SECTION 2

ASSEMBLY INSTRUCTIONS

2-1 Unpacking

As you unpack the RM4 Resistance Meter, check that the parts shown in Table 2-1 are present, and that nothing has been damaged during transportation.

Item	Quantity
RM4 Resistance Meter	1
Battery charger	1
Dummy Battery	1
Spare battery pack holder	1
Screwdriver	1
Instruction manual	1
Short releasable cable ties	5
Knoblets (10mm thread length)	3

Table 2-1. RM4 Packing List.

There are several different versions of the battery charger for different electrical standards and countries. Check that the pins and voltage shown on the charger are correct for your country. If they are not then do not attempt to use it - contact Geoscan Research.

The RM4 is supplied with Nickel-Cadmium rechargeable batteries already fitted. They will have been charged prior to shipment but may have lost much of their charge in storage. Therefore, to avoid damage, it is advisable to fully charge the batteries, as described in Section 3-3, before switching on the RM4 Resistance Meter for the first time.

2-2 Physical layout of the RM4

The names of the parts of the RM4 are shown in Figure 2-1. A brief guide to their function follows below, and more detail is given in subsequent sections of the Instruction Manual. Do not adjust any controls, or couple connectors until you have read the detailed sections thoroughly.

1 On/Off(Charge) and Range Switch

This switch is used to turn power on or off to the instrument and to select the display resistance range. When in the off position the battery pack is disconnected from the internal electronics but connected to connector (4) for recharging.

2 LCD Display Panel

The Liquid Crystal Display is used to indicate : (a) the instrument reading, (b) battery status, (c) if contact resistance is > 4 Kohm, and (d) if contact resistance is greater than the compliance of the RM4.

3 Filter Switch

Determines the amount of filtering introduced to combat interference. It may be set to Rural (minimum filtering) or Urban (maximum filtering).

4 Connector for Charger Input, Analogue Output and Range Status Output

This is a six way plug that has three functions - see Appendix B for details of connections. Firstly, the battery charger plugs into this connector and allows the batteries to be recharged without undoing the case - see Section 3-3 for further details. Secondly, an analogue output signal is provided for data logging or chart-recorders. Thirdly, range status information is provided via two logic bits for data loggers. The logic bits can also indicate if contact resistance is greater than the compliance of the RM4; they may therefore be used to detect when the mobile frame of Twin array is re-inserted into the ground, and hence trigger an external data logger to automatically take a reading.

5 Connector for : A (Current), M (Potential) probes / or for Twin Mobile Probes

A two way socket to connect with a Current (A) probe and a Potential probe (M) - see Appendix A for pin connections. This socket is usually used to connect to the mobile probes of the PA1 Twin frame or connect to a PA5 frame, when configured as a Twin array, via an AD1 adapter. More connection possibilities exist when using the PA3 or PA5 array for other probe configurations.

6 Connector for : B (Current), N (Potential) probes / or for Twin Remote Probes

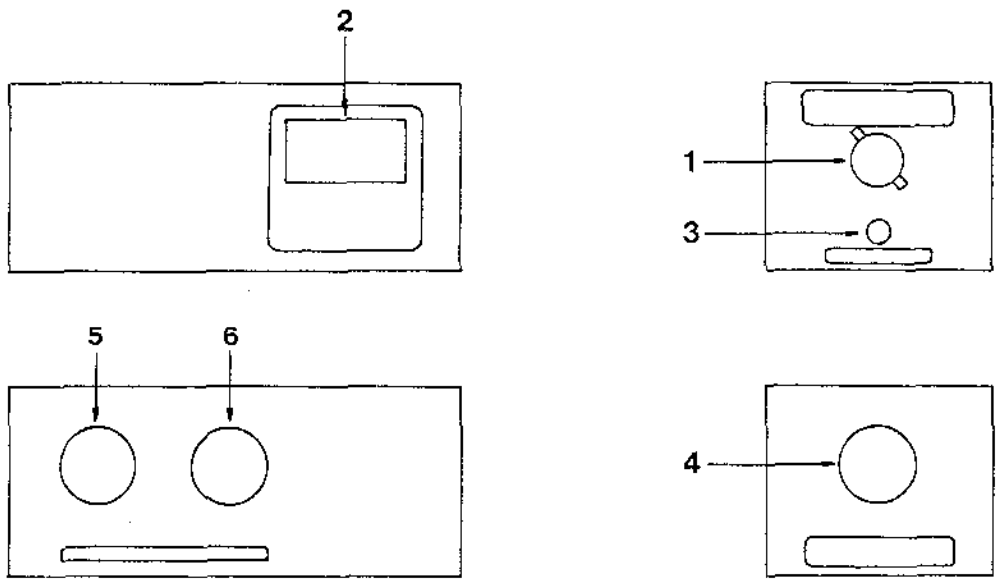
A two way socket to connect with a Current (B) probe and a Potential probe (N) - see Appendix A for pin connections. This socket is usually used to connect to the cable leading to the remote probes of the PA1 Twin array, or of a PA5 array configured as a Twin array. More connection possibilities exist when using the PA3 or PA5 array for other probe configurations.

2-3 Assembling the RM4 and Probe Arrays for Field Use

Instructions on how to assemble and inter-connect the RM4 to Probe kits PA1 and PA3 are given below. Details of how to use the resulting assembled measurement systems in the field use are given in Section 5. The PA5 is discussed in section 2-4.

1 PA1 Twin Electrode Probe Array

The RM4 is mounted on the mobile frame of the PA1 Twin array using the mounting brackets using two short knoblets, figure 2-2. The RM4 should be so orientated on the frame that the switch is nearest the cable and connector strapped to the frame.



1 On/Off(Charge) and Range switch
2 LCD Display
3 Urban/Rural Filter Switch
4 Connector for Charger, Range, Analogue Output
5 Connector for Potential and Current probes
6 Connector for Potential and Current probes

Figure 2-1. Component parts of the RM4 Resistance Meter.

After mounting the RM4 on the frame, the probe connections may be made. The waterproof sealing caps must first be undone on the instrument and cables - this may be most easily achieved by gripping the strap and instrument/cable with one hand and gripping and turning the "turret" extension of the cap with the other hand. Insert the socket at the end of the flying lead of the Twin Electrode frame into the RM4 plug (5) marked "Mobile Probes", figure 2-1 - there is a small locating pin inside the plug to ensure correct mating. Once engaged, screw the outer retaining ring into place.

Pay out **ALL** the cable on the cable drum - there is a lock on the side of the drum which should be slackened first - figure 2-3. Insert the socket at the free end of the cable into the RM4 plug (6) marked "Remote Probes". Use three of the releaseable cable ties provided to secure this cable to the centre of the frame. This prevents any strain being put on the connectors when the cable is pulled during surveying. (It is also a good idea to hold the cable in one hand as well during the survey to provide even further strain relief.) The cable ties may be released by keeping the small center tab depressed and pushing the strap back through the eye, figure 2-4.

Finally, connect the remote probes to the cable drum, as shown in figure 2-3. Remember to make the connection to the cable drum only when the cable is fully unwound, or the wire will become twisted as the drum rotates. Likewise, at the end of the survey remove the connector from the cable drum before rewinding the cable. Also, when removing the 4mm plugs from the remote probes or drum, grip the connectors and not the cable, so as to avoid straining the cable.

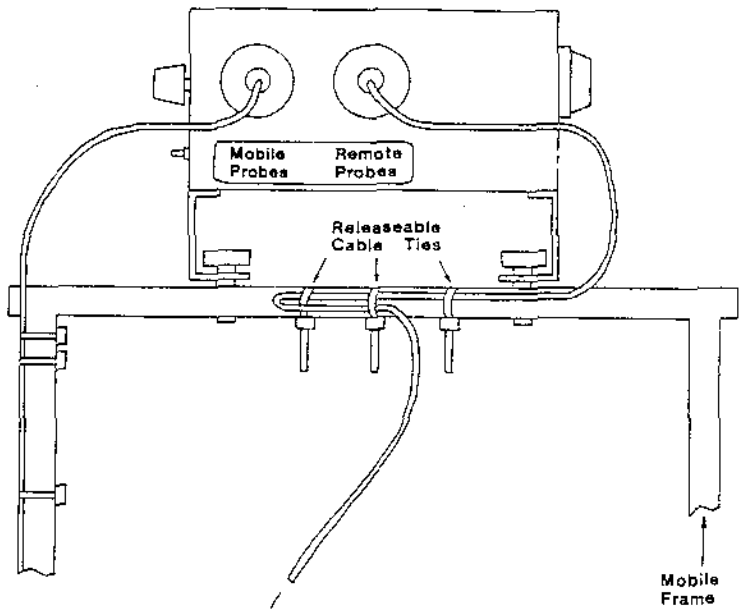


Figure 2-2. Mounting the RM4 on the mobile frame of the PA1 Twin Electrode array.

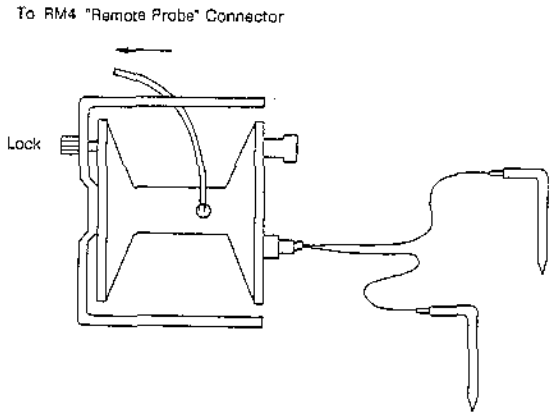


Figure 2-3. Connecting the remote probes and cable drum of the PA1 Twin Electrode array.

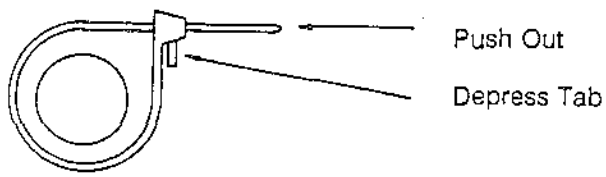


Figure 2-4. Releasing the "releasable" cable ties.

2 PA3 Four Probe Array - for general purpose use

The RM4 and PA3 interconnection is shown in figure 2-5. The cable must first be unreeled from the cable drums. Hold each cable drum by its handle in one hand whilst gently pulling out the cable with the other hand. Do **NOT** leave any cable still wound in the drum - this will help minimise measurement errors.

The cable drums may now be connected to the RM4 using the pairs of leads that merge together into one connector, which in turn plug into the RM4 "Mobile Probes" or "Remote Probes" connectors. The waterproof sealing caps must first be undone on the instrument and interconnection cables - this may be most easily achieved by gripping the strap and instrument/cable with one hand and gripping and turning the "turret" extension of the cap with the other hand. The two-way plugs should be inserted into the RM4 sockets as shown in figure 2-5 - there is a small locating pin inside the plug to ensure correct mating. Once engaged, screw the outer retaining ring into place.

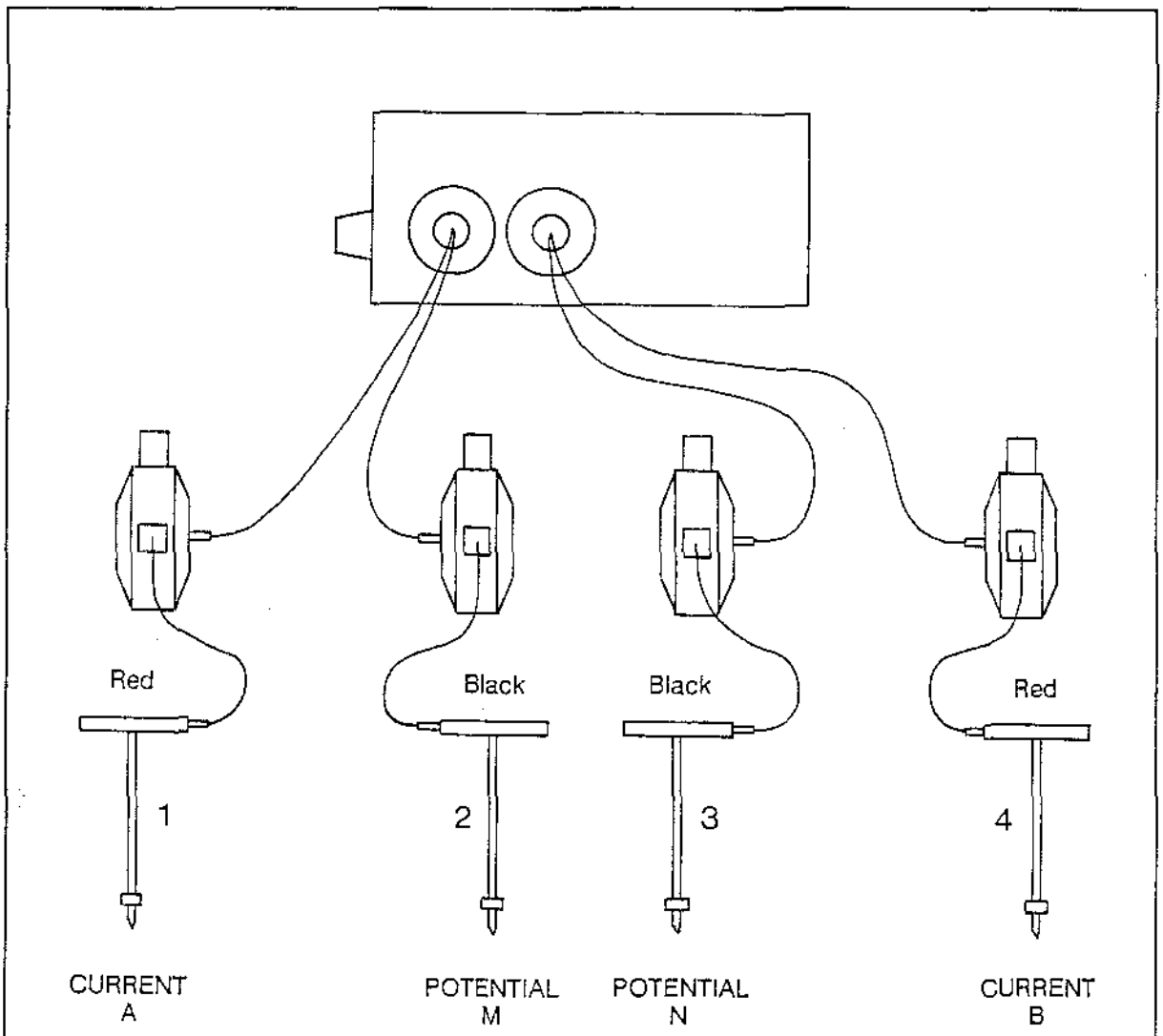


Figure 2-5. Assembly of the RM4 and PA3 probe array.

The other ends of the pairs of leads, which terminate in a 4mm "banana" plug should then be inserted into the 4mm socket in the side plate of each cable drum. Each of the four leads is coded to identify the current and potential pins - current leads are terminated with a red connector whilst potential leads are terminated with a black connector. In addition, each lead is identified as either "A, M, N, or B" and as "1, 2, 3, 4", where A (1), B (4) are current leads and M (2), N (3) are potential leads, figure 2-5. Likewise, each cable drum and cable within each drum is similarily identified.

Assemble the hand probes, adjusting the soil-stop to determine the required probe insertion depth, figure 2-6. Usually these will be left assembled for an insertion depth of 10cm - see Section 5-7 (4) for further guidance. Finally, insert the 4mm plugs at the end of the cable unwound from the drums into the sockets at the tops of the probes. Again red connectors are used to identify current probes/leads and black connectors to identify potential probes/leads. Use the large releasable cable ties to secure the cable to the hand probe, thus providing strain relief, figure 2-6.

At the end of the survey, the cable ties may be released by keeping the small center tab depressed and pushing the strap back through the eye, figure 2-4. When removing the 4mm plugs from the probes and cable drums, grip the connectors and not the cable, so as to avoid straining the cable.

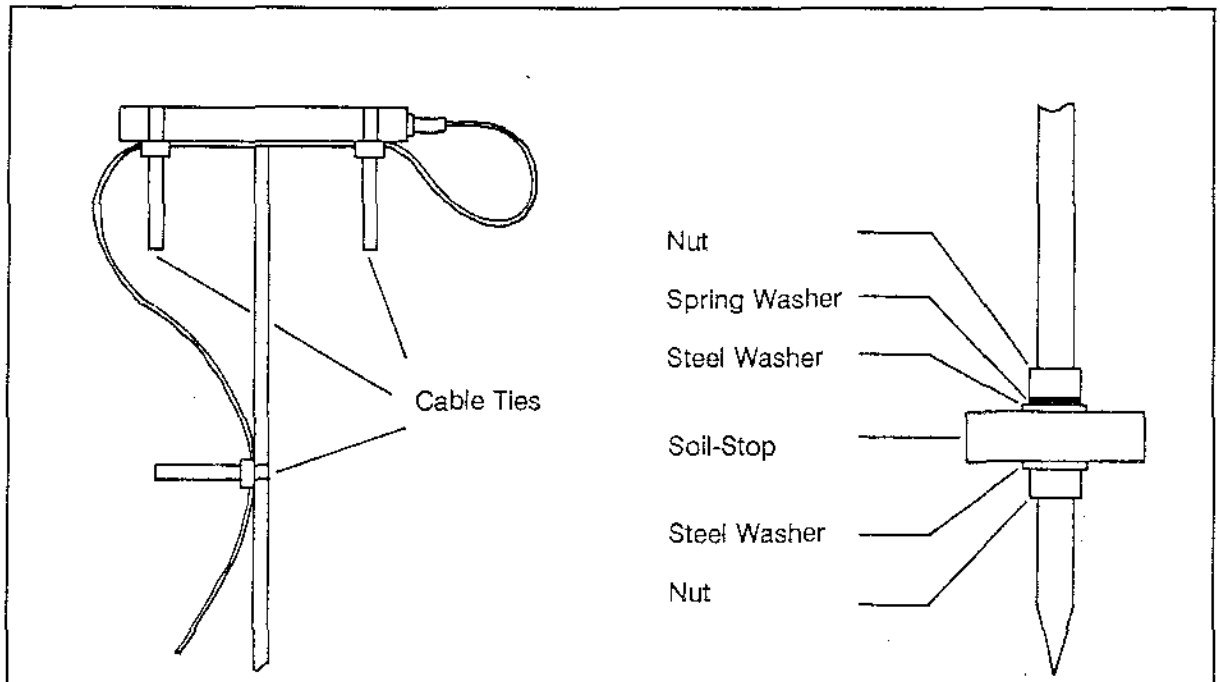


Figure 2-6. Cable strain relief (left) and soil-stop assembly (right).

2-4 Assembling the RM15 and PA5 Probe Array for Field Use

Instructions on how to assemble and inter-connect the RM4 to the PA5 Probe kit is given below. Details of how to use the resulting assembled measurement system in the field use is given in Section 5.

1 Early Versions of the PA5

If you have an early version of the PA5 then some of the jump lead connection details presented later in this section are not directly applicable. (Early versions of the PA5 used a central 0.6m aluminium beam and jump leads were plugged into two groups of three terminals, positioned at either end of the beam). All the beam colour coding specified is the same for both early and present PA5 systems, but due to the different location of the terminals for the jump leads, lead lengths (and hence their identifying colours) will be different. Jump leads for the wooden beam are of orange wire to distinguish them from the black leads used for the metal beam. Appendix K presents some corresponding illustrations and tables applicable to the earlier PA5 system.

If you have the current version of the PA5, which uses a wooden central beam and junction box attached to the frame, then you can follow the instructions presented in this section directly.

2 Assembly

Figure 2-7, upper illustration, shows the PA5 partly assembled. A short wing is shown on the right-hand side, whilst on the left-hand side the small wing is replaced by a medium sized wing (single probe position), together with supporting strut. In normal operation you would usually use two wings of the same size. Of course if you only wish to use a standard 0.5m Twin (see following section 2-4(3)) then you do not need to add any wings at all. The RM4 mounts on top of the frame in a manner very similar to that already described for the PA1, 2-3 (1), though before doing so, the PA5 should be assembled with the required wings, probes and jump leads.

Figure 2-8 shows the range of wings available for the PA5 frame : small wings (supplied with the entry level PA5), medium wings (single probe position), medium wings (double probe positions) and long wings (double probe position). Figure 2-8 also shows the possible locations for probes mounted on the mobile frame - a maximum of nine positions are available if the widest wings are used.

Wings are attached to the main frame using a pair of side brackets for each wing. The side brackets are attached : (a) to the wings by 6mm high-tensile hex-cap head bolts, (b) to the wooden beam by 70mm high-tensile stainless steel bolts and wing nuts. Fibre washers are provided to spread the bolt loading on the wooden beam and reduce damage to the paintwork of the wings. A hand-key wrench is provided to tighten the hex-cap bolts and spare fasteners are also provided should any be lost. The side brackets are supplied fitted to the wings and may be conveniently stored in this way when not in use. To fix the wings to the main frame loosen all the hex-cap bolts and offer the wing up the main frame. Loosely attach one of the side plates to the main frame using the 70mm bolts and wing nuts, along with the fibre washers either side - it is best to insert the bolt from the side which has the loops for the jumper leads. Make sure you fix the wings so that the plastic guide loops are on the same side as the metal ones on the main frame. Once all the bolts are in position tighten them all up, but not before.

If wings larger than the standard short wings are to be used then the support struts **MUST** also be fitted to provide rigidity - if they are not fitted then it is very probable that the main frame or wing will become stress damaged. To fit these first remove the plastic inserts from the horizontal main-frame tube (near the neoprene handle) and insert a steel strut support stub into each side - these will have a fairly loose fit. Loosely fix a strut to each stub using a hex-cap bolt, making sure that the stub and strut are electrically insulated from one another by the nylon bush and nylon washer supplied - the nylon washer fits between the strut and stub, and an outer steel washer protects the face of the nylon bush, figure 2-9. Fit the square bracket assemblies onto the wing using hex-cap head bolts and washers, at the same time loosely attaching the free end of each strut to the bracket assemblies. It is **IMPERATIVE** that you make sure the

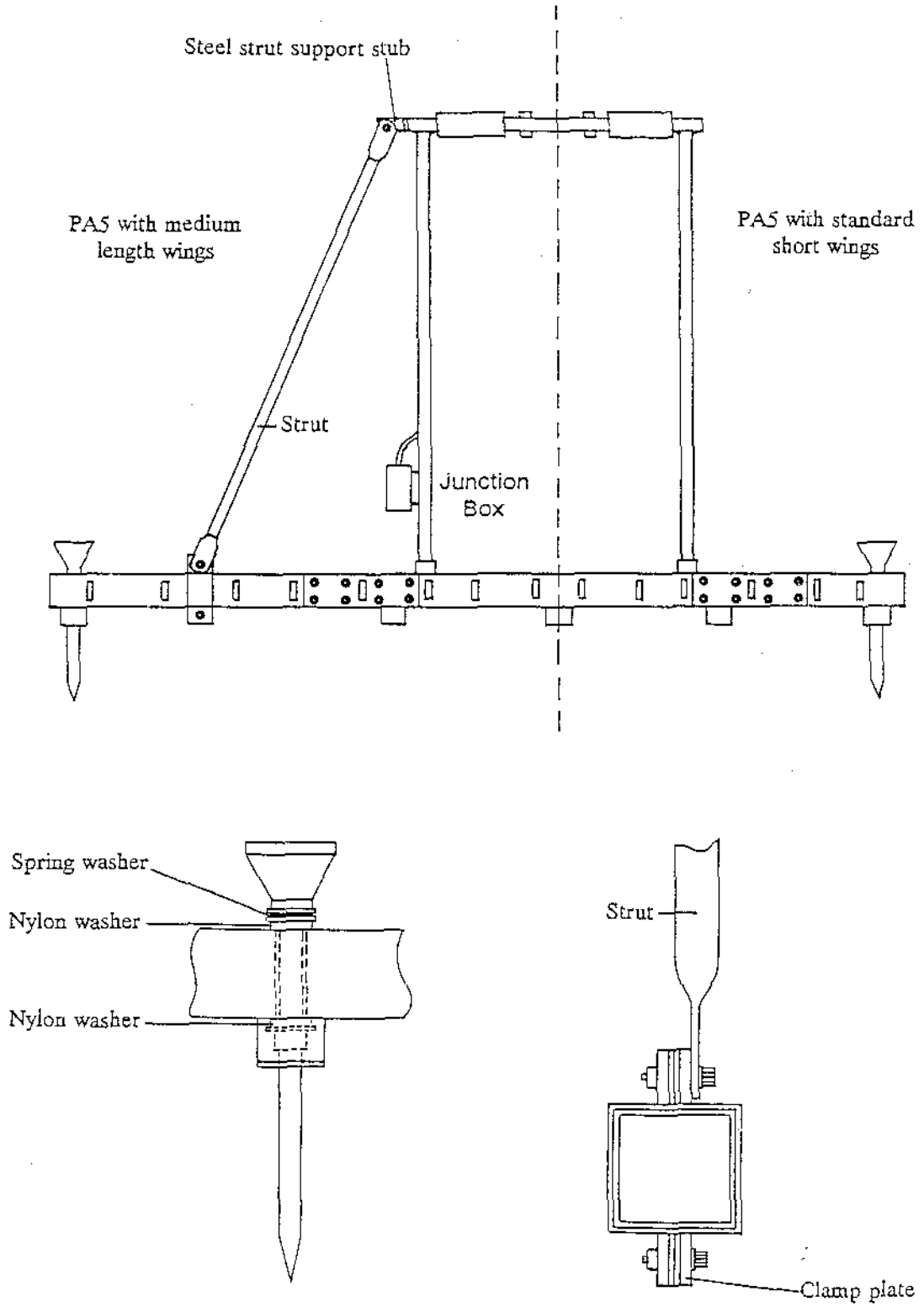


Figure 2-7. Assembly of the PA5 Multi-probe array.

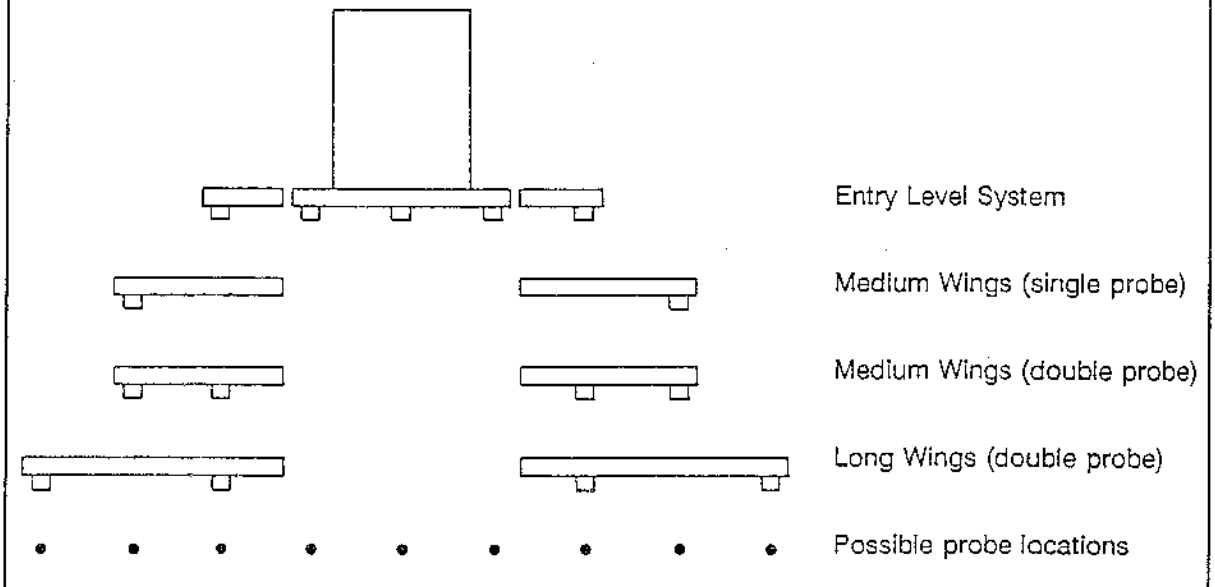


Figure 2-8. Wings available, and possible probe locations, for the PA5 probe array.

small clamp plates are placed immediately next to the brackets, figure 2-7 - and the strut should be added next to a clamp plate, not a bracket. Before tightening all the bolts, push the bracket assembly firmly along the wing towards the main frame so that the structure is rigid.

The probes are supplied with all fasteners assembled in the order they will be used on the PA5 frame. The two nylon washers and nylon tube insulate the probe from the frame - it is absolutely essential that you make sure the insulating tube is fitted and that the two nylon washers are placed next to the aluminium tube. If you do not do this then the insulation will not be complete and all readings will be meaningless. Once fixed in position on the frame, the fastener assembled order will be : Nut, plain steel

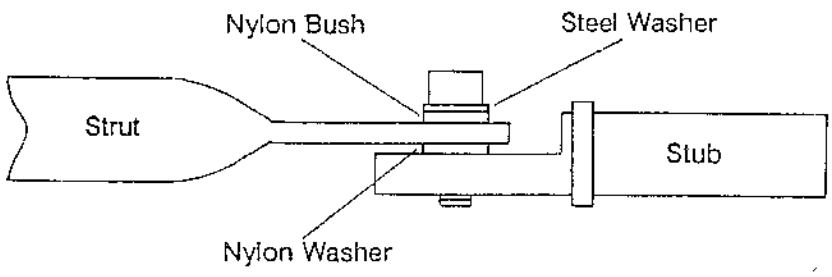


Figure 2-9. Detail of how a strut is attached to a strut support stub.

washer, nylon washer, tube insert, nylon washer, plain washer, spring washer, plain washer, hand-knob. Secure the probes firmly in place by tightening the hand-knob and slide a white circular tube cap (with hole punched in) up the probe and push into the cylindrical "mud-shield" at the bottom of the frame. Unpunched white circular caps may be used to plug unused probe positions and so keep mud out. It is important to fit these mud shields since they prevent mud from providing a possible shorting path between probe and any exposed aluminium which may appear with wear and tear.

Once the probes are in place jump leads may be fitted for the required probe configuration. There are six 4mm sockets on a small junction box which is mounted on the handle assembly of the main frame, all coloured differently, figure 2-10. The jump leads plug into the top of each probe and into one of the six sockets, with the cable routed via the guide loops to avoid tangling. You must choose either an adapter AD1, AD2 or AD3 (see sections 2-4(3), 2-4(4) and 2-4(5) to connect the flying lead of the PA5 frame to the RM15. This choice will determine which jump leads are required.

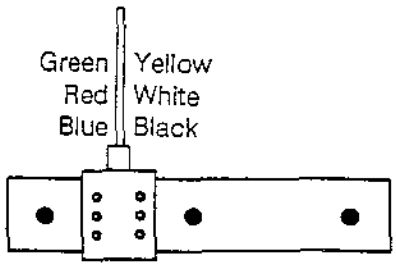


Figure 2-10. Schematic Junction Box showing socket positions and colours. Large dots represent probe positions.

For reference, the lengths of the jump leads supplied are given in table 2-2 - this may be useful if you lose a lead and need to make up a new one quickly. The number of jump leads supplied (Table 2-2) depends on whether just the entry level PA5 or additional wings were ordered - the default quantity supplied should suit most needs.

Colour	Jump Lead Length	Basic PA5 Quantity	Full Kit Quantity
Black	200 mm	1	1
Red	650 mm	1	2
Green	900 mm	1	2
Blue	1150 mm	1	2
Yellow	1400 mm	0	1
White	1650 mm	0	1

Table 2-2. PA5 Jump lead lengths and colours.

3 AD1 Adapter - Twin Array

The wing, probe and jump lead positions for a 0.5m, 0.75m and 1m Twin array are shown in figure 2-11. To configure the different spacings you will require a 200mm jump lead (terminated with black connectors), a 650mm jump lead (terminated with red connectors), a 900mm jump lead (terminated with green connectors), and/or a 1150mm jump lead (terminated with blue connectors). Wider spacings are also possible using the medium and long wings, together with the longer jumper leads supplied. For example a pair of medium wings with 900mm and 1400mm jump leads (terminated with green and yellow connectors repectively) will give a 1.5m Twin array, a pair of long wings with 1150mm and 1650 jump leads (terminated with blue and white connectors respectively) will give a 2m Twin array. Other intermediate separations are also possible. In all cases the AD1 adapter should be inserted between the 6 pole socket of the frame and the 2 pole plug of the RM4 "Mobile Probes" connector. The remote probes should be connected normally via the 50m of cable, as described in section 2-3 (1) for the PA1 Twin Array.

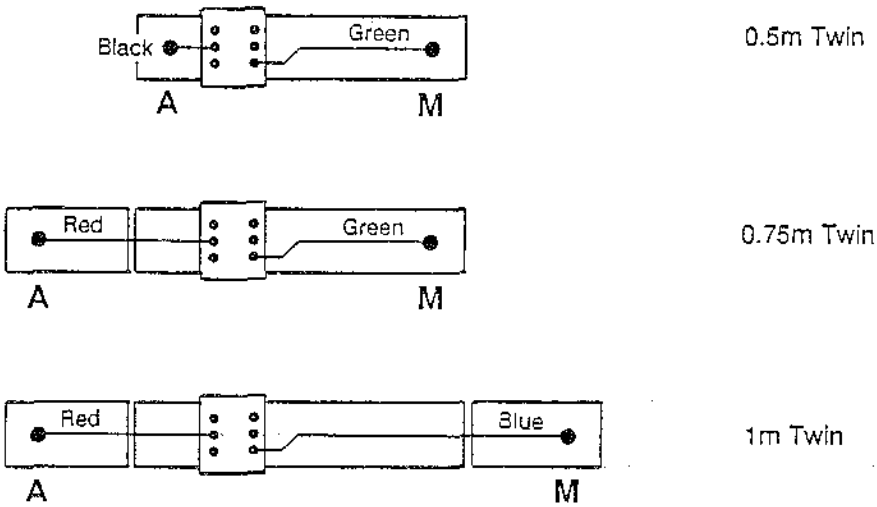


Figure 2-11. Wing, probe and jump lead positions required to configure a 0.5m, 0.75m or 1m Twin Electrode Array with an AD1 adapter.

4 AD2 Adapter - Gradient Array

The wing, probe and jump lead positions for a 0.5m, 0.75m, and 1m Gradient array are almost identical to that for the Twin array shown in figure 2-11 - the only difference is that instead of using the red and black socket positions on the junction box, the green and yellow socket positions, respectively, are used instead. Wider spacings are also possible as indicated for the Twin.

The AD2 adapter itself consists of one 6 pole plug, two 2 pole sockets and two 4mm sockets. It configures the two probe positions on the PA5 frame as potential probes (green = M, yellow = N) and connects two remote current probes (via the 4mm sockets, red = A, yellow = B) to the current terminals of the RM4.

Insert the 6 pole plug into the PA5 frame socket. Insert the two 2 pole sockets into the RM4, matching the cables with "M" and "R" white sleeving with the RM4 mobile and remote probes plug positions repectively. The two 4mm sockets connect with two 4mm plugs terminating cable leading to the remote current probe positions.

5 AD3 Adapter - Wenner, Double-Dipole or small Schlumberger Array

The wing, strut, probe and jump lead positions for a 0.5m Wenner, 0.5m Double-Dipole or are shown in figure 2-12.

To configure the arrays you will require a 200mm jump lead (terminated with black connectors), two 900mm jump lead (terminated with green connectors), and a 1400mm jump lead (terminated with yellow connectors). The AD3 adapter should be inserted between the 6 pole socket of the frame and the two 2 pole plug of the RM4. You must also add the strut support kit as detailed in section 2-4(2).

Although uniform separations wider than 0.5m are not possible for the Wenner or Double-Dipole array, the long wings may be used to create wider arrays with non-uniform separations. For example the Wenner can be turned into a small Schlumberger array by using long wings and a 1150mm jump lead (blue connectors) and a 1650mm jump lead (white connectors) instead of the medium wings and the 900mm and 1400mm jump leads respectively, shown in figure 2-12. Similarily, a non-uniform Double-Dipole can be made using two long wings and the same pair of replacement leads. A mini Schlumberger array can also be configured using just the standard PA5 kit (no struts) by using two small wings and a 650mm jump lead (red connectors) and a 1150mm jump lead (blue connectors), instead of the medium wings and 900mm and 1400mm jump leads respectively, shown in figure 2-12.

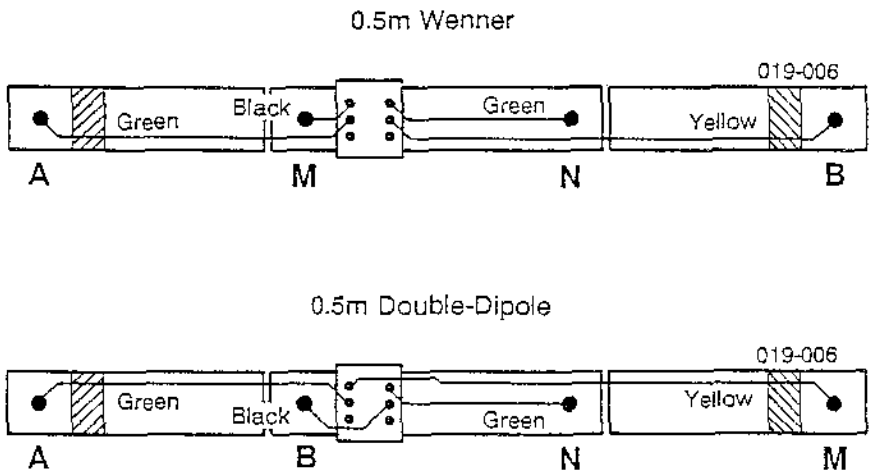


Figure 2-12. Wing, strut, probe and jump lead positions required to configure a 0.5m Wenner or 0.5m Double-Dipole with an AD3 adapter.

6 AD4 Adapter - Pole-Pole Array

The AD4 adapter is used to convert either a PA1 or PA5 Twin array to the Pole-Pole configuration, that is, instead of the remote probes being connected via the single 50m of cable, as described in section 2-3(1), they are connected via two independant cables (typically 50m) via a pair of 4mm sockets on the AD4 adapter.

The AD4 adapter should be inserted into the RM4 two pole plug marked "remote probes". The 4mm sockets connect with 4mm plugs that terminate cable leading to the remote probe positions - the red connector is current, black is potential.