

- TRAINING MANUAL -

< August 2006 Revision >

P3/P1 RADSL FIELD DEPLOYABLE COMMUNICATIONS & C4I EXTENSIONS OVER COPPER CABLES (DON10)



P3/P1 Training Program:

The training program is conducted by a systems expert (currently the product designer). Hands-on training is carried out with a focus on individual trainee requirements, with an ideal number of 10-15 trainees in one group.

A training session consists of theory and practice with the first hour dedicated to the technology and an applications overview. Remaining time is spent on practical aspects of equipment use, including detailed examples of configurations, management and trouble shooting.

TABLE OF CONTENTS

INTRODUCTION	3
The design of the P3/P1 system was in response to ADF's need to address the problem of downed fibre optic networks. With features specific to army's needs and designed in collaboration with actual users, the result is a system which closely reflects current field requirements.....	3
P1/P3 OVERVIEW	3
DSL TRANSMISSION OVERVIEW	3
DMT MODULATION IN DSL TRANSMISSION	4
P3/P1 APPLICATIONS OVERVIEW	4
P1 CONNECTIONS AND HEALTH INDICATORS	5
P1 TO P1 CONNECTIONS.....	6
P3 OPERATION - CONNECTIONS AND HEALTH INDICATORS	6
Hardware	6
Local Management and Telephony Features	6
Establishing a Link.....	6
Telephony Modes - Analogue.....	6
Redial and Stored Number functions are also available. See last page of document for setup instructions.....	6
Configuring the RADSL Channels	6
OPERATING P3/P1 WITH PC LAN INTERFACE	6
P3/P1 CONFIGURATIONS – SDSS MODEL	6
P3/P1 BANDWIDTH MANAGEMENT & PLANNING FOR REDUNDANCY	6
Table of Configuration Options.....	6
P3/P1 VoIP TELEPHONY, NETMEETING AND OTHER APPLICATIONS	6
Setting up VoIP	6
NetMeeting.....	6
Other Applications	6
Telephony Redial and Stored Number Functions – Handset Features.....	6
Dialling Mode Change – Tone to Pulse or Pulse to Tone	6
Permanent Tone Dialling Setting - Code	6

INTRODUCTION

The P3 and P1 products constitute a multi-functional stand-alone communications system for transmitting broadband voice and data over ordinary or steel reinforced (DON10) copper cables. Both products are used as an effective alternative to fibre-optic based comms systems. In addition, P3 provides integrated telephony, rechargeable battery and is contained in a weather-proofed, ruggedised carry box.

Current practice in tactical LAN deployment is the use of fibre optic cable – an expensive and fragile transmission medium, commonly damaged in the field. Copper wire is an old friend of the soldier in the field – robust, simple to rollout and to repair.

The design of the P3/P1 system was in response to ADF's need to address the problem of downed fibre optic networks. With features specific to army's needs and designed in collaboration with actual users, the result is a system which closely reflects current field requirements.

P1/P3 OVERVIEW

P3 (Portable 3 channel), is a self-contained unit which transmits voice and data over three Rate Adaptive DSL channels. Integrated battery supplies up to eight hours operation or it can be hooked up to alternative power supply such as mains, solar panel, generator, vehicle battery, etc. Two P3s can be linked via copper (DON10) to provide point to point transparent transmission or multiple P3s can be configured into a complex web of units.

All commands and configurations of P3 can be done via the integrated keypad and no additional equipment is required to setup. P3/P1 can also be managed remotely from a PC or laptop with LAN 10B/T interface (best for configuring several units at once) or via a serial RS232 interface.

P3 comes equipped with analogue field telephone which provides voice service between any connected units and will operate even if LAN networks are downed. Each P3 has its own IP address which enables a secure voice link (VoIP telephony).

P1 (portable x one channel) is a smaller unit used for simple point to point transmission (plug and forget) and requires mains power to operate. P3 and P1 are interoperable.

The technology behind both of the systems is *Rate Adaptive Digital Subscriber Line* (RADSL). Based on commercial off the shelf technology (COTS), it provides high speed (up to 8mbit/s) transmission over distances 3-7kms in any terrain.

DSL TRANSMISSION OVERVIEW

RADSL is a modem technology that transforms ordinary phone lines ("twisted copper pairs") into high-speed digital lines for fast Internet access. It provides speeds up to 8 Mb/sec downstream (to the user) and up to 1 Mb/sec upstream, adjusting its bandwidth rate, depending upon line length and its condition.



RADSL *Rate Adaptive DSL* is a version of ADSL whereby the modems test the line at start up and adapt their operating speed to the fastest speed the line can handle. This technology allows both P3 and P1 devices to dynamically (constantly) adjust the bandwidth rate depending on the condition of copper and any external noise that may affect it (i.e. length of cable, number of joints, stretching etc.) This ensures the systems' ability to function in any given condition.

P3/P1 RADSL channels can be configured as "master" (high transmission - >8Mbit/s) or "slave" (low transmission > 1Mbit/s) allowing flexibility of bandwidth allocation, depending on the task to be performed. For example, if large data files such as graphics need to be transmitted, the sender can set the channel to "master" – TX high. At the receiving end, the channel is set to "slave" – TX low. Bandwidth can be further increased by using two or three of the channels, boosting TX speed in increments of 8Mb/s up to 24Mb/s. Any channels not in use can be disabled to conserve power.

DMT MODULATION IN DSL TRANSMISSION

DMT stands for *Discrete Multi-Tone Transmission*. This modulation is becoming standard for DSL products within ADF. Simply put, it is a signal modulation technique in which incoming data is collected and then distributed over 250 small individual carriers (*multi-tone*). The result is its tolerance to noise is very high. When one or more of these small frequency carriers is affected by noise, it stops transmission. All the other carriers continue working and only a minor part of the bandwidth (about 64 Kbit/sec) is affected at any one time.

DMT can withstand operation in a noisy environment and adverse climatic conditions - continuing to operate even when subjected to the 'EW' (Electronic Warfare) type jamming frequencies.

This is an important feature with regard to secure transmission. In distributing data in this way, each data packet is effectively scrambled over 250 individual frequency carriers. As only the two devices that are connected (at either end of the copper line) will negotiate transmission parameters, no external devices would be able to "listen in" on the process of establishing the transmission parameters. Introduction of a "spying" P3 or P1 would result in error (i.e. no link will be established).

The more users there are connected to a P3 or a P1 link the higher the scrambling effect and the harder it is for a "spying" device to identify the true contents of any active frequency carrier. This process acts as an effective encryption measure.

P3/P1 APPLICATIONS OVERVIEW

P1 is a single channel modem for point to point transmission. There are two variants of the modems – P1-H meaning high speed out and P1-L, low speed out (Master/Slave). Both variants feature integrated bridge/router functionality. P1-H contains the main control functions for transmission and should be used with its opposite model, P1-L. Unless connected to a P3, these modems always work in pairs. They are lightweight, can be stacked on top of each other, or mounted on a wall via the fixing brackets.





P3 offers great diversity in the way it can be operated. As a stand alone device, it is particularly suited for applications in the field as no additional equipment is required to operate.

The robust casing - dust and moisture resistant and high tolerance components allow it to function in rugged terrain and extreme conditions.

With three RADSL channels, more than one channel can be connected at a time, providing automatic redundancy links should one cable become damaged.

P3 can be configured from a simple point to point transparent LAN link to a complex web of units. Used as data repeater, any number of units can be positioned, extending the physical reach of the P3 from in hops of 5km, indefinitely.

The main applications of the P3 system are:

- field deployed LAN networks, especially where no other data infrastructure exists
- general LAN network extensions or fibre optic backups
- telemetry applications
- rapid deployment of data networks for Defence, emergency services, mining or telemedicine.
- video surveillance and remote instrumentation control and monitoring

The integrated field telephone operates independently of data traffic providing backup voice service even if LAN networks are downed.

P1 CONNECTIONS AND HEALTH INDICATORS

These modems are powered directly from mains with AC power cable [voltage].

As with P3, P1s can be managed locally, or remotely from a PC or laptop with LAN 10B/T interface or via a serial RS232 interface. A handset can be plugged into the RJ11 socket to provide voice telephony. Optional voice splitter device can be used to separate the voice and data traffic.



On the left of front panel, copper cable is connected to the two spring loaded binding posts.

Six LED's indicate operating and interface status as in the following table. L - link and D - data. etc, etc



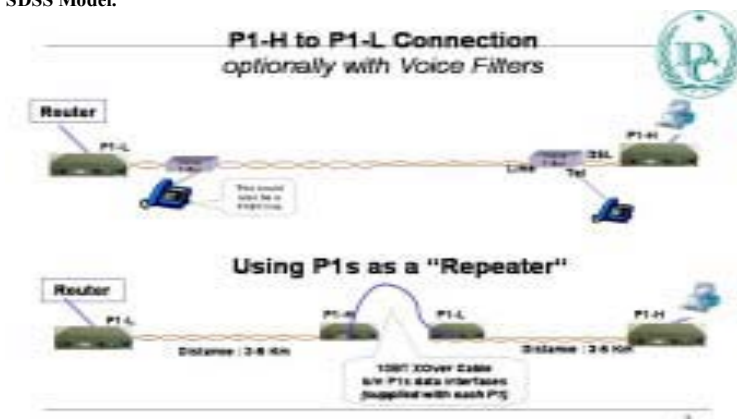
LED signalling (right to left on front panel)

Designation	Color	Status	Description
POWER	Green	On	Power supply available
		Off	Missing power supply
ALARM	Red	On	Internal system error
		Off	System operational
ETHERNET LINK	Green	On	LAN connectivity exists
		Off	No LAN connectivity
ETHERNET DATA	Yellow	On	Indication of sent or received Ethernet frames
RADSL LINK	Green	On	RADSL connection to remote site available
		Flashing	RADSL initialisation under progress
		Off	No RADSL connection to remote site
RADSL DATA	Yellow	On	Indication of sent or received data packets via the RADSL link

P1 TO P1 CONNECTIONS

Unless connected to a P3, these modems always work in pairs. P1-H is preconfigured for high transmission out (master - TX-High) and P1-L for low speed out (slave - Tx-Low). Establish a link between two P1s by connecting copper wire from each of the binding posts on each unit for a simple point to point connection. Multiple P1s can be connected in a repeater configuration as in the following diagram.

P1 is interoperable with P3 which is described in the following pages. See also **P3/P1 Configurations – SDSS Model**.





P3 OPERATION - CONNECTIONS AND HEALTH INDICATORS

Hardware

P3 is a stand alone device with three RADSL channels; integrated battery & power indicator; field telephone, VoIP facility, six LAN interface ports and additional three POTS telephone ports.

It is housed in a ruggedised casing and contains high tolerance components. Rubber edges on the casing enable operation with lid closed and tension relief for cables.*

Standard MilSpec DC power input allows it to be powered from alternative sources such as mains, generator, solar panel etc.

The lid is removable to allow for easy stackability and cables and other tools can be stored within the lid.

Three RADSL channels can each be configured for high (master- >8Mbit/s) and low (slave > 1Mbit/s) transmission.

* It is recommended that DON10 cables exit from the right hand edge of the box, and data, telephony and power through the lower edge.



Local Management and Telephony Features

All P3 units are now provided with Heads Up User Guide located on the inside of the lid.

As mentioned in the features overview session, all P3 commands can be carried out via the integrated touch keypad and configurations and status will be displayed on the LCD panel above.



Switch on P3 at ON/OFF button. P3 will take seven seconds to perform self-diagnostic and power up. Check LCD display. If LCD is faint, blank, or squared, use contrast buttons +/- on keypad top right/left.

Press **MENU** button. To browse menu, use ↑ or ↓; to select, use →; to go back, use ←; to confirm a selection, press **MENU**; return to main display keep pressing ←.

On LCD Display:

Text Line-1	shows LAN 10 or 100 Mbps and Battery Status
Text Line-2, 3 and 4	shows RADSL Configuration and Status
Text Line 5	[press ▼ to display] shows P3 IP address

RADSL lines will show “no link”. Before proceeding, check power. Battery lamp (**PS**) indicates as follows: Steady red lamp > 30% capacity (normal). Slow blinking red < 30% (needs recharge). Fast blinking red < 10% (must recharge within 5 min). Note: P3 will shut down when power is less than 5%.



When connected to an external power source, **PS** shows Orange (battery charging) and Green when battery is fully recharged.

Establishing a Link

Links over WD1T (DON10) synchronise when a transmission channel on one P3 is set to Tx-High (master) and Tx-Low (slave) on another (never the same setting). Connect copper wire to the binding posts of any one of the three RADSL channels on both devices.

For the purpose of the exercise, use analogue field telephone to convey instructions to “remote” P3.

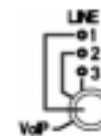
Telephony Modes - Analogue

Rotate channel switch to the corresponding RADSL channel (where copper is connected) and press **Ⓚ** (ring) button on keypad

On remote P3 a red light illuminates; operator rotates switch to the lit up channel (when selected, the handset rings also)

Detach handset and press green button to ‘off hook’ then speak (loudly as this is an un-amplified voice link).

(once link is established it is better to go to the VoIP telephony mode (amplified with a adjustable volume, bandwidth, etc)



Telephony Modes - VoIP

Allows connectivity to any P3 in the network and any other IP device (e.g. IP call from P3 to a Laptop with a NetMeeting application)

Rotary switch to **VoIP** position on all P3s

Handset off hook (green button); dial tone should be heard; dial full IP address (or “9”+ last 3 digits of the destination IP address) IP address is found on the 5th line of the menu.

By default a standard VoIP protocol and compression is used for compatibility; all VoIP parameters can be changed [**VoIP Submenu**]

Extending PABX Lines - Connect phone line to one of the ‘POTS’ sockets (1..3) – corresponds to RADSL channels. On remote P3 connect telephone into the corresponding POTS socket (1..3). If someone dials the line it can be answered at the remote P3 location (still works without DSL link between P3s. To extend further (Tel - P3 - P3...P3 - Tel) use cross-over jumper cables (e.g. from POTS1 to POTS2, etc.) P3 handset can also be used to answer the telephone by selecting the switch to the desired channel [1..3].

Redial and Stored Number functions are also available. See last page of document for setup instructions.

Configuring the RADSL Channels

Press **MENU** to commence management. Use arrows, select **RADSL Port #1..3 – Configuration – Mode – TX-High / Tx-Low / Disable – MENU** to confirm.

When channels are configured [**L** for Link] light begins flashing. When steady the link is synchronised. LCD shows established speed. **D** for Data light shows data packets being transmitted across the established link.

Set P3 (1) to master and P3 (2) as slave. Increase bandwidth by setting two or three channels on P3 (1) as master thereby achieving up to 24Mbit/s. Reverse the master/slave configurations and disable any channels not in use.

Note: Transmission over multiple channels makes for easy redundancy (i.e. if one cable is damaged, transmission continues over other cable)

OPERATING P3/P1 WITH PC LAN INTERFACE

It is more flexible to manage a number of P3s using PC with LAN 10B/T interface (best for configuring several P3/P1 at once) or via a serial RS232 interface.



Connect LAN cable from PC to any of P3 LAN plugs located bottom right. (LAN 2 – 6 are crossed over inside the hub. LAN1 is straight connection & may require a crossover cable.) Data and connection LED illuminates when correct connection is established.

- Open Telnet session or similar program on PC to establish comms to P3.
- type "o" to connect to P3s IP address. To find IP address, ↓ on keypad (5th text line on display)
- enter IP address including dots
- enter default user logon "user-p3"
- enter default user password "pw-p3"
- type "show" command (to show all menu options) and "set" to make configs, check status and transmit material. Open additional Telnet windows to manage several P3s.

Examples:

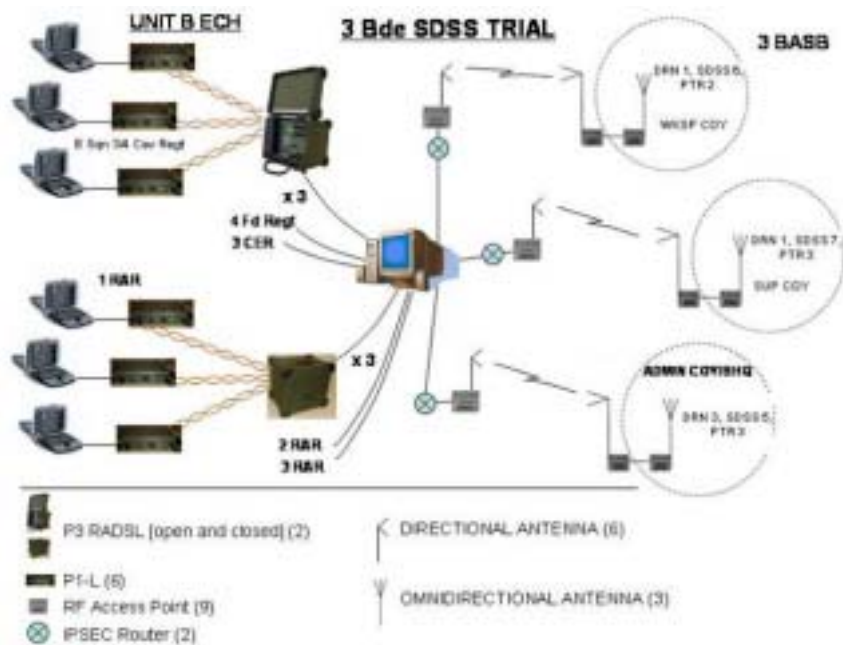
- to set RADSL 1 of P3 to "Master" use "set" / type "dsl 1" type "h" (set DSL1 channel to Tx-High). Disable one of the DSL channels (to save power) type "set" / type "dsl 2" / type "d"
- type "show power" to check battery status of remote units

Note: IP address can be changed using one of the corresponding menus. P3's IP address is required for VoIP telephony and management access

P3/P1 CONFIGURATIONS – SDSS MODEL

ADF's Standard Defence Supply System – the P3/P1 part – typically comprises nodes made up of one P3 and three P1-L units. On P3, all three channels are configured as master (Tx-high 8Mbit/s). Other P3/P1 configuration options are possible: the most flexible would be using all P3s that provide integrated voice and data, back up battery and various power sources for its operations.

Represented below is a 3 Bde SDSS Trial configuration (tested in April/May 1999).



P3/P1 – OTHER CONFIGURATION OPTIONS



P3/P1 BANDWIDTH MANAGEMENT & PLANNING FOR REDUNDANCY

Bandwidth management is the ability to configure independent transmission channels on P3 to either 'master' or 'slave'. The purpose is to increase data throughput from one P3 to another, or several P3s. The multiple channels on P3 allow for redundancy. In other words if two P3s are linked with two channels and one copper cable is broken, the second link seamlessly continues the traffic. This can be further optimised by using all three channels; interconnecting two P3s by diverse paths. If a large amount of bandwidth is required between P3s (for example, if several video cameras or sensors are connected to one unit, and that data is required to reach a remote unit, using multiple channels will achieve additional bandwidth. The following table will describe bandwidth management options. Note: each channel is capable of 8Mbit/s transmission in one direction and one Mbit/s in the other direction. By configuring each channel as either master or slave, the direction of the bandwidth can be altered to suit demand. The table below illustrates possible combinations.

Table of Configuration Options

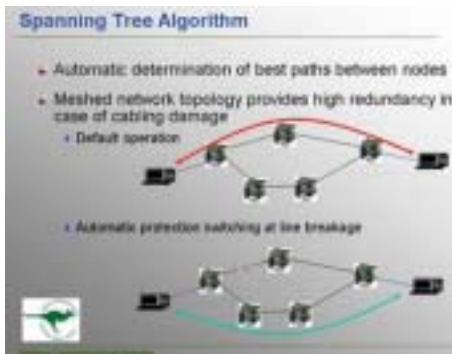
	Local P3	Effective Bandwidth	Remote P3
Option 1	Channel 1 – disabled Channel 2 – disabled Channel 3 – disabled	no bandwidth	Channel 1 – Channel 2 – Channel 3 –
Option 2	Channel 1 – master Channel 2 – disabled Channel 3 – disabled	→ 8Mbit/s ← 1 Mbit/s	Channel 1 – slave Channel 2 – Channel 3 –
Option 3	Channel 1 – master Channel 2 – master Channel 3 – disabled	→ 8Mbit/s ← 1 Mbit/s → 8Mbit/s ← 1 Mbit/s Effective Bandwidth 16Mbit/s → 2Mbit/s ←	Channel 1 – slave Channel 2 – slave Channel 3 –
Option 4	Channel 1 – master Channel 2 – master Channel 3 – master	→ 8Mbit/s ← 1 Mbit/s → 8Mbit/s ← 1 Mbit/s → 8Mbit/s ← 1 Mbit/s Effective Bandwidth 24Mbit/s → 3Mbit/s ←	Channel 1 – slave Channel 2 – slave Channel 3 – slave



In addition, the devices feature **Spanning Tree** algorithm which helps to eliminate network congestion by determining the most direct TX path in a multiple

P3 connection. This feature is particularly useful when P3s are connected in 'ring' as indicated in the illustration (i.e. Spanning Tree algorithm prevents data packets from endlessly looping in such a ring).

By connecting more than one channel, automatic redundancy links achieved in the event of cable breakage.



P3/P1 VoIP TELEPHONY, NETMEETING AND OTHER APPLICATIONS

Setting up VoIP

The VoIP optional feature is code protected. DCI provides the enabling code on request. The enabling code is unique to each P3 unit. Use PC via RS232 or Telnet to enable the VoIP feature. Enter the command "set voip". You are then asked to enter the code, and "e" to enable. Once entered the code will be permanently stored.

You need to know the IP address of the P3 unit(s) you wish to call. The 12 digit IP address is found on the 5th text line of the menu on the P3. With rotary switch set to "VoIP" on all units, you can call any P3 within the group or node by dialling either the full 12 digits – **Long Dialling Format** or by dialling 9 + last three digits of the IP address – **Short Dialling Format**.

P3 IP and VoIP Setting Interaction	
1. Network Setting - IP settings- IP Address (IPA)	That's the general Network node address of a P3 unit. It is used for all IP based applications (i.e. Voice over IP telephone function, Telnet management, ping ...)
2. Network Setting - IP- settings- Subnet Mask (SNM)	Indicates the network address part (set bits) and the node part (cleared bits) of IP addresses: By default 255.255.255.0 means that the first three octets must be interpreted as network address and the forth octet must be interpreted as node address
3. Network Setting - IP- settings - Default Gateway (DGW)	This setting is only required if a P3 needs to reach a node from a different subnetwork (i.e. network addresses of P3 and the destined node differ). In this case all such packets will be sent to a default gateway - if you configure it using this parameter. The network addresses of DGW and IPA must be equal.
4. Voice over IP - Configuration - Dialing Plan - Base Address (BAD)	This field is used for specifying a prefix for short dialling mode. If you chose short dialling mode by entering "9" as the preceding number P3 automatically dials this prefix and the user only needs to type the remaining numbers
5. Voice over IP - Configuration - Dialing Plan - Address mask (ADM)	This parameter specifies the length of the prefix (set bits). By default the first three octets are marked as prefix. In this case the prefix value corresponds with the network address as configured under network settings. Under these conditions it is possible to reach every node in the local network by using the prefix and adding in the remaining three digits. For example to call station 192.198.1.5 you must call the short dialling number 9005. Note the right number of 0s (zeros).
6. General Tip	Selecting the menu "Voice over IP – Statistic" before you start to dial, allows verification of the actually numbers dialed

NetMeeting

Windows based PC software "NetMeeting" enables applications such as teleconferencing, transfer of graphics and files, and VoIP calls.












With NetMeeting enabled, calls can be made from P3 using VoIP, to a computer by dialling that computers IP address. From computer to P3, enter the IP address of P3 and use the internal speaker and microphone of the computer for speech.

Other Applications


Using off the shelf software packages P3s can be tailored for use in a variety of applications:

- Tunnels and Underground Communications
- Oil and gas pipelines
- Weather and telemetry applications
- Disaster recovery applications
- Deployable communications for civil defence


Telephony Redial and Stored Number Functions – Handset Features

<p>Store Numbers: Off-hook handset wait for dial tone</p> <p>PRESS </p> <p>PRESS </p> <p>Enter a memory number (0..9) Enter number to be stored</p> <p>PRESS </p> <p>Dial a Stored Number Off-hook handset wait for dial tone</p> <p>PRESS </p> <p>Enter memory number</p> <p>Redial PRESS  Last number dialled is activated</p> <p>Delete Stored Numbers Off-hook wait for dial tone PRESS  Press "1" key Dial "1590" PRESS  Dial "251" PRESS </p>	
--	--

Dialling Mode Change – Tone to Pulse or Pulse to Tone

In case of the P3 handset operating in a Pulse Code Dialling mode (due to an accidental switchover) the following procedure will change the dialling mode back to Tone dialling: 

Permanent Tone Dialling Mode – Set Code

Use this sequence to set dialling mode to Tone: 



Latest product applications notes and documentation can be uploaded from the DCI's website: www.defence-comms.org

Other points of contact are:

email support@defence-comms.org

Tel. (03) 9850 6110

Fax (03) 9850 6113

Defence Communications Industry is a small Melbourne based company. Our mission is to provide the best specialised communications products for Australian Defence Forces. P3 and P1 were developed in close collaboration with various RASigC units and as a result closely meet actual user requirements.

In cooperation with CISSO, DCI provides annual product refresher training and tailored technical support.

The company always welcomes comments from the field and will always take them into consideration for future product developments.
