DMS 5000 manual

CHAPTER 1 - INTRODUCTION

GENERAL

The DMS-5000 is the most accurate air coupled ultrasonic distance measurement system available. It is designed to be used in industrial environments requiring measurement accuracies as small as two ten thousandths of an inch. Almost any surface, liquid or solid, can be used as a measurement target. Since there is no physical contact or loading, a true measurement is obtained. You will find the system software permits a variety of total system solutions to measurement and control application problems. The DMS-5000 can be used as a stand alone system or it can interface to other control devices such as programmable controllers, personal computers and microcomputers. Applications include: distance measurement, position monitoring, differential thickness measurement and target perpendicularity.

FIRST LOOK AT THE DMS-5000

The DMS-5000 is composed of one transducer and cable, mounting hardware, installation hardware and the controller housed in a NEMA 13 electrical enclosure. All components of the system are designed to be rugged; however, two areas require special care. The first is the foil surface of the transducer; it should never be touched by fingers or anything else. The second is the calibration reference bar in front of the foil surface which should never be bent or in any way distorted. An environmental filter for each transducer is supplied with the unit to protect the transducer face and an air hood is provided to mechanically protect the transducer and reference bar.

WARNING: Do not use high pressure air or water to clean the transducer area. Sparks from welding or cutting torches should also be prohibited. Completely protect the transducer area if any of the above procedures are necessary.

The 5 digit display on the controller is visible with the enclosure door open or closed; the door can be opened by rotating the door latch screw 90 degrees counter-clockwise with a flat blade screwdriver. Two buttons on the main board are used to program the unit for individual applications. A second set of buttons located on the outside of the door perform the same functions and may be locked by using the key switch on the enclosure door.

OPERATING ENVIRONMENT

The DMS-5000 is designed to be used in factory and mill environments. Each unit self calibrates to automatically correct for the effects of temperature changes, wind and humidity. The unit will operate within specification in normal factory environments; however, it will provide the optimum accuracy if:

- Clean line power is supplied to the controller.
- The transducer and cable are protected and are as far away from radiated electromagnetic noise as possible.
- An air hood is used to minimize random air temperature gradients between the target and the transducer. If there is radiated heat from the target or from objects close to the sound path, be sure to use the UAI air flow system.

The DMS-5000 will operate through smoke, fog, vapors, chips and other airborne particles. It will not operate if materials collect on the surface of the transducer. The transducer should never be mounted pointing up if there is any chance of materials being deposited on the surface of the transducer. Accessories are available from UAI to handle special installation needs, see Chapter 8.

CHAPTER 2 - TECHNICAL DISCUSSION OF THE DMS-5000

PRINCIPLE OF OPERATION

The UAI DMS-5000 is a high accuracy non-contact distance measurement system. The system propagates a high frequency sound pulse, measures the elapsed time for the pulse to travel from the transducer to the target and back and converts this time into a measurement of distance. The velocity of sound waves in air is affected by temperature. The DMS-5000 utilizes external reference bars and signal processing techniques to remove the environmental effects from the measurement data. The zero measurement point is always taken from the outer reference bar surface, not the active transducer surface. The accuracy specification of the device is +/- 0.0002" or +/- 0.02% of the distance from the transducer to the target surface; whichever is greater for distances up to 1.5", +/- 0.033% from 1.5" up to 4 inches and +/- 0.05% thereafter.

BEAM PATTERN

The half angular beam width is approximately 1.6 degrees. Due to the frequencies used, essentially all of the sound energy is specularly reflected from any target surface (angle of incidence equals the angle of reflection), therefore the spot size from a flat target is 0.85 inches at any range (the actual size of the transducer aperture).

ENVIRONMENTAL COMPENSATION

The speed of sound in air is affected directly by temperature. A measurement made at one temperature will be different than a measurement made at a different temperature. The DMS-5000 normalizes for environmental effects by the use of external reference bar targets. Each time the system takes a sample it measures the distance to the external reference bars and compares this measurement to the factory calibrated distance. If this distance changes, the speed of sound has changed. The system corrects the target distance based on the reference error. This calibration method works on the principle that the environmental influence is the same at the reference bars as it is over the path length to the target. If the ambient atmosphere is different at the reference bars compared with the path to the target, measurement accuracy will be affected. Air flow through the transducer enclosures effectively breaks up these temperature gradients.

CONTAMINATION

Many industrial environments have airborne contaminants such as oil, smoke, fog and chips. One of the major advantages of using high frequency ultrasound, over other non-contact measurement systems, is the ability to "punch" through these contaminants, due to the relationship of particle size to wavelength. Ultrasonic wavelengths are much larger (compared to particle size) than optical wavelengths, resulting in less absorption and the ability to penetrate contaminated atmospheres.

The environmental filters supplied with the unit should always be used. If contaminants build up on the surface of the transducer, the unit will eventually fail, see cleaning procedure in Chapter 6. UAI also has several accessories; air hood, fan and filter which are essential to protect the transducer in badly contaminated environments, see Chapter 8 or contact UAI for assistance.

REFERENCE BARS

The purpose of the reference bars is to provide an auto recalibration to overcome the effects of measurement inaccuracy due to temperature changes. All measurements are taken from the outer surface of the outside reference bar. Special care is taken to precisely machine and assemble each transducer; however, each transducer's reference bar locations are slightly different. The reference bar locations are a function of the calibration code marked on each transducer and is precisely determined at the factory before shipment. Evidence of an incorrect calibration code is non-linearity over range. On thickness "dIF" applications requiring the highest accuracy, the units should be re-calibrated daily. This calibration can be done by measuring a gauge block or other known thickness and re-entering the "dIF" value.

The DMS-5000 system depends on obtaining a valid echo from the reference bar for proper operation. If a valid echo is not received from the reference bar, the unit will display two horizontal bars (transmit question marks over the RS-232/422 line), indicating that the face of the transducer is dirty or has been damaged. If the reference bar is damaged in any way the calibration will change and will display incorrect measurements.

COMPUTER CONTROLLED GAIN SETTINGS

In addition to range re-calibration, the DMS automatically calibrates signal amplitude to enhance accuracy over time. The DMS measures the signal amplitude from the reference bar, compares it to a standard value, and automatically chooses a gain setting to obtain this amplitude. The value "cALr" is the calibrated reference amplitude for each transducer. The right hand three digits are the digitized amplitude value. The left hand two digits are the gain setting used to obtain this amplitude. A higher amplitude can be obtained by incrementing the keypad in the "cALr" mode, in order to obtain more signal from a weak reflector (contact UAI for assistance). In general, the lowest gain setting that provides a stable signal should be used to prevent noise interference. The "InS" mode can be used to check the target signal level. Any "InS" value above 060 is usable. When changing gain settings in the "cALr" mode, the gain setting values do not repeat. Hysteresis is built in to prevent hopping between gain settings.

FREQUENTLY ASKED QUESTIONS

1. Is the DMS-5000 affected by other sources of acoustic noise?

Generally no, the operating frequency is so high that it is virtually impossible to generate sound waves in a frequency range that could be picked up by the receiver. The unit can pick up high frequency air noise from discharges of high pressure air. Do not point the transducer towards these discharges. If a problem exists, use mechanical shields.

2. Does the DMS-5000 work with flat surfaces only?

No, the DMS-5000 can see targets of all shapes including cylinders, spheres, edges and other irregular shapes. A small target generally must have the transducer closer to the surface to be measured.

3. Does the target have to be perpendicular?

Yes, this is the most important parameter in developing a successful application. The target surface should be within ± 2.5 degrees of perpendicular with respect to the transducer.

4. What materials can be measured with the DMS-5000?

Essentially any material may be measured; however, the rougher the surface the more energy will be scattered, therefore the operating range may be reduced with a poor reflector i.e. foam. Such a problem may be resolved by increasing the gain setting ("cALr", right hand three digits) thus making the unit more sensitive.

5. Will the DMS-5000 work in areas where there is dirty line power?

To a point; there is substantial line filtering within the unit. If the lines are extremely dirty use an external line filter together with a dedicated power line free from external noise.

6. Will the DMS-5000 work in high temperature applications?

The speed of sound is directly affected by air temperature. If the air temperature is constant, the external reference will normalize for non-standard temperatures and provide correct data. We do not recommend transducer operating temperatures above specification. If a target is warmer than ambient, the external reference on the transducer will not completely bring the data into specification unless transducer enclosures with purging air are used to break up these temperature gradients.

7. Will the reference bar compensate for hot targets?

No, a target surface that is much warmer than the environment and/or the transducer will have significant temperature gradients at the target surface. These gradients will change the time of flight of the sound wave and cause irregular sound path lengths, leading to gross measurement inaccuracy. UAI's transducer enclosures with purging air effectively break up these temperature gradients.

8. Is the zero point measured from the foil surface or from the reference bar?

Zero is measured from the reference bar. There is a deadband or ignore zone for 0.2 inches from the reference bar.

9. What if a target is in the way of the surface to be measured?

A standard DMS-5000 measures to the first signal echo after the echo from the reference bar. By using the ignore feature, which must be enabled by the operator, it may see the second or third echos or ignore spurious targets, such as the lip of a bottle. See Chapter 7 to enable the ignore feature.

10. The measured value to a static target is unstable; what is wrong?

There are several possible causes for measurement instability.

A. The transducer is not perpendicular to the target. To correct, enter the install mode ("InS") and maximize the "InS" value in both the x and y axis.

B. The environmental filter is dirty preventing the acoustic signal from passing through it. To correct, go into the "cAL-r" mode and note the reference bar amplitude, which should be 120, then into the "InS" mode and note the value. If the "InS" value, to a flat, smooth target at a range of less than 6 inches, is less than 120 the filter is probably dirty and should be changed.

C. Noise could be coming through on the power line or could be radiating and being picked up by the transducer coaxial cable. To correct, see the installation guide, Chapter 3.

11. Is the DMS-5000 linear over its full measurement range?

Yes, this linearity can be verified by checking it against a known and accurate mechanical standard such as an accurate cross slide on a machine tool. If the unit is not linear then the wrong calibration code has been used.

SPECIFICATIONS

Electrical

Operating Range . . . . . 0.2 to 23.999 inches
or 5 to 609.5 millimeters

Absolute Accuracy . . . . . +/- 0.0002 inches or
+/- 0.02% of range, whichever is greater

Repeatability . . . . . .+/-0.015% of range

Readout Resolution . . . . . Selectable
00.00 to 23.99 inches
00.000 to 23.999 inches
0.0000 to 9.9999/10.000 to 23.999 inches
or
0 to 609.5 millimeters
0.00 to 609.50 millimeters
0.000 to 99.999 millimeters
(display, RS-232 and 16 bit parallel outputs)

Off axis alignment . . . . . +2.5 to 10 degrees depending on
range, material and target size.

NOTE: Targets that are off axis may appear nearer or thicker than actual, since a diagonal measurement is made.

Input Power . . . . . 105-130VAC, 60 Hz

Output Characteristics:

Relay Output . . . . . SPDT rated at 2A resistive
(standard electro-mechanical)
. . . . . SPST rated at 60mA resistive
(optional solid state)

RS-232C/422A . . . . . Serial input of set-up parameters
and output of measurement

16 Bit Binary Output . . . . . 16 line parallel output of
measurement in binary format

External Trigger . . . . . Switch closure to external
trigger ground

Environmental

Operating Temperature
Transducer . . . . . -20 to +55 degrees C
Controller . . . . . -20 to +55 degrees C
Humidity . . . . . 95% max. non-condensing

Response Time

Response time or time per measurement will vary depending on the number of samples taken per measurement. The following chart shows actual response time vs. sample size with baud rate at 19.2k and four inch standoff. Measurements will be slower at lower baud settings and greater standoff. For example, add 4msec to the approximate times shown below for 9600 baud.

NOTE: If no baud is selected or the serial output is disabled, then subtract 4msec from the table below.

Number of Samples	Time Per Measurement	Measurements Per Minute
1	11msec	5,455
2	20msec	3,000
4	30msec	2,000
8	47msec	1,277
16	84msec	714
32	158msec	380
64	310msec	194
128	610msec	98

Cable Length - Transducer

The standard cable length supplied with the transducer is 10 feet. Other lengths, up to 30 feet (in 5' increments), are available from UAI. Lengths up to 500 feet are available with the remote receiver option.

CAUTION:
Do not attempt to shorten the transducer cable length by cutting the cable and reinstalling the connector. If a shorter cable length is required, contact UAI. Excess cable should be in conduit, not in the controller enclosure. Excess cable in the controller enclosure can result in measurement instability.

The remainder of the DMS-5000 manual is divided into sections covering installation, operation, technical specifications, maintenance and troubleshooting, special features and accessories.

CHAPTER 3 - INSTALLATION

MOST IMPORTANT SECTION - Read Carefully

INTRODUCTION

A complete distance measurement system consists of a controller, one transducer, cables, air service, manual and miscellaneous items shown below. In certain cases, customers only purchase components which will not include items found in a complete system. Proper installation and careful attention to all of the guides and practices contained in this section are the key to obtaining the high accuracy that is possible with the DMS-5000. This chapter provides general installation instructions as well as a specific applications guide to serve as a check list during installation.

DMS-5000 CHECK LIST

The following check list should be used when unpacking the DMS-5000:

DMS-5000 with Industrial Air Hood:

___DMS-5000 Controller (Housed in a NEMA 13 enclosure)
___(1) Transducer
___(1) Transducer Cable
___(1) Industrial Air Hood with Transducer Mounting Gimbal Installed
___(1) Air Fan
___(1) Air Hose (12.5')
___(1) Package of Environmental Filters
___(1) Set of Adjustment Wrenches
___(1) DMS-5000 Manual

DMS-5000 with Non-Industrial Air Hood:

___ DMS-5000 Controller (Housed in a NEMA 13 enclosure)
___(1) Transducer
___(1) Transducer Cable
___(1) Non-Industrial Air Hood with Transducer Mounting Gimbal Installed with Internal Fan
___(1) Power Supply
___(1) Package of Environmental Filters
___(1) Set of Adjustment Wrenches
___(1) DMS-5000 Manual

DMS-5000 Without Air Hood:

___ DMS-5000 Controller (Housed in a NEMA 13 enclosure)
___(1) Transducer
___(1) Transducer Cable
___(1) Package of Environmental Filters
___(1) Insulating Washer
___(2) Locknuts
___(1) DMS-5000 Manual

If any of these parts are missing contact UAI at (206) 481-6611.

CONTROLLER MOUNTING

Mount the controller securely in a location free of severe vibration and sufficiently close to the object to be measured so that the transducer cable reaches from the point of measurement to the controller. Power (115 volts AC) must be supplied to the controller and connected to the barrier strip terminals on the display bracket. RS-232 or RS-422 input and output, relay, aux input, and external trigger input connections to desired devices are made at TB1 as required by the application. For ease of wiring, remove TB1 from its socket. Connections to the 16 bit parallel binary output port are made at connector J2 on the controller main board.

TRANSDUCER ENCLOSURE MOUNTING

Mount the transducer enclosure in an appropriate location to make the measurement and as close to the target surface as practical. The mounting means must be rigid to prevent movement of the transducer relative to the target area. The transducer enclosure must be aligned so that it is perpendicular to the surface of the object to within ±2.5 degrees to allow for maximum adjustment of the transducer. See Figure 1.

NOTE: FOR ACCURATE MEASUREMENTS, THE TRANSDUCER MUST BE ELECTRICALLY ISOLATED FROM CHASSIS GROUND OR ANY OTHER GROUND.

AIR HOOD DRAWING

Air Hoods must be aligned axially and must be perpendicular to target surface to be measured

FIGURE 1

TRANSDUCER WIRING

Run the transducer cable in its own conduit. The transducer cable can pick up electrical noise from motors and solenoids if it is not properly isolated. Since the transducer cable carries approximately 300 volts, encase the cable in a protective sheath to prevent damage to the cable and potential injury to personnel.

TRANSDUCER INSTALLATION

Never touch the "face" of the transducer since permanent damage may occur. Treat the face of the transducer as you would a camera lens. The transducer face may be cleaned by blowing off the surface with canned, clean, dry air. If you have any questions regarding cleaning the transducer call UAI. The environmental filter that covered the head of the transducer in shipment is actually a nylon mesh "screen" which keeps dust off the face of the transducer for proper operation. Ultrasound goes through the filter but dust and grit are prevented from entering. Additional filters can be purchased from UAI. Cut the filter in half, then install the filter so that the fold at the top makes contact snugly with the reference bar. In other words, put the filter on as far as it will go onto the transducer. Hold it in place with an elastic band or tie wraps. Install each transducer in its enclosure, such that the shoulder of the transducer is against the shoulder of the plastic bushing. Align the transducer to the target using the Install ("Ins") feature, see Chapter 4.

PLUGGING THE TRANSDUCER CABLE INTO THE PRINTED CIRCUIT BOARD

The transducer cable has a molex connector attached to the controller end for rapid connection to the controller. Plug the connector into the three prong J5 on the main board making certain the locking ramp on the cable connector mates with the locking header on the circuit board connectors. See Figure 2.

FIGURE 2

Do not plug the transducer cable in backwards, or electrical shock is possible between the outside of the transducer and signal ground. Signal ground is UAI's system ground which is to be isolated from earth ground. The signal ground test point is TB5 which is next to J4 on the main board.

CONTROLLER WIRING

AC POWER

Connect 115 VAC, 60 Hz power to the controller as shown in Figure 3. An internal fuse is provided in the controller on the primary side of the power supply but no power disconnect switch is provided.

Route the 110 VAC in a separate conduit. This will help prevent induced noise in the controller and communication wiring. Make sure that the 110 VAC line is at least 100 volts and not greater than 130 volts. If voltage spikes or power fluctuations commonly occur, UAI recommends that line filtering and surge protection be installed. If you wish to install a switch to disconnect the 110 volts to the unit, locate the switch in a separate box outside the unit. The power lines should be as short as possible once inside the electronics enclosure as they can radiate electrical noise into the main board.

FIGURE 3

EXTERNAL TRIGGER WIRING

The external trigger function can be connected if required by the application. Two terminals are provided on the controller barrier strip and are marked "EXT. TRIG." and "EXT. TRIG. GND.", respectively. A switch, relay contact or transistor can provide an open connection between these terminals during the time that measurements are not desired. When connection is made, such as by the jumper supplied from the factory in the initial configuration (EXT. TRIG. to EXT. TRIG. GND.) or by an external contact, the controller free runs and makes measurements continuously. Upon closure of the contacts between the external trigger and the external trigger ground, the unit takes as many samples as possible before the external trigger opens. It does not just make one set of samples upon closure, unless it is programmed to do so (see Chapter 7). When connection is open, measurements stop. See Figure 4 for reference.

NOTE: If a transistor brings the external trigger input to the same potential as the external trigger ground, the current rating for that transistor should be able to handle at least 50 milliamperes. The external trigger input ground is isolated from the system's signal ground. The external trigger input should never be more than 10 volts DC greater than, or two volts less than the EXT. TRIG. GND. input. See Figure 4 for a schematic of external trigger circuitry. There is no need for a "pull up" resistor on the EXT. TRIG. input.

FIGURE 4

SET POINT RELAY WIRING

Three terminals are provided on the controller barrier strip labeled "K1 COM", "K1 NC", and "K1 NO". These are respectively common, normally closed and normally open contacts of an electro-mechanical relay mounted on the main board. These contacts are rated for a maximum 2 amp resistive load. They can be wired to any external alarm, ejection device or other controller as desired by the user. Controller software allows changing the relay coil energization from "in-limits" to "out of limits" which with the NO and NC contacts provided, allows maximum flexibility in wiring.

When an optional solid state switch is installed in place of the electro-mechanical relay, only the "K1 COM" and "K1 NO" terminals are active. The solid state switch is rated for a 60 milliamperes maximum resistive load and can switch either AC or DC loads. See Figure 5 for reference.

FIGURE 5

To avoid compromising the noise suppression capabilities of the DMS-5000, do not use relay (K1) to directly control or switch voltages (AC or DC) greater than 100 volts. If it is absolutely necessary to switch 110 VAC, use a line filter between the DMS-5000 and the connected device. UAI recommends line filters manufactured by Shape, Topaz or the Isafil by Converter Concepts Corporation. Tranzorbs or metal oxide varistors should also be placed across the relay common and the normally open or normally closed terminal(s), whichever is used. UAI will furnish appropriate tranzorbs if requested. The transzorbs are transient suppressors that schematically resemble diodes. If it is necessary to switch 110 VAC through the common to the normally open relay terminal, transzorbs should be installed as in Figure 6.

FIGURE 6

RS-232 WIRING

To use the RS-232 communications feature, connect the "RS- 232 GND" (pin 7 of a standard DB-25 connector), "RS-232 in" (pin 2) and "RS-232 out" (pin 3) terminals to the host processor or other compatible asynchronous communication device. If you use shielded cable, terminate the shield to earth (chassis) ground at the host or terminal end only. There is a jumper adjacent to the relay on the main board that must be configured between the two pins that are closest to the barrier strip, see Figure 7. If the jumper is not placed properly, the DMS will not receive any data from the host.

NOTE: The RS-232 lines (including ground) are optically isolated from the DMS for better noise rejection.

FIGURE 7

RS-422 WIRING

There are five terminals on the barrier strip (TB1) for the RS-422; two each for receive and transmit, one for signal ground. The receiver is terminated with a shunt resistor of 240 ohms. The DMS can be connected in a "multi-drop" configuration with special software. Contact the factory for information. RS-422 is useful for long distance communication needs between the host and the DMS controller. Figure 8 shows how the RS-422 set of twisted pairs should be wired to the host. The jumper (JP1) should be between the two pins furthest from the barrier strip (TB1), or the DMS will not receive from the host, Figure 7.

RS-422 WIRING DIAGRAM

FIGURE 8

16 BIT PARALLEL PORT BINARY OUTPUT WIRING

This output is provided on connector J2 located on the main board. Wiring to this port requires a 20 pin female mating connector. The pin out diagram is shown below:

PIN	FUNCTION	PIN	FUNCTION
8	SIGNAL GND	11	BIT 8
6	BIT 0	13	BIT 9
4	BIT 1	15	BIT 10
2	BIT 2	17	BIT 11
1	BIT 3	19	BIT 12
3	BIT 4	20	BIT 13
5	BIT 5	18	BIT 14
7	BIT 6	16	BIT 15
9	BIT 7	14	LOW WHEN SAMPLING

Bit 0 is the least significant bit. The output lines will source up to 5mA or sink 20mA from the host. Pin 14 is the only open collector output. The switching time is 20-40 nanoseconds under standard TTL load. Data out depends on the resolution and type of units (inches or millimeters) that are set up for the application. The following chart indicates the output.

TYPE OF UNITS AND RESOLUTION	BINARY OUTPUT
Hundredths of inches (00.00)	Number of hundredths
Thousandths of inches(00.000)	Number of thousandths
Tenths of mm (0000.0)	Number of tenths
Hundredths of mm (000.00)	Number of hundredths
Thousandths of mm (000.000)	Number of thousandths

Note: Tenths of thousandths of inches (0.0000) is not available on the 16 bit parallel output.

The data is valid when the sampling line is not "low" with respect to pin 8. It will not change while that line is "high". The low voltage will never be above 1 volt with respect to pin 8.

CAUTION

The outputs are referenced to the system's signal ground which is the same ground to which the transducer's signal is referenced. If there is any possibility that the cable from the 16 bit port will be run in a noisy electrical environment, proper precautions must be taken or degradation in accuracy will occur. In this instance use a shielded cable between the DMS controller and the host computer end only, and let the cable "float" electrically on the DMS end. Run the cable in conduit to provide additional noise protection.

ANALOG OUTPUT OPTION INSTALLATION AND WIRING

OPERATION

The input to the analog output option is a 16 bit binary number transformed into an analog voltage or current by a 12 bit D/A converter. The analog option is implemented using a separate printed circuit board which is connected to the main board.

To use the analog outputs, the size, the position and the polarity of the analog span must be selected by using the menu items available on the display.

NOTE: If the differential feature is used, the displacement can be negative or positive from the differential zero point and the analog start parameter is ignored. The span will overlay the differential zero point equally negatively and positively. The analog output mid-point (5VDC/12mA) is at the differential zero point. Entering this new zero point into the "dIF" feature, see Chapter 4, causes the DMS to ignore the programmed analog starting point (AnStr). It now uses the zero displacement or differential point as the mid span point. For example if a span of four inches is entered, the span will range from -2.000 to +2.000 inches on the display, but physically from 1.000 to 5.000 inches in front of the reference bar, because the differential zero point is three inches in front of the reference bar.

INSTALLATION

Analog units shipped from the factory have the analog output board installed. No additional installation is required.

ANALOG SIGNAL WIRING

Four terminals are provided on the right side of the analog board barrier strip for analog wiring. Terminals 1 and 2 are for the 4-20mA output and terminals 3 and 4 are for the 0-10VDC output. Following is a simplified schematic of these outputs. Pin 1 of the terminal strip is the closest terminal to the main board terminal strip (TB1).

FIGURE 9

CONFIGURING THE ANALOG OUTPUT OPTION VIA RS-232C OR RS-422A

See Chapter 4 for the proper communications protocol to configure the span, starting point and polarity of the analog output.

AMPLITUDE DETECTION OPTION

The DMS-5000 operates as a conventional non-contact distance or differential thickness gauge and in addition can measure and digitize the voltage of the return echo. The magnitude of the target echo is directly dependent on the perpendicularity of the target surface with respect to the transducer. The amplitude detection feature can be used to detect cross threaded bolts or bottle caps, parts orientation and surface perpendicularity. This feature can also be used for edge detection and edge guiding through the use of the programmable amplitude limit (ALIM) parameter in the menu. See Chapter 7 to enable this feature. The DMS is not configured in the factory for amplitude detection; it is an optional feature. Units with the amplitude detection feature enabled can repeatably locate edges to within plus or minus 0.005 inches.

OPERATION

The amplitude detection option allows the user to measure the peak voltage of the returned signal echo. At any given range a flat target covering the full aperature of the transducer will result in a larger amplitude signal echo than a non-flat surface or a target partially in the sound beam. With this option the returned signal echo is digitized into a three digit number. This three digit number follows the range measurement on the RS-232C/422A serial port. For example, if the units and resolution chosen are .001" then the serial outputs will be: "XX.XXX" for range, then YYY for the amplitude, with a space between the range and the amplitude string. See Chapter 5, for the actual format of the serial output based on the configuration of the DMS.

AMPLITUDE LIMIT

The relay can be used as an output based on whether the distance or differential sample is within the programmed limits and if it is below the programmed amplitude limit. If the return echo's strength is too low, the relay can be programmed to change state. To use the relay for this purpose, enter the configuration menu, see Chapter 4, press and release the left switch until the five digit display prompts "HI-Lo". Follow the procedure to set the amplitude limit.

The relay state, delay and one-shot time parameters are still required to change the relay state when a sample is above or below the amplitude limit, see Chapter 4.

The amplitude hysteresis (A HYS) prevents the relay from oscillating near the amplitude limit. For example, an amplitude hysteresis value of 5 is entered and the amplitude limit is 100 and the last set of samples of the return echos amplitude is above 100. The DMS requires an amplitude of 95 before the relay will change to the "out of limits state" during the next one shot period. Conversely, the amplitude then must rise above 105 for the relay to return to an "in limits" state during the next one shot period. Hysteresis values from 0 to 255 can be entered using the same procedure used to enter the amplitude limit. The actual value of amplitude hysteresis displayed is preceded by an "H". If the number entered is zero, the hysteresis parameter is not used, see Chapter 4.

PERPENDICULARITY GAUGING

One application for amplitude detection is the detection of cross threaded caps in bottle filling operations. Look down at the cap and compare the signal amplitude from a cross threaded cap to the signal from a properly threaded cap. Set the amplitude limit just below the lowest amplitude measured from a properly threaded cap. All cross threaded caps will be rejected.

EDGE DETECTION

Edge a detection is possible with the amplitude detection feature. A transducer centered over a flat edge returns 25% of the signal amplitude compared to 100% return from a transducer located over a flat surface, both at the same range. Note the value of the signal amplitude value is available on the display. Enter 25% off the full surface signal amplitude into the amplitude limit. Enter a value of 5 - 10 in the hysteresis parameter. As the edge moves across the center of the transducer, the relay will change state.

NOTE: Remove the limit value from the amplitude limits when they ar not is use. An inadvertently stored amplitude limit will cause the relay to be erratic in the distance measurement mode. The amplitude limit always takes precedence over range limits, when installed.

INSTALLATION AND WIRING

The amplitude limit option is resident in the controller, hence no installation is required. Wiring of the relay for amplitude detection is the same as for normal relay wiring. The value of the digitized amplitude voltage is available in the install parameter or on a separate terminal if the RS-232C or RS-422A output is used. See the beginning of this chapter for proper wiring practices to the relay.

REMOTE CONFIGURATION VIA RS-232C OR RS-422A

The DMS with optional amplitude detection feature enabled, provides a message to configure the amplitude limit and hysteresis, see Chapter 4.

CHAPTER 4 - OPERATION

The DMS-5000 hardware permits the user to configure the system to a given application for optimum performance. Once configured the unit can free run, continuously make measurements, or sample on command whenever the external trigger is pulled to ground by external gating means. The unit can be configured to take only one set of measurements per closure of the external trigger, see special features, Chapter 7. Measured data will be displayed on the 5 digit display and continuously compared to set limits. If programmed to do so, relay closures will occur if limits are exceeded.

OVERVIEW OF THE DMS-5000 OPERATION

After all wiring connections are made and the transducer is mounted, apply power to the controller. Upon power up, the following conditions should be apparent:

- When power is first applied, the unit goes through a short diagnostic routine and self calibration procedure. The display has five dashes during this sequence. This procedure may take as long as 30 seconds. If error code 1-5 appears, contact UAI. If the transducer is connected properly and the dashes do not disappear, press both switches simultaneously and then follow the procedure to check the calibration of the transducer. If you still have a problem, contact UAI.

- An indication of measurement will be displayed on the readout, providing a target is within range of the transducer. If no target is present, or it is insufficiently perpendicular to the transducer, all decimal points will be lit on the five digit display.

- There are two LED indicators at each end of the digital display. Upon power up of a unit, configured as shipped from the factory, these LED's will be on, off or flashing as indicated in Figure 10.

FIGURE 10

MM	OFF	Indicates readout is in inches.
ACTIVE	FLASHING	Indicates computer is working.
RELAY	OFF	Target within limits/no limits entered.
SAMPLING	FLASHING	Indicates transducer is operating.

FACTORY CONFIGURATION

Parameter	Factory Setting
Transducer Calibration	Set to transducer shipped with system.
Units	Inches
Resolution	0.001
Average Samples	32
DIF (Background Distance)	00.000 (No differential)
High Limit	None
Low Limit	None
Relay	Normal closed
Delay to Relay One Shot	00.000
One Shot Time	00.000
End Line	Carriage Return - Linefeed
RS-232 Baud Setting	None

When first installed, to have a basic working system, check and reset the transducer calibration in accordance with the number shown on the transducer label.

NOTE: Isolate chassis ground and signal ground. At this time check the electrical isolation between signal ground and chassis ground. Using an ohmmeter, measure the electrical resistance between chassis ground and signal ground, which is the test point adjacent to the barrier strip (TB1). If properly isolated, the measurement is open, or at least 20 megaohms. If the measurement is less than 20 megaohms, check wiring and grounding practices. If isolation between chassis ground and signal ground is less than 20 megaohms, erratic measurements will occur.

ANALOG OUTPUT OPTION

The input to the analog output option is a 12 bit binary number transformed into an analog voltage or current by a 12 bit D/A converter. The analog option is implemented using a separate printed circuit board which is connected to the main board by two cables, one for digital signals (J2 on the main board) and one for the analog board power supply (J6 on the main board). The analog output signals are available at the four terminal barrier strip on the analog board, TB1. Two terminals are for analog voltage and two terminals are for analog current.

To use the analog outputs, the size of the analog span, the positioning of the span and the polarity must be selected using added menu items available on the display. Follow the conventional unit configuration to "AnStr", which is the starting or zero point of the analog output span. Configuring the zero point, analog span, analog polarity, and 10VDC/4-20mA output at the zero point, or at the top of the span is discussed later in this chapter.

The analog voltage or current will change in incremental steps (2.44mV/increment for 0-10VDC output and 3.9mA/increment for 4-20mA output) as the range differential offset changes.

MANUAL OPERATION AND CONFIGURATION OF PARAMETERS

SWITCHES, CONTROLS, AND INDICATORS

The controller has two momentary pushbutton switches which allow reprogramming of set-up parameters.

Measurement and set-up parameter information is provided on a 5 digit alpha-numeric display.

Four indicator LED's provide information on English/metric readout, computer operation, limit specification and transducer operation.

FIGURE 11

UPPER LEVEL PROMPTS:

- Pressing and releasing both switches on the main board simultaneously activates the upper level menu with the first menu item "cALd", calibration distance.

- Pressing the left switch (SW1) advances the unit to the next prompt. Continually pressing and releasing the left switch advances the unit to the next upper level prompt. The sequence for the whole menu on the various DMS-5000 models is:

		WITH SPECIAL FEATURES ENABLED (See Chapter 7)	
DMS-5000 Digital	DMS-5000 Analog	DMS-5000 Digital	DMS-5000 Analog
"cALd"	"cALd"	"cALd"	"cALd"
"cALr"	"cALr"	"cALr"	"cALr"
"InS"	"InS"	"InS"	"InS"
"unItS"	"unItS"	"unItS"	"unItS"
"rES"	"rES"	"rES"	"rES"
"Ac"	"Ac"	"Ac"	"Ac"
"dIF"	"dIF"	"dIF"	"dIF"
"HI-Lo"	"HI-Lo"	"ES"	"ES"
"rS"	"rS"	"AF"	"AF"
"dELAy"	"dELAy"	"Ignor"	"Ignor"
"oSHot"	"oSHot"	"HI-Lo"	"HI-Lo"
"End L"	"End L"	"rS"	"rS"
"bAud"	"bAud"	"dELAy"	"dELAy"
	"AnStr"	"oSHot"	"oSHot"
	"AnSpn"	"End L"	"End L"
	"AnPOL"	"bAud"	"bAud"
			"AnStr"
			"AnSpn"
			"AnPOL"

To access the lower or configuration levels of the upper level menu parameters press the right switch (SW2) on the main board after selecting the desired feature. Each of the above menu items will be described in greater detail.

UPPER LEVEL PROMPT DEFINITIONS:

cALd: DISTANCE CALIBRATION - Calibrated distance between the foil and the reference bar of the transducer.

cALr: SENSITIVITY CALIBRATION - Calibrated sensitivity of the transducer.

InS: INSTALL VALUE - Digitized value of the signal strength or amplitude of the return echo from the target.

unItS: UNITS - Configures output display to be in inches or millimeters.

rES: RESOULTION - Configures output display resolution in English or metric units.

Ac: AVERAGE COUNT - Defines number of samples to average.

ES: ENABLE SAMPLING - Special Feature used to control point at which samples are taken. Can be configured to sample in the normal "FrEE" run mode or in the controlled "gAtEd" mode.

dIF: DIFFERENTIAL - Enable measurement relative to an arbitrary reference zero.

HI-Lo: HIGH-LOW LIMITS - Defines maximum and minimum relay limits for acceptance or rejection of sample being measured.

rS: RELAY STATE - Configures relay to be in its normal state when the sample being measured is either "in" limits or "out" of limits.

dELAy: DELAY TO ONE SHOT - Defines delay time between sample rejection and energizing of relay.

oSHot: ONE SHOT - Defines amount of time relay will be in energized state.

End-L: END LINE - Configures DMS-5000 to terminate RS-232/422 transmission with either a carriage return "cr" or a carriage return-line feed "cr-LF".

bAud: BAUD RATE - Defines data transfer rate for RS-232/422 communications.

AnStr: ANALOG STARTING POINT - Defines minimum starting distance for the 0-10 VDC, 4-20 mA analog output span.

AnSPn: ANALOG SPAN - Defines the range of distance readings for which the analog output is to span.

AnPOL: ANALOG POLARITY - Defines Analog Polarity when the target distance is at or below the Analog Starting Point, either 0 VDC (4 mA) or 10 VDC (20 mA).

ACCESSING "cALd":

With "cALd" displayed, press the right switch to advance the unit into the configuration level. The display reads ".9xxx", where xxx is a number between 000 to 999. This number corresponds to the actual distance in inches to the reference bar. The number should match the cALd number on the transducer.

MODIFYING "cALd":

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by hundredths. While incrementing the displayed number, if it reaches .9999 it will roll over to .9000.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by hundredths. While decrementing the displayed number, if it reaches .9000 it will roll through to .9999.

EXITING "cALd":

Upon entering the proper number, exit this configuration sequence by pressing both switches together. The number last displayed is saved as the calibration number to the reference bar, except in the case stated below. The prompt will then be "cALr" for configuration of the sensitivity of the transducer, unless the "cALd" number chosen is listed under the EXCEPTION paragraph.

EXCEPTION:

Pressing both switches together with the following "cALd" number present has alternate results:

cALd #	Results or Function
.9000	Reserved for entering the unit configuration sequence to select or disable the special feature, see Chapter 7.
.9001	Auto-calibration of the distance to the reference bar. The display shows a number between .9000 - .9999, until the transducer is calibrated to the unit. Upon completion of the auto-calibration sequence, the unit displays "cALr" and resumes normal operation. If the unit is unable to calibrate the transducer, due to improper installation, pressing both switches simultaneously exits this sequence then displays "cALr" and resumes proper operation. If the sequence is aborted, the last number dispayed will be the "cALd" number saved. Wait at least one minute upon entering the auto-calibration sequence for it to be completed.

ACCESSING "cALr":

With "cALr" displayed, press the right switch to advance the unit into the configuration level. The display will read "GGxxx", where "xxx" is a number between 000 and 255, which corresponds to the sensitivity of the transducer. "GG" stands for the gain setting the unit is presently operating under to maintain the "xxx" sensitivity. The operator controls the last three digits, letting the unit control the gain setting or first two digits. Over time, the sensitivity of the transducer varies. For better accuracy and repeatability, the DMS automatically adjusts the electronic amplifier (receiver), to keep the sensitivity constant. The lower the right number, the lower the requirements for sensitivity. UAI sets the required sensitivity to 120. If it is felt that greater sensitivity is required for small or distant targets, the number can be raised to a maximum of 160; keep in mind that the system is less immune to electrical noise at this setting. If the sensitivity is increased, the DMS would then raise the gain setting (left two digits) to maintain the operation at the increased level. The gain setting will vary with operation. The number will be low, after applying power to the unit (0-12). With time, the gain setting may increase to compensate for a drop in transducer sensitivity. There are 40 gainsettings, numbered 0 to 39. If the gainsetting is above 30, or "--" is present, contact UAI.

MODIFYING "cALr"

Pressing the right switch increments the right three-digit number displayed. Holding the switch down for more than two seconds increases the number by tenths. While incrementing the displayed number, if it reaches 255, it will roll through to 000.

Pressing the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by tenths. While decrementing the displayed number, if it reaches 000, it will roll through to 255.

EXITING "cALr":

Once the desired "cALr" is entered, exit "cALr" by pressing both switches simultaneously. The last displayed number is saved as the new "cALr" number. The display then reads "InS" for the install sequence.

ACCESSING "InS":

Pressing the right switch accesses the install mode. This sequence is used to aid in the proper installation of the transducer. The right three digits on the display correspond to the strength or amplitude of the return echo from the target. The number will range from 0 to 255. The stronger the echo, the larger the corresponding number will be.

To use the "install" feature, the DMS unit must be sampling. The external trigger input on the barrier strip (TB1) should be connected to the external trigger ground terminal. Place a target in front of the transducer to simulate the same orientation as normal operating conditions.

MODIFYING "InS":

As the transducer is operating, align the transducer to obtain the maximum number on the display. Loosen the clamp screw(s) for the axis to be aligned and turn micro-adjustment screw to adjust that axis for the maximum number on the display. Tighten clamp screw(s). As the number increases, note that the frequency of samples increases (like a geiger counter). Repeat this process for the other axis. Check each axis again to ensure that the maximum number has been obtained on the display. A flat, smooth, perpendicular target, such as steel, about six inches away, would normally have an "InS" value between 150 and 250.

GIMBAL DRAWING

FIGURE 12

EXITING "InS":

Once the transducer is aligned properly, pressing the left switch exits "InS". The next menu item is "unItS" for the selection of output in inches or millimeters.

ACCESSING "unItS":

Pressing the right switch accesses the lower or configuration level. The display and output options are inches or millimeters.

MODIFYING "unItS":

Pressing and releasing the right switch toggles between the two options.

EXITING "unItS":

Pressing the left switch exits "unItS". The option shown on the display upon leaving the sequence is the format under which the unit will operate. The next prompt is "rES" for selection of output resolution.

NOTE: If the setting for "unItS" is changed, make a corresponding change to Hi-Lo Limits, and "AnStr" and AnSpn" if the analog output is used. The DMS will not convert the numbers to the new units.

ACCESSING "rES":

Pressing the right switch accesses "rES". This sequence selects the output resolution of the unit. The DMS is able to operate in three different resolutions for each type of units. If the DMS is to output its measurements in inches or English units, the three resolutions available are .01" (hundredths), .001" (thousandths) or .0001" (tenths of thousandths). If the DMS is programmed to output its measurements in millimeters, the available resolutions are 1mm, .1mm and .01mm. The five digit display, serial data output stream, and the 16 bit parallel port are affected by the resolution selected, see Chapter 5. If the measurements are in metric units, dashes will occupy the segments not needed. The possible selections are:

UNITS	RESOLUTION	DISPLAY PROMPT
English	.01"	0.01__
English	.001"	0.001_
English	.0001"	0.0001
metric	.1mm	--.1--
metric	.01mm	-.01--
metric	.001mm	-.001-

To change the resolution press then release the right switch to advance to the next resolution. Advancing beyond the highest resolution rolls the display around to the lowest resolution prompt.

EXITING "rES":

Once the desired resolution is on the display, releasing the right switch, then pressing the left switch advances the DMS to the next sequence, which is "Ac" for average count configuration sequence.

ACCESSING "Ac":

With "Ac" displayed, pressing the right switch advances the unit to the configuration level. The display then reads "Axxxx", where xxxx is a number between 1 to 4095. This number corresponds to the set size of the number of samples taken before averaging.

For example, if the unit is programmed to take 10 samples and the DMS does not "see" a target on one of the ten samples, due to insufficient signal strength or the absence of a target, only nine samples will be averaged. If all 10 samples do not see a target, the unit will output that there is no target present. If only one sample out of ten is valid, that reading will be displayed.

MODIFYING "Ac":

Subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increments the number by hundredths. While incrementing the displayed number if it reaches 4095, it will roll over to 1.

Subsequent depressions of the left switch decrements the number displayed. Holding the switch down for more than two seconds decrements the number by hundredths. While decrementing the displayed number if it reaches 1, it will roll through to 4095.

EXITING "Ac":

After entering the desired "Ac" number, exit "Ac" by pressing both switches together. The number last displayed is saved as the new "Ac" number. The display now reads "dIF", for differential mode.

ACCESSING "dIF":

With "dIF" displayed, pressing the right switch advances the unit into the configuration mode. The display shows "nodIF" for no differential number activated or distance, or "rLdIF" for differential number activated.

The differential feature sets a zero point in space and a measuring displacement from that point in either direction. If the target is closer to the transducer than the zero point, the distance or offset will be positive. Conversely, if the displacement is further from the zero point, the distance or offset will be negative.

To use the unit in the differential mode (rLdIF), the unit should be sampling or have a valid distance sample that is to be the zero point. Place the reference surface or target at the zero point, verifying proper orientation to the transducer, then take at least one sample to measure the proper distance prior to entering the "dIF" configuration sequence. The distance sample saved as the differential zero point is the last sample taken before exiting this configuration sequence. By requesting "nodIF", or no differential, upon leaving this sequence, the DMS is restored to a standard distance unit.

NOTE: If the analog output is used, the differential zero point is the mid-span point. The number present or entered in "AnStr" is ignored.

MODIFYING "dIF":

Pressing and releasing the right switch toggles between a straight distance device (nodIF), and a differential device (rLdIF). If there is no target present, the display will only show "nodIF".

Once the desired mode is selected, pressing the left switch saves the selected option. The unit then reads the distance from the transducer to the zero point or zero if "nodIF" is selected. The number can now be changed. This is useful if it is impossible to have a target present while in this mode. If the displayed distance is correct for the zero point (rLdIF mode), or zero (nodIF mode), pressing both switches simultaneously terminates this sequence. If it is not correct, the differential distance can be manually entered.

After releasing the left switch, which was used to retain the desired mode, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by tenths. While incrementing the displayed number, if it reaches 23.999 inches (609.5mm) it will remain there.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by tenths. While decrementing the displayed number, if it reaches 00.000 (000.0mm) it will remain there.

EXITING "dIF":

Pressing both switches simultaneously exits the "dIF" mode. The last number displayed is the differential zero point distance used, unless is was zero which disables this function. The display now reads "ES" for enable sampling.

ACCESSING "ES":

"ES" or enable sampling is a special feature which is enabled as required by the user. See Chapter 7 for the procedure to enable or disable this feature. In some applications it is required to take only one set of samples (based on the setting of "Ac") for each closure of the external trigger to external trigger ground. This is called sample gating. The standard DMS, from the factory, samples in the "free run" mode. This means if the external trigger input is the same potential as the external trigger ground on the barrier strip, the unit samples continuously until the external trigger point is ungrounded. The "ES" feature provides the option of running in either mode.

BYPASSING "ES":

Releasing both switches, then pressing the left switch, bypasses this sequence.

MODIFYING "ES":

Releasing both switches, then pressing the right switch advances the DMS into the configuration mode. The display will read either "FrEE" for free run mode or "gAtEd" for gated mode. Continually releasing then pressing the right switch toggles between the two options.

EXITING "ES":

To exit, release the switches, then press the left switch. The unit is configured to the last mode selected, gated sampling or free running. The next prompt is "AF".

ACCESSING "AF":

"AF", or amplitude filter is a special feature which is enabled as required by the user. See Chapter 7 for the procedure to enable or disable this feature. The amplitude filter ignores target echos that are not strong enough because of poor transducer alignment or vibration. When a target is perpendicular to the transducer, the amplitude or strength of the return echo is maximized. If a target is moving on an assembly line, for example, and the DMS is measuring thickness, the part may be vibrating such that it is not always perpendicular to the transducer. The DMS can be programmed to ignore measurements that are not above the amplitude filter number. If the unit is averaging one sample per set, and the target measurement is below the amplitude filter number, the DMS will output as if no target were present.

DETERMINING THE AMPLITUDE FILTER NUMBER:

To determine the amplitude filter number, place a target of the coarsest, thinnest product to be measured in front of the transducer with the unit sampling. Enter the install mode ("InS") and note the maximum number present, while the target is perpendicular to the transducer. The Amplitude Filter number should be 60-75% of the "InS" value. Once the system is running, if the DMS consistently reads no target, the amplitude filter number may need to be lowered.

MODIFYING THE AMPLITUDE FILTER:

Releasing both switches, then pressing the right switch displays the current amplitude filter number. The left two digits will display "AF", followed by a number between 000 and 255.

After releasing the right switch, subsequent depressions of the right switch increments the amplitude filter number. Hold the switch down for at least two seconds to increment the number by tenths. Press the left switch to decrease the amplitude filter number. If the switch is held down for two seconds, the number will decrease by tenths.

EXITING "AF":

Pressing both switches simultaneously saves the last number on the display as the amplitude filter number. The unit then displays "Ignor".

ACCESSING "Ignor"

"Ignor" is a special feature which is enabled as required by the user. See Chapter 7 for the procedure to enable or disable this feature. "Ignor" makes it possible to disregard the closest target and measure a target that is further away. For example, the checking of fill levels in bottles (Figure 13). If the transducer is pointing downward towards the bottle, the first echo it receives is from the bottle's lip. The standard DMS measures the distance to the lip. With this feature, an ignore is programmed, so the DMS looks for targets beyond a set distance. Once the distance to the lip is determined, a number is entered which reflects the distance to the first target, in this example the bottle lip. The DMS waits beyond the time required for the lip echo to return, then enables the next echo to trip the logic for calculating the distance to the corresponding target, which is the liquid level. The ignore distance is in 0.1" (1mm if in metric) increments. If it is desired to ignore up to 2" for example, the number entered is 1.8".

NOTE: The ignore is a powerful feature, but has limitations. The ignore will not work if the first target is within 0.3" of the target to be measured. The ignore should only be used if there is at least 0.4" between the targets. Contact UAI for further assistance if necessary.

FIGURE 13

BYPASSING "Ignor":

Releasing then pressing the left switch advances the DMS to the next menu item.

MODIFYING "Ignor":

To display or alter the ignore distance, release then press the right switch to advance the DMS to the configuration sequence. The leftmost digit will have an "I" with the right three digits having a number between 00.0 and 10.0. The number zero disables the ignore feature. If in metric, the number displayed will range between 000mm and 255mm.

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by tenths. While incrementing the displayed number, if it reaches 10.0 (255mm) it will roll over to 00.0 (000mm).

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by tenths. While decrementing the displayed number, if it reaches 00.0 (000mm), it will roll through to 10.0 (255mm).

EXITING "Ignor":

Once the desired number is displayed, pressing both switches simultaneously saves the number displayed as the ignore distance and advances the DMS to the next sequence.

ACCESSING "HI-Lo":

"HI-Lo" is used to examine or change the high and low relay limits. This is a selection sequence only. If the high and low limits are not to be examined or changed, pressing the left switch advances the DMS to the next prompt, "rS". If the right switch is pressed, the prompt "HI" will appear. The high and low limits are for the relay output only. The relay will change states if configured properly, when the new sample is in or out of limits.

MODIFYING "HI":

Once the "HI" prompt is displayed, releasing then pressing the right switch displays the present high limit. The range of limits are 00.000, which is no limit, to 9.9999 (99.999) inches or 000.00 to 99.999 (999.99)mm.

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by .1" or 10mm. While incrementing the displayed number, if it reaches 99.999 (9.9999) inches, or 999.99 (9.9999)mm, it will roll over to 00.000 or 000.00mm.

Subsequent depressions of the left switch decrements the number. Holding the switch down more than two seconds decreases the number by .1" or 10mm. While decrementing the displayed number, if it reaches 00.000" or 000.00mm it will roll over to 99.999 or 999.99mm.

DISABLING THE "HI" LIMIT:

Setting the display to 00.000" (000.00mm) disables the limit.

EXTING "HI":

After entering the proper number, exit this configuration sequence by pressing both switches together. The last number displayed is saved as the new HI limit. The prompt "Lo" is then displayed.

MODIFYING THE "Lo" LIMIT:

Releasing both switches, then pressing the right switch, enters the low limit configuration. Pressing the left switch, with the "Lo" prompt, bypasses the low limit and goes to the next configuration prompt. The range of limits are 00.000, which is no limit, to 9.9999 (99.999) inches or 000.0 to 99.999 (999.99)mm. The limits may be used in other resolution modes.

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by .1" or 10mm. While incrementing the displayed number, if it reaches 99.999 (9.9999) inches or 999.99 (9.9999)mm, it will roll over to 00.000 or 000.00mm.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by .1" or 10mm. While decrementing the displayed number, if it reaches 00.000 or 000.00mm it will roll over to 99.999 or 999.99mm.

DISABLING THE "Lo" LIMIT:

Setting the display to 00.000" or 000.00mm disables the limit.

EXITING "Lo":

After entering the proper number, exit this configuration sequence by pressing both switches simultaneously. The last number displayed is saved as the new "Lo" limit. The next prompt is then displayed.

ACCESSING "ALIm":

If the prompt "ALIm" is present, the unit has the amplitude feature enabled. See Chapter 7 for the procedure to enable or disable this feature. This amplitude limit is used to detect off-axis alignment of targets or in edge guiding applications. As a target becomes less perpendicular to the transducer, the amplitude of the return echo decreases. For many applications it is important to know if a target is properly aligned. Using the relay as an output that changes state when the amplitude decreases is a powerful way to control or monitor perpendicularity.

BYPASSING "ALIm":

To bypass "ALIm", press the left switch. The next prompt displayed will be "A HYS".

MODIFYING "ALIm":

Difficulty arises in determining the number or amplitude that corresponds to an acceptably aligned target. To determine this, orient the target at a minimally acceptable point. Enter the "InS" or install configuration sequence and let the unit sample. The number displayed is the strength of the returning echo. That number is the amplitude limit to be entered.

Once the ALIm is displayed, pressing the right switch displays the amplitude limit. The left two digits are "AL" and the right three digits are the amplitude limit.

After releasing the right switch, further depressions of the right switch increments the displayed number. Holding the right switch down for two seconds increases the number by tenths. While incrementing the displayed number, if it reaches 255, it will roll through to 000.

Pressing the left switch decrements the displayed number. Holding the switch down for more than two seconds, decreases the number by tenths. While decrementing the displayed number, if it reaches 000, it will roll through to 255.

EXITING "ALIm":

After entering the proper number, exit this configuration sequence by pressing both switches together. The number last displayed is saved as the new amplitude limit. The numbers 0 or 255 will disable the amplitude limit. The next prompt is "A HYS" for amplitude limit hysteresis.

ACCESSING "A HYS":

The hysteresis if used, aids in keeping the relay from chattering about an amplitude limit. If for example, the last sample's amplitude is above the amplitude limit, the amplitude limit for the next sample will be the amplitude limit minus the hysteresis value. If the last sample was below the amplitude limit, the new limit for the next sample will be the amplitude limit plus the hysteresis value. If no hysteresis is desired, set it to zero.

MODIFYING "A HYS":

Press the right switch to enter a hysteresis value. Pressing the left switch advances the unit to the next sequence, relay state configuration.

If the right switch is pressed, the DMS displays the hysteresis value. The display reads "AH" in the left two digits for amplitude hysteresis, while the right three digits display the current number. The range of values is 0 to 255.

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by tenths. While incrementing the displayed number, if it reaches 255, it will roll through to 000.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by tenths. While decrementing the displayed number, if it reaches 000, it will roll through to 255.

EXITING "A HYS":

After entering the desired number, press both switches together to exit this configuration. The number last displayed is saved as the new amplitude hysteresis limit. The next prompt is "rS" for the relay's normal state configuration.

ACCESSING "rS":

"rS", relay state, allows the configuration of the relay to be in its normal state when the measurement is within the programmed limits ("in"), or the relay shall be in its normal state when the measurement is outside of the programmed limits ("out"). The relay is in its normal state when the normally open contact is open, and the normally closed contact is closed. Thus, if the relay is configured to be normally "in", the relay changes state (energizes) after a measurement which is out of the programmed high and low limits. Conversely, if the relay is configured to be normally "out", the relay changes state (energizes) after a measurement which is within the programmed high and low limits.

NOTE: Both the normally open and normally closed contacts of the relay are located on the terminal strip TB1.

BYPASSING "rS":

Pressing the left switch with the display showing "rS" advances the unit to the next prompt, "dELAY".

MODIFYING "rS":

Pressing the right switch enters the configuration level. The relay output options are "in" or "out". Pressing then releasing the right switch toggles between the two options.

EXITING "rS":

Pressing the left switch saves the displayed prompt as the normal relay state being in or out of limits. The DMS will display the next prompt, "dELAY".

ACCESSING "dELAY":

The "dELAY" parameter delays the relay output based on whether the last sample is in or out of limits and the configuration of the relay's normal state. The delay parameter does not control the length of time the relay is energized. It is the amount of time between the measurement and the state change. The delay time can be up to 65.634 seconds with 0.002 second resolution. If the external trigger is tied to external trigger ground, or if another sample is requested, the delay time plus the relay's one-shot time is the total time required to elapse before another sample can be taken.

BYPASSING "dELAY":

Pressing the left switch advances the unit to the next parameter, "oSHot".

MODIFYING "dELAY":

Pressing the right switch displays the delay time to one-shot, in seconds. After releasing the right switch, subsequent depressions of the right switch increments the displayed number. Holding the switch down for more than two seconds increases the number by 0.1 seconds. While incrementing the displayed number, if it reaches 65.535, it will roll over to 00.000.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by 0.1 seconds. While decrementing the displayed number, if it reaches 00.000, it will roll over to 65.535.

EXITING "dELAY":

After entering the desired number, press both switches together to exit this configuration sequence. The number last displayed is saved as the new delay time. The display will read "oSHot".

ACCESSING "oSHot":

The one-shot parameter controls the amount of time the relay stays energized or changes state after each sample. The relay state changes based on whether the last sample is in or out of limits and the configuration of the relay's normal state. The time allowed is up to 65.534 seconds with .002 second resolution. If the external trigger is tied to external trigger ground, or if another sample is requested, the delay plus the relay's one-shot time is the total time elapsed before another sample can be taken.

BYPASSING "oSHot":

Pressing the left switch advances the unit to the prompt "End-L", to configure the serial output.

MODIFYING "oSHot":

Pressing the right switch displays the one-shot time, in seconds. After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by 0.1 seconds. While incrementing the displayed number, if it reaches 65.535, it will roll over to 00.000.

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by 0.1 seconds. While decrementing the displayed number, if it reaches 00.000, it will roll over to 65.535.

EXITING "oSHot":

Upon entering the proper number, exit this configuration sequence by pressing both switches together. The number last displayed is saved as the new one-shot time. The display will read "End-L".

ACCESSING "End-L":

"End-L" configures the unit to mark the serial output stream's end of line with a carriage return character (ASCII 13) or a carriage return followed by a line-feed (ASCII 10).

BYPASSING "End-L":

Pressing the left switch advances the unit to the next prompt sequence, "bAud".

MODIFYING "End - L":

Pressing the right switch enters the configuration level. The displayed options are "cr" or "cr-LF". Pressing then releasing the right switch toggles between the two options.

EXITING "End-L":

Pressing the left switch advances the unit out of this sequence. The option last displayed is saved as the new "End-L" format. The next prompt is "bAud".

The DMS ignores a line feed character (ASCII 10) from the host computer or terminal and looks for carriage returns (ASCII 13) as the marker for the end of a message.

ACCESSING "bAud":

"bAud" sets the speed that characters are received and transmitted via the serial port, (RS 232/422). The optional baud settings are "none", 300, 600, 1200, 2400, 4800, 9600, 19,200 bits per second. If the serial communications are not being used, set the baud to "none" to disable the serial output, resulting in higher sample rates. Set the baud to the highest possible setting to minimize time between samples. The DMS does not initiate another set of samples until the serial data has been transmitted.

BYPASSING "bAud":

Pressing the left switch skips this configuration parameter. If the unit is a DMS-5000 with digital output, this is the last menu prompt. The unit then displays the current distance or differential offset measurement. If the unit is configured with an analog output, the next prompt is "AnStr", for the analog output zero point.

CONFIGURING "bAud":

Pressing the right switch advances the unit to the configuration of the baud. The display will have "bxxxx" where "xxxx" is "no", "300", "600", "1200", "2400", "4800", "9600", or "19.2" for 19.2 kilobaud. Pressing the right switch rolls the baud setting up one rate. If incrementing at "19.2", the display rolls to "no".

EXITING "bAud":

Pressing the left switch reconfigures the unit to the last number displayed. If the unit is a DMS-5000 with digital output, this is the last menu prompt. If the unit is a DMS-5000 with analog output, the next parameter prompt is "AnStr", for the analog output zero point.

For each baud setting entered, except "none", the serial output of the data is re-enabled. The serial output of data can be re-disabled with the character "<ctrl>S" (ASCII 19) sent via RS-232/422 from the host computer or terminal. The serial output of data can be re-enabled with the character "<ctrl>Q" (ASCII 17).

ACCESSING "AnStr":

"AnStr", analog starting point, is used for the 0-10VDC or 4-20mA output configuration. The number entered sets the minimum distance for the analog span to begin, or is at the top or bottom in output voltage or current, depending on the polarity setting. For example, if the span desired is 2 inches and the lowest distance that the span is to be started at is 1 inch, enter "01.000". The polarity sequence will set the 1 inch distance to be either 0 volts (4mA) or 10 volts (20mA). (The analog output may be used in other resolution modes.)

BYPASSING "AnStr":

Pressing the left switch advances the DMS to the next prompt, "AnSpn", for analog output span.

MODIFYING "AnStr":

After releasing the right switch, subsequent depressions of the right switch increments the displayed number. Holding the switch down for more than two seconds increases the number by hundredths. While incrementing the displayed number, if it reaches 99.999 (999.99mm), it will roll over to 00.000 (000.00mm).

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by hundredths. While decrementing the displayed number, if it reaches 00.000 (000.00mm), it will roll over to 99.999 (9.9999) inches 99.999 (999.99)mm.

EXITING "AnStr":

After entering the proper number, exit "AnStr" by pressing both switches together. The number last displayed is saved as the new calibrated number for the analog zero point. The display will read "AnSpn".

ACCESSING "AnSPn":

"AnSPn", analog span, sets the range of distance readings the analog output is to span. For example, if the span desired is two inches, with the lowest range being one inch, enter "02.000". The polarity sequence sets the one inch distance to be either 0 volts (4mA) or 10 volts (20mA).

BYPASSING "AnSPn":

Pressing the left switch advances the DMS to the next prompt, "AnPoL", analog output polarity.

MODIFYING "AnSPn":

After releasing the right switch, subsequent depressions of the right switch increments the number displayed. Holding the switch down for more than two seconds increases the number by hundredths. While incrementing the displayed number, if it reaches 47.999 (609.59mm), it will roll over to 00.000 (000.00mm).

Subsequent depressions of the left switch decrements the number. Holding the switch down for more than two seconds decreases the number by hundredths. While decrementing the displayed number, if it reaches 00.000 (000.00mm), it will roll over to 47.999 (609.59mm).

EXITING "AnSPn":

Exit "AnSPn" by pressing both switches together. The number last displayed is saved as the new calibrated number for the analog span. "AnPoL" is then displayed.

ACCESSING AnPoL":

"AnPoL" configures the analog's output polarity. The DMS can output 0 VDC (4mA), or 10 VDC (20mA) when the distance to the the target is below the analog zero point. The voltage varies linearly over the entire span, based on the difference in the distance from the zero point.

BYPASSING "AnPoL":

Pressing the left switch advances the unit to the distance or differential display mode. This is the last configuration item in the menu.

MODIFYING "AnPoL":

Pressing the right switch enters the lower or configuration level. The display outputs are "P0-10" for zero volts at the analog starting point, or conversely "P10-0" for 10 volts at the starting point. Pressing then releasing the right switch toggles between the two options. Pressing the left switch advances the unit out of this sequence. The number last displayed is saved as the analog polarity setting. This is the last configuration parameter in the menu. The DMS will display the current distance or differential offset measurement.

REMOTE CONFIGURATION AND OPERATION VIA RS-232 OR RS-422:

The DMS-5000 provides a full duplex asynchronous RS-232 or RS-422 communications interface.

Parameter	RS-232C or RS-422A Data Format
Baud	300,600,1200,2400,4800,9600 or 19,200 baud
Word length	8 bit
Parity	7 bit ASCII data, no parity
Start bit	1 start bit
Stop bit	1 stop bit
Line status	disable

Send the following messages exactly as shown, to configure the DMS-5000 via the serial port. The message should be followed by a carriage return character (ASCII 13). The DMS ignores line feed characters on receipt (ASCII 10). The carriage return character is denoted here as [cr]. The DMS can be configured to echo or send a line feed with each carriage return character using the two switches on the main board.

TRANSDUCER'S CALIBRATED DISTANCE BETWEEN REFERENCE BARS (cALd):

C9xxx[cr] Where xxx is 000 to 999.

To query the present value of the DMS, send: C[cr].

The output from the DMS will be @C9xxx[cr] (xxx=000 to 999).

TRANSDUCER'S CALIBRATION FOR SENSITIVITY (cALr):

Rxxxxx[cr] Where xxxxx is the cALr number on the transducer.

To query the present value of the DMS, send: R[cr].

The output from the DMS will be: @Ryyxxx[cr].

yy is the present gain setting 00 to 39 and xxx is between 000 to 255.

NOTE: The left two digits may not match the two digits just sent.

UNITS/RESOLUTION (unItS/rES):

I1[cr] Configures the unit to inches, .01" resolution.
I2[cr] Configures the unit to inches, .001" resolution.
I3[cr] Configures the unit to inches, .0001" resolution.

M1[cr] Configures the unit to mm, .1mm resolution.
M2[cr] Configures the unit to mm, .01mm resolution.
M3[cr] Configures the unit to mm, .001mm resolution.

To query the present value of the DMS, send: I[cr] or M[cr].

The output from the DMS will be:
@I.01[cr] for inches, .01" resolution.
@I.001[cr] for inches, .001" resolution.
@I.0001[cr] for inches, .0001" resolution.

@M1[cr] for millimeters, .1mm resolution.
@M.1[cr] for millimeters, .01mm resolution.
@M.01[cr] for millimeters, .001mm resolution.

NOTE: Changing the units does not change the limits and analog parameters (zero point, span). If a change is made to the units, reconfigure the above mentioned parameters.

NUMBER OF SAMPLES TO AVERAGE (Ac):

To query the present value of the DMS, send: A[cr].

The output from the DMS will be:
@Ax[cr] where x is 1-9
@Axx[cr] where xx is 01-99.
@Axxx[cr] where xxx is 001-999.
@Axxxx[cr], where xxxx is 0001 to 4095.

DIFFERENTIAL OR ZERO POINT CONFIGURATION (dIF):

TR [cr]	Takes the latest distance sample to the target as the zero point.
TC [cr]	Resets the DMS to the standard distance measuring system.

To query the present configuration of the DMS, send: T[cr].

The output from the DMS will be:
@Tx.xxxx[cr] for inches or @Txx.xxx[cr] for mm.
If the number is zero, the differential is disabled.

If the number is not zero, it is the distance from the transducer to the zero point.

EXTERNAL TRIGGER CONFIGURATION (ES):

NOTE: This is an optional feature that is enabled by the operator. See Chapter 7 to enable this feature. If this feature is not enabled, the messages below will not work.

EF[cr] Configures the unit to sample whenever the external trigger input is low or ground (free run).

EG[cr] Configures the unit to sample only upon closure of the external trigger input to ground (gated).

To query the present configuration of the unit send: E[cr].

The response will be:
@EF[cr] if the unit is configured to free run while the external trigger input is at ground potential.

@EG[cr] if the unit is gated, or samples upon the closure of the external trigger input to ground.

AMPLITUDE FILTER (AF):

NOTE: This is an optional feature that is enabled by the operator. See Chapter 7 to enable this feature. If this feature is not enabled, the messages below will not work.

Fxxx[cr] Where xxx is a number between 000 and 255.

To query the present number programmed send: F[cr].

The output will be: @Fxxx. If the number is 000 or 255, the amplitude filtering is disabled.

IGNORE DISTANCE (Ignor):

NOTE: This is an optional feature that is enabled by the operator. See Chapter 7 to enable this feature. If this feature is not enabled, the messages below will not work.

Gxxx[cr] Where xxx is a number between 000 and 100 that represent 0.1 inch increments. For example, if the desired ignore distance is 2.0 inches, send "020".

If in metric, the number ranges between 000 and 255 in millimeter increments.

To query the present ignore distance of the unit, send: G[cr].

The response will be: @Gxxx.x[cr] where xxx is the ignore distance in inches or @Gxxx[cr] in millimeter increments.

HIGH LIMIT FOR THE RELAY OUTPUT (HI-Lo, HI):

"xx.xxx" is 00.000 to 99.999 inches, 00.000 is no limit.

Or "xxx.xx" in metric for 000.00 to 999.99, 000.00 is no limit.

Hxxx.xxx[cr]	Where the DMS is configured in inches with a positive limit.
H+xxx.xxx[cr]	Same as above, + is optional.
H-xxx.xxx[cr]	Where the DMS is configured in inches with a negative limit.
Hxxx.xxx[cr]	Where the DMS is configured in mm with a positive limit.
H+xxx.xxx[cr]	Same as above, + is optional.
H-xxx.xxx[cr]	Where the DMS is configured in mm with a negative limit.

To query the present configuration of the DMS, send: H[cr].

The output from the DMS will be:

@H+xxx.xxx[cr] for a positive inches high limit.
@H-xxx.xxx[cr] for a negative inches high limit.
@H+xxx.xxx[cr] for a positive metric high limit.
@H-xxx.xxx[cr] for a negative metric high limit.

NOTE: If the number is zero, (00.000 or 000.00), there is no limit.

NOTE: For maximum resolution (0.0001" or 0.001mm) omit one character to the left of the decimal point and add one character to the right of the decimal point.

LOW LIMIT FOR THE RELAY OUTPUT (HI-Lo, Lo):

"xx.xxx" is 00.000 to 99.999 inches, 00.000 is no limit.

Or xxx.xx in metric for 000.00 to 999.99, 000.00 is no limit.

Lxxx.xxx[cr]	Where the DMS is configured in inches with a positive limit.
L+xxx.xxx[cr]	Same as above, + is optional.
L-xxx.xxx[cr]	Where the DMS is configured in inches with a negative limit.
Lxxx.xxx[cr]	Where the DMS is configured in mm with a positive limit.
L+xxx.xxx[cr]	Same as above, + is optional.
L-xxx.xxx[cr]	Where the DMS is configured in mm with a negative limit.

To query the present configuration of the DMS, send: L[cr]. The output from the DMS will be:

@L+xxx.xxx[cr] for a positive inches low limit.
@L-xxx.xxx[cr] for a negative inches low limit.
@L+xxx.xxx[cr] for a positive metric low limit.
@L-xxx.xxx[cr] for a negative metric low limit.

NOTE: If the number is zero, (00.000 or 000.00), there is no limit.

NOTE: For maximum resolution (0.0001" or 0.001mm) omit one character to the left of the decimal point and add one character to the right of the decimal point.

AMPLITUDE DETECTION (ALIm):

NOTE: This is an optional feature that is enabled by the operator. See Chapter 7 to enable this feature. If this feature is not enabled, the messages below will not work.

Qxxx[cr] Where xxx is a number between 000 and 255.

To query the unit for the present number programmed, send: Q[cr].

The output will be @Qxxx. If the number is 000 or 255, the amplitude detection is not checked or disabled.

AMPLITUDE LIMIT HYSTERESIS FOR THE RELAY OUTPUT (A HYS):

NOTE: This is an optional feature that is enabled by the operator. See Chapter 7 to enable this feature. If this feature is not enabled, the messages below will not work.

Wxxx[cr] Where xxx is a number between 000 and 255.

To query the unit for the present number programmed send: W[cr].

The output will be Wxxx. If the number is 000, the amplitude limit's hysteresis is not used.

RELAY NORMAL STATE (rS):

NI[cr] Configures the relay to be not-energized or in the normal state when the distance or differential offset is within the specified limits.

NO[cr] Configures the relay to be not-energized or in the normal state when the distance or differential offset is not within the specified limits.

To query the present configuration of DMS, send: N[cr]. The output from the DMS will be:

@NI[cr] for normal state in limits
@NO[cr] for normal state out of limits.

DELAY TIME TO RELAY ONE SHOT (dELAy):

Dxx.xxx[cr] Where xx.xxx is a number between 0 and 65.535 seconds. The resolution is in .002 second increments, x is 0 to 9.

To query the present configuration of the DMS, send: D[cr].

The output from the DMS will be: @Dxx.xxx[cr] where x is 15.000 to 65.535.

ONE-SHOT TIME FOR THE RELAY OUTPUT (oSHot):

Oxx.xxx[cr]	Where xx.xxx is a number between 0 and 65.535 seconds. The resolution is in .002 second increments, x is 00.000 to 65.535.
	To query the present configuration of the DMS, send: O[cr].
	The output from the DMS will be: Oxx.xxx[cr], where x is 00.000 to 65.535.

SAMPLE ON COMMAND:

S[cr]	Tells the DMS to take one sample or set of samples, if the external trigger input is not tied to the external trigger ground.

ENABLING/DISABLING SERIAL OUTPUT OF DISTANCE OR DIFFERENTIAL DATA:

	The DMS will still echo any messages it receives.
<ctrl>S	Disables the serial output stream.
<ctrl>Q	Enables the serial output stream.

ANALOG OUTPUT STARTING OR ZERO POINT (DMS WITH ANALOG OPTION) (AnStr):

Zx.xxxx[cr]	When the unit is configured in distance mode, not differential, with the units in inches. (.0001" resolution only)
Zxx.xxx[cr]	When the unit is configured in metric with the differential disabled. (.001mm resolution only)
	NOTE: If the differential feature is used, the mid-point of the span is 5VDC or 12mA output, which is the zero differential point or offset. Any number sent in a valid format will be saved, but will not be used if in the differential mode. The number will be the span divided by two.
	To query the present configuration of the DMS, send: Z[cr].
	The output from the DMS will be:
	@Z+x.xxxx[cr] for a positive inches zero point. @Z-x.xxxx[cr] for a negative inches zero point, differential use only. @Z+xx.xxx[cr] for a positive metric zero point. @Z-xx.xxx[cr] for a negative metric zero point, differential use only.

ANALOG OUTPUT SPAN (DMS-5000 WITH ANALOG OPTION) (AnSPn):

Bx.xxxx[cr] When the unit is configured in inches.

Bxx.xxx[cr] For metric configuration.

To query the present configuration of the DMS, send: B[cr].

The output from the DMS will be:

@Bx.xxxx[cr] for the span in inches. (.001 resolution only)
@Bxx.xxx[cr] for the span in mm. (.01 resolution only)

ANALOG OUTPUT POLARITY (DMS-5000 WITH ANALOG OPTION)(AnPoL):

P0-10[cr] For the slope to be positive, or the minimum distance of the span will have an output of 0 volts or 4mA.

P10-0[cr] For the slope to be negative, or the minimum distance of the span will have an output of 10 volts or 20mA.

To query the present configuration of the DMS, send: P[cr].

The output from the DMS will be:

@P0-10[cr] for the slope to be positive, the zero point being 0 VDC or 4mA.
@P10-0[cr] for the slope to be negative, the zero point being 10 VDC or 20mA.

CHAPTER 5 - TECHNICAL SPECIFICATIONS OF INTERFACING

The DMS-5000 includes an ASCII RS-232C or RS-422A full duplex serial communications interface as well as a 16 bit parallel binary output port (J2).

RS-232C/422A SPECIFICATIONS

The DMS-5000 provides a full duplex asynchronous RS-232C, 3 wire communications interface (four wire for RS-422A). See Chapter 3 for proper wiring practices.

Parameter	RS-232C/422A Data Format
Baud	300-19,200 baud
Word length	8 bit
Parity	7 bit ASCII data, no parity
Start bit	1 start bit
Stop bit	1 stop bit
Line status	disable

RS-232C/RS-422A SERIAL INTERFACE

The RS-232C/422A interface permits the data displayed on the LED display to be remotely displayed on a dumb terminal or sent to a host computer. The keyboard on the remote terminal can be used to change most parameters in the menu as it is a full duplex interface. The only parameters that must be entered locally (via the two switches on the main board are the "bAud" and the end of line "End-L" of the serial output. See Chapter 4 to configure the unit serially. See Chapter 3 to wire the RS-232C/422A interface to the host or terminal. During the time data is transmitted to the controller, the controller continues to make measurements. Data format is an alpha character which tells the controller which parameter is to be changed, followed by either numbers or characters which tell the controller what change is to be made to that parameter. There must be no spaces between characters and the character group must be ended with a carriage return. A minimum of 25 milliseconds must be allowed between parameters during transmission to allow updating of the non-volatile memory.

The control unit will echo back the characters sent, unless the DMS buffer is full. If the buffer is full, the DMS returns a "beep" (ASCII 07) until it receives a carriage return. If the format is not a valid parameter or configuration, a question mark will be sent to the host, followed by a "cr" or "cr-lf" depending on the DMS configuration, see Chapter 4, "End-L".

The actual data string for distance or differential measurement for the different configurations and conditions is following.

RS-232C/RS-422A SERIAL PORT DATA OUTPUT

NOTE: <cr>=carriage return (ASCII 13) also can be <cr>-<lf> output: (<lf> is line feed ASCII 010). A bad reference means that there is a fault condition; the DMS is unable to "find" the echo from the transducer reference bar. The accuracy drops appreciably if the unit is unable get an echo from the reference bar. See Chapter 6, "Maintenance and Troubleshooting" to rectify the problem.

The table following is the actual data string sent by the controller for different units, resolution, output modes or fault conditions.

DISTANCE MODE

NOTE: X is a number from 0 to 9 and represents the distance from the target.

Distance Mode, Units=Inches, Good Reference

.01" resolution, serial output is: XX.XX<cr>
.001" " " " " XX.XXX<cr>
.0001" " " " " XX.XXXX<cr>

Distance Mode, Units=Inches, Bad Reference

.01" resolution, serial output is: XX.X?<cr>
.001" " " " " XX.X??<cr>
.0001" " " " " XX.X???<cr>

Distance Mode, Units=mm, Good Reference

.1mm " " " " XXX.X<cr>
.01mm " " " " XXX.XX<cr>
.001mm " " " " XXX.XXX<cr>

Distance Mode, Units=mm, Bad Reference

.1mm " " " " XXX.?<cr>
.01mm " " " " XXX.??<cr>
.001mm " " " " XXX.???<cr>

DIFFERENTIAL MODE

Differential Mode, Positive Difference, Units=Inches, Good Reference

.01" resolution, serial output is: +XX.XX<cr>
.001" " " " " +XX.XXX<cr>
.0001" " " " " +XX.XXXX<cr>

Differential Mode, Positive Difference, Units=Inches, Bad Reference

.01" resolution, serial output is: +XX.X?<cr>
.001" " " " " +XX.X??<cr>
.0001" " " " " +XX.X???<cr>

Differential Mode, Positive Difference, Units=mm, Good Reference

.1mm " " " " +XXX.X<cr>
.01mm " " " " +XXX.XX<cr>
.001mm " " " " +XXX.XXX<cr>

Differential Mode, Positive Difference, Units=mm, Bad Reference

.1mm " " " " +XXX.?<cr>
.01mm " " " " +XXX.??<cr>
.001mm " " " " +XXX.???<cr>

Differential Mode, Negative Difference, Units=Inches, Good Reference

.01" resolution, serial output is: -XX.XX<cr>
.001" " " " " -XX.XXX<cr>
.0001" " " " " -XX.XXXX<cr>

Differential Mode, Negative Difference, Units=Inches, Bad Reference

.01" resolution, serial output is: -XX.X?<cr>
.001" " " " " -XX.X??<cr>
.0001" " " " " -XX.X???<cr>

Differential Mode, Negative Difference, Units=mm, Good Reference

.1mm " " " " -XXX.X<cr>
.01mm " " " " -XXX.XX<cr>
.001mm " " " " -XXX.XXX<cr>

Differential Mode, Negative Difference, Units=mm, Bad Reference

.1mm " " " " -XXX.?<cr>
.01mm " " " " -XXX.??<cr>
.001mm " " " " -XXX.???<cr>

16 BIT PARALLEL PORT BINARY OUTPUT WIRING

This output is provided on connector J2 located on the controller main board. Wiring to this port requires a 20 pin female mating connector. The pin out diagram is shown below, where bit 0 is the least significant bit:

PIN	FUNCTION	PIN	FUNCTION
8	GND	11	BIT 8
6	BIT 0	13	BIT 9
4	BIT 1	15	BIT 10
2	BIT 2	17	BIT 11
1	BIT 3	19	BIT 12
3	BIT 4	20	BIT 13
5	BIT 5	18	BIT 14
7	BIT 6	16	BIT 15
9	BIT 7	14	LOW WHEN SAMPLING

NOTE: When the unit is sampling, pin 14 will be "LOW". It is brought "high" or "open", immediately after the new data is present on the port.

Pin 14 is driven by an open collector transistor. It will sink 60 milliamperes, but not source any current. The "bit" pins are totem pole outputs that will source 5mA and sink up to 20mA. The bit pattern depends on the resolution and type of units (inches or millimeters) selected. The following chart indicates the output:

TYPE OF UNITS AND RESOLUTION	BINARY OUTPUT
Hundredths of inches (00.00)	Number of hundredths
Thousandths of inches(00.000)	Number of thousandths
Ten Thousandths of inches (.0001)	Number of ten thousandths
Tenths of mm (0000.0)	Number of tenths
Hundredths of mm (000.00)	Number of hundredths

NOTE: Tenths of thousandths of inches (0.0000) is not available on the 16 bit parallel output.

FIVE DIGIT DISPLAY

The table following shows the five digit display format readout when the DMS is in the distance or differential mode.

"Bad reference" means there is a fault. The DMS will not sample accurately if it does not receive an echo from the reference bar. See the "Troubleshooting Guide" if this occurs.

NOTE: X is a number from 0 to 9 and represents the distance from the target.

Distance Mode, Units=Inches, Good Reference

.01" resolution, display should read	XX.XX
.001" " " " "	XX.XXX
.0001" " " " "	X.XXXX (range < 9.9999)
.0001" " " " "	XX.XXX (range > 9.9999)

Distance Mode, Units=Inches, Bad Reference

.01" resolution, display should read	XX.X-
.001" " " " "	XX.X--
.0001" " " " "	X.X--- (range < 9.9999)
.0001" " " " "	XX.X-- (range > 9.9999)

Distance Mode, Units=mm, Good Reference

.1mm " " " "	XXX.X-
.01mm " " " "	XXX.XX
.001mm " " " "	XX.XXX

Distance Mode, Units=mm, Bad Reference

.1mm " " " "	XXX.--
.01mm " " " "	XXX.--
.001mm " " " "	XX.---

Differential Mode, Positive Difference, Units=Inches, Good Reference

.01" resolution, display should read	XX.XX
.001" " " " "	XX.XXX
.0001" " " " "	X.XXXX (range < 9.9999)
.0001" " " " "	XX.XXX (range > 9.9999)

Distance Mode, Positive Difference, Units=Inches, Bad Reference

.01" resolution, display should read	XX.X-
.001" " " " "	XX.X--
.0001" " " " "	X.X--- (range < 9.9999)
.0001" " " " "	XX.X-- (range > 9.9999)

Distance Mode, Positive Difference, Units=mm, Good Reference

1mm resolution, display should read	XXX--
.1mm " " " "	XXX.X-
.01mm " " " "	XXX.XX

Distance Mode, Positive Difference, Units=mm, Bad Reference

1mm resolution, display should read	XXX.-
.1mm " " " "	XXX.--
.01mm " " " "	XXX.--

Differential Mode, Negative Difference, Units=Inches, Good Reference

.01" resolution, display should read	-XX.XX
.001" " " " "	-X.XXX (range < 9.999)
.001" " " " "	-XX.XX (range > 9.999)
.0001" " " " "	-X.XXX (.9999 < range < 10.000)
.0001" " " " "	-XX.XXX (range > 9.9999)

Distance Mode, Negative Difference, Units=Inches, Bad Reference

.01" resolution, display should read	-XX.X-	
.001" " " " "		-X.X-- (range < 9.999)
.001" " " " "		-XX.X- (range < 9.999)
.0001" " " " "	-.X--- (range < .9999)	
.0001" " " " "	-.XX-- (.9999 < range range < 10.000)	
.0001" " " " "		-XX.X- (range > 9.9999)

Distance Mode, Negative Difference, Units=mm, Good Reference

.1mm " " " "		-XXX.X-
.01mm " " " "		-XX.XX (range < 99.99mm)
.01mm " " " "		-XXX.X (range > 99.99mm)
.001mm " " " "		-X.XXX (leftmost digit alternates between - and X)

Distance Mode, Negative Difference, Units=mm, Bad Reference

.1mm " " " "		-XXX.- (range < 99.99mm)
.01mm " " " "		-XXX.- (range > 99.99mm)
.001mm " " " "	-XXX.-	

LAMP TEST

Pressing either switch while out of the configuration mode will light all segments and decimal points on the five digit seven segment display.

LED'S

SAMPLING LED will be lit while transducer is sampling.
METRIC LED will be lit when in metric, off in inches.
RELAY LED will be lit when relay is energized into abnormal state.
ACTIVE LED will blink every second (50% duty cycle) when unit is on.

FIGURE 14

CHAPTER 6 - MAINTENANCE AND TROUBLE SHOOTING

MAINTENANCE

No maintenance is required on the DMS-5000 transducer or controller other than to replace the environmental filters if they become dirty. A dirty filter will produce erratic measurements.

CLEANING PROCEDURE - TRANSDUCER

Never touch the face of the transducer since permanent damage may occur. Never operate the system without an environmental filter. The environmental filter that covered the head of the transducer in shipment is actually a nylon mesh screen which should be used to keep dust and other contaminants from sticking to the face of the transducer during operation. Ultrasound will go through the filter while contaminants will be blocked from entering the active transducer area and sticking to the face of the transducer. Cut the environmental filter in half, then install the filter by sliding it over the transducer with the crease of the filter parallel to the reference bar and pulled on as far as it will go. The crease should be just touching the reference bar. If improperly installed the filter can cause a false target echo. Secure the filter to the transducer with an elastic band or a pair of small tie wraps. Additional filters are available from UAI, part number 100390, see Chapter 8.

TROUBLE SHOOTING GUIDE FOR THE DMS-5000

POWER UP:

1. NOTHING HAPPENS: NO DISPLAY

   1.1 Check that power is applied to unit (110 VAC).

   1.2 Check fuse on bracket (1 AMP).

2. "ERR0" THRU "ERR5" APPEARS UPON POWER UP ON THE FIVE DIGIT DISPLAY:

   2.1 These "ERROR CODES" signify that the DMS-5000 has found a problem with its electronics during power up. If these error codes occur consult the factory for return and repair of unit. Pressing either switch on the main board should clear the error and make the unit continue its power up sequence. Do not use the unit if any of the "ERR" codes appear.

3. "-----" ON DISPLAY FOR MORE THAN THIRTY SECONDS UPON POWER UP:

3.1 The DMS is calibrating the transducer to its automatic gain compensation circuitry.

3.2 Check that the transducer is plugged in properly. See Chapter 5 for proper installation.

3.3 Press both switches (SW1, SW2) and verify the "cALr" number entered is the number on the transducer. See Set-Up Procedure, Chapter 4, for "cALr".

4. ACTIVE LED IS NOT BLINKING ON AND OFF EVERY SECOND:

4.1 The DMS-5000 has locked up.

4.2 Check line voltage level.

4.3 Verify that signal ground and chassis ground are properly connected, and are isolated from each other, see Chapter 3.

4.4 If the relay output (K1) is used, check for proper installation, see Chapter 3.

5. TRANSDUCER IS NOT SAMPLING (SAMPLING LED IS NOT ON, NO "BUZZ" OUT OF TRANSDUCER):

5.1 Check the one shot and delay times, see Chapter 4. They can be up to 65.535 seconds each, making the time between samples over two minutes.

5.2 Verify proper connection to the external trigger circuitry on the barrier strip. The external trigger pin should be 0 to 1.3 volts (VDC) with respect to the external trigger ground input on TB1 to allow sampling. It will float when sampling is disabled. Also check if the special feature, "Gated Sampling" is improperly programmed to only sample when the external trigger input is closed or connected to its ground, see Chapters 4 and 7.

5.3 Check isolation between signal ground and chassis or earth ground. There should be no electrical connection. The signal ground pin is a test pin (TP10) which is adjacent to JB2.

6. SAMPLING LED IS BLINKING BUT TRANSDUCER IS NOT "BUZZING":

6.1 Check to see if the transducer is plugged in, see Chapter 3, for proper installation of the transducer connections to the main board.

7. TRANSDUCER IS "BUZZING" AND THE SAMPLING LED IS BLINKING, BUT THE DISPLAY IS BLANK WITH ALL DECIMAL POINTS "ON", EVEN THOUGH THERE IS A GOOD TARGET IN FRONT OF THE TRANSDUCER:

   7.1 If the amplitude filter number is too high for the transducer for the application, no measurement will be displayed (see Chapter 4 to display or configure the amplitude filter number).

8. TRANSDUCER IS "BUZZING" AND SAMPLING LED IS BLINKING, BUT A "--" APPEARS IN THE RIGHT TWO DIGITS OF THE FIVE DIGIT DISPLAY, OR THE RS-232/422 OUTPUT HAS "?" IN THE DATA STREAM:

   8.1 The "--" in the right two digits indicates that the DMS unit cannot see its reference bar. The unit cannot resolve a measurement more accurately than 0.2 inch or 2mm if the reference echo is not being received.

   8.2 Check the connection between the transducer and the DMS electronics, see Chapter 3 for installation instructions.

   8.3 Verify isolation between signal ground and chassis ground. Signal ground is a test point (TP5) which is next to J4 on the main board.

   8.4 Check that the "cALr" number (right three digits) is the same as those on the transducer. "--" should not be in the left two digits of "cALr" configuration sequence. See "cALr" procedure, Chapter 4.

   8.5 Visually inspect the foil on the transducer for scratches, tears, or extremely smooth patches. When on, the face should have the texture of an orange peel with a halo around the edges near the black housing. The foil should not have transparent patches. It should look consistently metallic over the entire foil surface. The foil should not be wet or dirty. Foreign materials can load down the transducer membrane and reduce sensitivity. If the transducer face is contaminated, read the cleaning procedure in this chapter.

9. DISTANCE MEASUREMENTS ARE UNSTABLE:

   9.1 Check the calibration number stored in software versus calibration number on the transducer, see Chapter 4.

   9.2 Check that the target is perpendicular to the transducer to within $\pm$ 2.5 degrees, see Chapter 4, "InS", to optimize the reflected echo.

   9.3 If the target surface area is very small, erratic readings may occur. Move the transducer closer to the target. If you cannot move closer enter the menu, "cALr" mode, and raise the three digit number on the right, then determine if the measurements are stable. If this still does not help, call UAI for assistance.

9.4 If the target is hotter than the ambient air or if the transducer is at a different temperature than the air, thermal gradients might be causing erratic readings. One solution is to mix the air in the zone in front of the transducer and/or the target to insure the temperature between the transducer face and the reference bar is close to the air temperature between the target and the reference bar. Mixing is usually done with forced air (150 cubic feet per minute, more or less depending on temperature) at ambient temperature. Call UAI for further information if you suspect that this might be occurring.

9.5 Verify isolation between the signal ground and chassis ground on the display bracket. Check for proper installation as recommended in Chapter 3.

9.6 RFI noise could be "picked up" by the transducer cable and/or the power line even though they are in shielded conduit. Call UAI for assistance in further shielding techniques.

10. RELAY FUNCTIONING IMPROPERLY:

10.1 Verify relay is seated properly in main board socket.

10.2 Check the limits, delay and one-shot times are entered properly, see Chapter 4.

10.3 Enter relay configuration sequence (rS) with the two switches on main board. Change the relay state per instruction in set-up procedure, see Chapter 4, and listen for "contact click". Using an ohmmeter, check for continuity between K1-COM and K1-NC terminals on the barrier strip. With the unit sampling, enter a "one-shot" time for the relay to change states after a sample. The unit needs to be sampling for this to work.

11. THE SERIAL PORT IS NOT TRANSMITTING:

11.1 Verify that the wiring to the DMS is correct for RS-232C/422A, see Chapter 3.

11.2 Verify the baud setting, see Chapter 4, "bAud".

11.3 If the host or terminal has sent an ASCII 19 decimal <CTRL-S>, then the data from the DMS will not be transmitted upon completion of a sample. To re-enable the transmission, send an ASCII 17 decimal <CTRL-Q>, or reset the baud. Every time the baud is reset, it automatically re-enables transmission of the data.

11.4 Following is a diagnostic aid to verify that the DMS is connected properly to the terminal or host. To use the diagnostic aid as stated in the next section, set the "cALd" number to 9009, see Chapter 4. The DMS will transmit only one ASCII character upon completion of each sample. The character transmitted is displayed in the right three digits of the "cALr" number. See the next section on DIAGNOSTIC AIDS for a table of the character for each "cALr" number. For example, if the right three digits are 120, the DMS will transmit an "x" upon completion of each sample. The five digit display will flash a "St" in the left two digits and the "120" in the right three digits.

12. THE SERIAL PORT DOES NOT RECEIVE:

12.1 Verify that the wiring is correct for use of RS- 232C/422A, see Chapter 3. Verify that the jumper adjacent to the relay is in the proper position (JP1). If RS-422A is being used, the jumper should be between the two pins furthest from the barrier strip (TB1). If RS-232C is being used, the jumper should be on the two pins closest to the barrier strip.

12.2 Check that the word length and number of stop and start bits are correct, see Chapter 5.

12.3 Use the following diagnostic aid, set the "cALd" number for the transducer to 9008, and the last character received on the serial port in decimal will be displayed. This is a quick way to see if the DMS is receiving the data coming into the serial port.

DIAGNOSTIC AIDS

There are eight diagnostic modes that can be used to help check or install the unit properly. Record the transducer cALd number, then implement diagnostic testing by setting the "cALd" number to 9002-9009 depending on the desired test. Below is a description of each diagnostic mode:

cALd	DESCRIPTION OF DIAGNOSTIC MODE
9002	AMPLITUDE OR SIGNAL STRENGTH OF THE RETURN ECHO:

The distance to the target is alternated with the amplitude or echo strength of the target. This is like alternating between the install mode and the regular distance mode. When the DMS is displaying the amplitude, there is an "A-" in the left two digits. Since the "cALd" number is 9002, which is below the "cALd" number on the transducer, the distance to the target will be different. This mode is only to verify the target's echo strength, not for accurate distance measurement.

9003 ANALOG OUTPUT VOLTAGE:

This diagnostic aid is for the analog units only. The display will alternate between "AnA E" for "Analog voltage" and the proper voltage between pins 3 and 4 (TB1) on the analog output board. The voltage is accurate to within plus or minus .005 volts. Since the cALd number is different, the distance to the target will be different than if the unit had the proper cALd number entered. This mode verifies that the parameters entered for the zero-point, polarity, and span are correct, and that the analog board is working properly.

9004 ANALOG OUTPUT CURRENT:

This diagnostic aid is for the analog units only. The display will alternate between "AnA c" for analog current and the proper current through a load resistor of 1 to 2500 ohms between pins 1 and 2 (TB1) on the analog output board. The current is accurate to within plus or minus 0.005 milliamps. Since the "cALd" number is different, the distance to the target will be different than if the unit had the proper "cALd" number entered. This mode verifies that the parameters entered for the zero-point, polarity, and span are correct, and that the analog board is working properly. When showing the correct current, this number is between 4.000 to 20.000 milliamps.

9005 16 BIT PARALLEL PORT:

To verify the output on the 16 bit binary port (J2), the display reads the hexadecimal version of the number. The left digit will blink an "H" and the four digits to the right will have the number present. Each digit corresponds to 4 output pins. If the pin is on, or 5 volts, the bit which corresponds to that digit will be a "one". Following is a table that determines which pins are high for which bits:

The numbers in each digit can be "0" to "F". Each digit is 4 bits of the 16 bit word.

HEX NUMBER	BITS	HEX NUMBER	BITS
0	0 0 0 0	8	1 0 0 0
1	0 0 0 1	9	1 0 0 1
2	0 0 1 0	A	1 0 1 0
3	0 0 1 1	B	1 0 1 1
4	0 1 0 0	C	1 1 0 0
5	0 1 0 1	D	1 1 0 1
6	0 1 1 0	E	1 1 1 0
7	0 1 1 1	F	1 1 1 1

TABLE 1

The bits corresponding to each digit are as follows:

Digit 4	bit#	b15	b14	b13	b12
	J2 pin #	16	18	20	19
Digit 3	bit#	b11	b10	b09	b08
	J2 pin#	17	15	13	11
Digit 2	bit#	b07	b06	b05	b04
	J2 pin#	09	07	05	03
Digit 1	bit#	b03	b02	b01	b00
	J2 pin#	01	02	04	06

TABLE 2

The leftmost digit with the blinking "H" is digit number 5. For example, if the display is "H"9823, by using the two tables above, bits 0,1,5,11,12, and 15 are "high", and the rest are "low". In this example "J2" pins 6,4,5,17,19 and 16 are 2-5 volts DC, the remaining pins are ground.

If the DMS is configured as an analog unit, the upper digit (number 4) should always be zero, because only the lower 12 bits are needed for the D/A converter on the analog board.

9006 TARGET TIMER:

For proper verification of the target timer or counters, setting the "cALd" number to 9006 displays the counter number that corresponds to the time it took for the echo to return from the target. The left digit blinks between "t" and the upper most digit of the count. Following is a table of counts for targets at corresponding distances from the front of the transducer or reference bar.

TARGET DISTANCE	RANGE OF TARGET COUNT
.5 inches	4,500-5,5000
1 inch	6,200-8,200
2 inches	9,500-11,500
3 inches	12,500-14,500
4 inches	15,800-17,800
5 inches	19,100-21,100
6 inches	22,400-24,400
7 inches	25,700-27,700

TABLE 3

9007 REFERENCE TIMER:

For proper verification of the reference timer or counter, setting the "cALd" number to 9007 displays the number on the counter used for the reference bars. In this mode the counter is normally used to verify that it works with different distances to the target. Place a target at some distance in front of the transducer and using Table 3, determine if the numbers are within the range specified. If they are not, the reference counter's electronics are defective.

9008 SERIAL PORT RECEIVE:

To check the serial port for proper reception of the ASCII characters sent, set the "cALd" number to 9008. The right three digits display the last character in decimal that was received from the host computer or terminal. The left two digits blink "Sr" for "serial receive". Following is a table of the decimal equivalent of ASCII characters.

DEC	CHR	DEC	CHR	DEC	CHR	DEC	CHR	DEC	CHR	DEC	CHR
0	NUL	22	SYN	44	,	66	B	88	X	110	n
1	SOH	23	ETB	45	-	67	C	89	Y	111	o
2	STX	24	CAN	46	.	68	D	90	Z	112	p
3	ETX	25	EM	47	/	69	E	91	[	113	q
4	EOT	26	SUB	48	0	70	F	92	\	114	r
5	ENQ	27	ESC	49	1	71	G	93	]	115	s
6	ACK	28	FS	50	2	72	H	94	^	116	t
7	BEL	29	GS	51	3	73	I	95	B	117	u
8	BS	30	RS	52	4	74	J	96	\	118	v
9	HT	31	US	53	5	75	K	97	a	119	w
10	LF	32	SP	54	6	76	L	98	b	120	x
11	VT	33	!	55	7	77	M	99	c	121	y
12	FF	34	"	56	8	78	N	100	d	122	z
13	CR	35	#	57	9	79	O	101	e	123	{
14	SO	36	$	58	:	80	P	102	f	124	|
15	SI	37	%	59	;	81	Q	103	g	125	}
16	DLE	38	&	60	<	82	R	104	h	126	~
17	DC1	39	'	61	=	83	S	105	i	127	DEL
18	DC2	40	(	62	>	84	T	106	j		
19	DC3	41	)	63	?	85	U	107	k		
20	DC4	42	*	64	@	86	V	108	l		
21	NAK	43	+	65	A	87	W	108	m		

9009 SERIAL PORT TRANSMIT:

Setting the "cALd" number to 9009 forces the DMS to transmit only one character after each sample on the serial port. The number that is transmitted is displayed in the right three digits of the "cALr" number. If that number is "120", then the ASCII character sent is an "x". This is useful for the initial setup and connection to the host computer or terminal. Since only one character is sent at the rate desired (by using the external trigger to gate the sample) the unit can diagnose any problems when receiving that character. The display will have the character in decimal in the right three digits. The left two digits blink the characters "St" for "serial transmit".

HAVING YOUR UNIT SERVICED

Units returned to UAI for repair or exchange should be packaged carefully to prevent shipping damage and shipped prepaid to:

Albion Devices, Inc.
538 Stevens Ave.
Solana Beach, CA 92075
858-792-9585
www.AlbionDevices.com

Please call UAI for a return material authorization number (RMA#) prior to shipping the unit.

NOTE: Do not pack unit directly in styrofoam peanuts without wrapping in plastic first.

WARRANTY

UAI warrants the controller and transducer to be free from electrical and mechanical defects in material and workmanship for a period of one year from date of shipment from the factory. Repair or replacement will be made free of charge during this period for units returned prepaid to UAI. This warranty does not cover damage caused by misuse, negligence, or use with current or voltage other than that specified; nor does this warranty cover damage or liability for improper application of UAI products. UAI's liability is extended to the price of its products only. This warranty is in lieu of any other warranty either expressed or implied.

CHAPTER 7 - SPECIAL FEATURES

Additional features are available for some specialized applications. The first section of this chapter explains the additional features. The next section explains how to enable each feature.

GATED SAMPLING ("ES" in the configuration menu):

Some applications require only one sample for each closure of the external trigger input on TB2 (barrier strip) to external trigger ground. This is called "gating" the samples. The standard DMS from the factory samples in the "free run" mode. If the external trigger input is the same potential as the external trigger ground point on the barrier strip, the unit will sample continuously, "free run", until the external trigger point is disconnected. The "ES" feature allows the operator the option to run with either mode. If the gated sampling feature is not desired, or "free running" is all that is needed while the external trigger is grounded, there is no need to turn on this option. This option is useful to look at discrete parts on an assembly line, for example, where a gating device (optical or proximity switch) "drives" the external trigger to ground. Upon each closure of the external trigger input (EXT. TRIG.) to ground (EXT TRIG. GND.) the DMS will perform only one set of samples. The relay might be used to reject a bad part off the assembly line. The relay must return to the normal state before the next part comes through. The DMS programmed to sample on closure then will wait until the next part is in the "field of view" of the transducer by waiting for the next closure of the external trigger input to ground. The gating logic prevents the DMS from sampling when there is no part present.

AMPLITUDE FILTERING OF THE TARGET'S ECHO ("AF" in the configuration menu):

The amplitude filter is used to ignore target echos that are not strong enough because of poor alignment to the transducer. When a target is perpendicular to the transducer the amplitude of the return echo is the maximum. If a target is moving through, on an assembly line for example, and the DMS is measuring thickness, the part may be vibrating such that it is not always as perpendicular to the transducer as it should be for optimum measurement. The amplitude filter feature is helpful here. The DMS can be programmed to ignore samples in a set that are below the amplitude filter number and will only average samples that are above the programmed number. If the unit is averaging 1 sample per set (Ac=1) and the target is below the amplitude filter standard, the DMS will output as if no target was present.

DETERMINING THE PROPER NUMBER TO USE AS A FILTER:

To determine the number to use for the standard, place the target in front of the transducer with the unit sampling. Enter the install feature (InS), note the maximum number when the target is perpendicular to the transducer. Subtract 20 from that number and use the resulting number as the amplitude filter setting. Once the system is running, if the DMS consistently reads that there is no target, lower the amplitude filter number. The optimal use of this filtering method is to obtain enough samples which are perpendicular to get a good reading. Non-perpendicular samples are not desired because the path to the target will be longer and these samples will degrade the accuracy of the measurement.

PROGRAMMABLE IGNORE ("Ignor" in the configuration menu):

Some applications require ignoring the closest target and measuring a target which is further away. An example is checking the fill level of a bottle. If the transducer is pointing down towards the bottle, the first echo received is the bottle's lip. This feature allows the lip to be ignored and to look for the second echo, which would be the fill level, see Figure 13, Chapter 4. Once the distance to the lip is determined, enter this value so the unit will measure values beyond it. The DMS will wait beyond the time required for the lip echo to return and enable the next echo to trip the logic for calculating the distance to the target, which is the liquid surface. The ignore distance is in 0.1" (or 1mm if in metric) increments. To ignore two inches for example, the number entered on the display or via RS-232C/422A should be 1.8".

NOTE: Ignore will not work if the first target is within 0.3" of the target that is to be measured. Th ignore should only be used if there is at least 0.4" between the targets. Contact UAI for further assistance.

AMPLITUDE DETECTION:

If the application requires detecting targets that are off axis or not perpendicular to the transducer, the DMS can be programmed to detect this condition. The serial output also has the amplitude of the return echo, along with the distance, allowing a host computer to make decisions regarding the distance and orientation of the target or transducer. With this feature the relay can be used to change states if the target is not aligned. See Chapter 3.

TURNING ON/OFF THE SPECIAL FEATURE:

Simultaneously press both switches while the unit is in the distance or differential mode. The configuration menu will read "cALd" on the five digit display. Press the right switch to enter the "cALd" configuration sequence.

Set the "cALd" number to 9000, refer to Chapter 4 for setting "cALd". Once the number 9000 is displayed, simultaneously press both switches. Note that usually the display would read "cALr" but in this case there is a blinking "cL" followed by three zeros. The "cL" stands for "combination lock" which is a safety feature so no inadvertent unit configuration changes occur. Using the switches to increment or decrement, set the number to 123 on the display. Pressing both switches simultaneously puts the DMS into the unit configuration "uc" mode. If any number other than 123 is displayed when both switches are simultaneously pressed the sequence is aborted and no changes occur in the unit configuration other than the "cALd" number. This protects the unit configuration if this sequence is entered accidentally.

After the unit is in the configuration mode the switches are used to enter a number between 0 an 9, see the table following to turn on or off the desired feature.

NOTE: TO ENABLE MORE THAN ONE SPECIAL FEATURE IT IS NECESSARY TO GO THROUGH THIS SEQUENCE MORE THAN ONCE TO GET THE DESIRED CONFIGURATION.

Simultaneously pressing both switches with the number chosen configures the unit for the special feature being enabled. Removing power from the unit before both switches are pressed will not cause a change in configuration. If no change is desired set the number to 7 or 8 and simultaneously press both switches.

Be sure to reset the proper "cALd" number upon completion of this sequence.

DISPLAYED NUMBER	FEATURE ENABLED/DISABLED
uc 0	Disables: Analog output software Amplitude detection External trigger configuration Amplitude filter Programmable ignore
uc 1	Enables: Analog output software Disables: Amplitude detection
uc 2	Enables: Amplitude detection Disables: Analog output software
uc 3	Enables: Amplitude detection Analog output software
uc 4	Enables: External trigger configuration (Gating/free run sampling)
uc 5	Enables: Amplitude filtering (Not detection)

uc 6	Enables: Programmable ignore
uc 7, 8	No change
uc 9	Enables: External trigger configuration Amplitude filtering Programmable ignore

CHAPTER 8 - ACCESSORIES

Several accessories are available from UAI to protect the product and to facilitate installation. The following is a list of most commonly used items.

Description	Part Number
30mm Transducer	101344
30mm Transducer - Double Reference Bar	102251
18mm Transducer	101346
10 Foot Transducer Cable	100345
15 Foot Transducer Cable	100614
20 Foot Transducer Cable	100616
25 Foot Transducer Cable	100617
30 Foot Transducer Cable	100615
Transducer Calibration Kit	101872
Environmental Filters for 30mm Transducer (Package of 10)	100390
Environmental Filters for 18mm Transducer (Package of 10)	100391
"O" Mounting Frame (Maximum 12 Feet)	101606
"C" Mounting Frame (Maximum 3 Feet)	100995
Air Hood - Industrial	100813
Air Hood - Non-Industrial	101078
Power Supply for Non-Industrial Air Hood	101077
Air Hood - Upper for 30mm Transducer with Sonic Concentrator and Internal Fan	101400
Air Hood - Lower for 30mm Transducer with Sonic Concentrator and Internal Fan	101401
Air Hood Spare Filter	100811
Air Manifold	100939
Air Hose - 2 Inch	100733
Air Hose - 3 Inch	100729
Air Fan 100 CFM Sufficient for One Transducer	101645
Air Fan 600 CFM Sufficient for Up to Three Transducers	100994

Line Conditioner	101366
Sonic Concentrator - Two Inch Focal Length for 30mm Transducer	100713
Remote Display	100702