SmarTek Acoustic Sensor - Version 1 (SAS-1)

Installation and Setup Guide
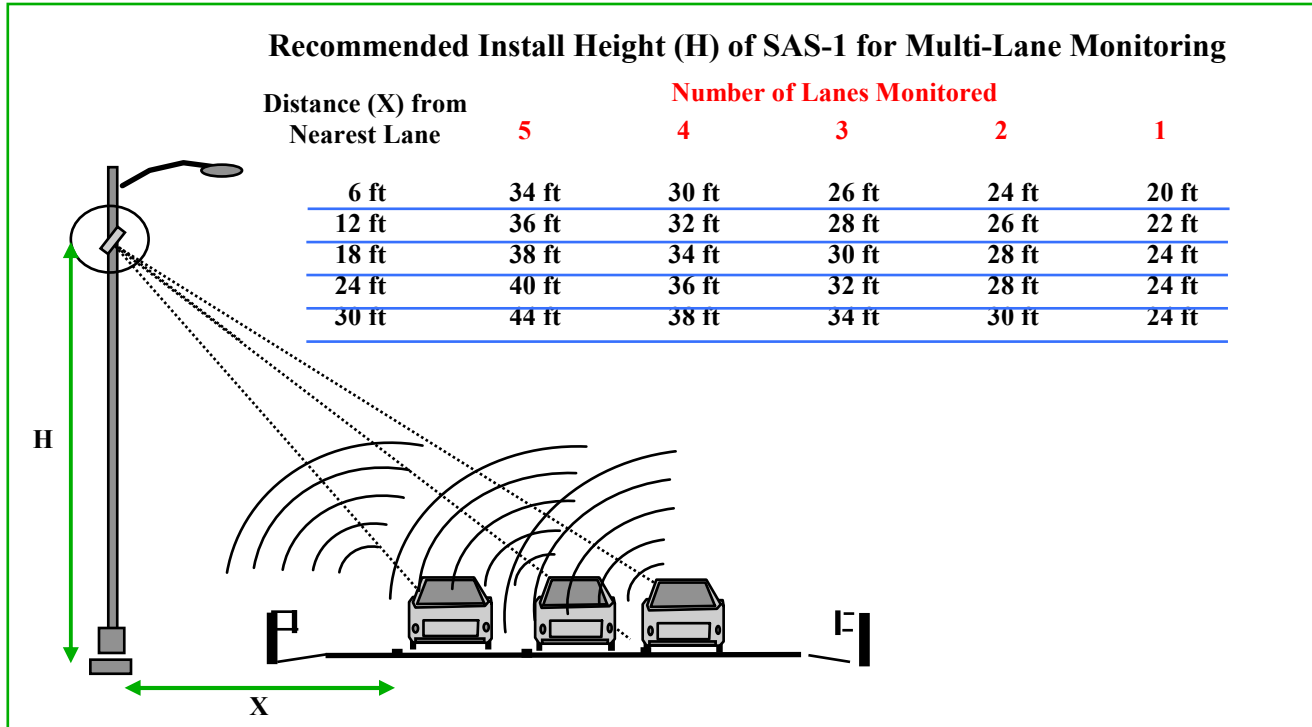
Part-E
Installation at the Traffic Monitoring Site

28 March 2003

Note: In all cases, do not work or position equipment over an active traffic lane. Working over active lanes presents a hazard to the installer and to travelers using the highway. Follow local authorized procedures when installing the SAS-1 unit and any associated components or subsystems.

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Installation at the Traffic Monitoring Site

Existing highway structures (light poles, sign bridges, overpasses, etc.) are suitable for mounting the SAS-1 for traffic monitoring. There is no need to mount the SAS-1 over any active lanes.

Recommended Install Height (H) of SAS-1 for Multi-Lane Monitoring

Distance (X) from Nearest Lane	Number of Lanes Monitored				
	5	4	3	2	1
6 ft	34 ft	30 ft	26 ft	24 ft	20 ft
12 ft	36 ft	32 ft	28 ft	26 ft	22 ft
18 ft	38 ft	34 ft	30 ft	28 ft	24 ft
24 ft	40 ft	36 ft	32 ft	28 ft	24 ft
30 ft	44 ft	38 ft	34 ft	30 ft	24 ft

Figure 1 SAS-1 Mounting Position Recommendations

From the "side fire" position, the SAS-1 can provide effective lane by lane monitoring for up to five (5) lanes. The typical mounting height (Figure 1) for the SAS-1 should be 25 to 35 feet (at least 34 ft if four or five lanes are to be monitored). The horizontal distance from the first active lane should be nominally 10 to 20 feet. Mounting the SAS-1 just off the shoulder is a good position.   Higher mounting positions reduce possible occlusion of smaller vehicles by tall trucks.

Sensor Mounting for Multi-Lane Monitoring

The basic mounting bracket for the SAS-1 consists of a 2 inch diameter aluminum tube and a cast aluminum flange (Figure 2). The flange should be matched to the structure the SAS-1 is mounted on (curved to fit different diameter structures or flat to fit rectangular structures or concrete walls). The flange may be attached to the structure via stainless steel strapping or bolts. The tube screws into the flange and is locked in place with a set screw. For mounting SAS-1 on a round structure such as a light pole or sign bridge, the orientation of the flange depends on whether the mounting position is on a vertical member (i.e. light pole) or on a horizontal member (i.e. cross member of a sign bridge).
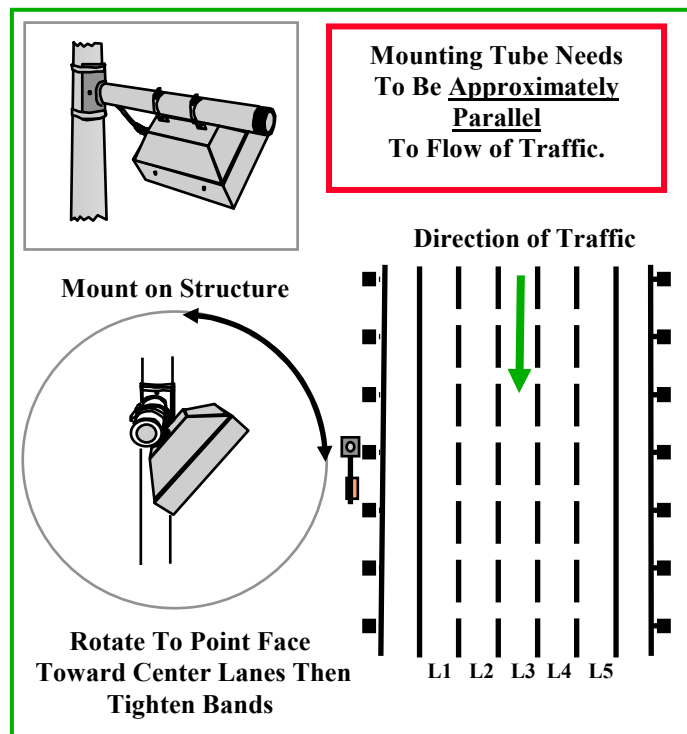
To mount the SAS-1 on the highway structure, first attach the flange and tube assembly to the structure so that the mounting tube is approximately parallel to the flow of traffic. Secure the assembly using stainless steel strapping. Position the flange and tube assembly on the down road side of the highway structure if possible (Figure 3). This positioning is highly effective in keeping the SAS-1 out of sight of motorists and therefore, reduces the chance for vandalism.


Figure 2 Mounting Tube and Flange

Once the flange and tube assembly is secure, **slide the SAS-1 unit over the aluminum tube so that the SAS-1 home run cable strain relief is toward the uproad direction**. Orienting the SAS-1 this way keeps the SAS Monitor and Setup TAI display interpretation consistent. That is, left on the TAI display is left of the SAS-1 and right on the TAI display is right of the SAS-1.

Rotate the SAS-1 about the tube until the face of the sensor is toward the center of the lanes that will be monitored as shown in Figure 3. **Remember that SAS-1 pointing does not have to be precise**. For the highway example shown in Figure 3, the face of the SAS-1 should be pointed toward Lane 3 or Lane 4. Once the SAS-1 is rotated to the desired direction, tighten the stainless steel straps around the 2 inch mounting tube and secure the short home run cable with tie straps to the mounting tube and the highway structure.

When mounting the SAS-1 on a bridge or overpass use a mounting arrangement that points the SAS-1 slightly away from the sign bridge (Figure 4). This eliminates sound reflections from under the structure which can cause false detections and result in poor performance. For example, if the SAS-1 mounting position is on the downroad side of an sign bridge, tilt the SAS-1 mounting tube upward approximately 10 to 15 degrees. This makes the SAS-1 pointing direction further downroad and moves the SAS-1 detection zones further downroad and away from the structure (Figure 4).

Figure 3 Mounting and Pointing for Multi-Lane
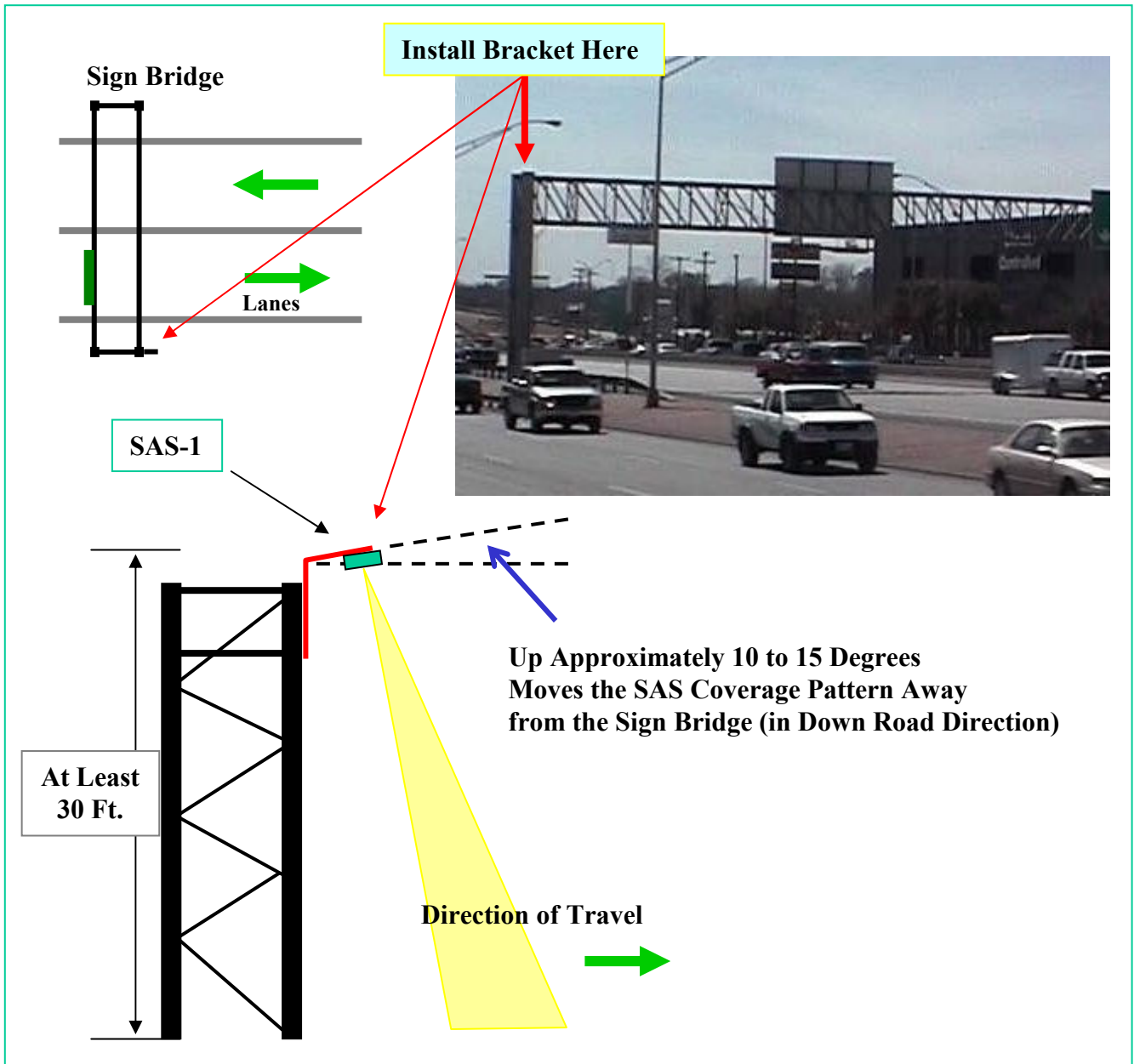
Figure 4 SAS-1 Mounting Orientations for an Overpass or Sign Bridge

Mounting and Connecting the SAS-Junction Box (SAS-JB)

Multiple SAS-1 units may be connected to a single cabinet controller and communicate over a single home run link using RS-422 or wireless. When using a cabinet controller such as SmarTek Systems' T-BOX, the number of SAS-1 units connected via a single home run cable is only limited by power supply considerations and the communication polling period. When connected via wireless, the number of SAS-1 units that share the same wireless link is only limited by the communication polling period.

The SAS-Junction Box (SAS-JB) is used to connect the short home run cable for one or more SAS-1 units to a single long home run cable for long runs to a roadside cabinet (Figure 5). For shorter cable runs to the roadside cabinet (less than 50 ft), the SAS-JB may not be needed.

Route and secure the short home run cable from each SAS-1 unit along the highway structure to a position selected for mounting the SAS-Junction Box (SAS-JB). Enough cable (short home run) is shipped with the SAS-1 to allow the SAS-JB to be positioned (Figure 5) so that it is easy to reach for maintenance or service without requiring a shoulder closing or a bucket truck. Mount the SAS-JB on the highway structure using stainless steel bands. If the highway structure
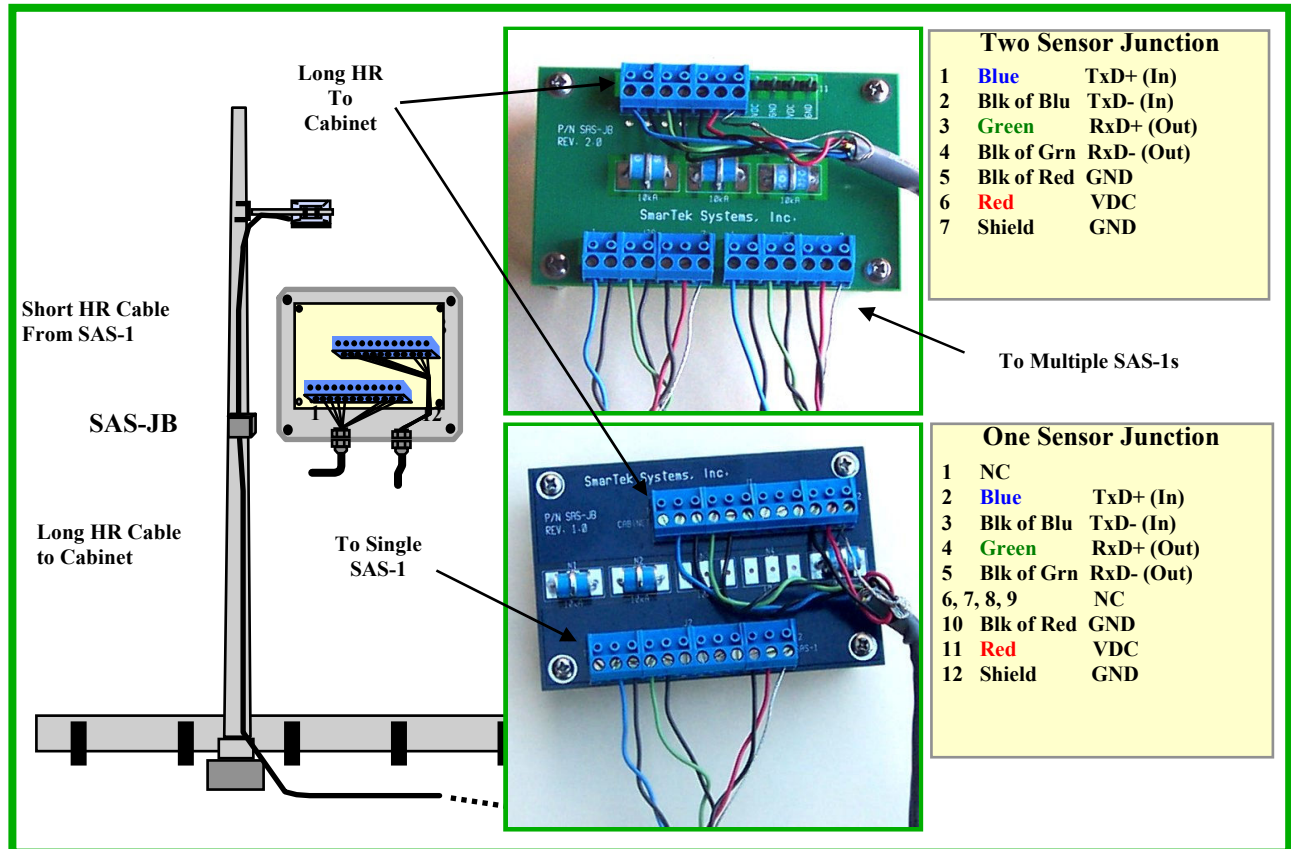

Two Sensor Junction

1	Blue	TxD+ (In)
2	Blk of Blu	TxD- (In)
3	Green	RxD+ (Out)
4	Blk of Grn	RxD- (Out)
5	Blk of Red	GND
6	Red	VDC
7	Shield	GND

One Sensor Junction

1	NC	
2	Blue	TxD+ (In)
3	Blk of Blu	TxD- (In)
4	Green	RxD+ (Out)
5	Blk of Grn	RxD- (Out)
6, 7, 8, 9		NC
10	Blk of Red	GND
11	Red	VDC
12	Shield	GND

Figure 5 Mounting and Connecting the SAS Junction Box

used for mounting SAS-1 and the SAS-JB is wood or some other non-conducting material or if the path to earth ground is questionable, then a grounding cable should be installed and connected to the stainless steel mounting saddle on the SAS-JB.

Once the SAS-JB has been mounted, remove the cover and route each cable into the SAS-JB through each strain relief as shown in Figure 5. Remove 3 or 4 inches of the sheathing from each home run cable being careful to not damage the shield wire or the insulation on the twisted pairs. **Be sure to keep each twisted pair together since there are multiple black conductors**. If more than one SAS-1 units are to be connected to the same long home run cable, they will be connected inside the SAS-JB using the "**Two Sensor Junction** " Card instead of the "**One Sensor Junction**" Card. Strip approximately 1/4 inch of insulation from each conductor in each

home run cable. **Do not let the black wires untwist from the corresponding colored wire of the pair**. Terminate each conductor and the shield wire in each home run cable using the blue pluggable terminal block connector (Figure 5). Once the terminal block connectors are complete, plug them into the appropriate header on the SAS-JB circuit board as shown in Figure 5. Be sure some of each home run cable sheathing enters the SAS-JB and tighten the strain relief to secure the long home run cable entry into the SAS-JB. **Also check to be sure that the bare shield wire does not short to other cable wires or components in the SAS-JB.**

Note: Wireless SAS-1 installations may use a SAS Junction Box to connect a longer home run cable to the cabinet providing power to the SAS-1 and its radio module. Since the home run cable in this case only provides power (VDC, ground, and shield), connect only pins 5, 6, and 7 for the "Two Sensor Junction" Card or pins 10, 11, and 12 for the "One Sensor Junction" Card.

Replace the SAS-JB cover and secure the screws. Be sure the SAS-JB cover is seated to ensure a weather tight seal (place a bead of silicone sealant around the lid before securing). Route the long home run cable to the roadside cabinet. For longer runs, use at least 22 gauge cable.

Connecting the SAS-Cabinet Termination (SAS-CT) for an RS-422 Home Run

Identify a convenient mounting position on the inside wall of the roadside cabinet and mount the SAS-Cabinet Termination (SAS-CT). If the Type 170 compatible SAS-CT is used, it slides into the type 170 card file. Connect a heavy ground wire from the SAS-CT to an appropriate point to create a good path to earth ground. Route the long home run cable into the roadside cabinet through conduit or a strain relief. Inside the cabinet, route the cable to the SAS-CT mounting position. Remove 3 to 4 inches of the sheathing from the cable. Be careful to not damage the shield wire or the insulation on each of the twisted pairs. **Do not let the black wires untwist from the corresponding colored wire of the pair**. Terminate each conductor and the shield wire in the long home run cable using the blue pluggable terminal block connector (Figure 6 or 7). Once the pluggable terminal block connector is complete for the long home run cable, plug it into the header on the SAS-CT circuit board as shown in Figure 6 or 7. Tie the home run cable to the top right stand off of the SAS-CT
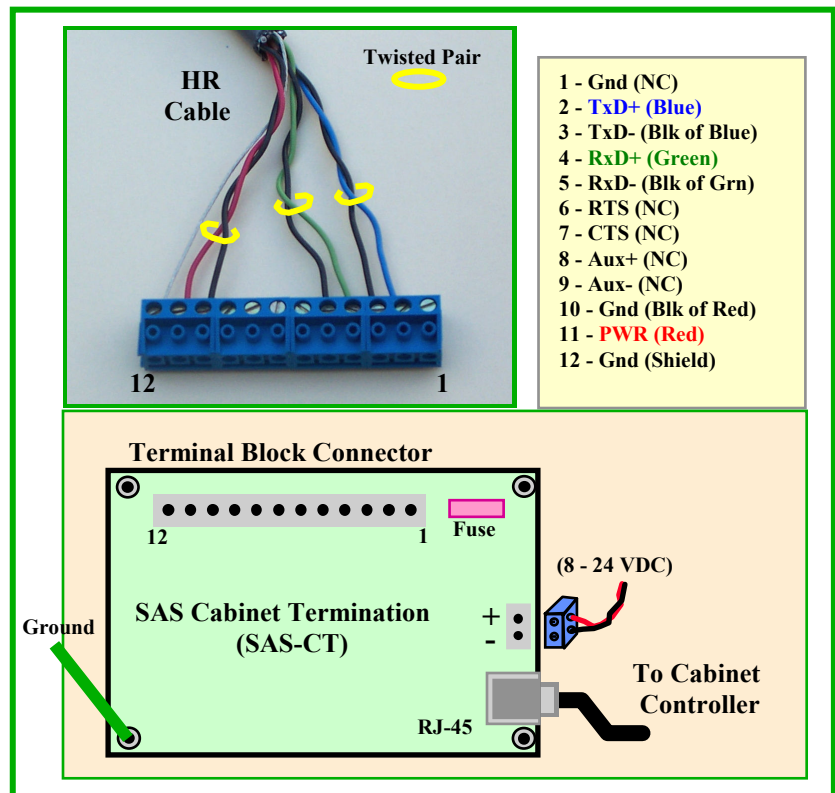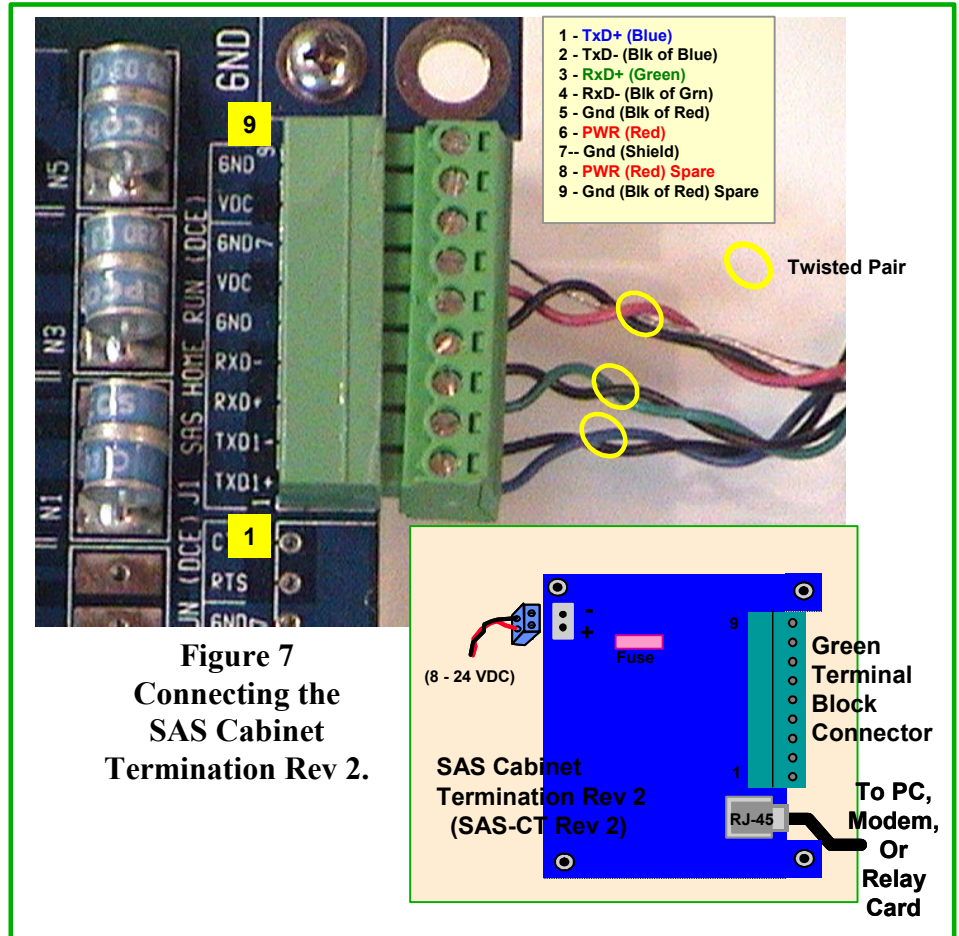

1 - Gnd (NC)
2 - TxD+ (Blue)
3 - TxD- (Blk of Blue)
4 - RxD+ (Green)
5 - RxD- (Blk of Grn)
6 - RTS (NC)
7 - CTS (NC)
8 - Aux+ (NC)
9 - Aux- (NC)
10 - Gnd (Blk of Red)
11 - PWR (Red)
12 - Gnd (Shield)

Figure 6 Connecting the SAS Cabinet Termination Rev 1.

circuit card for strain relief. If a Type 170 compatible SAS-CT is being used, tie the home run to the top right hole of the SAS-CT Carrier Card for strain relief.

Connect power (8 to 24 VDC) to the SAS-1 by means of a 2 position header on the SAS-CT. Use 18 or 20 gauge stranded cable (red and black color coded) terminated on one end using a pluggable terminal block connector and connected on the other end to the DC power source in the cabinet. Plug the connector onto the header on the SAS-CT as shown in Figure 6 for SAS-CT Rev 1 or Figure 7 for SAS-CT Rev 2. This step is not necessary for the Type 170 compatible SAS-CT since it takes power from the edge connector in the card file.
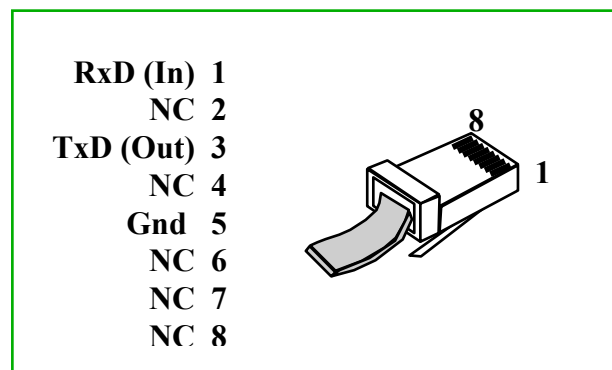

1 - TxD+ (Blue)
2 - TxD- (Blk of Blue)
3 - RxD+ (Green)
4 - RxD- (Blk of Grn)
5 - Gnd (Blk of Red)
6 - PWR (Red)
7-- Gnd (Shield)
8 - PWR (Red) Spare
9 - Gnd (Blk of Red) Spare

Figure 7 Connecting the SAS Cabinet Termination Rev 2.

Double check all connector positions and be sure the polarity of the power cable and connector are correct. Insert the blade fuse in place on the SAS-CT.

If a Type 170 compatible SAS-CT is being used, slide it into the appropriate slot in the Type 170 Card File. Be sure it is seated properly.

Signals and information to and from the SAS-1 and the cabinet controller (or SAS-Relay Interface) are passed over a serial RS-232 cable. One end of the cable is plugged into the SAS-CT via an RJ-45 connector (Figure 8). The other end is plugged into a PC during SAS-1 setup or into the cabinet controller (or SAS-Relay Interface) for operation. The RS-232 signal pin out for the SAS-CT RJ-45 plug is shown in Figure 8.

RxD (In) 1
NC 2
TxD (Out) 3
NC 4
Gnd 5
NC 6
NC 7
NC 8

Figure 8 SAS-CT RJ-45 Pinout