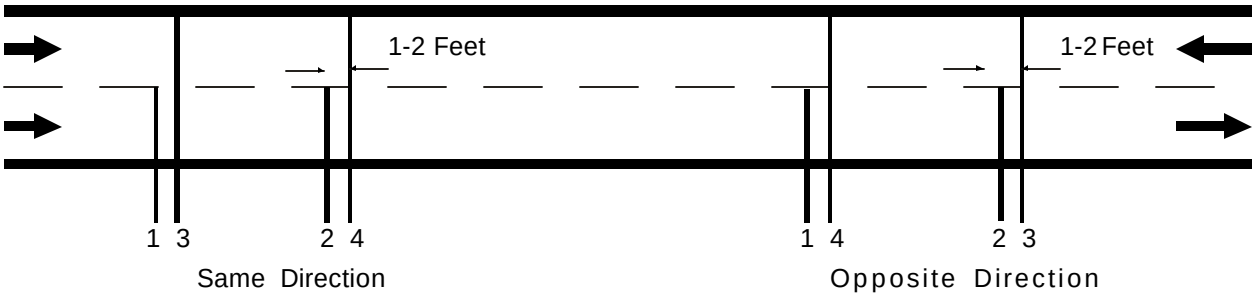
Four separate modes of Raw storage are available. Lanes are not individually set, all lanes will be in the same mode.

Normal	- This is a straight raw vehicle mode which will store lane number, time, speed, number of axles, and spacing between each axle.
Enhanced	- This data is in the same format as Normal with the exception that speed is now calculated to tenths of a MPH (or KPH) and the overall vehicle length axle is added to the record.
Raw with Bins	- The data is the same as Normal except the Speed, Axle, Length, Gap, and Headway bin numbers are stored with each record. This format does not store the data in binned format, but will tell you which bin a vehicle would have gone into if you were binning.
Enhanced with Bins	- This format is a combination (as the name implies) of Enhanced and Raw with Bins. The data is now Enhanced and stored with the bin numbers.

There is some give and take with the modes. Enhanced Raw will give a more precise records than Normal Raw; however, more memory space is used. The same comment goes for Raw with Bins - more memory to keep track of which bin it would have gone in. Appendix B gives an approximation of the number of vehicles which can be stored in memory depending upon which mode you choose.

While in Raw Storage, the user can select any of the four Sensor Modes (Axle-Axle, Pres-Pres, etc.) for each lane. The system will ask the user for Sensor Spacing and the Loop Length (if using presence). The maximum sensor spacing is 99.9 feet, and the maximum loop length is 25.5 feet.

Raw Storage also supports "Lane Overlap". If axle sensors are used to collect data from two lanes of traffic, the lanes can be configured as shown in the figure below. Note that the shorter tube is in the near lane (lane #1), and is activated first by oncoming traffic. This configuration will allow you to collect data from two lanes using 4 road tubes where one set of tubes crosses both lanes.



As is shown, lane overlap can support lanes which vehicles are going same or opposite direction.

IMPORTANT NOTE: You must make sure that for each road tube pair that the longer tube is always equal to or longer than the shorter tube in the pair when measured from the edge of the pavement closest to the counter. For example, when doing Same Direction road tube 3 (of pair 1 & 3) must be equal to or longer from the edge of the pavement to the counter than road tube 1 is from the edge of the pavement to the counter. The same is true for pairs 2 & 4. In the Opposite Direction, the pairs change to 1 & 4 and 2 & 3 where road tube 4 must be longer from the edge than road tube 1 and road tube 3 must be longer than road tube 2.

Raw data is stored in a straight fashion. As vehicles are detected and the information (speed, length, etc.) is gathered, the data is stored sequentially in memory in one long record. During collection, or during testing, the Phoenix will allow you to monitor any or all lanes.

II.d. Binned Storage and Specific Functions

Binned storage is very similar to Raw storage in that you can have any combination of lanes and each lane can be enabled for directional operation giving additional lanes of directional traffic. Binned Storage supports the same sensor modes and lane configurations.

The difference in the modes is the method of storage. In Raw storage, the Phoenix stores all data in chronological order as the vehicles are detected and data is registered (speed, length, etc.). Binned Storage sorts and classifies the data into separate category or "bins". The vehicle is then added to the correct Bin #. In this fashion, you can retrieve totals for various types of vehicles.

There are five basic bin types:

Axle	-	Data is binned by Number of Axles and Spacing Classification (for example: Scheme-F).
Speed	-	Data is binned by the individual vehicles speed.
Length	-	Data is binned by the individual vehicles overall length.
Gap	-	Data is binned by the distance between vehicles, from the tail of the first to the nose of the second.
Headway	-	Binned by the time vehicles are going in the same direction, from the nose of the first to the nose of the second.

Each lane can also be enabled to do two dimensional binning of either "Speed by Length", "Speed by Axle", or both. This modes create a table giving you individual speed bins for each vehicle type or for each vehicle length category.

The bins are compiled over a user specified time length, or "record interval". Up to five separate start times and sampling lengths are available (within a 24 hour period) for use. This allows specific sample periods to be adjusted according to the time of day. An example would be to select 15 minute intervals from 00:00 until 09:00, one hour intervals from 09:00 to 15:00 (3pm), 15 minute intervals from 15:00 to 19:00 (3pm to 7pm), and 1 hour intervals for the remainder of the day.

Each category or "Bin" has been pre-defined as to what it represents. For example, Axle Bin #1 is for motorcycles, Speed Bin #1 is for vehicles traveling between 1 and 19.9 MPH. While these bins have been preset to be the most common categories, you may change the type and number of bins for each binning mode. See the TrafMan Software Instruction Manual for more information on modifying these bin definitions to your own specific needs.

Binned Storage also supports the "Lane Overlap" function. Refer to the previous section, "Raw Storage and Specific Functions" for a detailed explanation.

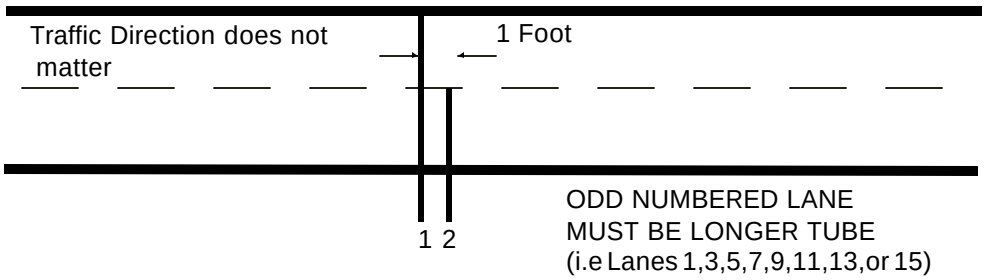
II.e. Count Storage and Specific Functions

In Count storage mode, the only information stored is the number of vehicles that have been detected in each lane. Up to 16 lanes are supported (depending on the number and type of sensor input boards installed) in this mode. Normally, each lane will use only one sensor to collect the count. When a Road Tube or Piezo Sensor is used as the lane sensor, the count may be divided by two. Since loop sensors hold presence for the duration of a vehicle, the divide by two option is not used with loops.

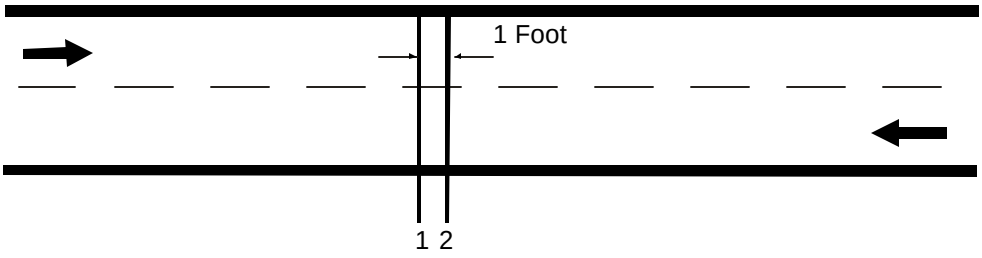
Storage of the counts is performed in the same manner as outlined above for Binned data (i.e. using "record intervals").

There are two specialized sensor configurations for Count data when two axle sensors are used (normally road tubes), they are Lane Subtraction and Directional.

Lane Subtraction- This mode is used when you want to get individual lane count from two different lanes of traffic from one side of the road.
The road tube attached to Lane 1 (or any other ODD numbered lane) is laid out across both lanes. The road tube attached to Lane 2 (or the next even numbered lane) is laid out across one lane. The Phoenix will subtract the even lane's from the odd lane's count to obtain the proper directional count for the odd numbered lane.



Directional -
This mode is used for counting two-way traffic on a narrow road.
A road tube pair (such as 1-2 or 3-4) are laid out across both lanes of a road tube one foot apart. The Phoenix will determine (from the order of actuation) the proper directional count for each lane.



You can monitor any or all lanes during collection or testing, with the system showing you the current lane totals for the record interval.

II.f. Sensor Storage and Specific Functions

Sensor Data Storage is a new, extremely flexible mode of storing traffic data. Data is stored sequentially when a sensor is activated, allowing custom software to organize the data in a way tailor made for the user.

Sensor Data Storage stores the simplest form of data. Inside the Phoenix is a timer that counts down (starting from 16,777,216) at the rate of 10.695 khz (10,695 cycles/second). When this 24-bit timer counts down to zero, it recycles to 16,777,215. At the rate of 10.695Khz, the time it takes to revolve through the counter is 16777215/10695 or about 26 minutes. When a sensor is activated, the counter stores the lane, time, type of sensor, and the timer reading. When the sensor is activated again, it stores the lane, time, type of sensor, and the new timer reading. The counter will store an "A On" for an axle strike, a "P On" for a presence sensor turning on, or a "P Off" for a presence sensor turning off.

Example:

Let's say we have two Presence Sensors in a road, 10 feet from leading edge to leading edge. In the Phoenix, we turn on Lane #1 and Lane #2 and select Pres as the sensor.

A record of strikes might appear as such -

1:14:38:56 (3369138) P On
2:14:38:56 (3367017) P On
1:14:38:56 (3366577) P Off
2:14:38:56 (3364057) P Off

Now, what this means is that the Presence Sensor in Lane 1 was activated at 14:38:56 (2:38pm + 56 seconds) when the timer was at 3,369,138. Lane 2 was activated with a Presence On when the timer was at 3367017. Lane 1 lost presence of a vehicle when the timer was at 3366577. Lane 2 lost presence of a vehicle when the timer was at 3364057.

The question you might ask now is, "OK, so what's the point?". Well, we know:

- The distance (10 feet)
- The time from activating the first to activating the second, which is 3369138 - 3367017 = 2,121 timer cycles.

Since we know the timer is running at 10,695 cycles/second, we can divide the number of cycles by the cycles/second rate and get the amount of time, or 2,121/10,695 = .198317 seconds. Now, since distance = rate X time, then rate = distance/time, or 10 feet/.198317 seconds = @50.42 feet/second. Using some conversions, this comes out to about 34.4 Mph. (if it's a 25mph zone, someone is speeding!).

Since you know the loop length, and have calculated the vehicle speed, you could also calculate the length of the vehicle. This is the exact process the Phoenix uses in Binned and Raw modes.

If you were using tubes, you could calculate speed, number of axles, axle length between individual axles, and overall axle length. Combine the two (use the option of Axle-Pres-Axle or Pres-Axle-Pres) and you can calculate everything the tubes can plus overall vehicle length. Quite a bit of information from a few timer counts.

As with the other storage modes, during testing or collection you can monitor any or all lanes.

III. Hardware

This section describes the hardware components associated with the Phoenix system.

III.a. Keypad

The Phoenix contains a built in 16-key keypad. With this keypad and the built in LCD display (section III.b.) you can completely program and operate the Phoenix.
When the ALT key is held down while you are pressing another key, an alternate set of keys is available to the user. The table below shows the alternate keys.

Table 1 - Alternate Keypad Entry

	0	1	2	3	4	5	6	7	8	9	Clear	⊗
ALT	ABC	DEF	GHI	JKL	MNO	PQR	STU	VWX	YZ[	-./	Abort	A...

Note that if the ALT key is continuously held and the number key is pressed, again, the letter will scroll through the following possibilities of letters:

```
 ABCDEFGHIJKLMNOPQRSRUVWXYZ[]^abcdefghijklmno
pqrstuvwxyz{|}!"#$%&'()*+,-./0123456789:;?@
```

For example, if you wanted the letter “W” you would hold down on “ALT” and then press the “7" key. Note that "V" appears in the space, as Table 1 shows. While still holding the “ALT” key, press the “7" key again, and the letter "W" will appear. Release the “ALT” key and the letter remains. You can also press the right and left arrow keys (while the ALT key is down) to scroll through the alphabet.

The rest of the keys are explained below:

ENTER - Used as a means of indicating to the Phoenix that an option is complete, and ready to be acted upon.

CLEAR - Used as means of backing up one question in a menu.

SPACE - TAM KEY. At any main menu, pressing this key activates the TAM interface. Also, when the counter is first powered up the user can press this key to start the TAM Memory Card Reader System. See section VI for a detailed description of the TAM interface.
When not at main menu, the SPACE key inserts a space at the current location of the command line and will also allow scrolling through options in ascending order.

⌊ - This key allows viewing/selection of options in a descending order. Also used as a non-destructive back space key when entering a line of data.

⊗ - This key allows viewing selection of options in ascending order. Also used to move non-destructively one position to the right when entering a line of data.

ALT - Used only in conjunction with other keys; ALT allows existing keys to perform alternate functions. Use of the ALT key is similar to the SHIFT key on a typewriter keyboard, in that the ALT key must be pressed and held for the duration of the associated keypress.

III.b. LCD Display

The Phoenix is equipped with a two-line LCD display (Liquid Crystal Display). Each line displays up to 16 letters or numbers. This display is used in conjunction with the key pad to program and operate the Phoenix. You will see various questions and information displayed at different times. Please refer to the appropriate section of this manual for more information on specific questions and displays.

The LCD type of display used in the Phoenix consumes very little power, thereby minimizing battery drain during setup and monitoring procedures. To further save battery power, the Phoenix will turn off power to the display when data collection is active and the display is not being used.

Road dust will inevitably cover the display from time to time, and the display will need to be brushed off. When cleaning the display, it is best to attempt blowing off as much dust as possible before wiping the surface with a soft damp cloth. This method limits the chances of scratches being caused by the abrasive found in the dust.

III.c. Serial Port

The serial port is used for the retrieval of traffic data that has been collected by the Phoenix. All serial devices are connected to the Phoenix through the Serial Port plug (located on the right side of the case). Note that the Phoenix can be completely programmed and operated from the serial port.

The serial port supports Baud Rates from 300 Baud to 19200 Baud. It does "auto baud" detection on all incoming data, and automatically matches itself to the speed of the incoming data.

The retrieval of data must be done through the serial port (unless a TAM Card used), and the method of transfer is 1K XMODEM with CRC error checking. An automatic switch to 128 Byte XMODEM transfer occurs when the system gets 10 or more errors (indicating a noisy line, which will transfer faster with smaller blocks).

There are two common types of devices which connect to the Serial Port: Computers and Modems.

- **Computers**

  This is the most common type of serial device. You will need to connect a computer to the Phoenix to retrieve your data. You can also completely program and configure your Phoenix using a computer and the included TrafMan Software (see appropriate manual). Note that any computer with a standard RS232 serial port plug may be connected.

- **Modems**

  Modems are used to provide a telephone link-up to the Phoenix. Modems are particularly useful if the site is a permanent location and there is access to a phone line. Modems provide a means of retrieving data over a telephone, thereby eliminating the need to send an operator to the site. The Phoenix is fully operable over a modem, and all functions are available (if the proper security password is specified). The Phoenix supports baud rates from 300 to 19,200 with a modem. See the Section III.c.1 for more information.

III.c.1. Using the Phoenix With a Modem

All Phoenix counters come fully operable with a modem. You will also need some kind of telephone communication package to access the counter through the modem. There are two pieces of software available from Diamond Traffic Products which give you this ability plus many other features; they are TrafMan Modem Enhancement Package and the Traffic Tally Link Software. See the appropriate manual for more information.

In addition to a software package, you will also need a modem and a Modem Interface Cable (available from Diamond Traffic Products). When choosing a modem, follow the below guidelines:

- If your site is AC powered, buy an AC powered Hayes Compatible Smart Modem. If your site is battery or solar powered, buy either a Line Powered Hayes Compatible Smart Modem or a Battery Powered Hayes Compatible Smart Modem.
  Note that some line powered modems are not "Smart Modems" (i.e. programmable modems), and we recommend you purchase a "Smart Modem". The Phoenix will work with a "Dumb Modem" (i.e. non-programmable), but you may not be able to take advantage of all of the features of the Phoenix.
  If you buy a battery powered modem, the Phoenix can be configured to provide the correct battery voltage to the modem from its Battery Charger Plug. Contact us for exact details and pricing.
- We recommend you purchase a 2400 Baud Modem. You may use slower or faster speed modems, but slower modems will dramatically decrease the speed of data transfer and a faster modem may cause problems with line noise. Also, as a general rule of thumb, the faster the modem, the more power it will consume.
  The Phoenix is fully compatible with MNP protocol and can be easily configured to accept 9600 or 4800 baud transfers. See the TT-Link Sofware Manual or the TrafMan Modem Enhancement Sofware Manual for more detailed information regarding the use of advanced modems.
- If your sites are in a lightning storm area, we strongly recommend you purchase a line surge suppressor between your modem and the telephone line.

Standard Modem Hook Up (1200 Baud Smart Modem):

1) Turn off the power to both the Phoenix and the Modem.

2) Connect the Phoenix to the Modem using the Modem Interface Cable.

3) Turn on the Modem.

4) Turn on the Phoenix. The counter screen should display (after the self test):

```
Phoenix   Vx.xx
<Setting Modem>
```

Counter is now initializing modem. The counter will perform this step every time you hang up after a connection & automatically at midnight and 2pm of each day. NOTE: x.xx is the current Phoenix version number.

5) If everything is done correctly, the Phoenix will configure the modem and adjust it properly. The screen will read:

```
Phoenix   Vx.xx
 <Smart Modem>
```

Counter is now ready to accept incoming calls. You can still use the counter key pad by pressing the ENTER key. Press the CLEAR key to return to this screen. NOTE: x.xx is the current Phoenix version number.

6) If a non-programmable (i.e. "Dumb") modem has been connected, your smart modem is not functioning, or you have incorrectly connected the cables, the screen will instead show:

```
Phoenix   Vx.xx
  <Dumb Modem>
```

If the counter is connected to a dumb modem, it is now ready to accept incoming calls. You can still use the counter key pad by pressing the ENTER key. Press the CLEAR key to return to this screen. NOTE: x.xx is the current Phoenix version number.
If the counter displays this when connected to a smart modem, then something is not working properly.

Connecting to a modem other than a 1200 Baud Modem

The Phoenix defaults to work with a 1200 baud modem, if you want it to accept higher speed calls (such as from a 2400 baud modem) or you are connecting a slower speed modem (such as a 300 baud modem), you must perform the following steps:

1) Disconnect any serial or modem cable from Phoenix.

2) Select the Configure System Option from the Not Collecting Data Menu.

3) Press ENTER until the following option screen appears:

```
Select Baud For
Modem? 1200
```

4) Using the Arrow Keys, select the speed of transfer you want to be able to call the counter at. Make sure it is not faster than the modem can handle.

5) Keep pressing ENTER until you return to the menu.

6) Follow the steps under Standard Modem Hook Up.

Notes about switch settings

If you are using a non-programmable dumb modem, all configuration of it is usually done through switch settings. Follow the below guidelines when setting these switches.

1) DTR Status (sometimes called Data Terminal Ready) should be in the Hang Up when Toggled setting.

2) DCD Status (sometimes called Data Carrier Detect) should be in the Reflect Actual State position (not always "on" or always "off").

If you are using a Smart Modem, switch settings are not normally important because the Phoenix will re-initialize the modem to the correct settings with software.

III.d. Sensors

A Phoenix cannot do anything for you unless it can receive signals from traffic. Some form of sensor must be used to transfer a vehicle passing by to a form of data the Phoenix can use. Variations include Road Tubes, Inductive Loops, Piezo Electric, Tape Switches, Infra-Red, etc.. The Phoenix supports any type of sensor with any type of data collection, thus selecting a sensor is largely a matter of personal preference and/or matching existing equipment.

III.d.1. Road Tubes

Road Tubes (or just "Tubes") refer to hollow rubber tubes usually ranging from 20 to 60 feet in length. These Tubes are stretched across the roadway so that oncoming vehicle traffic drives over them. This generates a sound-wave (or an "air impulse") which travels down the tube and allows the electronics of the Phoenix to determine that a vehicle axle has passed.

Tubes offer the advantage of being easily movable, quick to install, inexpensive, and capable of detecting individual axles of a vehicle. Their disadvantages include rapid wear, hard to secure for long periods, and drivers noticing the tubes and possibly changing speed, lanes, etc..

Follow these guidelines when using Tubes with the Phoenix:

- The counter will work with road tubes between 20' and 100' long. Shorter lengths are generally more accurate so use shorter lengths when possible.
- If collecting Raw or Binned data, make sure each lane's tubes (two per lane) are the SAME LENGTH. Also, try to stretch the tubes the same amount when securing them to the roadway.
- Make sure the Tubes are placed as squarely as possible to the oncoming traffic (so that both wheels of a vehicle strike the tube simultaneously).
- After each use, check the tubes for punctures or other damage.
- Plug the end of the with a suitable device to keep dirt out.

How to connect the Tubes to a Phoenix when collecting Raw or Binned Data:

- Get two equal length road tubes for each lane desired.
- Install one road tube perpendicular to the direction of traffic across a Single lane of traffic. You can string road tubes across multiple lanes using the "Lane Overlap" function or the "Directional" mode. This is fully covered under Section II.c.).
- Install the second road tube perpendicular to the direction of traffic from 1 to 25 feet from the first (12 feet) recommended.
- Connect the road tube which will be hit first by oncoming traffic into the 1st Input Nozzle for the particular lane you are using.
- Connect the road tube which will be hit second by oncoming traffic to the 2nd Input Nozzle for the particular lane you are using.

How to con nect Tubes to a Phoe nix when col lect ing Count Data:

- In stall a road tube per pen dic u lar to on com ing traf fic across a sin gle or dual (or more) lane of traf fic.
- Con nect the road tube to the Noz zle on the Phoe nix for the lane you are us ing.
- If you are us ing at least two lanes and you want to use Lane Sub trac tion or Di rec tional func t ion, you may want to read about these func tions in Sec tion II.e for more in for ma tion on how to cor rectly in stall and con nect tubes.

How to con nect Tubes to a Phoe nix when col lect ing Sen sor Data:

- In stall a road tube per pen dic u lar to on com ing traf fic across one or more lanes.
- Con nect the road tube to the Noz zle on the Phoe nix for the lane you are us ing.
- Note that the Sen sor mode sim ply stores times when this sen sor is ac ti vated, place ment of it is up to you.

FOR IM POR TANT IN FOR MA TION RE GARDING TUBES AND PO TEN TIAL ER RORS, SEE AP PEN DIX - E.

III.d.2. In duc tive Loops

This type of sen sor is made of mul ti ple turns of wire bur ied un der the road way, whether pavement, gravel, or dirt. Per haps the most com mon us age of Loops to day is with Traf fic Sig nals.

Ad van tages of loops are: They are per ma nent so they do not need to be in stalled each time they are used. They do not wear and are usu ally un de tect able by on com ing traf fic. Their dis ad van tages in clude: They lack the abil ity to dis cern in di vid ual ve hi cle ax les. They are some what more sus cep ti ble to ex ter nal fac tors, such as ve hi cle height and metal con tent. They are also slightly more com plex to in stall and con figure.

How To Use Loops With A Phoe nix:

- Loops should be in stalled in the cen ter of the de sired lane of traf fic and be no smaller than four feet by four feet (six foot by six foot loops are rec om mended).
- If you plan on us ing loops to col lect Raw or Binned data, be sure that each loop of a lane (two p er lane) is the SAME di men sions. The lead ing edge from the first loop to the lead ing edge of the sec ond loop should be 5 to 25 feet (16 feet rec om mended).
- Con nect loops to the Phoe nix Loop Plug ex actly the same as you would tubes (first loop goes to L oop #1 con nec tion, sec ond loop goes to Loop #2 con nec tion, etc..). Re fer to Ap pen dix C for more in for ma tion on what color wires of the loop har ness go to which loop.

III.d.3. Piezo Electric & Resistive Sensors

Piezo Axle Sensors combines the permanent advantages of Loops with the individual axle detectionabilities of Tubes. In addition, there are also some non-permanent Piezo strip sensors available. A Piezo sensor is a "Axle" sensor for setup and configuration purposes.

How to use Piezos with the Phoenix

- Install the piezos perpendicular to the oncoming traffic in a single lane.
- Connect to the appropriate piezo input connector for the lane you are using.
- The Phoenix defaults with the sensitivity of the Piezo Detection circuitry set to the most common value (75%). It may be necessary, however, to adjust this setting to accommodate more or less sensitive piezos. Follow the steps below to adjust this setting.

  - Bring the Phoenix to the Site you want to set it up at.
  - Connect all piezos to be used to the Phoenix.
  - Set the counter up to collect COUNT data (regardless which type of data you plan to eventually collect). See section V.d. for a step-by-step example of this.
  - Enable all of the lanes which have piezos connected to them.
  - When you get to the "Testing Lanes" screen, stop and wait for vehicles to cross each of the sensors. Ideally, you want several different types of vehicles to cross each of the piezo sensors so that you can verify that the sensors are counting trucks and small cars accurately.
  - If one of the piezos seems to be undercounting or overcounting, you should adjust its sensitivity level. This is done by holding the ALT key down and the pressing the number key corresponding to the sensor number. For example, press ALT + 1 to adjust piezo input #1.
    After pressing ALT and a number key, another screen will appear allowing you to set the piezo level. Use numbers 1-9 to select levels from 10% to 90%. Press the 0 key to select 100% sensitivity (i.e. maximum). Use the LEFT and RIGHT arrow keys to decrease/increase the level in smaller increments. Press the ENTER key when finished.
    See section IV.F for more detailed information.
  - Once all piezos have been set, return to the main menu (ALT + CLEAR) and then proceed to setup the counter to collect the type of data you desire.
    Note that you do not have to set the counter to collect Count data to set the piezo sensitivity levels, it is simply the easiest mode to use to determine if a sensor is overcounting or undercounting. You can also tell using the Raw or Binned modes if vehicles show extra axles, missed axles, or you get a lot of SnMis.

III.d.4. Remote Input

The remote input connector is a direct input plug to the counter. The Phoenix has a 8 channel open collector input which allows user to directly connect ANYTHING to the Phoenix you want to use which provides a momentary switch closure or other open collector type output. Examples would be: Tape Switches, Foot Mats, or Infra-Red Detectors. See Appendix C for information on remote harness wire colors.

The signal to the counter through the remote plug should be:

- Noise free.
- The pulse width should be about 10ms . Longer is allowed providing it is very clean.

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IV. Keypad Operation

This section describes the full operation of the Phoenix Field Unit using the built in keypad. For information on operations using the Serial Port, please refer to the TrafMan Software Instruction Manual.

Note that virtually all features of the Phoenix can be controlled with the keypad. The only exception is that of Data Retrieval, in which case you must use the Serial Port or a TAM Card.

IV.a. How To Use The Menus

The Phoenix menu structure has been designed to take full advantage of the system's capabilities with minimal effort and confusion of the operator. The menu system has been designed so that only those options which may be needed at any particular point are available. Selection of an option from within a menu is a simple matter of using the arrow keys. Press the direction you wish to go (either right arrow for forward through the menus or left arrow for backwards through the menus) and then press the ENTER key to activate that option. The menu will automatically roll-over at the end, so by pressing one direction or the other the desired option will always appear.

An alternate method of selection is to type the number which corresponds to the desired option. Each option has a number to which it may be referenced directly. These numbers are located on the inside of the Phoenix lid. This method has the benefit of skipping all other options by proceeding immediately to the one specified. Press ENTER to activate the option once it has been selected.

Different options under either menu will ask different questions based upon the Data Storage and Sensor Modes selected. For example, if you have selected Sensor Data Storage using Axle Sensors, the Phoenix will not ask you questions about time intervals or loop lengths. The options have been optimized to allow the quickest possible installation and configuration.

Aborting an option is done by pressing the CLEAR key. This backs the Phoenix up one questions per keypress until you return to the one of the menus. If you press CLEAR at the menu when data collection has started, the Phoenix will be placed into a special mode and the LCD display will go blank. At this point, the Phoenix will turn off the display to save power. Note that the counter continues to collect data in this mode.

You can turn the display on the counter back on at any time by pressing the ENTER key. Make sure you press the CLEAR key from the menu before you leave the counter to help save on battery power. You cannot tell the Phoenix to turn off the display unless it is collecting data.

Serial Cable Connection

If a serial or modem cable is connected, the counter will instantly switch from the menu to a screen which shows "<Serial Active>" or "<Setting Modem>". If you want to use the regular keypad menu after a serial or modem cable is connected, simply press ENTER and you will be returned to the menu and ALL SERIAL PORT INPUT IS IGNORED! Press the CLEAR key from the menu when you are finished and the counter will return to the "<Serial Active>" or "<Setting Modem>" state.

IV.b. The Two Main Menus

The Phoenix has two basic main menus that appear depending on whether you are collecting data or not.

IV.b.1. Not Collecting Data Menu

This menu appears when you turn on the counter and are ready to collect data. It has the following options:

- Start Collecting - The main option. It will ask a series of questions to determine the lanes and format for data collection. Once completed, it allows you to test your configuration, and then start collecting data. Once this option is finished, you will be in the Collecting Data menu (see next section, IV.b.2).
- Delete Files - Used to delete any files currently in memory. If no files are in memory, Phoenix will display "No Files In Memory" if selected.
- Show Status - Displays current memory usage & availability, number of files in memory, loop boards installed (if any), piezo boards installed (if any), current time and date, and a battery voltage.
- Test Sensors - Can be used to test any connected sensors. This function will tune any connected loops to the system, and then give a graphical representation of activations.
- Time of Shutdown - Displays the Time and Date the system was last shut down (power turned off, not stopped collecting).
- View Lane Totals - This option displays the total number of vehicles (Raw & Binned) or sensor activations (Count & Sensor) from the last Start to Stop Collection.
- Configure System - Configure System allows the user to configure options such as Storage Mode, Date and Time Formats, File Handling, Speed and Length Formats, and Maximum Allowable Axle Spacings, etc..
- Cold Restart - Cold Restart will completely restart the counter. All files, configurations, and setups will be erased. The option has a confirmation to avoid accidental data loss.

IV.b.2. Collecting Data Menu

After the Phoenix has been configured and data collection started, the collecting data menu is used. To reach the menu, press the ENTER key from sleep mode. To return to sleep mode, press the CLEAR key. The collecting data menu contains the following options:

- Stop Collecting - Closes the current file and stop collection of data. The option has a confirmation to avoid accidental file closure.
- Delete Files - Same as option in Not Collecting data menu.
- Show Status - Same as option in Not Collecting data menu.
- Monitor Lanes - Allows monitoring of Traffic Data while collecting. As vehicles are detected, the data will appear on the display, while concurrently being stored in the open file.
- Time of Shutdown - Same as option in Not Collecting data menu.
- View Lane Totals - Same as option in Not Collecting data menu.

IV.c. Start Collecting

The Start Col lecting op tion asks many ques tions, many de pend ing on what type of hard ware you have inside your Phoe nix as well as what type of Stor age Mode you plan on us ing. Press the “1" key from the menu and the dis play will show:

```
SELECT OPTION:
Start Collecting
```

Press ENTER to be gin the start col lect ing op tion.

Note that press ing the CLEAR key will back you up one ques tion. Holding down the ALT key and pressing the ENTER key will skip all ques tions and im me di ately be gin Testing Lanes un der the cur rentStart Col lecting Op tions. This is use ful to col lect data un der pre vi ously en tered setup con di tions.

Be fore you use the Phoe nix to ac tu ally start col lect ing data, ver ify the fol low ing things:

- The bat tery is fully charged (or will last as long as you plan on col lect ing data).
- You have enough free mem ory in the coun ter to hold all of the data you plan on col lect ing. Use the Show Sta tus op tion to ver ify the amount of free mem ory. Ap pen dix B con tains ta bles which will give you an idea of how much mem ory you need for dif fer ent col lec tion op tions and modes.
- You have used the con fig ure sys tem op tion to tell the coun ter what type of data you want to collect (Raw, Binned, Count, or Sen sor). Note that if you have pre vi ously set the coun ter, you will not need to Con fig ure Sys tem again as long as you plan to col lect the same type of data.

IV.c.1. Questions Asked With Any Stor age Mode:

```
Site: (15 chars)
_______________
```

En ter the cur rent site, up to 15 char ac ters long. You should al ways en ter a site, to help dis tin guish be tween dif fer ent data col lec tion ses sions. Note that the full al pha bet plus num bers and punc tu a tion can be used. NOTE: This is the only place you can see the full 15 char ac ters of the Site ID. In all other places only the first 10 char ac ters are shown.

```
Info: (1st Line)
_______________
```

En ter in the first line of in for ma tion, up to 15 char ac ters long. This Info line is pro vided in ad di tion to the Site string and can be left blank if desired.

```
Info: (2nd Line)
_______________
```

A sec ond line of Info which is also op tional.

```
Set The Current
Time: hh:mm:ss
```

En ter the cor rect time, in mil i tary for mat. If the time shown is cor rect, sim ply press ENTER to ac cept it and go on.

```
Set The Current
Date: mm/dd/yy
```

En ter the cor rect date. If the date is cor rect, sim ply press ENTER to continue. Note that the for mat may also be DD-MM-YY or YY-MM-DD depend ing on the date for mat you se lected in Con fig ure Sys tem op tion.

Set The Current Day Of Week? DAY

Enter the correct day of the week by pressing the arrow keys and toggling through the standard weekdays. Choices are Sun, Mon, Tue, Wed, Thu, Fri, or Sat.

With Raw or Binned Storage:

Select 1 2 3 4 Lanes : n n n n

If 1-2 loop boards.

Select 12345678 Lanes : nnnnnnnn

If 3-4 loop boards.

With Count or Sensor Storage:

Select 12345678 Lanes : nnnnnnnn

First Screen.

Select 9.....16 *Lanes : nnnnnnnn*

Second Screen. Displayed only if 3-4 loop boards installed.

Enter the enabled lanes by pressing the corresponding number below the lane. For example, pressing the 1 will toggle lane 1 on and off. You must enable at least one lane before proceeding. If no lanes are selected, the Phoenix will display an error message and will not allow the user to go any farther until at least one lane is enabled.

IV.c.2. Lane Grouping Questions

The Phoenix has the ability to group lanes together inside of the counter prior to storing them in memory. You could, for example, group lanes 1 through 4 together and store only there summed values in memory. This has the advantage of reducing the amount of memory that is being used, and the disadvantage of eliminating the individual lane totals.

Lane Grouping Questions are only asked if you are in Binned or Count mode and you have selected Yes for the Ask For Lane Groupings question in the Configure System option.

Select Number Of Groups? x

Select from 0 to 4 groups. Selecting 0 disables lane grouping. Selecting 1 puts all lanes into one group. Selecting 2 or more causes the counter to ask questions where you specify which lanes go into which groups.

If you select 2 or more groups, the counter asks you the following question for each group:

Group #y Lanes: (lanes)

Where y is the group number and (lanes) is which lanes are currently assigned to this group. To assign a lane to this group, simply press the number key corresponding to the lane number. To unassign a lane to this group, press the number key again. You assign and unassign lanes 11-16 using the ALT + 1-6 (ALT + 1 for Lane 11). 0 is used for Lane #10.
Note: You must assign at least one lane to each group. You cannot assign lanes to the group which have already been assigned to a lower numbered group.

Lane grouping is only visible when you retrieve the collected data. Monitoring the lanes and all other functions are not affected by lane grouping. Lane grouping does not affect the type of data collected (such as Axle Classification or Speed Classification) but simply adds several lanes classification values together to look as if all vehicles were in a single lane.

IV.c.3. Questions Asked With Raw Storage Mode

The following questions are asked for each lane you have enabled.

`Info For Lane #n _____`	Enter the appropriate information for this lane, up to 15 characters. This Info is normally used to indicate lane direction.
`Directional Mode For Lane #n: No`	Use if the arrows keys to toggle between Yes and No. If it is enabled, a directional lane is created (see Section II).
`Info For Lane #n _____`	Used if directional has been created. If directional mode has not been enabled, this will not be asked.
`Lane #n Sensors > Axle-Axle`	Select the Sensor Mode you wish to use. Options in Raw Mode are Axle-Axle, Pres-Pres, Axle-Pres-Axle, and Pres-Axle-Pres. Important - this question will only be asked if you have at least one loop board installed. If you do not, the Phoenix assumes Axle-Axle sensors (Tubes, Remotes, or Piezo Sensors).
`Lane #n Sensor Spacing: nn.n'`	Set this value to indicate the spacing in between your sensors. This can be set from 5.0 feet to 99.9 feet. See Section III (Sensors) for recommended spacing.
`Loop Length For Lane #n: nn.n'`	This question is asked if you selected any form of Pres in you Sensor selection. You must enter the Length of the loop used for this lane. If you have entered Pres-Pres, it is the length of the Second Loop. The Phoenix uses this information in calculating vehicle length.
`Select Raw Type: nnnnnnnnnnn`	Use the arrow keys to select which type of Raw Data you wish to collect (Section II). Options are Normal Raw Data, Enhanced Raw, Raw with Bins, and Enhanced & Bins. Press ENTER to select.

The system will now go into a lane test. If you have loops connected, the system will give the message "Tuning Loops" and then "Waiting For Any Vehicle...". Each lane may now be tested, with the data displayed on the LCD display as vehicles are registered. Note - If you have selected a Sensor Mode which uses a loop and no loops are connected, or if there is a failure in a loop, the system will display "Unconnected Loop Check:nnnn" with nnnn being the loop (or loops) which you have requested for use but is not detectable by the Phoenix. At that point, connect up the missing loops and press ENTER to try again.

From here, the system asks the final start questions.

IV.c.4. Questions Asked With Binned Storage Mode

The program asks the following questions for each lane you have enabled.

`Info For Lane #n` `_____`	Enter the appropriate information for this lane, up to 15 characters. This Info is normally used to indicate lane direction.
`Directional Mode` `For Lane #n: No`	Use the arrow keys to toggle between Yes and No. If it is enabled, a directional lane is created (see Section II).
`Info For Lane #n` `_____`	Used if a directional has been enabled. If directional mode has not been enabled, this will not be asked.
`Lane #n Sensors` `> Axle-Axle`	Select the Sensor Mode you wish to use. Options in Binned Mode are Axle-Axle, Pres-Pres, Axle-Pres-Axle, and Pres-Axle-Pres. Important - this question will only be asked if you have at least one loop board installed. If you do not, the Phoenix assumes Axle-Axle sensors (two Tubes or two Piezo Sensors).
`Lane #n Sensor` `Spacing: nn.n'`	Set this value to indicate the spacing in between your sensors. This can be set from 5.0 feet to 99.9 feet. See Section III (Sensors) for recommended spacing.
`Loop Length For` `Lane #n: nn.n'`	This question is asked if you selected any form of Pres in you Sensor selection. You must enter the Length of the loop used for this lane. If you have entered Pres - Pres, it is the length of the Second Loop. The Phoenix uses this information in calculating vehicle length.

The following questions ask which bins you want to enable for data collection. At least one bin must be enabled. All bins may be enabled; however, it is suggested the user read Appendix B (Memory Usage) to determine if enough memory is available.

`Collect Axle` `Bins? No`
`Collect Speed` `Bins? No`
`Collect Gap` `Bins? No`
`Collect Headway` `Bins? No`
`Collect Length` `Bins? No`

Collect Speed By Axle Bins? No	
Collect Speed By Length Bins? No	Se lect Yes or No for each of these op tions to turn on or off the type of data col lec tion..
No. of Different Intervals? x	Select how many different interval lengths (1-5) during the day the Phoe nix will use when col lect ing data.

If only one dif fer ent in ter val is se lected, the Phoe nix asks:

Record Interval Length: hh:mm	En ter the length of the re cord in ter val you want to use.

If more than one in ter val is se lected, the Phoe nix will ask the fol low ing ques tions for each in ter val:

Int Start: nn:nn #n Length: nn:nn	The first interval defaults to start at 00:00 (midnight) and cannot be changed. The Phoe nix will ask for length and time of start for each successive in ter val.

The Phoe nix will now dis play the mes sage “Tuning Loops” fol lowed by “Waiting for Any Ve hi cle” . Once a ve-hi cle has passed and the data viewed is cor rect, press ENTER to con tinue.

From here, the fi nal start ques tions are asked.

IV.c.5. Questions Asked With Count Storage Mode

The following questions are asked for each lane you have enabled.

`Info For Lane #n` `_____`	Enter the appropriate information for this lane, up to 15 characters. This Info is normally used to indicate lane direction.
`Select Lane #n` `Sensor: Axle`	Choices are Axle or Pres. This question is only asked if you have a loop board installed in the counter.

If you are setting an odd Numbered Lane, the counter asks:

`Select Lane #n` `Mode: Normal`	Choices depend on Lane Sensor. If Axle, choices are Normal, Direction, or Subtract. If Pres, choices are Normal or Direction. Selecting anything other than Normal will indicate that you are using this lane in conjunction with the next lane to get count. This causes the counter to automatically configure the next lane to be the same as this lane.

If you selected an Axle Sensor:

`Divide Lane #n` `Count By 2: No`	Select Yes or No to automatically divide the total count by two.

After the lanes have been entered, the following questions are asked:

`No. of Different` `Intervals? x`	Select how many different interval lengths (1-5) during the day the Phoenix will use when collecting data.

If only one different interval is selected, the Phoenix asks:

`Record Interval` `Length: hh:mm`	Enter the length of the record interval you want to use.

If more than one interval is selected, the Phoenix will ask the following questions for each interval:

`Int Start: nn:nn` `#n Length: nn:nn`	The first interval defaults to start at 00:00 (midnight) and cannot be changed. The Phoenix will ask for length and time of start for each successive interval.

After entering the interval information, the Phoenix will display "Tuning Loops" (if some loops have been selected) and then show a test screen. As data is collected, the count for each lane entered will be shown. Note that the Phoenix is not collecting and storing data at this point - it is testing the lanes for proper setup. Press ENTER to continue.

The system will now ask the final start questions.

IV.c.6. Questions Asked With Sensor Storage Mode

The following questions are asked for each lane enabled:

`Info For Lane #n` `_____`	Enter the appropriate information for this lane, up to 15 characters. This Info is normally used to indicate lane direction.
`Lane #n Sensor` `Type: Axle Only`	Enter the sensor type for lane #n. Options are Axle Only, Pres Only, or Axle+Pres.

The screen will display "Tuning Loops" if loops are selected, and then "Waiting For Any Sensor". The system is not collecting and storing data - it is for the user to confirm lane setup and configuration. Once several sensors have been activated and the data is satisfactory, press ENTER to continue.

IV.c.7. Final Start Questions

`Select Mode To` `Start? Now`	You can choose between Now, Midnight, or Date/Time options of starting. If you choose Date/Time, the system will request entering a time and a month/day to start.
`Select Mode To` `Stop? Never`	You can choose between Never, 24 Hours, Date/Time. Never will continuously run until manually shut down (or out of memory), 24 hours will simply run for 24 hours from the time of start, and if you select date/time the Phoenix will request entering a time and a month/day to stop.
`-SETUP COMPLETE-` `Press Enter Key`	The counter is now ready to start.

Once the ENTER key is pressed the system goes into sleep mode (the display will blank), and has started collecting data. If you press ENTER again, the system will wake up and you will be placed in the not collecting data menu.

Note about selecting any start time other than Now:

The counter will go ahead and put you in the Collecting Data Menu, even though you may have selected to start collecting at midnight or at some future time and date. This condition is called the "Preset Mode", since the counter has been preset to start collecting at a future time.
While in Preset Mode, no file is open nor is any data being stored in memory. You can still monitor collection, however, to verify the sensor configuration is working

Note about collecting Binned or Count data:

These two modes both use record intervals. The Phoenix will NOT start collecting data until the beginning of the next even record time. For example: The record interval is 15 minutes, you tell the counter to start Now when it is 10:53:00. The counter will not start until 11:00:00.
While the counter is waiting for the start of a new interval, it is also in Preset Mode (see above).

IV.d. Delete Files

The delete files option allows you to delete any or all files in the current memory. Press "2" from the menu and the display will show:

SELECT OPTION: Delete Files

Press ENTER to begin deleting files.

If there have been no files created in memory, the counter shows:

No Files In Memory.

If files have been created, the display will show:

(n) Delete What Files? All Files

"n" is the number of files currently resident in memory. By pressing the arrow keys the options of All Files, Single, or Retrieved may be selected.

If "All Files" is selected, the display will show:

DELETE ALL FILES You Sure? No

This message is the safety for deleting files. Use the arrow keys to toggle the answer to Yes.

If "Single" is selected, the display will show:

1:_____ n mmmmm mm/dd/yy

n is the designator for whether the file has been retrieved (Yes or No). mmmmm is the file size. # 1 is the file number. mm/dd/yy is the starting date of the file. To select the file to be deleted, use the arrow keys to toggle from file to file. Once the file has been selected, press ENTER. The display will show:

DELETE FILE #n You Sure? No

This is the safety for file deletion. Toggle to Yes using the arrow keys. Pressing ENTER will delete the file. If the file is deleted, the display will show the next file. Note that all files following the deleted file will be automatically renumbered down to keep file number continuity.

If "Retrieved Files" is selected, and no files have been retrieved, the display will show:

There Are No Retrieved Files.

If files have been retrieved, the display will show:

DELETE FILES You Sure? No

Use the arrow keys to toggle to Yes to delete the files.

IV.e. Show Status

The Show Status option allows display of the Phoenix System Status. This should always be performed prior to Starting Collection to ensure correct time/date and that there is enough memory free to collect files. From the menu, press "3" and the display will show:

SELECT OPTION: Show Status	Press ENTER to show sys tem sta tus.

First, the coun ter dis plays the amount of mem ory in the sys tem

Total Mem:mmmmmm Mem Left :nnnnnn	Dis plays the to tal amount of mem ory in your coun ter, and how much is left for use.

Next, how many files are in the mem ory is dis played:

Memory Holds n Data File.	“n” = num ber of files.	No Files In Memory.	If there are not any files.

Next, if there aren’t loop boards in stalled, the dis play will show:

No Loop Boards Installed

If loop boards are in stalled, the dis play will show:

Loop Board xxxxx Installed	Where xxxxx will be which loop boards are in stalled (1-4).

Next, the Piezo Board sta tus will show:

No Piezo Board Installed	If no piezo inputs	x Input Piezo Board Installed	“x” is number of piezo in puts avail able (0, 4, or 8).

Next, the TAM In ter face sta tus screen will show:

No TAM Interface Installed	TAM Interface Installed.

Next, the cur rent time and date is shown:

Time: hh:mm:ss Date: dd/mm/yy	The cur rent time and date are dis played. Note that the date will be dis-played in the cur rently se lected for mat.

Last, the bat tery con di tion is dis played:

```
Current Battery
Voltage = xx.x
```

This screen shows the current voltage on the battery, to the nearest tenth of a volt.

IV.f. Test Sensors

The Test Sensors option is for testing sensors and system response. Press "4" from the menu and the display will show:

```
SELECT OPTION:
Test Sensors
```

Press ENTER to begin testing sensors

If no loop boards are installed in the counter, the display shows:

```
Testing Sensors:
Axle: ________
```

The display is automatically set for eight axle sensors, and will indicate when a respective sensor has been activated.

For example, if sensor two is activated, the display will temporarily show:

```
Testing Sensors:
Axle: _2______
```

The display will show sensors as they are activated, and then return to the blank state.

If any loop boards are installed, the display will show:

```
Axle: ________
Pres: <$B0>  <$B0>  <$B0>  <$B0>  <$B0>  <$B0>  <$B0>  <$B0>
```

If 1-2 Loop Boards

```
Axle: ________
<$B0>  <$B0>  <$B0>  <$B0>  <$B0>
<$B0>  <$B0>  <$B0>  <$B0>  <$B0>
<$B0>  <$B0>  <$B0>  <$B0>  <$B0>
```

If 3-4 Loop Boards

Axle sensors are displayed above, presence sensors are displayed below. What is put in for the "<$B0> <$B0> <$B0> <$B0> <$B0> <$B0> <$B0> <$B0>" depends upon how many loops are connected. Each "<$B0>" is for a given loop; a square designates a connected loop, a square with the top bar missing designates no loop is connected. Presence in the loop is designated by the square being replaced with the loop number.

Press the "9" key at any time to retune the loops after you connect or disconnect loops. ENTER or CLEAR takes you out of the testing screen and back to the main menu.

If you have a Piezo Board Installed:

The Phoenix will allow you to set Piezo Sensitivity Levels from the Testing Sensors screen. These sensitivity levels control how much force is required to trigger a Piezo Electric or Piezo Resistive sensor. Levels are set in a range from 0% to 100% with 100% being the most sensitive (i.e. requires the least force to trip the sensor). Each piezo has its own sensitivity level which can be set differently from all others.

To set a par tic u lar Piezo Sen si tiv ity level, hold down the ALT key and press a num ber key from 1 to 8 cor re-spond ing to the Piezo Level you want to set. An other screen will ap pear as be low:

```
Piezo Trip Level
Input #x: yyy%
```

“x” is the piezo in put num ber and “yyy” is the cur rent level.

At this point use the fol low ing keys to set a new level:

0-9 - Sets level to a value from 10% to 100% (0 key sets 100%, 1-9 sets 10% to 90%).

CLEAR - Exits piezo sen si tiv ity set ting screen.

ENTER - Exits piezo sen si tiv ity set ting screen.

Left Arrow - De creases sen si tiv ity a small per cent age at a time.

Right Arrow - In creases sen si tiv ity a small per cent age at a time.

ALT + 1-8 - Switches to a dif fer ent Piezo Sen sor.

IV.g. Time of Shutdown

Time of shut down will give the last shut down time of the system. Press the number "5" from the menu and the display will show:

`SELECT OPTION:` `Time of Shutdown`	Press ENTER to see the time of shut down.
`Time: hh:mm:ss` `Date: dd/mm/yy`	The last time and date of shut down are displayed. Note the date will be displayed in the format selected in the configure system option.

Note that the time of shut down is either the time YOU turned the power off on the counter or the time the counter shut itself off due to a weak battery. It is NOT the time the counter stopped collecting data.

IV.h. Configure System

Configure system will set the system configuration for installation. Press the number "6" from the menu and the display will show:

`SELECT OPTION:` `Configure System`	Press ENTER to begin system configuration.
`Select Storage` `Mode: Binned`	This asks which storage mode you require. The choices are Raw, Binned, Count, or Sensor.
`Select Format Of` `Dates: MM/DD/YY`	This asks which format you require for the date. Options are: MM/DD/YY, DD-MM-YY, and YY-MM-DD.
`Erase First File` `When No Mem? No`	This asks if you want to continue collecting data when the memory is full, or should the counter delete the oldest file to make space for new data. If you select No the Phoenix will stop collecting when the memory is full. The default for this option is Yes if a TAM interface is installed.
`Verify Power Off` `Option: Disabled`	If the Phoenix is collecting data, is in sleep mode, and if it receives a signal to shut down, enabling this option (Enabled) will cause the counter to display a message to the user requiring the user press the ENTER key to shut down. If the user does not press the ENTER key, the Phoenix will continue to collect data. Enabling this option can help to avoid false shut downs due to circumstances such as static electricity (i.e. lightning). Note that if the battery voltage is below 5.8 volts (See "Show Status"), the Phoenix will ignore the option and power down anyway.
`Create New Files` `When? Manually`	The user may select to create new files Manually, Daily, or Weekly. Manually means that the counter will only create a file when you specifically tell it to.

Daily means the coun ter will cre ate a new file each day at mid night.
Weekly means the coun ter will cre ate a new file once per week.

If you se lect Weekly files, you will be asked:

`Starting Day Of Weekly File? Sun`	Se lect the day of the week that should be come the FIRST day of your weekly file. Choices are Sun, Mon, Tue, Wed, Thu, Fri, or Sat.
`Select Baud For Modem? 1200`	This op tion tells the coun ter the baud rate a mo dem con nected to it can send/receive data at. For example, if you are connecting a Hayes Smartmodem 2400 to the counter you should set this value to 2400. YOU HAVE TO CALL THE COUNTER AT THIS RATE! You can change the rate for fu ture calls by us ing a com mu ni ca tion pack age like TrafMan and pro gram ming the coun ter to ac cept fu ture calls at a dif fer ent rate. Your choices are 300, 600, 1200, 2400, 4800, 9600, and 19200.
`Ask For Lane Grouping? No`	This op tion en ables or dis ables the Lane Grouping Func tion. If you se-lect No, then Lane Grouping is disabled and the counter will not ask ques tions per tain ing to it in the Start Col lecting op tion (see IV.c.2).

The fol low ing con fig ure ques tions are only asked if ei ther Binned or Raw Stor age has been se lected:

`Speed and Length Format? U.S.`	Re quests ei ther U.S. feet and MPH, or Metric cen ti me ters and KPH For-mat.
`SnMis Storage Mode: View Only`	This op tion is used to se lect what the coun ter should do with sen sor miss in for ma tion. Sen sor misses oc cur when a ve hi cle does not cross both sen sors (see lid in struc tions on Phoe nix field unit for a de scrip tion of each sen sor miss code). View Only will dis play sen sor misses on the screen when mon i tor ing, but not store these misses to mem ory. View & Store dis plays the misses and stores them for later re trieval into mem ory. Note that stor ing sen sor misses in mem ory does use up mem-ory that could be used for data. Disabled causes the coun ter to ig nore sen sor misses.
`Maximum Axle Spacing: 35.0'`	This op tion de ter mines the lon gest spac ing be tween any two ax les to be al lowed when col lect ing Raw or Binned data us ing two axle sen sors. The coun ter uses this length to de ter mine where the end of a ve hi cle is, and the start of a new ve hi cle be gins. Most trucks do not ex ceed 35' be-tween ax les, and most ve hi cles do not travel closer than 35' to each other. You should change this value if you have many tail gat ing ve hi cles which have short axle spac ings (such as rush hour car traf fic), or if you have trucks with very long spac ings be tween ax les. Note that the lon ger the spac ing, the greater the chance two ve hi cles close to each other will be counted as one long ve hi cle.

The fol low ing ques tion is al ways asked re gard less of stor age mode:

Battery Warning Voltage: x.x	Select at what voltage you want the counter to warn you about the battery being low. Use the left arrow key to decrease the voltage or the right arrow key to increase the voltage.

IV.i. View Lane Totals

This option allows you to view the total amount of vehicles (Raw and Binned Storage Modes) or sensor activations (Count and Sensor Storage Modes) that have occurred from the last time you Started collection to the last time you Stopped Collection.

When you select this option, a screen will appear similar to the following:

Lane a: x Lane b: y	If two or more lanes enabled.
<< Lane Total >> Lane a: x	If only one lane is enabled.

a and b are the lane numbers of enabled lanes and x and y are the total vehicles or sensor activations. If you are collecting data then the totals will update as vehicles cross the sensors. To view additional enabled lanes, press the <Enter> key. To back up to view previous lanes, press the <Clear> key.

If you are use a preset time (such as Start At Midnight) then these lane totals will reset at end of the preset time. Also, using In-Day times will reset the lane totals at the beginning of each In-Day period. Daily or Weekly files does not reset the lane totals.

IV.j. Cold Restart

Cold restart will perform the same function as removing backup power. The system will restart with ALL memory clean. Note that time and date, along with ALL configuration parameters WILL BE LOST. Don't use this option if the system contains any data which has n't been retrieved for use. ALL DATA WILL BE LOST.

Press 7 from the menu and the screen will show:

SELECT OPTION: Cold Restart	Press ENTER to select the option.
Sure You Want To Restart? No	If you are SURE you want to do this, use the arrow keys to toggle to Yes. Press ENTER.
Phoenix Vn.nnt <Cold Restart>	"n.nn" is the version of the interior firmware. The "t" is the setup type (usually a 'A').
SELECT OPTION: Start Collecting	The system has now been completely reset to the factory defaults.

IV.k. Stop Collecting

Stopping data collection is the only way to return to the Start Collecting Data menu. Press 1 from the menu and the display will show:

`SELECT OPTION:` `Stop Collection`	Press ENTER to se lect the op tion.
`Sure You Want To` `Stop? No`	Use the ar row keys to tog gle to Yes. Pressing ENTER will close the current file.
`File Number #n` `Is Now Closed.`	“n” is the file num ber. Pressing ENTER again will re turn the user to the Start Col lecting Data menu.

IV.l. Monitor Lanes

Mon i tor Lanes al lows the real-time mon i tor ing of lanes. This op tion is in tended for the user to mon i tor traf fic to en sure the in stal la tion is work ing prop erly. Press 4 from the menu and the dis play will show:

`SELECT OPTION:` `Monitor Lanes`	Press ENTER to se lect the op tion.

IV.l.1. Monitoring Raw or Binned Data Collection

`Waiting For Any` `Vehicle...`	The coun ter dis plays this when first wait ing for a ve hi cle.

As a ve hi cle crosses the in stal la tion, the dis play will show the ve hi cle as it crosses.

`1: 10:00:00  2ax` `30mph  12.8’`	In di cates a ve hi cle passed in lane 1 at 10 o’clock. It had 2 ax les, was go ing 30 miles per hour, and the spac ing from the first to the sec ond axle was 12.8 feet. Note that only the first axle spac ing is dis played re gard less of how many ax les the ve hi cle has (you can view other spac ings us ing the ar row keys, see be low). If you are col lect ing Binned data, the axle spac ing will be re place by one or more bin clas si fi ca tion num bers that the ve hi cle matched.

While mon i tor ing, you may press the fol low ing keys:

1-8	-	Tells the coun ter to only dis play the lane num ber you press.
0	-	Tells the coun ter to dis play all lanes.
CLEAR	-	Aborts and re turns to the menu.
SPACE	-	Freezes the dis play. This al lows you to view a ve hi cle for a lon ger pe riod of time. Press SPACE again to un-freeze the dis play.
ALT 1-8	-	You can set piezo sen si tiv ity lev els with these keys. See sec tion IV.f for in for ma tion.
⌊ ⊗	-	Al lows you to see other spac ings. Press ei ther ar row keys and the screen will change to show up to 6 spac ings. Press ei ther ar row key again and the screen will re turn to the orig i nal dis play. These keys work even when the Freeze Key (Space) has been pressed.

If an as ter isk char ac ter ap pears be fore the lane num ber, this in di cates that col lec tion has not ac tu ally started yet, and the ve hi cles shown are not be ing stored in mem ory.

IV.I.2. Monitoring Count Data Collection

```
L:xxxxx L: xxxxx
L:xxxxx L: xxxxx
```

The coun ter dis plays the first four count lanes you have en abled. Note the coun ter only dis plays the lanes you have en abled.

While mon i tor ing data col lec tion, the fol low ing keys can be used:

0	-	If just Testing Lanes (i.e. from the Start Col lecting op tion) this key ze ros all to tals.
ALT 1-8	-	You can set piezo sen si tiv ity lev els with these keys. See sec tion IV.f for in for ma tion.
CLEAR	-	Aborts and re turns to the menu.
SPACE	-	Tog gles the screen to show other en abled lanes (if more than four are en abled).

An as ter isk on the screen in di cates that data col lec tion has not started yet.

IV.I.3. Monitoring Sensor Data Collection

```
Waiting For Any
   Sensor...
```

This is dis played first when the coun ter is wait ing for a sen sor pulse.

Each sen sor which is ac ti vated will be dis played as:

```
L: HH:MM:SS.00
13223455  P On
```

L is the lane #; HH:MM:SS is the time. 13223455 is the count on the 24 bit in ter nal clock. P On in di cates that a pres ence sen sor (such as a loop) was turned On.

While mon i tor ing, you may press the fol low ing keys:

1-8	-	Tells the coun ter to only dis play the lane num ber you press.
0	-	Tells the coun ter to dis play all lanes.
CLEAR	-	Aborts and re turns to the menu.
ALT 1-8	-	You can set piezo sen si tiv ity lev els with these keys. See sec tion IV.f for in for ma tion.
SPACE	-	Freezes the dis play. This al lows you to view a sen sor pulse for a lon ger pe riod of time. Press SPACE again to un-freeze the dis play.

If you see an as ter isk in front of the lane num ber, this in di cates that data col lec tion haws not yet be gun.

V. Keypad Operation Examples

The following sections gives seven examples using the keypad of the Phoenix. The first six give examples of setting up the counter to collect Raw Data, Monitoring Data, Stopping Collection, and Collecting Binned, Count and Sensor Mode data. The last one is an example of Deleting Files.

Note that these examples are not complete descriptions. You should refer back to section IV for more in-depth information.

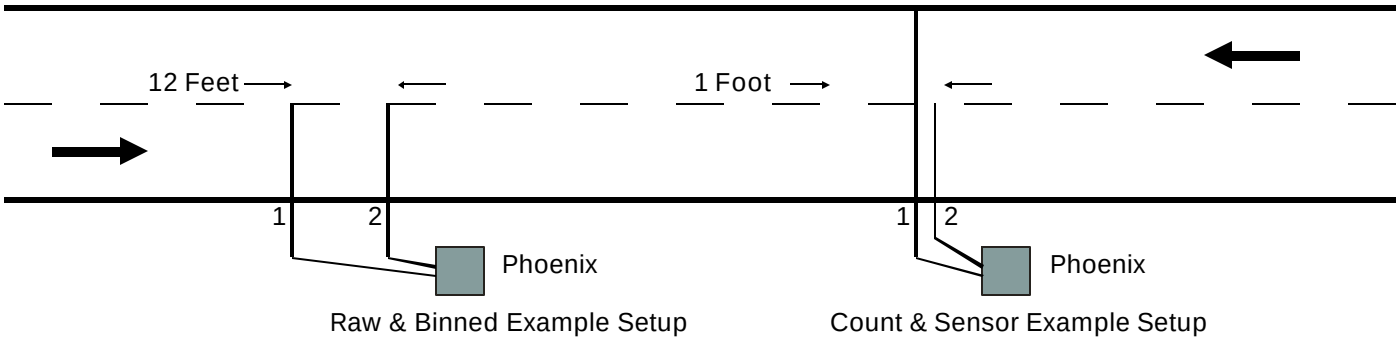
As the examples are worked through, files will be created in memory. The last example will show how to delete any or all selected files. If you get lost or a step is missed, simply return to the beginning.

Important

In many cases the Phoenix will skip certain questions during setup if there is only one possible answer for it. For example, the Phoenix will not ask questions pertaining to presence sensors if you do not have a loop board installed in your counter, therefore the only selection you can make is Axle Sensors.
These examples assume that you DO NOT have a loop board. If your counter does have a loop board, some questions will appear that are not shown here. In that case, read through the appropriate section of the manual for more information on how to answer these questions.

Example Site

The following diagram gives you an example site setup. It will be used as reference in the examples that follow.



Scenario: Two Road Tubes are installed in State Highway 58.

V.a. Configuring the System

This section is an example of configuring the system. Once the system is configured, it does not need to be done again unless a cold restart is done or the mode of collection (Raw, Binned, Count, or Sensor) needs to be changed. It can be used for each example that follows this one to change the storage mode. It is recommended to try variations on configuring the system in a test environment to familiarize oneself with the Phoenix further.

Turn on the power switch. System will self test and then show:

`SELECT OPTION:` `Start Collection`	Press “6".
`SELECT OPTION:` `Configure System`	Press ENTER key.
`Select Storage` `Mode: Binned`	Select the required mode (Raw, Binned, Count, or Sensor) by using the arrow keys; press ENTER. Which mode you select depends on which of the following examples you are following.
`Select Format Of` `Dates: MM/DD/YY`	Select this format by pressing ENTER, or select a different format with the arrow keys and then press ENTER.
`Erase First File` `When No Mem? No`	Since we want the counter to stop when memory is full, press ENTER to select No.
`Verify Power Off` `Option: Enabled`	Press ENTER to leave this option enabled.
`Create New Files` `When? Manually`	Press ENTER to leave at Manually.
`Select Baud For` `Modem: 1200`	Press ENTER to leave at 1200.
`Ask For Lane` `Grouping? No`	Press ENTER to leave at No.

.If you selected Count or Sensor mode for the first question, the next three questions are skipped.

`Speed And Length` `Format: U.S.`	Press ENTER for U.S. (i.e. MPH and Feet).
`SnMis Storage` `Mode: View Only`	Press the ENTER key to see Sensor Misses on the screen, but not to store them in memory.

Maximum Axle Spacing: 35.0’	Press ENTER to keep the default value.
Battery Warning Voltage: 5.8v	Press ENTER to keep the default value.
SELECT OPTION: Configure System	

The menu has rotated through the Configure System Option and returned to the Starting Collection Menu. Now that the system is configured, press 1.

SELECT OPTION: Start Collecting	You are now ready to continue with one of the collecting data examples.

V.b. Collecting Raw Data

This section will give an example of collecting Raw Data. Use Example V.a first to configure the system to collect Raw Data. After that example, the display should show:

SELECT OPTION: Start Collecting	Press ENTER.
Site (15 chars): _____	Note the blinking cursor on the character line. Use the key pad (Section III.a) to enter in a site ID, for example: HWY 58
Site:HWY 58_____ (Up to 10 chars)	Press ENTER when done.
Info: (1st Line) _____	Optionally enter a line of information, for example: System Test
Info: (1st Line) System Test____	Press ENTER when done.
Info: (2nd Line) _____	Optionally enter a second line of information. Press ENTER when done.
Set The Current Time: 00:10:15	Note the position of the cursor in the first digit of the time. Start entering the time with hour, minute, and then second. For example, 15:30:00 would be 3:15 pm and zero seconds. Press ENTER when done.

`Set The Current Date: 01/01/91`	Note once again the po si tion of the cur sor & that the date is in the for mat set in Con fig ure Sys tem. En ter the date, and press ENTER.
`Set The Current Day Of Week? Sun`	Use the ar row keys to tog gle to the cor rect day. Press ENTER when done.
`Select 1 2 3 4 Lanes: n n n n`	Press the num ber on the key pad which cor re sponds to the lanes you want to en able. For this ex am ple, press 1.
`Select 1 2 3 4 Lanes: Y n n n`	Press ENTER.
`Info For Lane #1 _____`	Use the key pad to en ter the di rec tion or some other piece of in for ma tion about the lane, for ex am ple: Eastbound
`Info For Lane #1 Eastbound_____`	Press ENTER when done.
`Directional Mode For Lane #1: No`	Since it is a two lane high way with a good chance of ve hi cles pass ing, press the right ar row key to tog gle the op tion to Yes. Press en ter when done.
`Info For Lane #9 _____`	Since we created a directional lane, we can now enter information about that lane. For ex am ple: West bound Pass
`Info For Lane #9 Westbound Pass_`	Press ENTER when done.
`Lane #1 Sensor Spacing: 10.0'`	Since our ex am ple road tubes are at 12.0', type 1,2,0 and press ENTER.
`Select Raw Type: Normal Raw Data`	Press the ar row to change the op tion to En hanced Raw Data (Sec tion II.c). Press ENTER.
`Waiting For Any Vehicle....`	At this point, the next ve hi cle to cross the loops will show as a test ve hi- cle. The first ve hi cle to cross in lane #1 will show some thing like.
`*1:14:54:30 2ax 55.4mph 9.0'`	The as ter isk (*) means no data is be ing stored yet. Wait for ve hi cles in both lanes two pass, and if data is cor rect, press ENTER.
`Select Mode To Start? Now`	Since we want to start col lec tion right now, Press ENTER.

`Select Mode To Stop? Never`	Since we are running a test file, Press ENTER.
`-SETUP COMPLETE- Press Enter Key`	Press the ENTER key. The counter is now collecting data as vehicles pass.

Raw data collection has started. After a few vehicles have passed you may want to try the Stop Collection example and then retrieve the data following the instructions in the TrafMan Software Instruction Manual.

V.c. Collecting Binned Data

This section will give an example of collecting Binned Data. Use Example V.a first to configure the system to collect Binned Data. After that example, the display should show:

`SELECT OPTION: Start Collecting`	Press ENTER.
`Site (15 chars): _____`	Note the blinking cursor on the character line. Use the key pad (Section III.a) to enter in a site ID, for example: HWY 58
`Site:HWY 58_____ (Up to 10 chars)`	Press ENTER when done.
`Info: (1st Line) _____`	Optionally enter a line of information, for example: System Test
`Info: (1st Line) System Test____`	Press ENTER when done.
`Info: (2nd Line) _____`	Optionally enter a second line of information. Press ENTER when done.
`Set The Current Time: 00:10:15`	Note the position of the cursor in the first digit of the time. Start entering the time with hour, minute, and then second. For example, 15:30:00 would be 3:15 pm and zero seconds. Press ENTER when done.
`Set The Current Date: 01/01/91`	Note once again the position of the cursor, and that date is in the format set in the "Configure System" option. Enter the current date, and press ENTER.
`Set The Current Day Of Week? Sun`	Use the arrow keys to toggle to the correct day. Press ENTER when done.

`Select  1 2 3 4` `Lanes:  n n n n`	Press the number on the key pad which corresponds to the lanes you want to enable. For this example, press 1.
`Select  1 2 3 4` `Lanes:  Y n n n`	Press ENTER.
`Info For Lane #1` `_____`	Use the key pad to enter the direction or some other piece of information about the lane, for example: Eastbound
`Info For Lane #1` `Eastbound_____`	Press ENTER when done.
`Directional Mode` `For Lane #1: No`	Since it is a two lane highway with a good chance of vehicles passing, press the right arrow key to toggle the option to Yes. Press ENTER when done.
`Info For Lane #9` `_____`	Since we created a directional lane, we can now enter information about that lane. For example: Westbound Pass
`Info For Lane #9` `Westbound Pass_`	Press ENTER when done.
`Lane #1 Sensor` `Spacing: 10.0'`	Since our example road tubes are at 12.0', type 1,2,0 and press ENTER.
`Collect Axle` `Bins? No`	Change this to "Yes" by pressing arrow key and then press ENTER.
`Collect Speed` `Bins? No`	Press the arrow key to toggle to "Yes". Press ENTER.
`Collect Gap` `Bins? No`	Leave this at no by pressing ENTER.
`Collect Headway` `Bins? No`	Leave this at no by pressing ENTER.
`Collect Length` `Bins? No`	Leave this at no by pressing ENTER.
`Collect Speed By` `Axle? No`	Leave this at no by pressing ENTER.

`Collect Speed By Length? No`	Leave this at no by press ing ENTER.
`No. of Different Intervals: 1`	For this example, two intervals will be set: The first from midnight to 05:00 to early morn ing traf fic, and the sec ond from 05:00 up to mid night for daytime traffic. You may set up different intervals, just follow the same ba sic steps. Press “2", then press ENTER.
`Int Start: 00:00 #1 Length: 00:15`	Note the cur sor is po si tioned in the sec ond line, show ing 00:15. This is the length of the in ter val start ing at 00:00 (mid night). Change this in ter-val length to 1 hour by press ing 0,1,0,0. Press ENTER when done.
`Int Start: 00:00 #2 Length: 00:15`	Note the cur sor is blink ing on the first line. En ter 05:00 for the time to start the sec ond time pe riod. Press ENTER again to leave the in ter vals at 00:15. The fi nal re sult is that our time in ter vals for binned data will be 1 hour from mid night to 5am, and 15 min ute for the rest of the day.
`Waiting For Any Vehicle....`	At this point, the next ve hi cle to cross the loops will show as a test ve hi-cle. The first ve hi cle to cross in lane #1 will show some thing like.
`*1:14:54:30 2ax 55mph A#2 S#6`	The as ter isk (*) means no data is be ing stored yet. Wait for ve hi cles in both lanes two pass, and if data is cor rect, press ENTER.
`Select Mode To Start? Now`	Since we want to start col lec tion right now, Press ENTER.
`Select Mode To Stop? Never`	Since we are run ning a test file, Press ENTER.
`-SETUP COMPLETE- Press Enter Key`	Press the ENTER key. The coun ter is now col lect ing data. Note that it will not start un til the be gin ning of the next even in ter val (if past 05:00, the next even 15 min utes).

Binned data col lec tion has started. Af ter a few re cord in ter vals have passed you may want totry the Stop Col-lec tion ex am ple and then re trieve the data fol low ing the in struc tions in theTrafMan Soft ware In struc tion Man-ual.

V.d. Collecting Count Data

This sec tion will give an ex am ple of col lect ing Count Data. Use Ex am ple V.a first to con fig ure the sys tem to col lect Count Data. Af ter that ex am ple, the dis play should show:

`SELECT OPTION: Start Collecting`	Press ENTER.

Site (15 chars): _____	Note the blinking cursor on the character line. Use the key pad (Section III.a) to enter in a site ID, for example: HWY 58
Site:HWY 58_____ (Up to 10 chars)	Press ENTER when done.
Info: (1st Line) _____	Optionally enter a line of information, for example: System Test
Info: (1st Line) System Test____	Press ENTER when done.
Info: (2nd Line) _____	Optionally enter a second line of information. Press ENTER when done.
Set The Current Time: 00:10:15	Note the position of the cursor in the first digit of the time. Start entering the time with hour, minute, and then second. For example, 15:30:00 would be 3:15 pm and zero seconds. Press ENTER when done.
Set The Current Date: 01/01/91	Note once again the position of the cursor, and that date is in the format set in the "Configure System" option. Enter the current date, and press ENTER.
Set The Current Day Of Week? Sun	Use the arrow keys to toggle to the correct day. Press ENTER when done.
Select 12345678 Lanes : nnnnnnnn	Press the number on the key pad which corresponds to the lanes you want to enable. For this example, press 1 & 2.
Select 12345678 Lanes: YYnnnnnn	Press ENTER.
Info For Lane #1 _____	Use the key pad to enter the direction or some other piece of information about the lane, for example: Westbound
Info For Lane #1 Westbound_____	Press ENTER when done.
Select Lane #1 Mode: Normal	Since we have set our road tubes up for lane subtraction, change this to Subtraction with the arrow keys and press ENTER.
Info For Lane #2 _____	Use the key pad to enter the direction or some other piece of information about the lane, for example: Eastbound

`Info For Lane #2 Eastbound_____`	Press ENTER when done.
`No. of Different Intervals: 1`	For this ex am ple, one in ter val length will be set. Press “1", then press ENTER.
`Record Interval Length: 00:15`	Change this in ter val length to 1 hour by press ing 0,1,0,0. Press ENTER when done.
`Testing Lanes..* 1: 0 2: 0`	At this point, the next ve hi cle to cross the road tubes will show as a test ve hi cle. The first ve hi cle to cross in the east bound lane will show:
`Testing Lanes..* 1: 0 2: 1`	The as ter isk (*) means no data is be ing stored yet. Wait for ve hi cles in both lanes to pass, and if count is cor rect, press ENTER.
`Select Mode To Start? Now`	Since we want to start col lec tion right now, Press ENTER.
`Select Mode To Stop? Never`	Since we are run ning a test file, Press ENTER.
`-SETUP COMPLETE- Press Enter Key`	Press the ENTER key. The coun ter is now col lect ing data.

Count data col lec tion has started. Note that the coun ter will not ac tu ally be gin stor ing record in ter vals un til the be gin ning of the next re cord pe riod. In this ex am ple, the next even hour (11:00:00). After a few re cord in-ter vals have passed you may want to try the Stop Col lec tion ex am ple and then Re trieve the data fol low ing the in struc tions in the TrafMan Soft ware In struc tion Man ual.

V.e. Collecting Sensor Data

This sec tion will give an ex am ple of col lect ing Sen sor Data. Use Ex am ple V.a first to con f ig ure the sys tem to col lect Sen sor Data. Af ter that ex am ple, the dis play should show:

`SELECT OPTION: Start Collecting`	Press ENTER.
`Site (15 chars): _____`	Note the blink ing cur sor on the char ac ter line. Use the key pad (Sec tion III.a) to en ter in a site ID, for ex am ple: HWY 58
`Site:HWY 58_____ (Up to 10 chars)`	Press ENTER when done.

Info: (1st Line) _____	Optionally enter a line of information, for example: System Test
Info: (1st Line) System Test____	Press ENTER when done.
Info: (2nd Line) _____	Optionally enter a second line of information. Press ENTER when done.
Set The Current Time: 00:10:15	Note the position of the cursor in the first digit of the time. Start entering the time with hour, minute, and then second. For example, 15:30:00 would be 3:15 pm and zero seconds. Press ENTER when done.
Set The Current Date: 01/01/91	Note once again the position of the cursor, and that the date is in the format set in the “Configure System” option. Enter the current date, and press ENTER.
Set The Current Day Of Week? Sun	Use the arrow keys to toggle to the correct day. Press ENTER when done.
Select 12345678 Lanes : nnnnnnnn	Press the number on the key pad which corresponds to the lanes you want to enable. For this example, press 1 & 2.
Select 12345678 Lanes: YYnnnnnn	Press ENTER.
Info For Lane #1 _____	Use the key pad to enter the direction or some other piece of information about the lane, for example: TWO LANES
Info For Lane #1 TWO LANES_____	Press ENTER when done.
Info For Lane #2 _____	Use the key pad to enter the direction or some other piece of information about the lane, for example: ONE LANE
Info For Lane #2 ONE LANE_____	Press ENTER when done.
Waiting For Any Sensor....	At this point, the next vehicle to cross the tubes will show as a sensor activation and will look something like:
*1:14:54:30.00 8944123 A On	The asterisk (*) means no data is being stored yet. Wait for sensor activations in both lanes, and if data is correct, press ENTER.

`Select Mode To Start? Now`	Since we want to start col lec tion right now, Press ENTER.
`Select Mode To Stop? Never`	Since we are run ning a test file, Press ENTER.
`-SETUP COMPLETE- Press Enter Key`	Press the ENTER key. The coun ter is now col lect ing data as ve hi cles pass.

Sen sor data col lec tion has started. Af ter a few ve hi cles have passed you may want to try the Stop Collection ex am ple and then re trieve the data fol low ing the in struc tions in the TrafMan Software In struc tion Man ual.

V.f. Monitoring Traffic & Viewing Status

This sec tion gives an ex am ple of mon i tor ing traf fic while the Phoe nix is col lect ing data. This does not af fect data col lec tion - it al lows the user to mon i tor the Phoe nix to en sure that the sys tem is func tion ing prop erly as the user has set it up.

To start, you will need a Phoe nix which has been in stalled and is col lect ing data. If you have fol lowed any of the last 4 ex am ples, it will work fine. If not, fol low one of the ex am ples for in stal la tion and re turn to this sec tion.

While col lect ing, the screen is nor mally blank in di cat ing the coun ter is in a spe cial “Sleep” mode, press ENTER to wake it up and the dis play will show:

`SELECT OPTION: Stop Collecting`	Press the 4 key.
`SELECT OPTION: Monitor Lanes`	Press ENTER to se lect op tion.

The next screen de pends on the type of data you are col lect ing, for Raw and Binned you will see:

`Waiting For Any Vehicle....`	When the next ve hi cle data is col lected, the dis play will show the ve hi cle on the screen.

If you are col lect ing Count data, your screen will show some thing like:

`Monitoring Lanes 1: 134 2: 99`	The ac tual lane num bers and to tals de pend on your cur rent setup. As each sen sor is ac ti vated the new to tals for that lane are dis played.

If you are col lect ing Sensor data, the Phoe nix will show:

`Waiting For Any Sensor....`	When the next sen sor is ac ti vated, the dis play will show the sen sor on the screen.

When fin ished mon i tor ing, press the ENTER or CLEAR key to re turn to the menu.

`SELECT OPTION: Monitor Lanes`	Use the ar row keys (or press “3") to scroll to the "Show Sta tus" op tion.
`SELECT OPTION: Show Status`	Press ENTER.
`Total Mem: 68536 Mem Left: 68084`	Note the above mem ory mes sages will de pend upon how much mem- ory is in stalled in your sys tem and how much has been used. Re fer to Ap pen dix B for mem ory us age in for ma tion. Press ENTER.
`File #1 is Open Site:Hwy_58____`	This shows that the file is ac tive and col lect ing data. Press ENTER.
`No Loop Boards Installed`	This tells you that there is no loop board in stalled in the sys tem. Press ENTER.
`4 Input Piezo Board Installed`	This tells you that there is a four in put Piezo board in stalled in your coun- ter. Press ENTER.
`TAM Interface Not Installed`	This tells you that there is no TAM (Take Away Mem ory) board in stalled in the sys tem. Press ENTER.
`Time: 10:25:34 Date: 07/15/92`	Show the cur rent time and date. Press ENTER again.
`Current Battery Voltage = 6.2v`	This is the bat tery volt age sta tus mes sage. It will tell you if your bat tery is get ting to low. Press ENTER.
`SELECT OPTION: Show Status`	You have com pleted the Show Sta tus Op tion. Press CLEAR. The dis- play will go blank. The Phoe nix is still col lect ing data and is now in a low power sleep mode.

V.g. Stopping Collection

This section gives an example of Stopping data collection. For information on file retrieval, please read the TrafMan Software Manual. Note that the counter must be setup to start data collection before you can stop collecting.

While collecting, the screen is normally blank indicating the counter is in a special "Sleep" mode, press ENTER to wake it up and the display will show:

`SELECT OPTION:` `Stop Collecting`	Press ENTER.
`Sure You Want` `To Stop? No`	Press either arrow key to toggle to "Yes". Press ENTER.
`File Number #1` `Is Now Closed.`	Note that the file # is the current active file. If you were using Raw Data and you have gone by the examples in this manual, it should show File #1. If you have collected other data files, the file # shown will vary depending upon how many times you have started new files. Press ENTER.
`SELECT OPTION:` `Start Collecting`	

Note that the Phoenix has automatically returned to the Not Collecting Menu from where you started the examples. However, if you select the "Show Status" option and ENTER through the messages, you will note that there are now files recorded in memory.

These files can be retrieved by the TrafMan Software. Power may now be turned off to the unit without losing any data stored in the files.

V.h. File Deletion

If all the ex am ples have been fol lowed, sev eral files will have been cre ated in mem ory. To re move unwanted files, use the De lete File Op tion, avail able from ei ther while col lect ing or when not col lecting.

If the sys tem is in sleep mode, press ENTER to wake the coun ter up. The dis play will show:

`SELECT OPTION:` `Stop Collecting`	Press the ar row keys (or press “2") un til the dis play shows:
`SELECT OPTION:` `Delete Files`	Press ENTER to se lect the op tion.
`(4) Delete What` `Files? All Files`	This shows there are 4 files in mem ory. Press the ar row keys un til the op tion “Sin gle” ap pears and press ENTER.
`# 1:HWY_58____ n` `  2176  03/17/92`	This shows file #1 Site ID is HWY 58. The n means the file has not been re trieved by a PC Com puter. 2176 is the file size in bytes, and 3/17/92 was the date the file was col lected. By press ing the ar row keys, dif fer ent files show ing the same in for ma tion will ap pear in the dis play. Se lect #1, and press ENTER.
`Delete File #1` `You Sure? No`	Press the ar row key to tog gle to “Yes”. Press ENTER.
`   Wait,` `  Deleting`	This will ap pear while the coun ter is de let ing the file.
`# 1:TEST_____ n` ` 12176  03/21/92`	This shows that the next file (the old file #2) has be come file #1 af ter you de leted the old file #`1. You can go ahead and delete more files, or press CLEAR to backup one step.
`(3) Delete What` `Files? Single`	Note the num ber of files have changed. Press CLEAR again.
`SELECT OPTION:` `Delete Files`	You are now back at the orig i nal menu you started with.

V.i. Collecting Data Using Lane Grouping

This sec tion will show you how to en able the Lane Grouping func tion to col lect Grouped Count Data on four lanes. To col lect grouped binned data, sim ply change the stor age mode. First, fol low ex am pleV.a to con fig-ure the sys tem to col lect count data. Stop When you get to the fol low ing ques tion in the Con f ig ure Sys tem option.

`Ask For Lane Grouping? No`	Press right ar row to se lect Yes then press ENTER to con tinue. Fol low through the re main der of V.a. to fin ish the sys tem con fig u ra tion.

Now that Lane Grouping has been en abled, go to ex am ple V.d. (col lect ing Count Data) and fol low all in struc-tions un til you get to the fol low ing screen, then fol low the be low in struc tions:

`Select 12345678 Lanes : nnnnnnnn`	Press the num ber on the key pad which cor re sponds to the lanes you want to en able. For this ex am ple, press 1,2,3, & 4.
`Select 12345678 Lanes: YYYYnnnn`	Press ENTER.
`Select Number Of Groups? 0`	This ques tion al lows you to se lect the num ber of groups. Press 2.
`Select Number Of Groups? 2`	Press ENTER to con tinue.

You will next need to as sign the lanes you want to be long to each group.

`Group #1 Lanes: (none)`	Press 1 and 2 to as sign lanes 1 and 2 to Group #1.
`Group #1 Lanes: 1,2`	Press ENTER
`Group #2 Lanes: (none)`	Press 3 and 4 to as sign lanes 3 and 4 to Group #2.
`Group #2 Lanes: 3,4`	Press ENTER to con tinue. Go back to the V.d. to fin ish out start ing the coun ter to col lect count data.

That's it. When data col lec tion is fin ished and you re trieve the data from this coun ter you will ac tu ally end up with only two lanes of data (Lanes #1 and #2). Lane #1 (which is ac tu ally Group #1) will con tain the com-bined to tal of phys i cal Lane #1 and #2 data. Lane #2 (which is ac tu ally Group #2) will con tain the com bined to tals of phys i cal Lane #3 and #4.

VI. TAM Interface

The Unicorn/Phoenix/Pegasus series of traffic counters all support an optional TAM (Take Away Memory) Interface Board. This "interface" consists of a plug in slot on the face panel of the counter and one or more TAM Cards.

The TAM Interface is used to provide a very fast and simple way of retrieving data from your traffic counters, and to allow easy and quick programming of the traffic counter. The TAM interface eliminates the need for the user to bring a laptop or ROVER to the field because all collected data can be stored on the credit card sized TAMs, and then brought back to the office for use by your PC.

There are three distinct uses for a TAM Card, listed below:

- As extended memory for the traffic counter.
- As a data retrieval system for retrieving data after it has been collected by a counter.
- As a on-site counter programmer (i.e. Autostart!).

Each of these three uses is described below, as well as a overview of using TAM Cards and a description of how to transfer data stored on the TAM card into your PC.

VI.a. Using TAM Cards

A TAM Card is nothing more than a Flash Memory Card that has been customed programmed at the Diamond Traffic Products factory for use in our traffic counters. The TAM card slot in the panel of the counter is PCMCIA type II slot and is designed to support many new types of cards that will be available in the future.

There are many different sizes of TAM cards available, ranging from 256k to 8Meg. The counter will automatically identify the size of any card inserted and treat it appropriately. You CAN NOT purchase any Flash Memory card and use it with the traffic counter. You MUST purchase all memory cards to be used with Diamond counters from Diamond Traffic Products. This is because Diamond screens all memory cards and then preprograms the qualifying cards for our customers. The traffic counter will simply ignore any card that did not come from Diamond Traffic Products.

Although the memory cards are solid state and generally very durable, please follow all cautionary measures as printed on the back of the cards. At a minimum, you can expect to fill your card and then erase it ten thousand times before it fails.

To insert a TAM card into the counter:

Orient the TAM card so that looking at the end of the card the write protect switch is closest to the eject button. Slide the card into the slot and press down firmly until you feel a definite stop. The green light should blink and the eject button should be out as high as the TAM card.

To remove a TAM card from the counter:

Push the eject button down and then remove the TAM. NEVER, EVER, REMOVE A TAM WHEN THE GREEN LIGHT IS ON! You might ruin the TAM and have to send it back to the factory.

VI.b. Transferring TAM Data to your PC

The next two sections, VI.c. and VI.d, cover how to put data collected by a traffic counter onto a TAM card. This section covers how to get this data off of the TAM and into your PC. To do this you will need to use your counter as a TAM Memory Card Reader.

Basically, you will need to have a traffic counter in the office of the PC you plan to transfer the data to. This counter will become the TAM Memory Card Reader. Note that the counter can serve double duty as a regular traffic counter and a reader, it just has to be in the office when TAM cards need to be read. Any traffic counter that has a TAM Interface can serve as a TAM Memory Card Reader.

To turn any counter into a TAM Memory Card Reader, simply turn the counter off (if it was on) then turn it on and press the SPACE key during the Self Test. The counter screen will change to show:

```
TAM Memory Card
Reader Vx.xx...
```

x.xx is the current TAM Card Reader version number. After a short pause, the counter will show (if you don't already have a TAM Card Inserted):

```
Insert TAM Card
Into Slot...
```

Insert a TAM Card and the screen will display:

```
Execute TrafMan
Link Up...
```

At this point, you need to execute (run) the TrafMan Software and select the Counter function from the main menu. TrafMan will recognize the counter as a TAM Memory Card Reader and let you link to it. TrafMan will allow you to retrieve data from the TAM Card, put in other TAM Cards, erase TAM Cards, set up a TAM card as an Autostart Card, plus a whole host of other features. See the TrafMan Software Instruction Manual for more information.

After becoming a TAM Memory Card Reader, you can return the counter to its regular operating mode by pressing the CLEAR key on the counter key pad, or turn the counter off/on.

IMPORTANT NOTE ABOUT TAM CARDS & EPROM VERSIONS: The TAM Card and the EPROM Version inside your traffic counter must be compatible in order for the TAM Card to function. Incompatible versions can cause your counter to lock up, erase data, or a variety of other problems. If you have an incompatible card and/or EPROM, please contact Diamond Traffic Products for upgrade information.

You can determine what version you have by turning on the counter (which will show you the counter version) and then pressing the <Space> key during self test to see what version of the TAM Card Reader you are. Refer to the table below for version compatibility:

Unicorn Version	Pegasus Version	Phoenix Version	Compatible With TAM Card Version
1.80	1.00	1.50	1.30
1.81-1.92	1.10-1.12	1.51-1.62	1.60
2.00-2.12			2.00-2.05
2.20-2.21			2.10

VI.c. TAM as extended memory for your counter

The counter comes default with 68K of data storage. If you plan on collecting a lot of traffic data between retrievals, your counter may run out of memory and stop collecting. To prevent this, you can dramatically increase the amount of memory by inserting a TAM card prior to starting collection.

If a TAM card is inserted into the counter PRIOR to collection being started, the counter will enter a special mode in which it will automatically copy out all files to the TAM Card whenever a file is closed. Generally, users will enable Daily Files and enable Erase First File When No Mem options from the Configure System menu when using this mode.

If Daily Files and Erase First File When No Mem is enabled, then the counter will close the current file at midnight and open a new file. When the current file is closed, the counter will copy it to the TAM card and mark it as retrieved. When the counter runs out of memory, it will start erasing the oldest data to make room for the new data. In this case, the oldest data will be files that are already copied to the TAM and therefore not needed.

For example:

1) Joe Traffic sets up a Phoenix by the road side. He is going to collect a lot of data before returning to the site, so he knows that he will need a TAM Card to extend the memory.

2) Joe goes into the Configure System option and enables Daily Files and Erase First File When No Mem.

3) Joe goes into Start Collecting and sets up the counter to collect his data. When he gets to the "—SETUP COMPLETE—Press Enter Key" screen, he inserts a TAM card, watches the green light flash, and presses ENTER.

4) Joe closes the counter up and leaves for 15 days.

5) Joe returns to the site, opens the counter up and uses the monitor lanes function to insure everything is working properly. Joe uses the show status option to check the battery level and decides he has enough juice to run another 15 days, but he wants the first 15 days now.

6) Joe pops out the TAM card (that contains the first 15 days) and inserts a new TAM Card to store the data for the next few days.

7) Joe hands the first TAM Card to his boss and promptly receives a raise for such commendable work!

Joe did every thing correctly. The most important thing to remember about using TAM Cards as extended memory is that the counter will only transfer FILES to the TAM card, so you must enable daily or weekly file creation to have data transferred automatically to the counter. If, when Joe returns, he opens up the counter and selects Stop Collection, the counter will immediately transfer the last file to the TAM Card.

Note that Joe did not have to wait until the very end of the Start Collecting process to insert a TAM Card. The card can be inserted any time BEFORE collecting starts (including before the counter is started).

Joe can insert/remove TAM cards at any time while collecting as long as a file is not closed when a TAM card is out (if Joe removed the card at 11:59pm and did not insert another until 12:02am). If this happens, the counter will no longer copy files out to the TAM.

VI.d. Retrieving data from a counter with your TAM

As described in the previous section, you plug a TAM card into your counter and have the counter transfer data to the TAM as each file is created. Alternately, you can use the TAM Card to retrieve files from a counter any time after it has been collected.

The SPACE key on the counter key pad is used to access a variety of TAM functions, and will work when any of the following screens are displayed on the counter:

```
SELECT OPTION:
 (any option)
```

```
Phoenix   Vx.xx?
  <(any mode)>
```

Pressing the SPACE key will, provided you have the TAM interface hardware, cause the following series of screens to appear:

```
Insert TAM Card
Into Slot...
```

If you press <Enter> key before inserting a TAM Card, you can see what version of the TAM Card Reader you have. See section VI.b to determine version compatibility between the TAM Card and your counter EPROM.

This screen appears any time a TAM Card is not inserted. Press the <Clear> key to return to the screen you were at prior to pressing the <Space> key. Insert a TAM card to continue.

```
<aaaaa> <ss> TAM
<mm> Free   <x>F
```

<aaaaa> is the manufacturer of the TAM card. <ss> is the size of the TAM card. <mm> is the amount of memory left on the TAM card. <x> is the number of data files stored on the TAM card.

This screen is the TAM STATUS SCREEN. This is a very important screen because it tells you all about the TAM card that is currently inserted. You should use this screen to verify that the TAM card you are inserting has enough memory available for the use you intend. In addition, you can verify that the TAM card is operating correctly. NOTE: It is normal for the first 12K of an erased TAM to be used.
Press <Enter> or <Space> to continue.

```
 No Unretrieved
Files In Counter
```

```
Unretrieved Data
Files In Mem:<x>
```

<x> is the number of unretrieved files in the counter memory.

The counter is telling you if you have any unretrieved data files in the memory of the counter. The counter assumes that you will want to transfer any unretrieved data files to the TAM card, so it is informing you if there are any.
If you have any unretrieved files in memory, the following screen will appear after you press <Enter>:

```
Copy Unretrieved
Data to TAM? Yes
```

Press <Enter> to select, <Space> or arrow keys to toggle choice between Yes and No.

Select yes to copy all of the unretrieved data files to the TAM card. Select no to not copy the files. If you select yes, the screen will change to show:

```
Copying Files
To TAM...
```

This will appear while the copy is going on. The green light will also be on during the copy.

If the TAM Card does not have enough memory left to hold the file, then the following message will appear:

```
TAM Card Is Out
   Of Memory!
```

After all of the unretrieved files have been copied (if any), the counter will present you with the TAM Functions Menu. The screen will change to show:

```
SELECT FUNCTION:
  (function)
```

Use the arrow keys to select a function, press <Enter> to select it. You can press <Clear> at any time to backup to previous screens. Press <Alt> + <Clear> to return completely out of the TAM Functions.

The options available under this menu are as follows:

Copy File To TAM
Erase TAM Card
Quit Functions

The Quit Functions option simply returns you out of the TAM Functions Menu (same as <Alt> + <Clear>). The other options are described below.

VI.d.1. Copy File To TAM

This function is used to copy a file out of the memory of the counter and onto the TAM card. It does not matter if the file has already been copied or if the file has been retrieved. After selecting this option, the following screen will appear:

```
ff:sssssssss rt
zzzzzz  dddddddd
```

ff is the file number. sssssssss is the Site ID of that file. r is the retrieved flag (Y if retrieved, N if not). t is the type of data (R-Raw, B-Binned, C-Count, S-Sensor). zzzzzz is the size. dddddddd is the start date.

For example, the following screen shows file #3 has a site ID of “Hello”, has never been retrieved, is binned data, is 1300 bytes long, and data collection started on March 3rd, 1993.

```
#3:Hello_____ nB
  1300  03/03/93
```

To copy this file to the TAM Card, press the <Enter> key. To select other files, press the arrow keys. To return to the TAM Functions Menu, press <Clear>.

If the TAM Card does not have enough memory left to hold the file, then the following message will appear:

```
TAM Card Is Out
   Of Memory!
```

VI.d.2. Erase TAM Card

This function will erase a TAM Card thereby removing all files stored on the card. Normally, users will use the TrafMan Software to do this function but it might be necessary for a user in the field to need to erase a TAM.

The TAM card will also maintain a flag on each file it contains as to whether or not the data has ever been retrieved from the TAM Card and into your PC. If the TAM card contains data files that have never been retrieved, the display will show:

```
Not All TAM Data
Retrieved! <ff>F
```

<ff> is the number of files on the TAM card that have not been retrieved.

Press <Enter> to continue, press <Clear> to abort. If you press <Enter>, the screen will show:

```
Sure You Want To
Erase TAM? No
```

Use the arrow keys to toggle the answer between Yes and No. Press <Enter> to select, <Clear> to abort erase.

During the erase, the counter screen will change to show:

```
Erasing TAM Card
   <x>% Done
```

The <x> represents what portion of the erase has been completed (from 0 to 100 percent). Time to erase a typical 256K TAM is about 50 seconds. Larger TAMs require multiples of 50 seconds. For example a 512K size TAM requires twice as much time as 256K, or about 1 minute and 40 seconds.

Erasing a TAM does use up some battery power. Erasing one 256K TAM in 50 seconds is equivalent to running the counter for about 20 minutes in normal operation.

REMEMBER: NEVER REMOVE A TAM CARD WHEN THE GREEN LIGHT IS ON!

VI.e. TAM as a counter programmer (Autostart)

A TAM card can be configured to automatically set some or all of the counters operating parameters when it is inserted and the power is turned on. This is called Autostarting the counter and the TAM card used to do this is called an Autostart Card. This is very useful to setup a counter quickly when a known type of data/configuration is to be used.

You must use the TrafMan Autostart Creation function to setup a TAM Card to be an Autostart card. Refer to the TrafMan Software Instruction Manual for more information. Note that setting a TAM card to be an Autostart card in no way interferes with the TAM cards ability to retrieve data from the counter. All other TAM card features are supported even if the TAM is configured to be an Autostart card.

The autostart feature only works when an Autostart TAM card is inserted in the counter and the counter is then turned on. Inserting an Autostart card any time after a counter is on will have no affect. You will know the counter is autostarting when the green light blinks twice on power up (instead of once).

VII. In-Day Times

The Phoenix has a special function called In-Day Times. In-Day Times are time periods in the day that you wish to Start and Stop collecting data. This is similar to the Daily Files function except you can Start and Stop collection several different times during a 24 hour period. The basic purpose of this function is to handle very large data collection requirements where you only have memory enough in the counter to store part of a day, and you want to transfer the data to a TAM card several times during the day.

A day can have up to four Start/Stop periods. You do not need to collect data during the entire day nor do you need to make sure that these periods of collection follow each other exactly. For example, you could collect data from 8am to noon, and then from 4pm to 8pm. The rest of the day no data would be collected and the counter is considered to be in the Preset Mode (see section IV.C.6).

In-Day times will work with any type of data collection (Raw, Binned, Count, or Sensor). If collecting Binned or Count data and you do not specify an In-Day Stop Time at the end of an interval, then you will lose the data of the current interval unless the next In-Day Start time is the same as the current In-Day stop time.

For example, suppose you are collecting Binned data in 1 hour intervals and you have specified an In-Day period from 10:00 to 11:30 and a second In-Day Period from 11:30 to 14:00. The counter will close the current file at 11:30 and then open a new file immediately because the next In-Day period starts at 11:30. The current binned data interval (which is from 11:00 to 11:59) will be preserved and will be written to the second file as its first interval even though the file was opened at 11:30. This is identical to retrieving the open file data when it is in the middle of an interval.

On the other hand, had you specified the second period to start at 12:00. Then all of the data from the 11:00 to 11:59 interval will be lost and the first interval written to the new file will start at 12:00.

You should be aware that In-Day times do not take affect until the counter first begins data collection according to the Start Mode (which can be Now, Midnight, or at a Date & Time). Until the very first file is opened according to all other counter settings, the In-Day Times will have no affect.

To Setup a Counter to use In-Day Times:

1) Link to the counter with TrafMan (version 3.50 or later) and go to the main link screen. You will see a new option called Set In-Day Times on the menu.

2) Select the Configure System option and setup all counter system parameters.

3) Select the Set In-Day Times function and select the number (0 to 4) and the times of all In-Day Time periods. Note that you must enter the times in order from the earliest to the latest.

4) Select the Start Collecting function and setup, test, and begin data collection.

That's it. After the very first file is opened the counter will then begin to check the In-Day Time settings to see if any specific time periods in the day have been tagged for data collection.

To use a TAM card in con junc tion with the In-Day Times:

Be cause the In-Day Times func tion op er ates just like the Daily Files Func tion, each time a file is closed and a TAM card has been in serted at the be gin ning of data col lec tion, then the newly closed file will be cop ied out onto the TAM card. As time goes on and mem ory fills, the “Erase First File When No Mem” func tion will start eras ing ear lier files that have al ready been cop ied to the TAM to make room for new files.

The field user sim ply has to go to the site, re move the TAM card that is in serted into the counter, and then in-sert a blank re place ment card. The TAM card that was in the coun ter is then re turned to the office where it can be read and erased for fu ture use.

VIII. Call-Back System

The Phoenix has a function which allows the counter to actually call up a remote computer with a modem and make a report if a particular lane goes down. This could happen if a sensor fails (such as a loop) or there is some sort of other problem which causes the system to stop collecting data properly.

The counter determines if a lane has gone down based upon the number of SnMis (Sensor Misses) that are continuously detected. You can set the number of these SnMis that occur in a row (such as 15) to trigger the counter to make a call back and report the failure.

The remote computer should be a PC compatible computer that is connected to a Hayes compatible smart modem. You will also need to have TT-Link installed on the computer (or any similar communication program, such as Procomm).

Note that the Call Back function only operates when the counter setup as follows:

- It is in Raw or Binned data collection mode.
- It is connected to a Smart Modem.
- It is not currently being used, either with the keyboard or through the serial port.
- The # Of SnMis To Call Back question is greater than zero (see below).
- The Call Back Dial Command starts with a "AT" (see below).
- It is collecting data.

If any of the above are not true, the the Call-Back system is disabled.

Follow the below steps to setup your counter to perform Call-Backs:

1) Link to the computer using TrafMan V3.50 or later.

2) At the main link screen, press <Alt+F10>.

3) You will see two questions that pertain to the Call Back Function. These are "Call Back Dial Command?" and "# Of SnMis To Call Back?".

4) Move the cursor to the Call Back Dial Command question. You must enter in a valid dial command for the modem that is connected to the counter. In most cases, this will be something like "ATDT<phone number>".

5) Move the cursor to the # Of SnMis To Call Back question. The default, zero, disables the Call-Back system. Enter in any other number up to 250 to specify the number of SnMis that must occur on a lane in a row before the call-back system is triggered.

6) Press <Enter> until you have returned to the main counter link screen, then press <Esc>.

7) If not connected to a smart modem, then follow all steps to setup counter to work with a smartmodem.

8) Start the counter collecting data.

That's it. The counter will do a Call-Back the next time a lane gets the correct amount of SnMis in a row.

Fol low the be low steps to setup your com puter to re ceive Call-Backs:

1) Con nect your com puter to a smart mo dem that is con nected to an out side line.

2) Run the TT-Link Soft ware.

3) At the main con sole screen, press <F2> to setup the se rial pro to col.

4) Se lect the COM port and Baud Rate that the coun ter(s) will be call ing to make the Call-Back re p ort.

5) Type "AT" and press <En ter>. If you are com mu ni cat ing to the mo dem, you should re ceive a "OK" or "0" as a re sponse. If you do not, then ei ther the mo dem is not work ing, you have not con nected the modem prop erly, or you have se lected the wrong COM Port or Baud rate.

6) Type "ATS0=1" and press <En ter>, this is the uni ver sal AT Com mand which tells your mo dem to answer the phone when it rings and try to link to a re mote mo dem.

7) Press <Alt+C> to clear the screen.

You are now ready to re ceive in com ing Call-Backs. Op tionally, you can store the Call-Back re ports on disk by press ing the <PgDn> key, se lect ing ASCII, and then en ter ing the name of the file to store the re ports to.

What Hap pens When A Coun ter Decides To Make A Call-Back?

The coun ter will dis play the fol low ing first mes sage on the screen and then is sue the Call-Back Dial Command to the mo dem. Af ter the dial com mand is sent, the coun ter dis plays the sec ond mes sage and waits for a car rier to be de tected (will wait up to two min utes).

```
Calling To Make
SnMis Report...
```

```
Waiting For Host
Modem To Answer
```

If, af ter two min utes, no car rier is de tected. Then the coun ter will go back and re is sue the dial com mand and wait again for a re mote car rier. This will go on for up to three at tempts be fore the coun ter gives up try ing to com mu ni cate to a re mote com puter. If a re mote car rier is de tected, the coun ter dis plays the first mes sage shown be low, sends the Call-Back re port, and then dis plays the sec ond mes sage shown be low while hanging up the mo dem. Af ter the mo dem is dis con nected, the coun ter re turns to the <Smart Mo dem> screen and waits for an other lane to fail or for the user to ac cess the se rial port or key board.

```
Sending Failure
Report To PC...
```

```
Now Hanging Up
Modem...
```

The fail ure re port will be in the fol low ing for mat:

```
Phoenix <version> SnMis Call Back (Ser#:<ser #>) For Site: <site>
Time: <current time>  Date: <current date>
—-> SnMis Failure On Lane #<lane #>
```

Note that if you call up and communicate with the coun ter or you use the coun ters key board, then the Call-Back sys tem is re set and you will be re called if a lane fails again. The coun ter pre sumes you will solve the prob lem while you are us ing it (ei ther with the key pad or through the se rial port).

IX. Appendix

Appendix A. Trouble shooting

This Sec tion is in tended as a guide to wards in stal la tion trou ble shoot ing. It is in no way in tended for the service or re pair of any type of Phoe nix sys tem.

Some ba sic prob lems can al ways oc cur dur ing op er a tion. Gen erally, they will be some small er ror in setup or sen sor in stal la tion. Listed are some ba sic prob lems and pos si ble so lu tions. If you can not solve an in stal la tion prob lem, or if you find a new so lu tion to an old prob lem, please call Di a mond Traf fic Prod ucts. We are glad to help solve any type of in stal la tion prob lem or re ceive new in stal la tion in for ma t ion.

Problem - Tubes are in stalled to col lect Raw or Binned data, but er rors keep oc cur ring in data col lection.

Solution - Are the tubes the same length? Are they stretched tight (both the same amount if us ing two tubes per lane) across the road way? Are there holes in the tubes (you can check this by plug ging the tube and putt ing it un der wa ter)? Is the end of the tube which is not be ing connected plugged prop erly?

Problem - I've in stalled loops in the road, but I am not get ting axle counts. Why?

Solution - The loops will not detect in dividual axles. They are Presence Sensors which will let the Phoe nix know if a ve hi cle is pres ent only. Tubes or Piezo Sen sors must be used for axle count ing. If you are not equipped for tubes, and you need axle count ing ca pa bil ity, con tact Di a mond Traffic Prod ucts.

Problem - I've in stalled tubes to col lect raw ve hi cle data, but I keep get ting er rors. I check the "Test Sen sor" op tion, and the tubes are func tion ing.

Solution - Are the tubes in the cor rect or der? Re mem ber - the tubes must be con nected in se quence de pend ing on your lane as sign ment and con fig u ra tion. Check the Ta bles in Sec tion II.a for con for ma tion. You may have a lane in stalled back wards. An other pos si ble prob lem is bi-di rec tional traf fic. Do you have the Di rec tional Op tion en abled?

Problem - I have in stalled a Phoe nix in a busy road way. The coun ter has stopped col lect ing data when I ar rive. Ev ery thing seems to be work ing.

Solution - Check the Show Sta tus op tion. Is the mem ory full? You may need to re trieve the data from the coun ter more of ten.

Appendix B.Memory Usage

Each mode uses a different amount of memory for storing traffic data. This appendix is intended to give the user an approximation of how long a Phoenix Field Unit may collect data before retrieval must be performed. Note that this is only a guide - it is recommended to retrieve data as often as is practical from the units, and deleting retrieved files from the memory (unless Erase First File When No Mem is enabled). Different configurations may store different amounts of data. For example, the amount of memory to store a single 2 axle vehicle in Raw Mode is 7 bytes if you are using axle sensors, and 7 if you are using presence sensors (loops). A 5 axle vehicle in the same mode will take 13 bytes if you are using axle sensors, but still seven if you are using presence sensors (the individual axle lengths are not stored since loops cannot see the individual axles).

The following tables give you formulas for calculating how much memory any particular storage mode might take. Simply find the table that most closely matches your application, and follow the steps described.

Appendix B.1. Raw Data Collection

Raw data stores each individual vehicle in memory, therefore the amount of memory used is directly dependent on how many vehicles pass the sensors. Another important factor is the number of axles per vehicle (more axles require more memory).

Generally, you can use the average of 2.75 axles per vehicle for most highways. If your site differs from this, you may wish to increase or decrease the numbers given below.

To calculate how many vehicles you can store with the Phoenix follow the below steps:

- Calculate the base average number of bytes per vehicle using the chart below:

SENSOR CONFIGURATION	NORMAL RAW DATA	ENHANCED RAW DATA	RAW DATA WITH BINS	ENHANCED & BINS
Axle-Axle Axle-Pres-Axle Pres-Axle-Pres	8.5	12.5	13.5	17.5
Pres-Pres	7	9	12	14

- Divide the Total Memory of your counter minus 2000 (for overhead) by the base number of bytes from the chart above. The total amount of memory in your counter can be found using the Show Status option (a standard Phoenix comes with 68536, which gives about 7800 vehicles for Normal Raw Data, Axle-Axle sensors).

Appendix B.2. Binned Data Collection

Binned data stores data as the total number of vehicles in each bin category every record interval. The three most important factors are: Which bin categories are enabled, What are the record interval lengths, and How many lanes are enabled.

Follow the steps outlined below to calculate how long your Phoenix can collect data with any given setup:

- Using the table below, calculate the base number of bytes in a single record period, for a single lane. This is done by adding up all the different modes you have enabled (Axle, Speed, Length, etc..). The table gives two values, the first is the default number if you have not modified the bin table configuration, the second is a formula you can use to calculate the number if you have put in your own bin table specifications.
  Note that "SnMis Bins" are created if you select "View&Store" from the "SnMis Storage Mode?" question in the Configure System option.

Axle Class	Speed Class	Length Class	Gap Class	Headway Class	Speed x Length	Speed x Axle	SnMis Bins
26 2 x Bins	32 2 x Bins	26 2 x Bins	16 2 x Bins	16 2 x Bins	416 (2xSpd Bin) xLength Bin	416 (2xSpd Bin) xAxle Bin	8

- For example, if you were collecting Axle & Speed classification, your base number of bytes would be 26 + 32 = 58 Bytes.
- Take your base number of bytes and multiply it by the number of enabled lanes (including directional lanes). Thus, if you had lane 1 enabled with directional, you would have two enabled lanes. This number is the BASE NUMBER FOR ALL LANES.
- Adjust the base number for all lanes by adding 1 for each type of classification you have enabled, except SpeedxLength and SpeedxAxle. If you enabled SpeedxLength, add in the number of Length Bins. If you enabled SpeedxAxle, add in the number of Axle Bins.
  For example, if you enabled Axle, Speed, and SpeedxAxle classification, you would add 1 + 1 + 13 + base number for all lanes = TOTAL NUMBER OF BYTES PER RECORD INTERVAL.
- The next step is to take the total number of bytes in your Phoenix, subtract 2000 (for overhead), and divide it by the total number of bytes per record interval. This gives you the NUMBER OF RECORD INTERVALS THE MEMORY WILL HOLD. Total number of bytes in your Phoenix can be determined by using the Show Status option. A standard Phoenix contains 68632 bytes.
- Next, multiply the total number of record intervals the memory will hold by the record interval length (in minutes). This gives you the total length of time, in minutes, the Phoenix will operate.
- You are basically done. You can calculate number of hours by dividing the time in minutes by 60, or the number of days by dividing the time in minutes by 1440.

The above system works only if you do not have different record interval lengths during the day.

Appendix B.3. Count Data Col lec tion

Count data stores the to tal num ber of ve hi cles (if us ing a pres ence sen sor) or the to tal nu m ber of ax les that crossed the sen sors for a given time pe riod. The two fac tors to con sider are: How many lanes ar e en abled, and What is the re cord in ter val length.

Fol low the steps out lined be low to cal cu late how long a Phoe nix will col lect count data:

- Mul ti ply the to tal num ber of en abled lanes by 2.
- Add one to the num ber. This is the TO TAL NUMBER OF BYTES PER RE CORD IN TER VAL.
- The next step is to take the to tal num ber of bytes in your Phoe nix, sub tract ing 2000 (for over head), and di- vide it by the to tal num ber of bytes per re cord in ter val. This gives you the NUMBER OF RE CORD IN TER- VALS THE MEM ORY WILL HOLD. To tal num ber of bytes in your Phoe nix can be de ter mined by us ing the Show Sta tus op tion. A stan dard Phoe nix con tains 68632 bytes.
- Next, mul ti ply the to tal num ber of re cord in ter vals the mem ory will hold by the re cord inter val length (in min utes). This gives you the to tal length of time, in min utes, the Phoe nix will op er ate.
- You are ba si cally done. You can cal cu late num ber of hours by di vid ing the time in min utes by 60, or the num ber of days by di vid ing the time in min utes by 1440.

The above sys tem works only if you do not have dif fer ent re cord in ter val lengths dur ing the day.

Appendix B.4. Sensor Data Collection

Sen sor data stor age will store in mem ory each in di vid ual sen sor ac ti va tion. There fore, the more sen sor ac ti- va tions you have, the quicker mem ory will run out.

Fol low the steps out line be low to cal cu late how many sen sor ac ti va tions can be stored in the mem ory of the Phoenix.

- Find out the to tal amount of mem ory in the Phoe nix. This can be de ter mined us ing the Show Sta tus op- tion. A stan dard Phoe nix con tains 68632.
- Sub tract from the to tal amount of mem ory 2000 bytes, for over head.
- Di vide by 8. This will be the amount of sen sor ac ti va tions which can be stored in mem ory. A standard Phoe nix will hold about 8300 sen sor ac ti va tions.

Appendix C.Plugs & Connectors

This section describes the physical hardware connections for connectors on the Phoenix. Note that the Unicorn, Phoenix, & Pegasus all use identical and interchangable (in most cases) connectors.

Phoenix/Unicorn/Pegasus 25 Pin Female Serial Interface Cable	
Phoenix/Unicorn/Pegasus 9 Pin Connector	25 Pin Female Sub-D Connector
#1 - Receive Data (RXD)	#2 - Transmit Data (TXD)
#2 - Carrier Detect (DCD)	#20 - Data Terminal Ready (DTR)
#3 - Data Terminal Ready (DTR)	#6 - Data Set Ready (DSR) #8 - Carrier Detect (DCD)
#4 - Ready To Send (RTS)	#5 - Clear To Send (CTS)
#5 - Serial Port Enable (ENA)	#1 - Frame Ground (GND)
#6 - Signal Ground (GND)	#7 - Signal Ground (GND) (Shield)
#8 - Transmit Data	#3 - Receive Data (RXD)
#9 - Clear To Send (CTS)	#4 - Ready To Send (RTS)

NOTE: On the Phoenix/Unicorn/Pegasus 9 Pin Connector, pin #7 is not used, pins #3 and pin #6 get two wires, and pins #5 and #6 are shorted to gether.

Phoenix/Unicorn/Pegasus 9 Pin Female Serial Interface Cable	
Phoenix/Unicorn/Pegasus 9 Pin Connector	9 Pin Female Sub-D Connector
#1 - Receive Data (RXD)	#3 - Transmit Data (TXD)
#2 - Carrier Detect (DCD)	#4 - Data Terminal Ready (DTR)
#3 - Data Terminal Ready (DTR)	#6 - Data Set Ready (DSR) #1 - Carrier Detect (DCD)
#4 - Ready To Send (RTS)	#8 - Clear To Send (CTS)
#5 - Serial Port Enable (ENA)	#5 - Signal Ground (GND)
#6 - Signal Ground (GND)	(Shield)
#8 - Transmit Data	#2 - Receive Data (RXD)
#9 - Clear To Send (CTS)	#7 - Ready To Send (RTS)

NOTE: On the Phoe nix/Uni corn/Peg a sus 9 Pin Con nec tor, pin #7 is not used, pin #3 gets two wires, and pins #5 and #6 are shorted to gether.

Phoenix/Unicorn/Pegasus 25 Pin Male Modem Interface Connector	
Phoe nix/Uni corn/Peg a sus 9 Pin Con nec tor	25 Pin Male Sub-D Con nec tor
#1 - Re ceive Data (RXD)	#3 - Re ceive Data (RXD)
#2 - Car rier De tect (DCD)	#8 - Car rier De tect (DCD)
#3 - Data Ter mi nal Ready (DTR)	#20 - Data Ter mi nal Ready (DTR)
#5 - Se rial Port En able (ENA)	#1 - Frame Ground (GND)
#6 - Sig nal Ground (GND)	#7 - Sig nal Ground (GND) (Shield)
#8 - Trans mit Data	#2 - Trans mit Data (TXD)

NOTE: On the Phoe nix/Uni corn/Peg a sus 9 Pin Con nec tor, pins #9 and #4 are shorted to gether and have no wires in serted, pin #5 and #6 are shorted to gether, pin #7 is not used, the RTS (#4) and CTS (#5) wires from the 25 Pin Sub-D are sol dered to gether and then sealed with heat shrink tub ing, and pin #6 gets two wires.

Phoenix/Unicorn/Pegasus 9 Pin Male Modem InterfaceConnector	
Phoe nix/Uni corn/Peg a sus 9 Pin Con nec tor	9 Pin Male Sub-D Con nec tor
#1 - Re ceive Data (RXD)	#2 - Re ceive Data (RXD)
#2 - Car rier De tect (DCD)	#1 - Car rier De tect (DCD)
#3 - Data Ter mi nal Ready (DTR)	#4 - Data Ter mi nal Ready (DTR)
#5 - Se rial Port En able (ENA)	Shield
#6 - Sig nal Ground (GND)	#5 - Sig nal Ground (GND)
#8 - Trans mit Data	#3 - Trans mit Data (TXD)

NOTE: On the Phoe nix/Uni corn/Peg a sus 9 Pin Con nec tor, pins #9 and #4 are shorted to gether and have no wires in serted, pins #5 and #6 are shorted to gether, pin #7 is not used, and RTS (#7) and CTS (#8) wires from the 9 Pin Sub-D are sol dered to gether and then sealed with heat shrink tub ing.

Phoenix/Unicorn/Pegasus External Loop Harness Cable	
Loop In put Num ber	Wire Pair
#1	Green/Black
#2	White/Black

#3	Red/Black
#4	Blue/Black

Phoenix/Unicorn/Pegasus Remote Airswitch Harness Cable

Name	Wire Color	Pin Num ber
In put #1	White	A
In put #2	Green	B
In put #3	Black	C
In put #4	Yellow	D
In put #5	Red	G
In put #6	Orange	H
In put #7	Blue	J
In put #8	Brown	K
6 Volts Out put	Red	E
Ground	Black	F

NOTE: The Peg a sus and Uni corn only sup port up to 4 in puts.

Phoenix 8 Input Resistive Harness Cable

Name	Wire Color	Pin Num ber
In put #1	White	A
In put #2	Green	B
In put #3	Yellow	D
In put #4	Orange	H
In put #5	Brown	K
In put #6	Blue	J
In put #7	Red	G
In put #8	Black	C
Common	Bare Wire	E
N/C	N/C	F

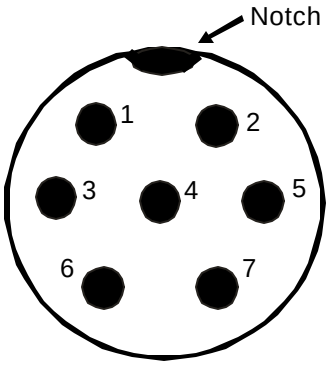
Phoenix 8 Input Piezo Electric Harness Cable		
Name	Wire Color	Pin Num ber
In put # 1	White	A
In put # 2	Green	B
In put # 3	Yellow	D
In put # 4	Orange	H
In put # 5	Brown	K
In put # 6	Blue	J
In put # 7	Red	G
In put # 8	Black	C
N/C	N/C	E
Ground	Bare Wire	F

Phoenix/Unicorn/Pegasus 4 Input Piezo Electric Harness Cable	
Piezo Elec tric In put Num ber	Wire Pair (Black is Ground)
# 1	Red/Black
# 2	White/Black
# 3	Green/Black
# 4	Blue/Black

Phoenix/Unicorn/Pegasus 4 Input Resistive Harness Cable	
Piezo Elec tric In put Num ber	Wire Pair (Black is Com mon, not Ground!)
# 1	Red/Black
# 2	White/Black
# 3	Green/Black
# 4	Blue/Black

Phoenix/Unicorn/Pegasus 7 Pin Power Connector		
Pin Num ber (see di a gram be low)	In ter nal Wire Color (ex ter nal color may dif fer)	Function
# 1	N/A	None
# 2	N/A	None
# 3	Green	AC In put # 1
# 4	Blue	So lar/12V DC In put
# 5	White	User Volt age Out put (6V)
# 6	Green	AC In put # 2
# 7	Black	Ground

The fol low ing di a gram shows the pin num bers of the Phoe nix/Uni corn/Peg a sus 7 In put Con nec tor. The ori- en ta tion of the di a gram is as if you were look ing di rectly at the con nec tor from the out si de of the box.



Appendix D.Default Bin Tables

This appendix describes the default bins categories that are used with the Phoenix. These "Bins" are used to total up all vehicles meeting a predetermined set of criteria. Note that this information is ONLY used if you configure the Phoenix to collect data in its Binned Mode. Raw, Sensor, and Count Modes do not bin data.

Default Axle Bin Classification Table (Scheme-'F')		
Bin Number	Axle Range	Bin Category Name
#1	2	Motorcycles
#2	2-4	Passenger Cars (w/wo trailers)
#3	2-5	Other two axle, 4 tire vehicles (w/wo trailer)
#4	2-3	Buses
#5	2-5	Two axle, six tire, single trailer trucks
#6	3	Three axle, single unit trucks
#7	4	Four axle, single unit trucks
#8	3-4	Four or less axle, single trailer trucks
#9	5	Five axle, single trailer trucks
#10	6-10	Six or more axle, single trailer trucks
#11	5	Five axle, multi-trailer trucks
#12	6	Six axle, multi-trailer trucks
#13	7-13	All Other Vehicles

Default Speed & Length Bin Classification Table

Bin Num ber	Speed Range	Length Range
# 1	0.0 - 19.9 mph	0.0 - 5.9 feet
# 2	20.0 - 24.9 mph	6.0 - 10.0 feet
# 3	25.0 - 29.9 mph	10.1 - 14.9 feet
# 4	30.0 - 34.0 mph	15.0 - 19.9 feet
# 5	35.0 - 39.9 mph	20.0 - 24.9 feet
# 6	40.0 - 44.9 mph	25.0 - 29.9 feet
# 7	45.0 - 49.9 mph	30.0 - 39.9 feet
# 8	50.0 - 54.9 mph	40.0 - 49.9 feet
# 9	55.0 - 59.9 mph	50.0 - 59.9 feet
#10	60.0 - 64.9 mph	60.0 - 69.9 feet
#11	65.0 - 69.9 mph	70.0 - 79.9 feet
#12	70.0 - 74.9 mph	80.0 - 89.9 feet
#13	75.0 - 79.9 mph	All Other Lengths
#14	80.0 - 84.9 mph	
#15	85.0 - 89.9 mph	
#16	All Other Speeds	

Default Gap and Headway Bin Classification Table

Bin Num ber	Gap Bin Time	Head way Bin Time
# 1	00:00:03.00	00:00:03.00
# 2	00:00:10.00	00:00:10.00
# 3	00:00:15.00	00:00:15.00
# 4	00:00:20.00	00:00:20.00
# 5	00:00:30.00	00:00:30.00
# 6	00:01:00.00	00:01:00.00
# 7	00:02:00.00	00:02:00.00
# 8	All Other Gaps	All Other Head ways

Appendix E.Road Tubes Problems & Solutions

This appendix discusses the various problems that road tubes can cause. Road tubes present their own unique set of problems for automatic vehicle classifiers & counters. Being aware of these potential problems before installing your road tubes can greatly reduce the frequency of these problems.

This appendix divides each problem (or "error") into a separate section, and then lists the known causes of the problem.

Appendix E.1. Missed Axles

Missed axles are the most frequent errors seen. They are caused, very simply, by the hardware (airswitch) inside the counter not reporting an actuation of the road tube when there is one. Some of the reasons for this are as follows:

- Speed and Spacing.
  The airswitch in the Phoenix is undoubtedly the best in the business, however, even it is limited to 30 activations per second, or about 33ms per activation. If a second strike of the road tube occurs faster than 33ms, then the airswitch will not report the second activation.

  Does this ever happen? Yes, take for example a car towing a 2 axle travel trailer at 65mph. A travel trailer typically has a spacing of 2.5ft between axles, and 65mph is about 95 feet per second. Therefore, how long does it take between the first road tube hit by the travel trailer, and the second. This is (2.5ft/(95ft/sec)) = 26ms. The airswitch would not report the second axle of the travel trailer and this axle would be missed by the Phoenix.
- Lifted wheels.
  Some trucks have an optional axle which may be raised slightly off the ground (to save on tread wear). The Phoenix will probably miss it, but sometimes it can show up as an error if human observation data is being compared to the counter and the observer is not aware that the wheel is lifted.
- Bouncing Vehicles.
  Although uncommon, roads with dips or other irregular surface features can cause some truck axles to bounce slightly. This can occasional lead to missed axles. Note that the Phoenix looks at both sets of road tube activations, so this problem is minimized.
- Improper Road Tubes or Installation.
  The type, length, and method of installation of your road tubes can lead to increasing the number of missed axles; Always plug the end of with a suitable device (unless the road tube is shorter than 25 feet, and then DON'T plug it); always plug the road tube onto the counter nozzle all the way; always use an approved brand, size, and type of material for all of your road tubes; don't over stretch the road tubes because the diameter shrinks the more you stretch it.
- Weak Signal With Longer Road Tubes.
  Very simply, the longer the road tube, the farther the "sound" of an axle striking the road tube has to travel. Make sure you use road tube lengths as recommended in the next section.

- Sound Wave Interference.
  To understand why this is a problem, you should understand that the Phoenix airswitch (like all airswitches) uses a "sound wave" to detect an axle hit. This wave is very similar to a water wave, in that it starts at a point and moves down the road tube to the round piezo disk sensor in the airswitch. It travels down the road tube at the speed of sound, which is about 767 MPH at 20 degrees celsius, or 1125 feet per second. The force of this "wave" of sound bends the piezo disk in the counter which causes a voltage spike to be generated. It is this voltage spike which the Phoenix detects as an axlestrike on the road tube.
  The following example shows how very close axle hits (such as with tandem axles on a truck) can actually interfere with each other and cause a missed axle.

  1) Assume you have a 50' road tube stretched across a single lane of traffic. The road tube has been stretched 50" to make it tight. The end of the tube on the roadway is plugged and the other end is plugged into a Phoenix.
  2) A 5 axle single trailer truck traveling 55mph crosses the road tube.
  3) The first axle is detected with no problem.
  4) The second axle (the first axle of first tandem pair) hits the road tube. This causes FOUR sound waves to be generated, TWO from each tire.
  5) The Left Tire will send two sound wave from it (1 in each direction) and the Right Tire will send two wave from it as well. The sound waves look something like the following:

     —— < A o B > ——— < C o D > —— (to Phoenix)

     Each Letter represents a sound wave and the arrow next to the letter shows the direction the sound wave is traveling.
  6) At this point the following things will happen: Sound "A" will travel to the end of the road tube and be absorbed by the plug. Sound "B" and "C" will travel towards each other, collide, and be seriously weakened. Sound "D", however, will be unin hibited and travel down the road tube towards the airswitch on the Phoenix.
     Since all of the sound waves except "D" have been destroyed, we will only talk about sound wave "D" for the rest of this section, and it will be called the Wave.
  7) The road tube has been stretched about 50", so it is now 54.16' long. Presuming the truck is in the center of the lane (lane being 12' feet wide) and the truck is 8 feet wide, the Wave should start at the 44' mark.
  8) The Wave will travel down the road tube towards the Phoenix and contact the airswitch in about 39ms (ms stands for milliseconds, or thousandths of a second).
  9) After the Wave hits the airswitch, it will bounce back and return up the road tube towards the vehicle. Thus, we have a weakened return ing wave going back up the road tube.
  10) The next axle on the truck hits the road tube about 56ms after the first (a 4.5ft spacing typical, on a 55mph vehicle). Once again, another Sound Wave "D" is generated and travels down the road tube towards the airswitch.
  11) At this point we have the following:

      —— D2 > ——— < D1 ——— Phoenix

      One wave traveling down, and one weaker wave returning. They will, of course, collide into each other at some point in the road tube, weakening both waves so that the second wave is to weak to register as an axle strike.

The question then becomes, if this is causing missed axles, why does a shorter road tube work better? If you take a 30' road tube, stretch it 50". Sound Wave "D" will start at about the 24' mark, and therefore will take only 21ms to reach the airswitch. Similarity, Sound Wave "D" will only take 21ms to return to the starting point (at the 24' mark). This makes the total time only 42ms for the first Sound Wave "D" to strike the airswitch and return to the starting point.
This time is BEFORE the 56ms time it takes for the next axle to hit. Therefore, the first Sound Wave "D" is past the point of origin and can not interfere with the next axle strike.

In summary, you are better off using shorter road tubes for faster speed vehicles. You are also better off using shorter road tubes for vehicles which have closer axle spacings (such as truck tandem axles).
To minimize missing axles and maximize accuracy we suggest using the following road tube lengths:

Speed	Road Tube Length
0-25mph	60 ft
26-35mph	50 ft
36-45mph	40 ft
46+	30 ft

While a shorter road tube at faster speeds is always more accurate, we do not suggest using road tubes shorter than 30' due to the potential damage to an airswitch by very strong "sounds" (or signals).

Appendix E.2. Extra Axles

This error, while not frequent, does happen. It is almost always a problem with the actual road tube installation, or with the road surface. Causes of extra axles are listed below:

- Road Tube Bounce (Slap).
  Since the road tubes are made of flexible rubber, they move when they are hit. Depending on how tightly they are stretched, how far apart the anchors to the roadway are, and how heavy the vehicle crossing the tubes is, the road tube may move only slightly, or may move a lot. When a tire hits the road tube normally, the airswitch is activated by the sound of that tire. If the road tube is moved a lot, it will return quickly enough to its original position and may "Slap" the road tube with enough force to actually "sound" like an other axle.
  This error is minimized by the fact that the airswitch will not re-activate for at least 33ms, and the road tube should be stabilized by then (but not always). You can also help this problem by taping the road tube to the road at short intervals along its length.

- Rutted Pavement.
  DO NOT INSTALL ROAD TUBES OVER BADLY RUTTED PAVEMENT. This will cause the road tube to bounce wildly when driven over by heavy vehicles. If you must install the road tubes in rutted pavement, tape them down heavily.

- Road Tubes Not Perpendicular to Traffic.
  This error (usually only at slow speeds) is caused by a vehicle not hitting the road tubes squarely. If the vehicle is going slow enough, the left tire (or tires) and the right tire (or tires) will cause an individual activation. This problem is most commonly seen in intersections, where vehicles are turning across the road tubes at slow speeds.

Appendix E.3. Bad Speed and/or Length

This problem is infrequent, but can occur sometimes when the counter misses axles. For example, assume a 2 axle, 8 foot axle spacing, vehicle traveling 60 mph crosses two road tubes spaced 8 feet apart. The spacings and timings occurred as below:

1) Road Tube #1 hit by first axle at 10:00:00.00000.
2) Road Tube #2 and #1 hit almost simultaneously by first and second axles at 10:00:00.09090. Counter missed the Road Tube #2 hit (for whatever reason).
3) Road Tube #2 hit by second axle at 10:00:00.18181.

Since the counter waits for the first hit on #1, and the first hit on #2 to determine the speed, the speed will be determined by the second road tube #2 hit. This gives (8ft/.18181sec) = 44ft/sec, or 30mph. This is only 1/2 the actual vehicle speed! Since the speed is calculated wrong, the counter will also give an incorrect length value for the vehicle.

Note that this error is really caused by a missed axle, the only difference is the Phoenix was still able to create a vehicle from the data, so it gave the values it could.

Appendix E.4. SnMis (Sensor Miss) for Entire Vehicle

Like the previous error, this problem only occurs as a result of missed axles. "SnMis" (forsensor miss) is the Phoenix's way of indicating that it did not have enough sensor data, or got sensor data not in the right order, to make a vehicle. Once a sensor miss occurs, the Phoenix blocks out all further sensor activations on that lane for 1 second.

- SnMis #0 occurs only with Axle-Pres-Axle or Pres-Axle-Pres combinations. This error indicates a improper sequence of sensor activations or missing one or more activations.
- SnMis #1 is that the counter only got a road tube 1 strike, with no further road tube activations. This can happen if a vehicle hits the first road tube, but misses the second, while changing lanes.
- SnMis #2 is that the counter only got a road tube 2 strike, without first getting a road tube 1 strike. This, like SnMis #1, can happen if a vehicle crosses into the lane but misses road tube #1.
- SnMis #3 is an overspeed or underspeed vehicle, and can optionally be used to indicate vehicles which only hit road tube 1 and road tube 2 once, with no further activations. Note that the counter will normally turn these types of activations into two axle vehicles with the axle length equal to the sensor spacing.

Appendix E.5. One vehicle shown as two

This error is normally caused by a vehicle with an axle spacing greater than the maximum axle spacing setting in the configure system option. The counter defaults to 35.0'. This value can be increased or decreased.

If you increase this value, you run the risk of counting vehicles traveling close together as one vehicle (two tailgating cars become one vehicle, usually turned into a four axle Scheme-F Class #8).

This error can also be caused by missed axles. The Phoenix only resets its time-out value after each axle hit, if you miss some and the counter does not reset its value, then the vehicle will be ended prematurely.

Appendix E.6. Two vehicles shown as one

This error, similar to the previous error, is caused by two vehicles traveling close enough together to be counted as one. Any vehicles closer than the maximum axle spacing value will be counted as one vehicle.

You can decrease the Maximum Axle Spacing value to correct for this problem.

Appendix E.7. Road Tube Setup That Does Not Cause Errors

The following section describes various road tube issues which do not cause errors. This is included to dispel any suspicions about these issues causing problems.

- Coiled road tubes.
  The effect of coiled road tubes versus non-coiled road tubes does not have a noticeable effect.

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