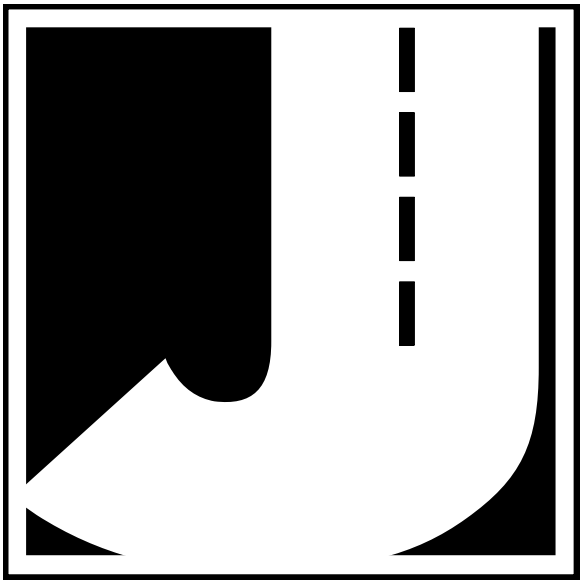


LIMITED WARRANTY

JAMAR Technologies, Inc. warrants the TDC Ultra against defects in material and workmanship for a period of one (1) year limited warranty on parts and one (1) year limited warranty on labor from the date of purchase. For information on extended warranty call 1-800-776-0940.

JAMAR Technologies, Inc. warrants each new instrument manufactured by the company to be free from defective material and workmanship and agrees to remedy any such defect. At its option, it may furnish a new part in exchange for any part of any instrument of its manufacture which, under normal use and service discloses such defect. The instrument must be returned to the JAMAR factory or authorized service agent intact, for examination, with all transportation charges prepaid.

This warranty does not extend to any products which have been subject to misuse, neglect, accident or vandalism. This warranty does not extend to products which have been repaired or altered outside the JAMAR factory or authorized service agent.

In no event shall JAMAR Technologies, Inc. be liable for any damages arising from the use of this product including damages arising from the loss of information.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for JAMAR Technologies, Inc. any other liability in connection with the sale or use of JAMAR products.

JAMAR Technologies, Inc. reserves the right to make improvements on the product and/or specifications at any time without notice.

Questions concerning this warranty or any JAMAR Technologies, Inc. product should be directed by e-mail, mail or telephone to:

JAMAR Technologies, Inc.
1500 Industry Road, Suite C
Hatfield, PA 19440
215-361-2244
sales@jamartech.com

If you have any questions about the TDC Ultra that you cannot find answers for in this manual, there are several ways to get additional information.

On the Hardware Support section of our web site at:

www.jamartech.com

Contact us by e-mail at:

sales@jamartech.com

Contact us by phone at:

215-361-2244

Monday - Friday 8:00 AM to 5:00 PM Eastern time

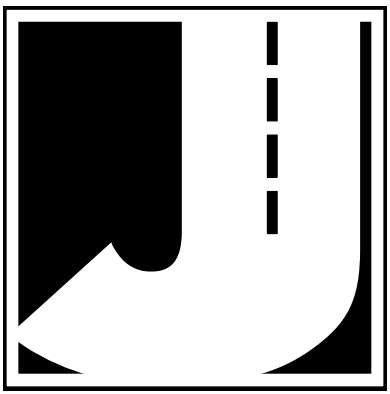
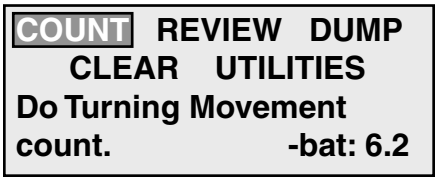


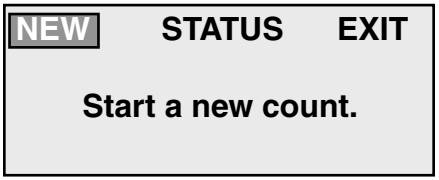
Table of Contents

Quick Start Guide for the TDC Ultra

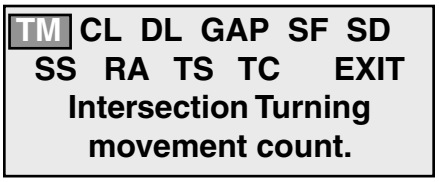
1. Turn the TDC Ultra ON. Once the start-up process is complete, the main menu will be displayed. Press DO while Count is flashing.



2. On the next screen, to start a new count, press TAB until New is flashing then press the DO key.



3. You are then given the option of selecting the type of study you want to do. The following abbreviations are used:



TM = Standard Turning Movement
CL = Classification DL = Signalized Intersection Delay
GAP = Multi-direction Gap SF = Saturation Flow Rate
SD= Stop Sign Delay SS = Spot Speed
RA = Roundabout TS = Time Stamped
TC = Enhanced Turning Movement

Press the TAB key until the study you want is highlighted, then press the DO key.

4. Each of the studies that can be done with the TDC Ultra has its own specific routine for setting it up and collecting the data. Refer to Chapters 3 through 12 for more information on how to perform each study.

5. Once you have finished your count, turn the TDC Ultra off and the data will be stored internally.

Chapter 1

Introduction to the TDC Ultra

What is the TDC Ultra?

The TDC Ultra is an electronic hand-held device that enables you to do some of the most common manual traffic data collection. You can collect:

- **Standard Turning Movement Studies**
  Collect turning movement data while classifying up to 3 groups of vehicles.
- **Enhanced Turning Movement Studies**
  Collect Turning Movement data while classifying up to 14 groups of vehicles.
- **Manual Classification Studies**
  Collect class data based on the Federal Highway Administration's classification scheme (Scheme F), or using your own customized schemes.
- **Multi-direction Gap Studies**
  Collect gap and count data in one direction or two directions with combined gap.
- **Stop Sign Delay Studies**
  Measure delay and queues at stop sign controlled intersections.
- **Signalized Intersection Delay Studies**
  Measure several vehicle delay parameters at an approach to a signalized intersection.
- **Spot Speed Studies**
  Do speed studies to find running speeds on approaches.
- **Saturation Flow Rate Studies**
  Collect Saturation Flow data at signalized intersections.
- **Roundabout Movement Studies**
  Collect movement data at roundabouts while classifying up to 3 groups of vehicles.
- **Time-Stamped Studies**
  Collect raw data with a time-stamp of every key pressed.

Multiple studies can be stored in the TDC Ultra, which has 128KB of available memory. For each study, the unit stores the type of study, the date and time, a site code, and the data.

While much of the data that has been collected with the TDC Ultra can be manually extracted from its display, the device is designed to be downloaded to a computer. At any convenient time, you can transfer the data to your computer through the USB port. The PETRAPro software allows you to easily read, edit and store most of the data, as well as print a variety of reports and graphs.

Maintaining Your TDC Ultra

The TDC Ultra is a complex electronic device. Like other electronic devices (computers, digital cameras, etc.) a certain amount of care should be taken to ensure it has a long, productive life. While the TDC Ultra is a very rugged and durable instrument, some precautions should be taken.

Like other electronic devices, the TDC Ultra can be affected by static electric discharge. Be careful to properly ground or discharge yourself, especially in cold weather when static electric build-up is more prevalent.

The TDC Ultra is not waterproof. Like other electronic devices, the TDC Ultra can be damaged or otherwise adversely affected by getting wet. Be sure to protect the unit properly during inclement weather. Be careful not to spill any liquids into the unit.

How is the TDC Ultra powered?

The TDC Ultra is powered by four AA batteries. The electronics of the unit are designed to draw as little power as necessary, so (depending on use) a fresh set of batteries may last several months before they need to be replaced.

The Main Menu shows the current battery voltage. Fresh batteries should read around 6.4 volts. Batteries should be replaced when this voltage falls around 5.5.

An external power supply can also be used with the unit to further extend the life of the batteries. The power supply, which plugs into a wall socket, is

recommend for use when downloading the TDC Ultra to a computer. When in the field, an optional cigarette lighter adapter can be used with the unit. This item draws power from the vehicle's battery and is required for TDC Ultras equipped with backlit displays.

Note: When using either the cigarette lighter adapter or external power supply, the On/Off switch of the TDC Ultra does not need to be turned on. We recommend that the switch be left in the OFF position as this will prevent the TDC Ultra from drawing power from the internal AA batteries, and extend their life.

Programming the TDC Ultra

The TDC Ultra is simple to use. An OFF/ON switch on top of the unit panel is used to turn the unit on and off. A 4-line by 20-character display helps you select the proper entries. All options are clearly displayed, with the currently selected option shown with a blinking highlight. The bottom lines of the display are used to explain the option that is highlighted.

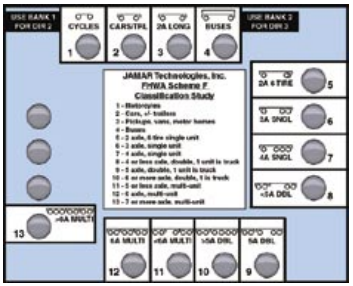
Two buttons are all that are used to move from menu to menu, and to select from the various options shown on the display. The TAB key is used to cycle through the options while the DO key is used to select an option. If you move the highlight too far and over-shoot the desired option, just keep pressing the TAB key until it is re-selected.

Collecting Data

The TDC Ultra is designed to make data collection simple and accurate. The 16 gray buttons are arranged to simulate a standard intersection, which makes doing Turning Movement studies intuitive. Of the 16 buttons, 12 are normally used for the left, through, and right movements from each of the four approach directions. The additional four buttons are user-defined; they can be used for buses, trucks, bicycles, pedestrians, or whatever you want. If a car makes a left turn from an approach, you simply push the button that shows a left turn from that direction. The TDC Ultra keeps track of everything else for you.

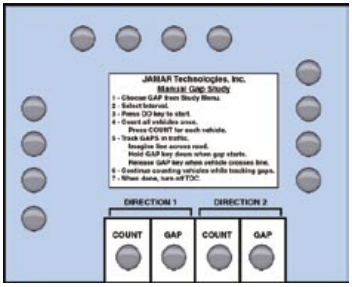
The 14 yellow buttons at the bottom of the board are used to classify vehicles while doing an Enhanced Turning Movement study.

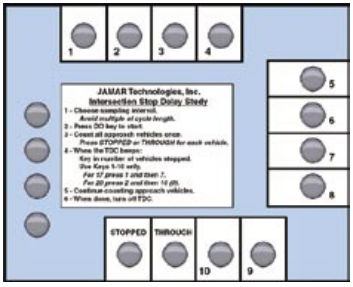
Four overlays are included with the TDC Ultra. These show how the keys are used when you do the various studies other than Turning Movement with the TDC Ultra.



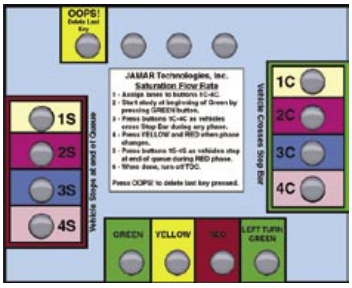
Overlay #1 is used for Classification studies. One side shows the FHWA Scheme F classes, and the other side is designed to allow you to define your own classification scheme. The overlay material allows you to write on it with a pencil or water-based marking pen.

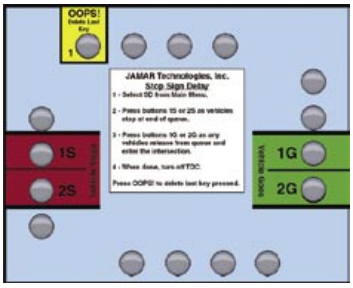
Overlay #2 is used for Gap or Signalized Intersection Delay studies.



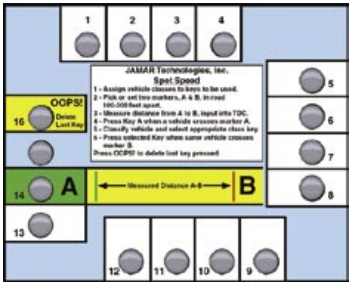


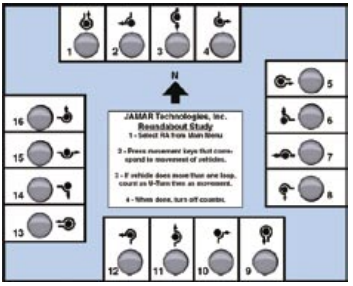
Overlay #3 is used for Saturation Flow Rate studies or Stop Sign Delay studies.





Overlay #4 is used for Spot Speed and Roundabout studies.





These overlays also show simple instructions on how to perform the different types of studies.

The overlays have four holes with serrated edges that easily snap onto the mounting studs on the TDC Ultra. It is a simple matter to pop an overlay on or off when doing a study. We suggest you keep the overlays in the carrying case when they are not being used. Replacement overlays are available if you lose one.

Before You Do a Study

When you first receive your TDC Ultra, we recommend clearing the memory before doing your first data collection to be sure you are starting fresh.

Before you attempt to collect important data with the TDC Ultra we strongly recommend that you familiarize yourself with both the operation of the TDC Ultra and how the data you want is collected. Few things are more frustrating than trying to resolve problems when working on a tight deadline or with critical data.

Whenever possible, we recommend that you perform a test study if you are new to the TDC Ultra or are planning to collect data that you have not in the past. This will help you become comfortable with the operation of the equipment and how the data is collected, which should make things easier when you have to do a real study.

Once you are familiar with the data you will be collecting, you are ready to begin. However, before going to the site you should prepare a checklist, like the one below, to prevent potential problems.

1. Is the equipment in good working condition? Can it collect, store and download data properly? **Yes No**

2. Have all decisions been made regarding how the data is to be collected? **Yes No**

3. Are the people doing the study familiar with how to collect the data? **Yes No**

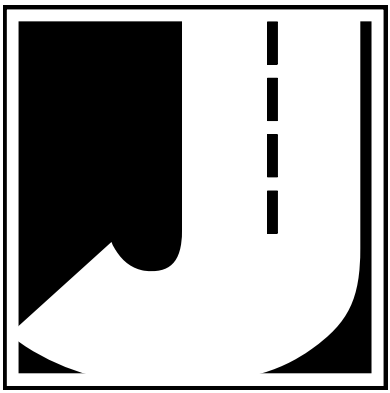
4. Are the people doing the study familiar with the equipment they will be using? **Yes No**

5. Are the people doing the study equipped with all needed accessories (spare batteries, watches, pens & paper, etc.)? **Yes No**

During the data collection itself, the first priority of those doing the study should be safety. Data collection personnel should stay a safe distance from the traffic, and distract drivers as little as possible. Whenever possible, data collection personnel should work in pairs to minimize the threat of crime, stray dogs, etc.

An excellent source for more detailed information on collecting traffic data is the *Manual of Transportation Engineering Studies*, published by the Institute of Transportation Engineers. The following is excepted from the manual:

> *Safe, efficient, and effective data collection requires skill, attention to detail, and common sense. The importance of "good" data cannot be overstated. Important conclusions are drawn from field data that form the basis for decisions that affect the expenditure of large amounts of money and can have a significant effect on the safety of the public at large. Data collection demands the same level of professionalism as any other task undertaken by an engineer or engineering technician.*



Chapter 2

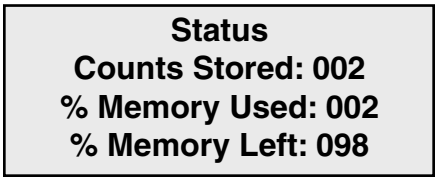
Basic Operation of the TDC Ultra

This chapter deals with some of the basic features found in the TDC Ultra. Chapters 3 through 12 provide more detailed information on how to do the data collection for specific types of studies.

Start-up Screens

To turn on the TDC Ultra, use the power switch that is mounted on the top panel of the unit. When the unit first comes on the sign-on screen is shown. This screen shows the current version number of the firmware in the TDC Ultra.

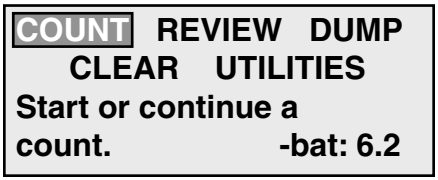
After a few seconds, this screen is replaced by the status screen.



This screen shows the number of counts stored in memory, and the amount of memory used and left for new studies. Make a note of the amount of memory left. If you are not sure if it is enough for the study you want to do, then you should download the data to your computer, and then clear the memory in the TDC Ultra before proceeding.

After a few seconds, the status screen clears and the Main Menu is displayed.

Main Menu



The Main Menu screen is the starting point for all of the options in the TDC Ultra. The options on this screen are:

COUNT Start a New count or Continue the previous count in memory. You can also check the amount of memory left for new counts.

REVIEW Display on the screen the data in memory for any of the counts. This process is described in chapter 13.

DUMP Download all of the data in the TDC Ultra to a computer through the USB port. This process is described in chapter 13.

CLEAR Clear the memory of all count data.

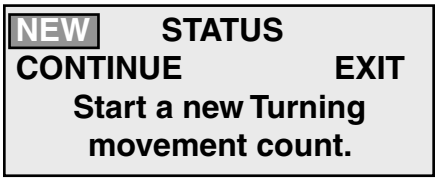
UTILITIES Perform miscellaneous operations that include a variety of hardware tests, set the time and date, and beeper control.

Battery Status

The Main Menu also displays the battery voltage of the AA batteries used in the unit. Fresh batteries should read around 6.4 volts. You should begin planning to replace the batteries once they fall to 5.5 volts. The unit will shut down once the voltage falls to approximately 4.5 volts.

For best results, always replace all batteries when changing the batteries. Do not mix and match new and old batteries

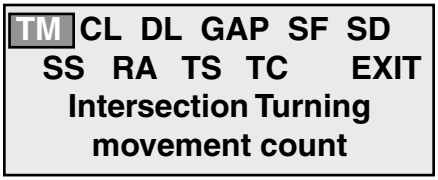
Count Menu



When you select Count from the Main Menu, the screen shown above is displayed. There are several options that may be available on this menu.

New

Select New from the Count menu whenever you want to start a new count. You are then prompted to select the type of study you want to do.



The option available are:

TM – Standard Turning Movement Study
CL – Vehicle Classification Study
DL – Signalized Intersection Delay Study
GAP – Multi-direction Gap Study
SF – Saturation Flow Rate Study
SD – Stop Sign Delay Study
SS – Spot Speed Study
RA – Roundabout Study
TS – Time-Stamped Study
TC – Enhanced Turning Movement Study

When you choose any of the studies, the TDC Ultra will step you through a series of menus to further define the parameters of the count, starting with the Site Code.

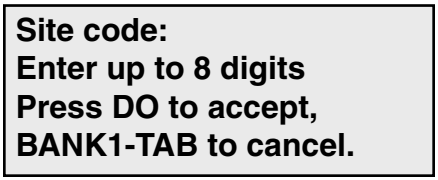
Site Code

The data in the TDC Ultra includes the *date and time* that the count was done, but no direct information on *where* the count was done. Correct use of the Site Code is a way for you to guarantee that the data you think was collected at a particular site was indeed collected there.

The TDC Ultra has two different types of site codes that you can use to identify your counts. The first is simply an 8-digit number that you assign to a particular count so that you can uniquely identify the location of the count when you download the data from the TDC Ultra to your computer. The second allows you to enter two lines of twenty alpha-numeric characters, typically used to show the North/South street name and the East/West street name at the intersection where the count is done.

Select 8-DIGIT to use a simple 8 digit site number to identify the location of the count, or select ALPHA and enter the actual names of the streets where the count is being done.

If you select 8-DIGIT the display changes to:



It is simple to enter the Site Code. Use the keys 1-10 like a keyboard (10=0). Enter the number you want. The display shows the numbers as you type them in. If you make a mistake, press BANK1-TAB and start over. When the number on the display is correct, press DO and you will go to the interval menu.

If you select ALPHA from the Site Code Type Select Menu, the display shows the screen below.

```
North/South Street:
A
use↑/↓, TAB=advance
^TAB=cancel,   DO=done
```

The top line of the display shows the title North/South Street, with the cursor flashing on the letter A. You enter the street names one letter at a time, using the Change keys (14 & 15) to scroll through the alphabet until the display shows the letter you want. You then press the TAB key to select that letter and advance to the next letter. The display now shows a blank character, which is the default character to start with each time. You can use the up arrow key to move to the letter A, or you can use the down arrow key to go to the number 9. In this way you can quickly select each letter you need. You have 20 characters for each street name, and you can use any letter from A-Z, and any number from 0-9. You can also use spaces.

You continue in this manner until the entire street name is visible on the display. If you make a mistake, press BANK1-TAB to cancel the operation. When the display is correct, press the DO key. The display then shows a similar screen for the East/West street. Repeat the procedure explained above. When you are done with the second street name, press DO and the TDC Ultra goes on to the interval menu.

The titles say North/South Street and East/West Street, but that isn't necessarily what you have to enter. You have two lines of characters you can use any way you want. Which of the two types of site codes you use is a matter of preference.

The ALPHA input is more precise, with the actual names of the streets entered with the data, but some people don't like to enter the names one letter at a time. The 8-Digit site code is certainly easier to use, but then you have to have some sort of system to link the site code entered into the TDC Ultra with the names of the streets.

The way to do this is simple:

Have the people who do the counts fill out a simple worksheet that has the location, date, time and type of count, along with any other information you think is important (a sketch of the location is usually a good idea). This worksheet is brought back to the office and used as a reference when the data is transferred to the computer. The site code that was entered into the TDC Ultra in the field is shown on the computer screen with the data. The computer operator compares the site code on the screen to the site codes on the worksheets to find the appropriate location information. It is a simple system that has worked well for many different agencies. It avoids the occasional problem of trying to remember exactly where a particular count was done, especially if the person who did the count is not available for one reason or another.

Once you have entered the site code, you will be taken to a new screen that will vary depending on the type of study you are doing. Refer to chapters 3 through 12 for more information on your specific study.

Continue

It is often necessary to do a study at the same location at different times of the same day. For example, you might do a study in the morning and then return later in the day to collect additional data. You can choose NEW and just do two separate counts and treat them separately, or (if it is an available option) you can choose to CONTINUE the first study.

The Continue option is not always available as an option, and as a result is not always shown on the display. The TDC Ultra checks the study in memory to determine if it is one that you can continue.

The rules for being able to continue a study are as follows:

1. You can only continue a Standard Turning Movement, Roundabout or Classification study. The other studies require uninterrupted data collection.

2. You cannot Continue a study unless it is on the same day as the previous study. All studies with the TDC Ultra are confined to a single day.

3. You can only Continue the last study performed. Previous studies cannot be continued.

4. You can Continue a study any number of times as long as the first three rules apply.

When selecting the Continue option, the TDC Ultra automatically selects the same counting interval and site code you used for the previous count. When the information is downloaded, the analysis software combines the data from the two sessions into one count, and puts zeros in all of the data points between the two counts. An option in the software lets you print just the collected data, so that all of the zeros are not printed on the report.

Status

Before starting a New study or Continuing a previous study, the Status menu can be used to determine whether or not there is enough memory in the TDC Ultra to conduct the next study.

```
  Counts stored: 002
% Memory used: 002
  % Memory left: 098
  Press DO to return
```

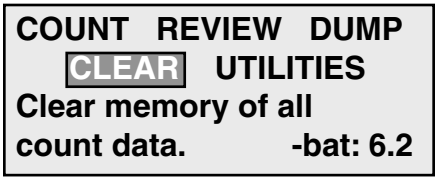
The status screen (shown above) shows you information about the memory in the counter. The most important number is on the third line, the percentage of memory left. You want to make sure you have enough memory to do your study **before** you bring the TDC Ultra out to the field.

The Appendix contains a chart which details how much memory each study uses. If you are not sure you have enough room, you should download the data in the TDC Ultra to your computer for processing, and then clear the memory to free up space.

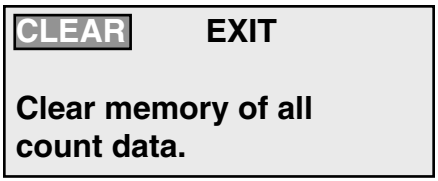
The status information is always shown when you turn on the TDC Ultra counter, but you can also re-display it from the Count menu if you didn't notice it the first time.

Clearing the Memory

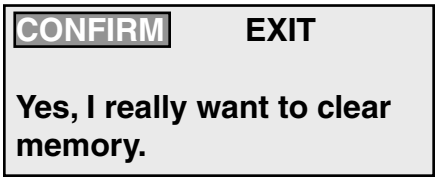
The TDC Ultra stores its data in flash memory, and retains the data even if the counter is turned off. However, once the data has been successfully transferred to the computer there is no need to keep it in the TDC Ultra. The only way to clear the data, and make room for new studies, is to use the Clear option. To start this process, select Clear from the Main Menu.



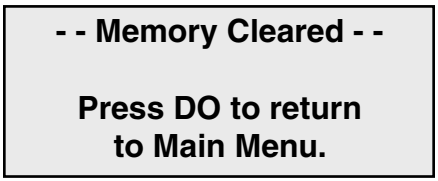
The first level of protection checks to make sure you pressed the correct key in the Main Menu. Assuming you did, move the highlight to CLEAR and press the DO key.



The second (and final) level of protection asks you to confirm that you really want to clear the memory. Again, assuming you do, move the highlight to Confirm and press the DO key. *If, after all this, you clear the memory by accident, don't blame us.*



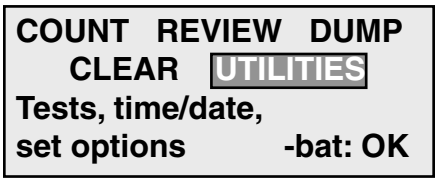
The memory is cleared and the screen shown here is displayed. Press DO and you will then be returned to the Main Menu.

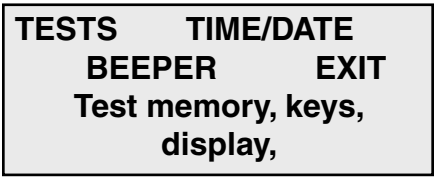


Note: When you first receive your TDC Ultra, we recommend clearing the memory before doing your first data collection to be sure you are starting fresh.

Utilities Menu

The Utilities Menu contains an assortment of operations that are necessary and/or helpful to the operation of the TDC Ultra. When you select Utilities from the main menu, the following screen is displayed.





You have three sub-menus from which to choose: Tests, Time/Date and Beeper.

Tests

The TDC Ultra is designed to be a very reliable instrument. It is manufactured with high quality components, and is designed to withstand rugged use in the field. It is also a very sophisticated product with a microprocessor 'brain'. One feature of this brain is that it can perform a series of diagnostic self-tests to help you verify the correct operation of the TDC Ultra, even in the field.

To perform one or more diagnostic tests, select Tests from the Utilities menu. The screen shown below is then displayed.

The display shows the three types of tests that can be performed, which are Memory, Display and Keys. Use the TAB key to move the highlight to the test you want to do, and then press DO.

Memory Test

The TDC Ultra contains low-power solid state memory that is used to store the data from the various counts. Solid state memory is extremely reliable. However, like any electronic element, it can go bad. If you suspect there may be a problem with the memory you can easily test it. To test the memory, select MEMORY from the TESTS menu. The screen shown below is then displayed.

```
- - - MEMORY TEST - - -
TESTING
Please wait
037k bytes tested...
```

The TDC Ultra automatically starts testing the memory. It takes only a few seconds to complete the test. The bottom line of the display shows the progress of the test, starting at 000k and ending at 132k. The test does not affect any data that is stored in the TDC Ultra. If the test is successful, the word PASSED is displayed, as shown below.

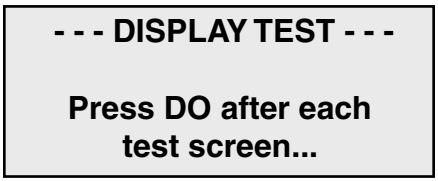
```
- - - MEMORY TEST - - -
PASSED
Press DO to return
to TESTS Menu
```

If the test is not successful, an error message is printed. There is not much you can do, except check the main batteries to see if they are low. It is possible (but very unlikely) that if the batteries are low, the microprocessor is not executing the test properly. If the memory test fails, contact us using the information in the front of this manual to arrange to ship the TDC Ultra back for repair.

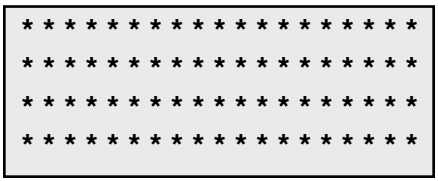
Display Test

The liquid crystal display used in the TDC Ultra displays four lines of 20 characters. Each character is made up of 35 dots, in a 5 x 7 matrix. That's a lot of dots! The display test lets you check the display to make sure it is showing what it should be showing.

To test the display, select Display from the Tests menu, and the screen shown here is displayed. Press DO to start the test.



The display should look like the screen shown here. Each character should be an asterisk "*", and there should not be any other dots displayed.



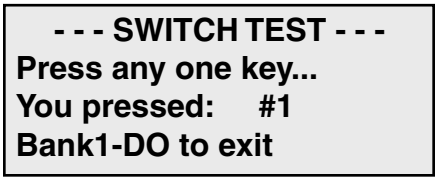
Press DO three times. You should see a full screen of "8", then full screen of "=", and finally a full screen of "l". If any of the screens do not display correctly, then something is wrong with the display of the TDC Ultra. Contact us using the information in the front of this manual to arrange to ship the TDC Ultra back for repair.

Keys Test

There are a number of push-button keys (or switches) on the front panel of the TDC Ultra, each of which performs a vital function. It is very important that the keys work reliably. The keys are the only components in the TDC Ultra that are susceptible to wear and tear. While they should have a long life (each key is rated to 1 million pushes), there is always the chance that a key will go bad and stop working correctly.

Our experience suggests that some customers think that the harder they push the keys, the more 'important' the TDC Ultra will consider the count. This is not true. Actually, the TDC Ultra prefers gentle pressing of the keys. Please keep it in mind.

To test the switches, select KEYS from the TESTS menu. The screen shown here is then displayed.



Each time you press a key, the TDC Ultra displays the number of the key on the display. The BANK1, BANK2, TAB, & DO keys are

spelled out. Press each of the keys until the all of the switches have been tested. Press BANK1 - DO to return to the TESTS menu.

If any of the switches won't register on the display, contact us using the information in the front of this manual to arrange to ship the TDC Ultra back for repair.

Note that the 14 yellow classification keys at the bottom of the board are included as part of the key test. These keys can be tested separately using the Enhanced Turning Movement study, as described in chapter 4.

Time/Date

The TDC Ultra has a built-in real time clock that is powered by the same lithium battery that is used to store the count data in the solid state memory. The clock normally keeps excellent time, but occasionally needs to have the date or time corrected.

To change the date or time, select TIME/DATE from the UTILITIES menu. The screen shown here is then displayed.

```
HR  MIN     MON  DAY  YR
 12:25       02/  13/  09
Change↑/↓ to modify
DO to set time/date
```

The display shows the current hours, minutes, month, day, and year. Use the TAB key to move the highlight to the parameter that you need to adjust. Then:

Use the Change (#15) key to add one to the current value,

or

Use the Change (#14) to subtract one from the current value.

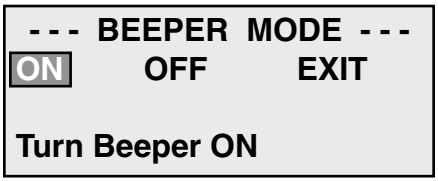
Continue using the Tab and Change keys until all of the parameters are correct, then press DO to set the new date and time.

Note: The time is not set until you press the DO key. To synchronize the time to the second, set the time one minute ahead then wait until your watch shows the seconds equal zero, and then press the DO key.

Beeper

The TDC Ultra has a built-in beeper that beeps when most keys are pressed. Some people like the beep. It is a positive indication that the key pressed was detected by the microprocessor. In the field, while you are busy watching the traffic, the beep can be reassuring. Other people don't like the beep, especially in a quiet car.

You can easily change the current mode of the beeper, from on to off, or from off to on. Select Beeper from the Utilities menu. The screen shown here is then displayed.



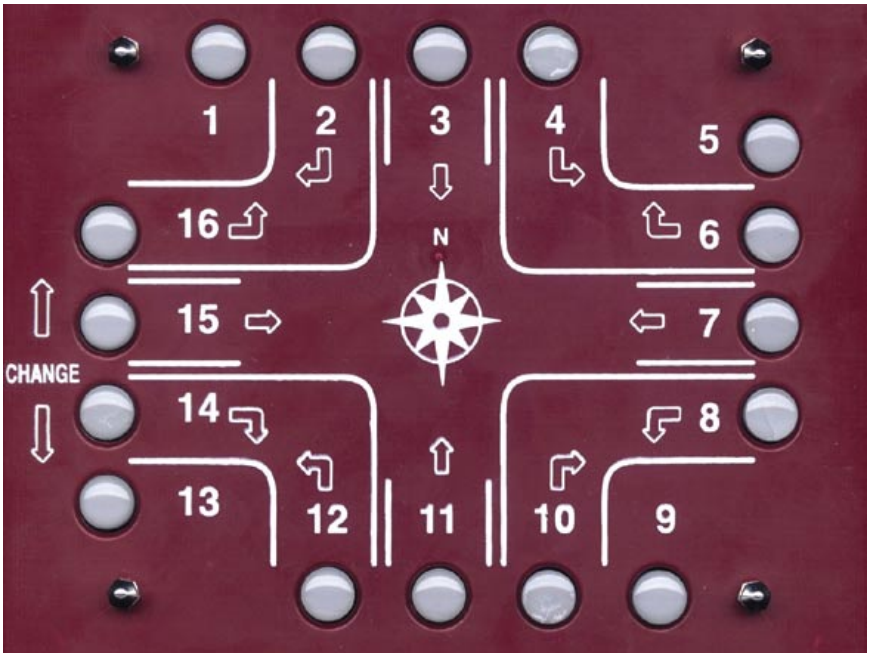
Use the TAB key to move the highlight to the mode you want, then press DO. The new mode is installed immediately. Press DO with Exit flashing to return to the Utilities menu.

The TDC Ultra remembers the mode you have selected even after it is turned off. If you change the beeper mode to off, then it will stay off unless you change the mode again.

Chapter 3

Standard Turning Movement Studies

Standard Turning Movement Studies



NOTE: This chapter deals with data collection for Standard Turning Movement studies, in which vehicles can be classified by up to three different groups using the Bank 1 and Bank 2 keys located near the top of the TDC Ultra. For information on Enhanced Turning Movement studies, in which vehicles can be classified by up to fourteen different groups using the 14 yellow keys located near the bottom of TDC Ultra, refer to chapter 4.

The TDC Ultra is designed to make turning movement data collection simple and accurate. The buttons are arranged to simulate a standard intersection, which makes collecting the data intuitive. There are 16 buttons, with 12 normally used for the left, through, and right movements from each of the four approach directions. The additional four buttons are user-defined; they can be used for buses, trucks, bicycles, pedestrians, or whatever you want. If a car makes a left turn from an approach, you simply push the button that shows a left turn from that direction. The TDC Ultra keeps track of everything else for you.

The TDC Ultra can also double or triple the number of movements counted from 16 to 32 or 48 by using the unit's two BANK keys in conjunction with

the regular movement keys. If a movement key is pressed, the count is registered in the "primary" movements (1-16). If the BANK1 key is held down while a movement key is pressed, the count is registered in the "secondary" movements (17-32). If the BANK2 key is held down while a movement key is pressed, the count is registered in the "tertiary" movements (33-48). Normally, the turning movements of less common events are counted with the secondary and tertiary (BANK1 and BANK2) keys.

The secondary and tertiary keys are often assigned to truck movements. For example, if a car makes a right turn from the north approach, then you press button #2. If a light truck makes the same movement, you press and hold down the BANK 1 key while pressing button #2, which is counted in the secondary movements. If a heavy truck makes the same movement, you press and hold down the BANK 2 key while pressing button #2, which is counted in the tertiary movements. Since it takes a little more work to press the BANK 1 and BANK 2 keys, the less common truck volumes are assigned to the secondary movements.

When this data is processed using the PETRAPro software, you can get percentage breakdowns of the data based on the different groups.

This is just one example of how the Bank keys can be used. They can also be used for counting additional approaches if you have more than the standard four at an intersection.

Preparing to do a Turning Movement Study

Before you start a standard turning movement study, you must ask yourself the following questions.

- What are the user defined buttons (1,5,9,13) going to be used for, if at all?
- Are the Bank 1 and Bank 2 keys going to be used?
- Can one person do the study, or will it require two or more, using separate TDC Ultras?
- How is the TDC Ultra going to be oriented?

The answer to these questions depends on the experience of the people doing the studies; there are no simple rules of thumb we can give you to help you decide. The important thing is to use your knowledge of the people doing the data collection, along with your experience with the traffic they are likely to see in the field, to decide in advance what the best strategy would be.

Deciding on how the TDC Ultra will be oriented during the study depends on where you will actually be located while doing the count. When the data from the unit is downloaded to our software, the program assumes that the 1 through 4 keys were for the from north (southbound) approach, and the rest of the keys are assigned accordingly. The TDC Ultra's front panel has a symbol with compass points showing north, south, east and west. This symbol is included to suggest that you align the counter so that buttons 1 though 4 faces north while you are doing the count. It is not necessary to always conform to this practice. Sometimes it is more convenient for you to face another direction when you do the count, especially if you want to be able to read the display.

The analysis software allows you to select which button was facing north during the count; it just defaults to button #3. We recommend that (if possible) you use the default direction, since it eliminates one source of error when you do the analysis. If you don't use the default direction, it is important to note this. If you keep good notes in the field, you won't have any problems, no matter which way the TDC Ultra is aligned.

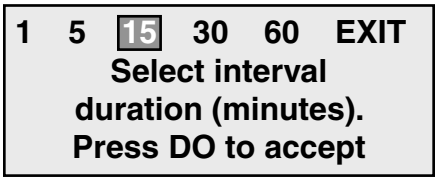
How to do a Turning Movement Study

When you are ready to begin a Standard Turning Movement study, select **Count** from the Main Menu, then select **New** and then select **TM**.

You are then prompted to select a site code type and assign a site code. Refer to chapter 2 for information on selecting a site code.

Interval

Once you have programmed a site code for the study, you are prompted to choose the interval length that will be used.



You are given the choice of 1, 5, 15, 30, or 60 minute intervals. An Interval is the amount of time the TDC Ultra collects data before it stores the accumulated totals in memory. You are barely aware of intervals

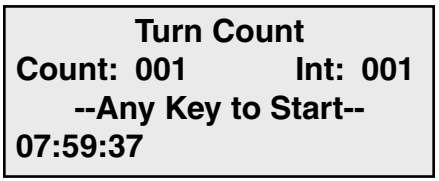
changing when you do a study with the TDC Ultra (it beeps at the end of each interval to let you know it may be time to go home). The TDC Ultra automatically keeps track of the time and stores the data at the end of the interval. You only have to concentrate on collecting the data. This is one of the major features of the TDC Ultra.

The default value is 15 minutes, as this is the most common interval length used for Turning Movement studies. We recommend that you use 15 minutes unless you have special requirements.

Press DO once you have selected the interval length you wish to use.

Start Study

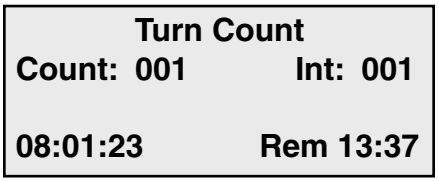
After you have selected an interval to use, you are ready to start the study. The display shows the current count number and the interval number. In the example shown, this is the first count done, and it is at the first interval.



The TDC Ultra is waiting for you to push any movement button, which starts the study. The display in the lower left corner shows the current time, so it is easy to synchronize the start of the count to the beginning of the desired interval. You do not have to push the first button exactly when the seconds roll over to zero. The analysis software rounds the start of the study to the nearest minute automatically. However, when starting a new study, always try to begin as close to an interval boundary as possible, such as xx:00, xx:15, xx:30, or xx:45.

Press any of the gray keys to begin counting and the TDC Ultra will start recording data.

When you push the first button to start the study, the display changes to show the amount of time left in the present interval. In this case, it starts at 15:00 minutes and counts down to zero. At the end of each interval, the TDC Ultra beeps three times.



Normally you are not watching the display, you are watching the traffic. The beeps remind you that the interval is over. This is only important if this is the last interval and you are ready to quit; otherwise, just ignore the beeps and keep counting vehicles.

**********IMPORTANT**********

Once you start the study, the only way to quit it is to turn the TDC Ultra off. Always wait for the end of interval beeps before turning the unit off.

There is no data stored in the counter until after the first interval. If, after starting a study, you realize that you set one of the parameters wrong, you can turn off the TDC Ultra and restart the study correctly. However, once an interval has finished, the study is stored in memory. So, if you realize after the first interval that you have made a mistake, you need to either make a note to the person downloading the data to ignore that study, or clear the TDC Ultra's memory, as described in chapter 2.

Viewing Data While Recording

You have two display options while you are doing the study. The status screen shows the current time and the amount of time left in the interval, among other things. Normally you do not look at the screen while you are doing a study, you are busy looking at the traffic. All you really need to know is the time so that you know when the study is over.

However, some people like to be able to see the data accumulate in memory, especially if they have done studies for years with mechanical counters that show the totals change as the buttons are pushed. Some people just don't believe the data is registered if they can't see any evidence for themselves.

If you press the TAB key while counting the display changes to show the totals for each of the primary movements, buttons 1-16. Each row shows one approach. *Note that this display assumes buttons 1-4 are the North direction.*

1N :	**000**	**000**	**000**	**000**
1E :	**000**	**000**	**000**	**000**
1S :	**000**	**000**	**000**	**000**
1W :	**000**	**000**	**000**	**000**

If you press the TAB key a second time, the display changes to show the totals for each of the secondary movements, BANK1 1-16. *This is designated by the number before the direction changing to a 2.* If you press the TAB key a third time, the display changes to show the totals for each of the tertiary movements, BANK2 1-16, with the number before the direction changing to a 3.

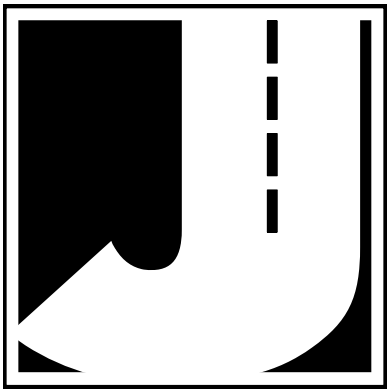
Press the TAB key a fourth time, and the display changes back to the default status screen showing the time. You can continually press the TAB key to cycle through the four screens (time, primary keys, secondary keys, tertiary keys).

At the end of each interval, the display automatically changes back to the default screen, so you can check to see if it is time to end the study. As soon as you press one of the movement keys, the display goes back to the screen you were using when the interval ended. If you know that you are not near the end of the study yet, you don't have to look at the display, just keep counting.

Ending the Study

When you get to the last interval, keep counting until the interval ends, signaled by the triple beep. Once you hear this, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.



Chapter 4

Enhanced Turning Movement Studies

The Enhanced Turning Movement study in the TDC Ultra is designed to allow you to collect turning movement data, while classifying vehicles in up to 14 groups.

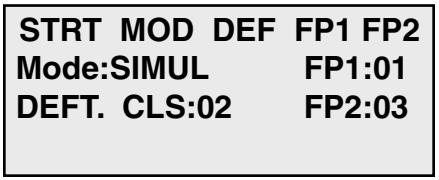
The data collection is very similar to the Standard Turning Movement study described in chapter 3. (If you are new to Turning Movement studies, review chapter 3 before proceeding.) However, instead of using the Bank1 and Bank 2 keys at the top of the board to classify up to three groups, with the Enhanced Turning Movement study you use the 14 keys at the bottom of the board to classify up to 14 groups.

How to do an Enhanced Turning Movement Study

When you are ready to begin an Enhanced Turning Movement study, select **Count** from the Main Menu, then select **New** and then select **TC**.

Study Options

Once you select TC, the Study Options screen appears.

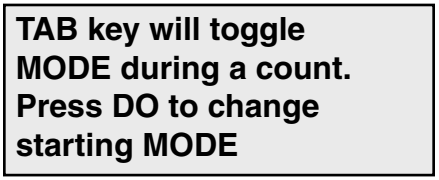


The middle two lines of this screen show the options that are currently set for the study. To use these options, press DO while STRT is flashing on the top line. Any of the options can be changed by using the other four selections on the top line: MOD, DEF, FP1 or FP2

MOD (Mode)

The Mode study option allows you to choose between two different formats for collecting data. The options you have are **Simultaneous** or **Latched**. When collecting data in Simultaneous mode, you must hold down the yellow class key each time you press one of the gray turning movement keys. When collecting data in Latched mode, the TDC Ultra retains the last class key you pressed in memory, so you only need to press one of the gray turning movement keys for any additional vehicles of that same class.

When you select the MOD option, the first screen you will see is an informational one to let you know that you can change modes while in the middle of a study by simply pressing the TAB key.



Press the DO key to continue and you will see the Mode selection screen.

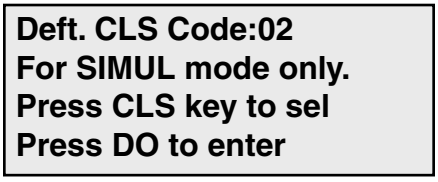
Select SIMUL if you want to use Simultaneous mode, or select Latched if you want to use Latched mode.

DEF (Default Class)

The Default Class study option only applies to studies being done in Simultaneous mode. It allows you to assign one vehicle class as the default for the study.

In most classification schemes there is one class that contains the majority of vehicles in the study. This is typically the class for passenger cars, but can vary. By using the Default Class option, you can press just the turning movement key (without holding the class key) for vehicles of this class. The only time you would need to press one of the class keys is if a vehicle is not part of the default class.

When you select the DEF option, you will see the screen shown here. Enter the class number you want to use as the default, using the 14 yellow classification keys, then press the DO key to return to the Options menu.



FP1 & FP2 (Foot Pedal 1 & 2)

The Foot Pedal 1 and 2 options allow you to assign a default class for any Foot Pedal switches you are using for the study. These devices plug into the Bank 1 and 2 slots on the top of the TDC Ultra (next to the Comm Port) and allow you to use your foot to record a class rather than pressing the key with your hand.

When you select either FP1 or FP2, you will see a screen similar to the one shown here. Enter the class number you want to use as the default for the foot pedal, using the 14 yellow classification keys, then press the DO key to return to the Options menu.

```
Foot Pedal 1 code:03

Press CLS key to sel
Press DO to enter
```

Once you have set the options the way you like, press the DO key while STRT is flashing and you will be prompted to select a site code type and assign a site code. Refer to chapter 2 for information on selecting a site code.

Start Study

After you have selected a Site Code, you are ready to start the study.

```
Turn by Cls.   SIMUL
Active CLS: [02]
CLS/Key:02/07 (01)
15:26:44          Count:03
```

The top line of the display shows the type of study and the mode being used. The second line shows the currently active class. The third line shows the data as you record it, while the fourth line shows the current count number and the current time so that you can start the study at a specific time.

To record your data, take note of the Active Class. For any vehicles that you record in this class, you only need record the turning movement by pressing one of the 16 gray movement keys. The TDC Ultra automatically assigns the active class to the movement.

For any vehicle not in the active class, you must also press one of the class keys.

In Simultaneous mode, you hold down one of the 14 class keys while you record the movement. When you release the class key, the active class automatically reverts back to the default setting.

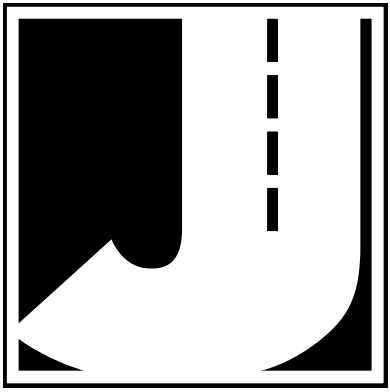
In Latched mode, you press the class key but do not have to hold it down while pressing the turning movement key. Pressing the class key automatically changes the Active Class. However, the active class does not revert back to a preset default so you must press the class key each time a different class makes a movement.

While you are recording your data, the last key combination you pressed is shown on the third line. The class is shown first, followed by the movement number. The number in parentheses keeps track of the number of times you pressed the same combination in a row.

Ending the Study

The Enhanced Turning Movement study data is stored on a vehicle-by-vehicle basis, divided into one-minute intervals. Once you have collected enough data, turn the TDC Ultra off.

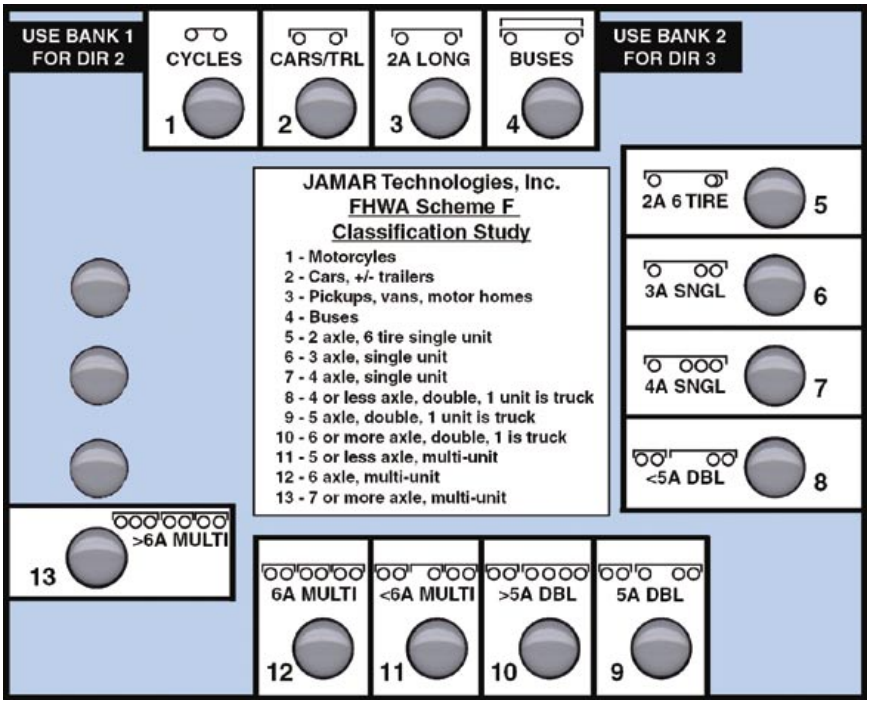
Remember, the only way to stop a study is to turn the power off.



Chapter 5

Classification Studies

Classification Studies



The TDC Ultra allows you to do many different types of classification studies. Technically, both the Turning Movement studies and the Gap studies are classification studies. In one, the classes are the number of vehicles making specific movements, and in the other the classes are time intervals between vehicles. In the TDC Ultra these studies are given special treatment to make them simpler to do, but they still are essentially classification studies.

The normal use of the term Classification Study involves a manual survey of the types of vehicles. Each class is a particular type of vehicle, either a passenger car, a bus, a type of truck, etc. The study, typically called a Manual Classification Study, involves counting the number of vehicles of each class for a given amount of time.

The TDC Ultra uses the term Classification primarily for vehicle classification studies, but not exclusively. With the TDC Ultra, you can do three types of classification studies:

1. Vehicle Classification using the Federal Highway Administration's vehicle classification system (scheme F).

2. Vehicle Classification using your own scheme.

3. Any type of classification study you invent.

The first two are very similar. They both involve assigning a vehicle type to each button. The FHWA scheme F uses 13 different classes of vehicles, based on the number of axles and the spacing of axles. It is designed to be compatible with automatic traffic counting equipment using road tube sensors, such as the JAMAR TRAX series. Road tubes can only measure the presence of an axle, so the automatic counters can only count axles and measure the spacing between axles. The FHWA Scheme F does a good job of discriminating most types of vehicles, but because it is designed for automatic data collection equipment, it suffers from some limitations when applied to manual counts. For example, it often is difficult to tell at a glance whether a truck has 5 or 6 axles, while it is easy to see the difference between two small cars following one another closely and a four axle truck, a situation which often confuses automatic classifiers.

Manual classification schemes can use criteria other than axle number and spacing. With the TDC Ultra you can design your own scheme using up to 48 different types of vehicles. You can also define schemes in 2 or 3 directions with up to 16 classes per direction. In these cases, each key on the TDC Ultra can be a different class, and multiple directions are classified by using the BANK keys. For example, Key 9 might be a city bus. If the bus is going north, you just press Key 9, if a bus is going south you press BANK1 and Key 9. In this way you can do a bi-directional study.

A common User-Defined scheme is to have 4 vehicle types defined: bikes & motorcycles, cars, trucks, & buses. Four approaches to an intersection can be counted with one counter without using the BANK switches.

The third type of classification study supported by the TDC Ultra is a User-Defined study that can have any kind of classification criteria, and count

any type of event. It doesn't have to be vehicles, or even traffic related for that matter. As long as you can define a unique button to a particular "class", and an observer can distinguish one class from another, then you can do a manual study with the TDC Ultra. Applications are limited only by the imagination.

One of the templates that is included with the TDC Ultra is designed for Classification counts. One side has the FHWA Scheme F pre-assigned to buttons one through thirteen, as shown on page 4-2. The other side has a special frosted surface to allow you to write your own scheme using a pencil or water-based marking pen. There is a rectangle next to each button so you can write some sort of easily recognized symbol or code designation that you develop. The center section allows you to write more complete descriptions of the classes.

The first step to do a classification study is to decide if you are going to use the FHWA Scheme F, or one of your own. For your own scheme, you need to carefully design the classes and assign a key to each class. Try to group the classes logically, with related classes next to one another if possible. Next, design the template symbols and descriptions and write them on Template 1B. A pencil, or a water-based marking pen work well. Once this is done, you are ready to bring the TDC Ultra out to the site and do the study.

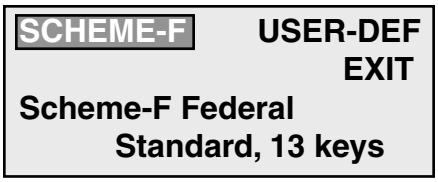
How to do a Classification Study

When you are ready to begin a Classification study, select **Count** from the Main Menu, then select **New** and then select **CL**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Choose Classification Scheme

Once you have entered your site code you will be prompted to select the classification scheme to use with your study.

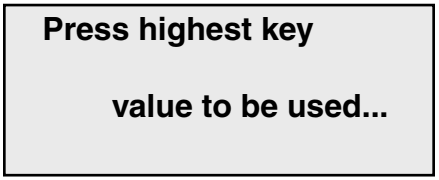


There are two choices:

- Scheme-F – Thirteen class federal standard
- User-Def – User Defined classification of up to 16 classes.

If you choose Scheme-F you are taken directly to the screen for selecting the number of directions to record. This screen is described in the *Select Number of Directions* section on the next page.

If you choose User-Def, then you will see the screen shown here.



You are prompted to enter the highest key that you will use during the study. This is the number of different classes that you have defined for the study, without regard to the number of directions you are counting. You can have up to 48 different classes. Press the highest key you would use (using the BANK keys as necessary).

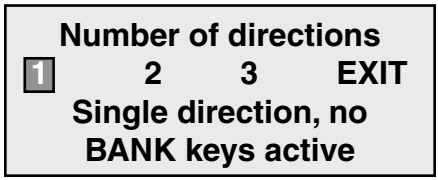
For example, if your class scheme uses only 5 classes of vehicles, press the number 5. If, however, you want to do a detailed class study of a parking lot, with 40 different classes of vehicles, press BANK2 & 8. This tells the TDC Ultra to use the 16 primary keys, the 16 secondary keys (BANK1) and the first 8 tertiary keys (BANK2). 16+16+8=40.

If you select to use more than 16 classes (and therefore pressed one of the Bank keys) you can only do one direction of data collection at a time. As a result, you'll be taken directly to the Interval Length selection screen, described later.

If, however, your class scheme has less than 16 classes (and therefore you didn't press one of the Bank keys) you can choose to collected more than one direction of data at one time. The procedure for doing this is described in the next section.

Select Number of Directions

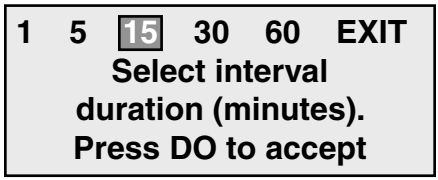
If you have chosen to use the FHWA's Scheme F, or selected a User Defined scheme with 16 or less classes, you will see the screen shown here.



This screen allows you to decide how many directions of data to collected. If you select 2 or 3, while doing the study you use the BANK keys in conjunction with the primary 16 keys to record data for a second or third direction.

Interval

Once you have selected the number of directions to record you'll be prompted to select an interval length.



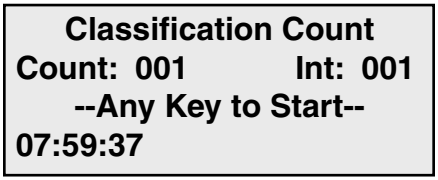
You are given the choice of 1, 5, 15, 30, or 60 minute intervals. An Interval is the amount of time the TDC Ultra collects data before it stores the accumulated totals in memory. You are barely aware of intervals changing when you do a study with the TDC Ultra (it beeps at the end of each interval to let you know it may be time to go home). The TDC Ultra automatically keeps track of the time and stores the data at the end of the interval. You only have to concentrate on collecting the data. This is one of the major features of the TDC Ultra.

The default value is 15 minutes, as this is the most common interval length used for classification studies. We recommend that you use 15 minutes unless you have special requirements.

Press DO once you have selected the interval length you wish to use.

Start Study

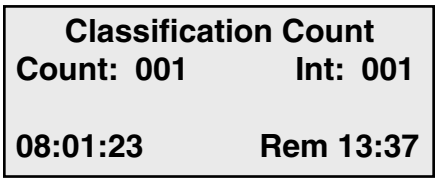
After you have selected an interval to use, you are ready to start the study. The display shows the current count number and the interval number. In the example shown, this is the first count done, and it is at the first interval.



The TDC Ultra is waiting for you to push any class button, which starts the study. The display in the lower left corner shows the current time, so it is easy to synchronize the start of the study to the beginning of the desired interval. You do not have to push the first button exactly when the seconds roll over to zero. The analysis software rounds the start of the count to the nearest minute automatically. However, when starting a new study, always try to begin as close to an interval boundary as possible, such as xx:00, xx:15, xx:30, or xx:45.

Press any of the gray keys to begin counting and the TDC Ultra will start recording data.

When you push the first button to start the study, the display changes to show the amount of time left in the present interval. In this case, it starts at 15:00 minutes and counts down to zero. At the end of each interval, the TDC Ultra beeps three times. Normally you are not watching the display, you are watching the traffic. The beeps remind you that the interval is over. This is only important if this is the last interval and you are ready to quit; otherwise, just ignore the beeps and keep counting vehicles.



**********IMPORTANT**********

Once you start the study, the only way to quit it is to turn the TDC Ultra off. Always wait for the end of interval beeps before turning the unit off.

There is no data stored in the counter until after the first interval. If, after starting a study, you realize that you set one of the parameters wrong, you can turn off the TDC Ultra and restart the study correctly. However, once an interval has finished, the study is stored in memory. So, if you realize after the first interval that you have made a mistake, you need to either make a note to the person downloading the data to ignore that study, or clear the TDC Ultra's memory, as described on page 2-9.

Viewing Data While Recording

You have two display options while you are doing the study. The status screen shows the current time and the amount of time left in the interval, among other things. Normally you do not look at the screen while you are doing a study, you are busy looking at the traffic. All you really need to know is the time so that you know when the study is over.

However, some people like to be able to see the data accumulate in memory, especially if they have done studies for years with mechanical counters that show the totals change as the buttons are pushed. Some people just don't believe the data is registered if they can't see any evidence for themselves.

If you press the TAB key while counting the display changes to show the totals for each of the primary movements, buttons 1-16. Each row shows one approach. *Note that totals are only shown for the number of classes in the scheme you are using. In the example below, only 13 totals are shown since the FHWA's Scheme F was selected for the study.*

1N :	000	000	000	000
1E :	000	000	000	000
1S :	000	000	000	000
1W :	000	...	...	...

If you press the TAB key a second time, the display changes to show the totals for each of the secondary movements, BANK1 1-16. *This is designated by the number before the direction changing to a 2.* If you press the TAB key a third time, the display changes to show the totals for each of the tertiary movements, BANK2 1-16, with the number before the direction changing to a 3.

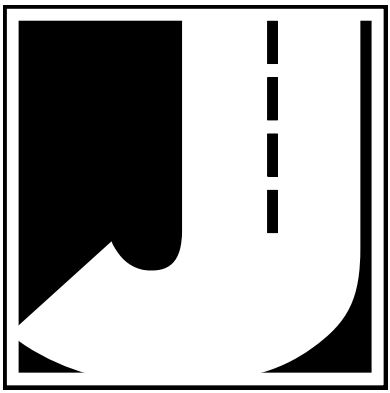
Press the TAB key a fourth time, and the display changes back to the default status screen showing the time. You can continually press the TAB key to cycle through the four screens (time, primary keys, secondary keys, tertiary keys).

At the end of each interval, the display automatically changes back to the default screen, so you can check to see if it is time to end the study. As soon as you press one of the movement keys, the display goes back to the screen you were using when the interval ended. If you know that you are not near the end of the study yet, you don't have to look at the display, just keep counting.

Ending the Study

When you get to the last interval, keep counting until the interval ends, signaled by the triple beep. Once you hear this, turn the TDC Ultra off.

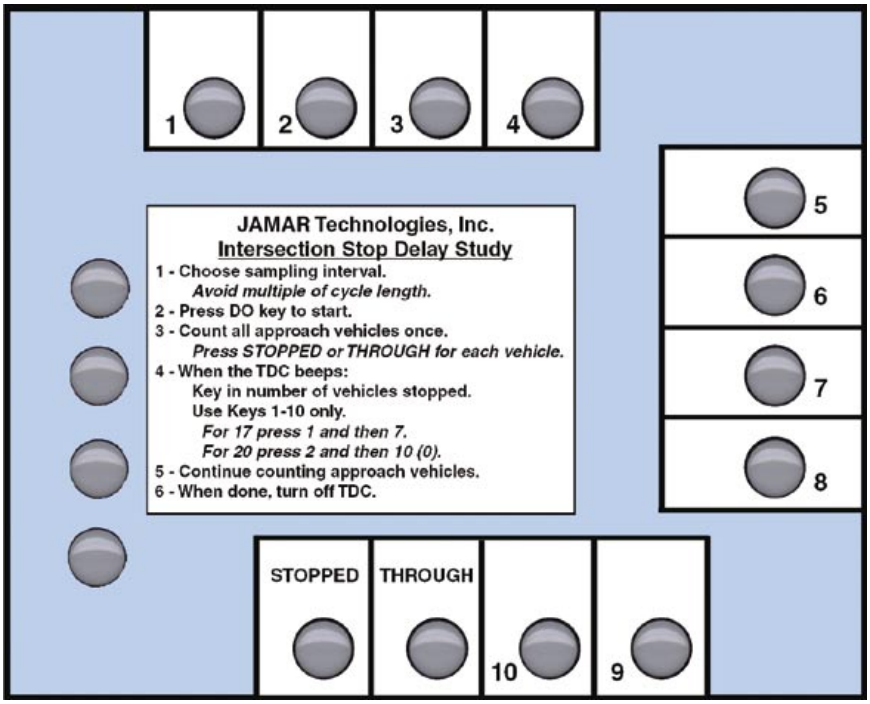
Remember, the only way to stop a study is to turn the power off.



Chapter 6

Signalized Intersection Delay Studies

Signalized Intersection Delay Studies



Signalized Intersection Delay studies are one of two types of delay studies done with the TDC Ultra. Since both are commonly called stop delay studies, we have adapted a naming convention to distinguish between the two types. Signalized Intersection Delay Studies are used at signalized intersections and use a statistical method to measure delay. Stop Sign Delay studies are done at stop sign controlled intersections and measure the delay of each vehicle directly. This chapter deals with Intersection Delay Studies. Chapter 8 explains Stop Sign Delay studies.

The method used by the TDC Ultra for this study follows the standard method used by traffic engineers for years to do Intersection Delay Studies. This manual assumes that you understand, at least generally, how a delay study is performed. If you don't then you should refer to a text book on Traffic Engineering. A good source is the "Manual for Traffic Engineering Studies" published by the Institute of Transportation Engineers.

Note that the data collection for this study is for one approach only. Also note that the data collection requires you to record the number of vehicles in the queue for an approach. **If your traffic volumes are so high that you cannot count the vehicles in the queue, or see the end of the queue, this study should not be used.**

Doing a Signalzied Intersection Delay study is actually like doing two studies at once.

First, you are recording every vehicle that comes to the intersection from a specific approach as either having *Stopped* (the light is red or the light is green but a queue exists) or gone *Through* (the light is green and no queue exists). You only record a vehicle once - it is either Stopped or Through.

Second, while you are recording the approach vehicles the TDC Ultra will beep at a designated interval you have selected (between 10 and 16 seconds). When the beep occurs, you enter the number of vehicles in the queue at that exact moment.

These two procedures, taken together, provide enough information to give measurements of the delay at that approach.

Signalized Intersection Delay Studies are not as intuitively obvious as most of the other studies performed with the TDC Ultra. It may seem at first glance that there isn't enough information to generate any realistic data. Rest assured, however. This procedure is well known in Traffic Engineering circles, and has been verified many times by researchers in the field.

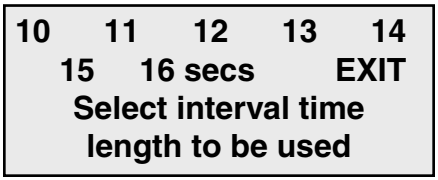
How to do a Signalized Intersection Delay Study

When you are ready to begin a Signalized Intersection Delay study, select **Count** from the Main Menu, then select **New** and then select **DL**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Interval

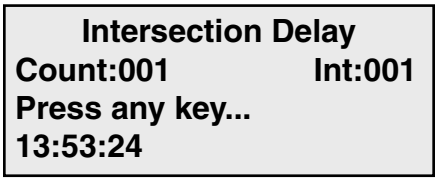
Once you have selected the site code you'll be prompted to select an interval time length to use for the study. You are given the choice of 10, 11, 12, 13, 14, 15 or 16 seconds.



In general, you want to use an interval that is not a sub-multiple of the signal's cycle length so that you will always be sampling during different parts of the signal cycle. If you don't know the cycle length, or don't believe it matters (there is some argument about it in the literature), then choose 15 seconds, if for no other reason than it makes the printouts look neater. Once you have selected the interval, you are ready to begin the actual study.

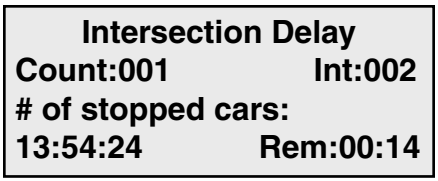
Start Study

As with all of the studies done with the TDC Ultra, the count does not start until you press the first data key. The screen shown below is displayed after you select the interval. The display shows the current time so that you can start the count at the proper time.



The template for the study (shown on page 5-2) shows that keys 11 and 12 are used to count the approach vehicles. The study is started when you press one of these keys. Each vehicle is counted (as described before) as either stopping or stopped (press STOPPED) or not stopping (press THROUGH). Remember, count each vehicle only once.

At the end of each interval period, the TDC Ultra beeps. The display changes to the following:



You are prompted to enter the number of vehicles that are stopped at the approach, if there are any. Use keys 1-10 (10 = 0) as a keypad to enter the number. When you press either the Stopped key or the Through key to count the next vehicle, the number you typed is accepted and stored in the memory. The Stopped and Through key acts like an Enter key on a computer.

For example, if there are 17 vehicles stopped, then press the 1 key, then the 7 key, and then wait for the next car and press either the Stopped or Through key, whichever is appropriate.

If there are no vehicles stopped, you can press either 0 (key #10) as explained above or just continue counting with the Stopped or Through key. The default value is zero, since that is the most common number you enter. When the light is green, and all of the vehicles are moving, there are zero vehicles stopped.

If you make a mistake while entering the number just retype the number until the number shown on the display is correct. Then continue as usual.

Keep counting the cars with the two keys, and entering the number of stopped cars every interval, until you have collected data for the amount of time you decided was necessary.

Ending the Study

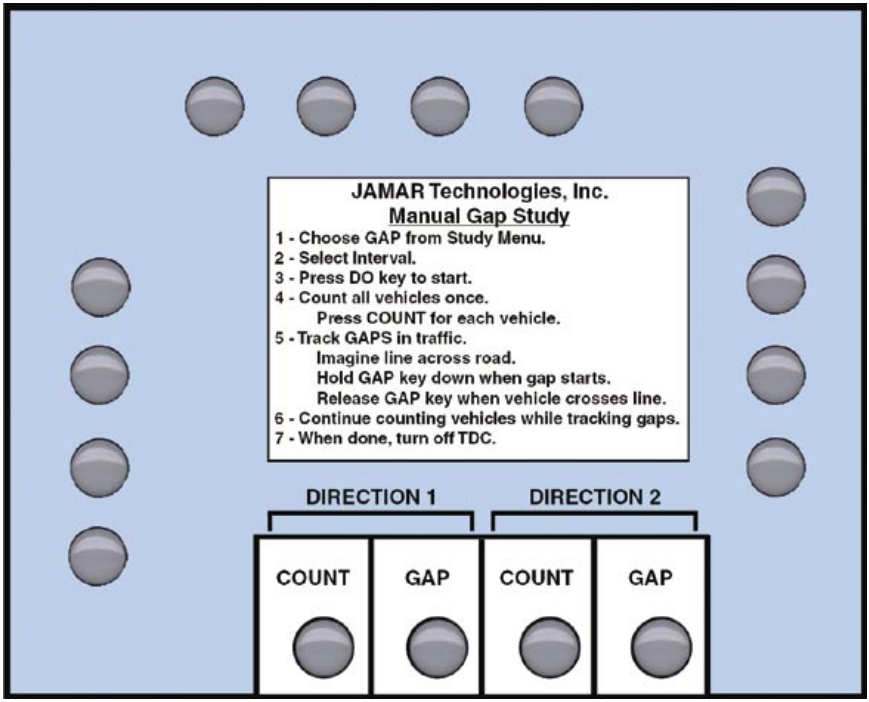
When you get to the last interval you want to record, keep counting until the interval ends, signaled by the triple beep. Once you hear this, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.

Chapter 7

Multi-direction Gap Studies

Gap Studies



The TDC Ultra makes it very simple to do manual gap studies. Most of traffic engineering is involved, one way or another, with managing gaps in traffic. After all, the primary purpose of a signal at an intersection is to artificially create gaps so that traffic can smoothly flow through an intersection.

A gap is normally defined as the amount of time, in seconds, between the end of one vehicle and the beginning of the next. You can measure gaps on an entire road, with several lanes of traffic, going in different directions, or you can measure gaps on individual lanes. It depends upon the data that is required.

The TDC Ultra measures gaps by counting the time that a key (the GAP key) is pressed and held down. This time is then sorted into one of 15 different bins, from 2 seconds up to 30+ seconds, in two second increments. The total in that bin is then increased by one. After each interval period (usually 5 or 15 minutes), the totals in all of the bins are stored in memory, and then reset to zero. Data is then collected for another interval.

You can do either a one direction or two direction GAP study with the TDC Ultra. It takes practice to do a two direction gap study, especially if the two approaches are at right angles to one another, but it can be done. Like many other things, practice makes perfect.

The TDC Ultra actually keeps track of three different gaps, even though you only measure two. One for each of the GAP buttons that you press while doing the study, and one that is a combination gap that is only valid when both GAP buttons are simultaneously pressed.

The combination gap lets you measure the gaps in the N-S direction with one key, the S-N direction with the other key, and still determine the distribution of gaps across both lanes. Typically this is used at an unsignalized intersection or a driveway access to determine the ease of making right and left turns.

You also have the option of doing a volume count while you are doing the gap study. A separate key (the COUNT key) is pressed for each vehicle. The total number of vehicles is stored with the gap data at the end of each interval. The analysis software prints the volume data next to the gap data in the reports. Information about the volumes at a certain location helps put the gap data into a proper perspective.

Imagine that at two different locations there were 100 gaps measured, and the average gap was 10 seconds. Now imagine that at the first location there were 125 cars counted, and at the second location there were 2000 counted. Aha! Location one is a quiet little street, with fairly steady traffic. Location two is much heavier with platoons of cars. Knowing the volumes helps a lot.

The volume count is optional. If you don't need the data, or if you are doing a two direction study and don't have the time to keep track of the gaps and count at the same time, then don't worry about it.

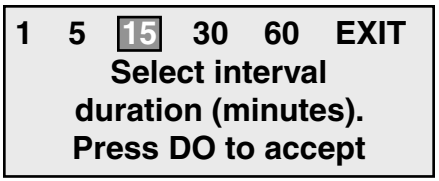
How to do a Gap Study

When you are ready to begin a Gap study, select **Count** from the Main Menu, then select **New** and then select **GAP**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Interval

Once you have selected the site code you'll be prompted to select an interval length.



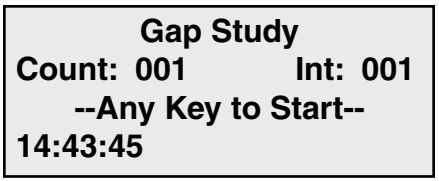
You are given the choice of 1, 5, 15, 30, or 60 minute intervals. An Interval is the amount of time the TDC Ultra collects data before it stores the accumulated totals in memory. You are barely aware of intervals changing when you do a study with the TDC Ultra (it beeps at the end of each interval to let you know it may be time to go home). The TDC Ultra automatically keeps track of the time and stores the data at the end of the interval. You only have to concentrate on collecting the data. This is one of the major features of the TDC Ultra.

The most common intervals for Gap studies are 5 and 15. We recommend that you use these unless you have special requirements.

Press DO once you have selected the interval length you wish to use.

Start Study

After you have selected an interval to use, you are ready to start the study. The display shows the current count number and the interval number. In the example shown, this is the first count done, and it is at the first interval.



The TDC Ultra is waiting for you to push a Count or Gap button, which starts the study. The display in the lower left corner shows the current time, so it is easy to synchronize the start of the study to the beginning of the desired interval. You do not have to push the first button exactly when the seconds roll over to zero. The analysis software rounds the start of the count to the nearest minute automatically. However, when starting a new study, always try to begin as close to an interval boundary as possible, such as xx:00, xx:15, xx:30, or xx:45.

Press either a Count key or a Gap key and the TDC Ultra will begin recording data.

When you push the first button to start the study, the display changes to show the amount of time left in the present interval. In this case, it starts at 15:00 minutes and counts down to zero. At the end of each interval, the TDC Ultra beeps three times. Normally you are not watching the display, you are watching the traffic. The beeps remind you that the interval is over. This is only important if this is the last interval and you are ready to quit; otherwise, just ignore the beeps and keep counting vehicles.

Gap Study	**Int:001**
Dir 1: N=002	**Gap=00**
Dir 2: N=004	**Gap=00**
08:01:23	**Rem 13:37**

There is no data stored in the counter until after the first interval. If, after starting a study, you realize that you set one of the parameters wrong, you can turn off the TDC Ultra and restart the study correctly. However, once an interval has finished, the study is stored in memory. So, if you realize after the first interval that you have made a mistake, you need to either make a note to the person downloading the data to ignore that study, or clear the TDC Ultra's memory, as described on page 2-9.

The second and third lines of the display also change. They show each direction with the current count values (N) and the times in seconds of the current gap being measured (Gap).

Collecting the gap data is very easy. Imagine a line across the road or lane that you want to measure. Press the Direction 1 GAP key (see template on page 6-2) when a gap starts, i.e. the end of a car just passed over the line, and there isn't a car immediately behind it. Hold the button

down until the front of the next car crosses the line. The display shows the time in seconds of the current gap as it is being measured, although there is not much need to watch the display while doing the study.

If you are also counting the cars, then you need to press the COUNT button once for every vehicle that goes by. The display shows the current count value as well.

If you are doing a two direction study, then you need to duplicate the above procedure for Direction 2.

The TDC Ultra is also keeping track of the combination gaps, when both buttons are pressed simultaneously. There is no indication on the display for combination gaps, but they are being recorded along with the other two gaps.

Ending the Study

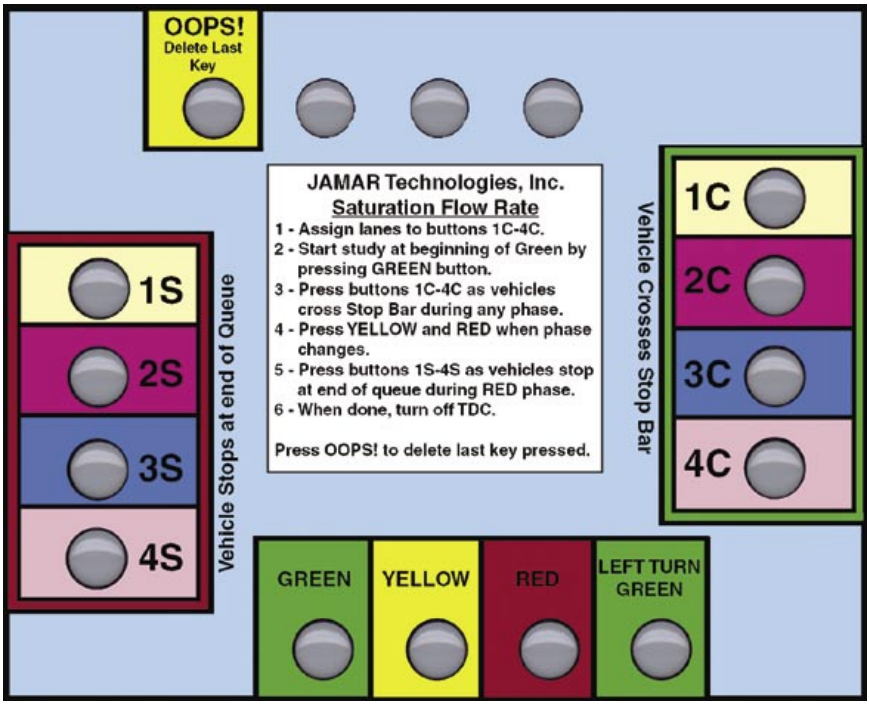
When you get to the last interval, keep recording data until the interval ends, signaled by the triple beep. Once you hear this, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.

Chapter 8

Saturation Flow Rate Studies

Saturation Flow Studies



The Saturation Flow Rate study in the TDC Ultra is actually a way to measure several separate but related traffic parameters. With one study you can measure:

- Vehicle headways for one to four lanes.
- Lost times for one to four lanes.
- Arrival types.
- Signal timing, on a phase by phase basis.
- Approach volume counts for each signal phase.
- Saturation Flow Rates.

This study is most commonly done in conjunction with a capacity analysis or signal timing optimization of an intersection, usually using computer software such as Transyt 7F, PASSER, or HCS. The parameters this study measures are required by these software packages. In the past, engineers had to guess at the values, now they can measure them directly.

This manual does not attempt to explain what is meant by terms such as saturation flow rate, or arrival type. If you are not familiar with the terms then you should consult a reference such as the Highway Capacity Manual, published by the Transportation Research Board.

The procedure implemented in the TDC Ultra is based on accurately measuring the time that events happen. This contrasts with most of the other studies in the TDC Ultra which are based on counting the number of events that happen in a relatively long time period. The events are timed to a resolution of 15.6 milliseconds. To perform this study correctly you have to press the proper keys at exactly the right times.

Saturation Flow Rate studies are done at one approach to a signalized intersection. You normally are interested in the critical lane or lanes, which usually are the through movement(s). You can also measure Sat Flows for a left turn lane as a separate study.

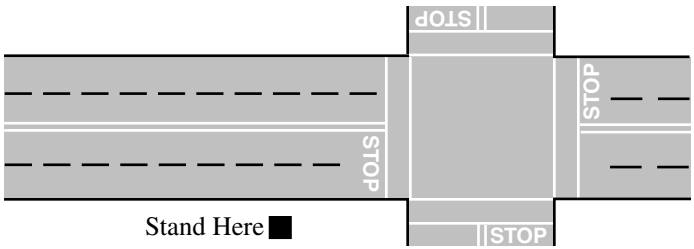
Your position at the intersection is very important as you need to be able to easily see three events:

1. Phase changes on the signal.

2. Cars entering the intersection. You press keys when vehicles pass over the stop bar as they enter the intersection.

3. Cars stopping during the red phase of the light.

The diagram below shows the position we recommend for doing the data collection, although you can position yourself anywhere you feel we let you easily observe the three events described above.



When you are in a good position, you are ready to start the study.

Saturation Flow Rate Template

Page 7-2 shows the template that is used for Saturation Flow Rate studies. It is color coded to make the study easier to perform. The Signal Phase keys at the bottom of the template show the proper colors. The keys labeled 1C-4C are primarily used during the green phase of the signal, therefore they are surrounded by a green border. The keys labeled 1S-4S are used only during the red phase, so they are surrounded by a red border.

The keys labeled 1C-4C represent individual lanes on the approach to the intersection under investigation. In theory you can monitor up to four lanes at once. In practice it is rarely necessary to do more than two lanes. You are primarily interested in the worst case situation, and that is usually limited to one or two lanes. You need to assign a given key to a given lane. You can use any of the four keys for any of the lanes, however it is easier to remember which key corresponds to which lane if you choose keys that match the lane configuration on the street.

If you are measuring the two through lanes, then use 2C and 3C. If you are measuring the left turn lane, then use 1C. Select keys that match the geometry.

Each of the keys 1C-4C has a corresponding key labeled 1S-4S. They have the same color and arrangement. It is important that you use the proper pair of keys while you do the study; if you use 2C then you must also use 2S.

At the top of the template is a very important key, the **OOPS! key**. This key deletes the last keys that were pressed. If you hit the wrong key (especially one of the phase keys), then you can quickly press the OOPS! key and then the correct key. If you hit several wrong keys in a row then you can repeatedly press the OOPS! key to try to get back in sync. Each press of the OOPS! key removes one key.

The OOPS! key is especially valuable if you hit a phase key by mistake. The analysis of the data for that cycle will be wrong if the phase timing is wrong. An error in the 1C-4C or 1S-4S keys is not as damaging, although errors should be corrected as quickly as possible.

What Data Do You Need to Collect?

There are three ways of collecting data for saturation flow studies. The first is a basic study where you assume all cars are part of the saturation flow (i.e. all vehicles recorded with the 1C-4C keys were in the queue at the start of green). No signal timings or arrival types can be calculated. The second is similar to the first, except that signal timing is recorded. Finally, the third study records all the data, including signal timing and arrival types. These different types of data collection are described below.

Type 1 – Saturation Flow Only

In the saturation flow only study, you will collect just enough data to calculate saturation flow rates. You will not be able to produce signal timings or arrival types, but the data collected is very easy. Collect the data as outlined below:

1. Wait for the signal controlling the approach you are studying to turn red.
2. Watch the queue begin building, as well as the opposing signal for the cycle change.
3. When the signal turns green, press the GREEN key.
4. As each queued vehicle crosses the stop bar, press keys 1C - 4C that corresponds to the lane that the vehicle is in.
5. Continue pressing keys 1C-4C until the last queued vehicle crosses the stop bar.
6. If you have enough samples, turn the TDC Ultra or go back to step 2 to record more data.

Type 2 – Saturation Flow with Signal Timing

This study is very similar to the Saturation Flow Only study. The difference here is that you will also record signal timing. The data collection is a little more difficult, because you have to carefully watch for the signal to change.

1. Wait for the signal controlling the approach you are studying to turn red.
2. Watch the queue begin building, as well as the opposing signal for the cycle change.
3. When the signal turns green, press the GREEN Key.
4. As each queued vehicle crosses the stop bar, press keys 1C-4C that corresponds to the lane that the vehicle is in. You must also keep a close eye on the signal to determine the next phase change.

5. Continue pressing buttons 1C-4C until the last queued vehicle crosses the stop bar.
6. When the signal turns yellow, press the YELLOW key.
7. When the signal turns red, press the RED key.
8. When you have recorded enough signal changes, turn off the TDC Ultra or go back to step 2 to record more data.

Type 3 - Saturation Flow with Signal Timings and Arrival Types

This study is the most difficult to perform, but yields the greatest amount of data. You can get saturation flow rates, signal timings, approach volumes and arrival types. Because of the complexity of the data collection, you may want to consider using two people to gather the data.

1. Wait for the signal to turn red, and watch for vehicles to come to a full stop in the queue.
2. As they do, press the 1S-4S keys for the lanes you are recording.
3. When the signal turns green, press the GREEN key.
4. As each vehicle crosses the stop bar, press the 1C-4C keys for the lanes you are recording.
5. When the signal turns yellow, press the YELLOW key.
6. When the signal turns red, press the RED key.
7. If you have enough data, turn the TDC Ultra off, or go to step 1.

**********IMPORTANT********

The difficulty of the data collection increases as you go from Type 1 to Type 2 to Type 3. If you only need to record the saturation flow rate we recommend you collect data using Type 1.

How to do a Saturation Flow Rate Study

Note: This section describes doing Type 3 data collection, which may provide more data than you need for your particular study. Refer to the *What Data Do You Need to Collect?* section on page 7-5 for more information.

When you are ready to begin a Saturation Flow study, select **Count** from the Main Menu, then select **New** and then select **SF**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Start Study

After you have selected a Site Code, you are ready to start the study. The display shows the current count number and the current time.

```
     Sat Flow Study
Count:  001
    --Any Key to Start--
08:45:06
```

When you are ready to start, wait until the light turns green, then press the GREEN key (#12). The study starts, and the screen shown here appears.

```
     Sat Flow Study
Cycle:001
Phase: Green
08:45:06
```

The display shows the current time, along with the current Cycle Number and the current Phase of the light. The Cycle Number is used to help you decide when you have collected enough data. It also is useful if you need to record any notes about the study. The Phase is shown to help you stay synchronized during the study. You should check the Phase display occasionally to make sure you haven't accidentally got lost. (It is very easy to do!) The phase shown on the display should match the phase of the light on the street.

As soon as you press the GREEN key to start to study, you have to be ready to press the 1C-4C keys.

As a vehicle in each lane you are recording crosses the stop bar (you can either use the front of the car or the end of the car, you just have to

be consistent) press the corresponding 1C-4C key on the TDC Ultra.

Keep pressing the keys as each car crosses the stop bar. Watch the light and be ready for a light change. When the light turns yellow, press the YELLOW key. Keep pressing the 1C-4C keys if any vehicles cross the stop bar after the yellow. Press the RED key when the light turns red. Again press the 1C-4C keys if any vehicles run the red light.

Now shift mental gears and wait for cars to come to the first full stop in each of the lanes you are monitoring. Press the 1S-4S as each vehicle arrives at the end of the queue and stops. If it is a very busy intersection, then the queue could build up for a considerable distance.

Cars often creep up to the end of the queue, and may not actually stop. You have to use your own judgement to decide when a vehicle has "effectively" stopped. Just try to be consistent.

Now comes the tough part! While you are watching the end of the queues and pressing the 1S-4S keys as each car stops, you have to also watch the light so that you are ready when it turns green. Press the GREEN key when the light changes. This is the end of one complete cycle of data collection, and the start of the next.

If there is a large queue build up at the signal, it is very difficult for one person to accurately catch the start of each green phase, yet this is the critical point in each cycle. We suggest you have two people doing the study. One handles the TDC Ultra and monitors the signal phases and 1C-4C keys, the other monitors the vehicles stopping during the red phase and calls out the lane number as each vehicle stops.

Ending the Study

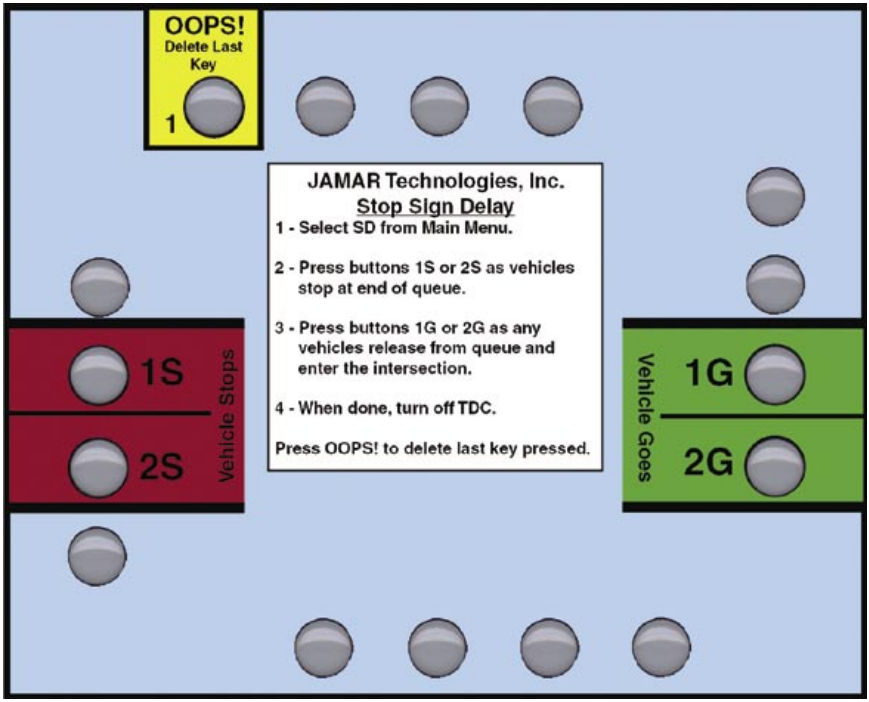
Continue to collect data until you have all of the data you need. Wait till the start of a new cycle (after you press GREEN), then turn off the TDC Ultra.

Remember, the only way to stop a study is to turn the power off.

Chapter 9

Stop Sign Delay Studies

Stop Sign Delay Studies



The Stop Sign Delay study in the TDC Ultra is designed to allow you to measure the traffic characteristics at an intersection controlled by a stop sign. Although it primarily measures delay, it also provides information about the queue length and traffic volumes at an approach.

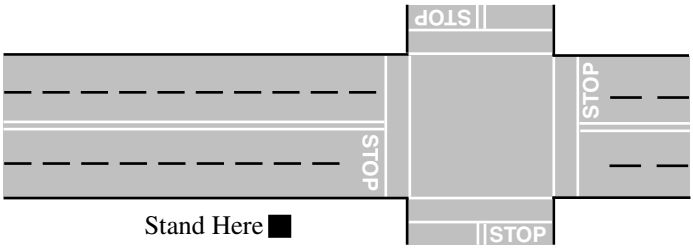
This study should not be confused with the Signalized Intersection Delay study in the TDC Ultra (Chapter 5) which is primarily used at high volume signalized intersections. That study uses a statistical average to calculate delay. This study measures the actual delay of each vehicle as it progresses through a stop controlled intersection. Note that this study can also be used for signalized intersections that have low volumes.

The procedure implemented in the TDC Ultra is based on accurately *measuring the time* that events happen. This contrasts with most of the other studies in the TDC Ultra which are based on *counting the number* of events that happen in a relatively long time period. The events are timed to a resolution of 15.6 milliseconds. To perform this study correctly you have to press the proper keys at exactly the right times.

This is a simple study to understand. You press one key when a vehicle stops at the end of the queue, and you press another key when a vehicle (not necessarily the same one) crosses the stop bar. The TDC Ultra accurately measures the times when you press each key. The analysis software then can calculate how long it takes each vehicle to progress through the queue and enter the intersection. The software also calculates the number of cars in the queue at all times.

Stop Sign Delay studies are normally done at one approach to an intersection. Typically, you would study the approach with the highest volume, since that approach would likely have the longest delays. You can measure one or two lanes at once.

You want to position yourself so that you can see vehicles as they stop at the back of the queue, and also as they enter the intersection. The diagram below shows the position we recommend for doing the data collection, although you can position yourself anywhere you feel we let you easily observe the vehicles you are recording.



When you are in a good position, you are ready to start the study.

How to do a Stop Sign Delay Study

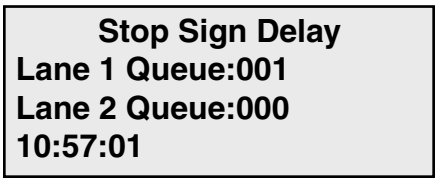
When you are ready to begin a Stop Sign Delay study, select **Count** from the Main Menu, then select **New** and then select **SD**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Start Study

After you have selected a Site Code, you are ready to start the study. The display shows the count number and type of study. It also shows the current time so that you can start the study at a specific time.

The TDC Ultra is now waiting for you to press one of the Stop keys (1S or 2S) to start the count. Ideally, you should wait until there are no vehicles in the queue in either of the lanes of interest. If that isn't possible, then you can start with any vehicle. Once a Stop key is pressed, the screen shown here is displayed.



Each time you press one of the Stop keys (1S or 2S), the display for that lane will increment by one. You want to press the Stop keys quickly to get the display to show the number of vehicles that are actually in the queue at the start of the study. If there are no vehicles in a lane when you start then you don't have to add any.

As each vehicle pulls up to the back of a queue and stops, press the corresponding key (1S or 2S) on the TDC Ultra. You need to determine when a car has "effectively" stopped. Many cars like to creep up on a stop sign. You have to use your judgement in cases like these. As long as you are consistent, the analysis results will be correct.

As any vehicle in a lane crosses the stop bar, press the corresponding lane Go key (1G or 2G). The display on the TDC Ultra for that lane will decrease by one to show that the queue has decreased.

**********IMPORTANT**********

The Lane Queues shown on the TDC Ultra should always match the actual queue lengths on the street. If they do not, a mistake has been made and there may be problems with the data analysis.

Use the OOPS! key if you hit the wrong key by mistake. Do not try to fix the data by pressing the Stop (1S or 2S) or Go (1G or 2G) to make the queue lengths on the display match the actual field conditions. This procedure would add or subtract vehicles from the data, and distort the analysis results. Always fix bad entries with the OOPS! key.

This is a fairly simple study to do. There is one way, however, the data can be distorted. If a car changes lanes after you have marked it as stopped, (which doesn't happen very often) then you must be careful to pretend that the car is still in the original lane, and press the original lane key when the car finally enters the intersection. The lane queue values on the display will be off until this rogue car clears the intersection, but this can't be helped.

Rolling Stops

Occasionally, when no queue is present, you may encounter a vehicle that does not completely stop at the intersection, but 'rolls' through it. The method we recommend for recording these vehicles is to press the Stop key then immediately after press the Go key. This will result in the vehicle being recorded with a delay of zero or one seconds, which will keep your volumes accurate. These vehicles can then be filtered out using the analysis software.

Ending the Study

When you are done collecting data, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.

Use at Signalized Intersections

This study is specifically designed for intersections controlled by stop signs, but it may appear the procedure would work just as well at signalized intersections. To some extent this is true. There are two limitations with this procedure at signalized intersections:

1. If the queues that build up are very long, it is very difficult to tell precisely when a vehicle stops, or even see the vehicles at all. The algorithm used to calculate the delays breaks down quickly if the operator misses a few vehicles.

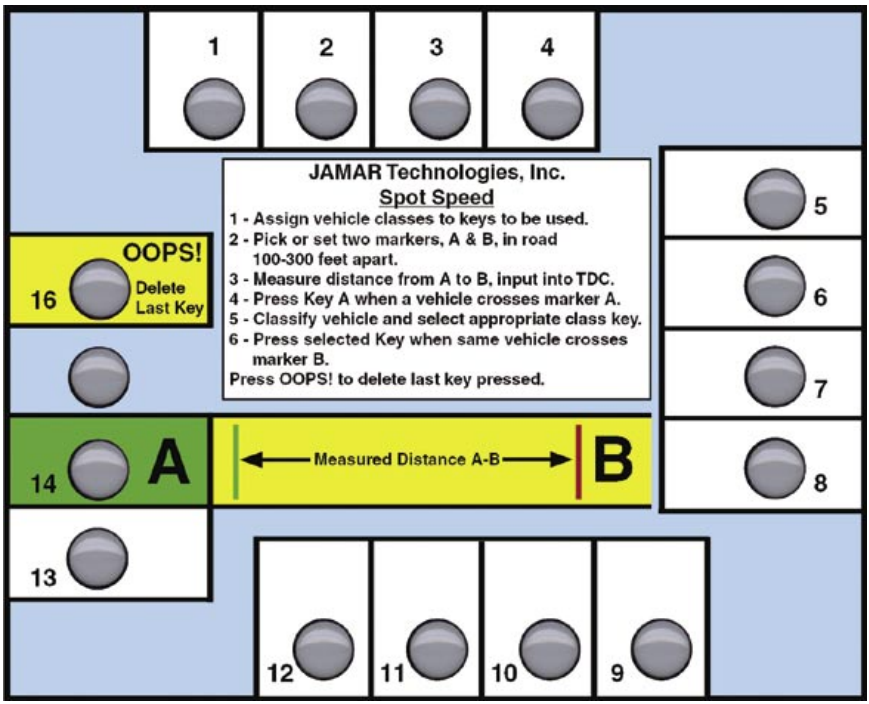
2. It is not obvious what to do with vehicles that don't experience any delay at all, i.e. they arrive at the intersection during the green phase. (All cars stop, to some degree, at Stop Signs.) You can ignore them completely, but then your total approach volume (which may or not be important) is wrong; or you can press the Stop and Go keys in sequence very quickly and say that each of the vehicles experienced a minimum amount of delay. This tends to distort the average delay per vehicle calculation in the analysis.

If these limitations do not affect your study, or if the other Delay study in the TDC Ultra, (which works best on large, busy signalized intersections), isn't appropriate for some reason, then go for it!

Chapter 10

Spot Speed Studies

Spot Speed Studies



The Spot Speed study in the TDC Ultra is designed to allow you to measure the speed characteristics at a specified location, typically an approach to an intersection. This study is not meant to replace a formal speed study using an automatic traffic recorder like those of the JAMAR TRAX series. Rather, it is meant to be used when the approach speed of traffic is required as part of a capacity analysis at an intersection, or possibly as a preliminary study to find appropriate locations for a formal speed survey at a later date.

The procedure implemented in the TDC Ultra is based on accurately measuring the time it takes a vehicle to travel over a known distance. The observer presses one button when the vehicle passes over one point (called the start line) and then presses another button when the same vehicle passes over another point (the end line) which is usually 100-200 feet away. The start and end lines may be cracks in the road, or markers on the side of the road. The TDC Ultra accurately measures the time between button presses, and calculates the speed.

The accuracy of this method depends upon several factors:

• The speed of the vehicle is assumed to be constant while driving from the start line to the end line. If the vehicle accelerates or decelerates while in the speed course then the accuracy will be reduced. You want to pick an area where the vehicles are likely to maintain their speed, if possible.

• The observer must press the buttons as accurately as possible. There is always some error due to poor reaction times. Some observers are simply better than others.

• The main source of error is caused by the difficulty in determining exactly when the vehicle passed over the start line (assuming the observer is standing even with the end line). A slightly elevated view usually enhances the ability of the observer to see the start line.

• Other factors, such as the length of distance between the start and end lines, the timing accuracy of the TDC Ultra electronics, and bias caused by the drivers detecting 'something going on' and slowing down all contribute errors to the results, but these errors are small compared to the ones mentioned above and generally can be ignored.

Since the sources of error can vary greatly, it is difficult to say what accuracy you should expect. However, our test indicate that an error of about 2-3 MPH is typical at a site with good visibility and steady traffic driving at a constant speed.

What Data Do You Need to Collect?

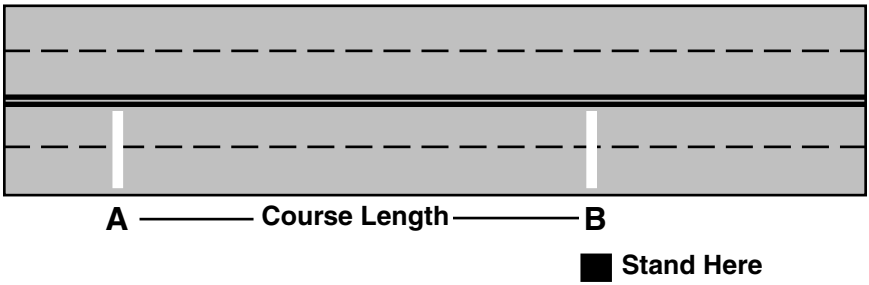
Spot Speed studies can be done in one of two ways – with vehicle classification or without vehicle classification.

The green key marked "A" on the template is pressed when a vehicle passes over the start line. If you are not concerned with distinguishing between types of vehicles when recording speeds, you can press the number 8 key shown next to the "B" on the template when the vehicle passes the end line. When the data is processed you will see one column of all the vehicle speeds, from the first to the last.

If you do want to classify vehicles while recording the speeds, rather than just pressing the number 8 key when the vehicle crosses the end line you can press any of the 1 through 13 keys to classify it. When the data is processed you will see several columns of speed data, each corresponding to one of the keys you used to classify the vehicles. The number of class used can be anywhere from 1 to 13.

How to do a Spot Speed Study

The first task to perform is to choose the start and end lines. These usually are cracks or marks in the road that are clearly visible and roughly perpendicular to the road. Objects on the side of the road can be used for the end line, but should not be used for the start line. If necessary, you can use a piece of chalk to define the lines. The lines can be anywhere from 100 to 250 feet apart. Measure the distance as accurately as possible, then position yourself on the side of the road, exactly even with the end line, as shown in the diagram below.



When you are in a good position, select **Count** from the Main Menu, then select **New** and then select **SS**.

You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

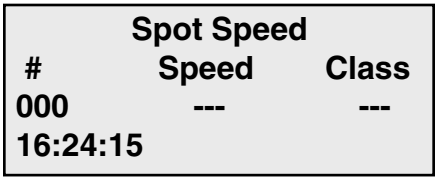
Enter Distance

Once you have entered the site code you will be prompted to enter the distance between the start and end lines. You must enter a distance less than 256 feet or you will get an error message. Use the #10 key for zero, as in other screens in the TDC Ultra.

Enter Distance:
Use keys 1-10
BANK1-TAB = cancel
DO = Done

Start Study

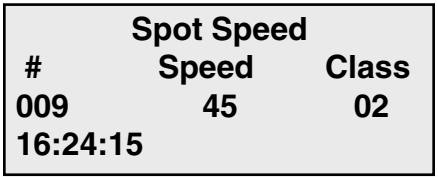
Once you have entered the distance the display shows the type of study and the current time so that you can start the study at a specific time.



The TDC Ultra is now waiting for you to press the green "A" key to start the study. Wait until a vehicle crosses the start line, then press the A key.

When the vehicle crosses the end line in front of you, press the key (#1-13) that corresponds to the vehicle classification based on the classification scheme you are using. The TDC Ultra calculates the speed and displays it on the screen. Wait for the next vehicle to cross the start line and press the green "A" key. Wait for this vehicle to cross the end line and press the classification key.

The display shows the number of cars that you have measured, the speed of the last vehicle you measured and the class of that vehicle.

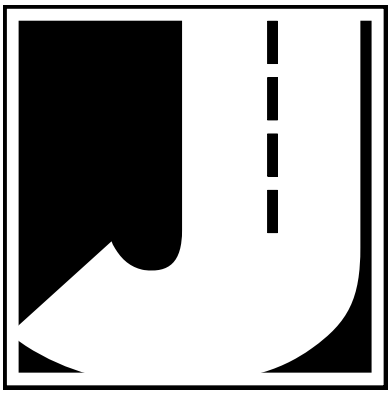


Continue measuring the speed of the vehicles until you are ready to quit. You can collect data for a fixed period of time, during the peak hour for example, or until you have enough data points for your requirements. In general, you want to measure at least 100 vehicles to guarantee a good statistical sample.

Ending the Study

When you are done collecting data, turn the TDC Ultra off.

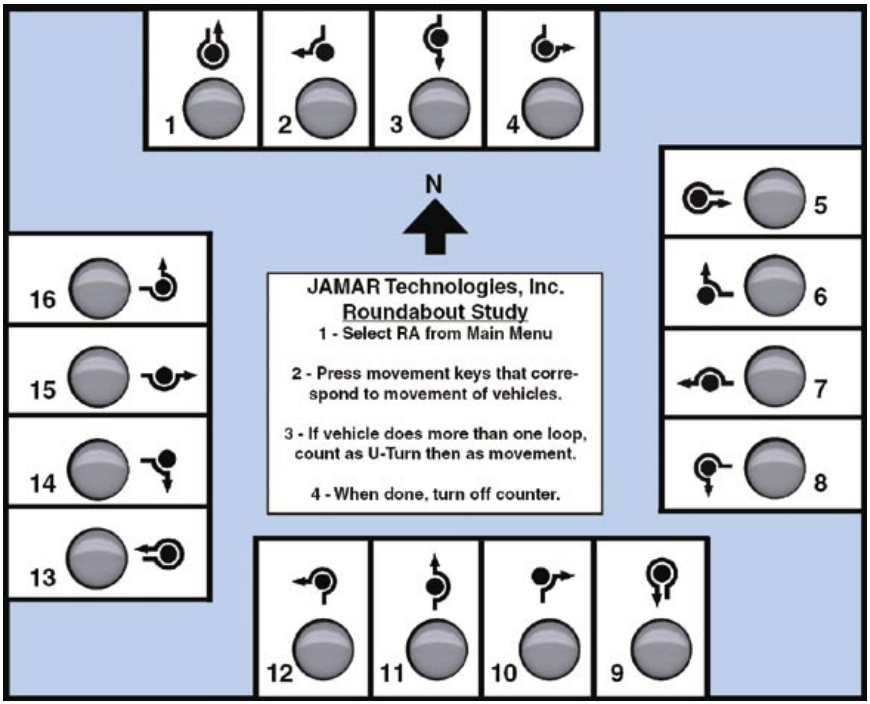
Remember, the only way to stop a study is to turn the power off.



Chapter 11

Roundabout Movement Studies

Roundabout Movement Studies



Modern Roundabouts are one of the more popular new developments in traffic engineering and are being installed at an ever increasing number of locations. However, while the physical design of a modern roundabout is different from that of a standard intersection, the resulting vehicle movements are very similar - in most cases either straight, left or right. As such, the data collection for a Roundabout Movement study is very similar to a Standard Turning Movement Study.

Note: To properly record roundabout movements with a TDC Ultra, you must be able to see not only which approach the vehicle enters from, but also track which approach it exits to. At busy intersections, more than one person may be needed for the data collection.

The TDC Ultra is designed to make roundabout movement data collection simple and accurate. The buttons are arranged to simulate the standard approaches to an intersection, which makes collecting the data intuitive. There are 16 buttons, which are normally used for the left, through, right

and u-turn movements from each of the four approach directions. If a car makes a right movement from an approach, you simply push the button that shows a right movement from that direction. The TDC Ultra keeps track of everything else for you.

The TDC Ultra can also double or triple the number of movements counted from 16 to 32 or 48 by using the unit's two BANK keys in conjunction with the regular movement keys. If a movement key is pressed, the count is registered in the "primary" movements (1-16). If the BANK1 key is held down while a movement key is pressed, the count is registered in the "secondary" movements (17-32). If the BANK2 key is held down while a movement key is pressed, the count is registered in the "tertiary" movements (33-48). Normally, the turning movements of less common events are counted with the secondary and tertiary (BANK1 and BANK2) keys.

The secondary and tertiary keys are often assigned to truck movements. For example, if a car makes a right movement from the north approach, then you press button #2. If a light truck makes the same movement, you press and hold down the BANK 1 key while pressing button #2, which is counted in the secondary movements. If a heavy truck makes the same movement, you press and hold down the BANK 2 key while pressing button #2, which is counted in the tertiary movements. Since it takes a little more work to press the BANK 1 and BANK 2 keys, the less common truck volumes are assigned to the secondary movements.

When this data is processed using the PETRAPro software, you can get percentage breakdowns of the data based on the different groups.

This is just one example of how the Bank keys can be used. They can also be used for counting additional approaches if you have more than the standard four at an intersection.

Preparing to do a Roundabout Movement Study

Before you start a standard turning movement study, you must ask yourself the following questions.

- Are the Bank 1 and Bank 2 keys going to be used?
- Can one person do the study, or will it require two or more, using separate TDC Ultras?
- How is the TDC Ultra going to be oriented?

The answer to these questions depends on the experience of the people doing the studies; there are no simple rules of thumb we can give you to help you decide. The important thing is to use your knowledge of the people doing the data collection, along with your experience with the traffic they are likely to see in the field, to decide in advance what the best strategy would be.

Deciding on how the TDC Ultra will be oriented during the study depends on where you will actually be located while doing the count. When the data from the unit is downloaded to our software, the program assumes that the 1 through 4 keys were for the from north (southbound) approach, and the rest of the keys are assigned accordingly. The TDC Ultra's Roundabout overlay has a North Arrow which suggests that you align the counter so that buttons 1 though 4 faces north while you are doing the count. It is not necessary to always conform to this practice. Sometimes it is more convenient for you to face another direction when you do the count, especially if you want to be able to read the display.

The analysis software allows you to select which button was facing north during the count; it just defaults to button #3. We recommend that (if possible) you use the default direction, since it eliminates one source of error when you do the analysis. If you don't use the default direction, it is important to note this. If you keep good notes in the field, you won't have any problems, no matter which way the TDC Ultra is aligned.

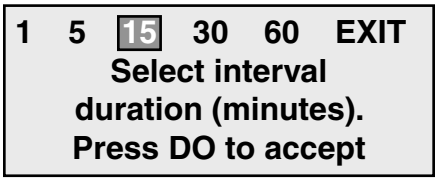
How to do a Roundabout Movement Study

When you are ready to begin a Roundabout Movement study, select **Count** from the Main Menu, then select **New** and then select **RA**.

You are then prompted to select a site code type and assign a site code. Refer to chapter 2 for information on selecting a site code.

Interval

Once you have programmed a site code for the study, you are prompted to choose the interval length that will be used.



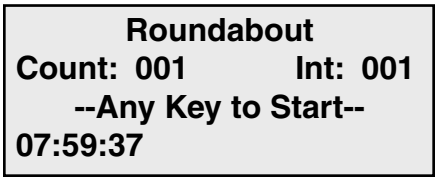
You are given the choice of 1, 5, 15, 30, or 60 minute intervals. An Interval is the amount of time the TDC Ultra collects data before it stores the accumulated totals in memory. You are barely aware of intervals changing when you do a study with the TDC Ultra (it beeps at the end of each interval to let you know it may be time to go home). The TDC Ultra automatically keeps track of the time and stores the data at the end of the interval. You only have to concentrate on collecting the data. This is one of the major features of the TDC Ultra.

The default value is 15 minutes, as this is the most common interval length used for Roundabout Movement studies. We recommend that you use 15 minutes unless you have special requirements.

Press DO once you have selected the interval length you wish to use.

Start Study

After you have selected an interval to use, you are ready to start the study. The display shows the current count number and the interval number. In the example shown, this is the first count done, and it is at the first interval.



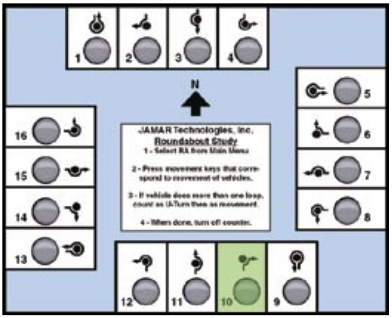
The TDC Ultra is waiting for you to push any movement button, which starts the study. The display in the lower left corner shows the current time, so it is easy to synchronize the start of the count to the beginning of the desired interval. You do not have to push the first button exactly when the seconds roll over to zero. The analysis software rounds the start of the study to the nearest minute automatically. However, when starting a new study, always try to begin as close to an interval boundary as possible, such as xx:00, xx:15, xx:30, or xx:45.

Press any of the gray keys to begin counting and the TDC Ultra will start recording data.

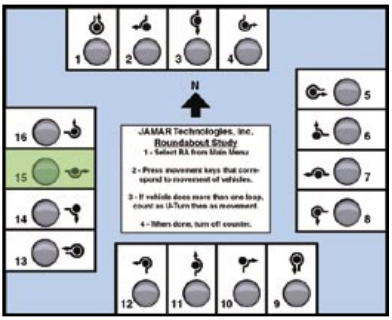
When you push the first button to start the study, the display changes to show the amount of time left in the present interval. In this case, it starts at 15:00 minutes and counts down to zero. At the end of each interval, the TDC Ultra beeps three times. Normally you are not watching the display, you are watching the traffic. The beeps remind you that the interval is over. This is only important if this is the last interval and you are ready to quit; otherwise, just ignore the beeps and keep counting vehicles.

Roundabout	
Count: 001	Int: 001
08:01:23	Rem 13:37

The actual recording of the data is very simple. Watch a vehicle as it approaches and track it as it moves through the roundabout. If it makes a right movement, press the right movement key for the approach it came from, as shown below.



Similarly, if a vehicle makes a through movement, press the through movement key for the approach it came from, as shown below.



There is no data stored in the counter until after the first interval. If, after starting a study, you realize that you set one of the parameters wrong, you can turn off the TDC Ultra and restart the study correctly. However, once an interval has finished, the study is stored in memory. So, if you realize after the first interval that you have made a mistake, you need to either make a note to the person downloading the data to ignore that study, or clear the TDC Ultra's memory, as described in chapter 2.

IMPORTANT: Once you start the study, the only way to quit it is to turn the TDC Ultra off. Always wait for the end of interval beeps before turning the unit off.

Viewing Data While Recording

You have two display options while you are doing the study. The status screen shows the current time and the amount of time left in the interval, among other things. Normally you do not look at the screen while you are doing a study, you are busy looking at the traffic. All you really need to know is the time so that you know when the study is over.

However, some people like to be able to see the data accumulate in memory, especially if they have done studies for years with mechanical counters that show the totals change as the buttons are pushed. Some people just don't believe the data is registered if they can't see any evidence for themselves.

If you press the TAB key while counting the display changes to show the totals for each of the primary movements, buttons 1-16. Each row shows one approach. *Note that this display assumes buttons 1-4 are the North direction.*

1N :	**000**	**000**	**000**	**000**
1E :	**000**	**000**	**000**	**000**
1S :	**000**	**000**	**000**	**000**
1W :	**000**	**000**	**000**	**000**

If you press the TAB key a second time, the display changes to show the totals for each of the secondary movements, BANK1 1-16. *This is designated by the number before the direction changing to a 2.* If you press the TAB key a third time, the display changes to show the totals for each of the tertiary movements, BANK2 1-16, with the number before the direction changing to a 3.

Press the TAB key a fourth time, and the display changes back to the default status screen showing the time. You can continually press the TAB key to cycle through the four screens (time, primary keys, secondary keys, tertiary keys).

At the end of each interval, the display automatically changes back to the default screen, so you can check to see if it is time to end the study. As soon as you press one of the movement keys, the display goes back to the screen you were using when the interval ended. If you know that you are not near the end of the study yet, you don't have to look at the display, just keep counting.

Ending the Study

When you get to the last interval, keep counting until the interval ends, signaled by the triple beep. Once you hear this, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.

Chapter 12

Time-Stamped Studies

The Time-Stamp study in the TDC Ultra is designed to allow you to collect data in a raw, unaltered format. Every key press is recorded along with a time stamp. Once this data has been downloaded, it can be used for any purpose you see fit. In most cases, the data will be exported to an external program for additional analysis.

How to do a Time-Stamp Study

When you are ready to begin a Time-Stamp study, select **Count** from the Main Menu, then select **New** and then select **TS**. You are then prompted to select a site code type and assign a site code. Refer to page 2-5 for information on selecting a site code.

Start Study

After you have selected a Site Code, you are ready to start the study. The display shows the count number, type of study and the current time so that you can start the study at a specific time.

```
      Time Stamp Study
14:02:58    #04     (key-1)
14:03:02    #06     (key)
14:03:10          Count:002
```

The middle two lines of the display are used to show the keys as you record them. The *(key)* line shows the most recently pressed key, along with its time stamp, while the *(key-1)* line shows the previously pressed key, along with its time stamp.

**********IMPORTANT**********

Only the gray 1 through 16 keys can be used with the Time-Stamp study. The other keys on the TDC Ultra are disabled when in this study mode.

To record your data, all you need to do is press a key to represent a specific event. The key you pressed is stored in memory, along with its time

Ending the Study

When you are done collecting data, turn the TDC Ultra off.

Remember, the only way to stop a study is to turn the power off.

Chapter 13

Retrieving Data from the TDC Ultra

There are two ways in which to retrieve data from the TDC Ultra: by downloading it to a computer or by manually retrieving it using the Review menu. Downloading the data is the easier (and much more commonly used) of the two options.

Downloading to the computer

The TDC Ultra is specifically designed to allow the data to be transferred to a computer for analysis. Although it is possible to use the Review option to read and remove some of the data by hand, it is not really practical if you do a study of any significant length. A much better method is to do the studies you need to do and then transfer all of the data to a computer at one time for further analysis.

Note: Use the optional external power supply during the download process whenever possible. The download process draws a significant amount of power, so use of the external power supply will prolong the life of your AA batteries.

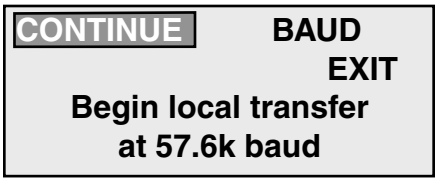
Our PETRAPro software is the program most commonly used for download and analysis. This software will download and process all of the data from the TDC Ultra.

The TDC Ultra has a built-in USB port that is used to transfer the data to any computer with a USB port.

To download your data, first turn on the TDC Ultra and plug a USB cable into it. Then, plug the other end into your computer.

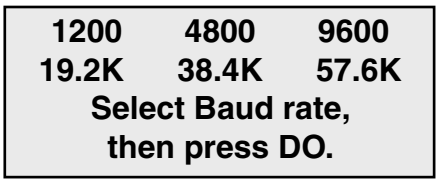
Note that the first time you are connecting the Ultra to a computer using the USB port, you will need to install the drivers for it. Refer to the Appendix for information on how to do this before proceeding. The USB drivers create a virtual comm port that you will select in the PETRAPro software.

Run the PETRAPro analysis software on your computer, and prepare it for download by selecting *Read* from the interface screen. On the Main Menu of the Ultra, use the TAB key to highlight DUMP, then press DO. The screen shown here is then displayed.



Note that the baud rate that the TDC Ultra is currently set for is shown on the bottom line. The baud rate is the speed at which the data will be sent from the Ultra to the computer. The baud rate set in the Ultra **must** match the baud rate that has been selected in the software. You normally only have to set the Baud Rate once, to match the setting in the software. To set the Baud Rate, use the following steps.

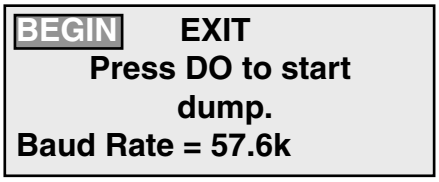
Press TAB until Baud is flashing, then press DO. The screen shown here is then displayed.



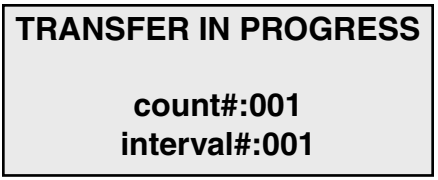
Use the TAB key to move the highlight to the baud rate you want. Most computers will allow transfer at the fastest baud rate of 57,600. Once you have set the baud, press DO.

As mentioned, once the baud rate has been set, it will be used every time for the download, unless you change it.

Press TAB to highlight *Continue*, then press DO. The screen shown here is then displayed.



At this point, the TDC Ultra is ready to download. Make sure your software is properly set up (refer to the software manual if you have any questions on this), then press the DO key. The screen shown here will then be displayed.



The TDC Ultra starts sending the data to the computer, beginning with the first interval of the first count. The screen shows the count number and interval number that is being transferred. When all of the data has been transferred, the screen returns to the Dump. Assuming the transfer is successful, you can then select EXIT to return to the Main Menu.

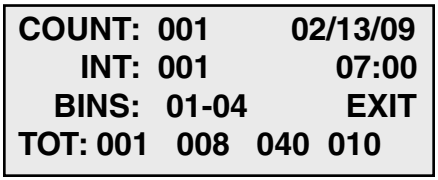
Note: The TDC Ultra has no way of knowing if the transfer is successful (for technical types, there is no handshaking). The data is sent out and hopefully something is there to catch it. If the data has been successfully sent to the computer, you should see a window for each file appear in the software. Check the data in the software to make sure the download has been successful. If everything looks okay, you may clear the memory of the unit using the process described on page 2-9.

Retrieving Data Using the Review Menu

Although the TDC Ultra is designed to be downloaded to a computer, some of the data that is stored in memory can be manually viewed and transcribed using the Review Menu. If you always use the analysis software to download and analyze the data (and we certainly hope you do), then you probably will never need to use the Review option. However, this options is useful if you do not have software to download the data or if you are having trouble getting data to download.

You can review the data for Standard Turning Movement, Classification, Gap, Roundabout and Signalized Intersection Delay studies. You cannot review the data for Saturation Flow Rate, Stop Sign Delay, Spot Speed, Time-Stamped or Enhanced Turning Movement studies. The data for these studies is in a very compressed, complicated format that makes it unreasonable to try to review it in the TDC Ultra.

The format for the display is the same for the different types of studies you can review. The screen, as shown below, has several parts:



- COUNT lists the number of the count being displayed.
- INT lists the number of the interval being displayed.
- BIN lists the number of the bin, or key, being displayed.
- TOT lists the total of the data for the bin, interval, and count displayed.
- The DATE and TIME for the count and interval being displayed.

When the highlight is on Count, Int or Bins you can go to the next or previous value by pressing the Change (14 & 15) keys.

You can move the highlight from Count to Int to Bins to Exit and back with the TAB key, just like with the other menus.

The procedure to examine data for a count is very simple:

Move the highlight to Count. Press Change (#14 or 15) until the desired count number is displayed. The date, time, and count type can be used to find a particular count if you are not sure of its count number.

If you want to look at all of the data, then move the highlight to Bins and press Change repeatedly while reading the data displayed next to TOT. The Bins number increments each time you press Change. After the last data point in the interval is displayed, the Int number increments by one and the Bins number automatically goes back to 001. You can go through all of the data by continuously pressing Change.

If you want to look at a specific interval of data, then move the highlight to INT and press CHANGE until the required interval is displayed. Then follow the procedure outlined above to display the data.

The number of bins displayed is a function of the type of count, and the number of keys used in the count. The table below shows the relationships between the type of count and the number of bins used to store data, and therefore the number of bins necessary to display the data.

		# of Bins
Turning Movement & Roundabout	Primary keys	16
Bin#1 is Key#1	If Bank1 keys used	32
Bin#2 is Key#2, etc.	If Bank2 keys used	48
Classification	Scheme F	13
Bin#1 is Key#1	Scheme F/2 Direction	26
Bin#2 is Key#2, etc.	User Defined	# of Classes
Gap	1 Direction	16
Bin#1 is Direction 1 Counted	2 Direction	32
Bin#2 is Direction 1 2-3 sec., etc.	2 Direction w/ Combined	48
Bin#17 is Direction 2 Counted		
Bin#18 is Direction 2 2-3 sec., etc.		
Bin#34 is Combined Gap 2-3 sec., etc.		
Signalized Intersection Delay	All	3
Bin#1 is Number Stopped		
Bin#2 is Approach Stopped		
Bin#3 is Approach Through		

Chapter 14

Battery Care

Installing Batteries

The TDC Ultra is powered by four AA cell batteries. Use of low power electronics in the TDC Ultra makes it possible for the batteries to last for several months, depending on use.

Eventually, however, the batteries will need to be replaced. The back of the TDC Ultra contains the battery compartment. The batteries can easily be popped out and replaced. You should use high quality alkaline batteries, which you can get at any convenience store.

**********IMPORTANT**********

Be very careful to observe the proper polarity when installing new batteries. Leaving incorrectly installed batteries in the Ultra can cause the batteries to burst and leak, damaging the unit.

Do not mix old batteries with new batteries, or mix brands of batteries, when replacing the batteries. This can cause batteries to burst and leak, damaging the unit.

You should be able to replace the batteries without disturbing the data in the TDC Ultra. The memory of the unit is backed by an internal lithium battery, and is retained even when the AA batteries are removed. Just to be safe, however, we suggest that you download the data to your computer before you replace the batteries. Then Clear the counter after the new batteries are installed to reset everything properly.

We recommend that you keep track of when you have changed the batteries in the TDC Ultra, and establish a regular routine for changing them. This should help to avoid having to change the batteries in the middle of a count.

Chapter 15

Troubleshooting

TROUBLESHOOTING

The following are some common questions/problems that can be encountered when using the TDC Ultra. The possible answers that are stated with them are not necessarily the only answer, but should be checked first before contacting us. If you cannot find the answer to your problem/question, do not hesitate to contact us. Contact information is listed on the first page of this manual.

The TDC Ultra will not turn on.
Check that the unit has enough power to operate. Replace the AA batteries with fresh ones, or plug in the external power supply.

The TDC Ultra will not download.
Perform the following checks:

• Check your cable connection between the unit and the computer.
• Check that the baud rate selected in the unit matches that in the software.
• Make sure there is enough power for the download. Either plug in the external power supply or try a new set of batteries.

Refer to Chapter 13, *Retrieving Data From the TDC Ultra*, for other items to check.

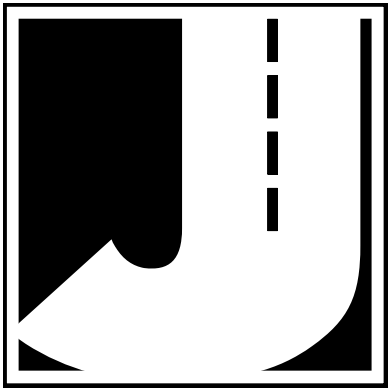
Data is not being recorded properly on Bank 1 or Bank 2.
When recording a count on one of the bank keys, you must **hold down** the Bank key **while** pressing one of the 1 through 16 keys.

The TDC Ultra beeps (or does not beep) every time I press a key. Can this be changed?
Yes. The beeper can be turned on or off by using the Utilities menu. Refer to chapter 2 for more detailed information.

A Real-Time Clock error appears when I turn the TDC Ultra on.
There are several possible causes for this. The unit may have been affected by static electric discharge, the internal lithium battery my be failing, or some other internal component may have been damaged. If you encounter this error, perform the following:
1. Clear the memory
2. Reset the Date and Time
3. Perform a short test count by programming the unit to start counting and letting it sit for 1 hour.
4. Turn the unit off, then back on to see if the error occurs again.
If the error occurs again, contact us using the information in the front of this manual.

Additional troubleshooting information can be found on our web site at www.jamartech.com.

If you are unable to find a solution to your problem or question, contact us using the information located on the first page of this manual.



Appendix

Installing USB Drivers

The first time you are downloading the TDC Ultra to a computer using the USB port, you will need to install the drivers for it. There are two drivers that will be installed, one right after the other. These drivers are available on the Downloads section of the JAMAR web site (www.jamartech.com), on the installation CD for the PETRAPro software, and as part of the Windows Update feature available from Microsoft using an Internet connection.

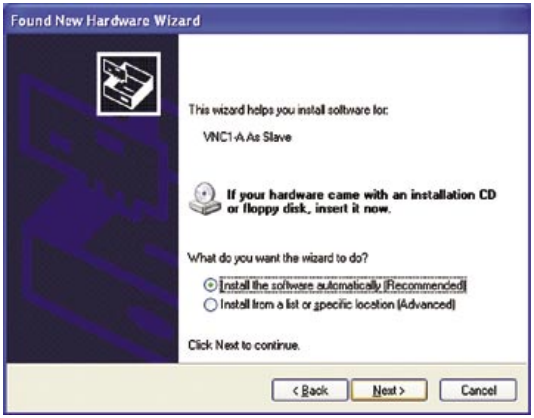
To install the drivers, first turn the Ultra on, then connect a USB cable to your computer and then to the USB port of the Ultra.

The Windows 'Found New Hardware' message will pop up, referencing USB Serial Converter, then the *Found New Hardware Wizard* will appear.

One of the features of Windows XP and Vista is to use your Internet connection to search the Windows Update web site for any available drivers for USB devices you connect to your computer, like the TDC Ultra. If you have not used this feature before, you'll first see a screen like the one shown to the right when you first connect the Ultra.

The drivers for the Ultra are available through this feature, so if you'd like to allow the wizard to connect to the Internet, select one for the first two options and click Next.

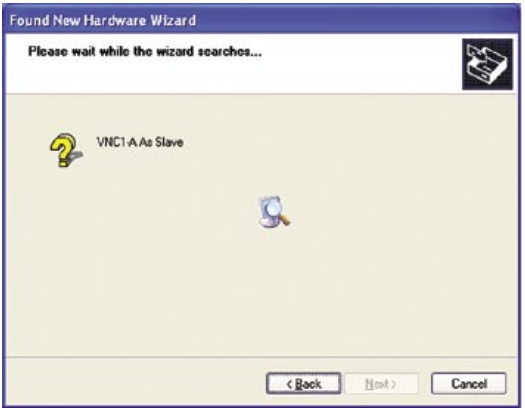
After you click Next (or if you have previously instructed Windows to always check the Windows Update web site for drivers), you'll see the screen shown to the right.



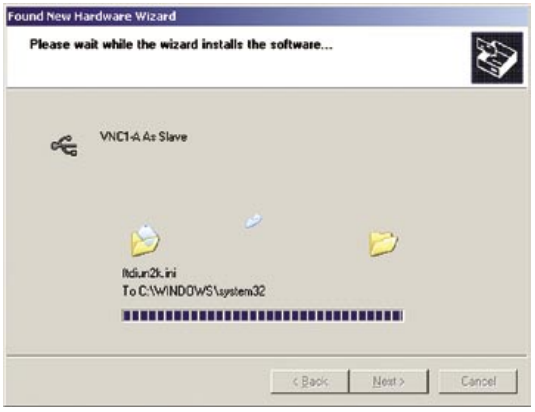
This screen is used to tell Windows where to look for the drivers it needs. We recommend using the first selection, *Install the Software Automatically*.

Note that whenever possible we recommend you use the drivers available through the Windows Update web site as this is the easiest method for loading the drivers. However, if you are not able to use the Windows Update web site, the drivers are also available on the Downloads section of the JAMAR web site and PETRAPro installation CDs for versions later than 1.5.0. If you are downloading the drivers from the JAMAR web site, be sure to follow the directions listed there. If you would like to use the drivers on the PETRAPro CD, insert the CD into your drive.

Once you are ready to proceed, click Next. The Wizard will then start searching for the best available drivers and you'll see a screen like the one shown to the right.



Once the wizard is finished searching, it will begin to load the driver it has found and you'll see a screen like the one shown to the right.



Note that if the Wizard finds more than one driver (like if you are using Windows Update and also have a PETRAPro CD in you drive), the Wizard will list all the available drivers. You can then select the one you'd like and then proceed.

When the driver is finished installing you'll see a screen like the one shown to the right.

Click Finish and you'll complete installing this driver, but there's still one more to go.

Once you click Finish, the Windows 'Found New Hardware' message will pop up again, referencing a USB Serial Port, and the *Found New Hardware Wizard* will reappear. Don't be alarmed, this is what's supposed to happen. There is a second driver that needs to be installed to create a virtual comm port.

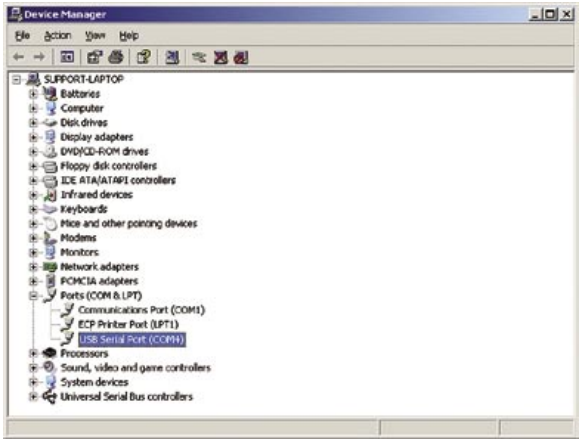
To install this second driver, follow the same steps as the first.

Once the second driver is installed, you may see a message like the one below, prompting you to restart your computer.

Restart your computer to complete the process of installing the drivers.

The process of installing the USB drivers has created a virtual comm port on your computer and assigned this port a number from 1 to 16. You will need to select this comm port number in PETRAPro when you go to download your Ultra. PETRAPro makes this easier to do by only listing the comm ports that are available in the download screen. However, if you want to check to see what port number the virtual comm port has been assigned, you can do so through the computer's Device Manager list.

To access this information, right-click on the My Computer icon then select Properties. In the System Properties window, click on the Hardware Tab, then click the Device Manager button. Click the plus sign (+) next to Ports and you should see a list similar to the one shown below, showing the port number that your computer has assigned.



Specifications

Size — 8.5" x 6" x 1.5"
Weight — approximately 1.5 lbs.
Memory — 128K, Flash memory
Power — 4 AA alkaline batteries or 6-18 volts, DC, 200 ma through external jack
Interface — USB B Port
Display — wide temperature, 20-character LCD display
Output — ASCII format capable of being read by JAMAR software or other communications program
Data Collection — Standard Turning Movements, Classification, Enhanced Turning Movement, Signalized Intersection Delay, Gap, Saturation Flow, Stop Sign Delay, Spot Speed, Roundabout, Time-Stamped
Clock — always active real-time clock

Memory Usage in the TDC Ultra

The TDC Ultra has a large amount of memory to store the data from your studies; the standard counter comes with 128K of flash memory. This memory can hold many different studies and it is unlikely that you will fill the memory before you download the data to your computer.

There are 10 different studies in the TDC Ultra, and each uses a different internal format to store the data. The following guidelines are provided to give an idea of how much memory is used by each study type.

Five of the studies (Standard Turning Movement, Classification, Gap, Intersection Delay, and Roundabout) store a fixed number of bytes at regular time intervals (although the number of bytes stored each interval and the intervals themselves vary considerably). The memory usage in these studies is fairly easy to calculate, since it is totally a function of the length of time you do the study. If you know how long you plan to collect data, then you can calculate how much memory it will take.

The remaining studies (Saturation Flow Rate, Stop Sign Delay, Spot Speed, Enhanced Turning Movement and Time-Stamp) store data (roughly speaking) on a per vehicle basis. The memory used depends on the volume of vehicles rather than the length of time.

The table below is a guide to help you determine if you have enough memory in the TDC Ultra to do the study you want. Only use the chart to get a rough estimate. If it seems close, then you should arrange to download the TDC Ultra before doing the study.

If you run out of memory during a study, nothing serious happens. The TDC Ultra simply displays a message saying that the memory is full. No data from previous studies are ever lost.

Standard Turning Movement, Roundabout Movement, Classification & Gap.....75 intervals for every 1% of memory

Intersection Delay.....300 intervals for every 1% of memory

Enhanced Turning Movement, Sat. Flow, Stop Sign Delay, Time Stamped.....400 cars for every 1% of memory

Spot Speed.....800 cars for every 1% of memory

Data Output Format

The following information is not normally needed to use the TDC Ultra. It is provided for those who are interested in some of the technical aspects of the TDC Ultra. It is also provided for those customers who do not plan to use the analysis software, or who are interested in interfacing the TDC Ultra to their own computer hardware and/or software systems.

The data that is sent out of the TDC Ultra is in standard ASCII (text) format. Any communications program, such as Windows Hyperterminal, can be used to capture the data. It is also easy to write software that can read the raw data, if you are familiar with a programming language. (Doing something with the data is another matter.)

Each interval of data is sent separately. The format of the data for each of the TDC Ultra's studies is as follows:

Standard Turning Movements, Roundabout:

	varies*	leader characters (20)
	001	count number
	001	interval number
	01	interval length (min)
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	nnnn,nnnn,...nnnn	data, 10 per line
	...	
	ccc	checksum

*The twenty leader characters vary depending on the study

^^^^^^^^^^^^^^^^^^^^	Standard Turning Movements
CCCCCCCCCCCCCCCCCCCC	Roundabout

Classification:

	##################	leader characters (20)
	001	count number
	001	interval number
	01	interval length (min)
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAA	(20 characters)
	s	scheme code
	kk	number of classes
	hhmm	start time
	mmddyy	start date
	nnnn,nnnn,...nnnn	data, 10 per line
	...	
	ccc	checksum

Multi-direction Gap:

	@@@@@@@@@@@@@@@@@@@@	leader characters (20)
	001	count number
	001	interval number
	01	interval length
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	nnnn,nnnn,...nnnn	data, 10 per line
	...	
	ccc	checksum

Intersection Stop Delay:

	$$$$$$$$$$$$$$$$$$$$	leader characters (20)
	001	count number
	001	interval number
	01	interval length
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	nnnn,nnnn,...nnnn	data, 10 per line
	...	
	ccc	checksum

Saturation Flow Rate, Stop Sign Delay, Time-Stamp:

	varies*	leader characters (20)
	001	count number
	001	interval number
		(always = 001)
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	ss tttt	data, 2 per line
	...	

ss = switch number (01-16, but not all switches are used)
ttt = # of timer ticks since last time marker (0001-2048)
1 tick = 15.6 msec
or
ss = 00 for time marker (1 every 30 seconds)
tttt = checksum for all data since last time marker

*The twenty leader characters vary depending on the study

++++++++++++++++++++	Saturation Flow
<<<<<<<<<<<<<<<<<<<<	Stop Sign Delay
RRRRRRRRRRRRRRRRRRRR	Time Stamp

Enhanced Turning Movement:

	AAAAAAAAAAAAAAAAAAAA	leader characters (20)
	001	count number
	001	interval number (always = 001)
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	ss cc (or ss ttt)	data, 2 per line
	...	

ss = switch number (01-16)
cc = class number (01-14)
or
ss = 00 for time marker (1 every 60 seconds)
ttt = checksum for all data since last time marker

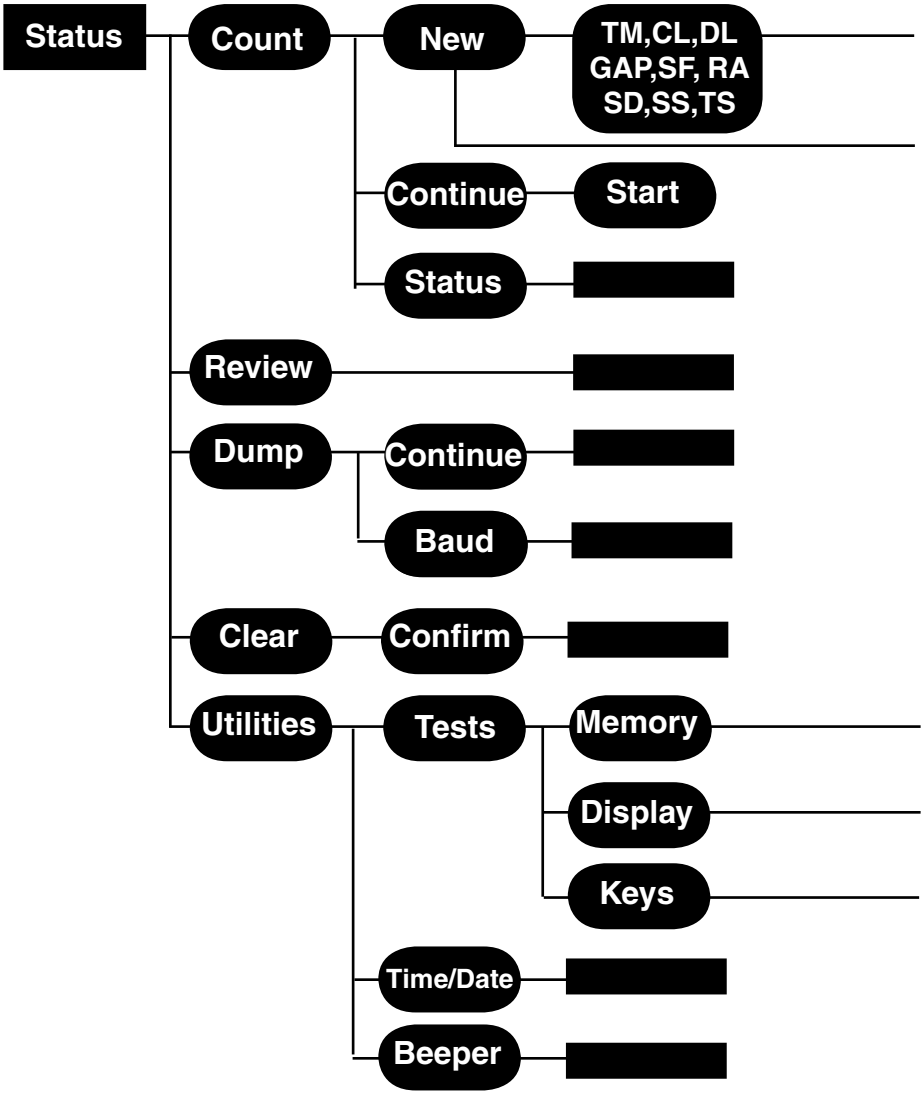
Spot Speed:

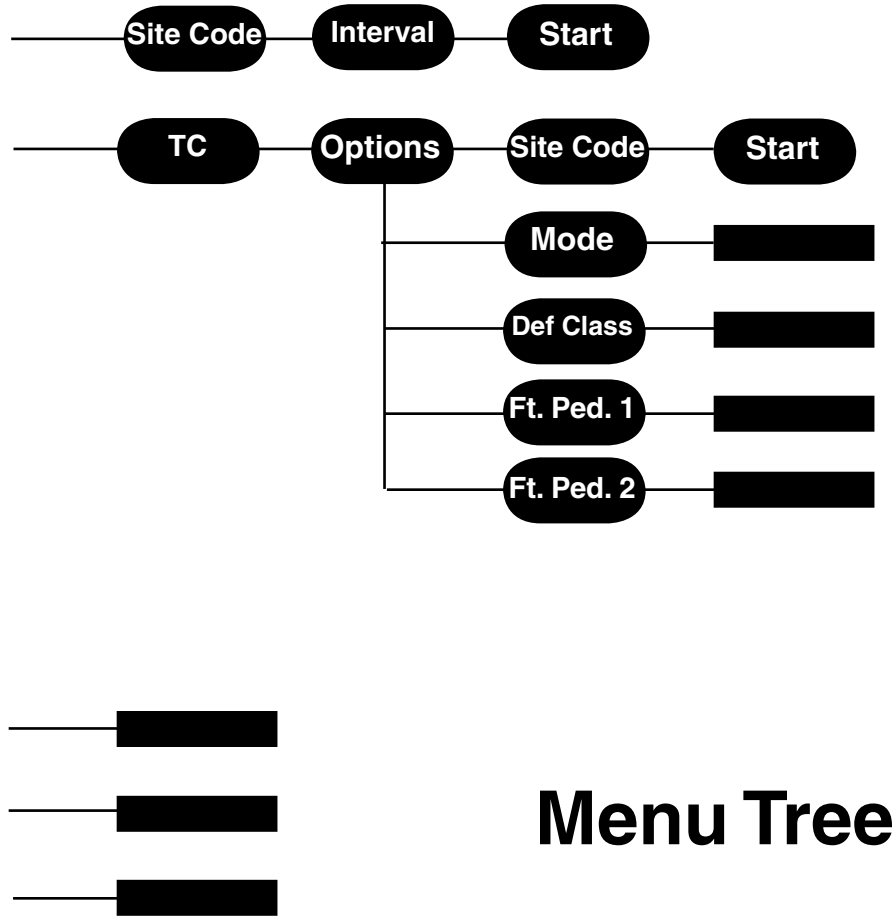
	!!!!!!!!!!!!!!!!!!!!	leader characters (20)
	001	count number
	001	interval number
	01	interval length (min)
	nnnnnnnn	8 digit site code
or	AAAAAAAAAAAAAAAAAAAA	Alpha site code
	AAAAAAAAAAAAAAAAAAAA	(20 characters)
	hhmm	start time
	mmddyy	start date
	sss cc	data, 2 per line
	...	
	ccc	checksum

ss = speed in mph
cc = class number

Notes:

- Checksum is mod 256 of all characters in interval
- All lines are followed by CR, LF characters
- Last line of data followed by 20 colons ":" (end of data character)


Status
Count
New
TM,CL,DL
GAP,SF, RA
SD,SS,TS
Continue
Start
Status
Review
Dump
Continue
Baud
Clear
Confirm
Utilities
Tests
Memory
Display
Keys
Time/Date
Beeper


Site Code
Interval
Start
TC
Options
Site Code
Start
Mode
Def Class
Ft. Ped. 1
Ft. Ped. 2

Menu Tree

We are pleased that you have chosen the TDC Ultra for your traffic data collection needs. We have strived to develop a unit that is easy to use and has the options that our customers require. The TDC Ultra has undergone extensive testing to verify the accuracy of its operations, and each unit is extensively tested before it leaves our facility. Should you detect any problems with this unit, or any of our products, please notify us immediately and discontinue use of the unit until we have verified its operation.