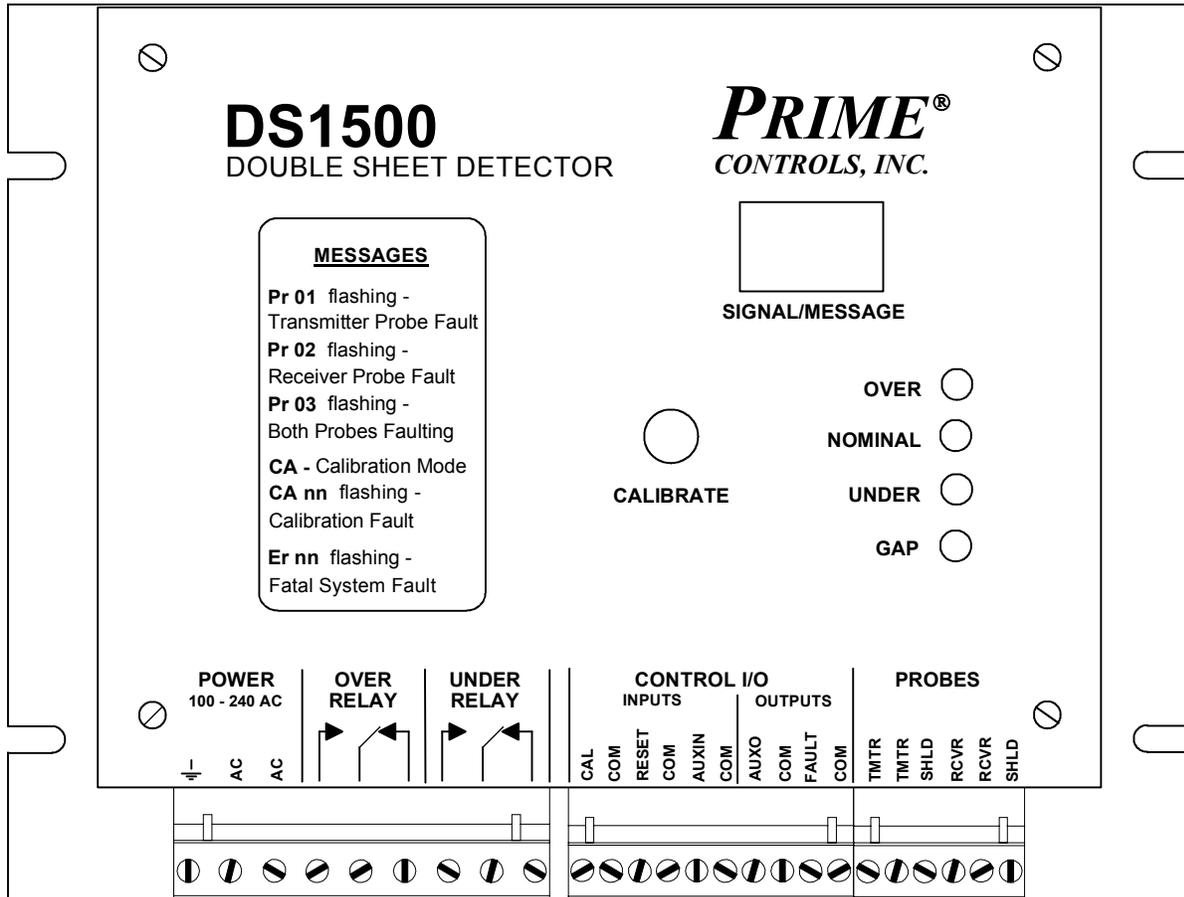


# OPERATING INSTRUCTIONS

## MODEL DS1500 DOUBLE SHEET DETECTOR



### DESCRIPTION

The Model DS1500 Double Metal Sheet Detector comprises a control module in a sheet metal housing with two probes to form a system that detects thickness of metals passing between the probes. The detector system may be used on automatic sheet feeders where double or overlapped sheet material may jam or damage the receiving machine. A double feed produces an output to stop the machine or signal the operator. The unit can also be used to detect material of grossly wrong metal thickness as it is capable of reporting an "under" condition as well as "over". The under and over conditions are reported on separate form C relay outputs.

## Control Module

The control module allows fast and easy setup and for quick diagnosis of system errors or problems. Calibration is achieved through the simple press of a push-button switch or an external contact closure. Faults are reported on a two digit display on the control module.

When the unit first powers up, the two digit display flashes the letters **SU** for several seconds indicating automatic setup is in process. *During automatic setup, there must be no material between the probes.* The unit is determining what type of probes are attached and the limits of setup parameters for your installation. When the operating conditions have been established, the two digit readout flashes **PR 1H**, **PR 70**, or **PR 15** for several seconds indicating what probes were detected. The unit is ready for operation when a purely numeric value appears and remains on the display.

Other features of the control module include:

- Universal power input accommodates AC voltages from 100 to 240 volts.
- Removable terminal blocks for quick change out of the control module.
- Separate form C relay outputs for independent reporting of OVER and UNDER conditions.
- LED indicators report the current gage states of NOTHING, UNDER, NOMINAL, and OVER.
- Automatic setup of system gain and operating parameters.
- External or front panel calibration through a contact closure or the front panel push-button switch.
- Two non-volatile calibration memories that are selected through the AUXIN terminal. These memories allow quick changeover between materials of different nominal thickness. The memory contents are retained even when power is removed from the unit.
- Latching OVER and UNDER outputs that are cleared by asserting the RESET input.
- A fast, open collector logic output that is ON for nominal readings and OFF for OVER or UNDER.
- An open collector FAULT output that may be connected to a master controller for monitoring fault and gauge-not-active conditions.
- Probe fault reporting on the two digit display warns of broken or disconnected probes or cables.

## APPLICATION CONSIDERATIONS

### Choice of Probes

The DS1500 accommodates a number of Prime probes but is most often used with the P1000B, P70A, and P70CS probes. The P70A and P1000B probes are potted and completely sealed units with permanently attached cables. The P70CS probes are potted with connectors for easy removal. The same probe type is used for transmitter and receiver and is not polarized.

The table below provides rule of thumb information for probe selection.

| <u>Probe</u> | <u>Housing</u>          | <u>Connection</u> | <u>Gap</u>    | <u>Application</u>   |
|--------------|-------------------------|-------------------|---------------|----------------------|
| P1000B       | Aluminum block          | Cable             | 0.5" to 1.25" | 0.060 and thicker    |
| P70A         | Threaded steel barrel   | Cable             | 0.5" to 0.75" | 0.004 to 0.060 steel |
| P70CS        | Smooth stainless barrel | Connector         | 0.5" to 3.00" | 0.004 to 0.060 steel |

Probes with non-ferrous (aluminum and stainless steel) housings offer greater probe separation. Probes with steel housings are not affected by the material used for mounting. Probes with aluminum or stainless steel housings are affected by steel near them including mounting clamps. To realize maximum separation with the P70CS type units, the probes must be mounted in non-ferrous clamps, e.g. Nylatron or 303 stainless steel.

Prime offers a number of other probes that allow the DS1500 to be applied to a wide range of materials including magnesium, copper, stainless steel, and aluminum. For more information or assistance in selecting the appropriate probes, contact Prime Controls.

### Gauge and Fault Monitoring

The open collector FAULT output provides a means for monitoring the status of the DS1500 to insure that all material passing between the probes is checked for doubles. When the DS1500 controller detects a fault from a probe or from within the controller itself, the FAULT output turns OFF. Since the OFF state is the fault state, a loss of power at the DS1500 is, by default, reported as a fault.

With firmware Version 3.6 and later, the FAULT output also turns off whenever the controller is not in gauge mode, i.e. whenever the unit is in setup (SU) or calibration (CA) mode.

## INSTALLATION

The installation of the components of the Thin Sheet Detector system is covered in the following paragraphs:

### DS1500 Control Module

The control board is designed to mount on the back panel of an electrical enclosure using the four mounting slots at the edges of the enclosure. The footprint is 8.25 inches (210 mm) by 6.25 inches (159 mm) with mounting slot locations on a rectangle 7.625 inches (194 mm) in the horizontal and 4.0 inches (102 mm) in the vertical. Insure that the mounting screws make good electrical contact between the module housing and the control enclosure back panel.

Avoid mounting locations with excessive heat and vibration.

### P1000B Probes

The probes must be mounted so that they face each other with typically a 0.75 inch gap between the sensing faces for steel and 1.25 inch gap for magnesium.. The sheet material should not pass closer than 1/16 inch from the sensing faces. The body of each probe has four threaded inserts on the back and four on one end for flexible and easy mounting.

The cables from the probes to the DS1500 should be run in conduit with no other conductors.

### P70CS Probes

See addendum for P70CS installation.

### Electrical Wiring

All wiring for the DS1500 connects to removable terminal blocks at the bottom of the control enclosure as described in the following paragraphs.

1. Connect 100 to 240 VAC, 50-60 Hz. power (15 watts) to the terminals labeled AC on the leftmost terminal block.
2. Connections to the control circuit of the machine are made through the OVER and UNDER form C relays as required. These relays are powered in the NOMINAL condition and the diagram on the DS1500 front panel reflects the NOMINAL state. As shipped from the factory, the NOTHING state places the relays in the same state as NOMINAL. DIP switch 2, beneath the cover of the DS1500, when ON, causes the NOTHING condition to place the OVER and UNDER relays in the over and under states simultaneously.
3. The shielded cables from the probes to the board should be run in conduit. The receiver probe is connected to terminals labeled RCVR on the rightmost terminal block and the transmitter probe to the terminals labeled TMTR on the same terminal block. Since the probes are non-polarized, the order of lead connection is not important and since the probes are identical, it does not matter which is the transmitter and which is the receiver. Connect the shield leads (drain wires) from the probe cables to the terminals labeled SHLD.
4. The OVER and UNDER relays may be operated in a "follower" mode or a "memory" mode depending upon the wiring of the RESET input. The operational modes and required connections are described below.

- a) For "follower" mode, jumper RESET and COM together on the center terminal block. In this mode, when an OVER or UNDER condition occurs, the appropriate relay drops out, and the OVER or UNDER LED comes on. After the fault condition is corrected, the relay returns to the normally energized condition and the LED goes out. Automatic reset is normally selected to control the operation when the fault condition is automatically removed or the DS1500 is wired into the stop circuit of the machine.
  - b) For "latch" mode, wire the RESET and its associated COM terminal to the normally open contacts of a switch, relay, or controller output. In this mode, when a fault condition occurs, the relay drops out and the OVER or UNDER LED comes on. After the fault condition is corrected, the contact must be momentarily closed to energize the relay.
5. The AUXIN input has two different functions depending upon the state of DIP switch 5. When DIP switch 5 is OFF, AUXIN allows two different setup memories to be accessed as described in the next paragraph. When DIP switch 5 is ON, the gap assessment at startup is bypassed unless a contact is closed across AUXIN.

With DIP switch 5 OFF, a switch or contact may be connected between AUXIN and COM to allow selection of two different calibration memories. Calibration data is stored in the memory that is selected at the time calibration occurs. Switching between calibration memories can be done at any time during DS1500 operation.

In normal use, when the DS1500 powers up, there must be no material in the probe gap since at that time the control unit assesses the probe arrangement and "remembers" the empty gap condition. For some applications, it is important that the unit be allowed to power up with material between the probes. DIP switch 5 and AUXIN accommodate this condition by allowing the signal at AUXIN to disable the gap assessment at power up. This feature is described in greater detail later in this document.

6. Optionally, the open collector FAULT output may be connected to a master system controller or to an indicator that warns of error conditions within the DS1500 system. This output is normally ON and turns OFF when an error condition is detected. Thus if the DS1500 loses power, the FAULT output reports an error condition by default.

With firmware Version 3.6 and later (see **Firmware Version** at the end of this document), the FAULT output turns OFF any time the DS1500 is not gauging the metal between the probes. In addition to error conditions, setup (**SU** on the display) and calibration (**CA** on the display) cause the fault output to turn OFF. This allows the unit to be monitored for non-gauge conditions.

## INDICATORS

The function of the indicators and controls on the DS1500 are described in the following paragraphs:

1. OVER LED is ON whenever the received signal is closer to the calibrated value for double thickness than for single thickness.
2. NOMINAL LED is ON whenever the received signal is closer to the calibrated single thickness value than to the calibrated double thickness value and is no more that 20% above the calibrated single thickness value.

3. UNDER LED is ON whenever the received signal rises above 120% of the signal received from the calibrated nominal thickness but does not exceed the measuring range of the instrument.
4. NOTHING LED is ON whenever the received signal goes beyond the measuring range of the instrument.
5. Numeric Display indicates the level of the signal from the receiving probe and reports error or status conditions.

## CONFIGURATION SWITCHES AND JUMPERS

An eight position switch is located on the main control circuit board to the left of the displays. Only four of the switches have any effect on the operation of the DS1500. Their effect is as follows:

### Switch 1      Switch 2

|     |     |  |
|-----|-----|--|
| OFF | OFF | Relay response delay is limited only by operating frequency. |
| ON  | OFF | Relay response delay is 100 milliseconds.                    |
| OFF | ON  | Relay response delay is 500 milliseconds.                    |
| ON  | ON  | Relay response delay is 1 second.                            |

Switch 3:            Not used.

Switch 4:            Not used.

Switch 5:    OFF    Probe and gap assessment occurs every time the system is powered up.

          ON:    Probe and gap assessment is bypassed at power-up if the AUXIN input is high. If AUXIN is held low (connected to COM), probe and gap assessment occurs at power-up.

Switch 6:            Not used.

Switch 7:            Not used.

Switch 8:    OFF:    The state of the relays for NOTHING in the gap is the same as for the NOMINAL state.

          ON:    The state of the relays for NOTHING in the gap, is OVER for the OVER relay and UNDER for the under relay.

Each of the logic inputs (CAL, RESET, and AUXIN) to the DS1500 has associated with it a two position jumper plug located under the front cover and immediately behind its associated connector. These jumpers allow the inputs to be driven by a sinking or sourcing device. When the jumper plug is installed on the pins closest to the connector, the input is set up for a sourcing driver. When installed on the two pins farthest from the connector, the input is set up for a sinking driver, or dry contact between the input and COM.

## INITIAL SETUP

### Probe and Gap Assessment

The startup process of the DS1500 commences immediately after power up and includes several processes which are transparent to the user except for the sequence of characters that appear on the two digit display.

When the unit first powers up, the several different sequences of characters may appear on the two digit display depending upon which options are currently active. Typically, if probe gap assessment is not bypassed, the startup display sequence includes momentary flashing of **SU**, followed by momentary flashing of the probe identifier (**PR 15**, **PR70**, or **PR 1H.**), followed by momentary display of the selected memory identifier, e.g. **SL 01**. When probe gap assessment is bypassed (Switch 5 ON) the typical startup sequence includes momentary flashing of **SU by**, followed by momentary flashing of the probe identifier, e.g. **PR 70**, followed by momentary display of the selected memory identifier, e.g. **SL 01**. If the probes are faulty, disconnected, or cannot be identified, the controller flashes **PR 01** indefinitely.

After the probes have been identified, the sensing system is characterized and the spacing between the probes is determined. *For this assessment there must be no material between the probes.* Switch 5 ON causes the controller to bypass this assessment unless a contact is closed across AUXIN. However, *it is essential that this process be completed at least once after initial installation or whenever the physical arrangement of the probes is changed.* If assessment process is bypassed, the system flashes **SU by** on the two digit display during startup.

When the operating conditions have been established, the two digit readout displays a numeric value representing the receiver signal strength.

### Startup Procedure

After all wiring is complete, proceed with setup as follows:

1. Set probe gap.
2. With DIP switch 5 OFF (factory default) and nothing in the gap between the probes, apply AC power or with DIP switch 5 ON, close a contact across AUXIN and COM and apply AC power.

## CALIBRATION SEQUENCE

For proper operation, the double sheet detector must be calibrated on both a single and a double thickness of the material to be fed any time prior to running. Calibration values are retained even when power is removed from the DS1500. Two different calibration settings may be retained in the calibration memories as determined by the signal on the AUXIN input.

1. Place a single sheet of the thickness to be gauged in the probe gap and press the CAL push button or close a contact across the external CAL input. If the calibration on single is accepted, the unit displays alternately "CA" and "2" indicating readiness to calibrate on a double thickness. If the calibration is not successful, the unit displays alternately "CE" and a number. Calibration may be attempted again immediately.
2. Place a double thickness of material to be gauged in the probe gap and press the CAL push button or close a contact across the external CAL input. If the calibration is successful, the unit resumes display of the signal strength. If the calibration is not successful, the unit displays alternately "CE" and a number. If this occurs, reinsert the single thickness and begin calibration again
3. Proceed with normal operation.

## **SPECIFICATIONS**

### **Power Requirements**

AC Power, 90 to 240 volts, 15 watts.

### **Logic Input Electrical Specifications**

CAL, RESET, AUXIN:                   30 Volts maximum  
Upper switch threshold - 6.9 volts  
Lower switch threshold - 3.3 volts

When the internal jumper is installed for pull up to accommodate sinking drivers, the input is pulled to +15 volts through 4700 ohms. When the jumper is installed for pull down to accommodate sourcing drivers, the input is pulled to common through 4700 ohms.

### **Logic Output Electrical Specifications**

AUXO, FAULT:                           NPN open collector, 100mA max., 50 volts max.

### **Output Relay Specifications**

Maximum switched voltage:           380VAC  
Maximum switched current:           14 amps N.O., 5 amps N.C, AC resistive,  
8 amps DC  
Maximum switched power:           200W DC, 2,000VA AC.  
Minimum required contact load:      12V, 100 mA  
  
Expected mechanical life:           20 million operations  
Expected electrical life:           100,000 operations at 8 amps, 240VAC  
50,000 operations at 14 amps N.O., 5 amps N.C.,  
120VAC resistive  
30,000 operations at 7.2FLA, 45LRA, 120VAC  
10,000 operations at 5FLA, 30 LRA, 240VAC

## TROUBLESHOOTING

Should trouble develop, proceed as follows:

1. If no indicators or displays are illuminated, check AC input power to the control module and the fuse located on the lower left of the chassis.
2. If the unit powers up but hangs displaying alternately “Pr” and “01”, the transmitter probe is either not connected, is shorted, or has an open in the wiring.
3. If the unit powers up, initializes and the LEDs indicate a response to the material in the gap but the relays do not switch, check that the relays are set to follow and not to latch (activate the RESET input to unlatch). For most installations, simply install jumpers between RESET and COM.
4. IF “PR” and “01” flash alternately on the display, check the transmitting probe for proper connection and continuity.
5. IF “PR” and “02” flash alternately on the display, check the receiving probe for proper connection and continuity.
6. IF “PR” and “03” flash alternately on the display, check both probes for proper connection and continuity.
7. If the unit flashes alternately “Er” and a numeric value between 1 and 8, perform the corrective action prescribed in the table below. If the error persists, consult the factory.

| <u>“Er” Number</u> | <u>Fault Description</u>        | <u>Correction</u>            |
|--------------------|---------------------------------|------------------------------|
| 01                 | Input shift register failure    | Reset through power down     |
| 02                 | Output shift register failure   | Reset through power down     |
| 03                 | Display shift register failure  | Reset through power down     |
| 04                 | Control shift register failure  | Reset through power down     |
| 05                 | System configuration data fault | Reset through power down     |
| 06                 | Gap assessment data fault       | Execute gap assess procedure |
| 07                 | Not used                        |                              |
| 08                 | Processor CONFIG register fault | Call the factory             |

8. During calibration, errors may occur that are reported through the alternate display of “CE” and a numeric value of 1 or 2. These error codes have the following meanings:

| <u>“CE” Number</u> | <u>Interpretation</u>  |
|--------------------|--|
| 01                 | The single thickness material is too thin for the system as configure with the current probes. |
| 02                 | The material is too thick for the system as configured with the current probes.                |

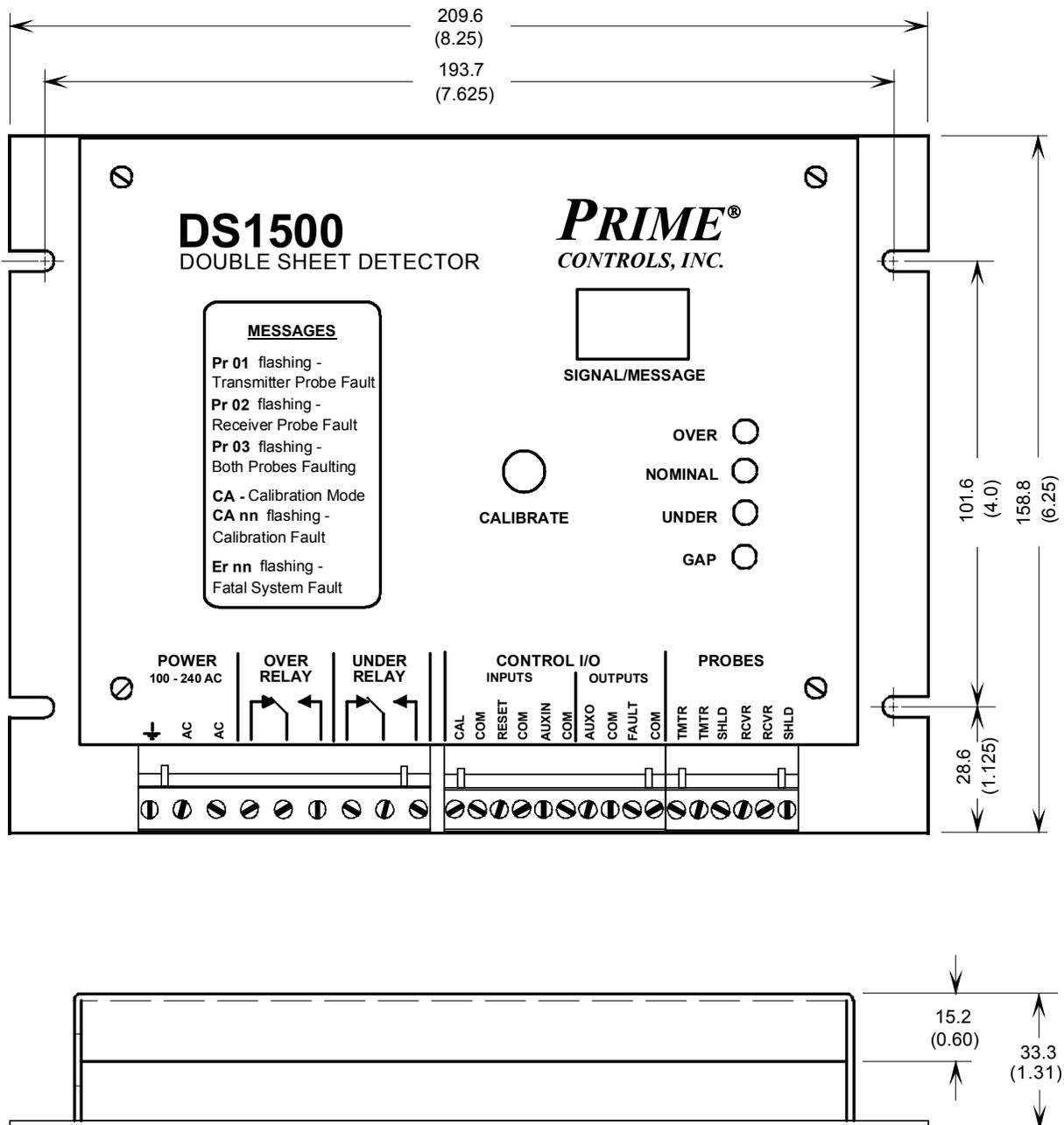
### Firmware Version

From time to time, as improvements are made to Prime products, the firmware controlling the units is revised. When setting a unit up or troubleshooting it may be necessary to determine the version number for the firmware installed in your unit. The version numbers begin with 1.0 and

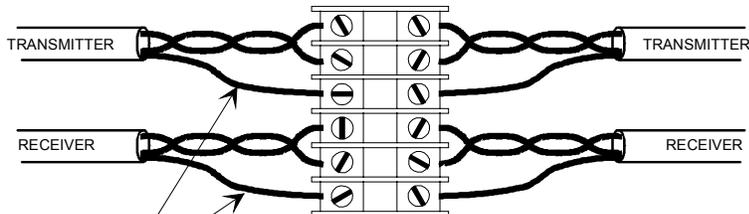
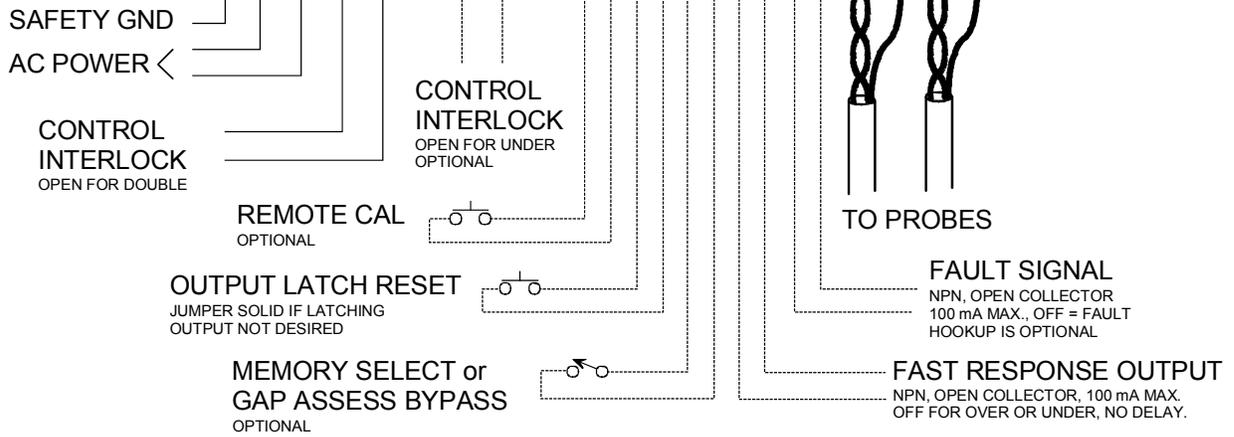
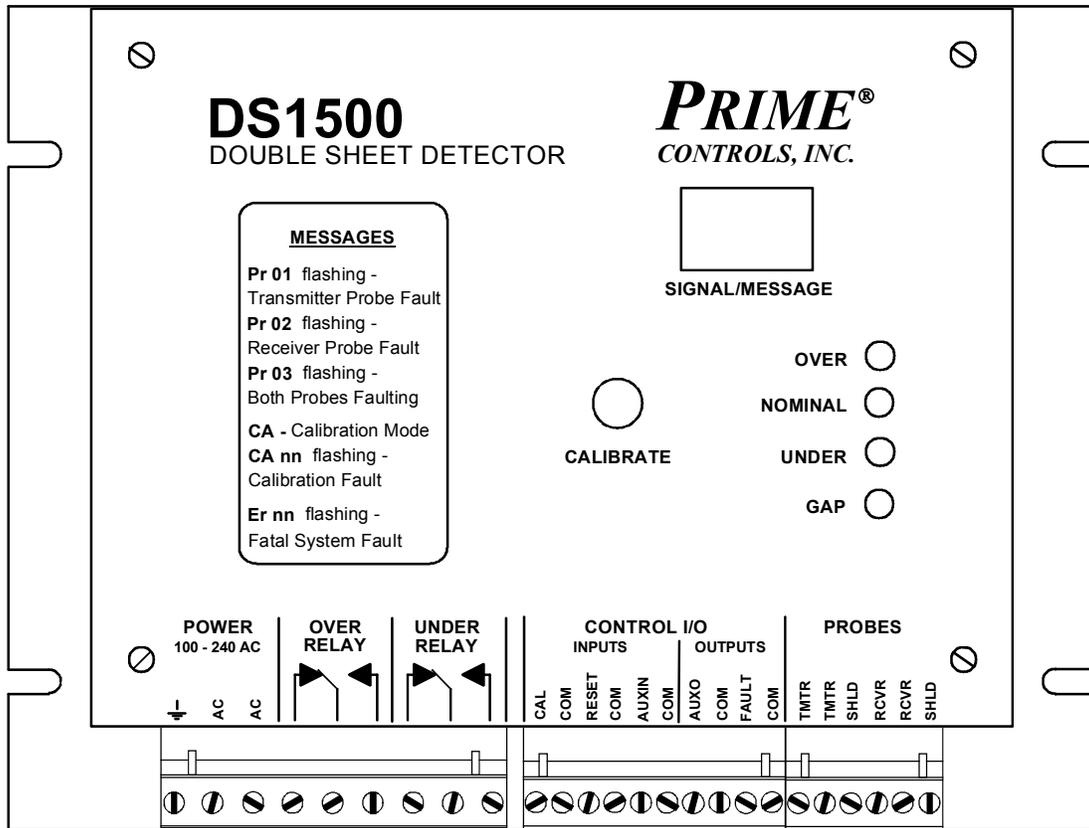
are incremented either by tenths (1.1, 1.2, etc.) for small revisions or by the integer digit (1.0, 2.0, etc.) for more significant revisions.

To determine the version of the firmware running in your unit, simply hold the calibration push button in as power is applied to the unit. The revision number will be displayed on the two-digit display alternately with the letters “Fr”. For example, Version 1.8 will flash alternately “Fr” and “1.8”.

For further information or service assistance, contact Prime Controls, Inc., 4551 Gateway Circle, Dayton, Ohio. Phone: (937) 435-8659. Mention model number and serial number.







- 3. MAINTAIN INDEPENDENT SHIELDS
- 4. POSITION SHIELD TERMINALS BETWEEN TRANSMITTER AND RECEIVER SIGNAL TERMINALS

FOR MAXIMUM NOISE IMMUNITY, SPLICE OR TERMINATE CABLES ONLY WHEN ABSOLUTELY NECESSARY.

WHERE EXTENSION IS NECESSARY, USE BELDEN 8761 OR EQUIVALENT SHIELDED, TWISTED PAIR CABLE.

THE DS1510 IS DESIGNED TO PROVIDE HIGH COMMON MODE NOISE REJECTION. COMMON MODE REJECTION IS REALIZED MOST EFFECTIVELY WITH TWISTED PAIR CABLING.

## **LIMITATION AND EXCLUSION OF WARRANTIES**

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