Simpeater

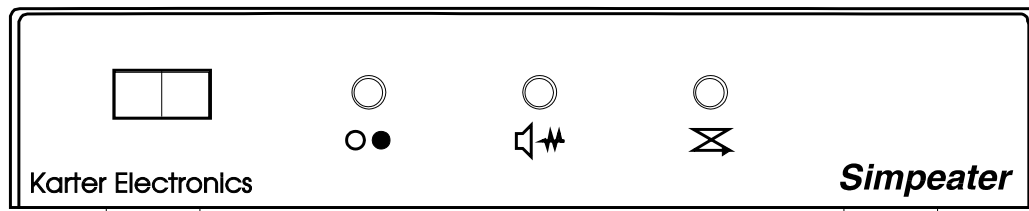## Simplex Repeater Adapter

Installation and Service Manual

Karter Electronics

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Release Record

Manual Issue	Software Version	PCB Version	Description	Date
1	1.0	2	First Production Issue	10/4/96
2	1.0	2	PCB layout modified as per AGC error	1/5/96
3	1.0	2	Application notes modified M110/GM300	20/5/96
4	1.0	2	Parts list Amended	1/6/96
5	1.0	2	GM350 Application Note added	11/9/96
6	1.0	3	CHANGES TO PCB ISSUE 3	11/11/96
7	1.0	3	General Changes to manual address etc	1/4/97
8	1.0	3	Part List amendments/changes	⅓/98
9	1.0	3	Maxon Application notes added	3/9/98
10	1.0	3	App note 3 amended, part list correction, app note 10 added (Alinco DR130)	1/2/99
11	1.0	3	Specification amended	30/1/03

1. General Description

The Simpeater is a cost effective method of extending radio range using a single frequency. It does this by recording speech and signalling and then replaying it. This increases range but also doubles the conversation length.
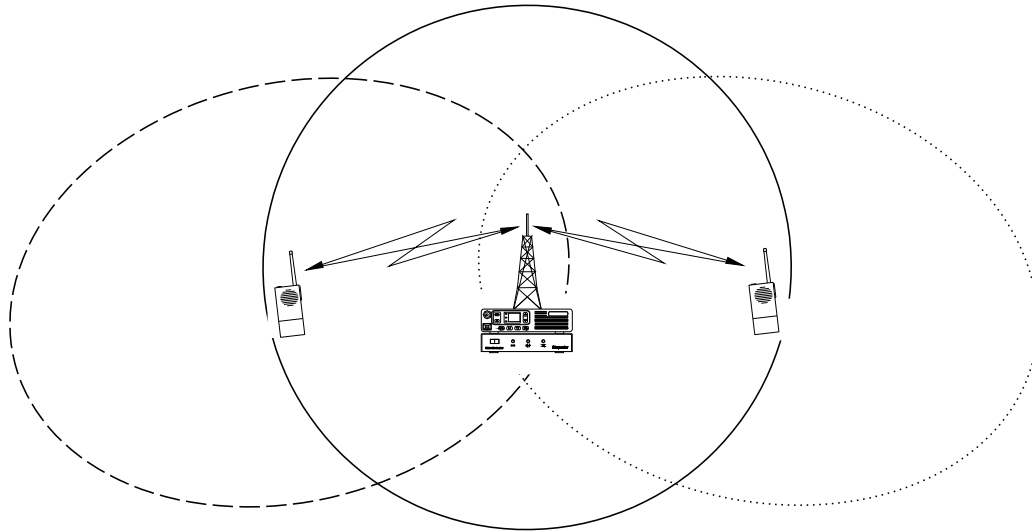
A typical base station arrangement is shown above. This installation uses the Simpeater connected to the base station radio. It allows the two portable radios to communicate indirectly using the base station. If the base station is also to be used then the Simpeater can be simply switched off. Now the base station will operate in the usual fashion.
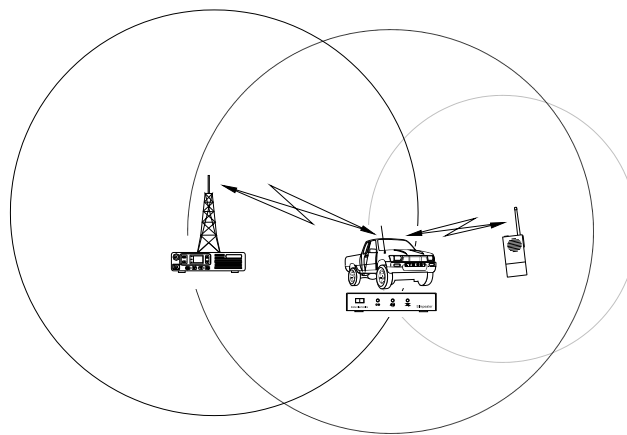
Other situations require the Simpeater to be used in a mobile environment. The illustration above shows how a Simpeater can be used to allow a hand portable user to communicate with base via a mobile radio over a far greater distance than would otherwise be possible. A typical situation would be when in a poor coverage area a mobile could be placed in a optimum position, e.g. the top of a convenient hill, then the users can stay in contact with the base station perhaps working up to several kilometres from the mobile repeater.

The Simpeater has be manufactured to a high standard using solid state recording technology coupled with a micro controller. It has been designed for simple installation and maintenance making this product a leader in its class.

2. Specifications

Electrical

Voice storage	Non volatile memory cells, Standard 60 Seconds storage time.
Microprocessor Clock Speed	4Mhz
Supply Voltage	Better than 8 to 18 Volts DC
Supply Current	<10mA Standby
	<45mA Recording
	<110mA Playback
Receive Level	10mV to 8V Peak to Peak
Transmit Level	10mV to 2V Peak to Peak
Carrier Detector	
Active State	Positive or Negative
Level Change	Less than 100mV
Hold Period	Link Selectable - 0.25, 0.5, 1 and 1.5 seconds
Transmitter lead in delay	150mS
Distortion	< 2.5%
Frequency Error	< 0.5% per message
	< 2.5% across full temperature range

	+/-3dB	+/- 1.5dB
Frequency Range		
60 seconds	Better than 300Hz to 3.6 KHz	300Hz to 2.8Khz
90 seconds	Better than 300Hz to 2.3 KHz	300Hz to 1.8KHz
Signal to Noise	Better than 45dB	
Low pass filter	Better than 6dB per octave	
Temperature Range	-10˚C to +60˚C	
Record Cycles	Better than 100,000	

Physical

Construction	Two part steel case with internal PCB mounted on pillars
Dimensions	220mm x 178mm x 33mm
Front Panel	Power On Off switch
	Power - Green
	Carrier - Yellow LED
	Transmit - Red LED
Connections	14 way screw terminal plug and socket
TX Level	Level jumper and potentiometer
RX Level	Level jumper and potentiometer
Carrier	Phase jumper and threshold potentiometer
AGC	Jumper Selectable ON or OFF
Carrier Hold	Four jumper Selectable settings
Fittings	4 small adhesive feet are provided for desktop operation

Options

90 second record duration
U bracket for mobile mounting of Simpeater
A range of radio specific connection leads
Please consult your price list for option details

All test measurements have been taken from production samples and reflect a true specification for the product.

3. SOFTWARE AND GUARANTEE STATEMENT

Each Simpeater comes with a license to operate the software contained in its one time programmable micro controller. The software ownership is not transferred from Karter Electronics with the purchase of the equipment. Copying or modifying any part of the operating code is strictly prohibited.

The product is warranted for a period of one year from the date of shipping. This does not cover any costs incurred returning the product to Karter Electronics.
Karter Electronics will return the product at their expense using their preferred carriers or agents.
If a problem is suspected then the technical support department should be contacted in the first instance. If it is necessary to return a product for service then a returns number must be sought and all correspondence should carry this reference number. Returned product for which a returns number has not been issued may incur costs and a time delay in repair or replacement of the product.

If the product has been modified changed or altered in any way without written agreement then Karter Electronics reserve the right to refuse maintenance or make a charge appropriate with any extra work that the alteration has caused. If the product has been damaged by external forces or reasonable care has not been afforded to the product then a charge may be made in order to return the product to a usable state.

If the product is outside of its warranty period Karter Electronics will advise the cost of any work that may be required this would usually not include any handling, shipping or local tax (VAT) charges.

Karter Electronic's liability is limited to the purchase price of the Simpeater. Under no circumstances shall Karter Electronics, its employees, agents or representatives be liable for any incidental or consequential damages, nor for any damages in excess of the original purchase price of the Simpeater.

This manual describes the state of this product at the time of its publication, and may not reflect the product at all times in the future.

4. Applications

The Simpeater can be used in numerous ways, just some of which are detailed below.

Simplex Base Station

This installation is with a mobile radio which is used as a base station. It would usually be enabled when the operator was not available or wished to allow users to communicate with each other through the base station. This can be especially useful if the radio fleet are portable radios and the base has a well located antenna.

Operation is very simple as the Simpeater has been designed not to impair its host radio's normal operation when switched off or disabled. Using the front panel switch the unit can be controlled separately from the radio and when enabled its LED's will indicate the current operational status. If the disable input is used than the power and Carrier LED's will operate in the usual way but the Simpeater will remained inert.
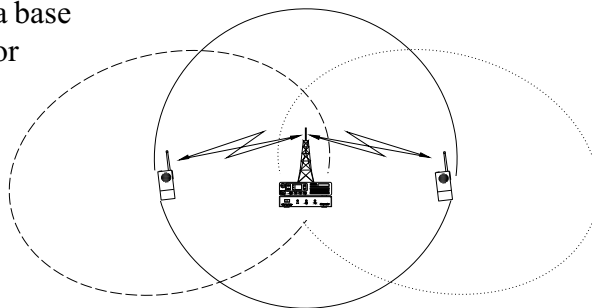
Mobile Operation

The concept is to use the Simpeater to pass calls from the mobile to another radio which would usually be a hand held radio. The typical scenario would be for use in forestry where a user would be alone for much of the working day and sufficiently far from base that hand portable coverage would not be possible. The Simpeater is fitted to a vehicle and the vehicle is positioned so as to be in coverage of the base station. Now the worker is within coverage of the radio system, daily work will be much safer with help just a call away.

Radio Coverage

A radio survey is often required for new system and confirming existing ones are performing as expected. This usually takes two people; one sitting in the base station while the coverage is confirmed by the other driving or walking through the required coverage area. The Simpeater can remove the need to have the base station occupied. It also allows the caller to hear each transmission replayed. This will also identify any unidirectional path problems which could be over looked in a conventional test. This test also increases the degradation of the signal as both path losses are perceived by the tester. Then when the system is commissioned it will be found to work slightly better than on the survey.
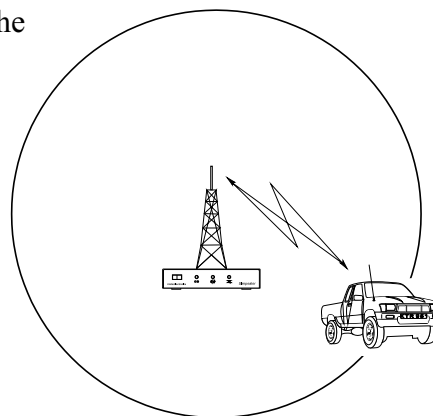
Community Repeaters

Many countries allow duplex radio repeaters which are shared by a number of different users groups. Connecting the Simpeater at the hill to site in such a way that it can be selected from a test radio will allow sales and service staff to demonstrate and test the operation of the system. In such systems it would be usual to use PL or Selcall code used in order to activate the system this can then be used to enable the Simpeater by use of its *enable* input.

If radio coverage tests are carried out on a regular basis then the purchase cost of the Simpeater will be recovered in a very short time.

How Not to Use a Simpeater

The Simpeater operates by identifying a valid carrier and then recording the in coming radio signal and then replaying it. If two Simpeater's are operating on the same frequency then it would be possible for one unit to receive a transmission and pass it on to another Simpeater which would then record the message back to the first unit which would record that message and so on.

If more than one Simpeater is to be used on a single frequency then care must be taken to prevent the scenario detailed above which would eventually end in noise being transmitted as the voice message slowly degraded with each transmission.
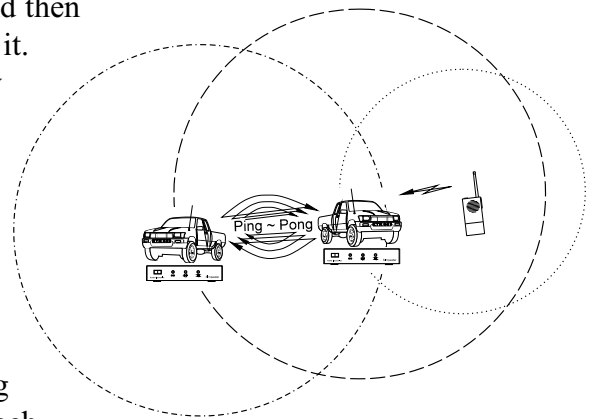
One solution can be to use different PL tone for each user, assuming that the Simpeater is with a mobile operator. The base station would then be arranged to scan through a number of channels each set on the same RF frequency but with a different PL tone. Thus allowing a number of Simpeater's to be used simultaneously.

5. Installation

The following installation instructions are generic, that is not specific to a particular make or model of radio. For specific instructions please refer to section 6 which lists all the currently available application notes.

The Simpeater operates on 8 to 18 Volts DC and draws less than 200mA, less than 10mA on standby. Therefore it is best if the supply is taken from a point after the mobile radio's on/off switch. Many radios have an accessory/auxiliary connector with a low current supply for this purpose.

To ensure a good ground connection this should be placed in parallel with the main feed inside the radio or to a predefined pin, if the radio has an accessory / auxiliary connector.
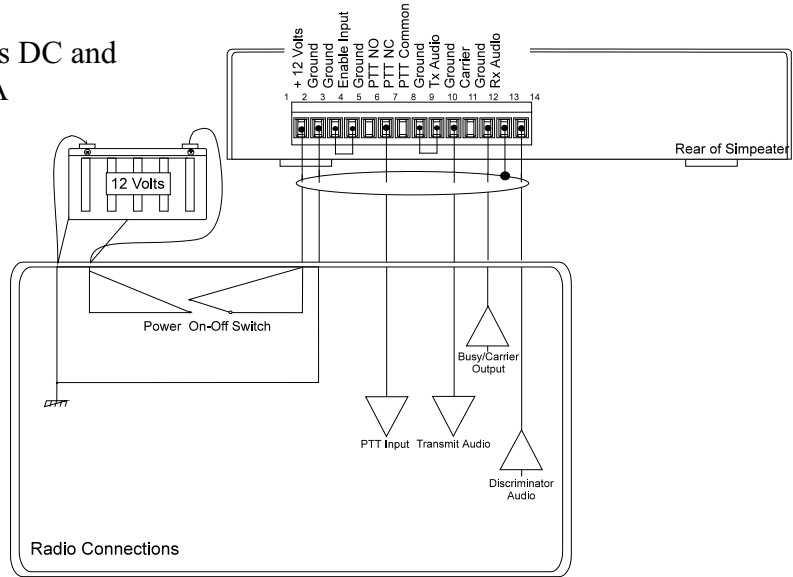
Carrier Indication

As the Simpeater needs to know when the radio is receiving a valid carrier it is imperative that this is correctly set up. A *Valid* carrier refers to the RF carrier validated by CTCSS or selective call, if fitted. As a guide, the only carrier indication sent to the Simpeater should be that which enables the radio's speaker.

In order to set the carrier activity it is advisable to disable Simpeater operation. To achieve this connect a wire from pin 4 to +12 Volts.

When carrier pick up point has been identified in the radio, connect this to pin 12 of P1 on the Simpeater. The phase of the signal is also important, if this output gives a positive voltage when carrier is present then set JP3,JP4 as shown in the left hand drawing below, if this output gives a negative voltage when carrier is present then set JP3,JP4 as shown in the right hand drawing below.
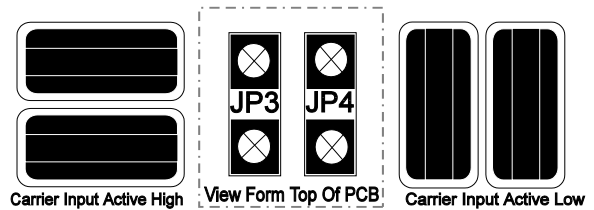
✎   If the carrier LED works in reverse i.e. it is off when carrier is present and is on with no carrier then simply remove JP3 and JP4 rotate them through 90° and then refit them both.

With a valid carrier signal present if the yellow carrier LED on the front of the Simpeater is not illuminated then adjust R24 (COR Level) until is lights. Now remove the carrier and ensure the yellow LED extinguishes if it does not then adjust R24 until it does, now apply carrier and repeat. By applying and removing the carrier a mid point adjustment for R24 should be found. In some cases this may require careful adjustment if the radio only gives a small DC output between the carrier on and off states, in most cases it will be a large variation and a mid point setting for R24 is all that is needed.

Receive Audio

If the radio has an auxiliary connector then identify a receive audio path which is not effected by the radio's volume control. It is possible that this audio will be before the squelch control and as such may have noise present when a RF carrier is not present. The level can be from a few millivolts to several Volts peak to peak. The input circuit has a potentiometer, R5 (RX Level), and a jumper, JP2 which are used to set the correct level.

Connect an oscilloscope to TP1 and apply an input RF signal to the radio with 60% of maximum system deviation at a frequency of 1KHz. Now adjust R5 for 2V peak to peak, if AGC is disabled, or 1V Peak to Peak if AGC is enabled. If this adjustment is difficult or the adjustment is at one end of its travel then either remove or insert JP2 to allow a correct setting.

✎ Insert JP2 for an input above 500mVolts P/P.

Response Filter

As receiver audio may not be flat across the audio spectrum then it is necessary check this. Set the signal generator for a frequency 600Hz and then 1.8Khz and ensure that the deviation is within 3dB of that for 1Khz. If this is not the case then fit a link in JP6 pin 1 to 2 or 2 to 3. It will be necessary to test for best response by testing each jumper setting at all three frequencies.

✎ When fitting JP6 reset TP1 for the appropriate peak to peak voltage (2V AGC disabled, 1V AGC enabled) at 1Khz.

Push To Talk (PTT)

The Simpeater uses a relay for this allowing maximum versatility. Three connections are presented to P1 as shown below.
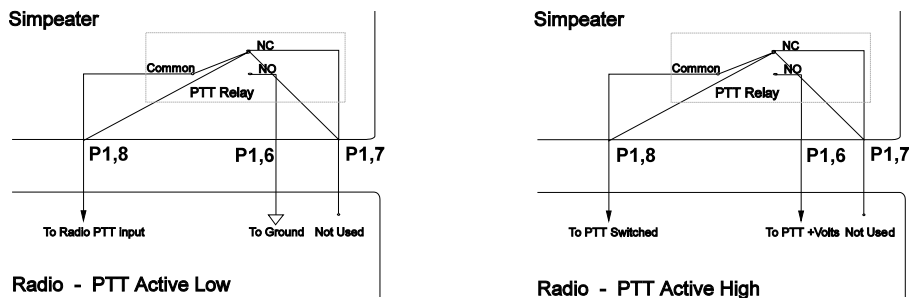
Most radios use a active low to enable transmit. This is easily achieved by connecting P1, Pin 8 (Relay Common) to Pin 9 (Ground) and then connecting the radios PTT to Pin 6 on P1.

Automatic Gain Control (AGC)

The Simpeater will faithfully reproduce the deviation or modulation of an incoming signal. Under most circumstances this is acceptable but if users are of different audio levels then communication can be impaired. Many duplex radio base stations offer some AGC and so does the Simpeater. AGC is designed to even out the variations in the level of the incoming audio. It does this by varying the gain of an amplifier in response to the level of incoming signal. When AGC is enabled it will increase the noise floor as the gain of the input amplifier is increased to maximum. If the Simpeater is to be used exclusively for paging or 5 tone signalling then AGC should be disabled.

✎	When AGC is enabled it will cause the noise floor to increase in level. This will only be noticeable then silence or very quiet transmissions are recorded. This effect will not usually be perceived users.
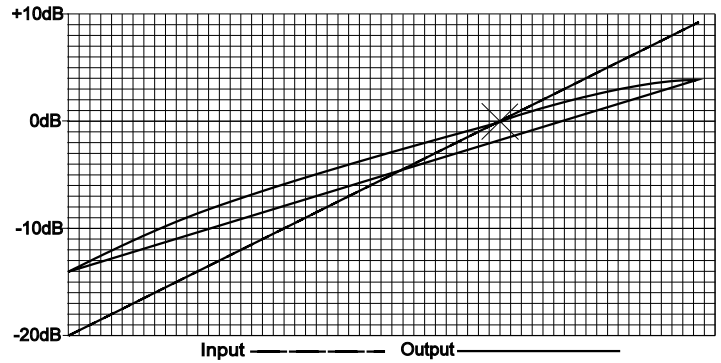
Transmit Audio

If the link from Pin 4 to +12 Volts is fitted, then this must be removed to enable the Simpeater to operate normally.

Identify a point in the radio which flat audio can be presented, this could be in parallel with the microphone. Connect this point to pin 10 of P1. Apply a modulated carrier to the radio as in the receive level alignment and leave for 30 seconds. The Simpeater is now recording this audio and when the carrier is removed the radio will go to transmit. Now set the transmit deviation for 60% of peak system deviation by adjusting R23(TX Level). If this potentiometer is at one end of its travel then it may be necessary to install or remove JP1.

If you have connected directly across the microphone then the low impedance of the Simpeater transmit audio should swamp any audio that may be picked up from the standard radio microphone. This can be tested by speaking into the microphone, without pressing the PTT button, when the Simpeater is replaying silence. If speech is heard then the microphone should be modified to prevent this.

| Microphone A | Microphone B | Microphone C | Microphone D |
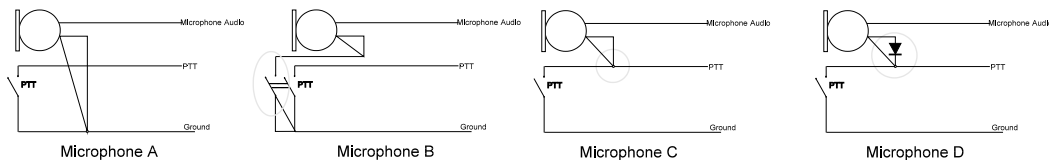
If your microphone is wired as microphone *A*, above, then if a spare pole is available on the PTT switch this can be utilized. If this is not available then the circuit can be modified as in *microphone 'C'* or *'D'. Microphone 'D'* is certain to function as expected where *Microphone 'C'* may not if the microphone can find a ground through the radios PTT input circuit.

✎	Transmit audio must be set after AGC has been selected as the AGC action may effect the level of output signal from the Simpeater.
✎	The output level is low with JP1 installed.

Enable Input

The Simpeater has an Enable input. By using this input the Simpeater to be enabled or disabled remotely. The input is used by the Simpeater to validate the start of carrier activity and is only checked once during each record playback session. As default this pin is low which enables the Simpeater's operation.

It is not strictly necessary to connect this pin but it is recommended as any RF pick up could possibly cause erratic Simpeater operation. If this pin is taken to logic 1 (3 volts or more) then the Simpeater will still indicate Carrier activity but will remain inert.

The Simpeater should now be fully functional and should be tested for reliable operation. All leads

should be kept as short as possible. The lead from radio to the Simpeater should be screened with the screen connected at the Simpeater end only. It is advisable to test operation using a hand held radio in close proximity to the Simpeater just to ensure that RF does not effect the installation.
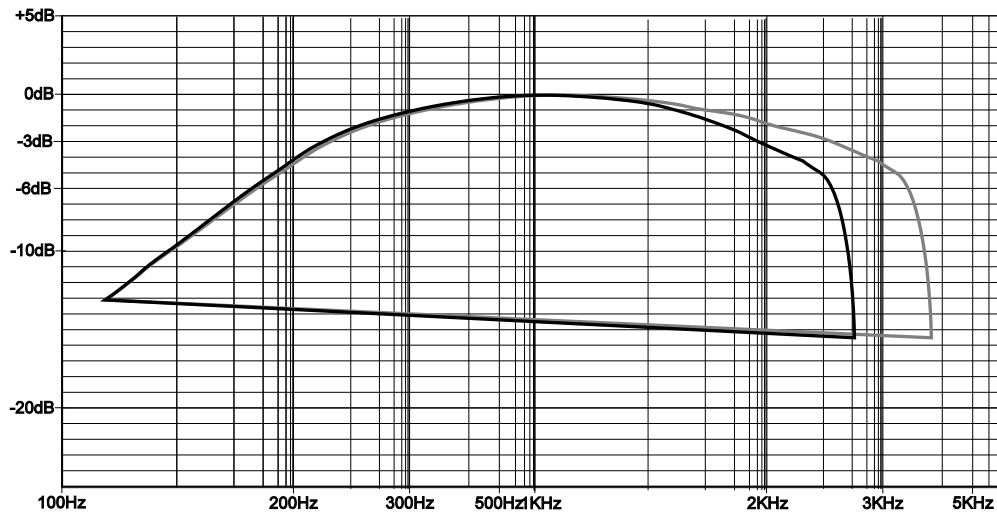
Simpeater frequency response

Generic Radio Connections

Radio

+ 12 Volts
Ground

PTT

Transmit Audio

Carrier Input
Cable Screen
Receive Audio

Link

Link

Simpeater P1

1 + 12 Volts
2 Ground
3 Ground
4 Enable Input
5 Ground
6 PTT ~ Normally Open
7 PTT ~ Normally Closed
8 PTT ~ Common
9 Ground
10 Transmit Audio
11 Ground
12 Carrier Input
13 Ground
14 Receive Audio

Generic Radio Connections

168.225000

Set Frequency   Set RF Level   Output

RF Signal Generator

Input

Modulation Meter

Channel A

Channel B

Oscilloscope

Volts   Amps

12Volt Power Supply

To TP1

Karter Electronics   Simpeater

General *Simpeater* Test Setup

6. Radio Specific Installation Notes

The following pages show the various application notes available at the time of the last manual update. If the radio model you are about to install is not covered here then please contact Karter Electronics as it may now be available.

If during your use of one of our application notes you find an inaccuracy or would like to comment on any aspect of the note, then please contact Karter Electronics with details. The following notes are offered in good faith and are believed to be correct, however, as radio's are constantly being improved it is possible that a note may no longer function as expected so please ensure that the operation of your Simpeater and radio are fully checked.

Application Note No	Issue	Radio Manufacturer	Model(s) Covered
1	1	Motorola	M110
2	1	Motorola	M120
3	1	Motorola	GM300
4	2	Motorola	GM900
5	1	Tait	T500
6	1	Tait	T2000 Series
7	1	Motorola	GM350
8	1	Maxon	SM4150
9	1	Maxon	SM2150
10	1	Alinco	DR130

Simpeater, Application Note No 1

The information below is specific for the Motorola M110. The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

Pin	Signal
1	12 Volts DC
2	Ground
3	Ground
4	Enable Input
5	Ground
6	PTT Normally Open
7	PTT Normally Closed
8	PTT Common
9	Ground
10	Tx Audio Output
11	Ground
12	Carrier Input
13	Ground
14	Rx Audio Input

12 Volts
Ground

Radio: 2, 1, 4, 5, 6, 3, 7

Rx Low Output — JP2
Carrier Active High — JP3 / JP4
JP6
Tx Low Output — JP1
Carrier Hold 500ms — JP7 / JP8
AGC OFF — JP5

⊠⊠ Link Not Fitted
■■ Link Fitted

Rear of M110 Plug

5 4 3 2 1
6 7 8 9
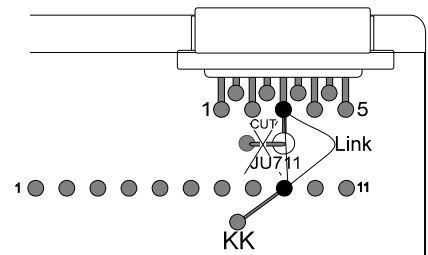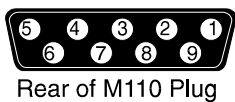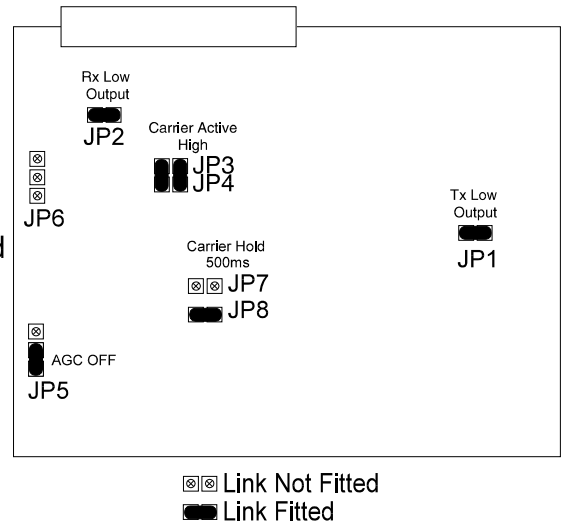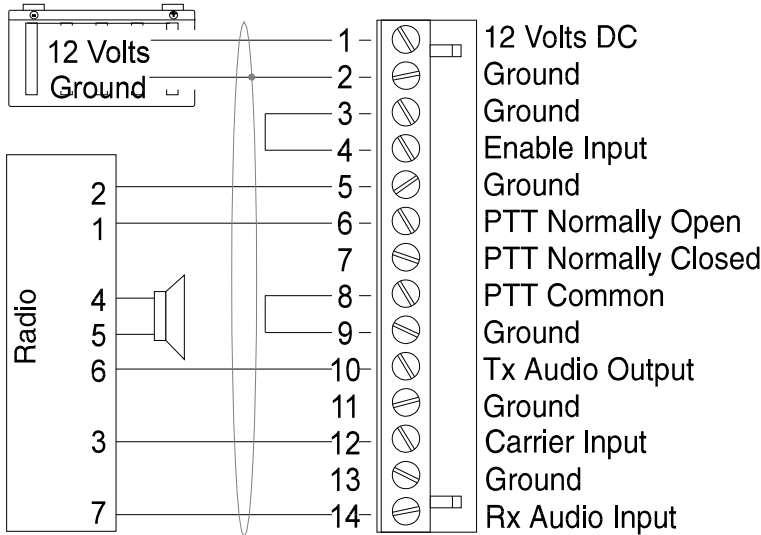
When installing the M110 it is necessary to ensure that the carrier indication is available at the rear connector, Pin 3. If this is not the case then implement the modification as detailed opposite - Link Pin 3 to 'KK' and cut JU711.

View of M110 Aux Socket

1 ... 5
CUT — Link
JU711
KK
1 ... 11

The M110 does not have power available at its auxiliary connector. This does not present a problem as power can be provided directly to the Simpeater from the same supply which feeds the radio. This will result in the Simpeater having to be switched off independently from the radio.

If this operation is unacceptable then the Auxiliary connector could be modified in such a way that switched 12Volts was available at one of its pins, and that pin then used to supply the Simpeater. If this is undertaken care should be taken when choosing a pin to prevent damage to other equipment which could be connected to this point at a future date.

When using the connections as shown the receive audio may not be validated by CTCSS, in this case as the M110 presents unsqualched audio to the Simpeater the *Carrier Hold Time* should be set for minimum by removing JP7 and JP8.

Simpeater, Application Note No 2

The information below is specific for the Motorola M120.
The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

Radio		Pin		Signal
10	—	1	⊘	12 Volts DC
7	—	2	⊘	Ground
		3	⊘	Ground
		4	⊘	Enable Input
		5	⊘	Ground
3	—	6	⊘	PTT Normally Open
		7	⊘	PTT Normally Closed
		8	⊘	PTT Common
		9	⊘	Ground
2	—	10	⊘	Tx Audio Output
		11	⊘	Ground
1	—	12	⊘	Carrier Input
		13	⊘	Ground
15	—	14	⊘	Rx Audio Input

15	13	11	9	7	5	3	1
16	14	12	10	8	6	4	2

Rear of M120 Plug

14   1

Rx Low Output
JP2

Carrier Active High
JP3
JP4

JP6

Tx Low Output
JP1

Carrier Hold 500ms
JP7
JP8

AGC ON
JP5

⊠⊠ Link Not Fitted
▬ Link Fitted

Simpeater, Application Note No 3

Motorola GM300

The information below is specific for the Motorola GM300. The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

Radio		Simpeater	
13	1		12 Volts DC
7	2		Ground
	3		Ground
	4		Enable Input
9	5		Ground
3	6		PTT Normally Open
	7		PTT Normally Closed
16	8		PTT Common
15	9		Ground
5	10		Tx Audio Output
14	11		Ground
8	12		Carrier Input
	13		Ground
11	14		Rx Audio Input

Rear of GM300 Plug

15	13	11	9	7	5	3	1
16	14	12	10	8	6	4	2

Rx Low Output — JP2
Carrier Active High — JP3 / JP4
JP6
Carrier Hold 500ms — JP7
JP8
Tx Low Output — JP1
AGC OFF — JP5

⊠⊠ Link Not Fitted
▬▬ Link Fitted

Pin 14 from the GM300 connector is not terminated, this lead reflects the squelch output of the radio. It is usual to use carrier which is validated by CTCSS. This is present on pin 14, if required this lead can be removed and radio Pin 8 connected to the Simpeater carrier input Pin 12.

The link from Pin 15 to 16 on the radio is to enable the radio's internal loud speaker.
Pin 9 in the GM300 16 channel ONLY connector can be configured as an alarm input and should normally be connected to Ground if so configured.
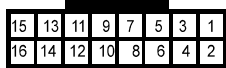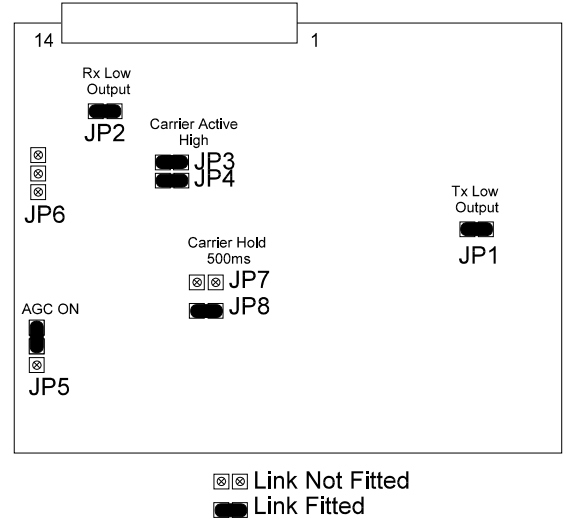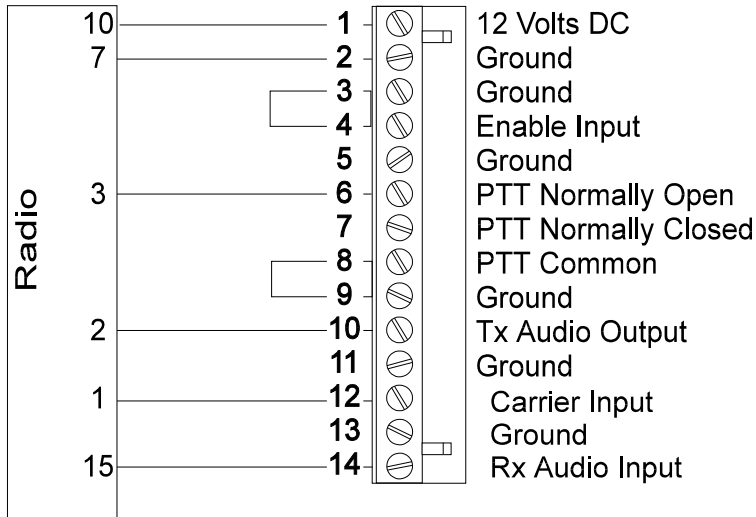
Simpeater, Application Note No 4

Motorola GM900

The information below is specific for the Motorola GM900.
The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

Radio		
14	1	12 Volts DC
4	2	Ground
	3	Ground
	4	Enable Input
10	5	Ground
21	6	PTT Normally Open
	7	PTT Normally Closed
	8	PTT Common
	9	Ground
13	10	Tx Audio Output
	11	Ground
3	12	Carrier Input
	13	Ground
11	14	Rx Audio Input

Rx Low Output — JP2
Carrier Active High — JP3 / JP4
JP6
Carrier Hold 500ms — JP7 / JP8
Tx Low Output — JP1
AGC ON — JP5

Link Not Fitted
Link Fitted
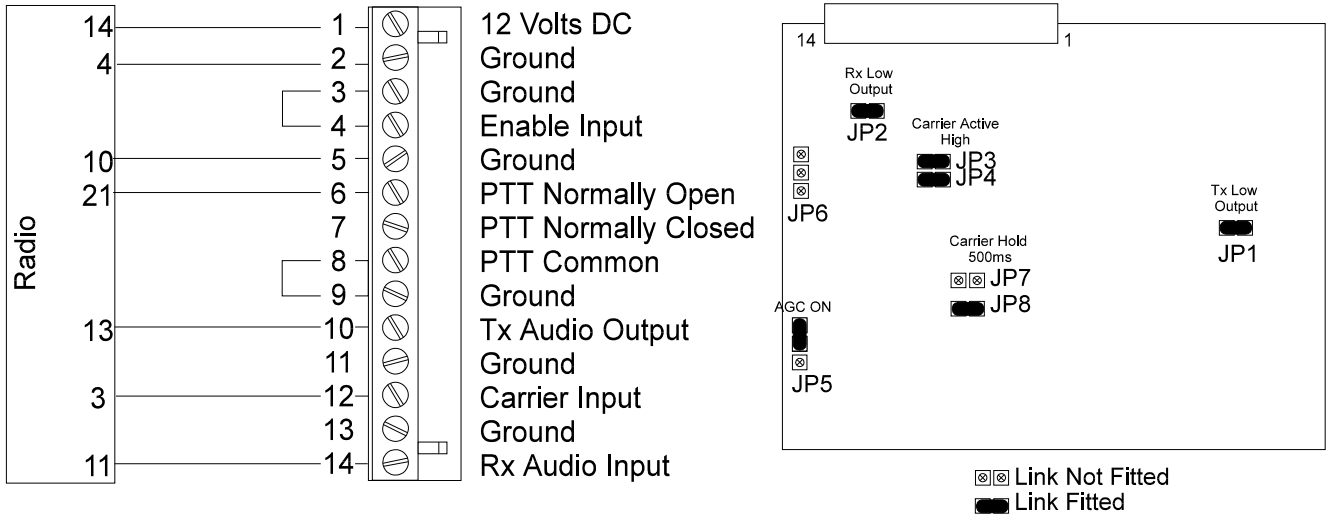
When programming the GM900 it will be necessary to select Data Mode to enable the audio input from the auxiliary connector. The speaker LED must be illuminated before audio will be passed to the Simpeater by the GM300, this can be programmed on as default or enabled manually.

Simpeater, Application Note No 5

The information below is specific for the Tait T500.
The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.
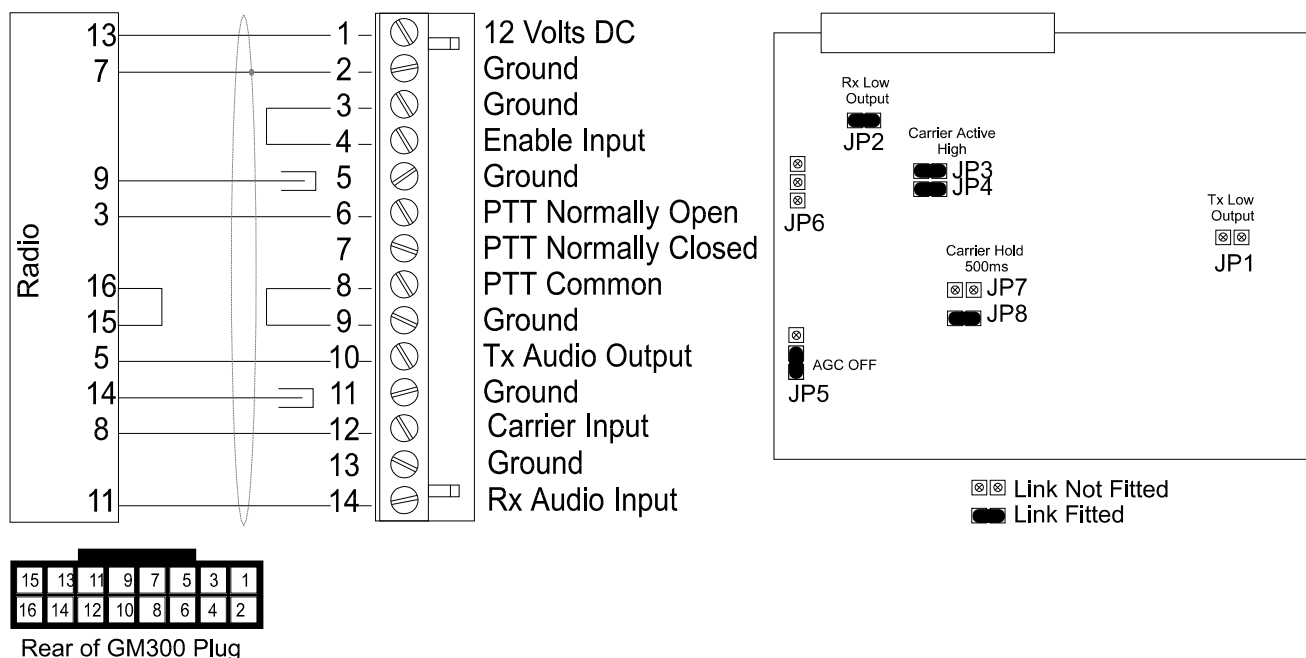
Radio		Pin		
+12 Volts		1		12 Volts DC
Ground		2		Ground
		3		Ground
		4		Enable Input
		5		Ground
PL5,4		6		PTT Normally Open
		7		PTT Normally Closed
		8		PTT Common
		9		Ground
PL5,3		10		Tx Audio Output
		11		Ground
PL1,4		12		Carrier Input
		13		Ground
PL1,5		14		Rx Audio Input

14   1

Rx Low
Output
JP2

Carrier Active
High
JP3
JP4

JP6

Tx Low
Output
JP1

Carrier Hold
500ms
JP7

JP8

AGC ON

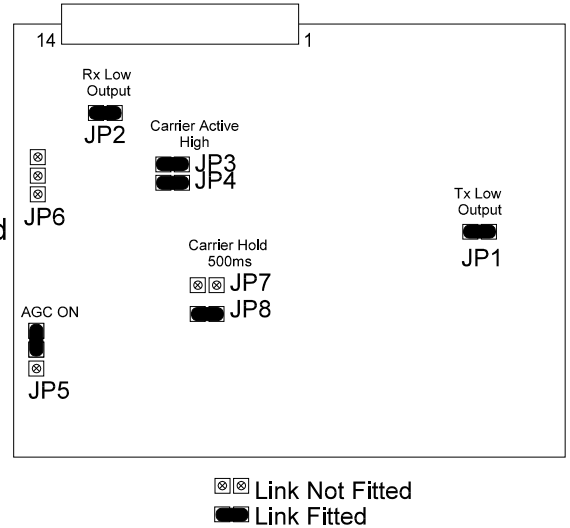JP5

⊠⊠ Link Not Fitted
■■ Link Fitted
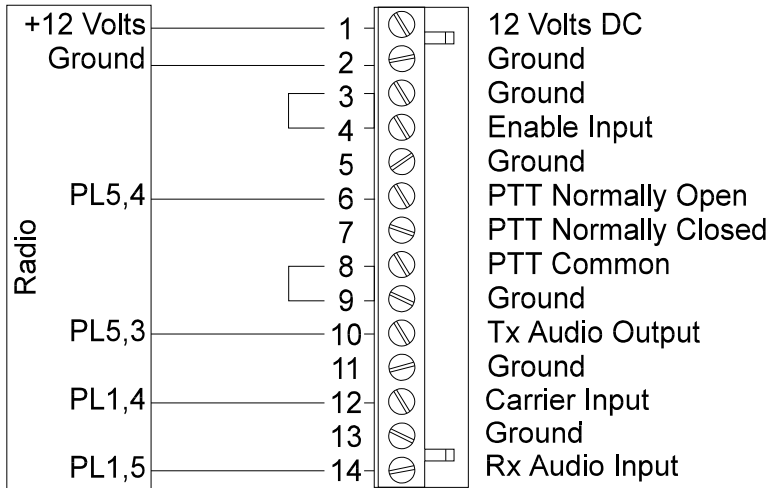
Simpeater, Application Note No 6

The information below is specific for the Tait T2000 Series of radio's.
The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

Radio		
4	1	12 Volts DC
10	2	Ground
	3	Ground
	4	Enable Input
	5	Ground
11	6	PTT Normally Open
	7	PTT Normally Closed
	8	PTT Common
	9	Ground
15	10	Tx Audio Output
	11	Ground
12	12	Carrier Input
	13	Ground
5	14	Rx Audio Input

Rx Low Output — JP2
Carrier Active High — JP3, JP4
JP6
Tx Low Output — JP1
Carrier Hold 500ms — JP7, JP8
AGC ON — JP5

⊠⊠ Link Not Fitted
▉▉ Link Fitted

Rear of Auxiliary Plug

S13: Aux Pin 5, Aux Pin 15, Aux Pin 10, Aux Pin 4
S14: Aux Pin 12, Aux Pin 11

The Tait T2000 series of radio's have an optional 15 Pin high density 'D' type connector fitted as an auxiliary connector. Inside the radio a small PCB is also added to provide 600 Ohm isolated Transmit and receive audio. If this PCB is not fitted then it is possible to connect the Simpeater by connecting the points marked S13 and S14 to a 'D' type connector. The Simpeater does not require isolated or balanced audio so the performance should be equally acceptable with or without the interface PCB.

Simpeater, Application Note No 7

Motorola GM350

The information below is specific for the Motorola GM350, **128 Channel Version**. For the 4 channel Version see note below. The jumper settings should be correct for normal operation, however, you may wish to change *Carrier Hold Duration* and *AGC*.

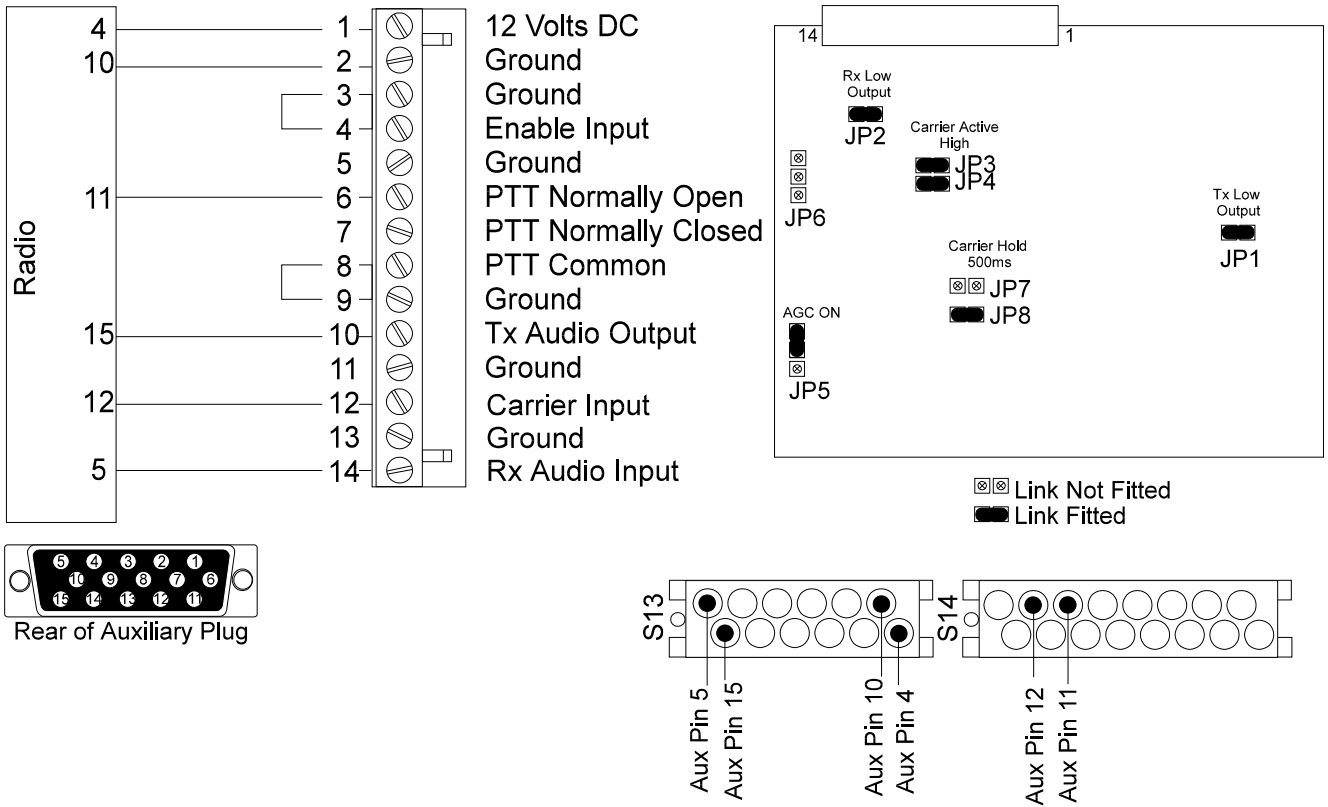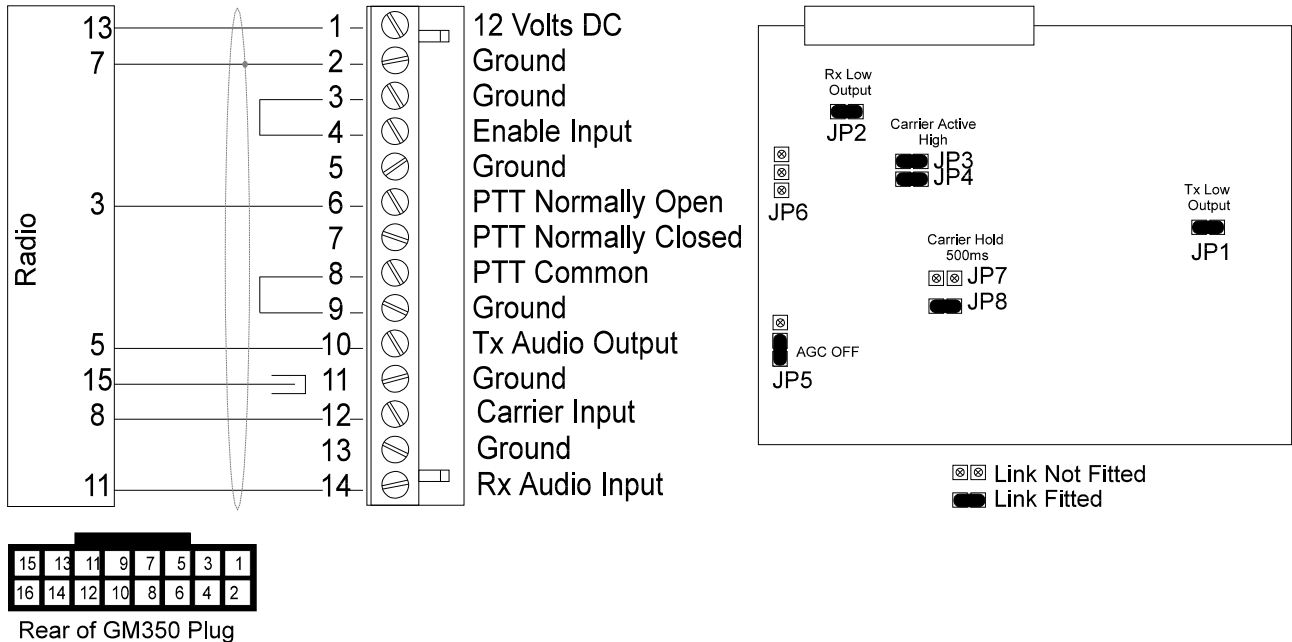| Radio		Pin		Function
13		1		12 Volts DC
7		2		Ground
		3		Ground
		4		Enable Input
		5		Ground
3		6		PTT Normally Open
		7		PTT Normally Closed
		8		PTT Common
		9		Ground
5		10		Tx Audio Output
15		11		Ground
8		12		Carrier Input
		13		Ground
11		14		Rx Audio Input

15	13	11	9	7	5	3	1
16	14	12	10	8	6	4	2

Rear of GM350 Plug

Rx Low Output — JP2
Carrier Active High — JP3, JP4
JP6
Carrier Hold 500ms — JP7, JP8
Tx Low Output — JP1
AGC OFF — JP5

⊠⊠ Link Not Fitted
▣▣ Link Fitted

Notes:
1. The above connections are only suitable for the 128 Channel Version of the GM350, to use this configuration, two of the General Purpose I/o pins must be setup by programming, Pin GP1 (3) must be programmed to be PTT input, and Pin GP3 (8) must be programmed to be COR Output.
2. This above setup is only valid for the 128 Channel unit and as such Karter Electronics do not recommend connection to the 4 channel GM350.
   To use this unit with the 4 channel GM350, the wire from pin 15 (RSSI) can be used as a carrier detect, you will need to set up the internal COR Level in the Simpeater by trial and error, NOTE this signal level output is continuously variable depending on signal level.
   The Receive Audio Output will have to be taken from Pin 16 (Speaker +), and the Power must be taken from an alternative source to the internal B+ Output.

Simpeater, Application Note No 8

**Maxon
SM4150**

The information below is specific for the Maxon SM2150 Radio

Switched 12V	1		12 Volts DC
0V	2		Ground
	3		Ground
	4		Enable Input
	5		Ground
PTT on Mic Input	6		PTT Normally Open
	7		PTT Normally Closed
	8		PTT Common
	9		Ground
C313 on Mic Input	10		Tx Audio Output
	11		Ground
Pin 38,IC105	12		Carrier Input
	13		Ground
Pin 16, IC2	14		Rx Audio Input

Rx Low Output
JP2

Carrier Active Low
JP3
JP4

JP6

Tx Low Output
JP1

Carrier Hold 500ms
JP7

JP8

AGC OFF
JP5

⊠⊠ Link Not Fitted
▬ Link Fitted

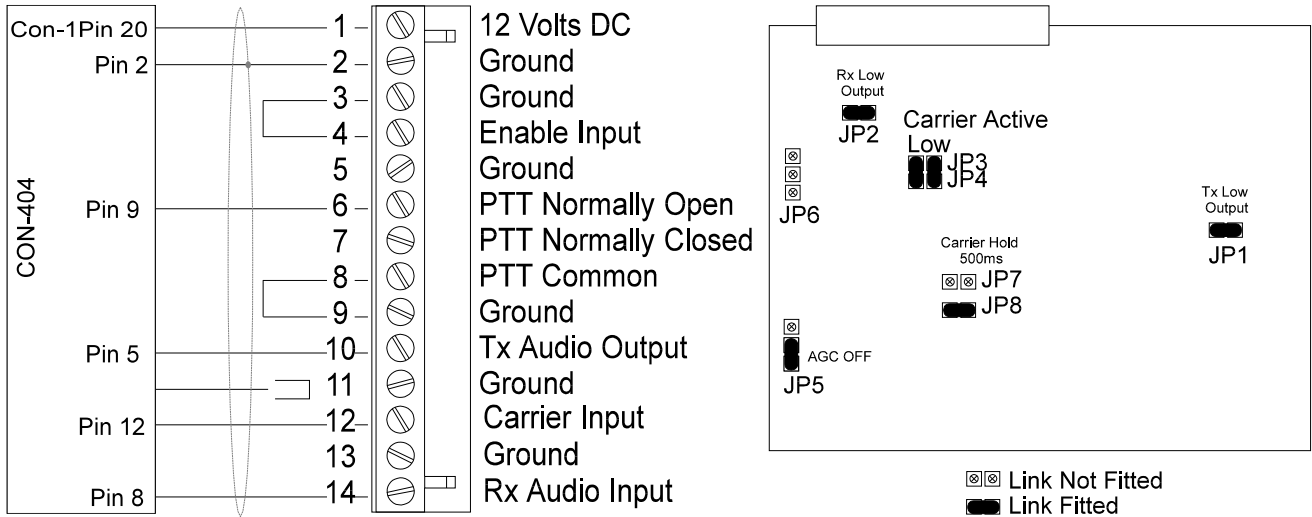# Simpeater, Application Note No 9

Maxon SM2150

The information below is specific for the Maxon SM4150 Radio

CON-404			
Con-1 Pin 20	— 1	⊘	12 Volts DC
Pin 2	— 2	⊖	Ground
	— 3	⊘	Ground
	— 4	⊘	Enable Input
	— 5	⊘	Ground
Pin 9	— 6	⊘	PTT Normally Open
	— 7	⊖	PTT Normally Closed
	— 8	⊘	PTT Common
	— 9	⊖	Ground
Pin 5	— 10	⊘	Tx Audio Output
	— 11	⊖	Ground
Pin 12	— 12	⊘	Carrier Input
	— 13	⊘	Ground
Pin 8	— 14	⊖	Rx Audio Input

Rx Low Output — JP2

Carrier Active Low — JP3 / JP4

JP6

Carrier Hold 500ms — JP7 / JP8

Tx Low Output — JP1

AGC OFF — JP5
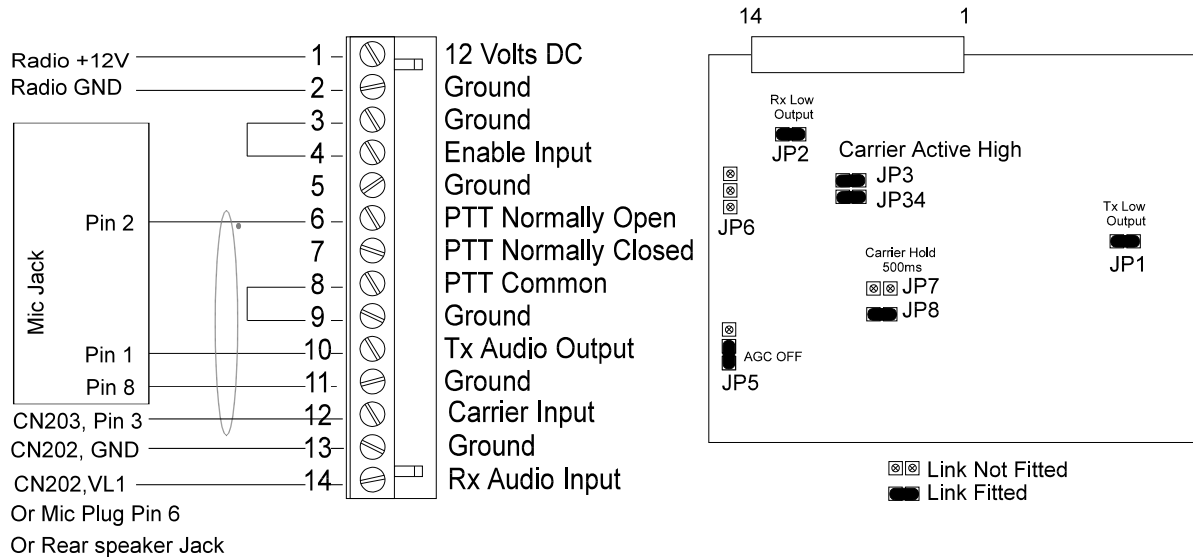
⊠⊠ Link Not Fitted
■■ Link Fitted

NOTES:

1.   A Male plug to fit CON-404 is available from Maxon, PT # 999-084-0
2.   An interconnect PCB which will allow easier connection of wires to the Simpeater is available from Maxon PT # 610-260-0009

Simpeater, Application Note No 10

Alinco DR130

The information below is specific for the Alinco DR130 Radio

Pin	Signal
Radio +12V — 1	12 Volts DC
Radio GND — 2	Ground
3	Ground
4	Enable Input
5	Ground
Pin 2 — 6	PTT Normally Open
7	PTT Normally Closed
8	PTT Common
9	Ground
Pin 1 — 10	Tx Audio Output
Pin 8 — 11	Ground
CN203, Pin 3 — 12	Carrier Input
CN202, GND — 13	Ground
CN202,VL1 — 14	Rx Audio Input

Mic Jack

Or Mic Plug Pin 6
Or Rear speaker Jack

Rx Low Output JP2

Carrier Active High
JP3
JP34

JP6

Carrier Hold 500ms
JP7
JP8

Tx Low Output
JP1

AGC OFF
JP5

Link Not Fitted
Link Fitted

NOTES:

1.	The radio internal microphone connector can be modified to take RX audio signal, use Pin 8, disconnect this from ground and connect to hot end of Volume control, the Simpeater RX audio input is AC coupled so the Simpeater will not affect the Radio operation.
2.	+12V and Ground can be taken directly from the radio supply connector.
3.	To the best of our Knowledge the Squelch output is available on Pin 6 of the microphone socket, other Alinco Radio's, or later revisions of the DR130 may have this pin allocated to other functions.

7. OPERATION AND MAINTENANCE

The Simpeater has been designed to be very simple to install and use. It is usual to supply the Simpeater's power from the radio as it only consumes a small amount of current. The Simpeater's transmit audio is applied to the radio via a relay allowing the radio's microphone to be connected in parallel. In use this allows a user switch off the Simpeater and use the radio in the usual way.

When the Simpeater first powers up it will ignore any carrier indications for 500ms, this allows the radio to go through any form power up routine without causing a spurious transmission due to the Simpeater. In addition if the Simpeater is switched on while the radio that it is attached to is receiving then the Simpeater will ignore this and will not react to the carrier signal the carrier indication ceases. When the carrier next becomes active the Simpeater will record and then playback as normal.
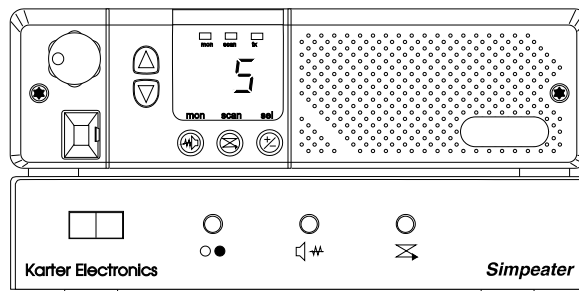
After power up the Simpeater has its red power LED illuminated, when an incoming carrier is detected by the radio it is passed to the Simpeater and the yellow carrier LED will illuminate. The Simpeater is now recording, when the carrier indication stops the Simpeater will wait a short time, as set by JP7 and JP8, it will then key the transmitter, wait a short time, and send its recorded audio. If during record mode the Simpeater runs out of memory i.e. the message length is longer than the maximum message duration, then, when receive carrier disappears, the Simpeater will send a two short beeps prior to the message replay to inform the users that the message has been truncated. Once the message has been sent the Simpeater will return to standby awaiting its next message.

Receive Audio

The Receive Audio input is AC coupled into U5A which is used to amplify or attenuate the signal so that TP1 is presented with a level of either 1 or 2V peak to peak (dependent on AGC setting) when an input is set for 60% system deviation at a frequency of 1KHz.

This level at TP1 is set by Jumper J2 which sets the gain of the amplifier U5A and Potentiometer, R5 which attenuates the input signal. Connected to TP1 are two RC networks which are used to select the frequency response of the stage. This is necessary as the audio presented to this stage could be flat or pre-emphasized (not de-emphasized) depending upon the radio audio pick up point.

✎   In some radios the audio output can be set for pre-emphasized or flat audio by software programming.

Automatic Gain Control (AGC)

Audio which is presented to Pin 17 of U2, which is the AGC input, it is amplified and then AGC is applied inside U2. R30 and C25 form the AGC decay time constant while an internal 5K6 resistor and C25 form the AGC attack time constant.

✎   The amount of AGC can be effected by changing the audio level at TP1. If this is done care should be taken as the more AGC that is applied the higher the noise floor will become.
✎   JP5 allows the AGC to be enabled of disabled.

Carrier Detection

The Simpeater carrier detector circuit has been designed to allow the use with a wide range of radios and as such is very sensitive and will trigger on positive or negative transitions of the carrier input line.

R8, R34, C15, C18 and VR2 form input protection for U5B as well as filtering out any interference which could be present on this input. R24 is used to set the comparator reference level. These two inputs are applied to U5B. The inputs can be reversed by removing JP3 and JP4 and reinserting them rotated through 90˚. The operational amplifier U5B will act as a compactor allowing LED D4 to indicate when a valid carrier is present. See installation instructions for more details on setting the carrier activity. D4 will indicate the true carrier condition, however, this signal is further processed by U4 which adds a carrier hold timer, with a period of between 0.5 and 1.5 seconds depending upon the setting of JP7 and JP8. This timer prevents the Simpeater from changing from Receive to Transmit due to a short break in carrier which could be due to rapid fading for example.

Enable Input

This input to the micro controller, U4, is protected and de-bounced by VR4, R39, D6, C30 and R38. R38 act's as a pull down to Ground to keep the Simpeater in the default enabled state. If this input is taken high then it will inhibit the operation of the Simpeater.

✎   For Normal operation leave the *Enable* input, P1 pin 4 unconnected or connect to ground, P1 Pin 3.

✎   This input prevents the carrier input from triggering a record and playback session. The input is only tested when an active transition is detected on the carrier input. At this time if the input is found to be active, greater than 3 volts, than the Simpeater will remain in its standby mode. It is not necessary to keep this pin low during the complete record and playback process.

Audio storage

While the carrier pin is active audio is continually stored in U2 until the maximum duration of storage is reached or the carrier indication stops. The Simpeater will now wait for a short period, as set by JP7 and JP8, if the carrier has not become active during this period then recording stops.
The Simpeater now enters its playback mode, and energizes RL1, which causes the host radio to start transmitting, then and after a short link establishment period U4 instructs U2 to commence replaying the stored message. If the recorded message was longer than the capacity of U2 then U4 will insert two short beeps between energizing RL1 and U2 commencing playback. The beeps indicate to the users that the message currently playing has been truncated.

Microprocessor

U4 is a single chip micro controller which has been programmed with the software which controls the operation of the Simpeater. Y2, C12 and C13 are the only external components required for operation of U4. U4 receives data from a number inputs it also communicates with U2 to control the record and playback procedures. The truncated message beeps are generated by U4 pin 1, this is then attenuated and filtered by R29,C21, R28 and C22.

✎   A full description of the microprocessors activities is beyond this document and it is not required in order to understand, install and service this product.

✎   If U4 should ever fail then a replacement must be sought from Karter Electronics along with the Simpeater model and serial number as this contains information specific to your Simpeater.

Transmit Audio

In playback U2 passes the recorded audio to U1A which forms a high pass filter which is required to remove any CTCSS or DCS signal which might have been present on the audio input.
U1B forms the transmit audio amplifier with output level setting by JP1 and by adjusting R23. The transmit audio is coupled to the output by RL1 which will then presents a low output impedance proportional to R15 and the output impedance of U1B. This allows the output to be placed in parallel with a microphone without effecting the microphone operation when the Simpeater is not in use.

RF Filtering

In order for the Simpeater to operate efficiently it is necessary to prevent RF energy from entering the circuitry and to prevent the various signals generated inside the Simpeater effecting radio reception. Filter networks have been placed in series with all the relevant inputs and outputs. This together with careful consideration to printed circuit layout and a metal enclosure should ensure reliable operation in all foreseeable applications.

Maintenance and Repair

The Simpeater has only two moving parts, the PTT relay and on off switch, both of which should be capable of many years trouble free service.
The recording process uses a Non volatile storage method which has a limited life which is greater than 100,000 record/replay operations. In the unlikely event of this number of messages being repeated then U2 may not accurately reproduce audio. This will be most noticeable at the beginning of each message as it is played back. This device can easily be replaced following standard anti static proportions.

8. Parts List

Item	Qty	Component Ref	Value
1	3	C1,C2,C15	1n
2	3	C3,C11.C27	10u
3	2	C4,C14	470n
4	1	C5	470p
5	9	C6,C7,C8,C9,C10,C18,C22,C24,C31	100n
6	2	C12,C13	15p
7	3	C16,C17,C30	10n
8	3	C19,C21,C23	220n
9	2	C20,C29	68n
10	1	C25	4u7
11	1	C26	1uf Tant
12	1	C28	220u
13	2	D1,D3	1N4002
14	3	D2,D4,D5	LED
15	1	D6	Zener Diode 4V7
16	1	F1	FUSE 500mA
17	3	FB1,FB2,FB3	FER BD
18	1	JP1	Link TX Gain
19	1	JP2	Link RX Gain
20	2	JP3,JP4	COR Phase
21	1	JP5	AGC On/Off
22	1	JP6	De-Emp
23	1	JP7	COR1
24	1	JP8	COR2
25	3	LK1,LK2,LK3	LINK
26	1	P1	14 Way Rt Ang Header
27	1	SW1	Solder Pads to Power Switch
28	1	Q1	BC547
29	12	R1,R3,R4,R6,R11,R14,R21,R22,R26-R28,R38	10K
30	4	R2,R17,R31,R40	1K
31	3	R5,R23,R24	47K VAR
32	1	R7	10M
33	8	R8,R25,R34,R43,R44,R45,R46,R47	100K
34	4	R9,R15,R19,R32	470R
35	1	R10	4R7
36	1	R12	4K7
37	1	R13	47K
38	1	R16	330R
39	1	R18	6K8
40	1	R20	47R
41	1	R36	39K
43	1	R30	470K
44	1	R33	220R
45	1	R35	22K
46	1	R37	3K9
47	1	R39	680R
48	2	R41,R42	200K

Item	Qty	Component Ref	Value
49	1	R29	1K2
50	1	RL1	BT47W/6
51	2	U1,U5	LM358
52	1	U2	ISD2560 (2590 option)
53	1	U3	LM7805
54	1	U4	Micro controller
55	4	VR1,VR2,VR3,VR4,VR5	EMC FILTER
56	1	Y1	4MHz
57	3	Led Spacer	8mm x 0.1"
58	1	PCB	KE054400 Issue 3
59	1	Case Top	KE05401
60	1	Case Bottom	KE05402 issue 2
61	1	Front Panel Label	PVC Back Printed
62	1	Rear Panel Label	PVC Back Printed
63	1	CE Label	PVC Back Printed
64	4	M3 X 6 Pan Head Pozi	Nickel Plated Steel Screw
65	2	M3 Locking Washer	Nickel Plated Steel Washer
66	4	M3 x 6/10 CSK Pozi	Nickel Plated Steel Screw
67	1	Switch	Single Pole Rocker
68	4	Feet	12.7mm Sq Rubber Adhesive
69	1	P1 Socket	14 Way Screw Terminal
70	1	M3 Nut	Nickel Plated Steel Nut
71	1	Earth link Assembly	
72	1	Product/Serial No Label	

9. Circuit Diagrams

The following is a list of the drawing numbers associated with the Simpeater Product, these are included in the installation/service manual as an aid to interfacing and fault finding.

Document No	Description
KE05400	Printed Circuit Ident
KE05401	Circuit Diagram
KE05404	Block diagram