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1746 Weigh Scale Module

Model HM-604-WM

Instruction Manual

February, 2010
Rev 1.3

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. "Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls" (Allen-Bradley Publication SGI-1.1) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will the Allen-Bradley Company or Helm Instrument Company be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, the Allen-Bradley Company or Helm Instrument Company cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Allen-Bradley Company or Helm Instrument Company with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual we use note to make you aware of safety considerations.

ATTENTION: Identifies information about practices or circumstances that can lead to property damage. Identifies information that is especially important for successful application and understanding of the product.

Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

ATTENTION: Please check power supply ratings before proceeding! Each tonnage module consumes (+24V @ 85.2mA +5V @ 79.9mA). Be sure to not overload the power supply.

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Preface

Read this preface to familiarize yourself with the rest of this manual. This preface covers the following topics:

- who should use this manual
- the purpose of this manual
- terms and abbreviations
- conventions used in this manual
- Allen-Bradley support

Who Should Use this Manual

Use this manual if you are responsible for the design, installation, programming, or maintenance of an automation control system that used Allen-Bradley small logic controllers.

You should have a basic understanding of SLC 500 products. You should understand electronic process control and be able to interpret the ladder logic instructions required to generate the electronic signals that control your application. If you do not, contact your local Allen-Bradley representative for the proper training before using this product.

Purpose of This Manual

This manual is a learning and reference guide for the Helm Weigh Scale Module. It contains the information you need to install, wire, and use the module.

Contents of this Manual

Chapter	Title	Content
	Preface	Describes the purpose, background, and scope of this manual. Also specifies the audience for whom this manual is intended and defines key terms and abbreviations used throughout this book.
1	Overview	Provides a hardware and system overview. Explains and illustrates the components of the system.
2	Installation and Wiring	Provides installation information and wiring guidelines.
3	Channel Configuration, Data and Status	Examines the channel configuration and the channel status word, and explains how the module uses configuration data and generates status during operation.
4	Ladder Programming Examples	Gives an example of the ladder logic required to define the channel for operation. Also includes representative examples for unique requirements such as sample count, trend calculation, etc.
5	Troubleshooting	Explains how to interpret and correct problems that occur while using the load module.
A	Specifications	Provides physical, electrical, Environmental, and functional Specifications for the module.
B	Ladder Program	

Related Documentation

The following documents contain information that may be helpful to you as you use Allen-Bradley SLC products. To obtain a copy of any of the Allen-Bradley documents listed, contact your local Allen-Bradley office or distributor.

For	Read this Document	Document Number
An overview for the SLC 500 family of products	SLC 500 System Overview	1747-2.30
A description on how to install and use your *Modular* SLC 500 programmable controller	Installation & Operation Manual for Modular Hardware Style Programmable Controllers	1747NI002
A description on how to install and use your *Fixed* SLC 500 programmable controller	Installation & Operation Manual for Fixed Hardware Style Programmable Controllers	1747-NI001
A procedural and reference manual for technical personnel who use an HHT to develop control applications	Allen-Bradley Hand-Held Terminal User's Manual	1747-NP002
An introduction to HHT for first-time users, containing basic concepts but focusing on simple tasks and exercises, and allowing the reader to begin programming in the shortest time possible	Getting Started Guide for HHT	1747-NM009
A resource manual and user's guide containing information about the analog modules used in your SLC 500 system	SLC 500 Analog I/O Modules User's Manual	1746-NM003
A complete listing of current Automation Group documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages	Automation Group Publication Index	SD499
A glossary of industrial automation terms and abbreviations	Allen-Bradley Industrial Automation Glossary	ICCG-7.1
An article on wire sizes and types for grounding electrical equipment	National Electrical Code	Published by the National Fire Protection Association of Boston, MA.

Terms and Abbreviations

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here refer to *Allen-Bradley's Industrial Automation Glossary*, Publication ICCG-7.1.

Calibration - Procedure, performed by trained personnel, where machine or press is dynamically loaded to impact on load cells. A process of linearity measuring to determine the loading capacity of the machine.

Calibration Number - Amplification values established during machine calibration or pre-assigned on force load cells.

Channel - Refers to one of two, strain gage inputs available on the modules terminal block.

Chassis - A hardware assembly that houses devices such as I/O modules, adapter modules, processor modules, and power supplies.

Configuration Word - Contains the channel configuration information needed by the module to configure and operate each channel. Information is written to the configuration word through the logic supplied in your ladder program.

Data Word - A 16-bit integer that represent the value of the analog input channel. The channel data word is valid only when the channel is enabled.

Gain - Amplification of an input signal.

Load/Force - Measurement of impact during a machine cycle. Sensors provide the input for this measurement.

LSB - (Least Significant Bit) Refers to a data increment defined as the full scale range divided by the resolution. The bit that represents the smallest value within a string of bits.

Remote Configuration - A control system where the chassis can be located several thousand feet from the processor chassis.

Resolution - The smallest detectable change in a measurement, typically expressed in engineering units (e.g. 0.15C) or as a number of bits. For example a 12-bit system has 4,096 possible output states. It can therefore measure 1 part in 4096.

Sample - Load/force values established from a series of machine cycles. Also defined as benchmark.

Sampling time - The time required by the A/D converter to sample an input channel.

Scale - Value used to describe the press/machine overall tonnage. Set for maximum value of one channel. For example, settings for a 150 ton press = 75.

Status Word - Contains status information about the channel's current configuration and operational state. You can use this information in your ladder program to determine whether the channel data word is valid.

Update Time - The time required for the module to sample and convert the input signals of all enables input channels and make the resulting data values available to the SLC processor.

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.

Product Support

Contact your Helm representative or call Helm direct at 419-893-4356:

- sales and order support
- product technical training
- warranty support
- support service agreements

Your Questions or Comments on this Manual

If you have any suggestions for how this manual could be made more useful to you, please send us your ideas.

Chapter 1

Overview

You have just purchased the most advanced load monitoring solution available. HELM INSTRUMENT COMPANY, INC. manufactures a complete line of load monitoring control solutions for use on metal stamping, forging, compaction and assembly presses; cold forming, cold heating, injection molding and die cast machines.

Standard or custom transducers and load cells are available for in-die monitoring of transfer or progressive tooling.

At HELM, quality is inherent not only in the design of our products but in the attitudes of our employees as well. We're working together to give you the best. After all, that's what our business is all about - providing innovative instrumentation to help make your manufacturing process more productive and your operation more effective.

The Helm Weigh Scale combines machine and tooling monitoring with programmable limit switch function. User programmable high and low limits protect the machine and tooling to ensure part quality.

Critical setup information can be stored and uploaded as part of a die recipe program. An optional resolver input module is used to compare machine/press tonnage to crank angle for real time signature analysis.

Components

The Helm Weigh Scale module is attached to the controller backplane. The system is comprised of two parts; the input module and two strain gage based sensors.

Strain Gain Transducer Operation

The primary part of the load monitoring system centers around the measurement. The basic function of the strain gain sensor is to detect the amount of deflection imposed on the press or die as parts are being formed. All Helm Strain Gain sensors are matched to within 1% and therefore can be replaced without recalibration of the machine.

The Helm Strain Gain sensors can be mounted to strategic high stress areas of the machine frame or strategically located in tooling or applied to stop blocks. Signals from these sensors are routed to the Weigh Scale module for processing. The Helm Strain Gage is capable of measuring either a tension or compression
signal.

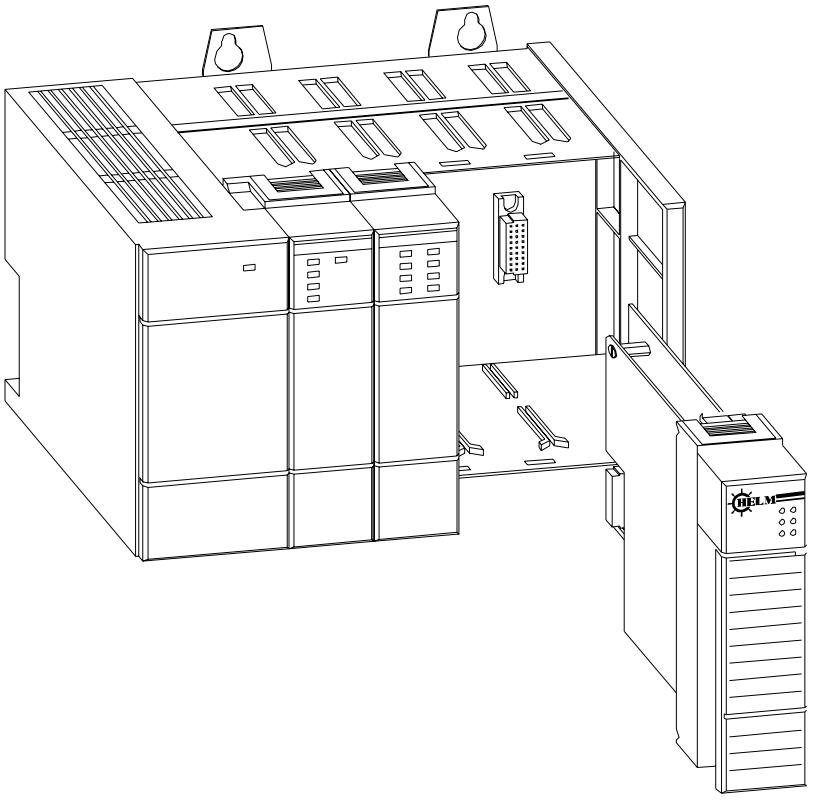
Hardware Overview

The Weigh Scale is a Class 1 module (uses eight input words and eight output words). It interfaces to strain gage based transducers (350ohm or 700ohm).

The module can accept input from two sensors. The module has no output channels. Module configuration requires manual and user programmable setup.

The Weigh Scale module receives and stores digitally converted analog data into its image table for retrieval by processor. The module supports connections from any combination of up to two strain gage sensors.

Any combination of Helm Strain Gage sensors can be used. Contact Helm for additional information on the type and application of different sensor options.



Chapter 2

Getting Started

This chapter can help you to get started using the Helm Weigh Scale module. The procedures included here assume that you have a basic understanding of PLC products. You should understand electronic process control and be able to interpret the ladder logic instructions required to generate the electronic signals that control your application.

Because it is a start-up guide, this chapter does not contain detailed explanations about the procedures listed. It does, however, reference other chapters in this book where you can get more information about applying the procedures described in each step. It also references other SLC documentation that may be helpful if you are unfamiliar with programming techniques or system installation requirements.

If you have any questions or are unfamiliar with the terms used or concepts presented in the procedural steps, always read the referenced chapters and other recommended documentation before trying to apply the information.

This chapter will:

- Tell you what equipment you need
- Explain how to install and wire the module
- Show you how to set channels for the sensor input

Required Tools and Equipment

Have the following tools and equipment ready:

- Small blade screwdriver
- Appropriate strain gage cable
- Programming equipment (All programming examples shown in this manual demonstrate the use of Allen-Bradley's RS Logix 500).

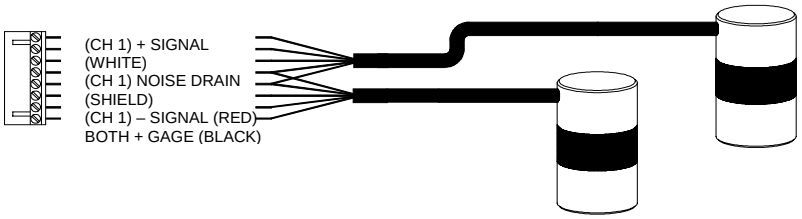
System Operation

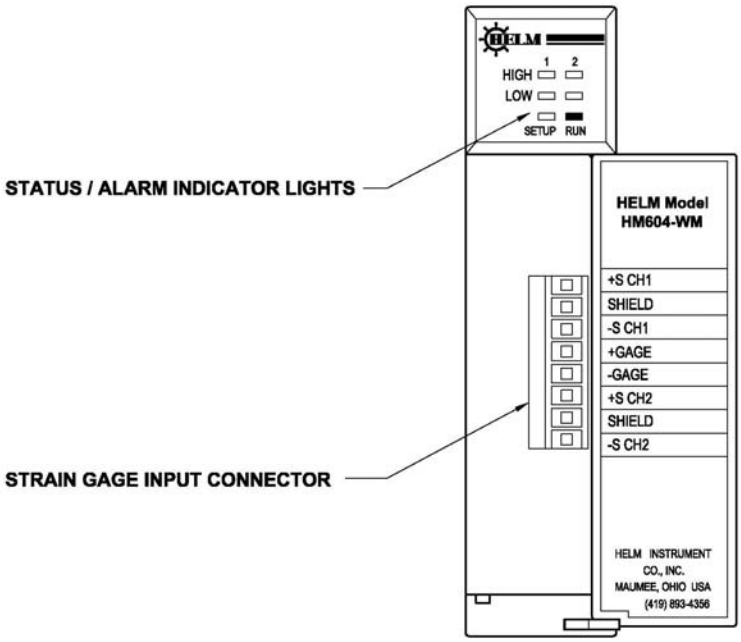
The HM-604-WM module communicates to the SLC processor through the parallel backplane interface and receives +5Vdc and +24Vdc power from the SLC power supply through the backplane. No external power supply is required. You may install as many HM-604-WM modules in your system as the power supply can support.

Each individual channel on the module can receive input signals from strain gage based sensors. The module converts the analog values directly into digital values.

Sensor Wiring

The module contains an 8-pin orange connector for wiring to the load cells. The pin-out is shown below.





To ensure proper operation and high immunity to electrical noise, always use Helm strain gage cable.

To limit noise, keep strain gage cable as far away as possible from power and load lines.

The module can support up to two sensor inputs DO NOT attempt to parallel additional gages as you will cause damage to the module and void product warranty.

Module Addressing

This chapter explains how the HM-604-WM module and the SLC processor communicate through the module's input and output image. It lists the preliminary setup and operation required before the module can function in a 1746 I/O system.

HM-604-WM Module ID Code 3535

The module identification code is a unique number encoded for each 1746 I/O module. This code defines for the processor the type of specialty I/O module residing is a specific slot in the chassis. With RS Logic 500 software, manually enter the module ID code.

No special I/O configuration (SPIO CONFIG) information is required. The module ID code automatically assigns the correct number of input and output words. The following memory map shows how the output and input image tables are defined.

Output Image

The 8 word output image (output from the CPU to the module) contains Information that you configure to define the way a specific channel will work. Example – If you want to configure channel 2 on the module located in slot 4 in the SLC chassis, your address would be O:4.2.

(o = file type : =element delimiter 4=slot .=word delimiter 2=word)

Bit	Set / Run	O:e.0/0
Bit	Initialize Balance	O:e.0/1
Bit	Read Balance	O:e.0/2
Bit	Vibration Filter 0=Off 1=On	O:e.0/5
Bit	Channel 2 Trim	O:e.0/6
Bit	Coarse Zero Up Adjust	O:e.0/7
Bit	Channel 1 Trim	O:e.0/8
Bit	Read Trim	O:e.0/9
Bit	Save Eprom	O:e.0/10
Bit	Reserved	O:e.0/11
Bit	Coarse Zero Down Adjust	O:e.0/12
Bit	Clear Tare	O:e.0/13
Bit	Tare	O:e.0/14
Bit	Channel Toggle 0=CH1 1=CH2	O:e.0/15
Integer	Channel 1 Scale value	O:e.1
Integer	Channel 2 Scale value	O:e.2
Integer	Channel 1 mV/V Setting	O:e.3
Integer	Channel 2 mV/V Setting	O:e.4
Integer	Sample Set	O:e.5
Bit	Filter Select Bits	O:e.6/0
Bit	Set Motion Stabilization Filter (MSF) range from -0.002% to +0.001% of full scale	O:e.6/1
Bit	Set Motion Stabilization Filter (MSF) range from -0.004% to +0.002% of full scale	O:e.6/2
Bit	Set Motion Stabilization Filter (MSF) range from -0.008% to +0.004% of full scale	O:e.6/3
Bit	Set Motion Stabilization Filter (MSF) range from -0.010% to +0.005% of full scale	O:e.6/4
Bit	Set Zero Dead Band to 0.025% of full scale	O:e.6/5
Bit	Set Zero Dead Band to 0.05% of full scale	O:e.6/6
Bit	Set Zero Dead Band to 0.075% of full scale	O:e.6/7

Output Image (cont.)

Channel 1 Trim Bit
Factory set bit to load Channel 1 trim value into module (Not for end user)

Channel 2 Trim Bit
Factory set bit to load Channel 2 trim value into module (Not for end user)

Coarse Zero Up Adjust Bit
Used to increase offset of amplifier to set to range of A/D.

Coarse Zero Down Adjust Bit
Used to decrease offset of amplifier to set to range of A/D.

Clear Tare Bit
Resets or removes tare value from module. (Used to initially setup module)

Tare Bit
Sets weigh value to zero.

Channel Toggle Bit
Used to switch from Channel 1 to Channel 2 when setting up channels.

Channel 1 Scale Value
Value of scale from capacity of load cell for Channel 1.

Channel 1 mV/V Setting
4 digit mV/V setting from load cell mV/V specification.

Channel 2 Scale Value
Value of scale from capacity of load cell for Channel 2.

Channel 2 mV/V Setting
4 digit mV/V setting from load cell mV/V specification.

Average Samples / Vibration Filter Setting

Vibration Filter Bit
Enables vibration filter to cancel out load variation due to mechanical noise
0 = Disable 1 = Enable
Enter the setting on O:e.5
Sets number of samples (for averaging) of weigh value. (0-200)
or vibration filter setting when vibration filter bit(O:e.0/5) is on.
Vibration Filter ON: 1 sample count equals 5msec
Vibration Filter OFF: Standard average 1 sample count equals 1msec

The Vibration Filter feature eliminates the effects of mechanical noise. By eliminating the factor of vibratory force, the module can capture the accurate weight data. Helm module provides the flexible settings to cover different range of vibration frequencies.

Data Table Input Image

The 8-word module input image (input from the module to the CPU) represents data words and status words. Input words (data words) hold the input data that represents the values of the sensor inputs.
Input words (status bits) contain the various status conditions and reflect the configuration settings you have entered into the output configuration words.

(I =file type : =element delimiter 2 =slot . =word delimiter 0 =word / 2 =bit)

Bit	CH1 Sign Bit	I:e.0/0
Bit	CH2 Sign Bit	I:e.0/1
Bit	Trim Mode	I:e.0/2
Bit	Reserved	I:e.0/3
Bit	Reserved	I:e.0/4
Bit	Reserved	I:e.0/5
Bit	Reserved	I:e.0/6
Integer	Channel 1 Weigh Value	I:e.1
Integer	Channel 2 Weigh Value	I:e.2
Integer	Reserved	I:e.3
Integer	Reserved	I:e.4
Integer	Reserved	I:e.5
Integer	Reserved	I:e.6
Integer	Reserved	I:e.7

Calibrate Mode Bit (I:e/2)
If set, module is in trim mode. Bit should always be clear.

Channel 1 Sign Bit (I:e/0)
If Channel 1 signal is positive value, Bit = 0 and negative value Bit = 1.

Channel 2 Sign Bit (I:e/1)
If Channel 2 signal is positive value, Bit = 0 and negative value Bit = 1.

Channel 1 Weigh Value (I:e.1)
Weigh value for Channel 1

Channel 2 Weigh Value (I:e.2)
Weigh value for Channel 2.

Setup Procedure

A complete listing of a sample ladder logic program is included at the back of this manual. Examples shown here are for reference.

All values are 0 (default) on initial start-up. This means that all alarms are disabled. You must make the following adjustments for proper operation:

- **Balance sensor input(s)**
- **Set Calibration numbers**

Step 1. Balance Sensor Input.

1. Set module to Setup Mode
2. Set Initialize Balance bit.
3. Press Clear Tare pushbutton.
4. Use Up and Down buttons to set amplifier to low range of A/D (20,000 counts). Only needed if sensor has pre-load.
5. Press Zero/Tare pushbutton.
6. Set module to Run Mode.

Step 2. Set Calibration Numbers

1. Set module to Run Mode.
2. Set Scale to capacity of load cell.
3. Set mV/V to load cell specification.
4. Example:

   100 ton load cell, 2.025 mV/V

   For scale set, enter 100

   For mV/V set, enter 2025

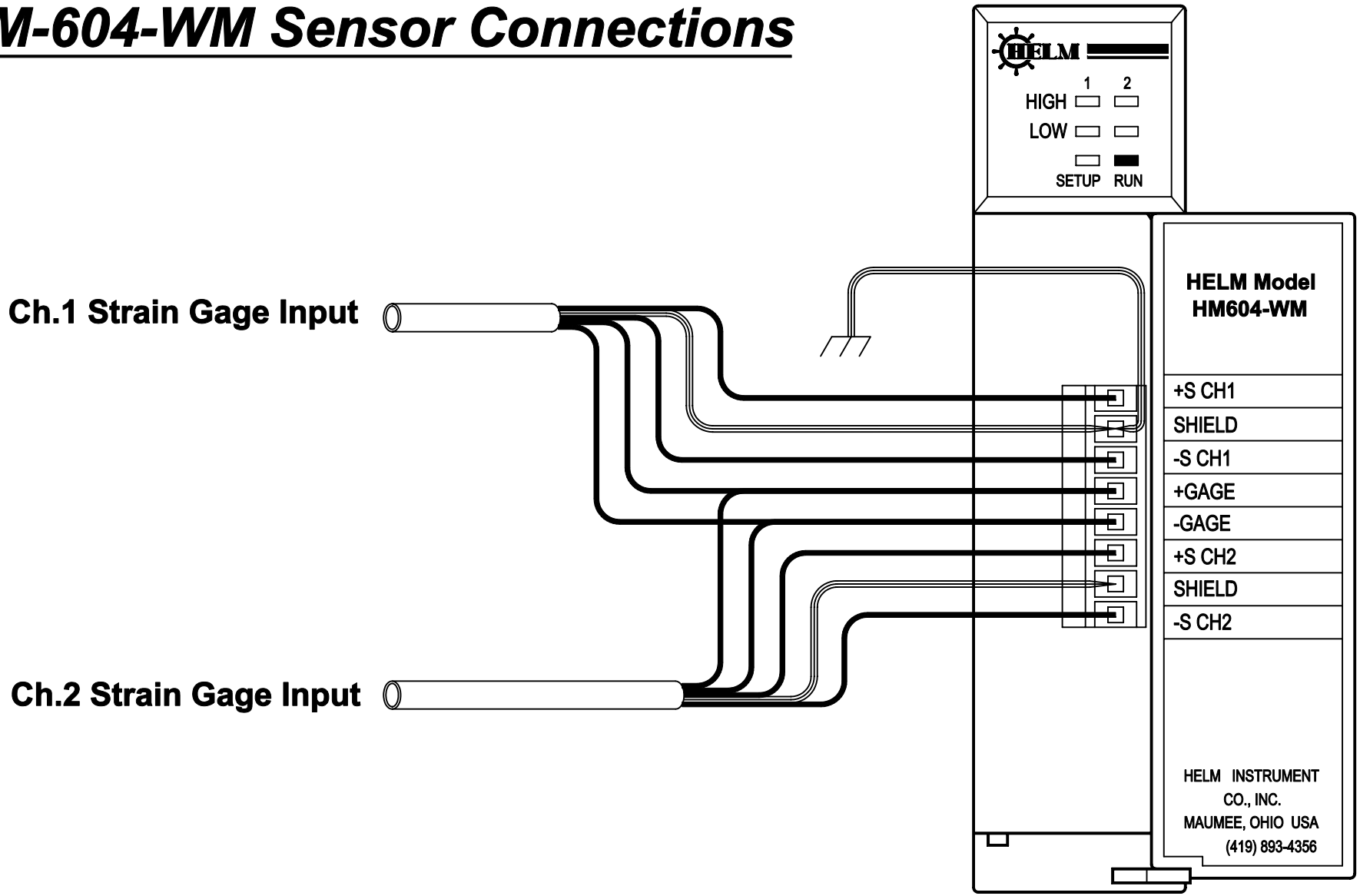
HT-400 Sensor Ohm Readings:

Green-Black	350 ohms
Red-White	350 ohms
All other color combinations	266 ohms
All colors to Ground	open
Shield to Ground	open

Electrical Specifications:

Backplane Power Consumption	**24V @ 85.2mA** **5V @ 79.9mA**
Type of input	**Strain Gage (350 ohm, 700 ohm)**
Input Impedance	**10k**
Display Resolution	**Up to .0025% of full scale**
Module Update Time	**1 msec**
Number of Channels	**2 (isolated)**
A/D Conversion Method	**Successive Approximation - 16 bit**
Normal Mode Rejection: (between +/- input)	**116DB CMRR**
Amplifier Bandwidth	**200 kHz**
Calibration	**Software Selectable**
Isolation:	**500 VDC continuous between inputs and chassis ground, and between input and backplane**
LED indicators	**2 LED's for Mode Status**
Operating Temperatures	**0°C to 60°C (32°F to 140°F)**
Hazardous Environment Classification	**Class 1 Division 2 Hazardous Environment**

HM-604-WM Sensor Connections



NOTES:

1.) MINIMUM INPUT OHMS/CHANNEL: 350 w/STD. 4V GAGE SUPPLY.

2.) MINIMUM INPUT OHMS/CHANNEL: 175 w/OPTIONAL 2V GAGE SUPPLY.

HELM INSTRUMENT CO., INC.
MAUMEE, OHIO USA

SCALE:	FULL	DESIGNED BY:	M.H.L.	DRAWN BY:	M.H.L.
DATE:	09/28/09	CHECKED BY:	R.J.G.	APPROVED BY:	R.J.G.
TITLE:	HM-604-WM SENSOR CONNECTIONS (HELM)				
DRAWER:		DRAWING NUMBER:	E1148W03		

ch1 weigh value

0000

MOV
Move
Source I:2.1
32255<
Dest N10:1
32255<

ch2 weigh value

0001

MOV
Move
Source I:2.2
-3<
Dest N10:2
-3<

ch1/ch2 toggle bit
0 = ch1
1 = ch2

0002

N10:0
0

O:2
15
OTHER

tare bit

0003

N10:0
1

O:2
14
OTHER

clear tare bit

0004

N10:0
2

O:2
13
OTHER

down coarse zero bit

0005

N10:0
3

O:2
12
OTHER

ch1 adtrim set bit
factory set only

0006

N10:0
4

O:2
8
OTHER

up coarse zero bit

0007

N10:0
5

O:2
7
OTHER

vibration filter on/off bit
1 = on, 0 = off

0008

N10:0
15

O:2
5
OTHER

ch2 adtrim set bit
factory set only

0009

N10:0
6

O:2
6
OTHER

setup - run bit
0 = setup
1 = run

0010
N10:0
7
O:2
0
OTHER

initialize coarse zero bit

0011
N10:0
8
O:2
1
OTHER

read balance value bit

0012
N10:0
9
O:2
2
OTHER

read adtrim value bit

0013
N10:0
10
O:2
9
OTHER

save to eeprom bit

0014
N10:0
11
O:2
10
OTHER

dither 1_2

0015
N10:8
0
O:2
96
OTHER

dither 2_4

0016
N10:8
1
O:2
97
OTHER

dither 4_8

0017
N10:8
2
O:2
98
OTHER

dither 5_10

0018
N10:8
3
O:2
99
OTHER

zeroband_01

0019
N10:8
4
O:2
100
OTHER

zeroband_025

0020
N10:8
5
O:2
101
OTHER

zeroband_05

0021

N10:8 6 — O:2 101 OTHER

zeroband_075

0022

N10:8 7 — O:2 102 OTHER

ch1 scale set

0023

MOV Move Source N10:3 10000< Dest O:2.1 0<

ch2 scale set

0024

MOV Move Source N10:4 10000< Dest O:2.2 0<

ch1 mv/v set

0025

MOV Move Source N10:5 2000< Dest O:2.3 0<

ch2 mv/v set

0026

MOV Move Source N10:6 2000< Dest O:2.4 0<

samples setting

0027

MOV Move Source N10:7 100< Dest O:2.5 0<

ch1 sign bit

0028

I:2 0 OTHER — N10:0 12

ch2 sign bit

0029

I:2 1 OTHER — N10:0 13

adtrim mode bit (factory set only)

0030

I:2
2
OTHER

N10:0
14

0031

END