TRIP

Traffic Responsive Interval Program
For The SBC Traffic Signal Controller

Junction (Intersection) Traffic Signal Firmware/Software

Operator's Manual

For Additional ZRI Traffic Products Check Our Website

www.zwiesler.com

Zwiesler Resouces, Inc.

Email: pkohl@zwiesler.com Skype: peterzwiesleresources

Phone/Fax: 001-760-943-8675 Mobile: 001-760-212-2215

Table of Contents

ZRI Interval Program Operators Manual

Revision Date April 20, 2011

Introduction

This manual describes the operation of the ZRI SBC controller and Interval program that can operate up to eight signal groups. Each signal group maybe operated as a vehicle group or as a Pedestrian group. The program can act as either a stand alone Time Base Controller (TBC) or as a slave controller which receives an external sync pulse. The program has a time of day table to select 1 of 8 traffic plans to meet nearly any traffic condition.

The SBC hardware and Interval program provides the following feature set

8 signal groups (any can be Ped group).
Actuated signal groups.
Detector locking.
Flashing walk (international standard).
Solid yellow on the next signal group to go green.
Yellow flash signal groups.
Green fast flash signal groups for green termination.
Flashing Red start up.
All Red start up.
Yellow start groups.
Green start groups.
Associated calls.
Group calls.
Stop time switch.
Flash switch.
Manual control
CPU watchdog monitor with status LED.

Input Connector

8 group inputs.
Time reset.
Manual control.
External synchronization.
Conflict monitor flash.

Input Connector

Low cost and efficient hand held terminal.
18 key hex keypad.
20 character by 4 line LCD display.
No batteries. Power is provided by the interface connector.
Easy learning curve for key codes.

Program Theory

The Interval program is based on a set of signal group intervals within a fixed cycle length. The cycle length and intervals have a range of 1-255 seconds. The cycle length is entered as the first interval time on the plan. The program cycle counter counts upwards from zero turning on each interval as it progresses. The cycle counter is shown in line 3 of the Base display of the terminal.

As the cycle counter counts up, it reaches an interval time. At that time, the program looks at the new requested signal groups and those that are already green (in service). If the same signal group is called for, it will remain green. If any signal group that is green is not requested again, it will terminate. When all terminating signal groups are out of service, the new signal groups will turn green. This means the total green time for the new signal group is the interval time less the termination time of the previous group.

Signal groups maybe semi actuated. Semi actuated signal groups will always turn green at the next interval time but then time by detector extension. If the minimum green time is complete and there is a Goto group assigned and the extension timer times out before the next interval, the Goto group will turn green once the parent group has completely terminated AND there are no other terminating groups currently timing. It is best to have the Goto group part of the next interval so it has the most green time.

Signal groups maybe fully actuated. Fully actuated signal groups will only turn green at their interval time if there is a detector call present or if another group in the interval has a call. Once green, they operate in the same manner as a semi actuated signal group.

An interval can be skipped if there are no calls on any signal group. In this case, the current interval will be skipped and the next interval will time regardless of the call status. The new interval will "Hold" until its normal interval time when the hold will drop. This allows the cycle timer to catch up to the current interval.

An interval will not be skipped if there is a call on any signal group. All groups will turn green even fully actuated groups with no detector calls. Once an actuated signal group has timed its minimum green, it operates as any semi actuated signal group.

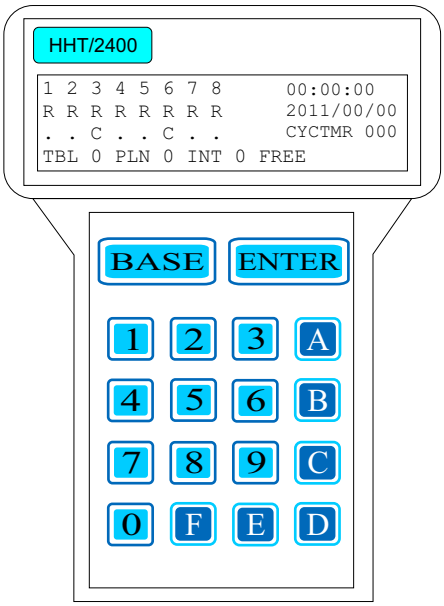
The interval times and signal group flags make up a traffic signal plan. The plan can run Free or Coordinated by Time of Day. The program has 8 available plans and a Time of Day scheduler. The program also contains an exception day scheduler for special Holiday operation by Date.

The Interval program provides an easy to use yet powerful tool to help solve the most demanding traffic applications.

Chapter 1

Display and Keypad Navigation

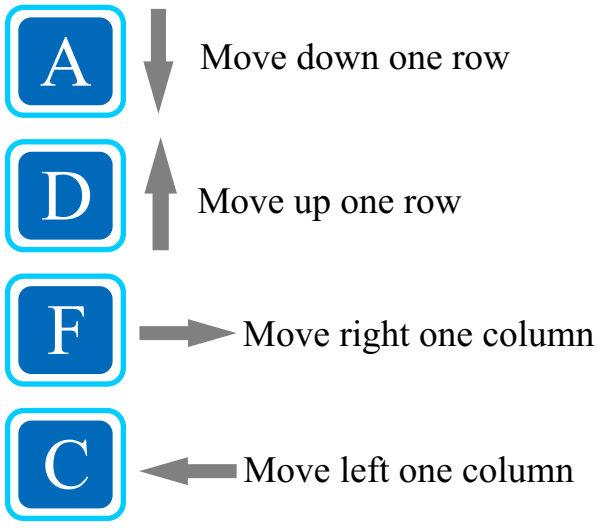
Hand Held Terminal



All timing changes are made through the hand held terminal (HHT). The HHT display and keypad plug into the SBC DB9 connector and it derives it power from the +12 volts on the SBC board (there are no batteries inside the HHT). The HHT uses an 18 position keypad and displays the information on a 4 line by 20 character LCD display. The keypad is the same hex keypad used in the popular model 170 controller. The key strokes are very similar to the 170 and the timing sheets clearly show the key press sequence.

The first two key presses select the page or table to display. All subsequent key presses are navigation keys or data entry sequences. Each key press can be observed on the display on the first line. The navigation keys are listed below.

Navigation Keys



Entering data, use the ENTER key at the top of the keypad or use the E key.

Base display, use the large BASE key at the top of the keypad or use the B key.

Holding any key down for more than 1 second will repeat the movement until the key is released. Note, the repeat frequency is very fast and it is easy to move too far.

When the cursor reaches the end of the row or column it will wrap around to the beginning of the row or column again. The operator may scroll up or down, left or right but will always stay in the same row or column. It is sometimes faster to get to a memory cell by backing up using the C or D keys rather than scrolling across the entire page of memory.

The Base Display

The Base display is the default display and the operator must always start from this display when moving between the F pages or table pages. The Base display provides signal group status, time, date, interval timer, coordination and plan status. Below is a sample of the Base display.

The Base Display

```
1 2 3 4 5 6 7 8                  00:00:00
R R R R R R R R                  2011/00/00
. . C . . C . .                  CYCTMR 000
TBL 0 PLN 0 INT 0 FREE
```

Line 1 displays the numbers 1-8. This represents the signals groups 1-8 that are available in the program. Next to the signal groups on line 1 is the Real Time Clock (RTC).

Line 2 displays the signal group color: Green, Yellow, Red, Walk and Don't walk (G Y R W D). Next to the signal group color on line 2 is the Date (Year, Month, Date).

Line 3 displays the call status for the eight signal groups C = call, dot = no call. Next to the call status information is the cycle timer. The cycle timer counts the seconds in the cycle until it reaches the cycle length when it resets to zero.

Line 4 displays the active table number (0-3) that the current plan is called from. Next is the plan number (1-8) + (9 flash) that is currently running. Next to that is the interval that is currently timing (0-F) and finally the coordination status FREE or CRD.

The Page Display

To access the F pages, the operator must start from the Base display. Pressing the BASE display key one or more times will always bring you back to the Base display. From there, press the F key and then the page number you wish to display. Use the navigation keys to move left and right in columns and up and down in rows. The page data can be displayed in either decimal numbers or as flags. The display will change to provide the correct entry format. Below is an example of a decimal location.

The Data Display (decimal)

```
PAGE  F-1-1-2
DATA  025
```

Here is an example on how to set signal group 1 minimum green time. From the Base display, press F then 1 to get to the F-1 page. Observe the display shows PAGE F-1-0-0. Press the F key to move one column to the right. Observe the display shows F-1-1-0. Press the A key twice and observe the page address shows F-1-1-2. This is the location of the group 1 minimum green time. Select a time (25) and enter it by pressing keys 2 then 5 then ENTER. Observe the final display matches the sample above.

When entering in the decimal data, you may press the number keys as many times as necessary to get the correct combination. When the correct data is seen on the display, the ENTER key must be pressed to save the data in memory. Press the E key or ENTER key to set the timing. You will notice the display will blink briefly to show the entry was accepted. If a mistake is made, it is not necessary to go back to the base display, just enter the data again.

Flag data is very similar to decimal data with one main exception. It is not necessary to press the ENTER key after turning on or off the flags you want set. Each number key press will toggle the flag data with key 0 clearing all flags and key 9 setting all data flags.

The Data Display (flags)

```
PAGE  F-1-1-0
DATA  1234...
```

In this example, we want to set the Permit flags for signal groups 1, 2, 3 & 4 at F-1-F-0. If you are already on the F-1 page, it is not necessary to go back to the Base display. Just press the F or C keys until you get to the correct column. Next, press the A or D keys until you reach the correct row. Observe the PAGE address matches the example display above. The data location is for flags. Pressing the number keys will toggle on and off the selected signal group. You do not have to press the ENTER key for flags locations. Press the keys 1 2 3 4 and observe the display matches the example above.

The Plan Page

The F-2 page contains the plan data. It uses all 16 columns (0-F) and has alternating columns of decimal data for the interval times and flag data for the signal groups to time next. The display will show the correct format for data entry as you move across the page. Data entry is the same as described above for the F-1 page.

The Table Pages

The table pages 9-0 to 9-4 have combined decimal data and flag data entries. The table data is entered in a similar fashion for all 5 tables. The data is entered in sequence and the ENTER key has to be pressed before the DOW flags can be set. The DOW flags are for each day of the week starting with Sunday as 1 and ending with Saturday as 7. The only difference is table 9-4 which is an exception day (holiday) table. This table only selects another table to run and the data entered is a date, not a time.

The Table Display

```
TBL 9-0-1
12:34 5 "E" .23456.
```

In the example above, we want to set plan 5 to start at 12:34 on Monday through Friday. From the Base display, press 9 and 0 to get to table 9-0. Observe the display shows TBL 9-0-0. Press the A key to move down one row to 9-0-1. We are now at the correct table entry point for this example. Enter the time 12:34 and then the plan number 5. Press ENTER to set the decimal data. Observe a "*" blink next to the plan data to show the entry was accepted. Now enter the flag data by pressing the DOW keys 2-6. Observe that the data matches the example above. If an error was made, move away from the row and come back to it and start again. This can be done at any time in the key sequence if you find a mistake as you can not move back and forth within the sequence itself. **Note: A single piece of data cannot be changed in the row; the entire sequence must be entered at one time.**

Table 4

Table 4 is similar to tables 0-3 but uses a Date and not a time to select the table to run. This is the exception day table and is used for holiday or special events within the year. There is no year data and each holiday will repeat if it falls on the DOW that is flagged for that event. The data is entered by Month, Date, Table to call and DOW flags. The key sequence is the same as the plan

The Table Display 4

```
TBL 9-4-0
01/01 3 "E" 23456
```

In this example, January 1st is a holiday and calls table 3. From the Base display, press 9-4. Observe the display shows TBL 9-4-0. Enter the Month (01), the Date (01) and the table to call on this day (3) and press the E or ENTER key. Observe a "*" next to the table data to show the entry was accepted. Next, select the Day of Week flags (DOW) for this event (2-6). The DOW flags are for each day of the week starting with Sunday as 1 and ending with Saturday as 7. Observe the display matches the example above.

Table 4 can select tables 0-3 for special event timing but it can also force table 0 to run Free all day by entering E for the table number. This allows the normal table 0 plans to run Free without the need to copy them to another table.

Chapter 2

Signal Group Configuration

Function Flags

The following flag locations configure the intersection for the type of operation desired. Actuated groups have several options while non-actuated groups must be placed on Max Recall or Ped Recall.

Page F-1 column F rows (0-F)
Row

0	Permit	Signal groups permitted at this location. Set the group flags for each group that will be in operation.
1	Max	Non-actuated signal groups. All groups that do not use detection must be placed on max recall.
2	Det	Detector calls that will lock in when the signal is not green. Place this group on lock if there is a chance a vehicle detector call can drop because the vehicle can move off of the detector.
3	Veh	Actuated Signal groups with guaranteed call. This recall always places a call every cycle but does not extend past the minimum green time.
4	(Reserved	
5	Ped	Pedestrian signal groups. Pedestrian groups must be flagged here and must also be a permitted group. Outputs on green and yellow.
6	Ped	Non-actuated Ped groups. Ped recall places a call every cycle.
7	Flash	The walk will flash during Ped clearance. Set this flag for the Ped group that uses a flashing walk for pedestrian clearance.
8	(Reserved	
9	(Reserved	
A	Sch	Group to output a school warning flasher. The school flasher can only come out a signal group that is NOT flagged as permitted. The flashers are on the green and yellow outputs.
B	Yel	Groups that will show yellow just before green. This feature turns on a solid yellow during the active group's termination time for the new signal groups that will be next.

C	Yel Flash	Groups that will flash yellow. If a group is not flagged for yellow flash, it will flash red during software flash conditions.
D	Grn Flash	Groups that will flash green just before yellow. Signal groups that require a flashing green during green termination time.
E	Y Start	Yellow start up groups. Power up yellow signal groups. If no groups are flagged for yellow start, green start will be next.
F	G Start	Green start up groups. Power up green signal groups. If no groups are flagged for green start, plan 1 interval 0 groups will start.

Group Vehicle Calls

The following flag locations are for Group VCalls. A group that is in service may place a constant call on another group using this feature. If a Pedestrian group is timing, it may not be desirable for the vehicle group to Gap out and Goto another signal group. The Ped group can place a constant call on the vehicle group as long as it is in service keeping the vehicle group from Gapping out if there is a Goto group assigned to it.

Address F-1-E (0-7)
Row

0	Gp V Call 1	Group 1 vehicle calls
1	Gp V Call 2	Group 2 vehicle calls
2	Gp V Call 3	Group 3 vehicle calls
3	Gp V Call 4	Group 4 vehicle calls
4	Gp V Call 5	Group 5 vehicle calls
5	Gp V Call 6	Group 6 vehicle calls
6	Gp V Call 7	Group 7 vehicle calls
7	Gp V Call 8	Group 8 vehicle calls

Associated Calls

The following flag locations are for associated calls. A group may call another group at the same time using this feature. If a call on a pedestrian group also requires placing a call on a vehicle group, so they can both start together, turn on the vehicle's group flag in the pedestrian's associated call location. In actuated groups, a pedestrian group will always call the associated vehicle group but the vehicle group does not have to call the pedestrian group.

Address F-1-E (8-F)
Row

8	Assc Call 1	Associated calls for group 1
9	Assc Call 2	Associated calls for group 2
A	Assc Call 3	Associated calls for group 3
B	Assc Call 4	Associated calls for group 4
C	Assc Call 5	Associated calls for group 5
D	Assc Call 6	Associated calls for group 6
E	Assc Call 7	Associated calls for group 7
F	Assc Call 8	Associated calls for group 8

Rules for Programming the Signal Groups

Start Up Sequence

The program may be configured to start up in a variety of sequences. The first parameter that the program looks for on power up is Flash Start. Flash Start will always be timed first if any time is set at location F-1-0-3. The vehicle signals will flash red, unless a group is set for yellow flash, for this period of time. All Red Start is the next sequence to be timed and its location is F-1-0-4. The signals will be all red for this period of time. After any flash and all red timing is complete, the program looks for any yellow groups that are selected to start first at location F-1-F-E. The yellow group will time or the program will go directly to the green start up group at location F-1-F-F. This location selects the first green groups substituting the first plan interval group before the plan parameters take over. If there are no green groups selected, the program will use the first interval groups from plan 1. Plan 1 will time first for one complete cycle before any table plan is selected. The first cycle will run FREE before coordination is enabled.

Goto Logic

The program has actuated signal groups to allow streets with few vehicles to use a minimum amount of time and then terminate and Goto a selected signal group. The Goto group is selected in the signal group timing at interval 4. This is a decimal entry and the operator can select one or two groups to Goto. The entry can be in any order such as 12 or 21. (Example: Signal group 1 can Goto signal group 2. Place a 2 at location F-1-1-4. Whenever group 1's detector extension timer reaches zero, group 1 will terminate and group two will start.). The Goto group is usually in the next interval time, if not, care should be taken to avoid signal group conflicts.

Group Vehicle Calls

It maybe necessary to hold one signal group from gapping out until an associated signal group is out of service. As an example, a vehicle group should not be allowed to gap out and go to another signal group if a conflict will result between the new signal group and the pedestrian group. To avoid this, the operator can use the group vehicle call feature in the program. Select the pedestrian group that will be in service, and flag the vehicle group number to hold until the pedestrian group is done timing. (Example: group 3 is a Pedestrian group to vehicle group 2). Turn on the signal group flag 2 at the Group VCall 3 location F-1-E-2. When group 3 is timing, it will also place a call on signal group 2.

Associated Signal Group Calls

It maybe necessary, at times, to call more than one signal group from a single detector. As an example, if group 2 is to always serve after group 1 in the next interval, a call must be generated to group 2 if there is a call on group 1. To do this, the operator may use the associated call feature in the program. Select the group that will place the call, group 1, and flag group 2 to receive the call. Note: it maybe necessary to place group 2 on Lock. (Example: Group 2 must always serve after group 1). The associated call locations are flag locations. Turn on signal group 2 flag at the group 1 location F-1-E-8. Whenever a call comes in on the group 1 detector input, it will also place a call on signal group 2. If Lock is set, the call will be locked in until group 2 turns green.
Note: Pedestrian groups require (internal or external) calls before being serviced.

Interval Skip

A fully actuated interval that has no calls on any of the signal groups that are "next" will be skipped and the next interval's group will start green whether there are calls or not. Constant calls are placed on the new vehicle signal groups and this condition holds the group green until its true interval time when the calls will drop and the extension timers can run. The last interval can not be skipped and should be flagged for max recall.

No Skip Interval

A fully actuated interval will not be skipped if any vehicle or pedestrian signal group has a call on it (Pedestrian groups must have calls on them to be serviced). All vehicle groups in the interval will be serviced for the minimum green time set on the timing page.

Chapter 3

Signal Group Timing Parameters

Signal Group Timing

The signal group timing parameters control the amount of time each group displays a particular color. Actuated groups may or may not serve during the calling interval. Enter the group times accordingly and observe that the decimal point on the timing sheets designates a timer that runs in 1/10 of seconds.

Address F-1 (Signal groups 1-8)-(Row 0-7)
Row

0	Walk	The minimum amount of time the walk will display. The walk times in seconds and can be set from 0-255 seconds. A signal group cannot terminate while still timing a walk interval.
1	DW	The flashing Don't Walk time. Pedestrian clearance times in seconds and can be set from 0-255 seconds. The clearance time may also be used for the flashing walk feature. A signal group cannot terminate while still timing a don't walk interval.
2	Min Grn	Minimum green time for actuated groups. Counts in seconds and can be set for 0-255 seconds. A signal group can not terminate if still timing the minimum green time.
3	Ext	Vehicle detector extension time for actuated groups. This interval times in 1/10s of a second and can be set from 0-25.5 seconds. The timer is loaded each time there is detection and only counts down when the detector input is clear.
4	Goto	Signal Group(s) to start green if detector extension times out. This location is not a time but a decimal number of the signal group to turn green next. The location will accept two group numbers. They can be entered in any order (i.e. 1-2, 2-1).
5	Grn Term	Green termination time before yellow. The amount of solid or flashing green time before yellow that is included in the termination (clearance) time for the signal group. This timer is in 1/10s of a second and can be set from 0-25.5 seconds.
6	Yellow	Yellow time before red. The amount of time to display the yellow indication. This timer runs in 1/10s of a second and can be set from 3.0 to 25.5 seconds.
7	Red	Red time before the next group is serviced. This timer provides a red after yellow indication for additional clearance protection. The timer runs in 1/10s and can be set from 0-25.5 seconds.

Observe the Signal Group Timers

The operator can observe the actual signal group timers by advancing down the signal group timing parameter column. The timers are in the same order as the parameters above. There are no locks on these locations allowing manual changes for test purposes. When a timer reaches zero, the next group will start timing.

8	*	Walk timer
9	*	Don't walk timer
A	*	Minimum green timer
B	*	Extension timer
C	*	Copy of Goto group
D	*	Green termination timer
E	*	Yellow timer
F	*	Red timer

Chapter 4
Timing Plan Description

Timing Plans

There are 8 timing plans that can be called by time of day. The plans are called by one of the tables 0-3 by Time of Day (TOD) and Day of Week (DOW). This allows the operator to fine tune the traffic signal timing to meet nearly all traffic conditions. The 8 timing plans have two columns of data to enter. The first column is the time within the cycle the interval will activate. The second column contains the signal groups that will serve during that interval. New signal groups will not turn green until all of the terminating groups have fully timed their clearance periods.

The first column, first row location must contain the cycle time. This is the time to complete one full cycle of the intersection. The following rows contain the time to start that interval. The interval timer can be observed in the Base display along with the signal group color. The second column contains the flags for the signal groups that will be active during the interval.
Note: Since any group can be turned on, it is very important to only select groups which can operate together safely.

Below is an example plan that runs a 60 seconds cycle and has 4 intervals. Each signal group will time for 15 seconds less the previous groups termination time. Signal group 3 will time from 0 to 15 seconds. Group 3 will then terminate and Group 4 will start. At 30 seconds, group 4 will terminate and group 1 will start. At 45 seconds, group 1 will terminate and group 2 will start.

Plan 1 F-2-0-row F-2-1-row

Row	Cycle time	Signal Group Flags
0	60	3
1	15	4
2	30	1
3	45	2

In the example above, Key press F - 2 takes you to the plan page. Observe the display shows PAGE F-2-0-0. In plan 1 row 0, enter the cycle time 60 seconds (press ENTER). Press the A key to move down one row to F-2-0-1 and enter 15 seconds. Press the A again to move down one row to F-2-0-2 and enter 30 seconds. Press the A key again to move down one row to F-2-0-3 and enter 45 seconds. Press the F key to move right one column to F-2-1-3 and enter flag 2 (flags do not require the ENTER key). Press the D key to move up one row to F-2-1-2 and enter 1 . Press the D key to move up one row to F-2-1-1 and enter 4 and press D one more time to get to F-2-1-0 and enter flag 3.

Note: The main street usually has the most green time of all the intervals. Placing it at the last interval allows it to absorb the coordination transition cycle shrinkage or expansion more easily than the other signal groups.

Plan Flash

Plan 9 is used for time of day flash operation. There are no timing parameters to set and no Plan 9 timing sheet intervals. Plan 9 is called by one of the time of day tables in the same manner as the other 8 plans. The operator may select any signal group to flash yellow by setting the Yellow Flash flags on the configuration page of the timing sheet. The flash plan is activated the same way as the other plans. When the cycle timer reaches 0, the new plan is loaded into the active plan status and all signal groups will be terminated. When all groups are out of serve, the intersection will begin to flash. Coming out of flash, the signals will go through the normal power up sequences before plan operation.

Any vehicle signal group can be made to flash yellow by setting the group flag at location F-1-F-C. Vehicle groups not flagged for yellow flash will flash red.

Chapter 5
Modes of Operation

Modes, Functions and other column zero locations

The Interval program can operate under several modes. These modes can be set on the F-1 page in the first column (0). Below is a list of the currently supported modes.

Page F - 1 - 0 - 0
Row

0	Address	"Future" system communication address.
1	Man Plan	Manual control plan. Set this location to 1-9 to manually run that plan. A zero will allow the TOD tables to control the plans.
2	Man CRD	Manual coordination. Set to 12 for TBC. 13 for Ext Sync. 14 for Free. Zero for automatic (table control).
3	F Start	Start up flash time. Intersection will flash at start up.
4	R Start	All Red time at start up.
5	Hawk	Run the Hawk pedestrian crossing program.
6	Time Set	Enable an external time reset pulse at 04:00.
7	RAMClk	Update the RTC with the clock in the RAM chip at 03:00.
8	(Reserved)	
9	(Reserved)	
A	RAM Test	Clear the number (240) to reinitialize the controller.
B	(Reserved)	
C	Pwr Ups	Counts the number of power starts.
D	(Reserved)	
E	(Reserved)	
F	(Reserved)	

System Communication Address

In the future, the program will be able to interface to a central system however there are several issues that need to be addressed before that can be done. The agency using the SBC controller needs to provide the system protocol and detailed explanation of the messages that go back and forth from the system to the controller. If the system protocol is proprietary, and letter of agreement must be provided before work can begin.

To set the communications drop address, enter the number at F-1-0-0. The location will support numbers between 1 and 255 but most systems have a limit on how many controllers can be on a communications drop.

Manual Control Plan

The controller can be forced to run a specific plan by placing the desired plan number (1-9) at location F-1-0-1. This overrides the table entries and forces the manual plan to run at the next cycle zero point. Place a zero to allow the tables to control the timing plans.

Manual Control Coordination

The controller can be forced to run Free or Coordinated by placing the desired coordination number at location F-1-0-2. This overrides the table entries and forces the plan to run Free or Coordinated. A code of 12 is for TBC coordination. A code of 13 is for External Synchronization coordination. A code of 14 is for Free (no coordination). Place a zero to allow the tables to control coordination.

Flash Start

The controller can start up in Flash if desired by placing the amount of flash time at location F-1-0-3. If no flash is desired, place a zero at this location. The operator may select 0-255 seconds of flash time.

All Red Start

The controller can start up in All Red if desired by placing the amount of Red time at location F-1-0-4. If no All Red is desired, place a zero at this location. The operator may select 0-255 seconds of Red time.

Hawk Pedestrian Crossing

The Hawk Pedestrian Crossing mode of operation is a separate program inside the Interval program. It was designed for one specific task, to run a mid-block Ped crossing. Enable the program to run by entering the number 205 in the Hawk location at F-1-0-5. The Hawk program runs without a plan and the Base display will show Plan 0. The Cycle Timer will count DOWN to show the time remaining in the interval. The Interval counter will show the intervals listed below. The sequence is activated by a Pedestrian call. Any interval that does not have time in it will be skipped.

Hawk Sequence of Operation by Signal Group:

Hawk Intervals

Veh Signals		Ped Signals	Active Group Timing
0	Dark (rest)	DW	1 Timing Minimum Green
1	Fls Yel	DW	1 Timing Green Termination
2	Yellow	DW	1 Timing Yellow
3	Red	DW	1 Timing Red
4	Red	WK	2 Timing Walk
5	Fls Red	Fls DW	2 Timing Flashing Don't Walk
6	Fls Red	DW	2 Timing Red

(Return to interval 0, rest state)

The parameters required to run the Hawk signal need to be set as follows:

Permit = 1-2 Active signal group 1 = Vehicle and 2 = Pedestrian group

Max Recall = 1 Signal group 1 (vehicle movement).

Ped group = 2 Signal group 2 (Pedestrian movement).

Active parameters in group 1 are:

Min Grn = Rest state time before the next Ped call is serviced (interval 0)

GTerm = Yellow flash time (interval 1)

Yellow = Solid yellow time (interval 2)

Red = Red time before walk (interval 3)

Active parameters in group 2 are:

Walk = Walk time (interval 4)

Don't Walk = Flashing don't walk time (interval 5)

Red = Solid don't walk time (interval 6)

Time Reset

The controller can update its Real Time Clock (RTC) by an input signal pulse at 04:00:00. The pulse needs to be a ground true with a duration of a minimum of 1 second. The clock will reset to 04:00:00 and also update the RAM Clock. The time base unit providing the pulse needs to be connected to the input connector on pin 12 and to logic ground. The logic is Ground True requiring the input must go to ground to be recognized. **To enable this feature, enter the number 206 at location F-1-0-6. Enter a 0 if not used.**

Ram Clock

The SBC controller board has a built in Clock/Calendar inside the RAM chip called a RAM Clock. The RAM Clock is powered by the same internal battery that holds up the RAM during power outages. The RAM Clock has a one second resolution and is used to update the controllers RTC. The controller's RTC runs off the crystal and may need to be updated from time to time. The RAM Clock feature allows the operator to select if the RTC is to be updated by the RAM Clock at 03:00:00. **To enable this feature, enter the number 207 at location F-1-0-7. Enter a zero (0) to disable the feature.**

Ram Test

The controller monitors this location constantly. Should this RAM location get corrupted, the program will automatically reinitialize all RAM locations to the default timing set in the initialization tables stored in the EPROM. **The operator can manually reinitialize the program by changing the number (240) at location F-1-0-A to any non zero number to restore the default timing data or enter zero (0) to clear all timing data. Normally, DO NOT change this location.**

Power Up Counter

The controller counts each time it start ups from a power down. Location F-1-0-C will count from 0 to 255 and will not roll over. The operator should monitor this location from time to time as it may indicate a power problem in the field. **The operator may set this location to zero (or any other number) at any time.**

Chapter 6

Coordination

Time Base Coordination (TBC)

The program can coordinate with other signal locations by means of Time Base Coordination. The Time Base used is derived from the controller's Real Time Clock or RTC. For coordination to be effective, the controller clocks in the system must be set to the same time. The cycle timer will then be controlled by the internal time base which is referenced back to midnight. Most TBC systems reference midnight as the starting point for the first cycle and is the standard method for synchronization. To enable Time Base Coordination (TBC), enter a C in the time of day tables. The C function will turn on coordination. Enter an E to run Free (no coordination).

The program continually checks the cycle timer and master cycle timer to make sure they stay within the plan parameters. Any adjustments are made automatically and affect the cycle following the calculation. The program looks at the cycle length and calculates a minimum cycle and a maximum cycle time used in the short way or dwell adjustment. The minimum cycle length is calculated as 88% of the cycle and the maximum length is 125% of the cycle. Note: Since the cycle can shrink by 12%, the timing must allow for the minimum green time of the last signal group. The main street usually has the most green time and placing it at the last interval of the plan allows the cycle to shrink or expand without much difficulty. The operator can observe the cycle timer on the Base display. It will shrink or expand (dwell) for the first few cycles until it reaches the correct point in time based on the master cycle calculation.

To keep the time base accurate, the RTC can be updated by an external Time Reset pulse. The Time Reset pulse will set the RTC to 04:00:00 every day to eliminate any clock drift due to

External Synchronization

The program coordination feature External Synchronization (Ext Sync) allows an external sync pulse to coordinate the controller. The external sync pulse is similar to the internally generated time base pulse but is derived from an outside source. The mode is set in the time of day tables as function D. Enter a D on the timing sheet at the time you wish the controller to coordinate by using an external device. Enter a C or E when you wish to go back to internal time base coordination or free.

The same logic is used for the external sync pulse as in TBC coordination and the same minimum and maximum cycle times apply. The sync pulse needs to be a minimum of one second long and can stay on for up to ten seconds. After ten seconds, the controller will sense a "stuck on" condition and run free until the proper operation of the sync pulse is restored. If no sync pulse is received by the time the cycle timer reaches the maximum cycle, the logic will reset the cycle timer to zero.

Chapter 7

Miscellaneous Program Functions

School Flasher

The program has the ability to control a set of alternating flashers by time of day. The feature is enabled by setting the appropriate function code in the time of day tables. Enter an A to turn on the flasher and a B to turn it off.

The signal group that will output the school flasher must NOT be a permitted group and must also be flagged at the School flasher location F-1-F-A. The field outputs will be on the green and yellow field terminals of the selected group. The outputs will alternately flash or "ping pong" resulting in a very visible display.

Time of Day Output

The program has the ability to turn on the red output of the school flasher signal group by time of day. The feature is controlled by a function code in the time of day tables. Enter a code of F to turn on the output and B to turn it off.

Manual Control Inputs

The program has two inputs that manually control the signal group outputs. The input connector uses ground true logic and the input must go to ground to activate the feature. Manual enable is on pin 9 and manual advance is on pin 10. Applying a ground to pin 9 will place a HOLD on the timing and the cycle timer will stop just before the next interval. The program will wait at this point until the advance pulse is issued to allow it to continue to the next interval. The manual logic will not allow the operator to advance the interval if it is timing a minimum green or terminating a signal group.

Conflict Monitor Flash

The program monitors pin 13 of the input connector as a Conflict Monitor Unit (CMU) flash input. If this input goes to ground, the intersection is placed immediately into Flash. This is in response to a fault condition sensed by the monitoring device. To clear this condition, the monitor unit must first be cleared of the fault.

Fuse Monitor Flash

The program monitors the fuse monitor line coming from the output driver boards through both 20 pin ribbon cables. If this input goes to ground, the intersection is placed immediately into Flash. This is in response to a "Blown Fuse" on one of the output driver boards. To clear this condition, the fuse or driver board must be replaced.

Setting the Real Time Clock (RTC)

The timing sheet shows locations that can be used to set the controller's RTC. Each location can be set independently to allow an update or correction for one or more locations. The RTC runs in 24 hour mode and there is no AM or PM setting. Location F-1-9-7 allows the operator to update the RAM clock if desired. To update the RAM clock, enter any non-zero number. The number entered will clear when the RAM clock is updated. Observe the timing sheet addresses on page F-1 column 9.

F-1-9-0 Hours 0-23

F-1-9-1 Minutes 0-59

F-1-9-2 Seconds 0-59

F-1-9-3 Day of week number 1-7 (Sunday 1 Monday 2 Tuesday 3 Wednesday 4

F-1-9-4 Years 00-99 Thursday 5 Friday 6 Saturday 7)

F-1-9-5 Months 1-12

F-1-9-6 Date 1-31

F-1-9-7 Update RAM Clock (enter any non-zero number to update the RAM CLK)

F-1-9-8 Daylight Savings Enable (0=disable DST, 1=enable DST)

Daylight Savings is +1 hour on the second Sunday in March and -1 hour on the first Sunday in November.

Program Version Date

Each EPROM chip has the program version date burned into it. The date can be displayed on the terminal to verify the program version. Observe the date on the F-1 page column 9 rows D - E - F.

F-1-9-D Program year

F-1-9-E Program month

F-1-9-F Program date

Example of a Simple Mid-Block Pedestrian Crossing Flasher

A simple mid-block pedestrian crossing warning flasher can easily be configured using the Interval program. The mid-block pedestrian crossing flasher will rest in dark (flasher off) and flash when a pedestrian presses the button to cross the street. The output will be on the pedestrian signal group green (walk) selected by the user. The timing is very simple. Select a pedestrian signal group. Set the pedestrian don't walk time in the signal group don't walk location (there is no walk time). Set up a plan to run a 2 second cycle with the selected pedestrian group as the only group to be on for that interval. Select green flash for the pedestrian output. When the pedestrian presses the button, the green output will flash for the programmed don't walk time then go dark again.

Example Timing:

DW F-1-1-1 = 10 (don't walk is the time the flasher is on)

PERMIT F-1-F-0 = 1

PEDS F-1-F-5 = 1

WKFLS F-1-F-7 = 1 (flash the walk for the don't walk time)

PLAN 1 F-2-0-0 = 2 (cycle length)

PLAN 1 F-2-1-0 = 1 (Flag group 1)

Software Flash

The Interval program will default to software flash if any of the three flash control inputs are active. The signals will flash either red or yellow depending on the yellow flash flags set at F-1-F-C.

CMU Conflict monitor unit fault signal on the input connector.
Fuse Monitor input from the driver boards (through ribbon cables).
Flash Switch located near the top of the SBC board.
To clear the flash condition, the fault must be cleared. Once the fault is cleared, the program will resume operation. The flash switch and stop time switch can be used to safely start up operation from a flash condition.

Hardware Flash

The SBC board has a watch dog circuit that will trip if the HC11 processor stalls. The watch dog circuit will force all outputs to flash Red. This is a hardware flash and can not be changed. The operator can observe the HC11 active watch dog pulse on the green LED located near the input connector. The watch dog LED toggles each 100ms and should never stop blinking.

Chapter 8

SBC Input Port Pin Description

Input Port Pin Description

The input port connector is a standard DB15S (Female) connector. Looking at the front of the connector, pin 1 is located at the top right. Pin 8 at the top left. Pin 9 at the bottom right and pin 15 at the bottom left.

Pin Description:

Top Row (from right) Pin	Bottom Row (from right) Pin
1 - Signal Group 1 input.	9 - Manual Enable input.
2 - Signal Group 2 input.	10 - Manual Advance input.
3 - Signal Group 3 input.	11 - External Sync input.
4 - Signal Group 4 input.	12 - Time Reset input.
5 - Signal Group 5 input.	13 - CMU Fault input.
6 - Signal Group 6 input.	14 - No connection.
7 - Signal Group 7 input.	15 - Ground.
8 - Signal Group 8 input.	

The input pins are high impedance CMOS inputs pulled up to +5 volts through a 10K ohm resistor. This is the normal rest state and will present a logic zero to the controller. For the pin to register active, the pin must be pulled down to ground (ground true logic). The controller will sense this condition as a logic one. The controller scans the input port every 100ms making it necessary to keep the pin active for a minimum of 100ms to be sure the controller will see the activity. The controller senses a level and not an edge requiring the level to be stable before determining its state.

Mating Cable

The mating cable connects to the input port and provides the wiring to the field sensors, conflict monitors and other related traffic signal equipment. The cable is a "flat" cable with wire #1 colored Red. The wires alternate between upper row and lower row on the input connector throughout the cable. Below is the wire list for the input cable.

Wire #	Wire #
1 - Signal Group 1 input.	2 - Manual Enable input.
3 - Signal Group 2 input.	4 - Manual Advance input.
5 - Signal Group 3 input.	6 - External Sync input.
7 - Signal Group 4 input.	8 - Time Reset input.
9 - Signal Group 5 input.	10 - CMU Fault input.

11 - Signal Group 6 input.
12 - No connection.
13 - Signal Group 7 input.
14 - Ground.
15 - Signal Group 8 input.

Communications Port Pin Description

The communications port is a standard DB9S (Female) connector. Looking at the front of the connector, pin 1 is located at the top right. Pin 5 at the top left. Pin 6 at the bottom right and pin 9 at the bottom left.

Pin 1 is a TTL input and is used to sense the terminal connection. Pin 1 must be tied to ground for the communication to be enabled. DO NOT place an EIA 232 signal on this pin or it may damage the SBC processor. Pins 2, 3, 7, 8 are EIA 232 logic levels (+/- 12 volts). Pin 9 is the terminal power pin (+12 VDC). Pin 5 is ground for both power and signal reference. The programming hand held terminal does not use pins 7 & 8 and there are no connections to the terminal. These pins are reserved for communications to other system equipment such as modems.

Pin Description:

Top Row (from right) Pin	Bottom Row (from right) Pin
1 - Terminal sense (TTL) input.	6 - no connection.
2 - Receive data input.	7 - Request to send output.
3 - Transmit data output.	8 - Clear to send input.
4 - No connection.	9 - +12 volts.
5 - Signal Ground.	

Cable Pin Out SBC to Laptop

SBC	Laptop
2	3 Rx Tx
3	2 Rx Tx
1+5	5 GND (Pin 1 is SBC terminal sense)

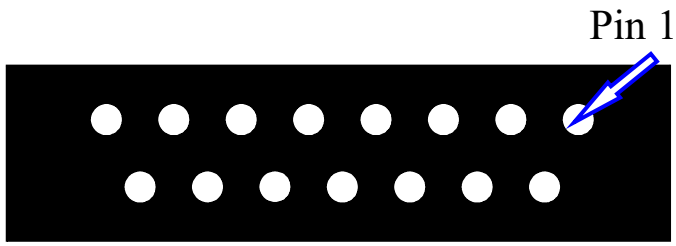
Cable Pin Out SBC to HHT

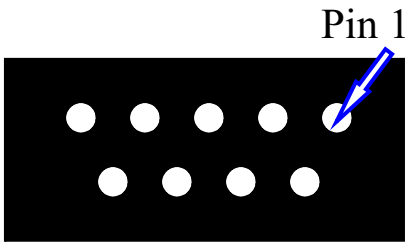
SBC	DB9M
1	1 Terminal Sense
2	3 Rx Tx
3	2 Rx Tx
5	5 GND
9	9 +12VDC HHT Power

Hand Held Terminal (HHT) Cable

HHT Rj12	DB9M
1 Blue	3 Tx
2 Yellow	1 Terminal Sense (tied to ground inside connector)
3 Green	2 Rx
4 Red	6 No connection
5 Black	9 HHT +12 volt power
6 White	5 Ground

Connector Diagram and Pin Locations





Appendix A Timing Sheets

Interval Program Timing Sheet

Intersection: _____

Signal Group Timing

Key press F-1 use cursor keys to move to signal group function cell.

< Columns 1 - 8 >

Row	Function	1	2	3	4	5	6	7	8
0	Walk								
1	DW								
2	MinGrn								
3	Ext	.	.	.	.	.	.	.	.
4	Goto								
5	GrnTerm	.	.	.	.	.	.	.	.
6	Yellow	.	.	.	.	.	.	.	.
7	Red	.	.	.	.	.	.	.	.

Signal Group Configuration Flags

Key press F-1 use cursor keys to move to configuration function cell.

Column E

Row	Function	Flags 1-8
0	Gp VCall 1	
1	Gp VCall 2	
2	Gp VCall 3	
3	Gp VCall 4	
4	Gp VCall 5	
5	Gp VCall 6	
6	Gp VCall 7	
7	Gp VCall 8	
8	Assc Call 1	
9	Assc Call 2	
A	Assc Call 3	
B	Assc Call 4	
C	Assc Call 5	
D	Assc Call 6	
E	Assc Call 7	
F	Assc Call 8	

Column F

Row	Function	Flags 1-8
0	Permit	
1	Max Recall	
2	Det lock	
3	Veh Recall	
4	(Reserved)	
5	Ped Groups	
6	Ped Recall	
7	Flash Walk	
8	(Reserved)	
9	(Reserved)	
A	Sch Flasher	
B	Yel Next	
C	Yel Fls	
D	Grn Fls	
E	Yel Start	
F	Grn Start	

Timing Plans 1 - 4

Key press F-2 use cursor keys to select column and row

	Plan 1	**Plan 1**	**Plan 2**	**Plan 2**	**Plan 3**	**Plan 3**	**Plan 4**	**Plan 4**
Col	0	1	2	3	4	5	6	7
Row	Time	Flags 1-8	Time	Flags 1-8	Time	Flags 1-8	Time	Flags 1-8
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
A								
B								
C								
D								
E								
F								

Timing Plans 5 - 8

Key press F-2 use cursor keys to select column and row

	Plan 5	**Plan 5**	**Plan 6**	**Plan 6**	**Plan 7**	**Plan 7**	**Plan 8**	**Plan 8**
Col	8	9	A	B	C	D	E	F
Row	Time	Flags 1-8	Time	Flags 1-8	Time	Flags 1-8	Time	Flags 1-8
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
A								
B								
C								
D								
E								
F								

Time of Day Tables

Table 9 - 0 (Key press 9 - 0)

Row	Time	Plan	Dow Flags 1 - 7
0	:		
1	:		
2	:		
3	:		
4	:		
5	:		
6	:		
7	:		
8	:		
9	:		
A	:		
B	:		
C	:		
D	:		
E	:		
F	:		

Table 9 - 1 (Key press 9 - 1)

Row	Time	Plan	Dow Flags 1 - 7
0	:		
1	:		
2	:		
3	:		
4	:		
5	:		
6	:		
7	:		
8	:		
9	:		
A	:		
B	:		
C	:		
D	:		
E	:		
F	:		

Time of Day Tables

Table 9 - 2 (Key press 9 - 2)

Row	Time	Plan	Dow Flags 1 - 7
0	:		
1	:		
2	:		
3	:		
4	:		
5	:		
6	:		
7	:		
8	:		
9	:		
A	:		
B	:		
C	:		
D	:		
E	:		
F	:		

Table 9 - 3 (Key press 9 - 3)

Row	Time	Plan	Dow Flags 1 - 7
0	:		
1	:		
2	:		
3	:		
4	:		
5	:		
6	:		
7	:		
8	:		
9	:		
A	:		
B	:		
C	:		
D	:		
E	:		
F	:		

Holiday date table

Select the Time of Day Tables 9-(1-3) on the Exception Date / Day of Week.
Selecting Table E will turn off coordination for Table 9-0 all day.

Table 9 - 4 (Key press 9 - 4)

Row	Mon/Date	Table 1 - 3	Dow Flags 1 - 7
0	/		
1	/		
2	/		
3	/		
4	/		
5	/		
6	/		
7	/		
8	/		
9	/		
A	/		
B	/		
C	/		
D	/		
E	/		
F	/		

F - 1 - (Column) - (row)

(Key press F-1 use cursor keys to select column and row)

Column 0: Communication Address, Manual Plans and Mode settings
Column 9: Set Real Time Clock (RTC), DST enable
Column A: Plan Offsets

	Mode Settings		**RTC**	**Plan Offsets**	
Col	0		9	A	
Row	Mode Settings	*	Set Time Clock	Plan Offsets	*
0	Comm Addr		Hours	(Reserved)	
1	Man Plan		Minutes	Plan 1	
2	Man CRD		Seconds	Plan 2	
3	Flash Start		Dow	Plan 3	
4	Red Start		Year	Plan 4	
5	Hawk Ped		Month	Plan 5	
6	Time Reset		Date	Plan 6	
7	RAM Clock		<Save>	Plan 7	
8	(Reserved)		DST 0-1 [ ]	Plan 8	