

# VERICOM VC3000RFM RUNWAY FRICTION METER CONDENSED OWNERS MANUAL

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## 1. INTRODUCTION

**W**elcome to state of the art technology in Runway Friction Testing. The VC3000RFM (**R**unway **F**ric**M**eter) has been designed for ease of use and simplicity of operation for quick and easy results.

The VC3000RFM is a version of Vericom's proven family of dynamometer and braking test computers. Special software within the VC3000RFM satisfies the requirements of runway friction testing.

U.S. Dept of Transportation Federal Aviation Administration Advisory Circular AC-150-5200-30A details the procedures used in performing and reporting runway friction surveys. The purpose of this manual is to aid in using the VC3000RFM in meeting AC-150-5200-30A requirements. This manual does not take precedent over any part of AC-150-5200-30A or local airport operating procedures.

This manual is a **condensed** version and covers everything necessary to operate your VC3000RFM. If you would like more details please see the VC3000DAQ manual in PDF form at the support/downloads page on our web site or the Profile CD.

## 2. VC3000RFM OPERATION

A Runway Friction Survey requires a minimum of **three** braking tests in each runway zone. The runway zones are: touchdown, midpoint, and rollout zones, for a minimum total of nine tests. After the tests are performed the VC3000RFM is used to generate a runway friction report. The runway friction survey may contain one runway or multiple runways.

The VC3000RFM requires no order in the braking tests as to runways or zones tested. When the VC3000RFM generates a report it automatically sorts the recorded brake tests into runways and runway zones before compiling the report numbers. This allows runway friction tests (brake tests) to be performed in any order.

The VC3000RFM maybe used with or without the printer in test vehicle. If the printer is installed in the test vehicle, reports can be printed in the vehicle. Another method is to only install the VC3000RFM in the test vehicle, perform the runway friction tests, remove the VC3000RFM from the vehicle, and print the runway friction reports in comfort of a warm office. Or if wireless radio modems are used, reports can be printed at several locations at the same time wirelessly.

### Pre-season VC3000RFM Steps:

1. Plug in VC3000RFM and printer into AC power for 5 hours to fully charge batteries.
2. Ensure supply of printer paper for the season.
3. Check VC3000RFM calibration using gravity. See page 19 of this manual.
4. Perform at a minimum one Friction Run, verifying display and printout results. Clear memory when completed.
5. Turn off VC3000RFM and printer.
6. Leave VC3000RFM and printer plugged into AC power to maintain batteries at a fully charged level.

### Runway Friction Survey Steps:

1. Mount VC3000RFM in runway test vehicle. See page 5.
2. Power up VC3000RFM.
3. Clear any old runs in VC3000RFM memory. See page 6.
4. If Airport Name has changed, use Setup to enter new airport name. See page 11.
5. If Operator Name or ID has changed, use Setup to enter new operator name and/or ID. See page 11.
6. Perform Brake Test
  - a. Position test vehicle at a complete stop about 300 feet before the runway zone being tested.
  - b. Press **Braking**. The VC3000RFM will display "Zero Adjusting".
  - c. If the displayed runway number is not correct, enter a new runway number by pressing NEW SURFACE. Then choose NEW RUNWAY or TAXIWAY.
  - d. Press ZONE TOUCHDOWN, ZONE MIDPOINT, or ZONE ROLLOUT depending on the runway zone being tested. The VC3000RFM will display "Auto Start Ready".
  - e. Accelerate test vehicle to approximately 20 mph (32 km/h) or more.
  - f. Hit the brakes hard and fast applying full brake pedal pressure. It's like an emergency stop with the brakes locked up. The VC3000RFM will display "B R A K I N G" when activated.
    - i. If Brake Time in setup = 0.0, hold brakes until the vehicle comes to a complete stop. See setup page 15.
    - ii. If Brake Time in setup is greater than 0.0, typically 1.0, hold the brakes until the VC3000RFM displays the run information.
  - g. The VC3000RFM will display data from the Braking run just completed.
  - h. Verify friction number looks to be good data. If so, press **ENTER**. If not, press **CLEAR** to delete run from memory and redo.
  - i. Repeat steps c through h until testing is completed.

7. Perform Brake Tests on all runways and runways zones.
8. Report the Runway Friction Survey per airport procedures.
  - a. Use the VC3000RFM to Display or Print the Runway Friction reports.
  - b. Download to a computer using Profile and use the Runway Friction Report.

**Post-season VC3000RFM Steps:**

1. If not already, fully charge VC3000RFM and printer batteries, by plugging into AC.
2. Send VC3000RFM to Vericom for calibration and inspection.
3. Store the VC3000RFM and printer in a cool, dry location if possible. This extends battery life.

## Friction Tables

**OLD TABLE**

The ICAO table has set the standard for measuring runway friction since 1955. The testing was done with the old style mechanical Tapley and Skiddometer. This table assumes that all friction devices essentially give the same friction number. This theory is no longer accepted by the FAA, see AC 150/5200-30A change 4. This table is most applicable to peak mu.

ICAO procedures	
Friction (mu)	Braking action
0.40 and above	Good
0.39 to 0.36	Medium to Good
0.35 to 0.30	Medium
0.29 to 0.26	Medium to Poor
0.25 and below	Poor

**NEW TABLE**

The following is an up to date table approved or accepted by the FAA, Northwest Airlines and Vericom Computers. For the up to date changes in reporting friction values see AC 150/5200-30A change 3 and 4. For the up to date changes in reporting braking action and issuing NOTAMS see AC 150/5200-28. This table is most applicable to average mu. **The official FAA abbreviation for the Vericom is "VER".**

FAA procedures	
Friction (mu)	Braking action
40 and above	Good (normally not reported)
34 to 39	Good
26 to 33	Fair
18 to 25	Poor
17 and below	Nil

## 3. VC3000RFM ASSEMBLY

### Putting your VC3000RFM together

Check to see that the following items are supplied with your VC3000RFM:

- 1 VC3000RFM Unit
- 1 Power cord (to cigarette lighter)
- 1 USB interface cable
- 1 RS232 interface cable
- 1 AC adapter
- 1 VC3000RFM manual
- 1 Profile manual
- 1 Profile CD
- 1 Case
- 4 Extra Suction Cups

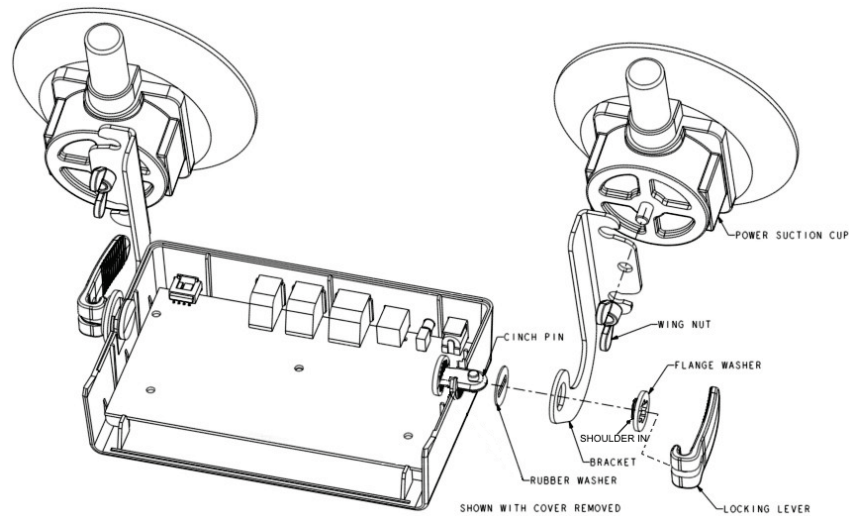
Optional Accessories:

- Ambient Air Temperature Sensor
- Infrared Runway Pavement Temperature Sensor
- Other sensors with RJ45 connectors
- Sensor Junction box
- Wireless computer connection for up to 7 mile range

### Assembly:

1. Put a rubber washer over the cinch pin. Attach the bracket with the suction cups angled to the outside as shown in Figure 1.
2. Place the flange washer with the shoulder facing inward toward the bracket and center the bracket on the shoulder of the washer.
3. With the unit facing you, snap the locking lever over the pin with the lever facing back. Then rotate the lever forward to lock.
4. If you do not wish to use the batteries, plug the power cord into the back of the VC3000RFM and into the vehicle's cigarette lighter.
5. Plug sensors into VC3000RFM if extra sensors are going to be used. See page 18 for connection description.

**Figure 1: VC3000RFM Assembly w/vacuum cups**



## 4. OPERATING YOUR VC3000RFM: THE BASICS

### Mounting

Most testing will be conducted by mounting the VC3000RFM roughly in the **middle of the windshield** using the supplied brackets and suction cups. It may also be mounted anywhere in the vehicle that allows the unit to be **parallel** to the road surface both **longitudinally** and **laterally**. Keep the VC3000RFM flat and level and keep vibration to a minimum. Foam may be used under the unit if mounting to a hard surface to eliminate vibration, but be sure the unit is tight to the foam so it doesn't move during the test. The unit should not shift in its mounting during the test.

### Leveling

Choose a location on your windshield that best allows for viewing the display and operation of the function keys. Do not mount the VC3000RFM on the windshield if that is in violation of federal, state or local laws. Be sure the windshield and suction cups are clean. To release them pull the release tab located on the edge of each cup. Square the VC3000RFM to within 3 degrees to the direction of travel and attach it to the windshield. Usually this means selecting a location that is roughly in the middle of the windshield. Align the VC3000RFM **parallel** to the road surface both **longitudinally** and **laterally**. Reference the integrated bubble levels only if the surface is flat and level in both axes.

You may position the vehicle level on a flat road surface or parking lot and use the integrated bubble levels to level it. Align the VC3000RFM to within 3 degrees of level and lock the levers forward. The VC3000RFM will **zero adjust** itself before each run, so you do not need to reference the bubble levels to get full accuracy. Eyeballing it is sufficient. Your VC3000RFM is ready for operation.

Turn on the VC3000RFM. It will display:

VC3000RFM  
READY

## Modes of Operation

From the READY screen you may select from the three basic modes of operation of the VC3000RFM: Acceleration runs, Braking runs and Continuous display of G or any sensor. Runway Friction Testing only uses the braking run mode.

If at any point you would like to back up and redo your steps, you can get back to the READY screen by pressing the **CLEAR** key a few times. Should you want further instructions on what to do next any time press the **HELP** key.

## Run Data Memory

The VC3000 stores all runs to **flash memory**. Eventually the memory will fill up or the number of files will exceed 255. When this happens you will have to clear memory. The display will prompt you to clear memory after the error message appears. You should clear run data memory **periodically** to ensure data storage is successful. To clear memory, press the **CLEAR** button when the screen displays READY and follow the prompts. See troubleshooting section on page 23 for details on each error message.

### Slope of the runway and zero adjusting

When performing a test the VC3000RFM will zero adjust itself for the **slope** of the runway. The VC3000RFM will give you accurate data if you operate it on a runway that is not strictly level but is of a constant grade. You must allow the VC3000RFM to perform its zero adjusting on that same grade.

When the **2 Braking** key is pushed before a run the VC3000RFM will zero adjust the accelerometer. During zero adjusting the vehicle must be at a complete stop and on the same grade that the test is being run.

## 5. BRAKING MODE

### Quick start guide to Runway Friction Testing

The top of the display shows the number of runs performed at each zone. It shows Tx.Mx.Rx where x is the number of tests performed in that zone. T = Touchdown, M = Midpoint, R = Rollout.

After a brake test, the VC3000RFM displays a screen that shows the runway, the zone and the Friction number and you must select **ENTER** or **CLEAR** to accept or reject the test.

Steps to perform testing:

- From the READY screen press **2\_Braking**. The VC3000RFM will zero adjust itself and then display:

NEW  
SURFACE

ZONE  
MIDPOINT

ZONE  
TOUCHDOWN

ZONE  
ROLLOUT

- If the current runway is not already entered, press **NEW SURFACE**. The VC3000RFM will step thru the runway or taxiway ID entering process.
- Press **ZONE TOUCHDOWN**.
- Do at least three skid tests at the touchdown area. (Press **ENTER** then **ZONE TOUCHDOWN** to perform another test).
- Press **ENTER**
- Press **ZONE MIDPOINT**.
- Do at least three skid tests at the Midpoint area. (Press **ENTER** then **ZONE MIDPOINT** to perform another test).
- Press **ENTER**
- Press **ZONE ROLLOUT**
- Do at least three skid tests at the Rollout area. (Press **ENTER** then **ZONE ROLLOUT** to perform another test).
- Press **ENTER** then **CLEAR** until you are back to the "READY" screen. Press the **Select Run** key, then DISPLAY REPORT or PRINT REPORT if printing the data.

Note: When testing taxiways, you do not have to perform three tests at each zone. Perform the number of tests required by your airport guidelines. Any zone can be entered for taxiways.

After pressing the zone button the VC3000RFM will display 'Auto-Start-Ready' and the current G reading.

Accelerate the test vehicle to the desired initial braking speed. After reaching the desired initial braking speed, hit the brakes hard and fast, applying maximum brake pedal pressure.

If Brake Time in setup = 0.0, hold brakes until the vehicle comes to a complete stop. See brake time setup page 15.

If Brake Time in setup is greater than 0.0, hold the brakes until the VC3000RFM beeps and displays the run information.

After a braking run, the runway, zone and the Friction number will be displayed. The run number is shown at the bottom. Press **ENTER** or **CLEAR** to accept or reject the run.

## Information available from a braking run

To check all the data from a braking run, get back to the READY screen then press Select Run, Display Run, type in the file number then press **ENTER**. The Friction Number, elapsed time, speed, distance, average X-axis G, average Y-axis G and G-force every 1/10<sup>th</sup> second will be displayed. Use the up and down arrow keys to scroll through the data.

Friction#: The friction number for the indicated zone and Peak or Average mode. Friction number equals the Peak or Average acceleration rounded to the nearest hundredth of a G and multiplied by 100.

Elapsed Time (E/T): The time from when the VC3000RFM was activated (see threshold page 15) until the vehicle came to a complete stop.

Speed: The speed of the vehicle when the VC3000RFM was activated (see threshold page 15). **Note:** only displays if Run Time was set to 0.0.

Distance: The distance the vehicle traversed during the braking time. **Note:** only displays if Run Time was set to 0.0.

Avg. Gx: Average longitudinal G force from when the VC3000RFM was activated to stop.

Avg. Gy: Average lateral G force from when the VC3000RFM was activated to stop.

G(x.x): The instantaneous G-Force at the corresponding time.

Peak Gx: The maximum longitudinal G-Force obtained from activation to stop.

Peak Gy: The maximum positive (left turn) and negative (right turn) lateral G-Force obtained from activation to stop.

Reports: Push the **CLEAR** key twice to get back to the 'READY' screen. Push the **Select Run** key, then DISPLAY REPORT or PRINT REPORT.

**Note:** Speed and distance only calculated if Brake Time was set to 0.0 seconds and vehicle came to a complete stop.

## 6. ACCELERATION MODE

The VC3000RFM can measure the performance of any vehicle using this mode. Common uses are measuring the time to 60 mph and to ¼ of a mile.

### Getting the VC3000 ready

If you do not wish to use the batteries on the VC3000RFM plug provided power cord into the back of the VC3000RFM and into the vehicle's accessory jack if one is available. Mount the VC3000RFM using the suction cups near the center of the windshield, but not so it blocks your vision of the road. Level the VC3000RFM as described on page 5. Drive to the spot you will be testing and bring the vehicle to a complete stop. Do not use this unit in violation of federal, state or local laws. For safety reasons the driver should never press any keys on the VC3000RFM while the vehicle is in motion. If observation and operation of the VC3000RFM are required from a moving vehicle, use a separate observer/passenger. Please buckle up and drive safely.

## Performing the test

**QuickSet™** is Vericom's term for one button programming for the ¼ mile. It assumes a ¼ mile acceleration run so programming to 1320 feet is not necessary. The VC3000RFM records data at 7 other distance points and 2 speeds within the ¼ mile (QuickData™ table).

To perform an acceleration run:

1. From the READY screen press **Acceleration**. The VC3000RFM will zero adjust itself and then display:

Select  
Option or  
Auto Start

2. Press **Auto Start**. Now start your run. Launch the car hard enough to trigger the Auto Start threshold (see threshold page 15).
3. To program a specific Time, Speed, Distance or G force, press the Time, Speed, Distance or G force button instead of the **Auto Start** button. Then enter the parameters, then **Auto Start**.

The run will end when:

1. The ¼ mile is completed for QuickSet™ mode.
2. The programmed end point is reached.
3. 99.9 seconds has elapsed.
4. The vehicle exceeds 255 MPH.
5. Any key is pressed.

Any information gathered up to when the run ended will be available.

The VC3000RFM is accurate through the ¼ mile, however, it is not recommended for use over ½ mile.

## Reading the data

After an acceleration run, bring the vehicle to a complete stop. Press the **Distance** or **G-Force** keys and the respective data will be displayed. Press the up **↑ 5** and down **↓ 0** arrows to scroll the data:

### QuickData™ table:

#### **Distance**:

- Ending Time, Speed, Distance and G.
- Time, Speed and G at the ¼ mile.
- Time, Speed and G at 1000 feet.
- Time, Speed and G at the 1/8 mile.
- Time, Speed and G at 330 feet.
- Time, Speed and G at 60 feet.
- Time, Speed and G at 30 feet.
- Time, Speed and G at 15 feet.
- Time, Distance and G at 30 MPH.
- Time, Distance and G at 60 MPH.
- Average Gx, Average Gy.
- Peak Gx and the Time, Speed and Distance where it occurred.
- Peak Gy and the Time, Speed and Distance where it occurred.
- Peak HP and the RPM, Speed and Distance where it occurred.
- Reaction Time. (Countdown start)

### G-Force:

- Longitudinal and lateral G-force at each QuickData point reached.

### Graph/Data:

- Display graphs of the run. Press 4 – 9 to get the data on the key. Press the same key again to scroll through multiple graphs, such as longitudinal and lateral G-Force.

Press **CLEAR** to get back to the READY screen.

While viewing the last test, press **Acceleration** to start a new acceleration test without re-zeroing the accelerometer.

The Acceleration Mode operating limits are:

	<u>English</u>	<u>Metric</u>
Maximum time	99.9 seconds	99.9 sec
Maximum speed	255 MPH	511 KPH
Maximum distance	9000 feet	1800 meters
Maximum acceleration	+2G	+2G

## 7. CONTINUOUS MODE

In this mode the VC3000RFM functions as a high-resolution G meter or a sensor monitor.

### Continuous G

As a G meter, it measures acceleration in **two axes**. The display is updated every 0.5 second with an average of several accelerometer readings. This is useful for coast-down and lateral G measurements.

To get into the Continuous G Mode:



Press the red **Power** key. From the READY screen press **Continuous**. The VC3000RFM will then display:

Select  
7=G-FORCE or  
9=SENSOR

Monitor longitudinal and lateral G force. VC3000RFM will read a negative G force for a right turn and positive G force for a left turn. The Vehicle must be stopped and level so the VC3000RFM can zero adjust itself accurately.



Press **G-Force**.

The VC3000RFM will then display:

Save in File  
Memory?  
Depress YES or NO

- ➔ Press **ENTER YES** or **CLEAR NO**. The unit will zero adjust and then display the current X and Y G-Force and the Peak X and Y G-Force.
- ➔ Press the **Graph/Data** key to scroll through various bar graphs and a friction circle graph.
- ➔ Press **CLEAR NO** to return to the Ready screen.

Max Lateral Acceleration can be measured using the VC3000RFM. The vehicle is driven in a circle accelerating and turning inward toward the center of the circle making the radius smaller until the vehicle skids laterally (sideways). This is called a skid pad test. When using the Coefficients of Friction to compare different road surfaces for skid pad testing static friction should be used instead of kinetic friction because "peak" G is being measured.

### Continuous Sensor

In this mode you can check or monitor any sensor connected to the VC3000RFM. It is useful to check sensors for connectivity or functionality. The VC3000RFM displays the voltage of the sensor. See page 15 for sensor setup.

- ➔ Press **SENSOR**.

The VC3000RFM will then display:

Save in File  
Memory?  
Depress YES or NO

- ➔ Press **ENTER YES** or **CLEAR NO**. The VC3000RFM display will show the voltage of the selected sensors.
- ➔ Press **CLEAR NO** to return to the Ready screen.

If the sensor shows no change, check the wire connections. If the sensor has no output, 0 V, a wire could be broken inside the insulation or the sensor could be malfunctioning.

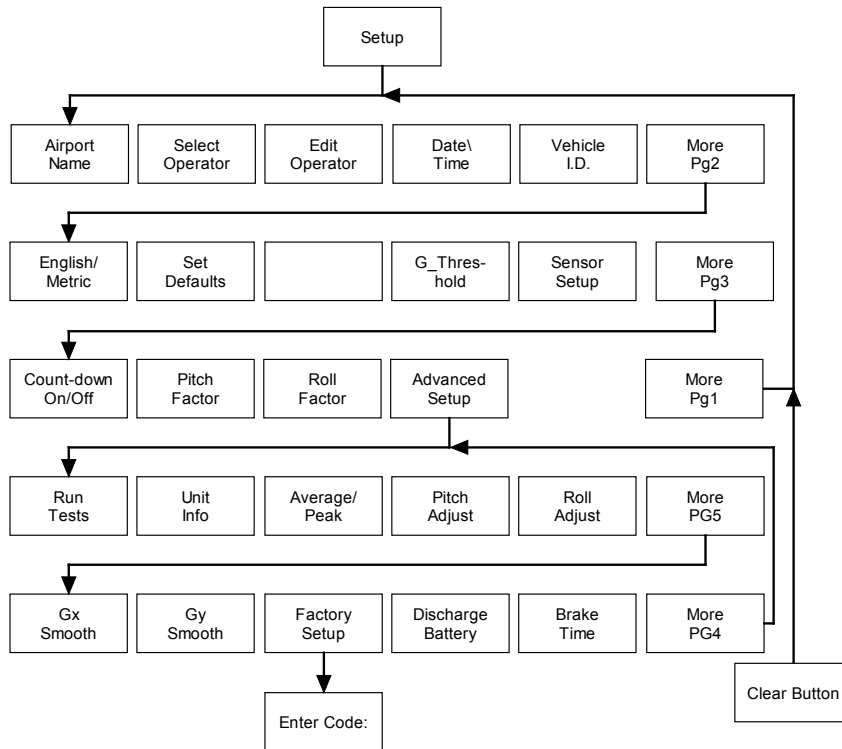
## 8. SETUP (Changing Parameters)

Press the **Setup** key from the READY screen to enter Setup mode and change the factory default values of user variables. The setup may also be changed by connecting to your computer and using Profile, Tools/VC3000 Setup.

### Flow Chart:

The following diagram is a flow chart of the various prompts and option selections on the VC3000. A detailed description of each setting follows. The unit will operate in default mode without any operator intervention after power up if desired.

**Figure 2: Setup Flowchart**



**Description of each setting:**

**Airport Name**

The Airport Name (Example Minneapolis-St. Paul, Minnesota is “MSP”) can be entered. It is displayed and printed with runs and reports.

1. Use the Up and Down arrows to scroll through the alphabet.
2. Use the Right and Left arrows to select the next character position.
3. Press **ENTER** to accept the airport name shown.

**CLEAR** may be pushed anytime to abort setting airport name.

**Select Operator**

The VC3000RFM lists all names of operators who have been entered into the units memory. Up to 6 names may be entered. To add names to the list, use **Edit Operator** or send from Profile (Tools/VC3000 Setup).

**Edit Operator**

Add, Delete or Edit the operator name and I.D.

1. Add Operator (Use the Up, Down, Left and Right Arrows to input)
  - a. Input Name.
  - b. Input I.D.
2. Delete Operator. Select from the list.
3. Edit Operator
  - a. Select from the list
  - b. Input new name and I.D.

**CLEAR** may be pushed anytime to abort setting Operator.

### Date/Time

The VC3000RFM has a date chip that maintains time and date even in the absence of power. It contains a **lithium battery** supply, which will last a minimum of 10 years. It is Y2K-Compliant and keeps track of the century. The time and date of each run is stored in memory and then uploaded to Profile and stored in the header of Profile for each run. This is useful if the file numbers do not correlate to the test number because you have had to clear memory after making some tests. At least you have the time of day for a reference point.

1. Set the time for your time zone by entering every number, including zeros. To enter time of 9:00 enter 0, 9, 0, 0.
2. Enter 1 for am or 2 for pm after the digits are entered.
3. Press **ENTER** to accept the time and date shown or enter the date including zeros. After the date is entered or **ENTER** is pushed the VC3000RFM sets the time and date in memory.

**CLEAR** may be pushed anytime to abort setting the time and date.

### Vehicle I.D.

The VC3000RFM allows the user to insert a vehicle ID for each test. The I.D. will print on the thermal printer and will also display in the vehicle field when imported to Profile.

### English/Metric

The VC3000RFM can give English or metric data for braking or acceleration runs.

The Metric data will be displayed in the following units:

KPH:	Kilometers Per Hour
M:	Meters

Metric runs are limited to 511 KPH and 1800 meters and the start to stop speed must be 10 KPH apart. The QuickSet™ mode will give distance QuickData™ points in English units and speed in metric.

### Set Defaults

This sets the user variable to factory default values of:

- Airport Name = blank
- Operator ID = 0
- Operator Name = blank
- Vehicle I.D. = 0
- Units = English
- G Threshold = 0.200
- All sensors = OFF
- Countdown = OFF
- Pitch and Roll factor = 1, (adjustment = 0.9700)
- Average/Peak mode = Avg.
- Gx and Gy smoothing = 3
- Brake Time = 1.0

### G Threshold

When using the Auto Start, the VC3000RFM starts timing your run when the vehicle reaches a  $\pm 0.2G$  threshold. If you launch or brake too gently you will be accelerating or decelerating before the

VC3000RFM considers the run to have started, so your run will be off by that much. Be sure to launch or brake hard enough to trigger the VC3000RFM the instant the car **changes motion**; otherwise your data will be off by the time and speed it takes for the car to reach the  $\pm 0.2G$  threshold. If you have trouble launching or braking hard enough to trigger the Auto Start threshold, use the Countdown mode or change the G threshold to 0.1G. If the VC3000RFM is starting too soon such as in a large truck that decelerates quickly when there is no throttle applied, use a 0.3G threshold.

### Sensor Setup

The VC3000RFM has 6 internal sensor connections. In the RFM model, Sensor 1 is dedicated to ambient temperature and sensor 2 is dedicated to surface temperature. If using temperature sensors 1 and 2 turn them on without zero adjusting.

Each of the 6 sensors can be turned on individually and setup with or without zero adjusting the sensor. When zero adjusting is selected the VC3000RFM will set the voltage at the time the internal accelerometers are zero adjusted, as the reference point and anything less will be negative. **Zero adjusting sensors should only be used for accelerometers.** Other sensors that the units range is balanced above and below zero may also use zeroing, so long as the values are supposed to be zero when the VC3000 zero's them. Sensors that range from 0 to a positive number should **not** be zero adjusted.

When a sensor is turned on, that sensor can be used to trigger the start of a run. Select "threshold yes" to set the threshold voltage to trigger on. Only one of the external sensors can be used to start a run. When a sensor is set to start the run, one of three events may trigger the start of a run: the G-threshold, the external activation or the sensor voltage threshold, whichever happens first. If you don't want the G-threshold to start the run, set it high, 0.500 G for example.

### Countdown On/Off

Turn countdown on to start the brake or acceleration run with a countdown sequence. When the Auto Start button is pushed the VC3000RFM will delay momentarily, then start the countdown. Acceleration runs use 3333, 2222, 1111 to simulate a drag strip tree with 0.50 sec. between each number and records reaction time. Brake runs use 5555, 4444, 3333, 2222, 1111 with 0.50 sec. between each number. In Acceleration mode the reaction timer starts when 1111 is displayed and the run timer starts when the rollout distance is reached. In Braking mode the run starts when the countdown is completed and the display shows "B R A K I N G".

### Pitch/Roll Factor

Enter the pitch and roll factors. The default is 1 for each. Pitch is the front-to-back tilt, and roll is the side-to-side tilt.

The VC3000RFM is affected slightly by the tilt of the car caused by suspension shifts under acceleration or deceleration. This effect is slight and for the purposes of the VC3000RFM is considered to be similar for all vehicles designed to be driven on the highways including motorcycles, passenger cars, semi tractor trailers and most off road vehicles. The VC3000RFM is set at a common pitch and roll factor (factor 1) for all vehicles with useful suspension systems.

The VC3000RFM is shipped with Pitch factor and Roll factor of 1, which is an adjustment of 0.9700. Once the Pitch and Roll factors are changed it will default to the new Pitch and Roll factors every time the VC3000RFM is turned on. The Pitch and Roll adjustment can be finely adjusted using advanced settings.

For rail cars, vehicles with abnormal or no suspension system and marine application the following guide will help you decide which pitch and roll factor to use:

Pitch and roll factor 0: Low Pitch and roll factor, for vehicles with no suspension system such as transit rail cars, fork lifts or farm tractors. Use 0 for testing on very low friction surfaces such as ice.

Pitch and roll factor 1: Normal Pitch and roll factor or default Pitch and roll factor, for all highway vehicles with useful suspension systems. Including motorcycles, passenger cars, semi tractor-trailers and most off road vehicles.

Pitch and roll factor 2: High Pitch and roll factor, for marine application and experimental vehicles.

Pitch and roll factor 3: Very high Pitch and roll factor, for marine or similar application when the bow rises higher than the stern.

Pitch and roll factor 4: Extreme high Pitch and roll factor, for marine or similar application when the bow rises higher than the stern.

## **Advanced Setup**

### **Run Tests**

Test some of the hardware on the circuit board including the accelerometer and the flash memory. **WARNING:** this test will erase all run memory!

### **Unit Info**

Display the software revision and hardware I.D.

### **Average/Peak**

Choose Average acceleration or Peak acceleration for the Friction **Number, FN**. Normally electronic decelerometers use average acceleration for the friction number of runways and taxiways but the VC3000 has a setting where it will use the peak acceleration to be compatible with old mechanical devices. Note that on ice peak may be two or more times higher than average.

### **Pitch/Roll Adjust**

Use this to finely adjust the Pitch and Roll factors.

### **Gx and Gy Smooth**

Smoothing is used to eliminate some of the **vibration** associated with vehicle testing. Smooth factors from 0 to 9 may be entered. The smooth factors affect the VC3000RFM calculations very little. The G data sent to Profile is the raw data before smoothing and Profile uses the VC3000's smooth factor by default, but can be changed for more or less smoothing effect. See Profile help or the Profile manual to change G smoothing factors.

### **Factory Setup**

Factory only settings.

### **Discharge Battery:**

Allows the battery to discharge quicker by leaving the backlighting on, and discharges more completely by not shutting off when a low battery condition occurs. Leave the unit on at least two hours after the green power light goes out.

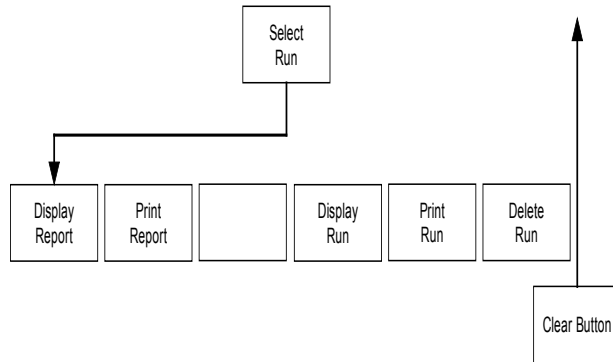
### **Brake Time:**

Sets the length of time a brake test will **log** data for. If this is set to anything other than 0.0, the VC3000RFM assumes the vehicle is not going to come to a complete stop. The VC3000RFM will not calculate speed or distance if the brake time is greater than 0.0 sec. Suspension settle time is set to 0.0 if the brake time is greater than 0.0 sec. A brake time of 1.0 is the default.

Settle time is the time at the end of a braking run that is cut off due to suspension settlement. The VC3000RFM uses 0.15 seconds if the vehicle comes to a complete stop. It can be changed in Profile after the data is imported but the settle time cannot be changed on the unit itself. It does not affect average G (friction number, FN) but will change speed a little and distance slightly more than speed.

## 9. SELECTING (displaying) RUNS AND RUNWAY FRICTION REPORTS

Press the **Select Run** key from the READY screen to Display Reports, Print Reports, Display Runs, Print Runs, or Delete Runs.



### Display or Print Runs

Any individual run stored in memory can be viewed on the VC3000RFM display or printed to our portable thermal micro printer. Press **Display Run** or **Print Run** then enter the file number you wish to review. Press **ENTER** to view the last run in memory.

When printing, be sure the printer is connected and the printer is powered up and ready.

### Delete Run

Any run stored in memory can be deleted. Press **Delete Run** and then enter the file number you wish to delete. Press **ENTER** to delete the last run in memory.

Run information can be printed on a portable thermal printer.

**Figure 3 Thermal Printer**



To print information from the VC3000RFM:

1. Connect the serial cable from the VC3000RFM to the Printer.
2. Turn the printer on.
3. Press the **Select Run** key from the READY screen.
4. Press Print Report or Print Run.

The printer can also be connected **wirelessly** at remote locations if two or more wireless **radio modems** are purchased. Simply plug one radio modem into the VC3000RFM RS232 port and the other radio

modems into the printers at remote sites. The VC3000RFM will **transmit to all printers at the same time**.

### Display or Print Reports

The VC3000RFM report process scans all runs and generates an airport **runway friction report**. Up to 20 runways can be grouped together into one report. Select PRINT REPORT or DISPLAY REPORT to generate a complete report of all data stored in memory.

## 10. VC3000RFM TO PC INTERFACE

The VC3000RFM version is designed for use with the PC compatible software "**Profile**". With Profile, Time, Longitudinal G, Lateral G, Speed, Distance, Horsepower and an additional 6 sensors can be analyzed every 1/100 sec.

The VC3000RFM has two **output** ports. One is a Universal Serial Bus (USB), and the other is an RS232 serial port that can be connected to a communications port of a PC compatible computer or a wireless transmitter. After gathering data into the VC3000RFM connect either the **USB** cable or the **serial** cable to a PC compatible computer or wireless transmitter. If you must use the RS232 port on the VC3000RFM and your computer does not have an RS232 port, you will have to buy an RS232 to USB converter. You will find these at any computer or electronics store or at an internet store and the price should range from \$20 to \$50.

Once the cable is plugged in and the VC3000 is turned on, no additional key pushes on the VC3000 are required. Profile controls communications. See Profile Software Manual for software description and USB driver installation.

## 11. USING THE ACTIVATION SWITCH (External Activation Input)

The External Activation Input is used for starting the run when one of the Reaction timers is used, when 12V is applied, or other input switch is used. This switch allows the operator to **bypass** the Auto Start G threshold. When using the external activation switch the activation of the test will be **either** the switch or the G threshold (0.2G default) which ever comes first. This switch may be used in the Acceleration mode as well as the Braking mode.

When using the brake light switch or brake pedal switch the brake run will start the instant the brake lights come on, which is typically before the 0.2G threshold is reached. The Friction Number (Average G) will be **significantly less** when using the external activation switch because of the increase in time due to the braking systems mechanical reaction time. The activation switch may be connected to any 12V input.

**Figure 4:** External Activation Switch input



Plug reaction timer or other 12V activation source here.

## 12. SENSOR INPUT

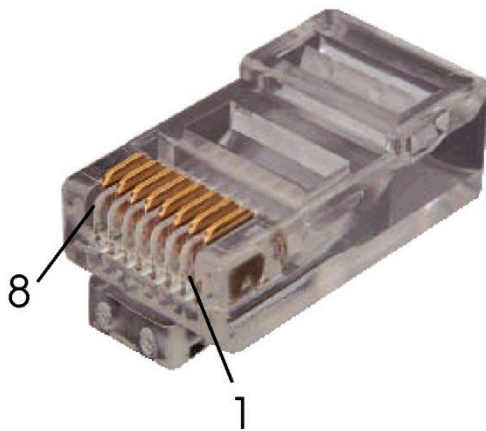
The VC3000RFM can have up to 6 analog sensors connected directly to it. Temperature, brake pedal pressure, fluid pressure and tri axis accelerometers are some examples of sensors that can be monitored along with the VC3000RFM information. Sensors 1 and 2 are dedicated to temperature measurements in the VC3000RFM model. Temperature displays on the main screen with **ambient** on the left and **infrared** on the right. See the supplement that accompanied the temperature sensors for more details. The VC3000RFM has six 10-bit A to D converters built in. See setup on page 15 to turn sensor logging on.

When only ambient temperature is used, connect it directly to the RJ45 connector on the back of the VC3000RFM marked "Sensors 0-5V". When 2 to 6 sensors are needed you will have to use the junction box. See page 18.

### Sensor Requirements

Sensors must have an RJ45 connector with pin 1 as power input to sensor, pin 2 as the signal out to VC3000RFM and pin 8 as ground.

Figure 5: RJ45 connector



Sensors must have an output in the range of 0 – 5 volts DC. The sensor does not necessarily have to have an output of exactly 0 to 5V, but it has to be within that range. For instance a sensor from 1V to 4V will work. The VC3000RFM can supply up to 0.50 Amps to sensors.

### Junction box:

The junction box is necessary to connect more than one sensor to the VC3000RFM. The output cable from the junction box connects to the RJ45 connector on the back of the VC3000RFM marked "Sensors 0-5V". The sensors plug into the junction boxes' RJ45 connectors marked 1 through 6.

Figure 6: Junction Box



## 13. CONFIRMING ACCURACY

To confirm the accuracy of the VC3000RFM using Gravity:

When measuring a slope the G force reading equals the sine of the angle. The sine of 90° is 1.000.

An accelerometer is a sensor that can measure both acceleration and deceleration. For runway friction measuring an accelerometer is used almost exclusively to measure longitudinal G-force. Likewise it can be rotated 90° up or down to measure the vertical axis such as the acceleration of an elevator. In the vertical position an accelerometer can be used to measure the gravitational pull of the earth.

Vericom **recommends** sending the VC3000RFM in to the manufacturer annually for a calibration check and inspection. This can be done in the off season, during the summer months. We will certify the calibration and send a calibration certification sheet back with the unit.

To check the calibration of the VC3000RFM using gravity only four items are needed:

1. A VC3000RFM
2. A flat and level surface
3. Gravity
4. A small mirror

The procedure is to set the Pitch and Roll factors to 0, then use **gravity** to check calibration. Rotate the brackets out of the way while performing the check.

To check the longitudinal accelerometer:

1. Turn the unit on. The READY screen will be displayed.
2. Press the **Setup** key to enter setup mode.
3. Press "More", then "Pitch Factor", then 0.
4. Press "Roll Factor", then 0.
5. At the setup screen press **CLEAR**.
6. Disconnect all connections to the back of the VC3000 and rotate the VC3000RFM so the front panel is facing up and the back panel is resting flat on the level surface.
7. Press the **Continuous** key, then the **CLEAR** key: Unit will zero adjust itself for temperature and incline. Do not move the unit during this time.
8. 'Gx = 0.000' will be displayed on the top line. Unit may now be moved.

9. Rotate the VC3000RFM 180° so the front panel is facing down with the bottom most portion of the front panel on the level surface, allowing the display portion of the unit to hang over the edge of the level surface.
10. Using a mirror or looking up from the floor, 'Gx = 2.000' ±0.020 will be displayed on the top line.

If only checking the longitudinal accelerometer, set the pitch and roll factors back to 1. Follow steps 1 and 2 above, then in steps 3 and 4 press 1 instead of 0.

The lateral accelerometer is more difficult to check because the panels are not flat and there are bracket pins sticking out so the unit will not set flat on its side. The side panels have an angle of 3 degrees so if the unit is flat on the side panel this calibration check will produce an error of 0.002 G.

**To check the lateral accelerometer:**

1. Follow the first five steps above.
2. Disconnect all connections to the back of the VC3000 and rotate the VC3000RFM so the X-axis bubble level (left side of unit) is facing down on the level surface. The pin will have to hang over the edge. Hold the unit so the **bottom** is **perpendicular** to the surface.
3. Press the **Continuous** key, then the **CLEAR** key: Unit will zero adjust itself for temperature and incline. Do not move the unit during this time.
4. 'Gy = 0.000' will be displayed on the middle line. Unit may now be moved.
5. Rotate the VC3000RFM 180° so the right side of the unit is down on the level surface. Hold the unit so the bottom is perpendicular to the surface.
6. 'Gy = 2.000' ±0.030 will be displayed on the middle line. Y-axis calibration check is completed.

Set the pitch and roll factors back to 1 after completing the calibration check. Use "Set Defaults" in setup (page 13) or set the pitch and roll independently (page 13).

## 14. SUMMARY:

What can be done from the READY screen.

<u>Key</u>	<u>Action</u>
Acceleration	QuickSet™ and Programmed Acceleration runs.
Braking	Braking runs.
Continuous	G meter and Sensor meter.
Setup	Set airport name, operator name and ID, vehicle I.D., RFM mode, etc. See page 11.
Select Run	Print or display a stored run or Friction report from memory.
Help	Display a help message for the current screen.
<b>CLEAR</b>	Clear the run data memory or get back to the READY screen.

## 15. CHARGING THE BATTERY

The battery charger inside the VC3000RFM requires 12 to 16 Volts DC at 800 milli Amps or greater to operate, so most 12V battery chargers will work. Suitable chargers are available from Vericom Computers, Inc. The center conductor of the VC3000RFM power adapter is positive, and the connector has a 5mm OD and a 2.5mm ID. The VC3000RFM will charge from a vehicle's cigarette lighter if the vehicle is running. It takes about **four** hours to fully charge them. The batteries take about **twelve** hours to fully discharge.

The battery gauge on the display will not be accurate while the unit is charging because of the high current going into the battery. The unit is fully charged when the red LED in the back panel goes out. The red LED will turn on anytime the unit is plugged in and stays on until the battery is fully charged.

## 16. CUSTOMER SERVICE

### Warranty

The manufacturer warrants that the VC3000RFM computer will be free from defects in material or workmanship appearing under normal use and service. This warranty extends only to the original purchaser and does not apply if the product has been connected, installed or adjusted other than in accordance with the instructions furnished by the Manufacturer.

The manufacturer will repair or replace any parts that are defective in workmanship or materials for a period of two years from the date of purchase. The manufacturer does not warranty the installation of the VC3000RFM computer and therefore will not be responsible for installation or reinstallation charges or damage caused by installation.

This warranty covers only the VC3000RFM computer and is not extended to equipment or component parts used in conjunction with the VC3000RFM computer. The manufacturer will not be liable for incidental and consequential damages or the loss of use of your vehicle.

This warranty gives you specific legal rights and you also may have rights that vary from state to state.

## Repairs

Repairs not covered by warranty are available by returning the unit, prepaid postage, to the manufacturer. Repair charges and shipping will be billed to the customer prior to repairing or returning the unit to the customer.

Please include the following information when returning a VC3000RFM:

1. Your name
2. Company name
3. Shipping address
4. Daytime telephone number
5. Model and Serial number of unit being returned
6. Description of problem
7. Method of payment
8. Description of any upgrades or repairs since purchased

For service, repair or product information contact:

Vericom Computers, Inc.  
14320 James Rd  
Suite 200  
Rogers, MN 55374  
Phone 763-428-1381  
Fax 763-428-4856

[vericom@vericomcomputers.com](mailto:vericom@vericomcomputers.com)  
[www.vericomcomputers.com](http://www.vericomcomputers.com)

# 17. TROUBLESHOOTING

<b>Problem</b>	<b>Solution</b>
Unit doesn't turn on	<ol style="list-style-type: none"> <li>1. No power to cigarette lighter plug. Check connection to plug, or fuse in plug, or power to cigarette lighter.</li> <li>2. Cigarette lighter cord not making connection to VC3000RFM. Push right angle plug all the way into VC3000RFM.</li> <li>3. Dead battery. Plug into cigarette lighter or wall adapter.</li> </ol>
Unit turns off or resets during run.	<ol style="list-style-type: none"> <li>1. Loss of power to VC3000RFM. Check power cord and fuse.</li> <li>2. Battery went dead. Recharge battery.</li> <li>3. Electrical noise interference. Eliminate noise from source.</li> </ol>
Inaccurate data	<ol style="list-style-type: none"> <li>1. VC3000RFM was not at same incline as when zero adjusted or level of VC3000RFM changed since zero adjusting. See page 5 for leveling.</li> <li>2. VC3000RFM started timing too soon. See page 15 to adjust threshold.</li> <li>3. Wrong pitch and roll factor for vehicle. See page 13 to adjust pitch and roll factor.</li> <li>4. Vibration: Mount unit on foam or eliminate vibration from vehicle.</li> </ol>
"ERROR-Flash-ERROR"	Flash memory has an error. Clear run data and try test again. If error persists, run "Run Tests" from Advanced Setup, see page 15, or return to factory for repairs.
"ERROR-RTC-ERROR"	Real time clock problem. Set time and date and try test again. If error persists, return to factory for repairs.
"ERROR-ACCEL-ERROR"	Accelerometer problem. Turn power off then back on. If problem persists, send to factory for repairs.
"ERROR-ERASE"	Memory didn't clear. Try clearing again. If that fails, try running RUN TESTS from Setup. If that fails, flash memory may be bad. Return to factory for repairs.
"ERROR-Full"	Flash memory is full. Import data to Profile then clear memory.
"ERROR-Runtime"	Run time in memory is wrong. Import data to Profile then clear memory.
"ERROR-FileLen"	File Length in memory is wrong. Import data to Profile then clear memory.
"ERROR-255"	The number of files exceeded 255. Import data to Profile then clear memory.
"ERROR-RUN FILE FULL"	Memory is filled. Import data to Profile then clear memory.
"ERROR-FLASH-ERROR"	Data in memory is corrupt. Import data to Profile then clear memory.
"ERROR SETUP AND CALIBRATION INVALID"	VC3000RFM settings are out of range or accelerometer calibration is out of range. Use "Set Defaults" in the Setup mode (page 13). Then check calibration (page 19).
"ERROR-RS232-ERROR or NO LOOPBACK"	When running unit tests, custom loop back connector not installed. No action required.
Calculation for Average G when using speed and distance doesn't	<ol style="list-style-type: none"> <li>1. When using distance in a formula to calculate average G assumes a constant acceleration. The VC3000RFM sums the samples and divides by the number of samples. This is the correct way to calculate an</li> </ol>

match the VC3000RFM Average G	average. 2. The VC3000RFM distance is a cumulative calculation from samples every 1/100 <sup>th</sup> second. Straight formulas such as $f=S^2/(30D)$ assume constant f, which is impossible with any vehicle. To get the correct numbers you have to integrate G and Speed 100 times per second.
Other Error messages	A setting in the VC3000 is out of range. Use "Set Defaults" in the Setup mode (page 13).

## 18. SPECIFICATIONS

Power input: 12V-16V DC (negative ground)

Momentary surge: 24V DC (10 seconds)

Nominal current draw: 175 mA

Temp. Range: -20° F to 160° F

External Activation: 5V-36V DC

Charging voltage: 8V-16V DC

Nominal battery life: 12 hours

### Accelerometer

Accuracy: 0.0030G  
Dynamic range: at least 4G (+2G, -2G)  
Minimum resolution: 0.0010G  
Bandwidth: 0 to 5Hz  
Shock survival: 1000G  
Sample rate: 100 Hz

### Internal A/D converters

Resolution: 10 bits  
Accuracy: ±1.0 LSB  
Sample rate: 400 Hz

Computer: High performance 16 bit, 16 MHz

Memory: 512Kb Flash RAM, 128 Kb ROM

### Power cord

Length: 6 feet  
Plug: 2.5 mm ID  
(center positive): 5 mm OD  
(Right angle Preferred): 10 mm L  
Fuse: 1.25 inches, 3 AG, 1 Amp

Dimensions: 6.75 inches long, 3.50 inches high, 4.40 inches deep

Manufacturer: Vericom Computers, Inc.  
14320 James Road - Suite 200  
Rogers, MN 55374

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