MARCUS® 3G Rev W2
Radio Module
Installation Manual

MARCUS®
3G GPRS Radio Module

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Contents

This manual covers the following:

List of Figures and Pictures

1.1 Introduction

Welcome: Following the purchase of the MARCUS® Radio Module, there will be several factors to consider prior to its installation, including placement of the radio module and selection and placement of the GPS & Radio antenna. This Operator's Manual is designed to provide instructions for the installation of the Discrete Wireless Third Generation (3G) wireless in-vehicle hardware; MARCUS® 3G Rev W-2. This manual also provides a detailed description of the MARCUS® 3G Radio Module with optional input/outputs (I/O).

Purpose: The purpose of this document is to outline the general requirements for installing the MARCUS® Radio Module for use with the MARCUS® GPS Fleet Management Application.

Audience: This document is designed for new and experienced installers and their managers to help overcome difficulties associated with radio module installations.

Scope: This manual covers the following:
- Equipment and Tools
- Antenna Types
- Installations
- Troubleshooting

Wireless Network: The MARCUS® 3G GPRS (Global Packet Radio Service) Radio Module is optimized to be utilized on the AT&T GPRS nationwide network in the U.S., Canada and other US based GPRS Data Networks.

1.2 Overview

The purpose of the MARCUS® Web application is to track vehicles using a standard Internet connection. The overall system consists of one or more mobile devices and the Discrete Wireless Gateway. A tracking device can be easily installed inside any vehicle. The MARCUS® Radio Module can also monitor operational status and can collect data from external probes or sensors through the Sensor Connector. All of this information is transferred to the Discrete Wireless Gateway through a wireless communication link. The Discrete Wireless Gateway is capable of controlling and monitoring multiple mobile devices. The position data received from the mobile devices is transferred to the Discrete Wireless Gateway where it is displayed on a Geographical Information System (GIS) utilizing mapping technology within the Internet-based on the MARCUS® GPS Fleet Management Application.

1.3 MARCUS® 3G Radio Module Hardware

The mobile devices are small, can be easily and quickly attached to a vehicle, and will receive commands, provide GPS position data and status information to the Discrete Wireless Gateway via various wireless networks.

The GPS and wireless communication modules require additional antenna. The device is powered by an external power supply; vehicle power (9-30 volts). The devices are designed to be installed in the vehicles cab and are capable of surviving and functioning inside the vehicle. **The unit is not waterproof, nor is it designed to be placed near or on heat generating sources (in the engine compartment, attached to the heater).**

The mobile devices consist of a nylon plastic engineered housing containing the electronic components. This includes the GPRS radio modem, the GPS receiver, along with power modules capacitors and support components. Also included, are the separate power connection cable, cellular and GPS antenna with cables. A listing of all these components their size and specification is given in Appendix B. The box enclosure exterior measurements and weight for each MARCUS® 3G Radio Module is given below.

The MARCUS® 3G Radio Module – 1.375" H x 3.375" L x 4.75" W. Weight 5.7 ounces, is shown below.

1.2.1 Picture - MARCUS® 3G Radio Module

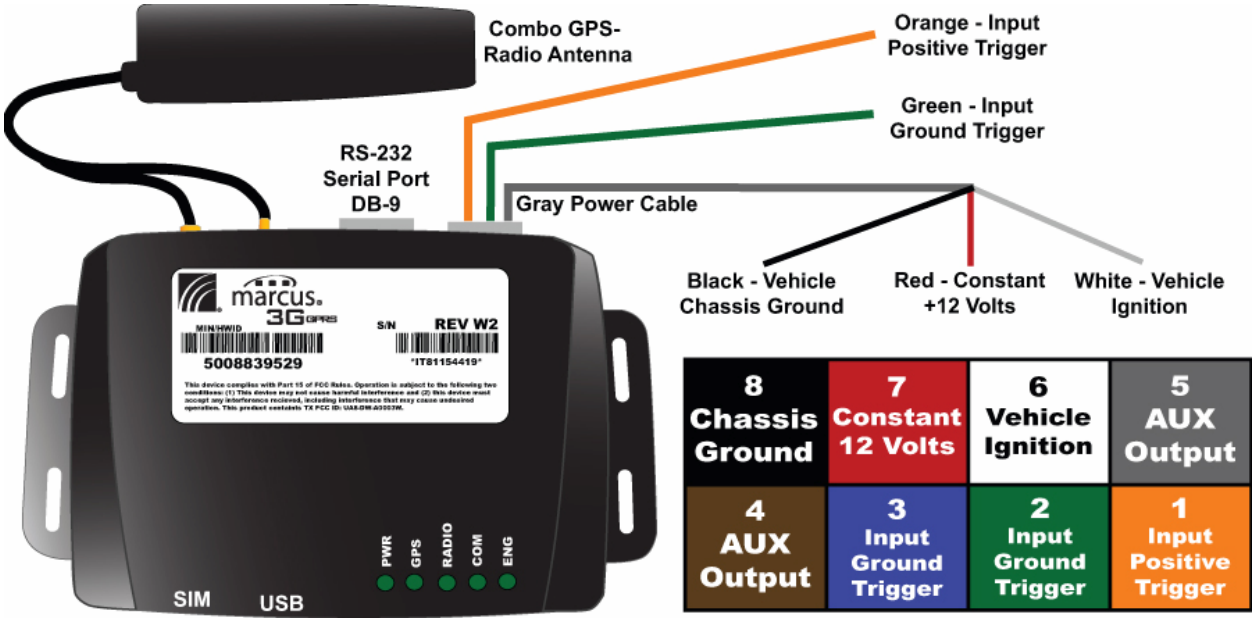
The MARCUS® 3G Radio Module has an operating temperature range of -10 degrees to +60 degrees centigrade, and operates in an extended temperature range of -30 degrees to +75 degrees centigrade for a short period of time. **Reminder: The unit is not waterproof; it is not designed to be exposed to excessive moisture or temperatures.**

External mounting tabs are provided which will allow the mobile device to be secured to the chassis of the vehicle. The box is black, and no part of the box will be less than one-eighth of an inch (1/8) thick.

The MARCUS® family of devices uses a common suite of connectors among the devices. The connector configuration is composed of dissimilar connectors to eliminate the chance of an operator incorrectly wiring the unit. Four connectors make up the connector configuration.

MARCUS® 3G Radio Module Wiring Diagrams

Figure 1.2.2 below shows the MARCUS® 3G Radio Module with a Combo GPS/Radio antenna.



2. Equipment and Tools

The following is a general list of tools and supplies required for installation of the MARCUS® 3G Radio Module.

2.1 Recommended Equipment

Digital Volt and Ohm meter (DVOM)
Screwdrivers (standard, Phillips, Torx, Hex)
Wire Strippers / Wire cutters
Coax stripper
Pliers
Razor knife
Cordless Drill
Drill bits
Wire snake
Crimping tool
Upholster removal tool
Flash light
Standard and Metric Socket set

2.2 Recommended Supplies

Electrical tape
Double sided tape
Velcro
Silicon sealant
3 amp fuses
Ground terminals
Tie-Wraps
Grommets
Crimp connectors
Butt end connectors
Sheet metal screws
18-gauge wire

3. Antennas

3.1 General Antenna Guidelines

Introduction
Among all installation variables, antenna location has the greatest impact on the performance of the radio module. Great care should be taken before selecting and installing the antennas. The standard antenna types that are used with the MARCUS® 3G Radio Module are Glass Mount Antennas. The below is an overview of these types and the recommended installation guidelines for each.

Glass Mount Antennas
The most popular type of antenna is the glass mount, 1dB gain antenna. This antenna does not require a mounting hole and is mounted on the inside glass of the vehicle's window. Observe the manufacturer's precautions when mounting the antenna near defroster wires. The defroster wires, as well as metal flake-treated windshields, can impede or stop the transfer of radio energy through the glass.

3.2 GPS Antenna

As a general rule, the placement of the GPS antenna must have a clear view of a large portion of the sky in order to be able to receive GPS satellite data. It is recommended that the GPS antenna have a clear view of at least 40 % of the sky and be as horizontal as possible. Reception is shielded by metal, but the antenna can be under such non-metallic materials such as plastic, fiberboard, fiberglass, etc. The GPS antenna should be a + 3.3V active gain (+26 dBm gain) antenna. You should always refer to the antenna manufacturer's guidelines that will be included with the antenna packaging.

3.3 RF Antenna

As a general rule, the placement of the Radio Frequency (RF) antenna is as high and vertical as possible. Windscreens, ladder racks, or other radio transmission antennas should not obstruct the antennas view of the sky. If there are other radio antennas on the vehicle, position the MARCUS RF transmission antenna at least 18 inches away. You should always refer to the antenna manufacturer's guidelines that will be included with the antenna packaging.

3.3.1 Picture - Example Placement of Glass Mount GPS and RF Antennas

3.4 Combo GPS/RF Antenna

Some configurations come with a combination GPS/RF antenna. This antenna should be placed on the center and top of the windshield with **the TX/RX side facing to the sky.**

3.3.2 Picture - Example Placement of Glass Mount GPS and RF combo Antenna

4. Vehicle Wiring

4.1 To connect power-

It is helpful to review the owner's manual of each vehicle to determine which wires are acceptable to use. Test probable wires with a digital voltmeter to determine if they have the proper voltage in both the engine running, and engine off states. It is recommended that a 14-18 gauge wire crimp be used to splice onto the proper wire. Acceptable methods of power wire installation include poke and wrap, T-taps and scotch locks.

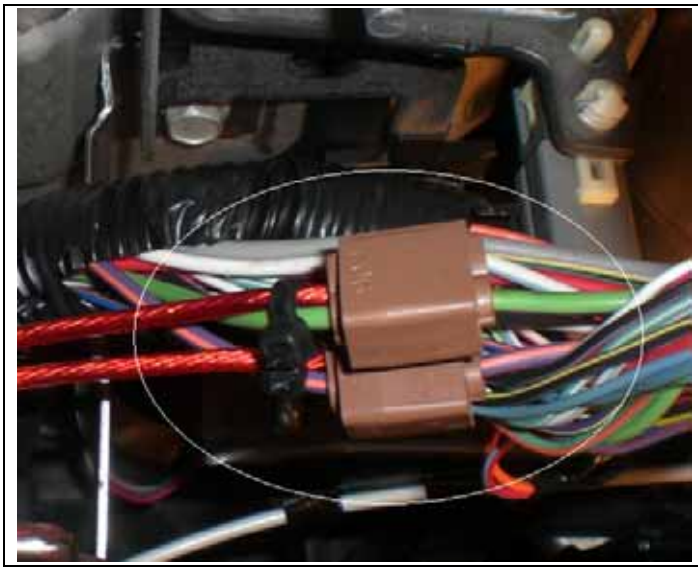
A constant power source is essential in the retention of GPS data inside the MARCUS® unit, and is REQUIRED. Be sure to verify that the power source you have chosen will work when the vehicle is not running, and the keys are removed. **Insert a 3-amp fuse in-line with the power and ignition lead. This will protect the unit against power surges and voiding the warranty.** There are 2 in-line fuses included in the installation kit.

An Ignition source is also required for proper operation of the MARCUS unit. This wire can be found in close proximity to the main power wire. **Be sure that the wire that is tapped is an ignition wire and not an accessory wire.** Some vehicles have wires that are only powered when vehicle is running, this is the preferred wire.

If there are any questions on what wire colors to use, you can contact the Field Operations Director or Supervisor

The best place to pull power is at the ignition harness leading to the ignition switch.

Make sure the ground point is WELDED not bolted to the under dash supports.



4.2 To use wire crimp

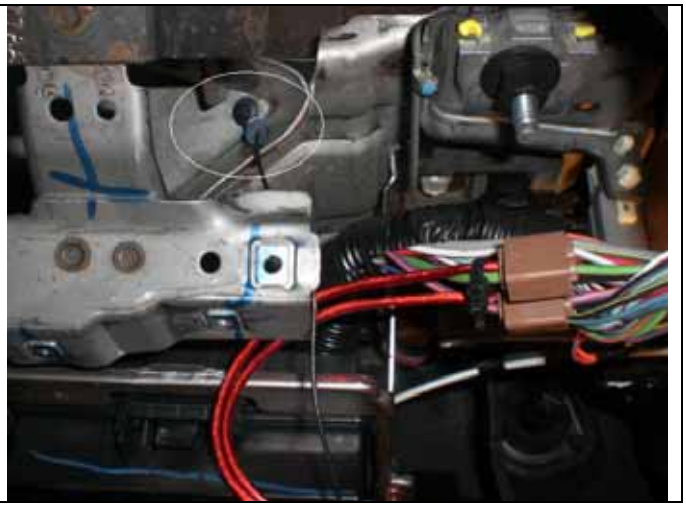
Find constant 12+v wire and slide crimp over wire. Slide red fused wire from Marcus power cable all the way into the holder and crimp with pliers. Cable tie the fused wire to the lead wire. Next, find an ignition wire that is 12+v when ignition is in the RUN position and open or ground when ignition is off. Slide crimp onto lead wire and then insert fused ignition lead into side of crimp and crimp with pliers. Cable tie the fused wire to the lead wire. Apply Torque Seal to all connections.

4.2.1 Picture - Proper use of in-line power crimp

4.3 Securing ground wire.

Strip enough slack in the power cable to allow sufficient length as to attach the black wire to a solid metal surface that is welded, not bolted to an under dash support. Add a grounding ring connector to the end of the black wire, crimp it and screw it securely onto a non painted metal frame or plate. Temporarily connect the radio module to ensure it is on constant power before final placement.

4.3.1 Picture - Proper placement of electrical ground wire



NOTE: When installing the **Marcus® 3G** unit in any late (new) model vehicle, verify all connections using a digital multi-meter. In some instances, obtaining power will require direct connection to the battery. CAN based vehicles will contain data lines which will show voltage on the line itself (usually 5V) but the line is actually a data line. Most late (new) model vehicles utilize "CAN" based ignition and accessory circuits so the ignition line running down the center of the steering column is actually a data circuit. Connecting the Marcus® 3G Module to these circuits can and will cause the unit to malfunction and may also damage the OEM electronic modules within the vehicle. **As a rule of thumb always use the thickest wires, as they carry the most amperage.**

4.4 Power Specifications

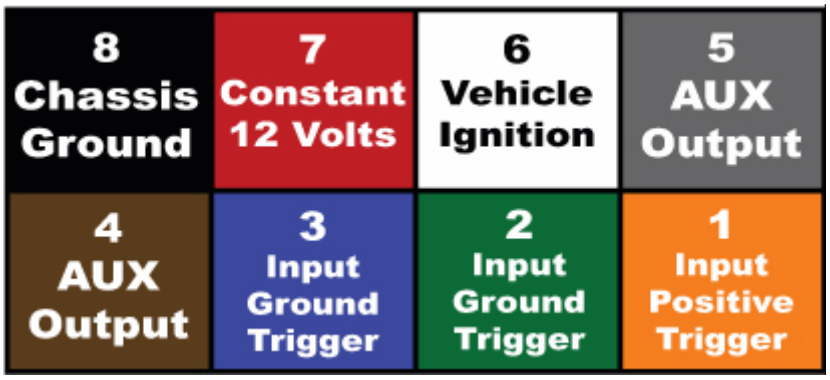
The power connector on the unit is a female Molex plug with 8 pins of which three are used to power the MARCUS® unit, and four pins are left available for sensor installations. These mate with the male Molex connector attached to the power cable. The power cable connector has a red + VDC lead, a white switched lead, and a black ground lead.

The power for each MARCUS® 3G Radio Module consumes approximately 80 milliamps while transmitting data over GPRS networks, and 35 milliamps when the unit is not transmitting or in sleep mode. In sleep mode the unit will draw the same amount of energy as the vehicles ECU.

There is an external connector for the power into the unit. The unit will operate with external vehicle power between +9 to +30 volts DC. The power supply board inside the box converts the externally supplied power to voltages needed by the system through DC-to-DC conversion components. The unit has been designed to power down in a "sleep" mode when the ignition is turned off to minimize battery drain.

All sensors and Ignition events are on a 3 second delay. When there is a state change, it will take the Marcus unit 3 seconds to accept that a state change has occurred before transmitting the ignition or sensor data.

Wiring Harness



5.4.1 Figure – MARCUS® 3G Rev W2 Radio Connector Pin Layout, as viewed from back of plug

1) **+12 Volt Input**
2) **Ground Input**
3) **Ground input**
4) **AUX Ground output**
5) **AUX Ground output**
6) **Vehicle Ignition**
7) **Constant +12 Volts**
8) **Chassis Ground**

5. Radio Module Location

The **MARCUS® 3G Radio Module** placement is dependant on several factors.

- the type of vehicle
- the placement of the antennas
- the availability of a constant 12 volt power supply

5.1 Radio Module Location

In most vehicles, the module can be placed inside or underneath the dashboard. The vehicle's radio can be removed and the unit placed behind the radio. A kick plate can be removed, and the unit can be safely secured to a firewall or zip-tied onto a permanent fixture. The module can be secured underneath the dashboard on either the driver or passenger side, in any location that will not interfere with the safety of vehicle operation. The device can be secured by the included Tie Wraps or by self taping screws or Velcro tape.

5.1 Picture - Example Placement of MARCUS® Radio Module inside dashboard

5.2 Radio Module Placement

Avoid placing the unit near moving parts, or next to any of the vehicle's pedals.

Always consider the placement of the antennas and be sure the cables can reach the desired location of the mobile.

Permanently mount the MARCUS® Radio Module

5.2 Picture - Example Placement of MARCUS® Radio Module inside dashboard

5.3 Radio Module Mounting

Connect the radio, GPS, and power cables to the MRM. Wrap any extra cable neatly with tie-wraps or electrical tape. Replace all paneling or molding that was removed in the running of any antennae wires or power cable.

(Before final placement of module, please read and complete Appendix B, vehicle wiring)

5.3 Picture - Example Placement of MARCUS® Radio Module inside dashboard

6. After Installation Testing

6.1 In the Field

The MARCUS® 3G Radio Module registers on the Discrete Wireless Gateway for the first time when it's in both radio and GPS coverage and the **ignition is switched on**. You can determine whether or not the unit is in coverage easily by the presence of solid green lights on the face of the MARCUS® 3G Radio Module. When the module is operating correctly there should be a solid green light on PWR, GPS, and COM. Note: The Radio light will flicker when transmitting.

6.2 On the Internet

It is recommended that after installation, the vehicle be driven around for 2 to 4 minutes. Through a computer connected to the Internet, using Internet Explorer 5.5 or higher, go to www.discretewireless.com and sign in using the end-users or dealers login and password. (note: Firefox browser will not work properly)

After logging into the end-users account, view the recently installed unit under the Find Tab (see **MARCUS® GPS FLEET MANAGEMENT APPLICATION USER'S GUIDE).** Check the recent history of the vehicle and verify the unit is operational.

If you have a mobile phone with an internet browser, you can go to www.trackerinstall.com and verify operation. This will also work with internet explorer, though it is designed to be read on a mobile platform. Please see the installer portal users guide for more information on trackerinstall.com

7 Troubleshooting an Installation

Problem Description	Troubleshooting Steps
Module will not power up	A) Check connection to power supply B) Check fuse holder for voltage C) Check with volt meter that there is 12-volts on the red power wire @ the plug end D) Make sure that unit is properly grounded snuggly to a non painted metal surface (chassis ground).
Vehicle will not appear on website	A) Be sure PWR, GPS, & COM are on & solid green. Check that ENG light comes on & off as the engine is turned on & off. B) Does the RADIO light flicker when the eng is turned on or off? C) Is there power to the mobile? D) Be sure to "view" the correct mobile on the MARCUS Application website. E) Check antenna connections and placement. F) Drive the vehicle. Be sure to get up to 30mph for more than 2 minutes
GPS light blinking or not on at all	A) Check all associated antenna connections. B) Ensure that nothing obstructs GPS antenna's view of the sky. (metal, concrete ceilings, rooftops, tall buildings) The GPS must be able to see at least 40% of the sky. C) Check the antenna cable for pinching or crimping in a corner. D) Reset Power
Com light not on or blinks	A) This means that the device has not been able to transmit to the Discrete Wireless Gateway. B) Check all associated antenna connections C) Ensure that nothing obstructs the RF antenna such as metallic sunscreens D) Make sure you are in AT&T coverage E) Reset Power
Idle Light not on when vehicle switched on	A) It is mandatory that the Idle wire be correctly wired to "on" power and not an accessory line. B) Test the circuit used for idle voltage with a digital volt meter

If you have any other questions, please contact Discrete Wireless Customer Support at customersupport@discretewireless.net or call 678-338-5955. You can also call the Service Administrator for your area.

Appendix A:
Installation of the MARCUS PTO/Door Sensor

The MARCUS® PTO/Door Sensor is used to gather PTO (Power Take Off) or Door (Door Open/Close) information from a vehicle. These events are recorded, and then transferred wirelessly to the Discrete Wireless Gateway and can be viewed through the MARCUS® Web Application.

The sensor can be wired to any +12-volt or -12 volt DC line that powers on and off along with the desired event. This wire can either be a 12v+ or 12v- trigger. When a vehicle's PTO is engaged, or the door is open, the current on the + or - 12-volt DC wire completes a circuit and sends a message through the MARCUS® 3G Radio Module. When the event is finished, and the + or - 12-volt DC wire loses power, a second message is sent signaling the end of the event. **All sensors need to be installed with a relay in line to ensure proper operation.**

(NOTE: Before installation of the MARCUS® sensor, Discrete Wireless Customer Service must be contacted to enable the sensor on the application. Please contact Discrete Wireless at customersupport@discretewireless.net or call 678-338-5955. Please be prepared to supply the type of sensor install, (PTO or Door) and the Min # of the MARCUS® unit the sensor will be used with.)

Connecting an Auxiliary device to the Marcus unit:

The Marcus device can be ordered with the Power Sensor Cable (PSC) if the customer needs to monitor an auxiliary device such as a PTO, Rear door, etc. The Marcus unit will accept 3 sensor inputs in addition to the Ignition input. The PSC will include 2-4 wires in addition to the Black, Red, and White. An Orange, Green, Blue Brown or Grey wire will be installed in to the harness for the auxiliary input. Depending on the type of Auxiliary device you will be connecting the Marcus unit you will either a POSITIVE trigger or a NEGATIVE trigger when the Auxiliary device is activated.

Do I have an Auxiliary device?

There are many different types of auxiliary devices that can be connected to the Marcus unit to capture an event. Many of these devices will be activated by the driver of the vehicle to perform some type of action using the vehicle, such as a PTO (Power Take Off) on a Tow truck or the sweeping device on a Street Cleaning truck. Other auxiliary devices may be installed by a technician at the time of the Marcus installation in order to capture other types of important information. One of the most common add on auxiliary devices is a Rear Door sensor (RDS). RDS are used to capture data when the rear door on a vehicle such as a box truck is opened.

Do I have a Positive or Negative trigger?

An Installation tech can determine what type of polarity your auxiliary device has by using a digital multi meter to test the auxiliary device when it is engaged.

Positive: It has been determined that the auxiliary device has a positive trigger. The ORANGE wire on the PSC will need to be connecter to the wire that is +12 volts then the auxiliary device is activated. One important thing to do when connecting a Positive trigger is to put an inline 3 amp fuse on the Orange wire between the Marcus unit and the auxiliary device. The fuse will need to be located as close to the auxiliary device as possible.

Negative: It has been determined that the auxiliary device has a Negative trigger. The GREEN wire on the PSC will need to be connected to the wire that goes to Ground when the auxiliary device is activated.

After Installation Testing

To see if your sensor is working on our website:

1) Go to www.discretewireless.com.
2) Enter your account login and password.
3) Click "**REPORTS**" and then choose either the "**Detailed Activity**" or the "**Sensor**" report.
4) If the unit is working correctly, you will see sensor data in both of these reports.

Appendix B:
Service Form

DISCRETE WIRELESS

Service Form **ST #**

Date

Discrete Wireless, Inc.
400 Northridge Road
Suite 500
Atlanta, GA 30350

Customer Service Phone: 678-338-5955
Customer Service Fax: 678-338-5957
Customer Service Email: customersupport@discretewireless.net

If there are any questions regarding any invoice(s) from Discrete Wireless, please contact us between 9 am – 5 pm eastern standard time at 678-338-5950 or via e-mail at billing@discretewireless.net. Thank you.

Customer Name:	VERTICAL EARTH				
Contact Person	AMANDA				
Customer Phone #	770-888-2224	Other:			
Customer Address	6025 MATT HWY				
City:	CUMMING	GA		Zip Code:	30041
Suite Number:					

Description of problem with units: NIT OLD UNIT STOLE

	Min #	Vehicle Name	Vin #	Tag #	Old Unit #	Sensor	Description of service preformed.
1	5004240417	MAINT TRUCK	804553	AKK9644			
2							
3							
4							
5							
6							
7							
8							
9							
10							

I agree that the installation has been performed and that the unit(s) are operational.

DW Service Form 3.0 CUSTOMER SIGNATURE _____ 5/6/2008, 4:00 PM

Appendix C:

DISCRETE WIRELESS
GPS Fleet Management System

MARCUS® 3G GPRS Technical Description and Specifications

Description of Views

Pictures and Diagram of the MARCUS® 3G Radio

Top View with LEDs MARCUS® 3G Radio Module

MARCUS® 3G Radio Module Top View

USB: USB Connector Port
SIM DOOR: SIM Tray
PWR: Device is powered
- GREEN Permanently ON - Device Functional
- Permanently OFF - No Power or Device Nonfunctional

GPS: GPS fix is valid
RADIO: GPRS modem transmitting
COM: Device online with MARCUS® Servers
ENG: Ignition is powered
- GREEN Permanently ON - Engine ON
- Permanently OFF - Engine OFF

Back View Connector Layout MARCUS® 3G Radio Module Back View

MARCUS® 3G Radio Module Back View

Left Connector: (8 pin) Power 12 Volts DC 3 wire install with optional Aux lines 3 Inputs / 2 Outputs

NOTE: Power connection must be wired in the following manner:
RED Wire = Constant 12 Volts, Pin 7
Black Wire = Chassis Ground, Pin 8
White Wire = Switched Ignition, Pin 6

RS-232/DB9 Port: Serial port connector

Center Connector: GPS Connector / SMB Male Snap-on
Right Connector: RF Connector / SMA Female Screw-on

MARCUS® 3G Radio Module Wiring Diagram

MARCUS® 3G GPRS Radio Module
DW-A0003-W2

Combo GPS - Radio Antenna: Glass mount with TX/RX side toward the glass on lower passenger side windshield.

NOTE: Sensors are connected through Pin 1-5. Power connectors are through Pins 6-8.

AUX/I Orange wire; Pin 1 can be configured to monitor powered sensors (+12 Volts trigger).

AUX/I Green wire; can be configured to monitor negative sensors (Ground trigger).

Recommended that Constant and Switched power be wired through a fused circuit (in-line fuse, 3 amps).

Important: Failure to properly wire the MARCUS® 3G Module will cause faulty operation.

DISCRETE WIRELESS

GPS Fleet Management System

MARCUS® 3G GPRS Technical Description and Specifications

MARCUS® 3G GPRS Device
FCC ID (UA80DW-0003W)

Manufacturer - Discrete Wireless, Inc. DW– A0003W2

Processor: ARM® Core, Blackfin® DSP
Dimension: 1.375" H x 3.375 L x 4.75" W
Weight: 5.7 ounces
Power: 9-26 Volts
Data Storage: Yes
Aux I/O: 5 port on power connector
USB Port: 1-Load 115.2 kbs 2-NMEA 4800bps
SIM Door: SIM Card tray externally accessible
RS-232 DB9 Port: Serial Connector

Wireless Modem

Type - Siemens Quad-band GSM/GPRS Radio Module

Frequencies: 850/900/1800/1900 MHz GPRS
Supply voltage: 3.3 - 4.5 V
Power Consumption:
- Power down ≤ 50 mA
- Sleep mode ≤ 30 mA
- GPRS class 12 600 mA

Operating Temperature:
- Normal operation: -30°C to +75°C
- Restricted operation: -30°C to 85°C
- Switch off: +90°C
- Storage: -40°C to +85°C

Specs for GPRS:
- GPRS class 12: max. 85.6 kbps
- Mobile station class B
- PBCCH support
- Coding schemes CS 1-4

Approvals: R&ETTE, FCC, UL, IC, GCF, PTCRB, e-mark, CE

Location is just the beginning.™

marcus® 3G

GPS Receiver

Manufacturer - U-blox GPS Receiver Module ANTARIS®

L1 frequency, C/A code, 16 channel
Accuracy: Position 2.5 m CEP
Start-up Times:
- Hot start <3.5 sec
- Warm start ~ 30
- Cold start ~ 35 sec
- Aided start ~ 5 sec

Signal reacquire: < 1 s
Sensitivity:
- Normal mode - 146 dBm
- High sensitivity - 150 dBm
- Weak signal tracking - 158 dBm

Power Supply: 2.3 - 3.6 V
Power Consumption:
- typ. 141 mW @ 3.0 V
- typ. 127 mW @ 2.7 V
- Sleep mode: typ. 100mA

Protocols: NMEA, UBX binary, RTCM
Operating Temp: -40°C to 85°C
Storage Temp: -40°C to 125°C
Vibration: 5Hz to 500 Hz, 5g
Shock: Half sine 30g/11ms

GPS - RF Antenna

Manufacturer - ARC Wireless Solutions, Inc.
ARC VLPA™ Wedge Mobile Antenna

GPS Electrical Specifications
Antenna Gain: 27 dB typ.
LNA Supply Voltage: 3.3 +/- 0.6 V or 5 V +/- 1 V
LNA Current Consumption: 9 mA typ., 12 mA max.
Cable Type: 8 ft
Standard Connectors: SMB Female Snap-on

GSM/GPRS/UMTS Electrical Specifications
Frequency Range:
- 806-960 MHz
- 1710-2170 MHz

Gain 2 dBi typ.
Power Rating: 10 Watts
Standard Cable Type: 8 ft.
Standard Connectors: SMA Male Screw-on

Length: 4.50 in
Width: 1.4 in
Depth: 0.63 in
Housing Material: UV Stabilized ABS Plastic, Black
Operating Temperature Range: -40°F to +194°F
Mounting Interface: Double sided adhesive tape