

## **RTMS**

The RTMS (Remote Traffic Microwave Sensor) unit is a traffic sensor which uses microwave signals to detect vehicles. Unlike sensors which use the Doppler effect, this sensor continuously modulates the transmitted frequency and can therefore detect stationary objects.

The RTMS can be used to count vehicles and their speed in either a side-fired or forward-looking set-up. In the side-fired position, one detector can monitor up to eight lanes for volume and occupancy. It can also measure *average* speed from the average length of a vehicle and the amount of time spent in a detection zone. In the forward-looking position, three detection zones all line up in one lane, setting up a speed trap. In this mode, speed and vehicle length measurements are much more accurate but one RTMS per lane is required.

### **Detector Package**

The entire system is composed of three main parts. The 1) RTMS, 2) cable, and 3) the RTCP counter unit. Additional items for deployment include solar panel, batteries and modem with cellular telephone.

### **Wiring**

The RTMS cable connects the RTMS to the RTCP via its J1 connector. The round MS connector connects to the RTMS and the DB9F (serial) connects to the RTCP. When the system is first received you will notice that the serial connector is purposely left disassembled from the rest of the cable. This is to allow for the cable to be run through a pipe at the site it will be able to fit through it and the bulky DB9F can be connected after the cable is put through the pipe.

The wires from the RTMS cable come labeled with pin numbers. These numbers correspond to the pin numbers on the DB9F connector, which are also labeled from 1-9. Only some of the pins are used. A more detailed description of the wiring and the corresponding functions can be found on pg. 34-36 of the RTMS user manual.

### **Power Requirements**

The RTMS can take 12-24 V AC or DC. If it is DC, the polarity does not matter. In our set-up we used a 12V DC source from two gel cell battery connected in parallel.

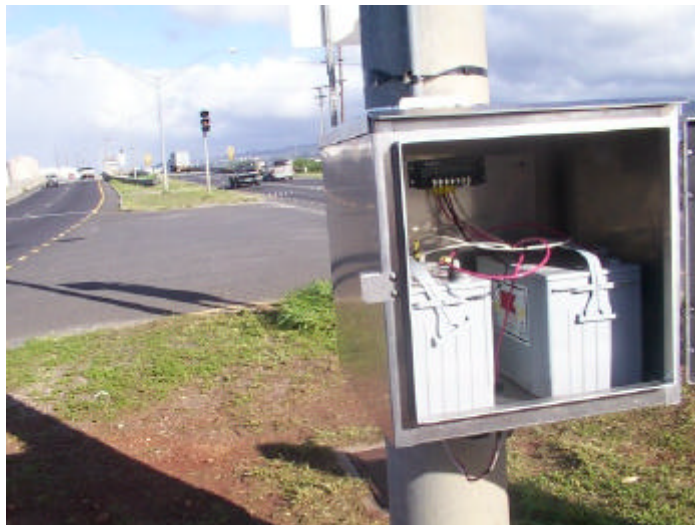
The RTCP takes 5-12V DC and polarity does matter. Although the RTCP can get its power from the RTMS, through the RTMS cable, in our set-up (preferred) the RTCP received power straight from the batteries in the cabinet.

The wires for the RTCP are labeled as “-12V” and “+12V”. This does not mean the RTCP takes a total of 24 V but simply indicates the polarity with minus (-) being the negative terminal and plus (+) being the positive terminal of the 12V battery. A more detailed description of the power requirements can be found on pg. 32 of the RTMS user manual and pg. 12 of the RTCP user manual.

Once power is supplied to both units, the LED on the RTCP flickers dimly. The LED is bright only when data is being downloaded from it.

### **Solar Panel**

The solar panel recharges the battery via a solar controller. The solar controller is designed for a 12V load so if two batteries are used they must be connected in parallel.



The solar panel, batteries, and the load all connect to the controller, which is clearly marked. The batteries used in this prototype deployment were sealed batteries so the jumper was left on the controller. Both the controller and solar panel are equipped with diodes for nighttime protection. Of the three wires on the solar panel, the outer two were used which provided an open circuit voltage of about 18 V.

Two batteries were available and were used for the first month of the deployment. Subsequently, one battery was removed to gain space in the cabinet to install a cellular modem for remote data downloading. The RTMS draws 6 watts while the RTCP draws 0.5 watts so one battery was thought to be enough to last a few days without sunlight. This calculation is correct, however, about two weeks after the installation of the cellular phone and modem (which stay on all the time), power outages began. They were manifested by data counts stopping a few hours after midnight and re-starting at about 11 AM, after enough power was provided by the solar panel.

### **Installation (side-fired highway)**

In this mode, one RTMS can monitor up to 8 lanes of traffic for volume, occupancy, average speed, and long vehicle count. The RTMS requires a certain set back distance from the first lane as well as a height. The table on pg. 11 of the RTMS manual lists the minimum set back distances and heights along with the number of lanes it can monitor.

### **On-site and remote data download**



Once the RTMS is installed, data retrieval is done through the RTCP counter unit. The RTCP stores the data received from the RTMS and data can be retrieved from it via a direct computer connection or a modem. The computer (or modem) connects to the RTCP's J2 connector with a serial cable. In order to download the data from the RTCP to the computer, the RTC Utility (provided on a diskette) needs to be installed.

The basic set-up of the RTCP includes the clock and location. Setting the clock retrieves the time of the computer and copies it to the RTCP. The Location is simply a name or the exact data collection station code given to the RTCP. Reading the set-up option of the menu provides the time, location, and memory information of the RTCP being accessed. By clicking Download, the binary data is downloaded and saved to the computer as an ASCII file. This process may take a few minutes depending on the amount of data in storage since the transfers at the slow rate of 9600 bits/sec. This process can be found on page 11 of the RTCP manual with detailed descriptions of each function on pages 8-11.

Once the ASCII file is downloaded, the Data Analyst program that comes with the RTMS package is used to filter and generate reports in Microsoft Excel. Instructions for the Data Analyst program can be found in Appendix 1 of the RTCP user manual. A portion of a data file formatted in 15 minute intervals is shown below.

RTMS Data Analyst 2.5

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File Path: C:\RTMS\DataAnalyst\Asc\december1.asc

File Date: 12 20 2001 12:10:54

Speed In: Mph

Location: Hawaii

Station ID	Active Zones	Messages	Time Period(sec)	LVeh Used?	Fwd Speed	Date Start	Date End	Filtered Slic
1	11000000	2264	290	True	No	12/18/01	12/19/01 12:15:00 AM	900

	Time Slice Ending	Volume	Occup.	Speed	LongVeh	Fwd_Speed	Messages
1	12 18 2001 00:15:00	8	0.8	36.6	0.0		6
2	12 18 2001 00:30:00	3	0.5	49.0	0.0		6
3	12 18 2001 00:45:00	19	1.0	38.7	0.0		6
4	12 18 2001 01:00:00	9	1.0	37.5	0.0		6
5	12 18 2001 01:15:00	4	0.5	47.0	0.0		6
6	12 18 2001 01:30:00	5	0.5	31.3	0.0		6
7	12 18 2001 01:45:00	4	0.5	36.0	0.0		6
8	12 18 2001 02:00:00	11	0.7	32.8	0.0		6
9	12 18 2001 02:15:00	18	0.8	33.2	0.0		6
10	12 18 2001 02:30:00	11	0.7	36.8	0.0		6
11	12 18 2001 02:45:00	5	0.5	32.7	0.0		6
12	12 18 2001 03:00:00	12	0.8	30.4	0.0		6
13	12 18 2001 03:15:00	2	0.3	37.0	0.0		6
14	12 18 2001 03:30:00	4	0.5	33.7	0.0		6
15	12 18 2001 03:45:00	1	0.2	25.0	0.0		6
16	12 18 2001 04:00:00	10	0.8	40.2	0.0		6
17	12 18 2001 04:15:00	14	0.8	30.8	0.0		6
18	12 18 2001 04:30:00	17	1.0	36.5	1.0		6
19	12 18 2001 04:45:00	55	1.0	32.8	0.0		6
20	12 18 2001 05:00:00	67	1.2	32.2	2.0		6

## Cellular Telephony Modem

The RTMS and RTCP can be connected to a cell modem for wireless access to the RTCP. The cell modem we used was a Zyxel U1496 P modem. The entire system consists of a cell phone handset (for on site phone calls), a cell phone, cell phone modem converter, and the cell modem. The power for the phone and modem also comes from the 12 V batteries.



The modem connects to the RTCP via a cable that adapts the 25 pin connector (modem) to the 9 pin serial connector (RTCP). However, the pictured null modem adapter is also required to switch the transmit and receive lines.



AT Commands: The modem requires some programming so that it can automatically pick up and answer the call coming to it. This requires the use of Hyperterminal which comes standard with Microsoft Windows. After connecting the modem to the serial (COM 1) port on a PC, the speed in Hypterterminal is set to match the speed of the modem; 9600 bps in our case. After than, the

following commands followed by the return key after every line must be downloaded to the modem via Hyperterminal:

```
ATQ0 'Show result code
ATE1 'Echo on screen
AT&N0 ' MultiAuto Baud rate selection
AT&D0 ' DTR always on
ATS0=1 'Answer on first complete ring
ATE0 'Echo off
ATQ1 'No result code
AT&WZ 'Write to current profile (Profile 0, V0)
```

Connecting to the RTCP through the modem is similar to the direct cable connection. In the RTC utility, first the port has to be changed to the modem port (COM 2). Then the phone number of the cellular phone is entered and dialed in the communications set-up. Once connected, the rest of the process is the same as for the direct connection with serial cable.

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