INDIRES

Information Driven Incident Response

User Documentation
Guidewire Mines Rescue Communication System

10th August 2020

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1 INTENDED AUDIENCE

An output of the INDIRES project is user documentation for each of the products produced during the project. However, the status of the various products differs and, for this reason, the intended audience for the *User Documentation* will be different for each product. It is necessary, therefore, to indicate the type of user who will benefit from this particular *User Document*.

The guidewire communication system described here was fully prototyped and tested in a mine environment. As such, the information provided in this *User Document* could be utilised by end users who have a need for the exact functionality provided by the INDIRES prototypes. Such users can consider the instructions on how to use the guidewire equipment as definitive.

It is important to recognise, though, that the prototypes produced in INDIRES made use of commercially available CB transceivers, that were re-housed in ATEX certified casings to permit their use in coal mines. The same approach could be used for organisations requiring just a few units, but organisations needing a larger number of units will almost certainly prefer to develop, or arrange for a third-party to design and develop, their own units that can be manufactured in volume. For that reason, it is anticipated that this *User Document* will also be relevant to organisations who intend to develop equipment that can be used as part of the guidewire communication system.

End users or developers who want to know more, and perhaps to discuss possible collaborative opportunities, are referred to *Section 6*.

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2 INTRODUCTION

2.1 The Guidewire Concept

The “guidewire” communication system that has been developed in the INDIRES project allows mines rescue personnel to communicate along a tunnel when the mine’s normal communication system is not operating following an incident. It provides communication over a range of up to 1km, and this can be increased to several kilometres by using in-line amplifiers. It is independent of the tunnel dimensions and is unaffected by bends in the tunnel.

The system works in the same way as the leaky feeder systems that are used in road and railway tunnels and in some mines. Signals are transmitted along the cable, but the users do not need to connect any equipment to that cable. Instead, they just need to be within a few metres of the cable. Normal leaky feeder systems use a special type of cable which is expensive and heavy. However, the cable used in this system is smaller and lighter, for ease of deployment, and it is cheap enough to be used and then discarded. This latter point is important because of the risk of damage to the cable during the rescue operation.

Some wire-guided systems have previously been developed for emergency communication during mines rescue operations. However, that equipment required the user to hold a handset very close to the line, or even to clip onto it. The system presented here, however, allows users to operate with their handsets more distant from the line, often up to a few metres. This, therefore, would be less disrupting to the rescue action. Rescuers could, for example, communicate while walking normally along a gallery.

2.2 System Overview

A system diagram is shown in *Figure 1*.

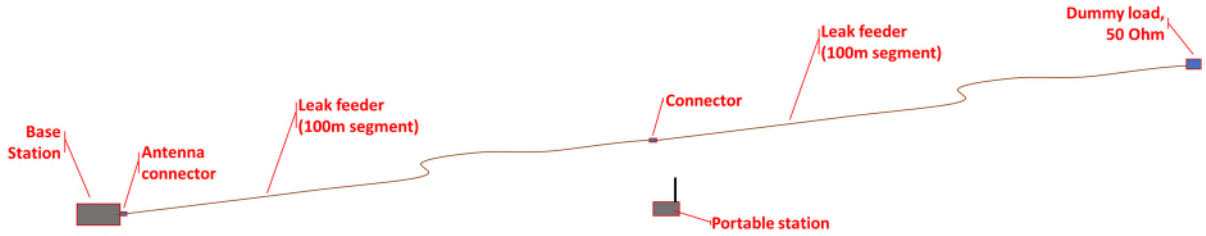

Figure 1 – General System Layout

It will be noticed that communication is possible between a base station radio, which is directly connected to the coaxial cable, and one or more mobile handheld radios which are not directly connected. Communication is also possible between two handheld radios although often over a shorter range.

2.3 Equipment Details

The main emphasis of the work carried out in the project was the development of a communication method. The hardware used for the base station and the handsets can be met by off-the-shelf equipment, specifically CB radios that operate in the 27MHz band. To demonstrate the technique, therefore, commercially available radios were

re-housed in new enclosures that provided equipment that was tougher and more waterproof and, therefore, better suited to use underground, and which would permit ATEX certification. The units produced in INDIRES have not actually been ATEX certified, but the voltage, current, and RF power levels used are compatible with certification as a Group I Ex ia (intrinsically safe) device. Therefore, users could quite easily adapt the design for ATEX certification in the future, or design and build similar ATEX certified hardware.

The equipment that was prototyped and used in field trials is shown in *Figure 2*.

Figure 2 – Prototype Radios – Left: Base Station, Right: Handheld

For organisations that require only a small number of units, the same approach of re-packaging off-the-shelf radios in rugged, ATEX enclosures could be used.

Organisations that require a larger stock of equipment would need to design and manufacture their own equipment. However, although the technique developed in INDIRES is novel, the radio equipment used is standard, so it is not considered onerous for organisations to undertake such a design exercise.

3 CABLE DETAILS AND PREPARATION

3.1 Cable Specification

The guidewire system uses a cable that has not been designed as a leaky feeder – this is why it is so inexpensive. However, the specific cable was chosen after carrying out tests on a range of cables, and other cables will not work as well. It is important, therefore, to use the same cable that was used during the development of this system or, if that isn't possible, a cable with a very similar specification should be used. Using a cable with a different specification will probably reduce the range very significantly. In particular, cables which have specifications that seem to be better (e.g. cables with a shield comprising both foil and braid, or which have a higher percentage coverage braid shield, and therefore have a lower attenuation per unit length) will usually perform much worse for this application.

The specific type of cable is intended for use with domestic TV antennas. It is available from electronic equipment and component supplier Farnell or CPC Farnell as the parts shown in *Table 1*. Note that all these cables are identical electrically, and where there are differences, this is only in the colour of the outer jacket and/or the length of cable on the drum. Also, some products are identical. For example, Farnell's 3383250 is the same as CPC Farnell's CB14616, and Farnell's 3383251 is identical to CPC Farnell's CB14617.

Supplier	Part No.	Manufacturer	Description	Reel Length	Price (3+)
Farnell	3383250	Pro Power	LOWLOSS CCAFF - LOW LOSS BROWN CCA F/FILLED	100m	£12.40
CPC Farnell	CB14616	Pro Power	CCA F/Filled Low Loss Coaxial Cable Brown	100m	£12.01
Farnell	3383251	Pro Power	LOWLOSS CCAFF - LOW LOSS WHITE CCA F/FILLED	100m	£12.40
CPC Farnell	CB14617	Pro Power	CCA F/Filled Low Loss Coaxial Cable White	100m	£10.53
CPC Farnell	CB15098	Pro Power	CCA F/Filled Low Loss Coaxial Cable White	250m	£27.81

Table 1 – Suitable Cable Types

Although the version of the cable with the brown outer jack was used while testing the system, the version with the white outer jacket is more suitable because it will be more visible in a mine environment and hence less likely to damage by footfall.

Also, assuming that communication is required over a distance of at least 250m, it is recommended that 250m reels are used because this will require less preparatory work in terminating the cable so that reels can be connected together during deployment.

Because future availability of these cables cannot be guaranteed from these suppliers, details are provided so that equivalent cables can be obtained from other manufacturers and suppliers. A photo of the cable is provided as *Figure 3* and the specification is provided in *Table 2*.

Figure 3–3383250 / CB14616 (Alternatives Identical Except for Jacket Colour)

Nominal Impendence		75Ω
Capacitance		69pF/m
Attenuation	@ 50MHz	11.0dB/100m
	@ 100MHz	18.0dB/100m
	@200MHz	20.5dB/100m
	@800MHz	30.5dB/100m
	@ 1000MHz	33.8dB/100m
Conductor Resistance		≤120Ω/km
Insulation Resistance		≥5000MΩ × km
Inner Conductor		1/1.02mm copper-plated steel
Inner Insulator (Dielectric)		Ø4.7mm air-spaced polyethylene
Shield		16 × 4/0.12mmcopper-clad aluminium (40% coverage)
Jacket		Ø6.5mm PVC (0.7mm wall thickness)

Table 2 – Cable Specification

3.2 Connections Preparation and Testing

3.2.1 Requirement

The cable is supplied in 100m or 250m reels, so reels need to be connected together in order to provide longer runs and, therefore, allow communication over a longer distance. The obvious method is to solder plugs onto both ends of each cable segment. This would allow the reels to be connected together in the mine using female-female adapters. However, because the cable is a particularly lightweight design, for which ideal plugs are not available, it was found that it is not easy to solder the plugs to the cable without damaging it. For this reason, the following method involving pig-tails is recommended.

The method involves splicing a short length of pre-made cable with a connector at one end (this assembly is called a pig-tail) to a longer cable. This method allows the installation of connectors in a controlled and repetitive manner. In this case, pig-tailing was done using standard crimp N-type plugs and RG-58 cable. The process comprises two main operations: preparing the pig-tails and splicing them to the cable. These two operations are described in *Section 3.2.3* and *Section 3.2.4*, respectively. Testing is also important, as detailed in *Section 3.2.5*.

Another – and more convenient – option is to purchase an N-Male to N-Male cable assembly (for example, ref CBA-NM-NM1 from RF Solutions, available from CPC Farnell – part number RF00370, or from Farnell – part number 3404268) and cut it in half to form two pig-tails. In this case, ignore *Section 3.2.2*, and also omit Steps 1-4 of *Section 3.2.3*, proceeding directly to Step 5.

3.2.2 Connectors

Any N type plug intended for RG58 cable will be appropriate. They can be sourced easily from any major electronic components supplier, like RS, Farnell, Mouser, etc.

A suitable one from Amphenol has the manufacturer's reference N1121A1-NT3G-1-50. The RS part number is 700-9543 and the Farnell part number is 1111381.

3.2.3 Preparing the Pig-tails

1. Start by cutting a length of RG-58 cable (400-500mm).

2. Strip its outer jacket at one end, cut the braid to length, and strip the central insulation, according to the instructions of connector's manufacturer. For the Amphenol N1121A1-NT3G-1-50, these are as shown in *Figure 4*, and the specification sheet is reproduced as *Appendix A* (*Section* 6).

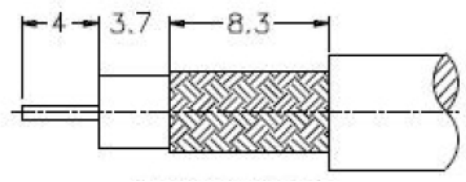

Figure 4 – Amphenol N1121A1-NT3G-1-50 Recommended Stripping Dimensions

3. Then, crimp the pin to the central conductor, and push it into the connector body until it is retained. This results in the braid being trapped between the connector body and a ferrule, so the final step is to crimp the ferrule.

4. Place on the crimped ferrule a short length of self-gluing shrinking tube. It should cover the ferrule and 5.0 - 7.5mm of the adjacent cable jacket. Shrink it applying heath with a hot-air gun.

5. Strip the outer jacket at the other end of the cable, and also strip the inner insulator from the inner conductor. The central conductor should be cut 10-20mm shorter than the braid, because some braid overlap will be needed when splicing the pig-tail to the leaky feeder.

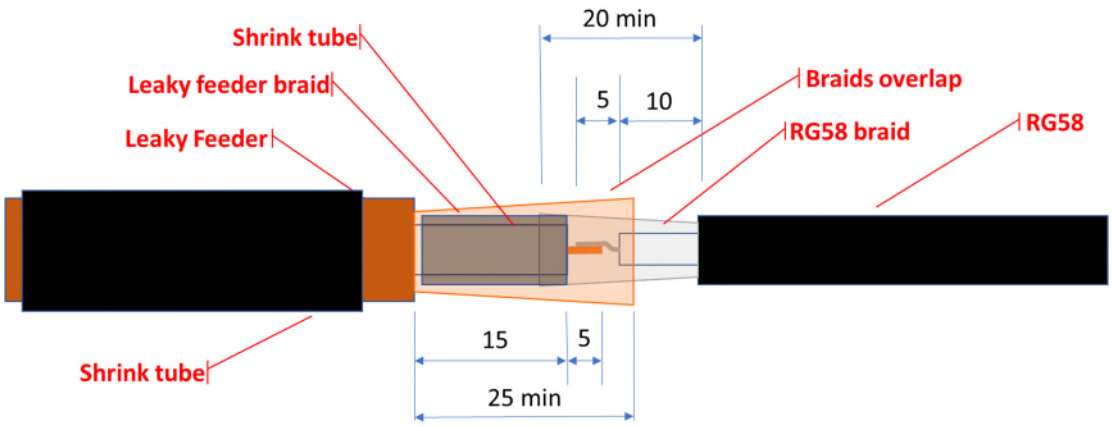

Figure 5 – Pigtail Splicing Diagram, Including Stripping Dimensions (mm)

6. Test the pig-tails for electrical continuity and short circuits using a continuity tester or a test meter. This involves the following actions:

   a. Make sure that the stripped part of the inner conductor is not touching the outer conductor at the end of the cable that does not have the N-type plug attached. Any contact will invalidate the first of these measurements because it will suggest that there is a short circuit inside the N-type plug.

   b. Check between the casing and the centre pin of the N-type plug on the end of the pig-tail. If continuity (or a low resistance) is found between these two points then there is a short circuit in the N-type plug and this must be corrected.

   c. Check between the centre pin of the N-type plug and the centre conductor of the other end of the cable, and between the casing of the N-type plug and the outer conductor (the braid) of the other end of the cable. If continuity (or an extremely low resistance) is not found in either of these cases then the N-type has not been fitted correctly and this must be corrected.

These main steps (excluding the testing for continuity and shorts) are shown in the right-hand part of *Figure 6* and the left-hand part of *Figure 7*. Finished pig-tails are shown in the right-hand part of *Figure 7*.

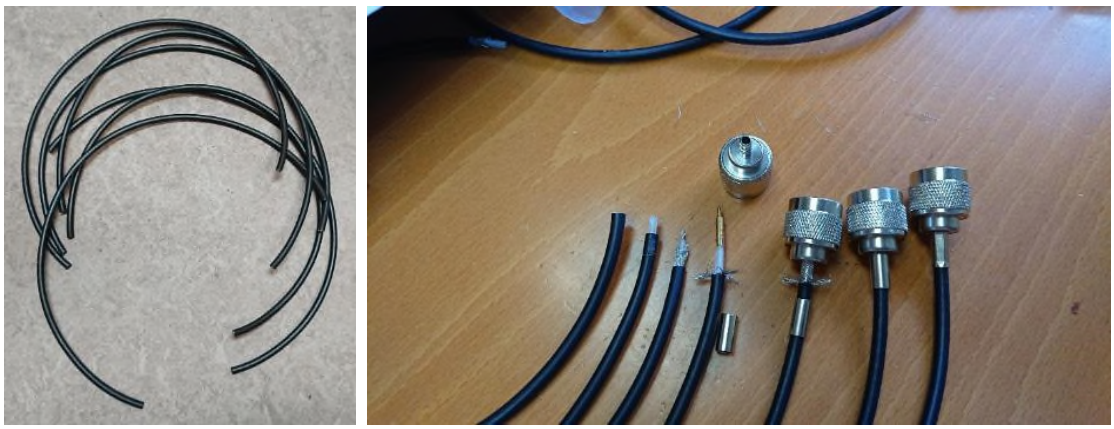

Figure 6 – Pig-tail Blanks (left) and Stages for Attaching Connectors (right)

Figure 7 – Installing Connectors (left), Cable Blanks and Finished Pig-tails (right)

3.2.4 Attaching Pig-tails to Cable

1. Extract the buried end of the reel of coax from the centre of the drum, as shown in *Figure 8* or, as an alternate approach, re-reel it onto a suitable auxiliary drum, taking care not to bury the end.

2. Attach a pig-tail to both ends of the reel of cable as follows, as illustrated in *Figure 9*. The procedure for each end is as follows:

    a. Strip the outer jacket at the end of the reel of cable, and also strip the inner insulator from the inner conductor (see *Figure 5* for dimensions).

    b. Solder the central conductor of the pig-tail to the central conductor of the main cable.

    c. Insulate this with heat shrink tube which, of course, must have been threaded onto the cable before soldering.

    d. Solder the braid of the pig-tail to the braid of the main cable.

    e. Protect it with heat shrink tube, of the type that has fusible glue inside, again remembering to thread it onto the cable before soldering. The glue will melt when shrinking, protecting the cable in an effective manner against water ingress.

Figure 8 – Extracting Buried End for Splicing Pig-tails

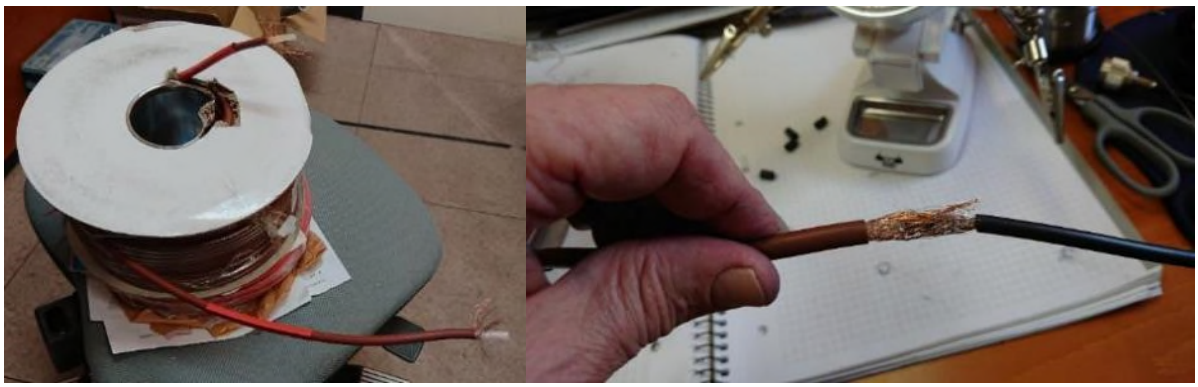

Figure 9 – Splicing a Pig-tail to the Main Cable

Figure 10 – Ready for Splicing and Finished Reels (left),
and Reels Ready for Transport (right)

3.2.5 Final Testing

Testing the cable after attaching the pig-tails to both ends involves checking for electrical continuity and short circuits using a continuity tester or a test meter. This requires the following two steps.

1. Check between the casing and the inner pin of the N-type plug on either end of the cable. If continuity (or a low resistance) is found between these two points, then there is a short circuit between the inner and outer conductors of the cable and this should be corrected. If the pig-tails were tested individually and they passed, this will most likely be due to a fault in the splice between one of the pig-tails and the main cable.

2. Check between the casing of the N-type plug on one end of the cable and the casing of the N-type plug on the other end of the cable, and between the inner pin of the N-type plug on one end of the cable and the inner pin of the N-type plug on the other end of the cable. If continuity (or an extremely low resistance) is not found in either of these cases, then there is an open circuit and this should be corrected. If the pig-tails were tested individually and they passed, this will most likely be due to a fault in the splice between one of the pig-tails and the main cable.

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4 CABLE DEPLOYMENT

Before communication is possible, it is necessary to deploy the cable along the gallery in which communication is required. That procedure is described here. Note that, before you deploy the cable, it is necessary for the reels of cable to have been prepared by the addition of pig-tails, as described in *Section 3.2*.

4.1 Check List

As a check, the following equipment and parts are required:

- A base station radio. This remains at the start of the cable run, all the other equipment is carried by the cable laying party.
- At least one handheld radio.
- Several reels of cable, with pig-tails attached. The number of reels and their length depends on the expected length of the communication path. 250m reels are recommended, although it might be beneficial to carry one 100m reel which could be used if it appears, from "checking as you go"' that the limit of communication is being approached. If there is sufficient manpower, it might also be a good idea to carry an extra reel which can be used if a fault is found in one reel.
- Several N-type female-female adapters. You need one adapter less than the number of reels of cable, but it is a good idea to carry a few spares, because these are small items that might get lost during installation.

Figure 11 – N-type Female-Female Adaptor

- A 50Ω dummy load. Again, it would be wise to carry a spare.

Figure 12 – Dummy Load

- A few reels of self-amalgamating tape, for ensuring that joints in the cable are waterproof. This is not needed in a mine that can be guaranteed to be totally dry.

- A pair of small cutters to remove self-amalgamating tape from joints, and an ATEX continuity tester or test meter to check for open- or short-circuits. These items are highly recommended to assist in finding the cause of any faults that are found during cable deployment or during operation after deployment.

4.2 Check as You Go

The quickest way to deploy the cable is to simply lay it out along the gallery, joining segments together are necessary, until the end point is reached. With this approach, after deployment is complete, it is assumed that the system will work and that communication will then be possible between that end point and the base station and, probably, with other users of handheld radios along the cable. However, this is not the best method, so the instructions provided here suggest a different approach.

The problem with laying out all the cable before attempting to use the system is that, if it doesn't work, it is not at all obvious where the problem lies because there are many potential points of failure including:

- a fault in the base station radio,

- a fault in the handheld radio,

- damage to one or more segments of the cable,

- two segments of the cable not being properly connected together.

For this reason, the method of deployment described here adopts a "check as you go" philosophy in which the integrity of the system is checked after each reel of cable has unrolled, as a minimum.

4.3 Practical Instructions

To deploy the cable, following a method that adheres to the "check as you go" philosophy, the following steps should be carried out:

1. Connect the loose outer end of the first reel of cable to the base station radio (which will usually be located in a safe place) by plugging it into the radio's antenna socket. Also, prepare the base station for operation, as described in *Section 5.1* and ensure that someone remains at the base station to listen for, and respond to, any communication from the cable laying party.

2. Secure that cable, close to the base station, to a fixed object. This prevents strain on the connection between the cable and the base station radio, or the radio being dragged along the gallery, when the cable is being unrolled.

3. Lay out the reel of cable along the floor of the gallery. It is better to lay the cable close to a galley wall than to lay it in the middle of the gallery because this will reduce the likelihood of other members of the rescue team walking on it and

potentially causing damage to the cable. Note that reels can be partial or totally uncoiled, without affecting the performance of the system. Also, try to avoid laying significant portions of the cable in standing water. Although this will not affect the operation of the system as a whole, it is likely that communication will not be possible to a handset that is adjacent to a submerged section of cable.

4. When the reel of cable has been unrolled, attach a 50Ω dummy load to the end of the cable. Make sure that the dummy load is not allowed to come into contact with water. Also, if this is the last reel of cable and a check has already been made on the system integrity by making contact the base station, protect the dummy load and its connection to the cable from water ingress using self-amalgamating tape (unless it can be guaranteed that the mine is totally dry). Do not do use the self-amalgamating tape if this is not the last reel of cable because the dummy load will only be connected temporarily.

5. Now, using a handheld radio according to the instructions provided in *Section* 5, attempt to make contact with the base station. Also check that it's possible to make contact at a normal distance of 2m from the cable because, if communication is possible close to the cable but not a 2m, this might suggest that the limit of communication is being approached. Such an observation might suggest that the next reel to be unrolled should be a 100m reel instead of a 250m reel. If communication is achieved, continue with the deployment procedure at Step 6. If not, it is pointless to continue so the cause of the fault should be investigated and corrected before continuing.

6. Remove the 50Ω dummy load from the end of the cable and keep it safe.

7. Connect the end of the next reel of cable to the end of the most recently unrolled reel using an N-type female-female adaptor. Although these adaptors will provide some protection again the ingress of water, it is highly recommended that the connection between the two reels of cable is not allowed to come into contact with standing water and that it is not positioned close to any pools of water into which it might be dragged as the next reel of cable is unrolled. Protect the whole of the joint area – from before the N-type plug on one reel of cable, to after the N-type plug on the other reel of cable, therefore including both N-type plugs, the N-type female-female adapter and a few centimetres of both cables –from water ingress using self-amalgamating tape (unless it can be guaranteed that the mine is totally dry).

8. Go back to Step 3 to continue with the next reel of cable.

As an alternative to this method, and to give a more immediate indication of a fault, it is possible for checks to be made by talking to the base station while the cable is being unrolled, not only after each reel has been unrolled. However, this will not always be possible because it requires the availability of a person in the cable laying team who can operate a handheld radio during the unrolling process. To allow continuous testing to be carried out, the dummy load should be attached to the inner end of a cable that is currently being unrolled and kept in place until it has been fully unrolled and any further communication checks carried out.

4.4 Cable Removal

The rationale of this system was that it should use a cable that is sufficiently cheap that it can be discarded following a rescue operation. This is because a cable which is deployed quickly during a rescue action will not be adequately protected from incidents including people walking on it, or rock or other equipment falling on it. For this reason, it would not be safe to use it again in a rescue operation without inspecting and testing it, both of which are likely to be expensive activities. In fact, even if an organisation was prepared to check the cable carefully before any reuse, it is important to recognise that invisible damage could have occurred during the rescue and, although that might not affect its performance immediately, such a cable could be liable to future and sudden failure. For this reason, salvaged cable should never used in a rescue action. However, it is possible that such cables could be used for rescue training purposes.

If the cable is not going to be used again, the easiest and quickest way to remove it from the gallery after the rescue has finished is just to put it into one or more sacks, making no attempt to roll it up or prevent any further damage.

However, if an organisation does intend to use it again, perhaps for rescue training (but definitely not for operational use in a rescue), and is prepared to spend time in checking its integrity before re-use, it is essential to roll it up to prevent any damage from occurring. Rolling it up onto the reels on which the cable was supplied is a slow process (and it is possible that those cardboard reels could have suffered water damage during the rescue), so it is recommended that specially made re-reeling drums, ideally mounted on a cart or trolley, are used, as shown in *Figure 13*. Experience suggests that it is feasible to roll up the cable in lengths of up to 200-250m and that this can be carried out fairly quickly, although it is recognised that it will be more difficult in a mine gallery with a rough floor than in the environment shown in *Figure 13*.

Figure 13 – Salvaging a Used Cable for Training Use Only

5 OPERATION

5.1 Equipment Maintenance

All equipment that forms part of this system should be battery powered and care should be taken to ensure that all equipment is kept in a state of readiness so it can immediately be used in a rescue. In particular, batteries should be in good condition (i.e. new enough that they are able to maintain a good level of charge) and fully charged. Two packs of NiMH batteries (8 × 1.2V = 9.6V, 2300mAh nominal capacity) are used. These packs are made of AA size cells, which can be replaced by opening the enclosure (See D1.5 for details).

The prototype equipment is charged via a socket on the case, using the charger provided with the equipment. The chargers are the standard ones supplied by Midland with the ALAN-42DS transceiver, fitted with a plug that is compatible with the socket on the case. The charging socket is a standard 5.5mm barrel connector, with a 2.5mm central pin. It is located next to the 4-pin M12 audio connector, and it is mechanically protected when the equipment is in use – see *Figure 14*. At the left is the portable unit – note the red charging LED close to the connectors – and at the right is the base station – the window for charge monitoring is located below the connectors.

Figure 14 – Audio and Charging Connectors (with Mechanical Protection in Place)

To access the charging socket, the mechanical protection (held in place by a thumbscrew) should be removed. In *Figure 15*, the protectors are shown removed, and the charging jack plugged in. The charge state is signalled by a LED in the case of the portable unit or by an internal LED (visible through a window in the case) in the base station, as shown in *Figure 15*.

Figure 15 – Prototype Radios with Battery Charger Plugged in (Charging)

Charging employs the standard (slow) charging method. Therefore, it will take around 12 hours to get a full charge if the batteries are empty. Please refer to page 6 of the ALAN-42DS user's manual (section "Recharge of the Batteries") for more details. This is available as *Appendix B* (*Section 8*) of this document.

5.2 Equipment Setup

Information provided here refers to the specific base station and handheld radios used during the field tests. The positions of connectors and controls are shown in *Figure 16* and, although this represents the portable unit, the base station is similar. Note also *Figure 2* which shows both the base station and the handheld radio, and also both the types of microphone/speaker that can be used with these radios. If other equipment is used, although the principles will be the same, details such as the location of sockets and controls and their labelling might be different.

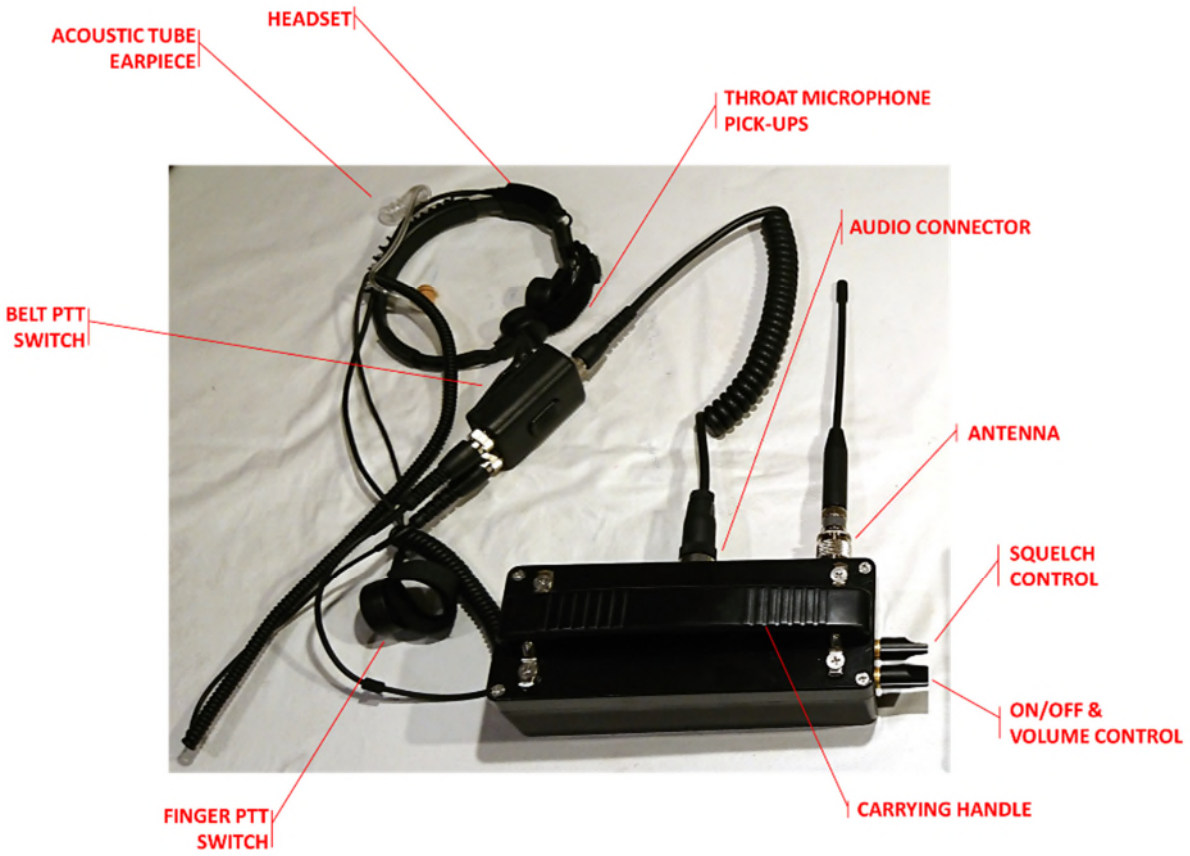

Figure 16 – Portable Station Connections and Controls

Before using the equipment, the following connections need to be made, indeed it is recommended that this is done before starting to deploy the cable so the cable laying party can maintain contact with the base station while the cable is being unrolled, as a "confidence check":

1. In the case of the base station, the end of the coaxial cable should be plugged into the radio's antenna socket.

2. In the case of the handheld units, the associated whip antenna should be plugged into the radio's antenna socket.

3. The selected handset or headset (as convenient for the rescue operation) should be connected to the audio connectors of all devices to be used (base station and handhelds).

When all the connections are made, the devices are ready for operation and can be switched on by turning the ON/OFF – Volume control knob. The volume should be adjusted for comfortable listening. Moreover, the squelch level can be adjusted, using the Squelch control. This feature ensures that no sound can be heard from the radio unless it is louder than a threshold, i.e. the squelch level. This means that the user will not hear annoying hissing noises when nobody is talking on the system, but if it is set too high, then weak voice signals might also be suppressed. It is vital, therefore, that this is not set too high, and if might be safer to set it to the minimum, even though this means that hissing sounds might be heard.

These radios only allow the operator of one radio to talk at the same time. For this reason, the microphones are fitted with PTT (Push to Talk) switches. When you want to talk, therefore, you should hold down the PTT switch. Because this prevents the radio from receiving, after you finish talking you should release the PTT switch.

Additional features are available on these radios but they cannot be controlled while the radios are in their protective ATEX cases. Such controls are available to the technicians who maintain the rescue communication equipment, but are not available to users during a rescue. For full details of these radios (but remember that other radios will be different),please refer to the user manual for the ALAN 42-DS which is included as *Appendix B* (*Section 8*).

5.3 Operating Guidelines

Near the start of the guidewire – i.e. close to the base station – the signal in the cable will be very strong so users of mobile handsets will not have to stand close to the cable. For the first hundred metres or so, communication will probably be possible at a distance of ten metres or more from the cable. However, as the distance along the cable increases, it will be necessary to get closer to the cable. Even so, tests suggest that, even at a distance of 800m, it should not generally be necessary to be closer than 2m from the cable.

However, at some distances, generally when the range to the base station is more than 600m, the signal strength might fluctuate along the cable, i.e. there will be peaks and troughs in the signal strength. This means that, if communication is difficult at a particular location, it will often be improved by walking a few more metres along the cable.

As general guidance, it is suggested that, as a user of a mobile handset walks along the cable away from the base station, communication is checked with the base station every few tens of metres. This will provide the operator with knowledge on how strong the signal is and will prompt the user to start walking closer to the cable as the signal strength decreases. It will also alert the user if the limit of communication has been reached.

6 FURTHER INFORMATION

Further information about the guidewire communication system is available from the Camborne School of Mines, College of Engineering, Mathematics & Physical Sciences, University of Exeter, Penryn Campus, Penryn, Cornwall, TR10 9FE, UK, http://emps.exeter.ac.uk/csm/.

Please contact Mike Bedford at M.D.Bedford@Exeter.ac.uk.

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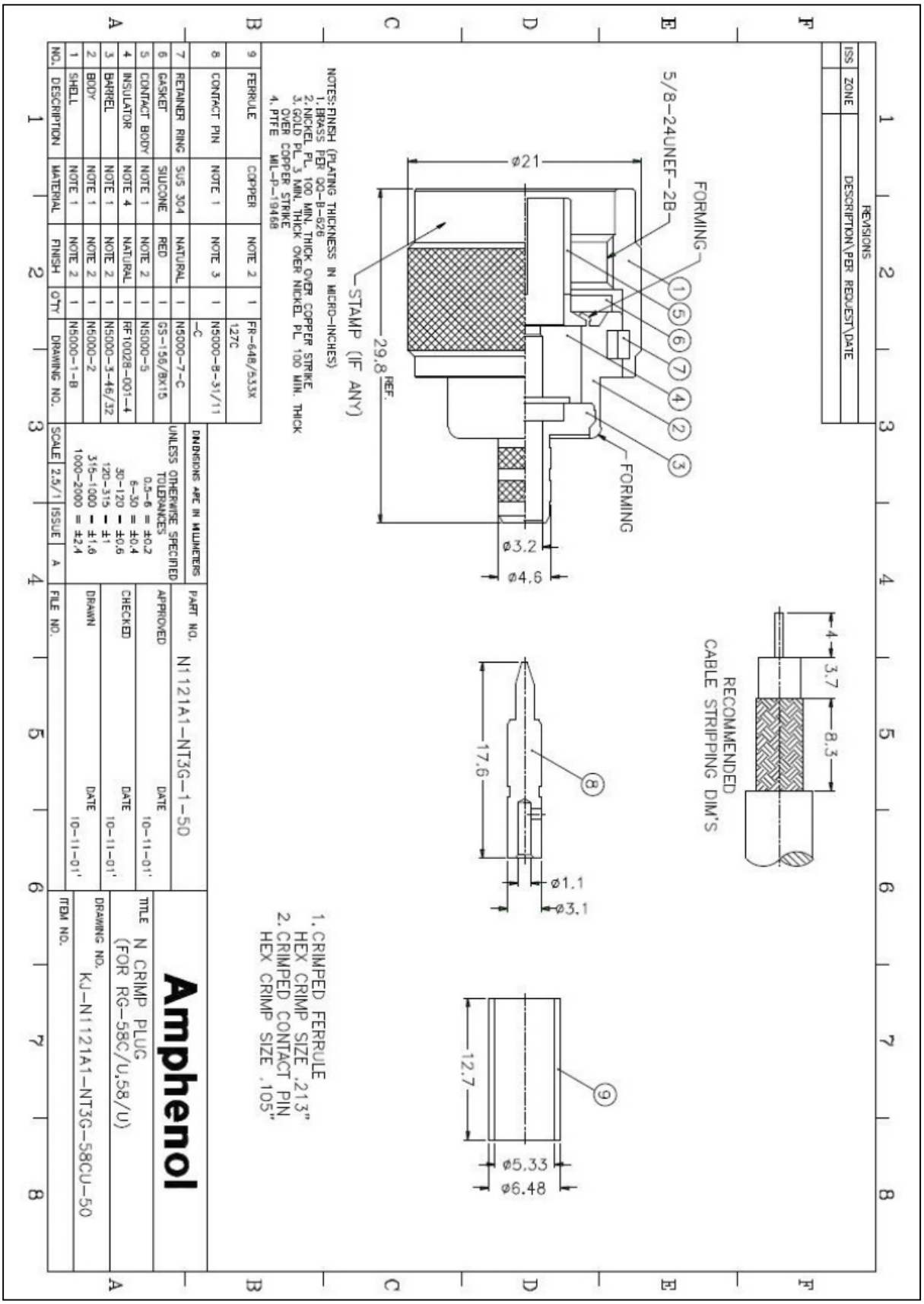
7 APPENDIX A – AMPHENOL N1121A1-NT3G-1-50 SPECIFICATION SHEET



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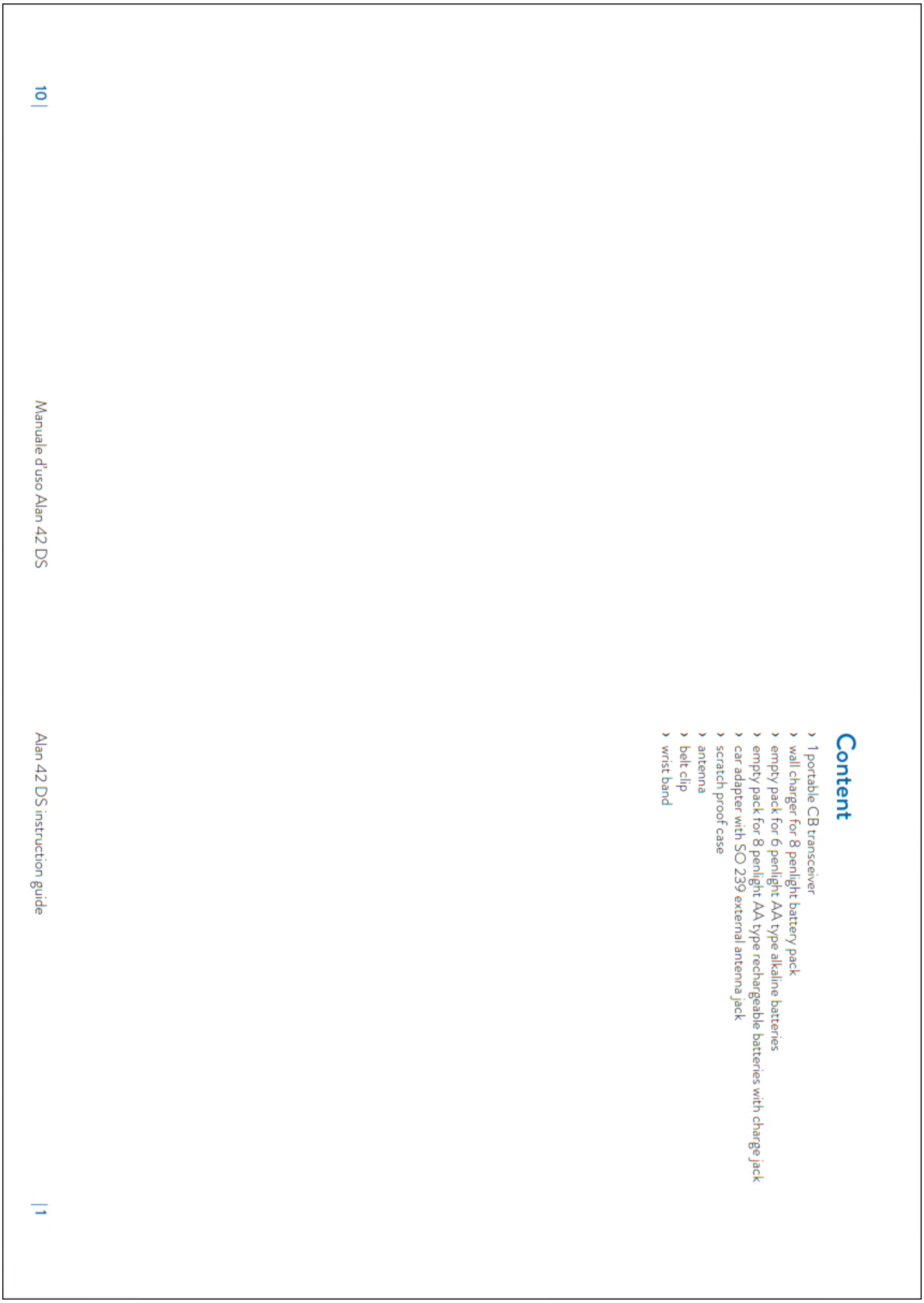
8 APPENDIX B – ALAN 42DS USER MANUAL



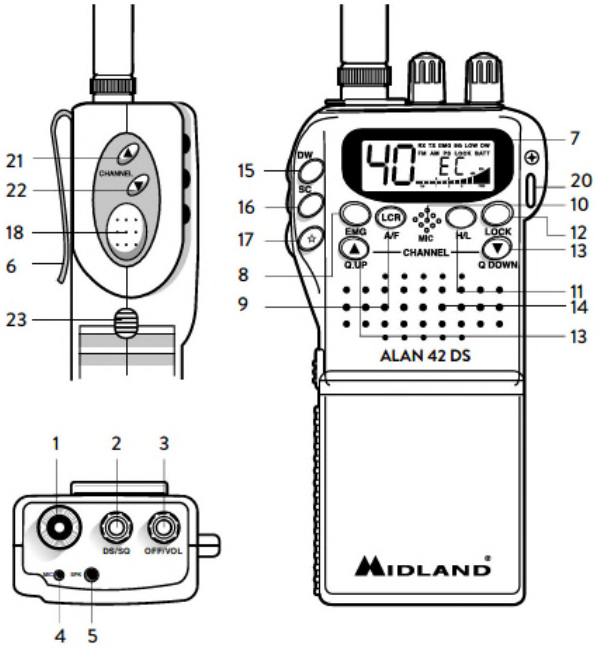
Content

- 1 portable CB transceiver
- wall charger for 8 penlight battery pack
- empty pack for 6 penlight AA type alkaline batteries
- empty pack for 8 penlight AA type rechargeable batteries with charge jack
- car adapter with SO 239 external antenna jack
- scratch proof case
- antenna
- belt clip
- wrist band

10 | Manuale d'uso Alan 42 DS

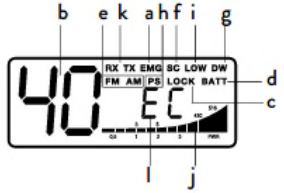
Alan 42 DS instruction guide | 1

Function and location of the controls



1. **Antenna connector:** insert into this plug the antenna supplied with the radio. It is possible to use external vehicular antennas to obtain a better performance.
2. **Squelch knob :** it allows to eliminate the background noises in rx and to operate in DS mode (Digital Squelch).
3. **On/Off Volume Control.**
   In "off" position your transceiver is off. Turn this control clockwise to switch on the unit. Turn the knob clockwise a little more to set the audio level, until you get a comfortable reception.
4. **MIC jack:** connect by inserting the loudspeaker mike to the plug.

5. **External loudspeaker jack:** connect by inserting the loudspeaker mike to the plug.
6. **Belt clip**
7. **Multifunction backlighted display.**



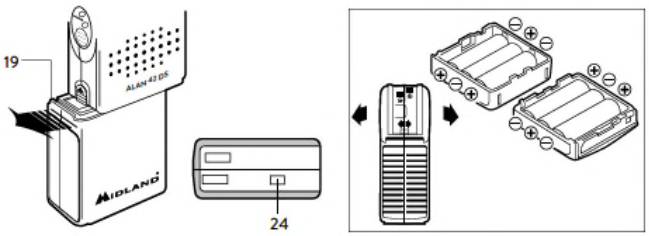
This liquid crystal display has been projected to show the operative modality:

a. **EMG** function activated
b. Channel selected number(from 1 up to 40)
c. **Lock**: keyboard lock function activated
d. **BATT**: Run-down batteries indicator
e. **AM/FM:** it shows the emission mode and the Noise Blanker activation (in this case, the indication will blink)
f. **SC:** SCAN function activated
g. **DW**: DUAL WATCH function
h. **P. S.**: Save function activated
i. **LOW** function activated
j. The received signal strength and the power of the transmitting signal
k. **RX/TX**: TX=transmit mode; RX=receive mode
l. Frequency band selected

8. **EMG button:** emergency channel. By pressing this button, the unit automatically skips to Channel 9 (emergency channel). The display will shows **EMG**. It will not be possibile to change accidentally the channel. To cancel this function, press the button again.
9. **A/F-LCR button:** to select AM mode or FM mode; the modulation you choose will appear on the display. If you select a frequency band operating in FM mode only, the **A/F-LCR** button will activate the **LCR** function (Last Channel Recall).
10. **Microphone:** during transmission, speak with a normal tone of voice to the microphone.
11. **H/L button:** it selects the output power level during trasmission.When the unit

is turned on, it always transmits with high power (4W). By pressing this button, the unit will transmit with low power (1W). The display will show "LOW". Press again the H/L button to return to "HIGH" power level.

12. **LOCK button**: it allows you to lock the keyboard, thus avoiding accidental use of the keys.
13. **Q.UP - Q.DOWN buttons**: to skip 10 channels up (Q.UP) or 10 channels down (Q.DOWN).
14. **Loudspeaker**
15. **Dual Watch:** this function allows the synthonization on two different channels at the same time. Thanks to this function, you can monitor a second channel. When a signal on the second channel is received, the conversation on the first channel is automatically interrupted and the receiver switches on the second channel. The monitoring starts again 4 seconds after the signal end.
    To activate this function, operate as follows:
    - Select the desired channel through the channel selector
    - Press the **DW** button
    - Select the second channel
    - Press the button **DW** again
    - To cancel the function press again the **DW** button or the **PTT** button.
16. **SCAN /Noise Blanker button:** with this control, you can automatically seek for a busy channel.
    - Rotate the squelch clockwise until the background noise is no longer heard; or rotate the knob totally anti-clockwise to use the digital squelch.-
      Press the "SCAN" button: the transceiver will scan automatically all the channels until a carrier is being received.
    - When it finds the carrier, it stops and starts again some seconds after the end of the communication on the channel.
    - When the radio is transmitting, the scan function is deactivated.
    - Keep pressed the SCAN button for 2 seconds to activate the Noise Blanker filter; "AM" or "FM" will blink on the display.
17. ☆ **button:** display lighting (temporized).This function allows to operate in darkness conditions. By pressing this button, the display is lighted for 5 seconds.
18. **Push to talk button (PTT)**: Its pressure activates the transmission. When it is released, the receiver is activated.
19. **Battery compartment**: insert 6 alkaline batteries or 8 rechargeable Ni-Mh batteries.
20. **Hole for wrist belt**
21. **Channel UP**: to skip to the next channel. Keeping this button pressed, the "autorepeat" function is obtained.
22. **Channel DOWN:** to skip to the previous channel. Keeping this button pressed, the "autorepeat" function is obtained.
23. **Battery pack contact:** lift the button and take the batteries out (see drawing).
24. **Auxiliary antenna contact:** for the connection to the vehicular adaptor.



Installing/removing the battery case

Alan 42 DS works with both Alkaline and with Ni-Mh rechargeable batteries.
For this reason, 2 kinds of battery case are supplied: empty battery case for 8 penlight AA type rechargeable batteries with charge jack and an empty battery case for 6 penlight AA type alkaline batteries.
To remove the battery case, lift the side trigger and slide the battery case off. Put the batteries in.
To replace the battery case, slide it again onto the dual track system of the back side of the transceiver.

Recharge of the batteries

The battery recharge can be possible only by using the NiMH rechargeable battery case.
Do not try to charge alkaline batteries or non rechargeable batteries. Make sure that when you charge the radio, only rechargeable NI-MH batteries should be contained in the battery compartment!
Use a socket ready accessible for ac/dc adaptor; Connect the socket of the wall adaptor to a mains power socket and insert the jack of the wall adaptor into the charge jack of the battery case.
When charging is complete detach the socket of the wall adaptor from the mains.
To obtain the maximum performance and capacity, at the first use of the radio, it is highly recommended to completely discharge/recharge the batteries 2 or 3 times.

Warnings

- ***The supplied wall charger is using "standard charging" method. This is a method, where the charging current is about 10 % of the capacity. Using this method, chargers do not automatically disconnect charging when batteries are fully charged.***
- ***You should avoid to keep the radio permanently connected to the wall charger, when you do not need it.***
- ***The charger is only designed for NiMH rechargeable batteries and cannot be used for standard Alkaline or other not chargeable batteries. Trying to charge such kind of batteries can be a risk. Such batteries may leak, explode or even burn and cause damage or personal injuries!***
- ***Please use only the supplied wall charger type and no other charger.***
- ***Dispose of the batteries according to the procedures set out by local regulations.***
- ***Mains plug used shall remain readily operable.***

How to operate with your Alan 42 DS

1. Insert the antenna in the antenna connector.
2. Insert the batteries into the battery compartment, noting polarity.
3. Rotate the **ON/OFF** volume control clockwise to turn the unit on. Adjust the volume for a normal listening level.
4. Adjust the **SQUELCH** control
5. Select the desired channel by the **UP/DOWN** or **QUICK UP/QUICK/DOWN** buttons

Note: if the channel does not change,control that the EMG or LOCK button has not been pressed. In this case, press the EMG or LOCK button to deactivate this function.

As far as the other functions are concerned, refer to previous instructions.

To transmit: press and hold the PTT button, then talk to the microphone.

To receive: simply release the PTT button.

CAUTION: DON'T EXPOSE THE DISPLAY TO EXTREME TEMPERATURES.

Frequency band selection

The frequency bands must be chosen according to the country where you are operating.

Procedure:
1. Switch off the unit.
2. Turn it on while pushing the "**A/F-LCR**" and "**SC**" buttons.
3. By pushing the ▲ and ▼ buttons at the left hand side of the radio, select the desired frequency band (see the chart).
4. To fix your selection, press the "**A/F-LCR**" button.

NOTE[1]: If you select a frequency band which operates in FM mode only, the "A/F-LCR" control activates the LCR function (Last Channel Recall).

NOTE[2]: In the UK frequency band, you can select directly the I (Italy) band by pushing the "AM/FM" button for 2 seconds.

Frequency band chart

Displayed digits	Country
I	Italy 40 CH AM/FM 4Watt
I2	Italy 34 CH AM/FM 4Watt
D4	Germany 80 CH FM 4Watt / 40 CH AM 4 Watt
EU	Europe 40 CH FM 4Watt / 40 CH AM 1 Watt
EC	CEPT 40 CH FM 4Watt
E	Spain 40 CH AM/FM 4Watt
F	France 40 CH FM 4Watt / 40 CH AM 1 Watt
PL	Poland 40 CH AM/FM 4Watt
UK	England 40 CH FM 4Watt English frequencies + I (Italy) 40 CH AM/FM 4Watt

ATTENTION!
The frequency band allowed all over Europe is 40CH FM 4W (EC) – See the "Restrictions on the use" table.

Technical specifications

Channels ..... 40 FM (see the Frequency band chart)
Frequency Range* ..... 26.565 - 27.99125 MHz
Operating mode ..... F3E (FM), A3E (AM).
Antenna impedance ..... 50 Ohm.
Loudspeaker ..... 8 Ohm 0.5W.
Microphone ..... condenser type
Power supply ..... min 7.2Vdc;max 13,8Vdc; nom 12,6Vdc
Dimensions ..... 30x70x140 mm.
Weight ..... 220 gr. (without batteries).

RECEIVER
Sensitivity at 10dB S/N ..... 0.5µV (AM), 0.25µV (FM)
Selectivity ..... more than 60dB
Squelch range 0.25V-500µV
Audio output power ..... 0.5W 8 ohm (10% distortion)
Distortion at 1000 µV 3%
Audio frequency response ..... 400-2400 Hz
Intermediate frequency ..... I° 10.695 MHz
..... II° 455 KHz
Spurious response ..... more than 60 dB
Current drain at stanby ..... 100 mA when the save mode is off
..... 45 mA when the save mode is on

TRANSMITTER
RF Output Power ..... duty cycle 10% 4W AM/FM
Frequency Tolerance 0.005%
Harmonic Suppression ..... more than 70 dB
Current Drain ..... 900 mA
Modulation ..... AM 90% (± 5%)
..... FM dev. 2.0KHz

* (covering all approved EU frequency bands)

Specifications are subject to change without notice.

WARNING: Direct plug-in ac/dc power supply must be used for disconnecting the transceiver from the mains; the desktop charger must be positioned close to the unit and easily accessible.

- INFORMAZIONE AGLI UTENTI: Ai sensi dell'art. 13 del decreto legislativo 25 luglio 2005, n.151 "Attuazione delle Direttive 2002/95/CE, 2002/96/CE e 2003/108/CE, relative alla riduzione dell'uso di sostanze pericolose nelle apparecchiature elettriche ed elettroniche, nonché allo smaltimento dei rifiuti". Il simbolo del cassonetto barrato riportato sull'apparecchiatura indica che il prodotto alla fine della propria vita utile deve essere raccolto separatamente dagli altri rifiuti. L'utente dovrà, pertanto, conferire l'apparecchiatura giunta a fine vita agli idonei centri di raccolta differenziata dei rifiuti elettronici ed elettrotecnici, oppure riconsegnarla al rivenditore al momento dell'acquisto di una nuova apparecchiatura di tipo equivalente, in ragione di uno a uno. L'adeguata raccolta differenziata per l'avvio successivo dell'apparecchiatura dismessa al riciclaggio, al trattamento e allo smaltimento ambientalmente compatibile contribuisce ad evitare possibili effetti negativi sull'ambiente e sulla salute e favorisce il riciclo dei materiali di cui è composta l'apparecchiatura. Lo smaltimento abusivo del prodotto da parte dell'utente comporta l'applicazione delle sanzioni amministrative di cui al dlgs. n.22/1997 (articolo 50 e seguenti del dlgs. n.22/1997).
- All articles displaying this symbol on the body, packaging or instruction manual of same, must not be thrown away into normal disposal bins but brought to specialised waste disposal centres. Here, the various materials will be divided by characteristics and recycles, thus making an important contribution to environmental protection.
- Alle Artikel, die auf der Verpackung oder der Gebrauchanweisung dieses Symbol tragen, dürfen nicht in den normalen Mülltonnen entsorgt werden, sondern müssen an gesonderten Sammelstellen abgegeben werden. Dort werden die Materialien entsprechend ihrer Eigenschaften getrennt und, um einen Beitrag zum Umweltschutz zu liefern, wiederverwertet.
- Todos los artículos que exhiban este símbolo en el cuerpo del producto, en el embalaje o en el manual de instrucciones del mismo, no deben ser desechados junto a los residuos urbanos normales sino que deben ser depositados en los centros de recogida especializados. En estos centros, los materiales se dividirán en base a sus características y serán reciclados, para así poder contribuir de manera importante a la protección y conservación del medio ambiente.
- Tous les articles présentant ce symbole sur le corps, l'emballage ou le manuel d'utilisation de celui-ci ne doivent pas être jetés dans des poubelles normales mais être amenés dans des centres de traitement spécialisés. Là, les différents matériaux seront séparés par caractéristiques et recyclés, permettant ainsi de contribuer à la protection de l'environnement.
- Zużyte towary oznaczone tym znakiem mogą stanowić zagrożenie dla środowiska naturalnego, dlatego nie należy ich wyrzucać tylko oddać sprzedawcy, który przekaże je do przedsiębiorstwa zajmującego się utylizacja odpadów.
- Toate produsele care au aplicat acest simbol pe ambalaj sau in manualul de utilizare, nu trebuie să fie aruncate in coşurile de gunoi, ci duse in centrele de colectare a deşeurilor electrice si electronice. Aici, diversele materialele vor fi impărţite in funcţie de caracteristici si reciclate, aducându-se astfel o contribuţie importantă la protectia mediului.

RED

IT / RSM

Cte International Srl dichiara che il prodotto è conforme ai requisiti essenziali e alle disposizioni della Direttiva 2014/53/UE. La Dichiarazione di conformità si può scaricare dal sito **http://www.midlandeurope.com/it/pagina/10090-certifications**

GB / CY / MT

Hereby Cte International Srl declares that this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/UE. The declaration of conformity is available on the web site **http://www.midlandeurope.com/it/pagina/10090-certifications**

AT / DE / CH / LI

Hiermit erklärt Cte International Srl, dass das Produkt die grundlegenden Anforderungen und anderen relevanten Bestimmungen der Richtlinie 2014/53/UE. Die Konformitätserklärung ist unter folgendem Link verfügbar: **http://www.midlandeurope.com/it/pagina/10090-certifications**

ES

CTE International SRL. declara, bajo su responsabilidad, que este aparato cumple con lo dispuesto en la Directiva 2014/53/UE, del Parlamento Europe. La Declaración de Conformidad está disponible en **http://www.midlandeurope.com/it/pagina/10090-certifications**

FR / LU / CH

Par la présente Cte International Srl déclare que le modèle est conforme aux exigences essentielles et autres dispositions pertinentes de la directive 2014/53/UE. La déclaration de conformité est disponible sur le site internet **http://www.midlandeurope.com/it/pagina/10090-certifications**

PT

A CTE INTERNATIONAL declara que este aparelho cumpre com o disposto na Directiva 2014/53/UE do Parlamento Europeu. A Declaração de Conformidade está disponível no sitio na Internet em **http://www.midlandeurope.com/it/pagina/10090-certifications**

GR

Με το παρών, η Cte International Srl δηλώνει ότι το όνομα του μοντέλου συμμορφώνεται ως προς τις βασικές απαιτήσεις και άλλες σχετικές διατάξεις του Κανονισμού 2014/53/UE. Η δήλωση συμμόρφωσης είναι διαθέσιμη στην ιστοσελίδα http://www.midlandeurope.com/it/pagina/10090-certifications

NL

Hierbij verklaard CTE International Srl dat dit model voldoet aan de essentiële eisen en andere relevante bepalingen van richtlijn 2014/53/UE. De verklaring van conformiteit is beschikbaar op de website **http://www.midlandeurope.com/it/pagina/10090-certifications**

BE

CTE INTERNATIONAL Srl verklaart dat het product overeenstemt met de voorschriften en andere bepalingen van de richtlijn 2014/53/UE. De conformiteitsverklaring is voorhanden op de website **http://www.midlandeurope.com/it/pagina/10090-certifications**

PL

CTE International Srl deklaruje, że ten model jest zgodny z wymaganiami zasadniczymi i innymi istotnymi postanowieniami Dyrektywy 2014/53/UE. Deklaracja Zgodności jest dostepna na stronie **http://www.midlandeurope.com/it/pagina/10090-certifications**

RO

Cte International Srl declara ca acest model este in conformitate cu cerintele esentiale si alte prevederi ale Directivei 2014/53/UE. Declaratia de confomitate este disponibila si pe site-ul **http://www.midlandeurope.com/it/pagina/10090-certifications.**

BG

С настоящото CTE international Srl декларира, че продукта е в съответствие с основните изисквания и съответните модификации на Директива 2014/53/UE. Декларацията за съвместимост е налична на сайта: http://www.midlandeurope.com/it/pagina/10090-certifications

NO

CTE INTERNATIONAL Srl erklærer at produktet er i overensstemmelse med de viktigste kravene og andre relevante betingelser i Direktivet 2014/53/UE. Samsvarserklæringen finnes tilgjengelig på nettstedet **http://www.midlandeurope.com/it/pagina/10090-certifications**

DK

Hermed erklærer Cte International Srl , at dette apperat er i overensstemmelse med kravene og andre relevante bestemmelser i direktiv 2014/53/UE. Overensstemmelseserklæringen findes på webstedet **http://www.midlandeurope.com/it/pagina/10090-certifications**

SE

CTE INTERNATIONAL Srl förkunnar att produkten överensstämmer med de väsentliga kraven och övriga bestämmelser i direktiv 2014/53/EU. Denna försäkran om överensstämmelse finns på webbplatsen **http://www.midlandeurope.com/it/pagina/10090-certifications**

FI

CTE INTERNATIONAL Srl vakuuttaa, että tuote täyttää direktiivin 2014/53/UE. Vaatimuksenmukaisuusvakuutus on saatavilla **http://www.midlandeurope.com/it/pagina/10090-certifications –verkkosivuilla.**

HR

Cte International Srl ovime izjavljuje da je ime ovog modela u suglasnosti sa bitnim zahtjevima te ostalim relevantnim odredbama Propisa 2014/53/EU. Ova Izjava o suglasnosti je dostupna na web stranici **http://www.midlandeurope.com/it/pagina/10090-certifications.**

EE

Käesolevaga kinnitab Cte International Srl selle mudeli vastavust direktiivi 2014/53/UE. Vastavusdeklaratsioon on kättesaadav veebilehel **http://www.midlandeurope.com/it/pagina/10090-certifications**

LT

CTE International patvirtina, kad šis modelis atitinka visus esminius Direktyvos 2014/53 / UE. Atitikties deklaracija yra pateikiama internetinėje svetainėje **http://www.midlandeurope.com/it/pagina/10090-certifications**

LV

CTE INTERNATIONAL Srl deklarē, ka produkts atbilst pamatprasībām un citiem ar to saistītajiem Direktīvas 2014/53 / UE. Atbilstības deklarācija ir pieejama mājas lapā: **http://www.midlandeurope.com/it/pagina/10090-certifications**

SK

Týmto Cte International Srl prehlasuje, že tento názov model je v zhode so základnými požiadavkami a ďalšími príslušnými ustanoveniami smernice 2014/53 /UE. Vyhlásenie o zhode je k dispozícii na webových stránkach **http://www.midlandeurope.com/it/pagina/10090-certifications**

SI

Cte International Srl deklarira da je ta model skladen z bistvenimi zahtevami in drugimi relevantnimi določili EU direktive 2014/53/UE. Deklaracija o skladnosti je na voljo na spletni strani **http://www.midlandeurope.com/it/pagina/10090-certifications**

CZ

CTE INTERNATIONAL SRL prohlašuje, že výrobek je v souladu s 2014/53/UE. Prohlášení o shodě je k dispozici na webových stránkách **http://www.midlandeurope.com/it/pagina/10090-certifications**

H

Mi, a CTE International Srl. saját felelősségre kijelentjük, hogy ezen elnevezésű termék megfelel az 2014/53 /UE. A megfelelőségi nyilatkozat elérhető weboldalunkon a **http://www.midlandeurope.com/it/pagina/10090-certifications** címen.

Prodotto o importato da:
CTE INTERNATIONAL s.r.l.
Via. R.Sevardi 7
42124 Mancasale Reggio Emilia Italia
www.midlandeurope.com
In Italia l'uso è soggetto a dichiarazione.
Prima dell'uso leggere attentamente le istruzioni.

Produced or imported by:
CTE INTERNATIONAL s.r.l.
Via. R.Sevardi 7 - 42124 Mancasale Reggio Emilia Italy

Imported by: **ALAN-NEVADA UK**
Unit 1 Fitzherbert Spur Farlington Portsmouth Hants. P06 1TT - United Kingdom
www.nevada.co.uk
The use of this transceiver can be subject to national restrictions. Read the instructions carefully before installation and use.

Importado por:
MIDLAND IBERIA, S.A.
C/Cobalt, 48 - 08940 Cornellá de Llobregat
España - **www.midland.es**
El uso de este equipo puede estar sujeto a la obtención de la correspondiente autorización administrativa. Antes de utilizar, lea atentamente el manual de uso.

Vertrieb durch: **ALAN ELECTRONICS GmbH**
Daimlerstraße 1K - D-63303 Dreieich
Deutschland - **www.alan-electronics.de**
Die Benutzung dieses Funkgerätes ist von den landesspezifischen Bestimmungen abhängig. Vor Benutzung Bedienungsanleitung beachten.

Importowane przez:
ALAN TELEKOMUNIKACJA SP. z o.o.
Jawczyce, Poznańska 64 - 05-850 Ożarów Maz. Polska - **www.alan.pl**
Używanie tego radiotelefonu może podlegać pewnym ograniczeniom. Przed instalacją i pierwszym użyciem przeczytaj uważnie instrukcję.

CE RoHS √

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