



**DART- 2400RT™**  
**Installation Instructions**  
**and**  
**User's Guide**

Preliminary Release

October 9, 2002



## **DART™ Firmware Release 1.0**

### **COPYRIGHT**

Copyright ©2002 Graviton, Inc.

All Rights Reserved. No part of this document may be reproduced or transmitted in any form without the prior written consent of Graviton, Inc.

Graviton Inc. transmitted in any form without the prior written consent of Graviton,  
11025 North Torrey Pines Road, Ste. 200  
San Diego 92037-1020  
858-646-0774

Preliminary edition: February 2002

Printed in U.S.A.

### **ACKNOWLEDGMENTS**

WINDOWS® and Internet Explorer are registered trademarks of Microsoft Corporation.

### **NOTICE**

The information contained in this document is subject to change without notice. Graviton, Inc. assumes no responsibility for any errors that may appear in this document, nor does it make expressed or implied warranty of any kind with regard to this material, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose. Graviton, Inc. shall not be liable for incidental or consequential damages in connection with, or arising out of the furnishing, performance, or use of this document and the hardware product and program material which it describes.

# Contents

---

	<b>Regulatory Compliance Information .....</b>	1-2
	<b>Customer Support .....</b>	1-6
<b>1</b>	<b>Introduction .....</b>	<b>1-6</b>
	<b>Overview .....</b>	1-6
	<b>About This Document .....</b>	1-9
	<b>Audience .....</b>	1-9
<b>2</b>	<b>Installation .....</b>	<b>2-9</b>
	<b>Before You Begin .....</b>	2-10
	<b>Unpacking and Inventory .....</b>	2-10
	<b>Important Safety Precautions .....</b>	2-10
	<b>Parts Substitution .....</b>	2-11
	<b>Overview of Installation Steps .....</b>	2-11
	<b>Hardware Installation Instructions .....</b>	2-11
	DART-2400RT Front Panel .....	2-11
<b>3</b>	<b>Using DART-2400RT (Operation) .....</b>	<b>1</b>
<b>4</b>	<b>Appendix .....</b>	<b>2</b>
	<b>Appendix A: Specifications .....</b>	3
	<b>Appendix B – Signal Conditioner Input / Output Summary .....</b>	4

**WARNING** – Graviton components should only be installed by qualified personnel and should not be used in a manner inconsistent with prescribed practices. Whenever electrical voltages are involved, the risk of physical injury or equipment damage exists.

## Regulatory Compliance Information

### USA

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device uses, generates, and radiates radio frequency energy. The radio frequency energy produced by this device is well below the maximum exposure allowed by the Federal Communications Commission(FCC).

**WARNING** A minimum separation distance of 20 cm.(8 inches) must be maintained between the radiating element of the transmitter and nearby persons in order to ensure compliance with FCC rules for rf exposure. This transmitter must not be co-located with other transmitters or antenna

This device complies with the limits for intentional radiator devices pursuant to Part 15 subpart C of the FCC Rules and Regulations. Operation is subject to the following two conditions:

1. This device must not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

The FCC limits are designed to provide reasonable protection against harmful interference when the equipment is installed and used in accordance with the instruction

manual and operated in a commercial environment. However, there is no guarantee that interference will not occur in a particular commercial installation, or if operated in a residential area.

If harmful interference with radio or television reception occurs when the device is turned on, the user must correct the situation at the user's own expense. The user is encouraged to try one or more of the following corrective measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that on which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## CANADA

This device meets the requirements of RSS 210, Issue 3

**To prevent radio interference to the licensed service,  
this device is intended to be operated indoors and away  
from windows to provide maximum shielding.**

**Equipment (or its transmit antenna) that is installed  
outdoors is subject to licensing.**

EU



Danish	Undertegnede Graviton, Inc. erklærer herved, at følgende udstyr Wideband Transmission System Radio overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
--------	---

Dutch	<p><b>Hierbij verklaart Graviton, Inc. dat het toestel [Wideband Transmission System Radio in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.</b></p> <p>Bij deze verklaart [Naam van de fabrikant] dat deze [naam /type van het apparaat] voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.</p>
English	Hereby, Graviton, Inc., declares that this Wideband Transmission System Radio is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
German	<p>Hiermit erklärt Graviton, Inc., dass sich dieser/diese/dieses Wideband Transmission System Radio in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet.</p> <p>Hiermit erklärt Graviton, Inc. die Übereinstimmung des Gerätes Wideband Data Transmission System Radio mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG.</p>
Greek	?? ??? ?????S? Graviton, Inc. ???O??? ??? Wideband Data Transmission System Radio S?????FO????? ???S ?S ??S?O??S ???S?S?S ???S?S ???S S?????S ???S?S ??S ???G?S 1999/5/?.
Finnish	Graviton, Inc. vakuuttaa täten että Wideband Data Transmission System Radio tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	<p>Par la présente Graviton, Inc. déclare que l'appareil Wideband Data Transmission System Radio est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.</p> <p>Par la présente, Graviton, Inc. déclare que ce Wideband Data Transmission System Radio est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables.</p>
Italian	Con la presente Graviton, Inc. dichiara che questo Wideband Data Transmission System Radio è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Portuguese	Graviton, Inc. declara que este Wideband Data Transmission System Radio está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Spanish	Por medio de la presente Graviton, Inc. declara que el Wideband Data Transmisión System Radio cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Swedish	Härmed intygar Graviton, Inc. att denna Wideband Data Transmission System Radio står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

Restrictions:

**Austria:** Use of plug-in radio devices only with host equipment and external antennas as declared by the manufacturer

**France:** Limited to 2446.5-2483.5 with some geographical constraints and e.i.r.p limited to -20dBW/MHz. Indoor: 10 mW eirp in 2400-2446 MHz.

Inside private area: 2446-2483.5 MHz with 100 mW with authorisation.

Outside private area: the band is not opened.

**Belgium:** E.I.R.P limited to 10 mW.

**Hungary:** Processing gain: min 10 dB, Antenna type: integral or external with max gain 6 dBi.

**Italy:** None If used outside of own premises, general authorisation is required.

**Luxembourg:** None System provider for third party traffic may require a telecommunications Act licence

**The Netherlands:** 10 mW licence free indoor and outdoor.

100 mW licence free indoor only. 100 mW with licence outdoor within 2451- 2471 MHz. Protection of existing use Government and ENG/OB.

**United Kingdom:** System provider for third party traffic may require a Wireless Telegraphy and/or Telecommunications Act Licence.

Model Number DART – 2400RT

## Customer Support

For customer support in the U.S., call Graviton, Inc. toll free at the following number:

1-866-GRAVITON (472-8486) M-F 8:30 – 5Pm PST

# 1 Introduction

## Overview

The Graviton DART-2400RT provides an easy-to-use wireless interface to instruments and devices through their traditional RS-232 serial communications port. The FCC approved radio operates in the unlicensed 2.4 gigahertz industrial, scientific, and medical (ISM) frequency band. The DART over-the-air protocol automatically provides transport layer functions such as error checking and retransmission as necessary.

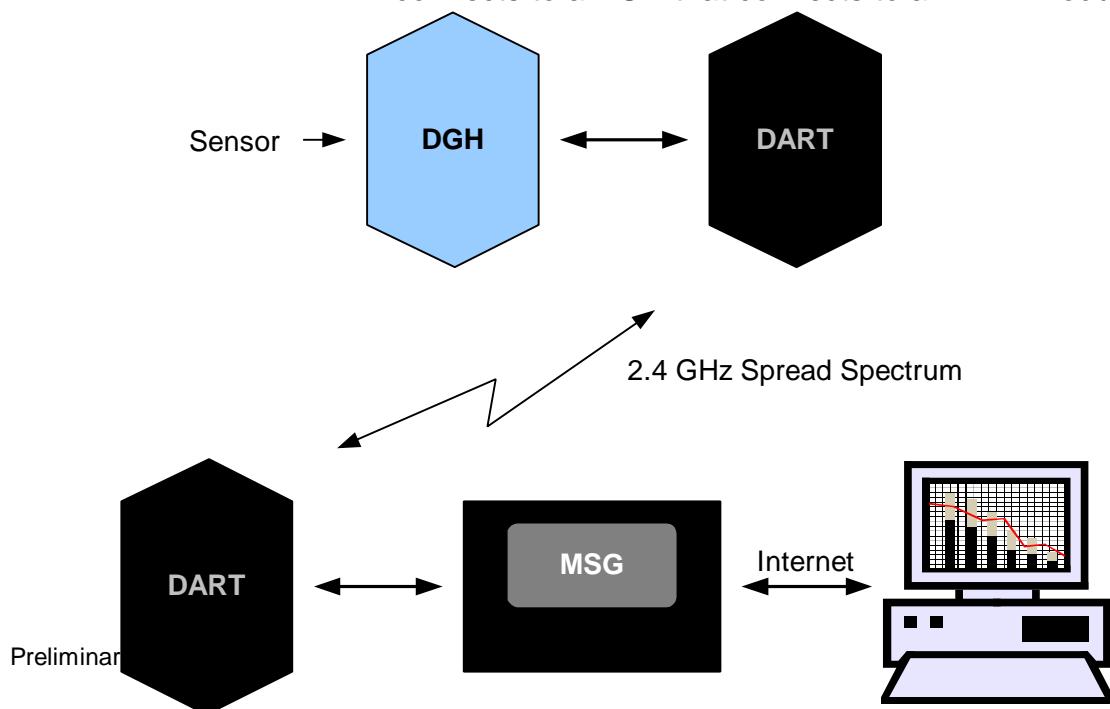
The Graviton DART<sup>TM</sup> system module and accompanying Multi-Services Gateway (MSG) provides a wireless interface between DGH D1000 and D5000 Series input/output modules and Graviton's Wireless Device Sensor Network (WDSN).

## General Working Principles

The following terms are used throughout this document:

- Sensor – a measurement device that produces a known electronic signal directly correlated to some physical property. For example, a thermistor is a temperature measurement sensor whose resistance changes as the temperature surrounding it changes. Sensor signals typically change only a very small amount per unit change of the parameter that is being measured (ohms per degree in the case of thermistor measurement of temperature) and although predictable and repeatable, are often non-linear functions (the resistance change from 25 degrees to 26 degrees is different than the resistance change from 40 degrees to 41 degrees).
- Signal Conditioner (SC) – a device that measures the electronic signal from a sensor and either converts it to a more robust analog signal (such as 4 to 20 millamps) or to a digital value (either raw “counts” or scaled to the units being measured such as degrees).
- Intelligent Field Device (IFD) – A special-purpose device that typically performs measurement and/or control functions. Examples include refrigeration and lighting controllers.
- Serial Device Radio Interface – A device that provides a RF-to-serial and serial-to-RF interface to an Intelligent Field Device.

The following figure shows block diagram for connecting the DART in a particular system. The sensor being monitored connects to a DGH that connects to a DART module that is



in close proximity. The DART module then connects with another DART to complete connection with MSG as shown (this DART is in close proximity of the MSG). The DGH unit is typically connected using the mounting screws on the DART module.

### A typical system using DART

The sensor inputs go to the DGH that converts the analog signals from the sensor to engineering units and then transmit in ASCII format to the DART host with standard RS-485 or RS-232 port. The DART module then transmits the data to another DART that is connected to the Multi Service Gateway (MSG) unit using the S-band wire less spread spectrum telecommunications link. The data received by the MSG in turn transmitted to the graviton signal processing PC that monitors and analyzes the data as well as issues commands.

## DART components

- DART-2400RT with 4-position removable screw-type terminal block attached to telesensor.
- The DART module is a single module that includes components required to support its data transport function. However, to complete any sensible monitoring system scenario, other components such as the sensors, and MSG will be required.

## About This Document

This guide includes procedures to help the installation and use of the DART module.

## Audience

Information in this guide is directed to field engineers and technicians, customer engineers, technicians, and contracted installation personnel with background in data acquisition and control systems.

## 2 Installation

This chapter lists the required hardware and software needed to install DART 2400RT and provides step-by-step instructions.

## Before You Begin

Before you install the DART module, follow the guidelines in this section to help you prepare for installation.

### Unpacking and Inventory

- Unpack the DART 2400RT and related components (if any) on a flat, clean surface at the installation site.
- Check the quantity of items received against the packing list and a copy of the purchase order to ensure that you have received your complete order.
- Inspect all components to determine that they are not damaged. If a component appears to be damaged or is missing, contact your shipper and Customer Service immediately.
- Save all packing materials.

Components:

- DART 2400RT modules
- Sensor Component Interface Models (DGH units)

### Important Safety Precautions

Observe the following protective procedures during installation:

- 10 to 30 VDC power

## Parts Substitution

Do not use substitute parts or perform any unauthorized modification of equipment. This will void your warranty and may create an unworkable condition.

## Overview of Installation Steps

Installing the DART-2400RT involves the following steps:

1. Connect the serial lines
2. Connect power

There are at least 2 DARTs that need to be configured/installed. Refer to the figure shown in the “General Working Principles” section earlier in this document.

1. Install the first DART module connected to the Multi Service Gateway (MSG) unit.

Install the second DART 2400RT module (as well as all subsequent DARTs if there are more than two DARTs in the system installation. Once completed, connect the DGH receiving inputs from the sensor(s).

All safety precautions listed in this document should be followed during the installation.

## Hardware Installation Instructions

### DART-2400RT Front Panel

The front panel of the DART-2400RT Telesensors includes a bank of LEDs, as the figure on the next page shows.



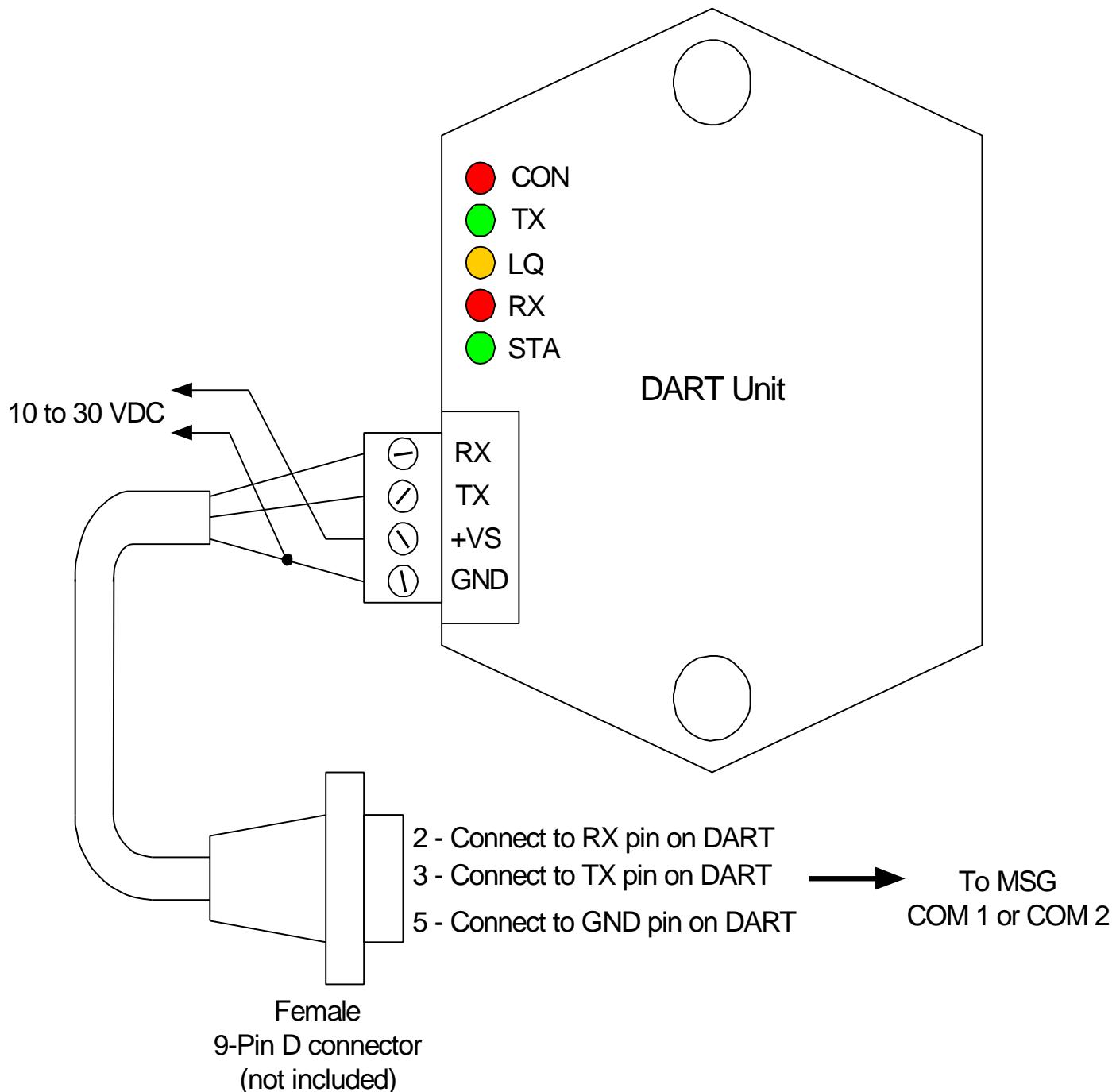
DART-2400RT Front Panel

The table below lists each LED and its corresponding function and color.

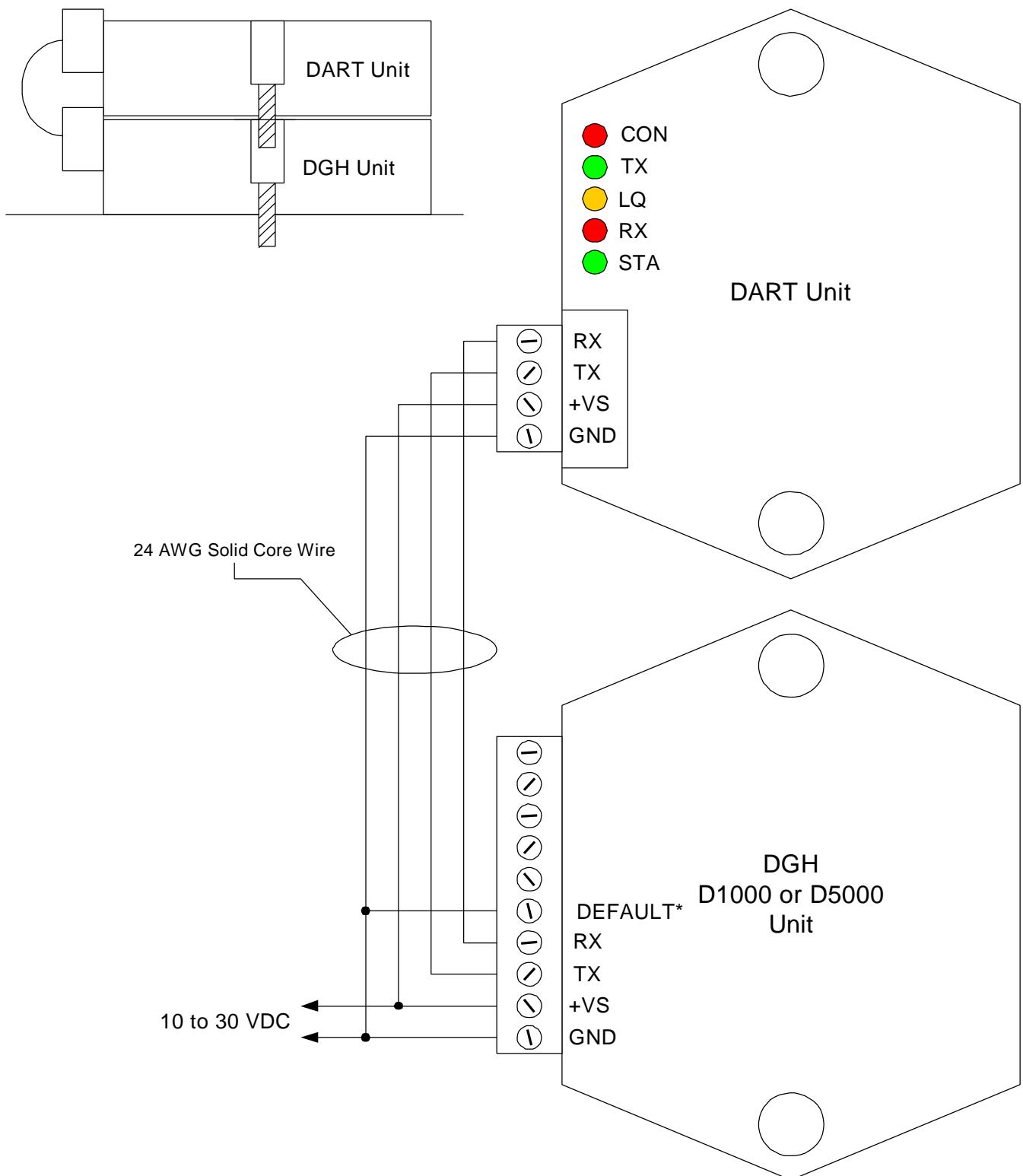
Label	Function	Color
RES	Reset Switch	N/A
CON	Control Indicator	Green
TX	Transmit	Red
LQ	Link Quality	Amber
RX	Receive	Green
STA	Status	Red

The following two diagrams show the connections that need to be completed between the DART and MSG, DART and DGH and sensor(s). The first diagram describes the connection of the DART module to the MSG equipment, while the second diagram shows the connection for the DART module to the DGH module and the connection of the sensor(s) to the DGH.

The following figure shows the front panel of the DART 2400RT module, the installation procedure uses the LEDs and connections shown.



Connection/Interface Diagram – DART to MSG



Connection/Interface Diagram – DART to DGH

1. Attach a DART to the MSG as shown in the first diagram noted above. This unit will act as the MASTER

CON - Solid RED

TX - Not illuminated

LQ - Solid ORANGE

RX - Not illuminated

STA - Solid GREEN

2. Connect a DART module to the DGH module as shown in the second diagram noted above. After 6 seconds, the indicators should be lit as follows:

CON - Solid RED

TX - Not illuminated

LQ - Flashing when an interface DART is connected to an MSG

RX - Not illuminated

STA - Solid GREEN

### Precautions

1. If using stranded wire it is recommended that the ends be tinned with solder before they are connected to the screw terminals on the DART or DGH units.
2. When multiple wires are connected to the same screw terminal on a DART or DGH connector, they should be soldered together.

3. If the LQ light on a DART-DGH combination is solid ORANGE, double check the TX and RX connections between the DART and the DGH units. Also verify that the default signal is connected to GND on the DGH unit.



### 3        Using DART-2400RT (Operation)

Once the DART unit is connected to an MSG, this unit will act as the MASTER to receive data from all other DART/DGH units. This is indicated by the solid LQ LED.

The DART units that are attached to external sensor devices (i.e. DGH) will act as SLAVE units reporting to the MASTER associated with the MSG.

Contact your system administrator to determine what the reporting rate has been configured for on each of the SLAVE DART units.

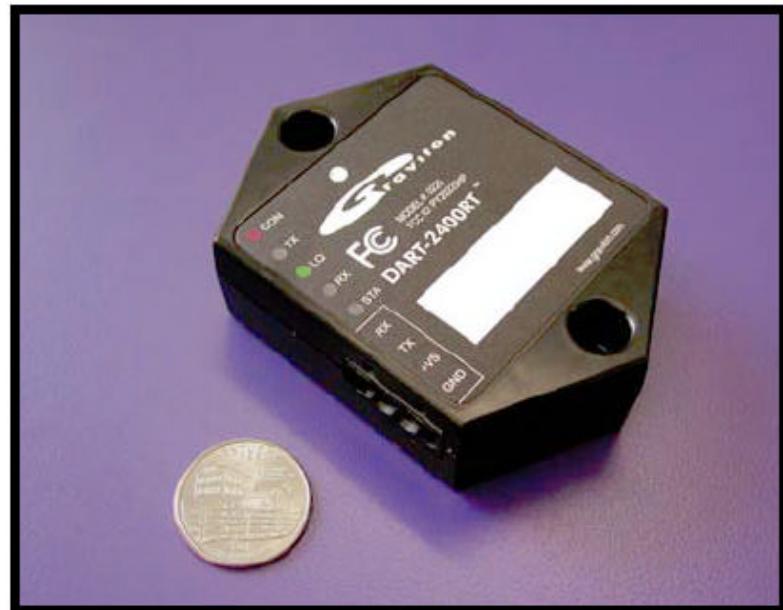
After the connection and installation of a SLAVE unit, verify the unit is reporting by watching the SLAVE unit TX & RX LED's to confirm communication between the SLAVE and associated MASTER.

Consult the MSG 1.5 Manual for an explanation of the reporting and diagnostic features for the associated telesensor product application.

## 4 Appendix

Appendix A lists the product specifications.

Appendix B provides a summary of the signal conditioner functions that are recommended for use with the DART.



## Appendix A: Specifications

Contact your system administrator to determine what the reporting rate has been configured for on each of the SLAVE DART units.

### **I/O Interface:**

Type: RS-232C (2-wire); daisy chain  
Protocol: DGH ASCII  
Data rate: up to 19.2 kbps

### **Radio transmitter / receiver:**

Frequency: 2.4 GHz (unlicensed ISM band; complies with FCC part 15.247 regulations, Industry Canada RSS 210, Issue 3, and R&TTE standards EN 300 328:1996 and EN 301 489-17:2000)

Channels: 53

Transmitter power levels:

High power: 100 mW  
Mid-high power: 25 mW  
Mid-low power: 6.3 mW  
Low power: 1.5 mW

Data modulation: FSK Direct Sequence Spread Spectrum

Range: 330 m under ideal conditions

### **Power:**

Unregulated 10-30VDC; 9 W max.

### **Mechanical:**

Dimensions: 3.6" x 2.5" x 0.9"

Weight: 2 oz.

### **Environmental:**

Temperature:

Operating: -25°C to +70°C

Storage: -25°C to 85°C

Humidity:  
0 to 95% non-condensing

## **Appendix B – Signal Conditioner Input / Output Summary**

Consult the DGH Users manual for specific DGH module for further information summarizing the protocol used to communicate and the signal conditioner functions that are recommended for use with the DART.

## Index

---

- appendices, 2
- battery
  - IEEE recommended maintenance, 4
- BattGuard
  - components, 1-6, 2-7
  - front panel LEDs, 2-8, 2-9
  - screen overview, 1
- customer support
  - contacting, 1-3
- front panel LEDs, 2-8, 2-9
- IEEE recommended battery maintenance programs, 4
- installation, 2-7
  - components, 2-7
  - hardware, 2-8
  - overview, 2-8
- safety precautions, 2-7, 2-8
- substituting parts, 2-8

,