

DS210 Operating Instructions

V1.2

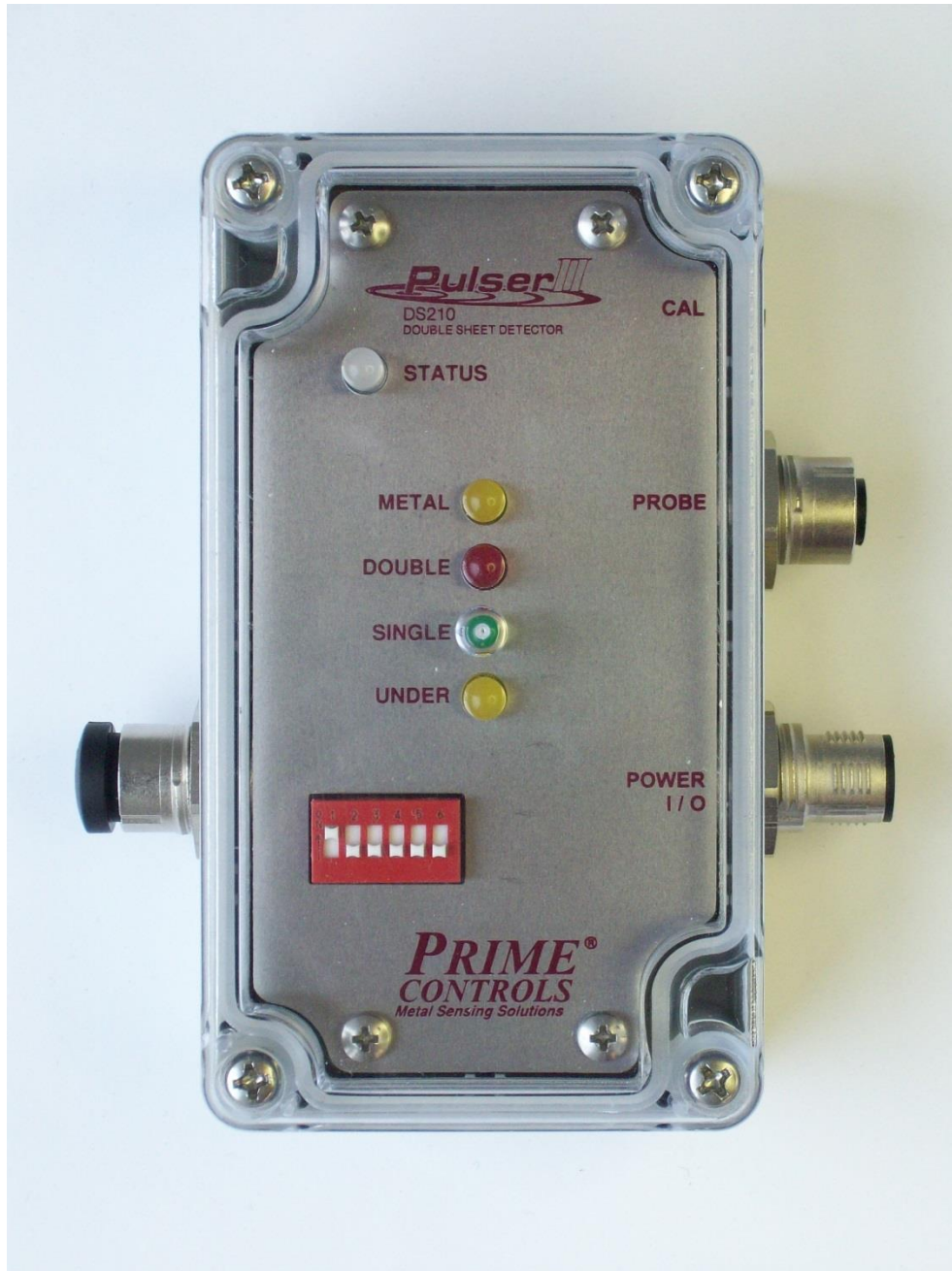


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1 Overview

The Model DS210 Double Metal Sheet Detector , together with one of 4 available probes, is designed to determine a double sheet condition for ferrous metal ranging in thickness from approximately 0.01” to 0.24” (single thickness). The DS210 is housed in a NEMA 4X rated polycarbonate enclosure, with a transparent lid. Connections are made via 12mm industry standard connectors, and cord-sets.

The DS210 is a single probe system that uses the magnetic properties of the sample to determine relative thickness. The DS210 Probe must be in close contact with the sample in order to produce a consistent result. Since the DS210 does not directly measure sample thickness, it is necessary to perform calibration from a representative sample.

2 DS210 Installation

The DS210 is intended to be installed on a flat surface, using 2 #8 (M4) Pan Head screws. For access to the mounting holes, remove the cover. At this time it is also a good idea to set the DS210 option switches (See section 5).

The location of the DS210 should be within 2m of the probe (note: this may be extended up to 5m if necessary). Be sure to allow clearance for the cables / connectors.

3 DS210 Power Requirements

The DS210 operates on 22-28VDC. With the largest probe, the current requirement is approximately 0.6A RMS, 1.7A peak. The DS210 dissipates very little heat – The majority of power usage is in the probes. The DS210 power source should be regulated, and meet the following requirements:

Voltage: 22-28 VDC

Current: 2A

If the DS210 is to be mounted more that 2m away from the power source, steps should be taken to ensure that the voltage at the DS210 does not fall below the minimum requirement, even at the peak current.

It is recommended that the DS210 be powered with a 24VDC source having a capacity of 2A. Power should be grounded at the source. DS210 probes can be grounded or floating, as the application demands.

4 DS210 Cable Wiring

The DS210 requires two cables for operation. The first is the Power / IO cable, the second, the probe cable. An RS-232 cable is available if the communications interface is used. A protective plug is provided to protect the communications interface connector if it is not in use.

4.1 Power / IO Cable

The Power / IO cable incorporates 8 conductors whose functions are defined below:

Pin #	Wire Color	Function
1	White	24VDC @ 2A
2	Brown	GND
3	Green	METAL
4	Yellow	DOUBLE
5	Gray	UNDER
6	Pink	CALIBRATE
7	Blue	RESET
8	Red	GND

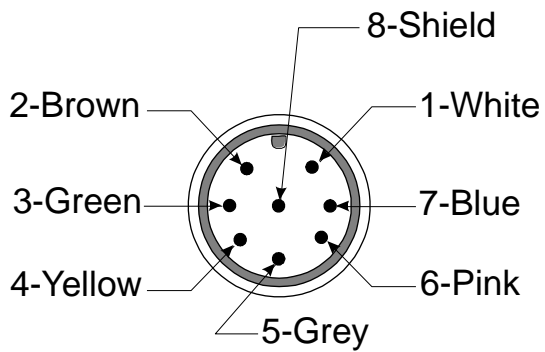
Table 3.1: Power / IO Cable Wiring

4.2 Probe Cable

DS210 Probes are connected to the DS210 via a Standard 8-conductor M12 M/F cable. Lengths beyond 5m may not function properly, and are not recommended.

DS210 / Probe		
Pin	Color	Function
1	White	Coil 1
2	Brown	Coil 2
3	Green	Sensor Out
4	Yellow	Proximity Out (Active Low)
5	Gray	24V
6	Pink	Gnd
7	Blue	Probe_ID
8	Red	Shield

Table 3.2: Probe Cable Wiring



View from Back of Probe

Figure 4.2: Probe Cable Pinout

4.3 RS-232 Communications Cable

The DS210 communications cable consists of a 5-conductor M12 Cable with a female 9-pin D-Sub connector on the mating end. DATA is sent at 9600 No parity, 8 data bits, 1 stop bit (9600 N81). Wiring for this cable is shown in Table 4.2 below.

DS210			D-Sub	
Pin	Color	Function	Pin	Function
1	Brown	N/U		N/U
2	White	TXD	2	RXD
3	Blue	Signal Gnd	5	Signal Gnd
4	Black	RXD	3	TXD
5	Gray	N/U		N/U

Table 4.2: DS210 Communications Cable Wiring

5 DS210 Option Switches

The DS210 incorporates 6 option switches whose functions are as indicated in Table 3.1 below. These switches are accessible by removing the DS210 cover.

Switch #	Position	Function
1	↓(Off)	Continuous sampling OFF
	↑(On)	Continuous sampling ON (See switch 2)
2	↓(Off)	Allow continuous sampling (See Switch 1)
	↑(On)	Continuous sampling only on DOUBLE (See Switch 1)
3	↓(Off)	Inputs and Outputs emulate PNP (Active High). Outputs are open if not active. Inputs are inactive if open.
	↑(On)	Inputs and Outputs emulate NPN (Active Low). Outputs are open if not active. Inputs are inactive if open.
4	↓(Off)	UNDER output indicates "SAMPLE TOO THIN"
	↑(On)	UNDER output becomes "SAMPLE OK"
5	↓(Off)	Reset Required After Double (and at power ON)
	↑(On)	Auto Reset After Double
6	↓(Off)	RS-232 to Text Mode
	↑(On)	RS-232 Commands Disabled

Table 5.1: DS210 Switch Settings

6 DS210 Indicators

The DS210 is equipped with 5 LED indicators. These serve to give a visual indication of the state of DS210 operation. These will be briefly described individually. Their operation, both individually, and in combination will be summarized in Table 6.1.

- **Status LED:** The Status LED is capable of indicating three colors, with meanings as given below:
 - RED – Error. The DS210 has encountered an error condition. This may be accompanied by other indicators specifying what the error is.
 - Yellow –Offline. This is an indication of either initialization, or calibration being underway.
 - Green – Normal Operation
- **METAL:** The proximity sensor in the probe is sensing metal. Note that this sensor will respond to any metallic presence, although the DS210 only senses ferrous metal.
- **DOUBLE:** Indicates that a double has been sensed. Also used during calibration, and in some error conditions.
- **SINGLE:** Indicates that a single has been sensed. Also used during calibration, and in some error conditions.
- **UNDER:** Indicates that an under has been sensed. Also used during calibration, and in some error conditions.

LEDs / States					Condition	Action
Status	Metal	Double	Single	Under		
ON		Any	Fast	ON	Missing or failed probe	Connect or replace Probe
ON	ON		Fast	Fast	Attempt to Initialize while on metal. Normal operation, using previous initialization values will start in 30 seconds if no action taken.	Remove Probe from metal, and either cycle power, or reset via RS-232.
ON	ANY	ANY	Slow	Alt Slow	Failed Calibration, metal most likely too thick. Normal operation, using previous initialization values will start in 30 seconds if no action taken.	Retry with 2-point calibration.
ON			Fast		Single-point Calibration: Waiting for metal. 2-point Calibration: Waiting for first sample	
ON		Fast			2-point Calibration: Ready for second sample	
ON	ON		ON		Single detected	
Blink			ON		Continuous sampling on Single	
Blink					Continuous sampling - no metal	
ON					Ready to sample on metal detect / change	
ON	ON	ON	ON	ON	Controller Failure	Try Cycling Power. If condition persists (or re-occurs), contact factory.

Table 6.1: DS210 LED Indicators and Their Meanings

7 DS210 Inputs

The DS210 is equipped with two inputs, capable of emulating either PNP or NPN, according to the setting of switch 3 (see section 5 Table 5.1). The functions of these inputs are as follows:

- External Calibration: When active, behaves the same as pressing the Calibration Button (See section 11 on calibration).
- Reset: When enabled (Option Switch 5 is OFF), and active, resets a latched DOUBLE condition. If held continuously active, the DS210 will behave as if Option Switch 5 is ON.

8 DS210 Outputs

The DS210 has three outputs, capable of emulating either PNP or NPN, according to the setting of switch 3 (see section 5 Table 5.1). The functions of these outputs are as follows:

- METAL: When active, indicates that the proximity sensor in the probe senses metal. Note that this sensor will respond to any metallic presence. The DS210 can only sense ferrous metals.
- DOUBLE: This output is active whenever the DS210 has sensed a NO-DOUBLE condition. Thus this output is inactive at power ON. The behavior of this output depends on the setting of switch 5.
 - If switch 5 is OFF, and a double is sensed, the DOUBLE output latches in the inactive state, and must be reset by the Reset input. In this case, DOUBLE must also be Reset at power ON.
 - If switch 5 is ON, and a double is sensed, the DOUBLE output will become inactive until the next condition which is not a double (either a single, under, or no metal) is seen.
- UNDER: The UNDER output has two different behaviors, depending of the setting of Switch 4
 - If Switch 4 is OFF: The UNDER output becomes active when a sample has been sensed which is thinner than the “under” threshold, but thicker than 0.
 - If Switch 4 is ON: The UNDER output becomes active when a sample has been sensed that is between the “under” threshold and the “double” threshold. It may be thought of as a “sample good” output.

9 Miscellaneous Functions

9.1 Firmware Version

The version of firmware within a DS210 may be checked by holding down the Calibrate Button while power is applied. The SINGLE led will flash the major version, the UNDER led will then flash the minor version. This process will repeat twice, and the normal operation will commence.

For example:

- Version is 2.1
- SINGLE flashes ON for ½ second, OFF for ½ second
- SINGLE flashes ON for ½ second, OFF for ½ second (2 flashes total)
- UNDER flashes On for ½ second, OFF for ½ second (1 flash total)
- No LEDs flash for 1 second
- SINGLE flashes ON for ½ second, OFF for ½ second
- SINGLE flashes ON for ½ second, OFF for ½ second
- UNDER flashes On for ½ second, OFF for ½ second (1 flash total)
- Normal operation commences with probe initialization.

The firmware version is also contained within the initialization message sent from the RS-232 port at power-on.

9.2 Controller Malfunction

In the event of malfunction of the DS210's microcontroller, a Controller Failure indication may be displayed. This condition is indicated by the STATUS LED turning RED, and all of the other LEDs turning ON steady. If this failure has occurred, operation of the DS210 will cease, and the METAL, DOUBLE, and UNDER outputs will become inactive

The DS210 should recover if power is cycled. If it does not, or if this happens repeatedly, contact the factory.

10 DS210 Compatible Probes and Mounting Brackets

The DS210 is compatible with 4 sizes of probe covering overlapping ranges from 0.25mm (0.01") to 6.0mm (0.24"). Each probe is available with a spring bracket. Spring brackets are recommended, as they ensure that the probe makes good contact with the sample, as is required for proper operation of the DS210. Refer to Table 5.1 for details.

Probe Model #	Probe Range		Probe Dimensions			Thread		Accessories
	Min Thickness*	Max Thickness*	Dia.	Height (Body)	Height (Overall)	Probe Body	Connector	Spring Bracket
PE36M	0.25mm 0.01"	2.3mm 0.09"	36mm 1.42"	61mm 2.40"	72mm 2.83"	M36 x 1.5mm	M12 x 1mm	BR36AL
PE42M	0.5mm 0.02"	3.6mm 0.14"	42mm 1.65"	83mm 2.11"	94mm 3.70"	M42 x 1.5mm	M12 x 1mm	BR42AL
PE54M	0.75mm 0.03"	4.6mm 0.18"	54mm 2.13"	96mm 3.78"	107mm 4.21"	M54 x 0.75mm	M12 x 1mm	BR54AL
PE75M	1.0mm 0.04"	6.0mm 0.24"	75mm 2.95"	125mm 4.92"	136mm 5.35"	M75 x 1.5mm	M12 x 1mm	BR75AL

Table 5.1: PEXXM Probe Specifications

11 DS210 Calibration

When using the DS210 it is important that the controller probe combination be properly calibrated for the sample to be tested.

Two methods of calibration are available for the DS210, one point, and two point. One point calibration works well if the sample thickness is not too close to the upper or lower end of the probes range. If a one point calibration fails (indicated by slow alternate flashing of the SINGLE and UNDER LEDs), try using the two point method.

If both methods fail, it is likely that the sample is too thin or thick for the chosen probe. Consult Table 5.1, and make sure that the chosen probe spans the necessary thickness. Note that results may vary according to the magnetic characteristics of the sample.

11.1 One Point Calibration

A one point calibration is performed using a nominal single thickness sample.

1. The calibrate button is pressed (or pulsed if using the external calibrate input, from inactive to active, and back to inactive after 100-500msec).
2. The status LED will turn yellow, and the SINGLE LED will flash if the sample is not in contact with the probe. (Calibration will commence if it is.)
3. Place the sample in contact with the probe. The DS210 will pulse twice, and the SINGLE LED will come on steady (indicating a SINGLE).
4. Calibration is complete
5. The status LED will turn green, and normal operation will commence.

If multiple memories are used, this process must be repeated for each memory to be used. (See section 12.1.3). The same or different samples can be used for calibration.

11.2 Two Point Calibration

A two point calibration is performed using two samples: A nominal single, and a nominal double.

1. To enter the two point calibration mode. the calibrate button is pressed and released (ext cal pulsed) twice within one second.
2. The STATUS LED will turn yellow, and the SINGLE LED will flash if the sample is not in contact with the probe. (Calibration will commence if it is.)
3. If the first sample (single or double – it does not matter) is not in contact with the probe, place it in contact. The first calibration point will be taken, and the DOUBLE LED will begin to blink.
4. Place the second sample in contact with the probe, and press (ext cal pulse) the CAL button.
5. The second calibration point will be taken. (Note that the 2nd calibration point will not be taken without pressing the button.)
6. The DS210 automatically uses the thinner sample as single, the thicker as double.
7. The double threshold will be placed half way between the single and double. The under threshold will be set as far below single as double threshold is above, or half-way between single and zero if there is not enough room otherwise.
8. Calibration is now complete.
9. The status LED will turn green, and normal operation will commence.

If multiple memories are used, this process must be repeated for each memory to be used. (See section 12.1.3). The same or different samples can be used for calibration.

12 DS210 Communications Interface Commands

DS210 commands are optimized for use with a simple terminal program, such as Hyperterminal, or Tera-Term. They are issued by simply typing a command character and (depending on the command) a parameter, followed by the Enter key.

DATA is sent at 9600 baud, No parity, 8 data bits, 1 stop bit (9600 N81). The most pleasing display will generally be achieved if the terminal program is set for new-line upon received and sent Carriage-Return, and local echo of typed characters.

Text Mode Commands are divided into Run Time Commands, and Diagnostic Commands.

12.1 Run Time Commands

Run time commands are issued while the DS210 is in full operation. They include Memory Select, Text Mode Select, Reset, and Diagnostics Mode.

12.1.1 Reset Command

Syntax: <R><Enter>
<r><Enter>

The reset command causes the DS 210 to perform a soft reset. This is the same as cycling power. The DS210 will cease normal operation, and look for the probe to be clear of metal, and then perform the initialization procedure. Normal operation then resumes.

12.1.2 Diagnostics Command

Syntax: <D><Enter>
<d><Enter>

The Diagnostics command will cause the DS210 to cease operation, and enter the Diagnostics Mode. At this time, serial port will display the Diagnostics Menu.. Refer to the Diagnostics section for details.

12.1.3 Memory Select Command

Syntax: <M> <#><Enter>
<m><#><Enter>

Note: # is a single digit number from 0-7.

The Memory Select command allows the user to select one of the eight available calibration memories within each probe. This selection is persistent when probes are changed, or when power is cycled, or the DS210 is Reset. For example, if channel 1 is selected, every probe subsequently connected to the DS210 will use its memory 1 calibration values.

Upon receipt of a complete, valid memory select command, the DS210 ceases operation, changes to the selected memory, and performs a Reset (the same as the Reset command).

The memory select command is only available for PEXXM (where XX is the probe size: 36, 42, 54, or 75). An error will result if the command is issued while a PEXX probe is connected, as these probes do not have the necessary internal memory.

12.1.4 Text Mode Select Command

Syntax: <T> <#><Enter>
<t><#><Enter>

The Text Mode Select command allows the user to select one of the four available text modes DS210 status messages. This selection is persistent when probes are changed, or when power is cycled, or the DS210 is Reset. A Heading will be displayed each time a Text Mode selection is made (even if the mode is the same as that already selected). Details of the four Text Modes are as follows:

T0: No reading data is sent to the serial port.

T1: The most recent reading is sent to the serial port as a 4 digit decimal number.

Rdg

0000

T2: The most recent reading, and the status of the DS210 I/Os is sent to the serial port in the following format:

Rdg	Dbl	Sgl	Und	Rly	Mtl	Mem
NNNN	B	B	B	B	B	N

Where

- N is a number from 0-9
- B is 0 or 1, indicating inactive (0) or active (1)
- Rdg is the most recent reading
- Dbl is the state of the DOUBLE Led
- Sgl is the state of the SINGLE Led
- Und is the state of the UNDER Led
- Rly is the state of the DOUBLE Relay Output
- Mtl is the state of the METAL Led
- Mem is the currently selected probe memory (0-7)

T3: The most recent reading, and related variable values

rdg	dt	cv	ut	dbl	sgl	udr	prx	mem
NNNN	NNNN	NNNN	NNNN	B	B	B	B	N

Where

- N is a number from 0-9
- B is 0 or 1, indicating inactive (0) or active (1)
- rdg is the most recent reading
- dt is the double threshold in counts
- cv is the calibration value in counts
- ut is the under threshold in counts
- dbl is the state of the DOUBLE LED
- sgl is the state of the SINGLE LED
- udr is the state of the UNDER LED / Output
- prx is the state of the METAL LED / Output (metal present)
- mem is the currently selected probe memory (0-7)

12.2 Diagnostics

When the DS210 diagnostics mode is selected, the DS210 ceases operation, switches to the diagnostics mode, and sends the diagnostics header and menu of commands to the communications interface:

```
DS210 Diagnostics
Firmware 2.2

X - Exit Diagnostics
I - Display Inputs
L - Control LEDs With Switches
O - Control Outputs With Switches
H - Display Sensor
C - Display Probe Data
>
```

Available commands, while in the diagnostics mode are detailed in the following subsections.

12.2.1 X - Exit Diagnostics

Syntax: <X><Enter>
<x><Enter>

Exits from the DS210 Diagnostics mode, Resets, and returns to RUN mode.

12.2.2 I - Display Inputs

Syntax: <I><Enter>
<i><Enter>

The current state of the internal calibrate button, external calibrate input, external RESET input, probe-mounted proximity switch, and the 6 DIP Switches are displayed continuously.

```
I - Display Inputs
Hit any key to abort
DIP SW
CALBtn ExtCAL ExtRST PROX 123456
  0      0      0      1  101111
```

Be sure to return the switches to their correct settings before exiting the diagnostics mode.

Any key exits the mode, and displays the Diagnostics menu.

12.2.3 L - Control LEDs With Switches

Syntax: <L><Enter>
<l><Enter>

SW1-1 – SW1-6 control the state of the front panel LEDs.

1 – UNDER
2 – SINGLE
3 – DOUBLE
4 – METAL
5 - STATUS (RED)
6 – STATUS (GRN)

Be sure to return the switches to their correct settings before exiting the diagnostics mode.

Any key exits the mode, and displays the Diagnostics menu.

12.2.4 O - Control Outputs With Switches

Syntax: <O><Enter>
<o><Enter>

Option switches 1-6 control the state of the DS210 Outputs.

L - Control Outputs With Switches
1=PNP/NPN 2=METAL 3=UNDER 4=DOUBLE 5=TP12 6=NU

1-PNP/NPN: This selects whether the outputs will behave as PNP or NPN (See sections 5 and 8).

2-4: These switches control the states of their respective outputs.

Switch 5 controls an on board test point

Switch 6 is not used

Be sure to return the switches to their correct settings before exiting the diagnostics mode.

Any key exits the mode, and displays the Diagnostics menu.

12.2.5 H - Display Sensor

Syntax: <H><Enter>
<h><Enter>

The output of the sensor in the currently connected probe is displayed continuously. As an aid for tracing noise problems, the highest and lowest readings since the command was invoked are also displayed.

A few counts of variation from high to low is normal.

Read Hall Sensor
hall= 491 high= 494 low= 491

Any key exits the mode, and displays the Diagnostics menu.

12.2.6 C - Display Probe Calibration Data

Syntax: <C><Enter>
<c><Enter>

The contents of the currently selected probe memory is displayed, in engineering units.

L - Display Probe CAL Block from Probe Memory
11 = 42mm, 12 = 36mm, 13 = 54mm, 14 = 75mm

Probe Memory = 0
Probe ID = 12
calvalue = 0519
doublethreshold = 0601
underthreshold = 0437
zerothickness = 0832
update_count = 0000
update_count_2 = 00
current = 00

Any key exits the mode, and displays the Diagnostics menu.

13 Specifications

13.1 Electrical Specifications

13.1.1 Power Requirements

Input Voltage: 22-28VDC

Input Current: 1.85A peak, 0.6A RMS

Input Power: 44.4W peak, 14.4W RMS

Note that the DS210 uses efficient switch-mode regulators for its operation, and so dissipates very little heat internally. The majority of heat dissipation is in the probes.

13.1.2 Input Specifications

Switch 3 ON: Inputs active when pulled to 24V (PNP), inactive otherwise

Switch 3 OFF: Inputs active when pulled to ground (NPN), inactive otherwise.

13.1.3 Output Specifications

All outputs on the DS210 are rated at 50mA DC, and are internally protected by a resettable fuse. Output behavior is switchable between PNP and NPN, according to the position of switch 3. See below:

Switch 3 ON: METAL, UNDER, PNP, Normally Open, DOUBLE PNP Normally Closed

Switch 3 OFF: METAL, UNDER, NPN, Normally Open, DOUBLE NPN Normally Closed

13.2 Temperature / Environmental

The DS210 and its probes are rated for operation between 0C and 50C (32F to 122F). Humidity can range from 10% to 90% non-condensing.

13.3 Dimensions

13.3.1 Overall

Overall dimensions are 115mm H x 96mm W x 41mm D (4.53" H x 3.78" W x 1.61" D)

13.4 Weight

DS210 weight is 233g (8.2Oz), not including cables and probes.

14 LIMITATION AND EXCLUSION OF WARRANTIES

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