MD9 MULTIDROP INTERFACE
INSTRUCTION MANUAL

REVISION: 5/03

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CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

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MD9 Multidrop Interface
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MD9 Multidrop Interface

1. Introduction

The MD9 Multidrop Interface functions as a direct wire link between a computer and a Campbell Scientific datalogger via coax cable. MD9s may be networked thereby permitting a computer to address and communicate with up to 254 dataloggers. Total coax length may be up to 3 miles when fewer dataloggers are used.

With the communication link initiated and controlled by an IBM PC or clone using Campbell Scientific's telecommunication software, the operation of the MD9 in the system is transparent to the user. Call back from a remote datalogger via MD9 is not possible.

TABLE 1-1. Specifications

Size: 6.5 X 3.5 X 1.25 in.

Weight: 5 oz.

Accessories: SC12 cable, BNC "T" connector

Voltage: 5 Volts from datalogger or SC532(A)

Current:

State 0	"Standby"	1.2 mA
State 1	"Active"	17 mA
(when transmit line drives network)		80 mA
State 2	"Sleep"	3 mA
State 3	Pull ring line & buffer bytes	17 mA

Temperature range: -25 to +50°C

Baud rates: 9600, 1200, 300

Carrier frequency: 1.2 MHz

Communication cable: RG59/U Coax

Cable connector: BNC

2. System Description

The block diagram in Figure 2-1 depicts the connection of a computer to a network of Campbell Scientific dataloggers using MD9s.

Connection of the MD9 to the computer's RS-232 SIO port is made via the SC532(A) 9 Pin Peripheral to RS-232 Interface. The SC532(A) supplies +5 VDC power to the MD9 as well as converts the MD9's CMOS voltage levels to voltage levels consistent with RS-232 requirements. A computer with the PC201 card installed could use the SC925 Cable to connect directly to the MD9.

The MD9 at the computer is connected to one or more other MD9s with coax cable terminated with BNC connectors. Refer to Appendix A for cable specifications and source references.

The MD9 at the datalogger is connected via an SC12 cable (supplied with the MD9) and is powered from the datalogger SERIAL I/O port.

Each MD9 includes a BNC "T" connector to allow for coax in/ coax out. "T" connectors on MD9s at the beginning (computer) and end (last datalogger) of the network must be terminated with 75 ohm Coax Terminators in order to prevent signal reflection from one end of the cable to the other. Place terminators on the ends of the main cable only. Any branch cables from the main cable to an MD9 should be less than 10 feet in length. No terminator is used on the T connector at the MD9 on a branch. (Figure 2-1).

NOTE There are two ground terminals located between the Serial I/O and Coax Connectors on the MD9. When installing the MD9, a 16AWG or heavier wire should be connected from earth ground to one of these terminals.

FIGURE 1-1. MD9 Multidrop Interface

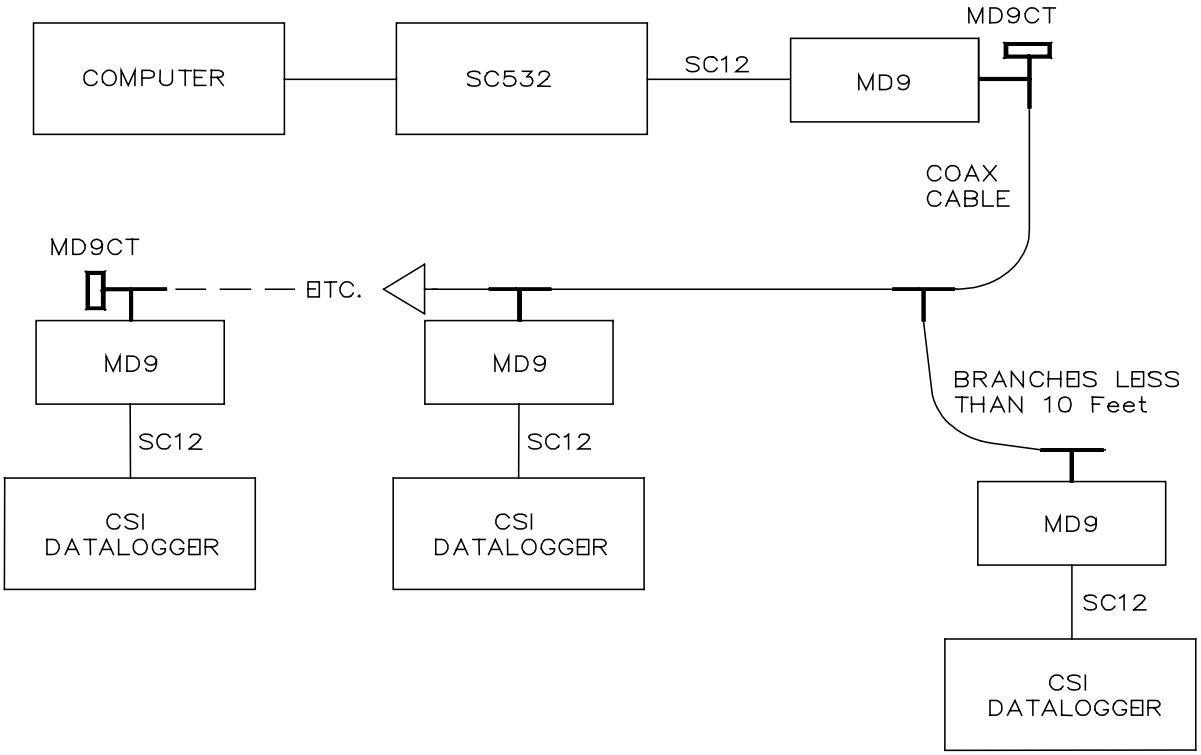


FIGURE 2-1. System Description

3. Software and Datalogger Compatibility

PC208 Software Index #5348-00 or higher is required for use with MD9s. Customers using older software may purchase a software update for a nominal charge by contacting Campbell Scientific.

The following dataloggers may be used in an MD9 network.

CR10	all
21X	SN6195 or higher
700X	Control Module SN1670 or higher

21Xs and 700Xs with lower SNs require a resistor modification which permits the respective 5 Volt power supplies to source enough current to operate an MD9. Contact Campbell Scientific customer service if your datalogger requires this modification.

4. ID and Baud Rate Selection

Each MD9 in an MD9 network must have a unique ID. The ID is set by the ID select switch (Figure 4-1). This switch is located under the cover, and can be accessed by removal of the four cover screws.

Appendix C gives a complete list of ID and switch settings.

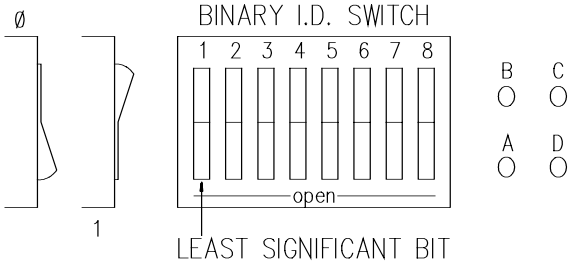
TABLE 4-1. ID Settings for MD9 Connected to Computer

Software Used	ID
Dos PC208 (GraphTerm, Telcom, and PC208E)	1 - 254
Windows PC208W (Tcom)	255

NOTE An MD9 with the ID set to 255 can be used with the DOS PC208 by adding a pound sign (#) to the end of the base MD9 dialing path in the PC208 station file. This is useful if PC208 and PC208W must be used on the same MD9 network.

NOTE Address 255 is also used when the MD9 is connected to a telephone modem (Section 6).

MD9s are shipped with the Baud Rate Selection Jumpers set at 9600 Baud. Other baud rates may be selected when necessary. All MD9s in a system must be set at the SAME baud rate.



9600 Baud	1200 Baud	300 Baud
A-B Short	A-B Open	A-B Short
C-D Short	C-D Short	C-D Open

FIGURE 4-1. ID Switch and Baud Rate Selection Jumpers

5. Maximum Number of Dataloggers and Coax Length

The maximum coax run that can operate reliably is dependent on the signal loss due to the type of wire selected and the load placed on the system by each MD9 and coax terminator. The total signal loss in an MD9 system cannot be greater than 50 db.

Each MD9 attenuates the signal by 0.2 db. Each 100 ft. of Belden 9100 coax cable attenuates the signal by 0.6 db. The terminator pair account for a 6 db loss. A quick calculation shows that a network of 34 dataloggers on 5,000 feet of coax is a workable system.

35 MD9s @ 0.2 db	7 db	(including MD9 at PC)
5,000 ft. @ 0.6 db/ 100 ft.	30 db	
Coax terminator pair	6 db	
Total Signal Loss	43 db	

6. Telephone to MD9 Network

It is possible to access an MD9 network via telephone when the network is miles from the PC. See Figure 6-1.

A Campbell Scientific Model COM200 Telephone Modem is used in conjunction with a Model PS512M 12 and 5 Volt Charging Regulator to communicate with an MD9. The COM200 and the MD9 are both supplied with a 9 pin SC12 cable suitable for connection to the PS512M. The PS512M provides 5 volts for system operation and performs the function of a null modem (the COM200 & MD9 are both "modem" devices).

The PS512M requires a 12 Volt battery for operation and contains a charging circuit to maintain the battery voltage level. The PS512M includes an AC wall transformer for AC operation A solar panel (optional) may be used if AC is unavailable.

NOTE A PS512M with a serial number less than 1712 does not supply 12 volts to the COM200 modem. Use adapter 10704 or connect 12 volts and ground to the 12 volts and ground terminals on the COM200.

The MD9 connected to the COM200 telephone modem must have the ID switch set to 255 (all switches open). When creating the station file in PC208 the base telephone with phone number is entered first and the MD9 with ID is entered second.

When configuring the network in PC208W a modem device (9600 baud) is added to a COM port, the MD9 device attaches to the Modem, and the datalogger to the MD9. The base phone number is entered in the MD9 window and the “Switch Setting of Remote MD9” (ID) is entered in the datalogger window.

NOTE In order to make measurements at the telephone to MD9 location, a datalogger with it's own MD9 is required.

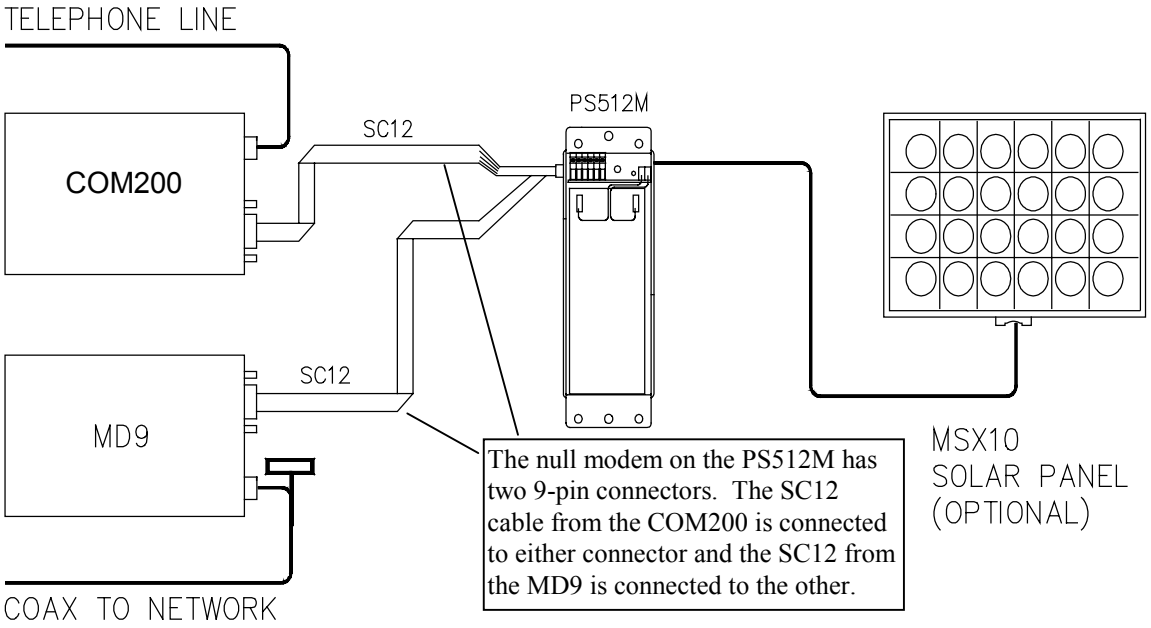


FIGURE 6-1. Telephone to MD9 Conversion

7. Operation

Communication between the computer and a datalogger is initiated and controlled by the computer. The MD9 at the computer is activated when Pin 20, Data Terminal Ready (DTR), is pulled high on the computer's I/O port. The signal is passed through the SC532(A) and in turn brings Pin 5 Modem Enable (ME) high on the MD9s I/O port.

When the ME line is pulled high, the MD9 goes from State 0 standby to State 1 active. Once in State 1, any information transmitted by the computer is passed on to the coax network. This remains true until the DTR and ME line are pulled low and the MD9 reverts to State 0.

Immediately after the computer enables its MD9 it must send a "BREAK" command followed by the "ADDRESS" of the destination MD9. See the timing diagram in Appendix C.

Upon detecting activity on the coax line, remote MD9s convert from State 0 to State 2. State 2 is a sleep mode in which the MD9 begins a timing routine to determine if a BREAK has occurred. If a BREAK is not detected, the MD9 returns to State 0. If a BREAK is detected, all remote Multidrop Interfaces capture and read the ADDRESS.

The properly addressed MD9 progresses to State 3 in which it pulls the datalogger ring line and buffers any bytes of information which followed the ADDRESS. All other remote MD9s alternate between States 0 and 2 trying to identify whether the continuing activity on the network is a new BREAK.

When the datalogger detects the ring line signal it enters its telecommunication mode and pulls its ME line high causing the MD9 to enter State 1. The link is

now complete. The computer can now send several carriage returns which permits the datalogger to synchronize at the same baud rate.

Once the datalogger baud rate has been synchronized, data retrieval, data monitoring and re-programming of the datalogger can be carried out.

To terminate communications with a datalogger, use the E command (followed by a carriage return) listed in the datalogger instruction manual. The datalogger will respond by lowering the ME line to its MD9 causing it to return to State 0.

In order to activate the next datalogger station, a BREAK and the next ADDRESS is sent by the computer. This procedure continues until all dataloggers in a network have been interrogated.

When all data for a particular time period has been collected and stored by the computer, the computer's DTR line is released causing the local MD9 to return to State 0.

An MD9 used in the telephone conversion must be operated in the "Protocol Mode". In the Protocol Mode, the MD9 communicates with the computer via the phone and controls activity on the coax network generating the "Break" command, etc. The Protocol Mode is activated when the MD9 ID switch is set to 255 (all switches OPEN).

When a station file is set up using PC208 software and the MD9 is not entered as the FIRST "Interface Device", the software assumes the MD9 at the phone modem is in the Protocol Mode.

If both conditions are met the MD9 ID set to 255 and the MD9 is not the first Interface Device the telephone to MD9 conversion is transparent to the user.

Appendix A. Cable Specifications and Source References

Belden 1505A:

Conductor: 20 AWG solid copper (.032" ∅)
Jacket Material: PVC
Jacket O.D.: .235
Shield: Braided tinned copper (100% coverage)
Resistance: 10Ω/1000'
Capacitance: 16.2pf/ft.
Impedance: 75 Ohms
Attenuation at 1 MHz: 0.29 db/100'

Belden Wire and Cable
P.O. Box 1980
Richmond, IN 47375
317-983-5200

Appendix B. Break/Address Timing

A BREAK consists of continuous spacing for time greater than 10 times the inverse of BR (baud rate). The BREAK is followed by a marking period and single byte ADDRESS. The marking time must be greater than one times the inverse of BR and the marking time and ADDRESS must be completed within 100 msec.

This is to say that a 9600 baud, the BREAK must be greater than 1.1 m sec followed by marking for 105 usec. The 8 bit single character ADDRESS (least significant bit first) is then completed within 100 msec after the end of BREAK.

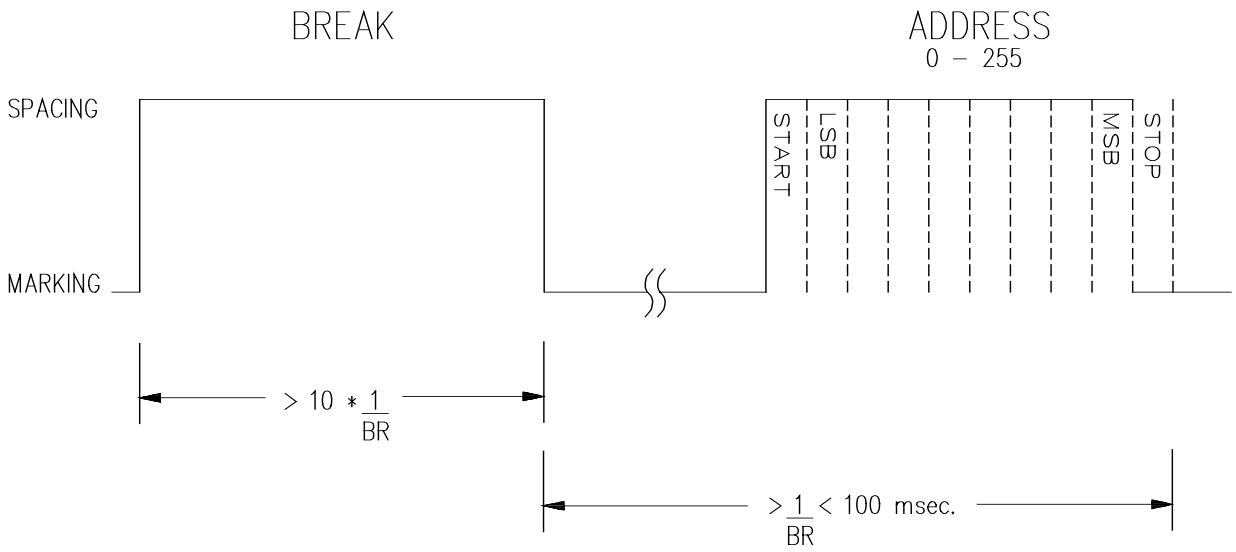


FIGURE B-1. Break/Address Timing Diagram

Appendix C. Setting the Station ID

Each MD9, including the one in the MD9 base station, must have a unique Station ID. Following is a list of all possible Station IDs with the corresponding setting of the dip switches. Here, 1 represents open and 0 is closed.

When a station is configured for phone to MD9, PC208 DOS software cannot recognize an MD9 address greater than 127.

	SWITCHES			SWITCHES			SWITCHES	
ID	1234	5678	ID	1234	5678	ID	1234	5678
			43	1101	0100	86	0110	1010
1	1000	0000	44	0011	0100	87	1110	1010
2	0100	0000	45	1011	0100	88	0001	1010
3	1100	0000	46	0111	0100	89	1001	1010
4	0010	0000	47	1111	0100	90	0101	1010
5	1010	0000	48	0000	1100	91	1101	1010
6	0110	0000	49	1000	1100	92	0011	1010
7	1110	0000	50	0100	1100	93	1011	1010
8	0001	0000	51	1100	1100	94	0111	1010
9	1001	0000	52	0010	1100	95	1111	1010
10	0101	0000	53	1010	1100	96	0000	0110
11	1101	0000	54	0110	1100	97	1000	0110
12	0011	0000	55	1110	1100	98	0100	0110
13	1011	0000	56	0001	1100	99	1100	0110
14	0111	0000	57	1001	1100	100	0010	0110
15	1111	0000	58	0101	1100	101	1010	0110
16	0000	1000	59	1101	1100	102	0110	0110
17	1000	1000	60	0011	1100	103	1110	0110
18	0100	1000	61	1011	1100	104	0001	0110
19	1100	1000	62	0111	1100	105	1001	0110
20	0010	1000	63	1111	1100	106	0101	0110
21	1010	1000	64	0000	0010	107	1101	0110
22	0110	1000	65	1000	0010	108	0011	0110
23	1110	1000	66	0100	0010	109	1011	0110
24	0001	1000	67	1100	0010	110	0111	0110
25	1001	1000	68	0010	0010	111	1111	0110
26	0101	1000	69	1010	0010	112	0000	1110
27	1101	1000	70	0110	0010	113	1000	1110
28	0011	1000	71	1110	0010	114	0100	1110
29	1011	1000	72	0001	0010	115	1100	1110
30	0111	1000	74	0101	0010	117	1010	1110
32	0000	0100	75	1101	0010	118	0110	1110
33	1000	0100	76	0011	0010	119	1110	1110
34	0100	0100	77	1011	0010	120	0001	1110
35	1100	0100	78	0111	0010	121	1001	1110
36	0010	0100	79	1111	0010	122	0101	1110
37	1010	0100	80	0000	1010	123	1101	1110
38	0110	0100	81	1000	1010	124	0011	1110
39	1110	0100	82	0100	1010	125	1011	1110

	SWITCHES			SWITCHES			SWITCHES	
ID	1234	5678	ID	1234	5678	ID	1234	5678
40	0001	0100	83	1100	1010	126	0111	1110
41	1001	0100	84	0010	1010	127	1111	1110
42	0101	0100	85	1010	1010	128	0000	0001
129	1000	0001	172	0011	0101	215	1110	1011
130	0100	0001	173	1011	0101	216	0001	1011
131	1100	0001	174	0111	0101	217	1001	1011
132	0010	0001	175	1111	0101	218	0101	1011
133	1010	0001	176	0000	1101	219	1101	1011
134	0110	0001	177	1000	1101	220	0011	1011
135	1110	0001	178	0100	1101	221	1011	1011
136	0001	0001	179	1100	1101	222	0111	1011
137	1001	0001	180	0010	1101	223	1111	1011
138	0101	0001	181	1010	1101	224	0000	0111
139	1101	0001	182	0110	1101	225	1000	0111
140	0011	0001	183	1110	1101	226	0100	0111
141	1011	0001	184	0001	1101	227	1100	0111
142	0111	0001	185	1001	1101	228	0010	0111
143	1111	0001	186	0101	1101	229	1010	0111
144	0000	1001	187	1101	1101	230	0110	0111
145	1000	1001	188	0011	1101	231	1110	0111
146	0100	1001	189	1011	1101	232	0001	0111
147	1100	1001	190	0111	1101	233	1001	0111
148	0010	1001	191	1111	1101	234	0101	0111
149	1010	1001	192	0000	0011	235	1101	0111
150	0110	1001	193	1000	0011	236	0011	0111
151	1110	1001	194	0100	0011	237	1011	0111
152	0001	1001	195	1100	0011	238	0111	0111
153	1001	1001	196	0010	0011	239	1111	0111
154	0101	1001	197	1010	0011	240	0000	1111
155	1101	1001	198	0110	0011	241	1000	1111
156	0011	1001	199	1110	0011	242	0100	1111
157	1011	1001	200	0001	0011	243	1100	1111
158	0111	1001	201	1001	0011	244	0010	1111
159	1111	1001	202	0101	0011	245	1010	1111
160	0000	0101	203	1101	0011	246	0110	1111
161	1000	0101	204	0011	0011	247	1110	1111
162	0100	0101	205	1011	0011	248	0001	1111
163	1100	0101	206	0111	0011	249	1001	1111
164	0010	0101	207	1111	0011	250	0101	1111
165	1010	0101	208	0000	1011	251	1101	1111
166	0110	0101	209	1000	1011	252	0011	1111
167	1110	0101	210	0100	1011	253	1011	1111
168	0001	0101	211	1100	1011	254	0111	1111
169	1001	0101	212	0010	1011	255	1111	1111
170	0101	0101	213	1010	1011			
171	1101	0101	214	0110	1011			

Appendix D. SC532A

The SC532A differs from the SC532 in three ways:

1. Provides 12 V on PERIPHERAL Port pin 8
2. "PROGRAM" mode
3. Jack on SC532A POWER input

The SC532A supplies 12 VDC via PERIPHERAL connector pin 8 for the purpose of powering 12 V peripherals.

The SC532A's internal jumper selects "SC532" or "PROG" mode. For the MD9 leave the jumper in the factory default position of "SC532." "PROG" is a special mode for satellite transmitters only.

The SC532A has a POWER jack allowing convenient replacement in the event of AC adapter failure (see CAUTION below). The jack also facilitates operating the SC532A from datalogger power at remote sites by using optional field cable (item number 14020) in place of the AC adapter. Simply plug the cable's DB9 connector into the datalogger's CS I/O port for 12 V power. If you have an earlier datalogger lacking 12 V on CS I/O port pin 8 (DVM test between paper-clip inserted in pin 8 and GND) the field cable can be modified to connect to the datalogger's power terminals as follows:

1. Unplug field cable from datalogger and SC532A.
2. Cut off DB9 connector.
3. Remove cable sheath exposing positive (RED) wire and negative (BLACK) wire 2 inches back.
4. Strip ¼ inch of insulation from each wire and tin ends.
5. Connect RED wire to datalogger "12 V" and BLACK wire to datalogger power ground terminal. The correct barrel connector polarity is (+) on the inner bore and (–) on the outer sleeve.

The MD9 requires that a minimum of 6 VDC @ 90 mA be supplied to the SC532A POWER jack from AC adapter or field cable. The maximum voltage that can be safely applied to the SC532A POWER jack is 17 VDC.

CAUTION

Before plugging the power connector into the SC532A, if you have 1) cut off optional field cable's DB9, 2) replaced the factory AC adapter, or 3) built your own dc power cable, make sure that the voltage polarity is correct on the barrel connector. Application of REVERSED POLARITY power to the SC532A can damage the SC532A, datalogger, and peripheral (not covered under warranty)!

Barrel connector inner bore (+)

Barrel connector outer sleeve (–)

The maximum POWER input voltage is 17 VDC!