RS8 HF & V/UHF Channel Simulator – 3, 6 kHz

User and Maintenance Manual

Date: **2019/04/30**

Revision: **02A**

RapidM

RapidM equipment is subject to continuous development and improvement and, in consequence, may incorporate minor detail changes from the information contained in this handbook.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the equipment.

RAPIDM assumes no liability for the user's failure to comply with these requirements.

Read and follow the recommendations in this handbook to minimize the risk of injury.

NOTE: This symbol used throughout this manual, indicates a danger, a caution or warning. When this symbol is encountered during all phases of operation, service and repair of this equipment, read the corresponding section in this manual carefully.

Ground the equipment
To minimize shock hazard, the equipment chassis must be connected to ground with a low impedance wire by using the appropriate terminal to this end.

Keep away from live circuits

Components replacement and internal adjustments must be achieved by qualified and trained maintenance personnel. Do not replace components when the power cable is connected.

Do not substitute parts or modify equipment

Because of the danger of introducing additional hazards, do not substitute parts or perform any unauthorized modification to the equipment.

Do not operate in an explosive atmosphere

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes an important safety hazard.

Do not breathe in fumes

In case of equipment burning, toxic fumes must not be breathed.

SAFETY INFORMATION

A. INTRODUCTION

The equipment is designed to operate safely when installed and used according to the product instructions and general safety practices.

The guidelines included in this chapter explain the potential risks associated with equipment operation and provide important safety practices designed to minimize these risks.

To protect oneself from hazards and create a safer work environment, follow carefully following the information contained in this chapter and the specific instructions provided with the equipment.

CE	**REGULATION INFORMATION** RAPIDM equipment complies with main safety requirements and other relevant clauses of 2006/95/EC Low Voltage Directive and 2004/108/EC EMC Directive. A copy of the Declaration of Conformity is provided with the equipment.

B. SERVICING

Do not service any equipment yourself, except for the operations described in this manual.

Opening or removing covers that are marked with warning symbols or labels may expose you to an electric shock.

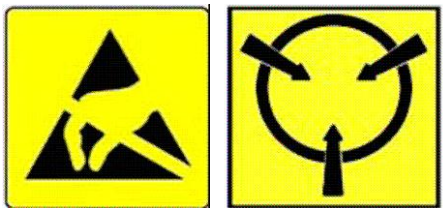
Service on internal components must be achieved by qualified and trained maintenance personnel.

Replacement Parts

Do not replace components when the power cable is connected.

When replacement parts are required, be sure the maintenance personnel uses the replacement parts specified in the Illustrated Parts List.

Before any servicing on electric circuitry, in order to protect the components and printed circuits against electrostatic discharges, wear an electrostatic discharge bracelet and connect the linked cord of the bracelet to an electrical ground.



ESD

Battery

Special precautions should be taken during handling, assembly, storage and destruction of lithium batteries.

Any internal overheating (resulting from a spontaneous emission of heat or a conducting effect) may produce a decomposition of the cell into dangerous products, which may cause an explosion.

Do not crush, pierce or short-circuit the (+) and (-) terminals of the battery by means of conducting elements (metallic for example). Do not heat or solder directly. Do not throw away into fire.

Do not mix batteries of different models or different trademarks. Do not mix new batteries and worn batteries. Keep the batteries in non-conducting boxes (plastic boxes for example).

Lithium-ion batteries are not rechargeable and should never be recharged under any circumstances.

Follow the manufacturer's recommendations concerning the operating temperature range.

The removal and replacement of the battery shall be only performed by qualified personnel.

C. CLEANING

Unplug the equipment before cleaning. Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning.

D. PROTECTIVE GROUNDING

The equipment is equipped with a three-wire electrical grounding-type plug.

This plug only fits into a grounded electrical power. This is a safety feature. Do not cancel the safety purpose of the grounding-type plug by trying to insert it into a non-grounded outlet.

The equipment is provided with a ground terminal for the connection to the earth.

This symbol indicates the connection of the equipment by grounding. This connection must be realized before any other connection and has to be disconnected last. Check the earth continuity thereafter at regular intervals.

HAZARDS RELATED TO ELECTRIC CURRENTS

High voltages are required for the operation of this equipment. These voltages are extremely dangerous, as a voltage of 110 V can cause death. The staff must observe all the safety requirements at all times:

- switch off the power supply before performing any operation inside the equipment,
- do not forget that safety systems are intended only for normal access to the equipment and that you can come into contact with dangerous circuits if the equipment is disassembled,
- in some cases dangerous voltages may still persist after the equipment has stopped functioning because charge is retained by the capacitors. You must therefore be careful to discharge them before working on the equipment.

ELECTROSTATIC DISCHARGE HAZARDS (ESD)

Before any servicing on electric circuitry, in order to protect the components and printed circuits against electrostatic discharges, wear an electrostatic discharge bracelet and connect the linked cord of the bracelet to an electrical ground.

Take the following precautions:

- do not remove an electricity-sensitive electronic circuitry from its protective packaging until you are ready to install it,
- to discharge the static electricity between the work surface and an electronic circuit, touch the work surface with one hand and the electronic circuit with the other,
- once you have removed an electronic circuit from its protective packaging, do not put it down until it is installed in the equipment or replaced in its protective packaging.

use the protective packaging of an electronic circuit as a seating plane.

ELECTRIC SHOCK: FIRST AID

The first aid instructions are theoretical and practical. These instructions concern the personnel involved in installation, operation and servicing of this equipment.

Everyone must be prepared to provide first aid in order to save lives.

The most important thing is to remain calm.

Generally, an electric shock is not immediately fatal. The victim can be saved, even if he or she is not breathing.

The first aid instructions consist in protecting, examining, calling for help, and providing first aid.

1st action: PROTECT

- Localize the accident. Be prepared to break the victim's fall when the power is shut off, especially if he or she is working at height.
- Shut off the power.

  or
- If you cannot shut off the power, you must:
  - protect yourself: protect your hands with a dry, non-conductive material (e.g. rubber gloves, fabric), and stand or sit on an insulating material (e.g. wooden or plastic stool),
  - move the victim away from the circuit: use a dry, non-conductive stick to move the victim completely away from the live circuit. Make sure to move the victim away from any metallic or wet material, as metal and water conduct electricity,
  - mark out the area to prevent further accidents.

2nd action: EXAMINE

Before sending for help, check for consciousness and breathing.

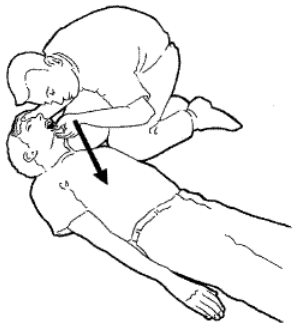
- Lay the victim on their back.
- Take the victim's hands and ask him or her simple questions to check if he or she is conscious.

e.g. "Can you hear me? If you can hear me, squeeze my hand!"

- **If the victim responds**, then he or she is conscious and breathing (1st case),

Or

- **If the victim does not respond**, then he or she is not conscious. At this point you must check for breathing:
- loosen their clothes (collar, tie, belt),
- carefully tilt the victim's head back to open the airway: Placing one hand on the forehead, the index and middle finger of the other hand under their chin, gently tilt the head backwards,



- open the victim's mouth and look inside. Remove anything likely to interfere with breathing, using your hand that was previously on the forehead,
- bring your ear and your cheek close to the victim's nose and mouth to check for breathing. Check if the stomach and/or chest is heaving,
- remain in this position for about 6 to 10 seconds.

At this point, the first-aider will know whether:

- the victim is unconscious and is breathing (2nd case),
- the victim is unconscious and is not breathing (3rd case).

3rd action: CALL OR SEND FOR HELP

- Call the emergency number for the mobile emergency medical service or fire department.
- Provide the following information:
  - the exact location: address, building, floor, hallway, room,
  - the number of victims,
  - the status of the victim(s) (e.g. unconscious, not breathing, etc.).
- Do not hang up before being told to do so.
- Facilitate the arrival of the emergency service as close as possible to the victim.
- Report to the emergency services when they arrive.

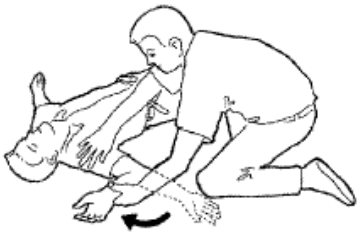
4th action: PROVIDE FIRST AID

1st case: The victim is responsive and breathing:
- wait for the emergency service.

2nd case: The victim is unresponsive and breathing:
- place the victim on their side in the recovery position (see below),
- the recovery position is used in case of a fall or trauma,
- the recovery position prevents the victim from choking on their tongue or inhaling vomit.

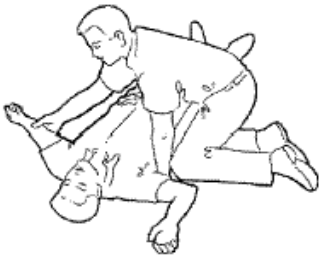
RECOVERY POSITION

1



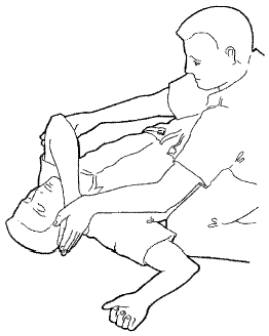
Kneel beside the victim on the side you want to turn them towards. Place the nearest arm of the victim at right angles to their body and bend the elbow so that the upper arm is parallel to his or her head, palm upwards.

2



Kneel next to the victim's waist.
Grip the victim's opposite arm.

3



Place the back of their hand against the victim's cheek from your side.

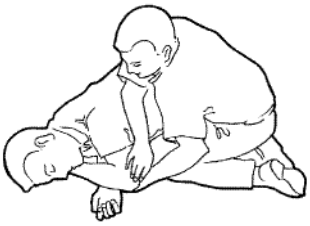
4

With your other hand, grip the victim's leg furthest away from you and placing your hand under the victim's knee, bring the knee up so that their foot is resting on the floor. This allows you to use the leg for leverage. Back up approximately to the level of the victim's elbow.

5

Roll the victim towards you and on to their side, by pulling on the knee until it touches the ground.

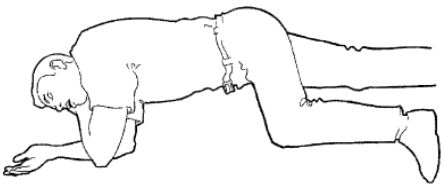
6



Gently remove your hand from under the victim's head.

Final Position:

Continue to check for breathing by placing your hands on either side of the victim's chest.



3rd case: The victim is unresponsive and not breathing:

- begin cardiopulmonary resuscitation (CPR) at once: Mouth-to-mouth ventilation and external chest massage,
- place the victim on a hard surface,
- perform cycles consisting of 15 chest compressions (external heart massage) followed by two deep lung inflations (mouth-to-mouth ventilation).

MOUTH TO MOUTH

1 Kneel next to the victim, near their face.

2

With your hand on the victim's forehead, use your thumb and index finger to pinch the nose shut, while keeping the head tilted back.

With the hand under the victim's chin, lift up and open their mouth slightly.

Take a deep breath, open your mouth wide and make a tight seal around the victim's mouth with your own.

Give a slow breath for about 2 seconds until the victim's chest begins to rise.

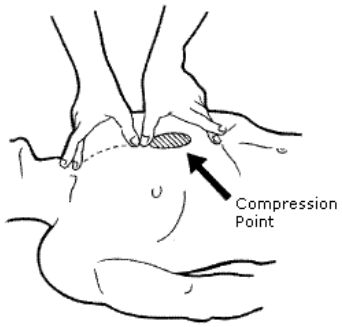
3

Slightly straighten up and breathe in while watching for the victim's chest to sag. The victim will exhale automatically.

EXTERNAL HEART MASSAGE

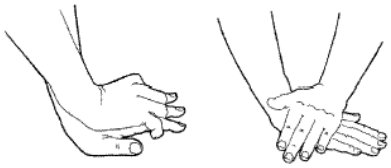
1 Whenever it is possible, bare the victim's chest.

2 Locate the compression point by finding the middle of the sternum.



3 Place the heel of your hand just below the located point.

4 Place your other hand on top of the first hand.



5 Press down on the sternum while keeping your arms straight and in line with your shoulders. Between each compression keep your hands on the victim's sternum. The victim's chest must return to its initial position.

6 Check for breathing every 8 cycles.
A cycle = 15 compressions + two breaths.

NOTE: It is recommended to have two first-aiders performing CPR. One first-aider does chest compressions while the other does mouth to mouth. The first-aiders position themselves on opposite sides of the victim. With two first-aiders working, less time is wasted between compressions and breaths, which makes the CPR more effective.

DANGER

All first aid action, whether it is the recovery position or CPR, must be continued until outside help arrives.

CONTENTS

FIGURES

TABLES

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ALE	Automatic Link Establishment
ARM	ARM Micro-processor
ASYNC, Async	Asynchronous
AUD	Audio
BB	Base Band
BER	Bit Error Rate
BIT	Built-In Test
Bps, bps	Bits per second
BW	Bandwidth
CH, CHAN	Channel
CRC	Cyclic Redundancy Check
CS	Channel Simulator
CTRL	Control
dB	Decibel(s)
dBFS	Decibels referenced to Full Scale
dBm	Decibels referenced to 1 mW into 600Ω
DC	Direct Current
DCE	Data Communications Equipment
DSP	Digital Signal Processor
DTE	Data Terminal Equipment
FSK	Frequency Shift Keying
GND	Ground
GUI	Graphics User Interface
HF	High Frequency
HFCS	HF Channel Simulator
H/W	Hardware
Hz	Hertz
ICD	Interface Control Document
I/O	Input/Output
ISB	Independent Sideband
ISR	Interference-to-Signal Ratio
kHz	Kilohertz
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LF	Low Frequency
LSB	Lower Sideband, Least Significant Bit
MF	Medium Frequency
MHz	Megahertz
MIB	Management Information Base
MIL-STD	Military Standard
Modem	Modulator/Demodulator
ms, msec	Milliseconds
NB	Narrowband
opscreen	Operational Screen
OTA	Over-the-Air
PO-BIT, P-BIT	Power On Built-In Test
PC	Personal Computer
PCB	Printed Circuit Board
p-p	Peak-to-Peak

PSK	Phase Shift Keying
RAP	Remote Control Application Protocol
REM	Remote
RF	Radio Frequency
RMS	Root Mean Square
RTC	Real-Time Clock
Rx	Receive, Receiver
S	STANAG
SDM	Software Defined Modem
SIR	Signal-to-Interference Ratio
SNR	Signal-to-Noise Ratio
SSB	Single Sideband
STANAG	Standardization Agreement
SYNC, Sync	Synchronous
TCP/IP	Transmission Control Protocol/Internet Protocol
Tx	Transmitter
UM	User Manual
USB	Upper Sideband
VAC	Volts Alternating Current
VDC	Volts Direct Current
VHFCS	V/UHF Channel Simulator
WB	Wideband
W/F, W/Fs	Waveform, Waveforms

ASSOCIATED PUBLICATIONS

The following publications are applicable to this User Manual.

No	Reference	Title	Issue
[1]	**RapidM Application Control Protocol (RAP1)**	*"Remote Control Protocol: RAP1 over DLP1/RIPC or TCP/IP – Control Protocol", RapidM* • *MAIN - RM-RAP1-0002DOC* • *PART12: HF Channel Simulator - RM-RAP1-0023DOC*	Latest

Table 1: Associated Publications

1 INTRODUCTION

1.1 OVERVIEW

The ***RS8*** *HF & V/UHF Channel Simulator (HFCS & VHFCS)* is a standalone device used to provide reproducible HF & V/UHF channel conditions which allows consistent performance tests of modems and waveforms to be carried out.
The **RS8** provides a PC hardware and software independent solution and is fully controllable via the front panel and remote control port interface. The RapidM RIPC/RAP1 protocol is used for this purpose. A PC GUI is also provided for graphical control if desired.

The HF channel conditions are simulated using the **Watterson-Coon HF Channel model** with a few enhancements. These include the addition of radio filters at the input and output, the ability to handle more than two paths (up to 5) and the addition of a time-varying Doppler offset.

VHF channel settings simulate propagation paths with either a Classical or a Rician Doppler Spectrum. The vehicle speed and operating frequency for the simulated propagation is configurable. The RS8 VHFCS can simulate up to 6 individually configurable paths.

Narrowband capabilities are implemented for **RS8** with noise bandwidths of 3 & 6kHz produced. Wider-band implemented for VHFCS with noise bandwidths of 3, 6, 12 & 24 kHz to being generated.

Fixed frequency, FSK waveform (HF only), Swept Continuous Wave and Narrowband channel interference simulation is also available in the **RS8**.

With a maximum system delay of 25ms, the **RS8** can be used for ALE 3G testing with a zero *k* parameter.

Note: In this document HFCS will refer to the HF simulator mode of the RS8 and VHFCS will refer to the V/UHF simulator mode. The channel pre-set selected on the RS8 will determine whether the RS8 operates as HFCS or VHFCS. It is therefore a single RS8 firmware that supports both HF & V/UHF operation. In similar fashion a single PC GUI also supports both these modes of operation.

Figure 1: RS8 HF & V/UHF Channel Simulator

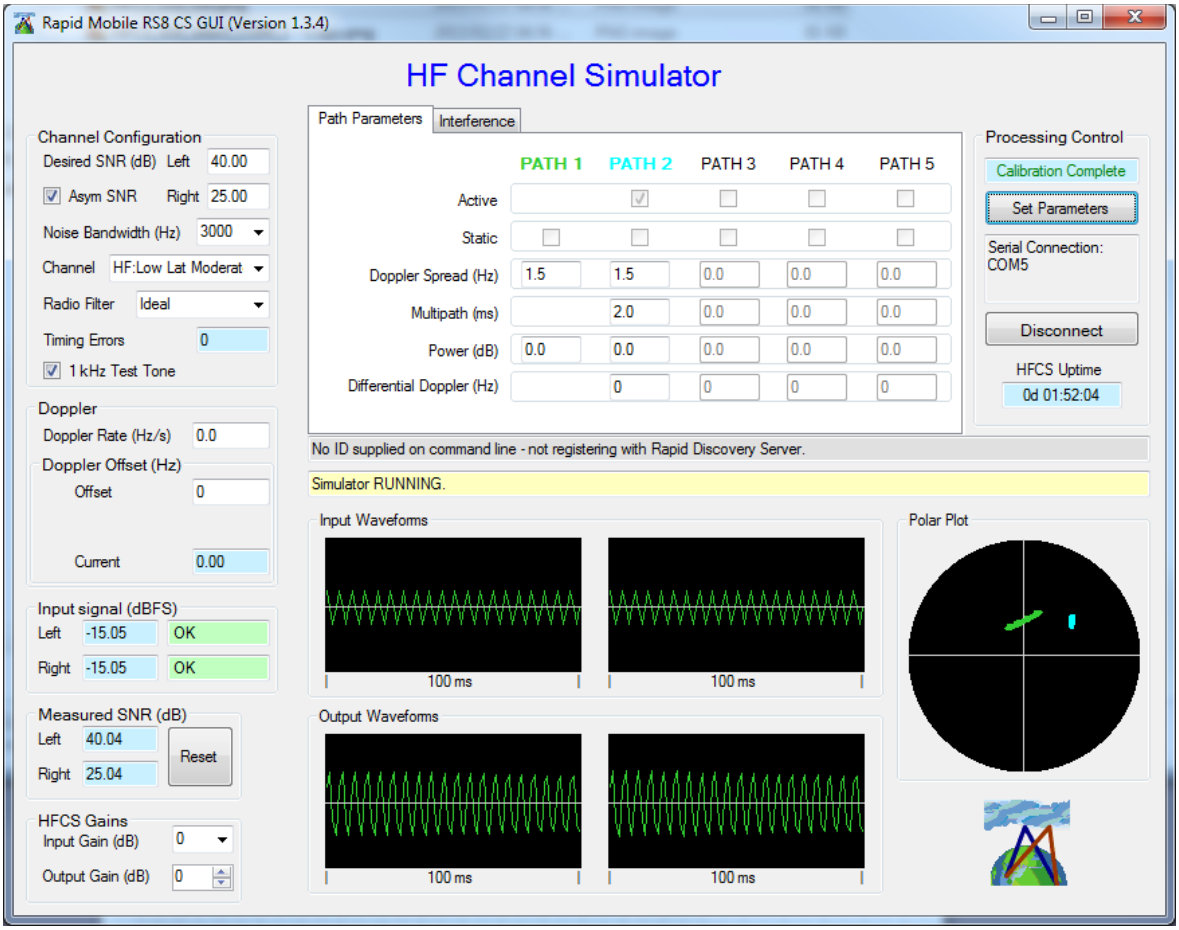


Figure 2: Rapid Mobile RS8 CS GUI

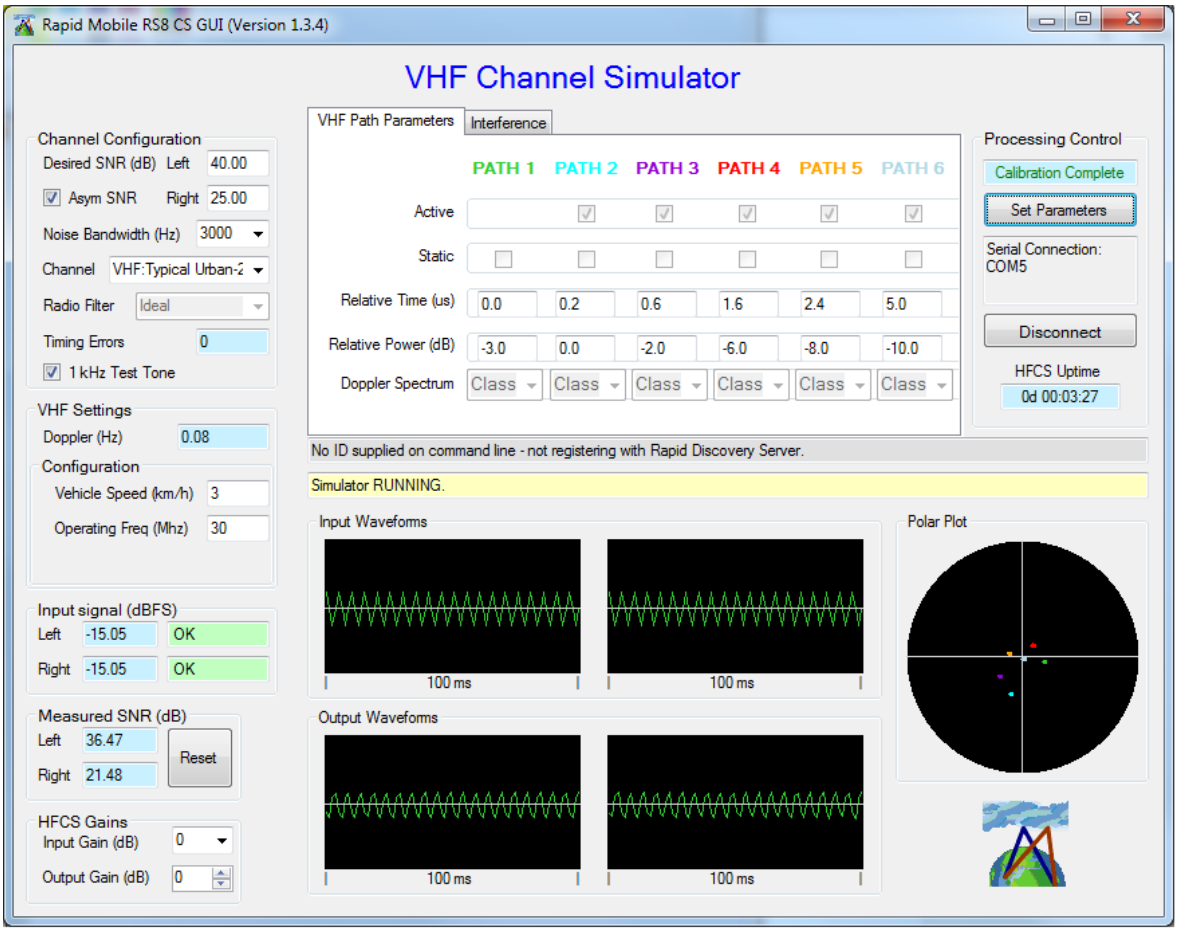


Figure 3: Rapid Mobile RS8 CS GUI

1.2 RS8 CAPABILITIES

1.2.1 SAMPLING RATE

A sampling rate of **96 kHz** is used for the **RS8** for all channel bandwidths. However, when using the S4203 radio filter with 3 kHz bandwidth, this sampling rate drops down to 19.2 kHz due to the larger processing needed for the radio filter at a high sampling rate.

Note: this is only for the HFCS mode as the VHFCS does **not** support the S4203 radio filter and therefore this sampling rate remains constant for all configurations of the VHFCS.

The high sampling rate of the **RS8** is required to support the larger bandwidths of up to 48 kHz.

1.2.2 SYSTEM DELAY

The ***RS8*** *HF & V/UHF Channel Simulator* has a maximum system delay of 25 ms. This allows it be used for ALE 3G testing with a zero *k* parameter.

1.2.3 ASYMMETRIC GAUSSIAN NOISE

Gaussian noise is added independently to the left and right channels. This noise has a selectable range of -63 → 63 dB and is band-limited to the bandwidth selected.

The actual frequency spectrum of the filtered noise needs to be from 300 → 3300 Hz, 300 → 6300 Hz, etc right up to 300 → 24300 Hz, with the cut-off frequency at -3dB. This means a band-pass filter is used for this purpose.

The asymmetry allows the **RS8** CS to be used either in dual left and right channel mode for full ISB testing or for each channel to be used separately for forward and reverse ARQ testing.

The SNR can also be continuously ramped from a minimum to maximum SNR limit, over a specified duration, and back down again. This can be set and performed independently for both the left and right channels.

1.2.4 RADIO FILTER

The **RS8** currently supports the use of an **ideal** or **S4203** radio filter. This is used at the input and output of the channel simulator.

The S4203 filter is compliant with STANAG 4203 with pass-band characteristics as defined in STANAG 4539 §4.6.2 but resampled to 19.2 kHz.

When the S4203 radio filter is used, the Channel Simulator *must be in the HFCS and 3 kHz bandwidth mode*. It is not supported for larger bandwidths as it itself limits the bandwidth to the 3 kHz range so would not make sense to use it with higher bandwidths.

The VHFCS does **not** support any radio filter and this setting is set to 'Ideal' whenever the **RS8** is in VHFCS mode.

1.2.5 INTERFERENCE

In addition to the channel simulation, the **RS8** can also be used to introduce interference to the channel other than the usual Gaussian noise. This can be very useful in testing of certain circumstances.

The interference which can be added is as follows:

1) Fixed Frequency (FF) interferer x4
2) Swept Continuous Wave (SCW) interferer
3) FSK Waveform interferer (*HFCS only*)
4) Narrowband interferer (BPSK, QPSK, 8-PSK or 16-QAM modulation)

Note: due to the computational load, a **maximum of 2 VHF paths** are allowed when any interference is enabled.

1.2.5.1 FIXED FREQUENCY INTERFERENCE

Fixed frequency interference is narrow band interference of a single frequency. Up to 4 FF interferers can be enabled on the **RS8**.

The left and right channels are independently set by specifying the following parameters:
1) Interference-to-Signal (ISR) ratios (-63 → 63 dB)
2) Fixed frequency of the interferer (0 → 24 kHz)

1.2.5.2 SWEPT CONTINUOUS WAVE INTERFERENCE

Swept continuous wave interference is also a form of narrowband interference but where the frequency sweeps between two frequency limits in a triangular fashion.

For this the left and right channels are independently set by specifying the following parameters:
1) Interference-to-Signal (ISR) ratios (-63 → 63 dB)
2) Low frequency limit (0 → 24 kHz)
3) High frequency limit (0 → 24 kHz)
4) Sweep rate of the frequency (max 48 kHz/s)

1.2.5.3 FSK WAVEFORM INTERFERENCE (*HFCS ONLY*)

FSK Waveform interference simulates the transmission of an FSK signal on the same channel. Random data is transmitted for this interferer.

The left and right channels are again independently set by specifying the following parameters:
1) Interference-to-Signal (ISR) ratios (-63 → 63 dB)
2) First frequency component (0 → 24 kHz)
3) Second frequency component (0 → 24 kHz)
4) Bit rate of transmitted data (max 48 k bits/s)

1.2.5.4 NARROWBAND INTERFERENCE

Narrowband interference simulates the transmission of a PSK signal on the same channel. Random data is transmitted for this interferer with the modulation selectable as either BPSK, QPSK, 8-PSK or 16-QAM.

The left and right channels are again independently set by specifying the following parameters:
1) Interference-to-Signal (ISR) ratios (-63 → 63 dB)
2) Centre frequency of signal (620 Hz → 47380 kHz)
3) Bandwidth of signal produced (1240, 3000Hz → 24 kHz)
4) Signal modulation (BPSK, QPSK, 8-PSK or 16-QAM)

1.2.6 PC INDEPENDENT

The ***RS8*** *HF & V/UHF Channel Simulator* offers a standalone device which is completely independent of any PC hardware or software. This allows reliable results to be obtained without the hassle and many variabilities of using PC based HF Channel simulators.
Additionally, it allows very low system delay periods so that full ALE 3G testing can also be performed.

The **RS8** is fully controllable from the front panel screen and keyboard or over the remote control interface using the RapidM RIPC/RAP1 protocol. A PC GUI is also available to make the remote control of the **RS8** easier, but is by no means required.

1.3 HFCS Specific Capabilities

1.3.1 Channel Model

The **RS8** HFCS simulates the HF channel conditions using the Watterson-Coon HF Channel model with a few enhancements. These enhancements include the addition of radio filters at the input and output, the ability to handle more than two paths (up to 5) and the addition of a time-varying Doppler offset.

The Watterson-Coon channel model is widely considered to be a good model of HF ionospheric transmissions especially in the lower bandwidths. This is confirmed with many administrations reporting a good correlation between laboratory test results and real-world tests of the modems in operation.

Narrowband channels channel are supported by **RS8** – 3 & 6 kHz noise bandwidths for HF.

1.3.2 Doppler

An overall Doppler offset (channel frequency shift) applied across all paths. This is apart from the Differential Doppler Offset which is applied individually to each path (see Section 1.3.3).

The Doppler offset is either a constant value, in the range of ±3000 Hz, or sweeps between a given minimum and maximum Doppler value. This is done in a triangular pattern at a specified rate. The sweep rate is in the range of -3.5 to +3.5 Hz/s.

1.3.3 Path Parameters

The **RS8** HFCS supports up to 5 paths. Each path contains the following parameters:

1) **Static**:
   - This specifies whether the path is a fading path or not
   - Static - non-fading/Doppler spread = 0
   - Fading - Doppler spread non-zero

2) **Doppler Spread**:
   - Watterson-Coon Doppler spread fading in selected increments ranging from 0 → 50 Hz
   - This specifies the rate of fading experienced for the path
   - A higher Doppler spread means more/quicker change of the fading for the path

3) **Multipath Delay**:
   - This specifies the time delay (in ms) between the paths (all relative to path 1)
   - A non-zero value means that a slightly delayed version of the signal is mixed to the channel for the given path
   - Specified in the range of 0 → 26 ms

4) **Path Gain/Power**:
   - The individual attenuation of a path in the range -40 → 0 dB
   - This gives the ratio of 'importance' between the paths
   - The higher the path power, the greater the influence of the path on the overall channel

5) **Differential Doppler Spread**:
   - This allows each path to have a slightly different Doppler frequency shift from the others (relative to path 1).
   - This represents the phase change between paths when a signal, reflected by the ionosphere, is split into multiple signal paths.
   - Specified in the range of 0 → 10 Hz

Both the *Multipath Delay* and the *Differential Doppler Spread* parameters cannot be set for Path 1 since they are relative parameters referenced to Path 1.

1.3.4 PRESET CHANNEL CONDITIONS

The **RS8** HFCS contains path parameter channel presets for CCIR and ITU defined channel conditions. These predefined channel presets include:

- Gaussian
- CCIR Good
- CCIR Moderate
- CCIR Poor
- Low Latitude Quiet
- Low Latitude Moderate
- Low Latitude Disturbed
- Mid Latitude Quiet
- Mid Latitude Moderate
- Mid Latitude Disturbed
- Mid Latitude Disturbed NVIS
- High Latitude Quiet
- High Latitude Moderate
- High Latitude Disturbed
- Ricean

However, *Custom* conditions can be set by individually adjusting the various path parameters.

1.4 VHFCS Specific Capabilities

1.4.1 Channel Model

The **RS8** VHFCS simulates VHF propagation paths with either a Classical or Rician Doppler Spectrum with a maximum Doppler offset determined by the vehicle speed and operating frequency specified. The VHFCS is capable of simulating up to 6 paths.

Bandwidths of 3, 6, 12 & 24 kHz are supported by the **RS8** VHFCS.

1.4.2 Maximum Doppler Offset

The maximum Doppler offset of a V/UHF propagation channel is determined by the operating frequency and the vehicle speed.

The operating frequency is specified in MHz in the range of 30 – 500 MHz.
The vehicle speed is specified in km/h in the range of 3 – 4000 km/h.

1.4.3 Rician Doppler Spectrum

If a path is set to have a Rician Doppler Spectrum then this path will be simulated to have a direct or line of sight component added to the Classical Doppler component of the path.

The Rician K-factor is fixed to 1, meaning that the power of the line of sight component is equal to that of the Classical Doppler component.

The line of sight component has a frequency offset of 0.7 the maximum Doppler offset of the path, in accordance with GSM 05.05.

1.4.4 Path Parameters

The **RS8** VHFCS supports up to 6 paths. Each path contains the following parameters:

1) **Active**: paths 2 to 6 can be enabled or disabled (path 1 is always enabled)
2) **Static**: fading or non-fading path
3) **Doppler Spectrum**: Classical or Rician Doppler Spectrum.
4) **Multipath Delay**: Relative signal delay in the range of 0 → 50 us
5) **Path Gain**: the individual attenuation of a path in the range -40 → 0 dB

1.4.5 Preset Channel Conditions

The **RS8** VHFCS contains path parameter channel presets for propagation models as defined in GSM 05.05. These predefined channel presets include:

- Typical Rural Area (RAx)
- Typical Hilly Terrain (HTx)
- Typical Urban Terrain (TUx)
- Profile for Equalisation test (EQx)
- Typical case for very small cells (TIx)

Some of these presets have more than one defined model, hence there are presets such as Typical Rural-1 and Typical Rural-2.

However, *Custom* conditions can be set by individually adjusting the various path parameters.

1.5 Specifications and Interfaces

1.5.1 HF Channel Simulator Specifications

An overview of the **RS8** HF Channel Simulator specifications are given in Table 2.

Functionality	Units	Range
Channel Model	-	Enhanced Watterson-Coon model
Sampling rate	kHz	▪ 96 ▪ 19.2 when S4203 radio filter is used
Noise Bandwidth	kHz	3 & 6
Number of paths	-	Up to 5 paths
Static	-	Fading or non-fading path
Doppler Spread	Hz	0 → 50 (in selected increments)
Multipath delay	ms	0 → 26 (not available for Path 1)
Power (path gain)	dB	-40 → 0
Differential Doppler Spread	Hz	0 → 10 (not available for Path 1)
SNR specification	dB	-63 → 63
Noise	-	Asymmetric Gaussian band-limited noise ▪ dual left & right channels for ISB testing ▪ forward & reverse channels for ARQ testing
Radio Filter	-	▪ Ideal ▪ S4203 Radio Filter (only available with 3kHz bandwidth)
Doppler Sweep (triangular)	Hz/s	-3.5 → 3.5
Doppler Offset (min and max)	Hz	-3000 → 3000
Preset Channel Conditions	-	▪ Custom ▪ Gaussian ▪ CCIR Good ▪ CCIR Moderate ▪ CCIR Poor ▪ Low Latitude Quiet ▪ Low Latitude Moderate ▪ Low Latitude Disturbed ▪ Mid Latitude Quiet ▪ Mid Latitude Moderate ▪ Mid Latitude Disturbed ▪ Mid Latitude Disturbed VI ▪ High Latitude Quiet ▪ High Latitude Moderate ▪ High Latitude Disturbed ▪ Rician
Output Gain	dB	-20 → 20

Table 2: RS8 HF Channel Simulator specifications

1.5.2 V&UHF CHANNEL SIMULATOR SPECIFICATIONS

An overview of the **RS8** V&UHF Channel Simulator specifications are given in Table 3.

Functionality	Units	Range
Channel Model	-	Classical or Rician Doppler Spectrum
Sampling rate	kHz	96
Noise Bandwidth	kHz	3, 6, 12 & 24
Number of paths	-	Up to 6 paths
Static	-	Fading or non-fading path
Operating Frequency	MHz	30 → 500
Vehicle Speed	km/h	3 → 4000
Relative Time (path delay)	us	0 → 50
Relative Power (path gain)	dB	-40 → 0
SNR specification	dB	-63 → 63
Noise	-	Asymmetric Gaussian band-limited noise ▪ dual left & right channels for ISB testing ▪ forward & reverse channels for ARQ testing
Preset Channel Conditions	-	▪ Custom ▪ Typical Rural (RAx) ▪ Typical Hilly (HTx) ▪ Typical Urban (TUx) ▪ Equalisation test (EQx) ▪ Tiny Cell (TIx)
Output Gain	dB	-20 → 20

Table 3: RS8 V&UHF Channel Simulator specifications

1.5.3 INTERFERENCE SPECIFICATIONS

An overview of the **RS8** Interference specifications are given in Table 4.

Interferer	Functionality	Units	Range
Fixed Frequency (4 available)	ISR Left	dB	-63 → 63
	ISR Right		
	Frequency Left	Hz	0 → 24000
	Frequency Right		
Swept Continuous Wave	ISR Left	dB	-63 → 63
	ISR Right		
	Frequency Low Left	Hz	0 → 24000
	Frequency Low Right		
	Frequency High Left	Hz	0 → 24000
	Frequency High Right		
	Sweep Rate Left	Hz/s	-48000 → 48000
	Sweep Rate Right		
FSK Waveform (HFCS only)	ISR Left	dB	-63 → 63
	ISR Right		
	Frequency 1 Left	Hz	0 → 24000
	Frequency 1 Right		
	Frequency 2 Left	Hz	0 → 24000
	Frequency 2 Right		
	Bit Rate Left	bits/s	-48000 → 48000
	Bit Rate Right		
Narrowband Waveform	ISR Left	dB	-63 → 63
	ISR Right		
	Carrier Frequency Left	Hz	620 → 47380
	Carrier Frequency Right		
	Bandwidth Left	kHz	1.24, 3, 6, 9, 12, 15, 18, 21, 24
	Bandwidth Right		
	Modulation Left		BPSK, QPSK, 8-PSK, 16-QAM
	Modulation Right		

Table 4: RS8 Interference specifications

1.5.4 ELECTRICAL INTERFACE SPECIFICATIONS

1.5.4.1 J28 MODEM AUDIO/CTRL INTERFACES

Parameter	Description
Function	• UART A and UART B • Audio Tx/Rx Signal
Modes	• 2-ISB: left and right channels on AUDIO1 and AUDIO2 respectively • SSB: Forward on AUDIO1 (left), Reverse on AUDIO2 (right)
Connector	• DE25, Male
Standard	• Asynchronous serial, full duplex
Electrical	• UART: RS-232 • Audio: Tx/Rx 600 Ohm balanced
Protection	• Short Circuit (to ground), ESD protection
EMI Measures	• Cable Shield to Chassis Ground of Control Equipment
Audio Tx Level	• -40 dBm to +15 dBm (*max.* RMS, peak-to-peak)
Audio Rx Level	• -40 dBm to +10 dBm without adjustment
Data Format	• Char 7, 8, parity NONE, EVEN, ODD, Stop 1, 2
Data Rates	• 75, 150, 300, 600, 1200, 2400, 3600, 4800, 9600, 19200, 38400, 57600, 115200 bps
Flow Control	• None
Cable	• Shielded twisted pair, gauge 22 (0.34 mm^2), max length 20 meters

Table 5: Specifications: J11 RADIO CTRL/AUDIO Interfaces

1.5.4.2 J14 ETHERNET CTRL INTERFACE

Parameter	REM CTRL Port - Description
Function	• Remote Control of **RS8** unit
Electrical	• 10/100-BASE T Ethernet port
Data Format	• Transmission Control Protocol/Internet Protocol (TCP/IP)
S/W Protocol	• RAP1/RIPC/TCP/IP Control Protocol
Cable	• RJ45 cable category 5

Table 6: Specifications: J14 Ethernet CTRL Interface

1.5.4.3 J15 REM CTRL/GPS INTERFACE

Parameter	REM CTRL Port - Description
Function	• Remote Control of **RS8** unit
Internal Connection	• Connected to CTRL SAM Processor
Connector	• DE9, Male
Standard	• Asynchronous serial, full duplex for RS-232
Electrical	• RS-232
Protection	• Short Circuit (to ground), Electro-static Discharge (ESD) protection
Cable expected	• Null Modem REM CTRL Cable (RS-232)
EMI Measures	• Cable Shield to Chassis Ground of Control Equipment
Data Format	• Char 8, parity NONE, Stop 1
Data Polarity	• Normal
Data Rates	• 115200 bps
Flow Control	• None
Configuration	• Point-to-point (RS-232)
S/W Protocol	• RAP1/DLP1 Control Protocol.
Cable	• Shielded twisted pair, gauge 22 (0.34 mm^2), max length 20 meters

Table 7: Specifications: J15 REM Control Interface

1.5.4.4 J8 MAINS INTERFACE

Parameter	Description
Electrical	• **Wide-range supply input:** The 100-240 VAC, 50–60 Hz, 2 A supply makes the unit suitable for use on military base stations, ships and aircraft.

Cable	• 3 wires, section 1.5 mm^2, max length 20 meters
	• Wiring colours according to International Standard **IEC 60446**
	  ○ Protective Earth (PE) – Green/Yellow bi-colour wire
	  ○ Neutral (N) – Blue colour wire
	  ○ Single phase: Line (L) – Brown colour wire

Table 8: Specifications: J8 MAINS Interfaces

1.5.4.5 GROUND STRAP INTERFACE

Parameter	Description
Electrical	• M4 lug & bolt < 16mm
Cable	• 1 wire (green and yellow), section 1.5 mm^2, max length 20 meters

Table 9: Specifications: GROUND STRAP Interface

1.5.5 Overall Dimensions & Weight

Parameter	Description
Weight	1.75 kg
Width	212.1 mm
Depth	225.65 mm (defined length) / 233 mm (overall)
Height	41.1 mm (excl. front panel) 44.1 mm (incl. front panel)

Table 10: Specifications: Overall Dimensions

1.5.6 Installation

Parameter	Description
Design	The unit occupies half of the width of a 1U 19” rack slot.

Table 11: Specifications: Installation

1.5.7 ENVIRONMENTAL SPECIFICATIONS

1.5.7.1 ENVIRONMENTAL

The **RS8** adheres to the following:

Parameter	Description		
Mechanical	**Vibration Testing: MIL-STD 810F, Method 514.5**		
	Category	**Platform**	**Life Phase**
	7: Jet	Aircraft	Transportation
	8: Propeller	Aircraft	Transportation
	10: Surface Ship	Ship	Transportation
	12: Jet	Aircraft	Operation
	21: Marine Vehicles	Surface Ship	Operation
	24: Minimum Integrity	All	Supplemental
	Shock Testing: MIL-STD 810F, Method 516.5		
	Procedure I: Functional Shock		
Climatic	**High Temperature Testing: MIL-STD 810F, Method 501.4**		
	Procedure I: Storage (Hot)		
	Procedure II: Operation (Hot)		
	Low Temperature Testing: MIL-STD 810F, Method 502.4		
	Procedure I: Storage (Basic Cold C1)		
	Procedure II: Operation (Basic Cold C1)		
	Humidity Testing: MIL-STD 810F, Method 507.4		
	Humidity Test (aggravated temperature and humidity cycle)		

Table 12: Specifications: Environmental

1.5.7.2 TEMPERATURE

The **RS8** adheres to the following:

Procedure	Temperature
Storage	• -30 °C to +60 °C.
Operation	• -30 °C to +60 °C.

Table 13: Specifications: Storage and Operational Temperature

The modem does not employ or require any additional external devices such as extraction fans for cooling.

1.5.7.3 EMC/EMI

Parameter	Description
EMC/EMI	**CE: Electromagnetic Compatibility (EMC)**
	Conducted Emissions, Power Leads (CE102)
	Radiated Emissions, Electric Field (RE102) (14 kHz – 1 GHz)
	Conducted Susceptibility, Power Leads (CS101)
	Conducted Susceptibility, Bulk Cable Injection (CS114)
	Radiated Emissions, Magnetic Field (RE101)
	Radiated Susceptibility, Magnetic Field (RS101)
	Radiated Susceptibility, Electric Field (RS103) (10 kHz – 1 GHz)

Table 14: Specifications: EMC/EMI

1.5.7.4 SAFETY

The **RS8** adheres to the following Safety Specifications:

Procedure	Directives and Regulations
No Asbestos	• European Directives: 76/769/EEC and 1999/77/EC • French Regulation: 96-1133 of December 1996
No Radio Nuclide	• European Directives: 96/29/EURATOM of May, 1996 • French Regulation: L.1333-1 to 20, R.1333-75 to 93 and law 2006-686 of June, 2006 relative to nuclear security
REACH - No Harmful Substances	• REACH Regulation: 1907/2006/CE
RoHS	• European Directive: 2002/95/CE

Table 15: Specifications: Safety

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2 INSTALLATION AND TESTING

2.1 FRONT PANEL

The **RS8** is locally operated via the front panel. The keypad and graphical display are designed for easy operation of the modem. LED indications help to assess the operational status of a rack-mount system.

The front panel of the unit is shown in Figure 4 below.

Figure 4: RS8 Modem Front Panel Layout

Figure 4 identifies the following:

Control/Indicator	Description
POWER Switch	• Mains Power On/Off switch
Status LED indicators	• TX: Currently not used • RX: Currently not used • ALE: Currently not used
LCD	• Graphical Liquid Crystal Display (32 x 202 pixels)
ESC Key	• Used for MENU functions and control (can be soft-assigned in the menu system)
ENTER Key	• Used for MENU functions and control (can be soft-assigned in the menu system)
NAVIGATION Keys	• Used for up/down, left/right navigation in MENU for parameter setup and control
ALPHANUMERIC Keys	• Used for parameter and data input in cases where there is not a list to select options from

Table 16: RS8 Modem Front Panel Controls and Indicators

2.2 REAR PANEL

2.2.1 OVERVIEW OF REAR PANEL INTERFACES

The **RS8** rear panel with external interfaces is shown in Figure 5.

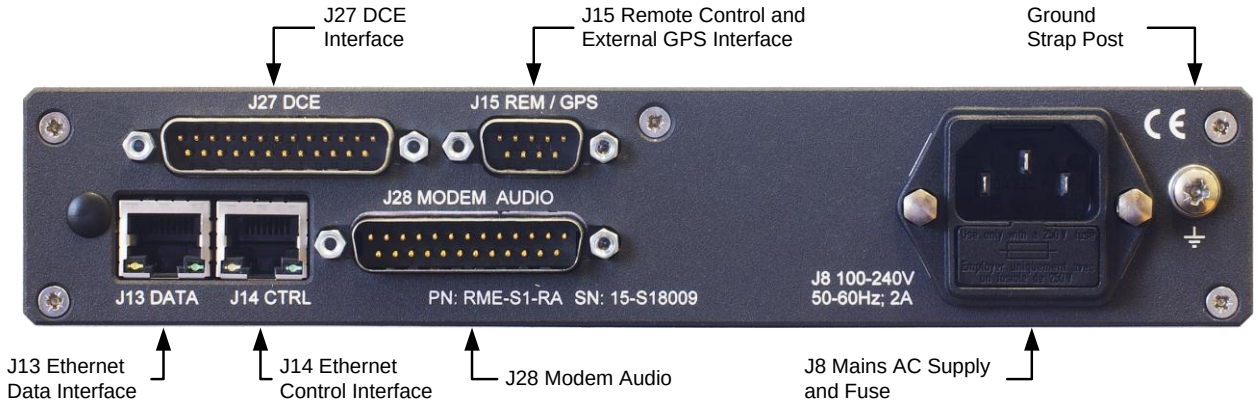


Figure 5: RS8 Rear Panel Layout

An overview of the **RS8** modem external interfaces is given in Table 17.

MARKING	INTERFACE	DESCRIPTION
J8 100-240V	AC Mains supply	100-240 VAC at 50 to 60 Hz ; 2A
GND	Ground Screw	Ground strap connection
J27 DCE	DCE Interface	Currently not used
J28 MODEM AUDIO	UART and Radio Interfaces	2x RS-232 / UART 2x Audio channels, 600 ohm balanced
J13 DATA	Ethernet Data Interface	Currently not used
J14 CTRL	Ethernet Control Interface	10/100 BASE-T Ethernet port for Control Protocol: TCP/IP
J15 REM / GPS	Remote Control	RS-232

Table 17: Overview: Rear panel Interfaces

2.3 System Setup

2.3.1 Safety Precautions

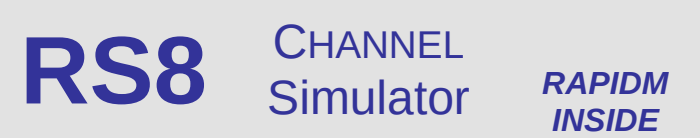
Before proceeding with the installation of the **RS8** unit, please read and observe Safety Guidelines at the front of this manual.

2.3.2 Powering Up

The unit must only be connected to a 100–240 VAC mains or 6–36 VDC supply. Please ensure that the Earth terminal is connected. Ensure that the power cables are routed away from sharp edges, near rolling chairs or operating surfaces.

A number of initial tests can be done to ensure that the modem is operating correctly. Perform the following procedure to power up the **RS8** unit:

- Turn on the power switch.
- After a short delay the *splash screen* message will be displayed on the per function Liquid Crystal Displays (LCDs) on the front panel:



- This indicates that the modem has started the Boot Program.
- A continuous stream of messages will appear indicating the boot program progress:

- Following the Boot Program, the modem will start the power-on Built-in Test (BIT).
- After a few seconds, the LCD will show the operational screen reflecting the current channel simulator operating parameters.
- After a successful power-up the **RS8** is ready for use.

ATTENTION:

- If the power up sequence does not occur as indicated or the LCD displays a **BIT**, **ERR**, **FLT** or **FAIL** status indicator field after Power Up, refer to Section 12 for modem Fault-Finding.

2.3.3 WB HFCS Configuration: Selecting a Default Preset

To ensure the **RS8** is in a known state before continuing, it is recommended that a Preset is loaded to restore the WB HFCS to its default state.

Perform the following steps to configure the **RS8** modem:

- Press ESC (4x) to ensure that no menu or short-cut items are selected.
- Press ENTER to access the main menu.
- Press ▲ and ▼ keys on the navigation button to access the 'Presets' menu.
- Press ENTER, ▼ keys and ENTER again to select 'Factory Presets'.
- Press ENTER, ▼ keys and ENTER again to select 'WB HFCS Presets'.
- Press ENTER to select the preset # 1: 'WB HFCS defaults'.
- Press ENTER to accept the selection.

2.3.4 AUDIO CONNECTION

The first step involves the physical connection of the modems to the **RS8**s ***J28 MODEM AUDIO/CTRL*** port. Make absolutely sure that the correct physical connections exist between the modems and the **RS8** before switching on any of the devices.

The **RS8** *WB HF Channel Simulator* has a transformer coupled audio interface designed to work with a 600-ohm balanced load for input and output signals. This should be connected to the same impedance input and output for the modems.

The **RS8** *WB HF Channel Simulator* will generally be used for **SSB** (Single Side Band) testing. However, it can also be used for **2-ISB** (Independent Side Band) testing. For the 2-ISB testing 2 **RS8** Channel Simulators are required.

2.3.4.1 SSB AUDIO CONNECTIONS

Figure 6 gives a block diagram of the **RS8** audio connections with two modems for SSB mode testing. In the diagram the forward path is Modem 1 → Modem 2 while the reverse path is Modem 2 → Modem 1.

Figure 6 shows how the Rx/Tx audio connections of the modems should be connected to the In/Out audio connections of the Audio 1 and Audio 2 of the **RS8** for SSB mode. These connections should be made using the labelled banana connectors from the ***J28 MODEM AUDIO/CTRL*** port connector cable supplied with the **RS8**.

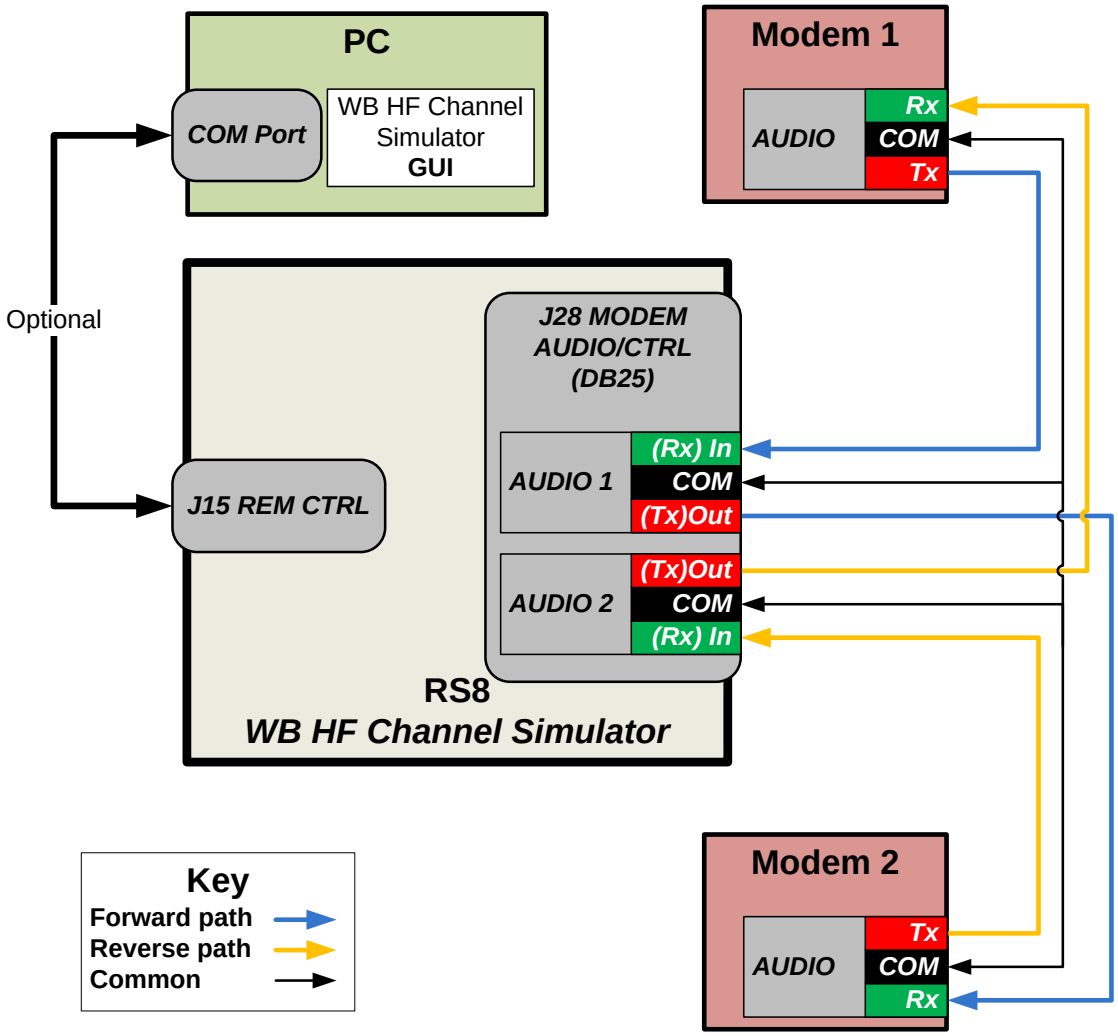


Figure 6: SSB audio connection of the RS8 with two modems

2.3.4.2 2-ISB AUDIO CONNECTIONS

Figure 7 gives a block diagram of the audio connections required for 2-ISB mode testing using 2 **RS8**s and two modems. In the diagram the forward path is Modem 1 → Modem 2 while the reverse path is Modem 2 → Modem 1. With 2-ISB mode 2 channels are needed for the forward path and two for the reverse path. Therefore 2 ***RS8*** *HF & V/UHF Channel Simulators* are required – one for each of the forward and reverse paths.

Figure 7 shows how the Rx/Tx audio connections of the modems should be connected to the In/Out audio connections of Audio 1 and Audio 2 of the **RS8**s for 2-ISB mode. These connections should be made using the labelled banana connectors from the ***J28 MODEM AUDIO/CTRL*** port connector cables, supplied with the **RS8**s.

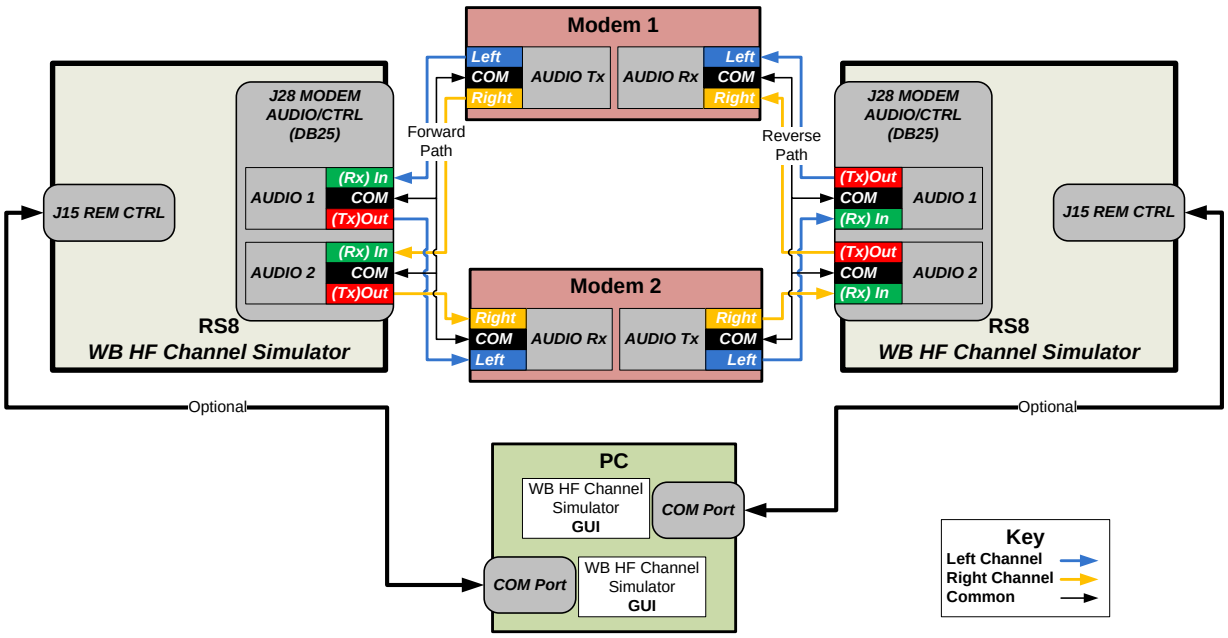


Figure 7: 2-ISB audio connections of the two RS8s with two modems

Before connecting the audio cables, ensure that the **RS8** and the modems are switched off.

2.3.5 CONNECTION TO PC

The ***RS8*** *HF & V/UHF Channel Simulator* can be completely controlled via its front panel. However, it can also be controlled via a Graphical User Interface on the PC if desired. This may be done via either a RS-232 serial port cable or an Ethernet cable.

If using a serial connection, the **RS8** should be directly connected to a PC's serial RS-232 port from the **J15 REM CTRL** port with a Null Modem cable.

The settings given in Table 7 are to be used for the serial connection and the serial COM port of the PC used should be specified on the RS8 CS GUI to establish the connection. See Section 9 for more information on using the PC GUI.

If using a TCP/IP connection, the **RS8** should be connected to the network from the **J14 CTRL** Ethernet port with an Ethernet cable.

The settings given in Table 6 are to be used for the TCP/IP connection and the IP address of the RS8's J14 CTRL Port should be specified on the RS8 CS GUI to establish the connection. See Section 9 for more information on using the PC GUI.

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3 BASIC OPERATION

3.1 INTRODUCTION

The ***RS8*** *HF & V/UHF Channel Simulator* has a number of configurable parameters for both the channel simulator Configuration and Path Parameters section as well as the Interference section of the **RS8**.

A more detailed description of these parameters is given in Section 5.

3.2 CONFIGURATION OPTIONS

The configuration of the **RS8** can be changed in one of the following ways:

PRESET SELECTION	The **RS8** unit can be configured by choosing a **preset**. Selection of a preset will load a fixed configuration from the non-volatile memory of the unit.
FRONT PANEL CONFIGURATION	The ***RS8*** *HF & V/UHF Channel Simulator* can be set up individually **via the front panel** (main menu). The purpose of providing this option is to allow complete PC independence when running channel simulator tests.
REMOTE CONFIGURATION	The **RS8** modem units can be set up **via the J15 Remote Control Port** or **J14 Ethernet Ctrl Port**. The purpose of providing this option is to allow control of the modem parameters from a remote location. A *WB HF Channel Simulator PC GUI* is available for this purpose.

Table 18: Configuration Options

3.3 HFCS Operational Screen

3.3.1 HFCS Operational Screen: Default

An example of the operational screen during operation of the **RS8** in HFCS mode is shown in **Figure** 8. This is the default operational screen which is displayed. It displays information about the Configuration and Path Parameters of the WB HFCS and allows setting of various parameters via menu shortcuts.

The various information fields are listed below. The greyed-out letter fields are not directly accessible and indicate status information. The number fields indicate accessible indications and parameters where related settings can be edited via menu shortcuts.

The RS8 will automatically switch from HFCS mode to VHFCS mode depending on the Channel Preset that is selected. Either the HFCS operational screen of the VHFCS operational screen will be accessible on the front panel, but never both at the same time.

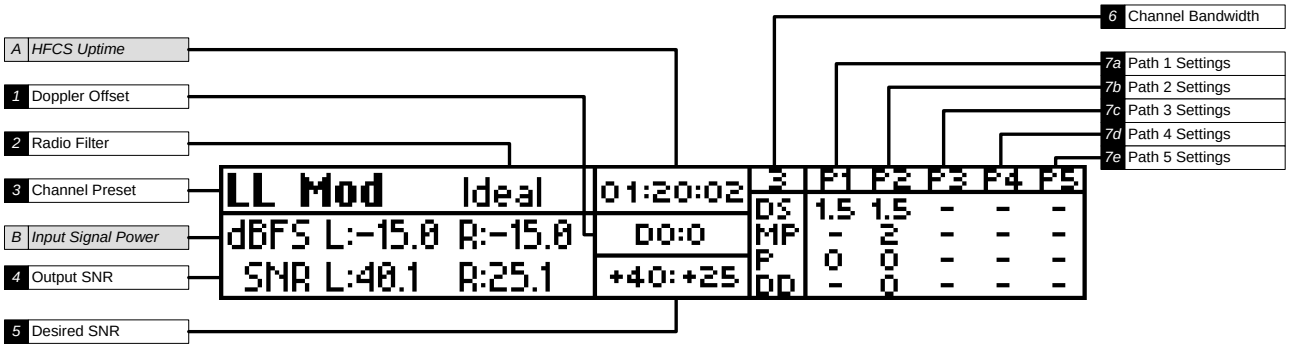


Figure 8: Default operational screen of the WB HFCS

1- Doppler Offset indication
Menu Shortcut to Doppler settings.
2- Radio Filter setting
Menu Shortcut.
3- Channel Preset setting
Menu Shortcut.
4- Output SNR indication
Menu Shortcut to Desired SNRs, Noise Bandwidth and SNR Meter Reset settings.
5- Desired SNR
Special Shortcut to adjust Desired SNR directly via the operational screen (opscreen).
6- Channel Bandwidth (kHz)
Menu Shortcut.
7a-e- Path 1-5 settings
Menu Shortcut.

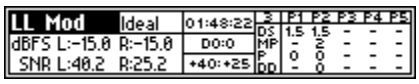
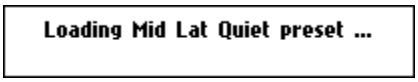
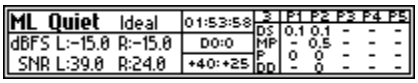
***A*- Channel Simulator Uptime**
Run time in the format of HH:MM:SS
***B*- Input Signal Power indicator**
The measured power of the input signal along with power units used.

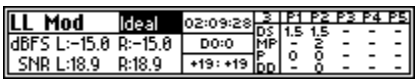
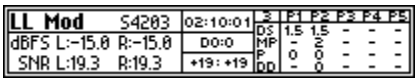
3.3.2 Shortcut Keys

Pressing the **ESC** and **LEFT ARROW** keys at the same time will cause the **RS8** to reset the SNR Meter.
The display of different operational screen can be accessed by pressing the **ESC** and ▼▲ navigation keys at the same time.

3.3.3 Operator Control: WB HFCS

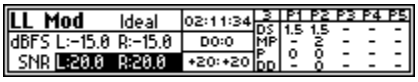
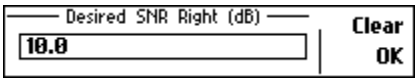
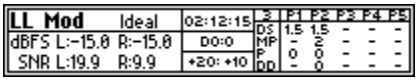
Operational Screen and Menu navigation is achieved via the **Navigation (◄►▲▼), ENTER** and **ESC** keys. To begin navigating around the operational screen, the **RIGHT ARROW (►)** must be pressed with the operational screen visible. The navigation keys allow selection of certain fields in the operational screen. Upon pressing **ENTER**, a shortcut is established directly to the relevant menu item so that the parameter can be changed. Some examples follow, showing the keystrokes and corresponding contents of the graphical display.

CHANNEL PRESET SETTING	KEYS	RESULTING SCREEN
In this example the Channel Preset configuration setting is changed from Low Latitude Moderate (LL Mod) to Mid Latitude Quite (ML Quiet). • **Navigate** to the desired field.	►	
• Press **ENTER** ('Menu' shortcut action). • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action). • Navigation will automatically return to the operational screen.	**ENTER** **▼ or ▲** **ENTER**	 
• Message window showing that the Channel Preset is loading.		
• Press **ESC**.	**ESC**	

RADIO FILTER SETTING	KEYS	RESULTING SCREEN
In this example the Radio Filter is changed from Ideal to S4203. • **Navigate** to the desired field.	► ►	
• Press **ENTER** ('Menu' shortcut action). • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action). • Navigation will automatically return to the operational screen.	**ENTER** **▼ or ▲** **ENTER**	
• Press **ESC**.	**ESC**	

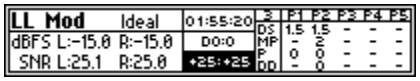
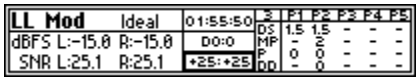
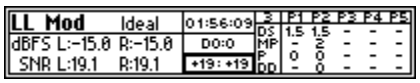
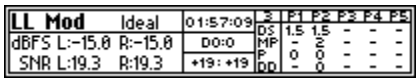
ATTENTION:

- The ***S4203*** radio filter is only available when using a channel bandwidth of **3 kHz**.
- If the **S4203** radio filter is selected and the bandwidth is changes from 3 kHz to another *higher bandwidth*, the radio filter is automatically change to **IDEAL** and a warning message is displayed.

SNR SETTINGS	KEYS	RESULTING SCREEN
In this example the Desired SNR of the right channel is changed from 20 to 10 dB. • **Navigate** to the desired field.	▶ ▼	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Noise Parameters'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	ENTER ▼ or ▲ ENTER	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	ESC 0-9	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	ENTER ESC ESC	

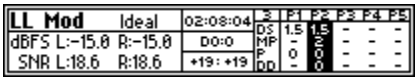
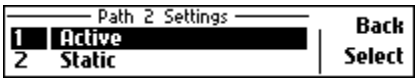
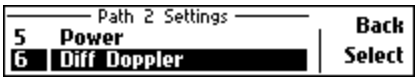
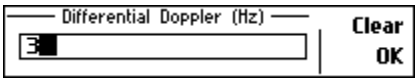
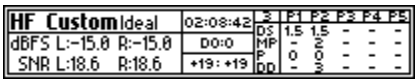
ATTENTION:

- When a **Desired SNR** value is changed, the SNR Meter is automatically reset so that the output SNR indicated on the opscreen is measured for the new SNR value.

DESIRED SNR SETTING	KEYS	RESULTING SCREEN
In this example the Desired SNR is changed from +25:+25 to +19:+19 for the left:right SNR values • **Navigate** to the desired field.	▶ ▼ ▶	
• Press **ENTER** ('Menu' shortcut action). • A *Special Shortcut* mode is entered to adjust Desired SNR directly from the operational screen window.	**ENTER**	
• Use the ▼ or ▲ **Navigate** buttons to adjust the desired SNR up and down. • The left and right values are adjusted together between the limits of -63 → +63. • Press **ESC** once the required value is reached. • **Navigate** in the menu to the desired setting,	**▼ or ▲** **ESC**	
• Press **ESC**.	**ESC**	

ATTENTION:

- Using this method, the left and right Desired SNR values are adjusted together.
- To independently adjust the left and right values, use the menu option or previous SNR shortcut setting.

PATH 2 SETTINGS	KEYS	RESULTING SCREEN
In this example the Differential Doppler value of the Path 2 Parameters is changed from 0 to 3 Hz. • **Navigate** to the desired field.	▶ ▶ ▶ ▶ ▶	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Path 2 Settings'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	**ENTER** **▼ or ▲** **ENTER**	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	**ESC** **0-9**	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	**ENTER** **ESC** **ESC**	

ATTENTION:

- When a Path Parameter setting is changed, the Channel Preset changes to **Custom** to indicate that it is no longer a preset used.
- The Settings menu for Path 1 is slightly different. It is always Active and does not have Differential Doppler or Multipath Delay settings – so these options are not displayed. However, the settings menus for Paths 2 – 5 are identical.

3.4 VHFCS Operational Screen

3.4.1 VHFCS Operational Screen: Default

An example of the operational screen during operation of the **RS8** in VHFCS mode is shown in **Figure** 9. This is the default operational screen which is displayed. It displays information about the Configuration and Path Parameters of the WB VHFCS and allows setting of various parameters via menu shortcuts.

The various information fields are listed below. The greyed-out letter fields are not directly accessible and indicate status information. The number fields indicate accessible indications and parameters where related settings can be edited via menu shortcuts.

The RS8 will automatically switch from HFCS mode to VHFCS mode depending on the Channel Preset that is selected. Either the HFCS operational screen of the VHFCS operational screen will be accessible on the front panel, but never both at the same time.

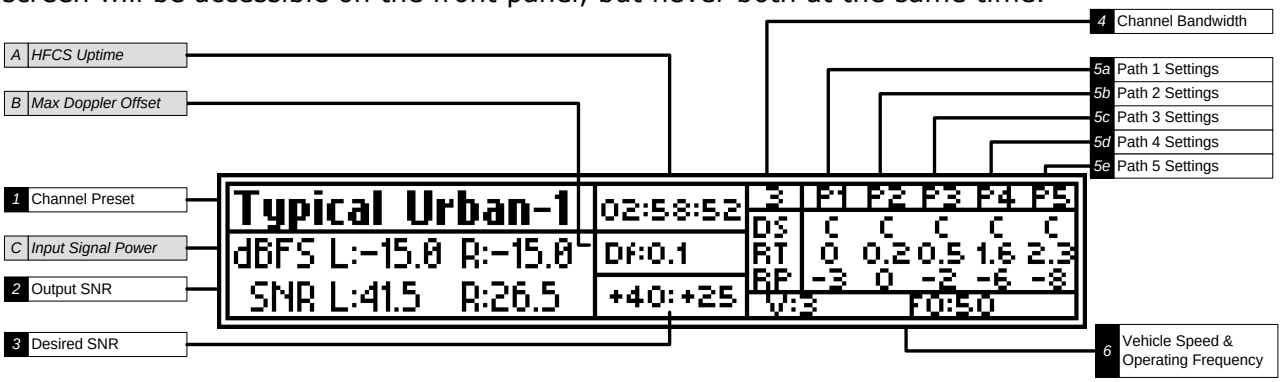


Figure 9: Default operational screen of the WB VHFCS

1- Channel Preset setting
Menu Shortcut.
2- Output SNR indication
Menu Shortcut to Desired SNRs, Noise Bandwidth and SNR Meter Reset settings.
3- Desired SNR
Special Shortcut to adjust Desired SNR directly via the opscreen.
4- Channel Bandwidth (kHz)
Menu Shortcut.
5a-e- Path 1-5 settings
Menu Shortcut.
6- Vehicle Speed (km/h) & Operating Frequency (MHz)
Menu Shortcut to VHF config settings

***A*- Channel Simulator Uptime**
Run time in the format of HH:MM:SS
***B*- Max Doppler Offset indicator**
Max Doppler offset of current configuration.
***C*- Input Signal Power indicator**
The measured power of the input signal along with power units used.

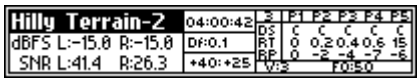
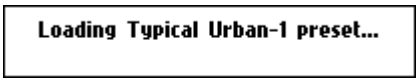
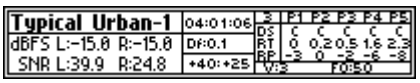
3.4.2 Shortcut Keys

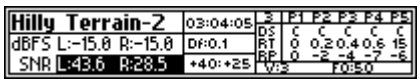
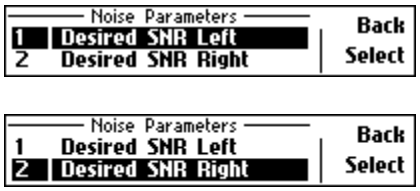
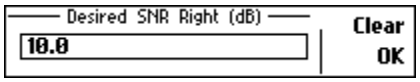
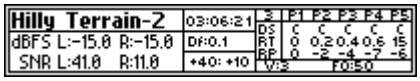
Pressing the **ESC** and **LEFT ARROW** keys at the same time will cause the **RS8** to reset the SNR Meter.

The display of different operational screen can be accessed by pressing the **ESC** and ▼▲ navigation keys at the same time.

3.4.3 OPERATOR CONTROL: WB VHFCS

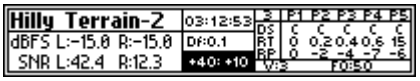
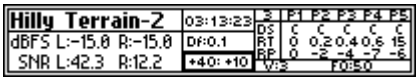
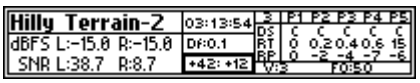
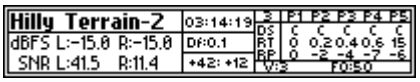
Operational Screen and Menu navigation is achieved via the **Navigation (◄►▲▼)**, **ENTER** and **ESC** keys. To begin navigating around the operational screen, the **RIGHT ARROW (►)** must be pressed with the operational screen visible. The navigation keys allow selection of certain fields in the operational screen. Upon pressing **ENTER**, a shortcut is established directly to the relevant menu item so that the parameter can be changed. Some examples follow, showing the keystrokes and corresponding contents of the graphical display.

CHANNEL PRESET SETTING	KEYS	RESULTING SCREEN
In this example the Channel Preset configuration setting is changed from Hilly Terrain-2 to Typical Urban-1. • **Navigate** to the desired field.	►	
• Press **ENTER** ('Menu' shortcut action). • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action). • Navigation will automatically return to the operational screen.	**ENTER** **▼ or ▲** **ENTER**	 
• Message window showing that the Channel Preset is loading.		
• Press **ESC**.	**ESC**	

SNR SETTINGS	KEYS	RESULTING SCREEN
In this example the Desired SNR of the right channel is changed from 25 to 10 dB. • **Navigate** to the desired field.	▶ ▼	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Noise Parameters'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	ENTER ▼ or ▲ ENTER	
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	ESC 0-9	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	ENTER ESC ESC	

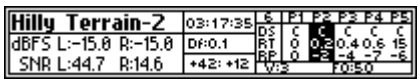
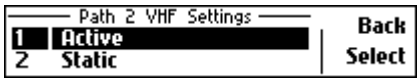
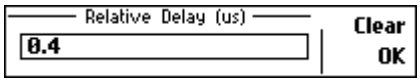
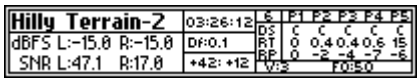
ATTENTION:

- When a **Desired SNR** value is changed, the SNR Meter is automatically reset so that the output SNR indicated on the opscreen is measured for the new SNR value.

DESIRED SNR SETTING	KEYS	RESULTING SCREEN
In this example the Desired SNR is changed from +40:+10 to +42:+12 for the left:right SNR values • **Navigate** to the desired field.	▶ ▼ ▶	
• Press **ENTER** ('Menu' shortcut action). • A *Special Shortcut* mode is entered to adjust Desired SNR directly from the operational screen window.	**ENTER**	
• Use the ▼ or ▲ **Navigate** buttons to adjust the desired SNR up and down. • The left and right values are adjusted together between the limits of -63 → +63. • Press **ESC** once the required value is reached. • **Navigate** in the menu to the desired setting,	**▼ or ▲** **ESC**	
• Press **ESC**.	**ESC**	

ATTENTION:

- Using this method, the left and right Desired SNR values are adjusted together.
- To independently adjust the left and right values, use the menu option or previous SNR shortcut setting.

PATH 2 SETTINGS	KEYS	RESULTING SCREEN
In this example the Relative Time delay of the Path 2 Parameters is changed from 0.2 to 0.4 us. • **Navigate** to the desired field.	▶ ▶ ▶ ▶ ▶	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Path 2 VHF Settings'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	**ENTER** **▼ or ▲** **ENTER**	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	**ESC** **0-9**	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	**ENTER** **ESC** **ESC**	

ATTENTION:

- The VHFCS supports up to 6 paths, it is however only possible to access shortcuts for paths 1 – 5 via the front panel, to change parameters for path 6 the menu structure has to be used.

3.5 Interference Operational Screen

3.5.1 Interference Operational Screen: default

An example of the Interference operational screen during operation of the **RS8** is shown in **Figure** 10. It displays information about the Interference Parameters of the WB HFCS and allows setting of various interference parameters via menu shortcuts.

The various information fields are listed below. The number fields indicate accessible indications and parameters where related settings can be edited via menu shortcuts.

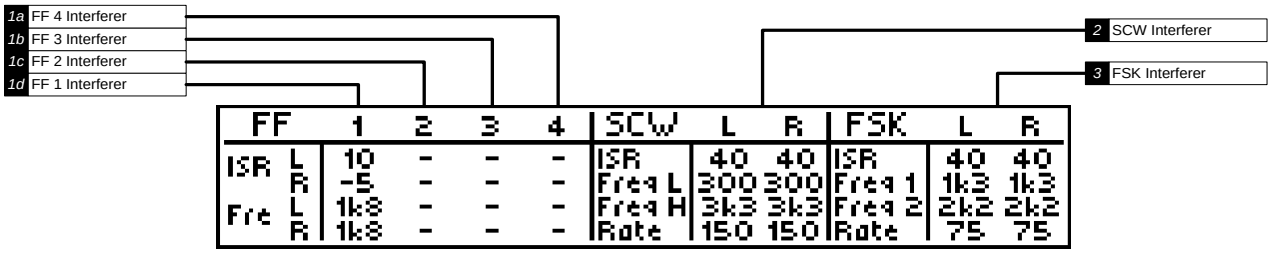


Figure 10: Interference operational screen of the WB HFCS

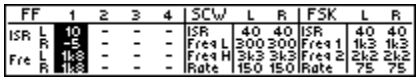
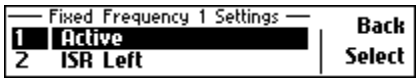
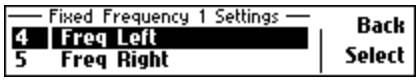
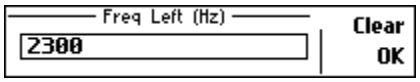
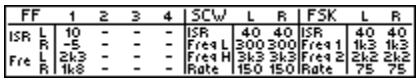
1a-d- Fixed Frequency 1 – 4 settings
Menu Shortcut.
2- Swept Continuous Wave settings
Menu Shortcut.
3- FSK waveform settings
Menu Shortcut.

3.5.2 Shortcut Keys

The display for the operational screen can be accessed by pressing the **ESC** and ▼▲ navigation keys at the same time. This scrolls between the Default and Interference operational screens.

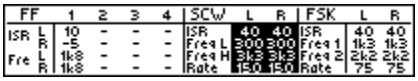
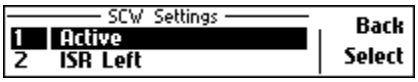
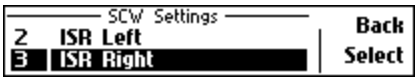
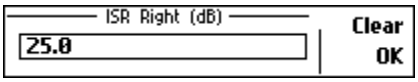
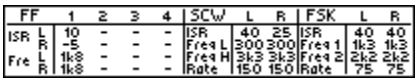
3.5.3 Operator Control: Interference

Operational Screen and Menu navigation is achieved via the **Navigation (◄►▲▼)**, **ENTER** and **ESC** keys. To begin navigating around the operational screen, the **RIGHT ARROW (►)** must be pressed with the operational screen visible. The navigation keys allow selection of certain fields in the operational screen. Upon pressing **ENTER**, a shortcut is established directly to the relevant menu item so that the parameter can be changed. Some examples follow, showing the keystrokes and corresponding contents of the graphical display.

FIXED FREQUENCY 1 SETTINGS	KEYS	RESULTING SCREEN
In this example the Frequency of the left channel for the Fixed Frequency 1 Interferer is changed from 1800 to 2300 Hz. • **Navigate** to the desired field.	►	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Fixed Frequency 1 Settings'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	**ENTER** **▼ or ▲** **ENTER**	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	**ESC** **0-9**	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	**ENTER** **ESC** **ESC**	

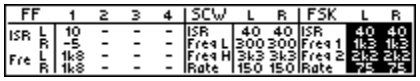
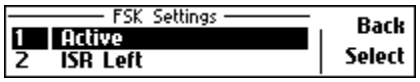
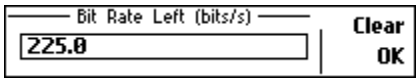
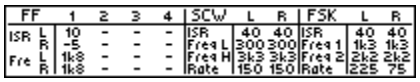
ATTENTION:

- When a specific interferer is not active (**Disabled**), dashes (**-**) are shown for all its parameter values.
- All Fixed Frequency interferers have the same settings.
- In VHFCS mode enabling any Fixed Frequency interferer will limit the number of active paths to 2.

SWEPT CONTINUOUS WAVE SETTINGS	KEYS	RESULTING SCREEN
In this example the ISR of the right channel for the Swept Continuous Wave interferer is changed from 40 to 25 dB. • **Navigate** to the desired field.	▶ ▶ ▶ ▶ ▶	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'SCW Settings'. • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	**ENTER** **▼ or ▲** **ENTER**	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	**ESC** **0-9**	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	**ENTER** **ESC** **ESC**	

ATTENTION:

- In VHFCS mode enabling a SCW interferer will limit the number of active paths to 2.

FSK WAVEFORM SETTINGS	KEYS	RESULTING SCREEN
In this example the Data Rate of the left channel for the FSK Waveform interferer is changed from 75 to 225 bits/s. • **Navigate** to the desired field.	► ◄	
• Press **ENTER** ('Menu' shortcut action). • This brings up a second menu structure of 'Noise Parameters' • **Navigate** in the menu to the desired setting. • Press **ENTER** ('Select' action).	**ENTER** **▼ or ▲** **ENTER**	 
• This brings up a numerical input block. • Press **ESC** repeatedly until the current entry has been cleared. • Use the **Alphanumeric** keypad to enter the desired value.	**ESC** **0-9**	
• Press **ENTER**, then **ESC** ('Back' action), then **ESC** once again.	**ENTER** **ESC** **ESC**	

ATTENTION:

- In VHFCS mode FSK interference is not enabled and attempting to enable an FSK interferer will result in an error message.

4 ELECTRICAL INTERFACES

4.1 CONNECTOR PIN DEFINITION

4.1.1 J8 MAINS

The signals and associated pins on the J8 Mains port are listed in Table 19.

Pin	Signal Name	Direction (Relative to RS8)	Description
1	**Protective Earth (PE)**	Ground	Connected to ground
2	**Neutral (N)**	Input	Neutral or mid-point lead of AC mains supply
3	**Line (L)**	Input	Single phase line lead of AC mains supply
-	**Fuse**	-	2A slow blow, 250 VAC

Table 19: Specifications: J8 Mains: Connector Pin Definition

4.1.2 J28 MODEM AUDIO/CTRL PORT

The signals and associated pins on the J28 MODEM AUDIO/CTRL Port port are listed in Table 20 and Table 21.

Pin	Signal Name	Direction (Relative to RS8)	Description
3	**AUD1_TX+**	Output	Radio Audio I/F (USB): Audio 1 Transmit, balanced 600Ω transformer
15	**AUD1_TX-**		
2	**AUD1_RX+**	Input	Radio Audio I/F (USB): Audio 1 Receive, balanced 600Ω transformer
14	**AUD1_RX-**		
8	**AUD2_TX+**	Output	Radio Audio I/F (LSB): Audio 2 Transmit, balanced 600Ω transformer
20	**AUD2_TX-**		
23	**AUD2_RX+**	Input	Radio Audio I/F (LSB): Audio 2 Receive, balanced 600Ω transformer
22	**AUD2_RX-**		
6	**AUD2_AUX_TX+**	Output	Headset Audio I/F: Aux Audio 2 Transmit, balanced 600Ω transformer
19	**AUD2_AUX_TX-**		
25	**AUD2_AUX_RX+**	Input	Headset Radio Audio I/F: Aux Audio 2 Receive, balanced 600Ω transformer
24	**AUD2_AUX_RX-**		
5	**AUD1_KEY_CC+**	Output	Radio Audio I/F: Key-line 1 Contact Closure A *(PTT output to radio)*: Shorts to pin 13 when active *(Note: externally connect (short) pin 13 to pin 7 (GND) to use pin 5 as Open Collector output, e.g. to radio's PTT input)*
13	**AUD1_KEY_CC-**		Radio Audio I/F: Key-line 1 Contact Closure B *(PTT output to radio)*: Shorts to pin 5 when active *(Note: externally connect (short) pin 13 to pin 7 (GND) to use pin 5 as Open Collector output, e.g. to radio's PTT input)*
4	**AUD2_KEY_CC+**	Output	Radio Audio I/F: Key-line 2 Contact Closure A *(PTT output to radio)*: Shorts to pin 1 when active *(Note: externally connect (short) pin 4 to pin 7 (GND) to use pin 1 as Open Collector output (Note: externally connect (short) pin 1 to pin 7 to use pin 4 as Open Collector output, e.g. to radio's PTT input)*
1	**AUD2_KEY_CC-**		Radio Audio I/F: Key-line 2 Contact Closure B *(PTT output to radio)*: Shorts to pin 4 when active *(Note: externally connect (short) pin 1 to pin 7 (GND) to use pin 1 as Open Collector output (Note: externally connect (short) pin 1 to pin 7 to use pin 4 as Open Collector output, e.g. to radio's PTT input)*
18	**AUD1_PTT_IN**	Input	Radio Audio I/F: PTT input 1: Senses closure to RADIO_CTRL_AUDIO_GND (pin 7)
17	**AUD2_PTT_IN**	Input	Headset Audio I/F: PTT input 2: Senses closure to RADIO_CTRL_AUDIO_GND (pin 7) *(Used to sense when PTT on Headset has been pressed)*
21	**N/C**	-	Do Not Connect
16	**N/C**	-	Do Not Connect

Table 20: Specifications: J28 MODEM AUDIO/CTRL Port Port: Connector Pin Definitions 1

Pin	Signal Name	Direction (Relative to RS8)	Description
12	**RADIO_CTRL1_TX**	Output	Radio Control I/F: **RS-232 Mode:** Radio Control 1 Transmit Data **TTL Mode:** Radio Control 1 Transmit Data *(TTL)* **1-wire Mode:** Radio Control 1 1-wire Open-Collector bus *(Transmit & Receive Half-Duplex)*
11	**RADIO_CTRL1_RX**	Input	Radio Control I/F: **RS-232 Mode:** Radio Control 1 Receive Data **TTL Mode:** Radio Control 1 Receive Data *(TTL)* **1-wire Mode:** Unused
10	**RADIO_CTRL2_TX**	Output	Radio Control I/F: **RS-232 Mode:** Radio Control 2 Transmit Data **TTL Mode:** Radio Control 2 Transmit Data *(TTL)* **1-wire Mode:** Radio Control 2 1-wire Open-Collector bus *(Transmit & Receive Half-Duplex)*
9	**RADIO_CTRL2_RX**	Input	Radio Control I/F: **RS-232 Mode:** Radio Control 2 Receive Data **TTL Mode:** Radio Control 2 Receive Data *(TTL)* **1-wire Mode:** Unused
7	**RADIO_CTRL_ AUDIO_GND**	Ground	Radio Audio I/F, Radio Control I/F, Aux I/F: Signal and Power Reference / Return

Table 21: Specifications: J28 MODEM AUDIO/CTRL Port: Connector Pin Definitions 2

4.1.3 J14 ETHERNET CTRL PORT

The signals and associated pins on the J14 ETHERNET CTRL port are listed in Table 22.

Pin	Signal Name	Direction (Relative to RS8)	Description
1	**ETH_CTRL_TX+**	Output	Transmit data
2	**ETH_CTRL_TX-**		
3	**ETH_CTRL_RX+**	Input	Receive data
6	**ETH_CTRL_RX-**		
4	**N/C**	-	Do Not Connect
5	**N/C**	-	Do Not Connect
7	**N/C**	-	Do Not Connect
8	**N/C**	-	Do Not Connect

Table 22: Specifications: J14 ETHERNET CTRL Port: Connector Pin Definition

A summary of the interface protocol for the J14 ETHERNET CTRL port are listed in Table 23.

Parameter	Description
Electrical	10/100-BASE T Ethernet port
Data Format	Transmission Control Protocol/Internet Protocol (TCP/IP)
S/W Protocol	*RAP1/RIPC/TCP/IP* Control Protocol.

Table 23: Specifications: J14 ETHERNET CTRL Port: Interface protocol summary

4.1.4 J15 REM / GPS PORT

The signals and associated pins on the J15 REM / GPS port are listed in Table 24.

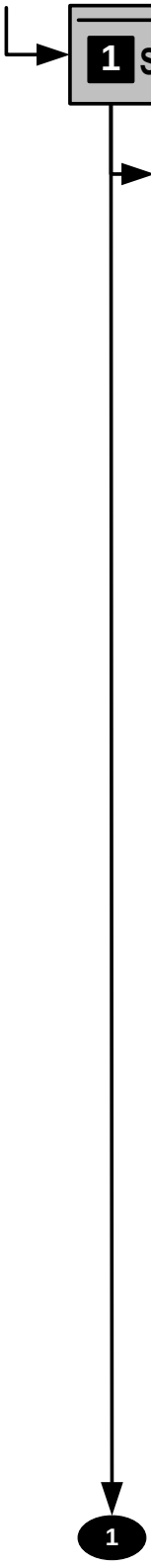
Pin	Signal Name	Direction (Relative to RS8)		Description
		RS-232	RS-422	
1	**REM_CTRL_RX_B** TIA: BB CCITT: 104	Hi-Z	Input	Remote Control I/F: **RS-232 mode:** Unused **RS-422 mode:** Receive Data (+)
2	**REM_CTRL_RX_A** TIA: BB CCITT: 104	Input	Input	Remote Control I/F: **RS-232 mode:** Receive Data **RS-422 mode:** Receive Data (-)
3	**REM_CTRL_TX_A** TIA: BA CCITT: 103	Output	Output	Remote Control I/F: **RS-232 mode:** Transmit Data **RS-422 mode:** Transmit Data (–)
4	**REM_CTRL_TX_B** TIA: BA CCITT: 103	Hi-Z	Output	Remote Control I/F: **RS-232 mode:** Unused **RS-422 mode:** Transmit Data (+)
5	**REM_CTRL_GPS_GND** TIA: AB CCITT: 102	Ground	Ground	Remote Control / External GPS I/F: Signal and Power Return
6	**GPS_PPS** TIA: - CCITT: -	Input	N/A	External GPS I/F: 1 pulse-per-second
7	**GPS_TX** TIA: BA CCITT: 103	Output	N/A	External GPS I/F: RS-232 Transmit Data
8	**GPS_RX** TIA: BB CCITT: 104	Input	N/A	External GPS I/F: RS-232 Receive Data
9	**REM_CTRL_GPS_5V_OUT** TIA: - CCITT: -	Output	N/A	Remote Control / External GPS I/F: Switched +5VDC Supply Output

Table 24: Specifications: J15 REM / GPS Port: Connector Pin Definition

5 RS8 SETTINGS MENU

5.1 MENU DIAGRAM

The menu for Settings is shown is the figures below. Menu navigation is achieved via the **Navigation (◄►▲▼)**, **ENTER** and **ESC** soft keys.



Desired SNR Left	*-63 to 63 dB (decimal, 0.5 resolution)*		
Desired SNR Right	*-63 to 63 dB (decimal, 0.5 resolution)*		
Noise Bandwidth	*HF:* *3000 Hz* *6000 Hz*	*VHF:* *3000 Hz* *6000 Hz* *12000 Hz* *24000 Hz*	
Noise Bandwidth Centre Frequency	*1800 to 46500 Hz (integer)* *Depending on Noise Bandwidth selected*		
Channel Preset	*HF-Custom* *HF-Gaussian* *HF-CCIR Good* *HF-CCIR Moderate* *HF-CCIR Poor* *HF-Low Lat Quiet* *HF-Low Lat Moderate* *HF-Low Lat Disturbed* *HF-Mid Lat Quiet* *HF-Mid Lat Moderate* *HF-Mid Lat Disturbed* *HF-Mid Lat Disturbed VI* *HF-High Lat Quiet* *HF-High Lat Moderate* *HF-High Lat Disturbed* *HF-Rician*	***HFCS mode***	
	VHF-Custom *VHF-Rural Area-1* *VHF-Rural Area-2* *VHF-Hilly Terrain-1* *VHF-Hilly Terrain-2* *VHF-Typical Urban-1* *VHF-Typical Urban-2* *VHF-Equalisation Test* *VHF-Very Small Cells*	***VHFCS mode***	
Radio Filter (*HF only)*	*Ideal* *S4203*		
1kHz Test Tone	*Disabled* *Enabled*		
Input Gain	*0, 3, 6, 9, 12, 15, 18, 21 or 24 dB*		
Output Gain	*-20 to 20 dB (integer)*		

Figure 11: Menu: Settings: Part 1 of 5

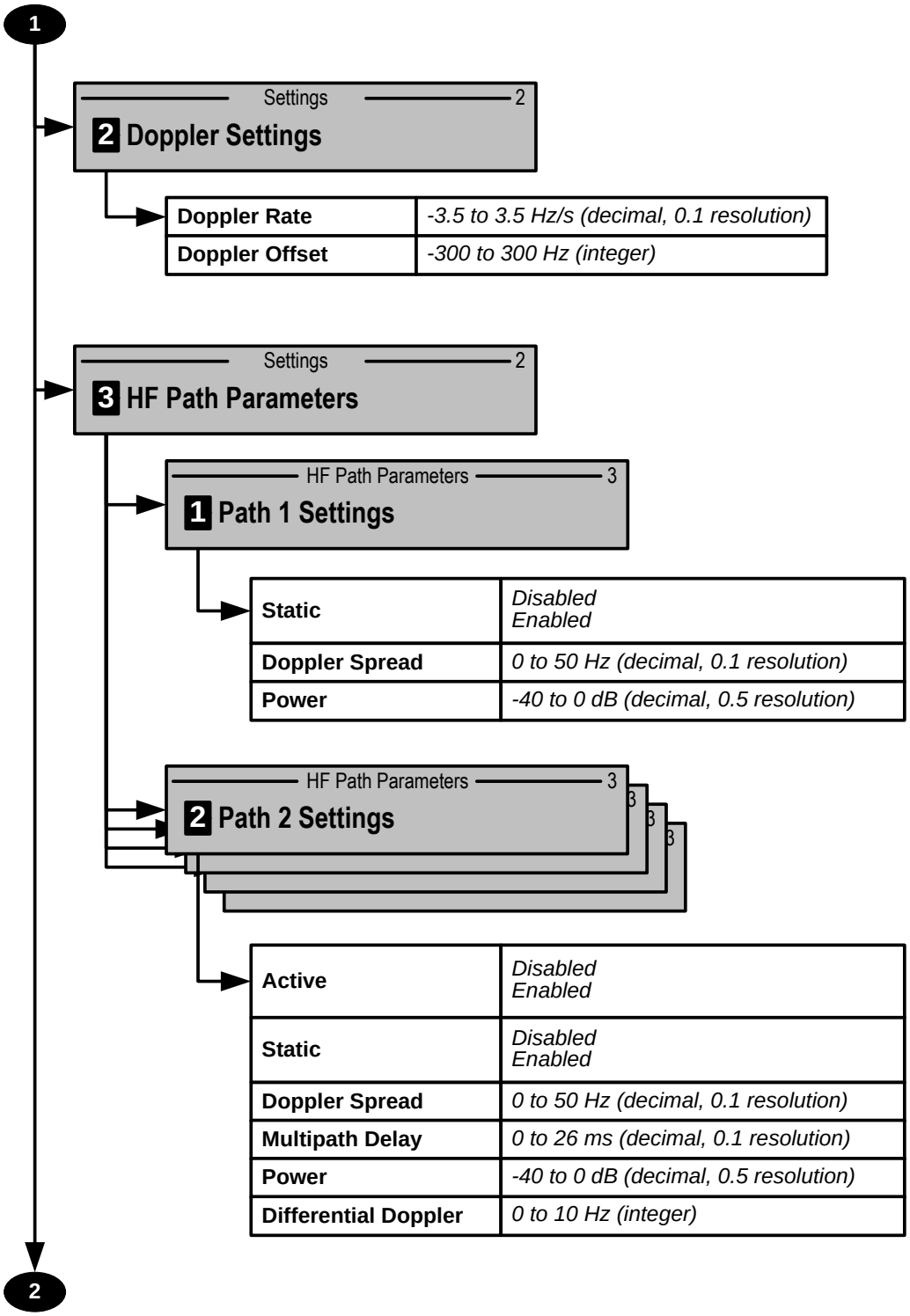


Figure 12: Menu: Settings: Part 2 of 5

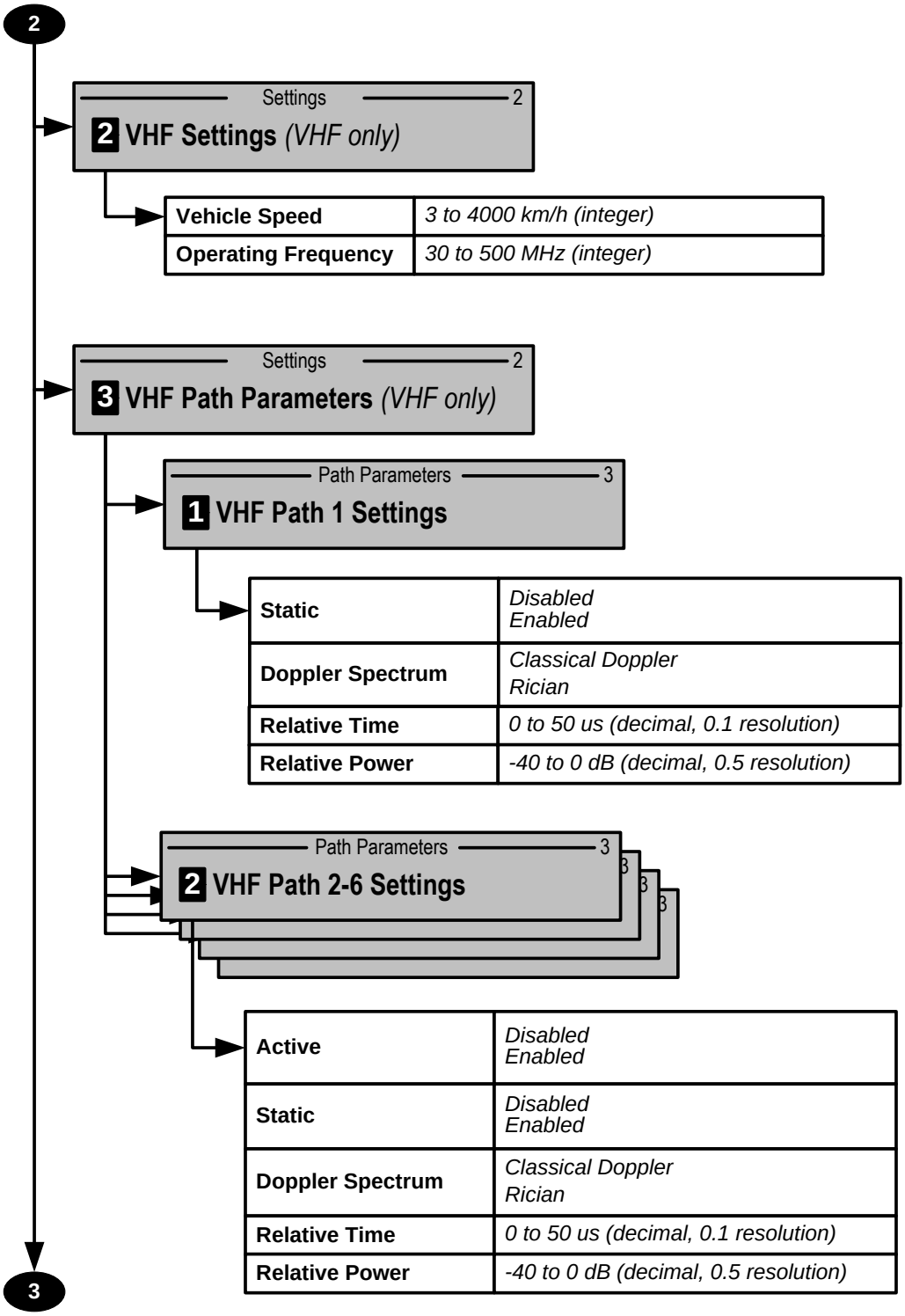
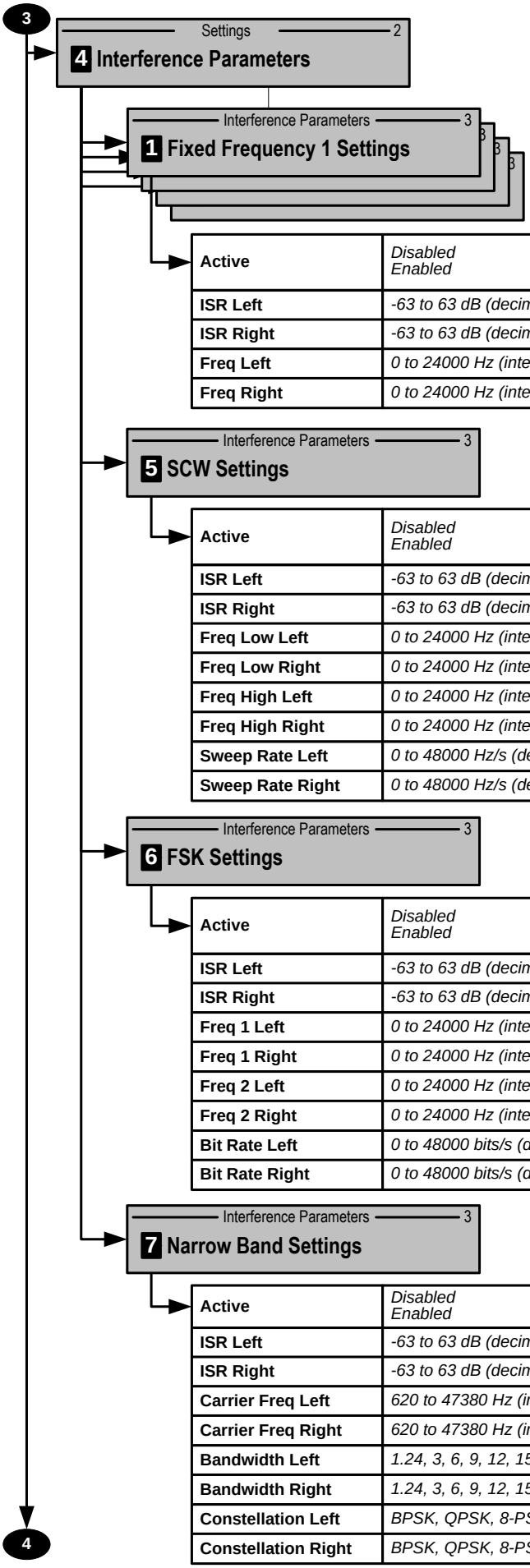


Figure 13: Menu: Settings: Part 3 of 5



Active	*Disabled* *Enabled*
ISR Left	*-63 to 63 dB (decimal, 0.5 resolution)*
ISR Right	*-63 to 63 dB (decimal, 0.5 resolution)*
Freq Left	*0 to 24000 Hz (integer)*
Freq Right	*0 to 24000 Hz (integer)*

Active	*Disabled* *Enabled*
ISR Left	*-63 to 63 dB (decimal, 0.5 resolution)*
ISR Right	*-63 to 63 dB (decimal, 0.5 resolution)*
Freq Low Left	*0 to 24000 Hz (integer)*
Freq Low Right	*0 to 24000 Hz (integer)*
Freq High Left	*0 to 24000 Hz (integer)*
Freq High Right	*0 to 24000 Hz (integer)*
Sweep Rate Left	*0 to 48000 Hz/s (decimal, 0.1 resolution)*
Sweep Rate Right	*0 to 48000 Hz/s (decimal, 0.1 resolution)*

Active	*Disabled* *Enabled*
ISR Left	*-63 to 63 dB (decimal, 0.5 resolution)*
ISR Right	*-63 to 63 dB (decimal, 0.5 resolution)*
Freq 1 Left	*0 to 24000 Hz (integer)*
Freq 1 Right	*0 to 24000 Hz (integer)*
Freq 2 Left	*0 to 24000 Hz (integer)*
Freq 2 Right	*0 to 24000 Hz (integer)*
Bit Rate Left	*0 to 48000 bits/s (decimal, 0.1 resolution)*
Bit Rate Right	*0 to 48000 bits/s (decimal, 0.1 resolution)*

Active	*Disabled* *Enabled*
ISR Left	*-63 to 63 dB (decimal, 0.5 resolution)*
ISR Right	*-63 to 63 dB (decimal, 0.5 resolution)*
Carrier Freq Left	*620 to 47380 Hz (integer)*
Carrier Freq Right	*620 to 47380 Hz (integer)*
Bandwidth Left	*1.24, 3, 6, 9, 12, 15, 18, 21 & 24 kHz*
Bandwidth Right	*1.24, 3, 6, 9, 12, 15, 18, 21 & 24 kHz*
Constellation Left	*BPSK, QPSK, 8-PSK, 16-QAM*
Constellation Right	*BPSK, QPSK, 8-PSK, 16-QAM*

Figure 14: Menu: Settings: Part 4 of 5

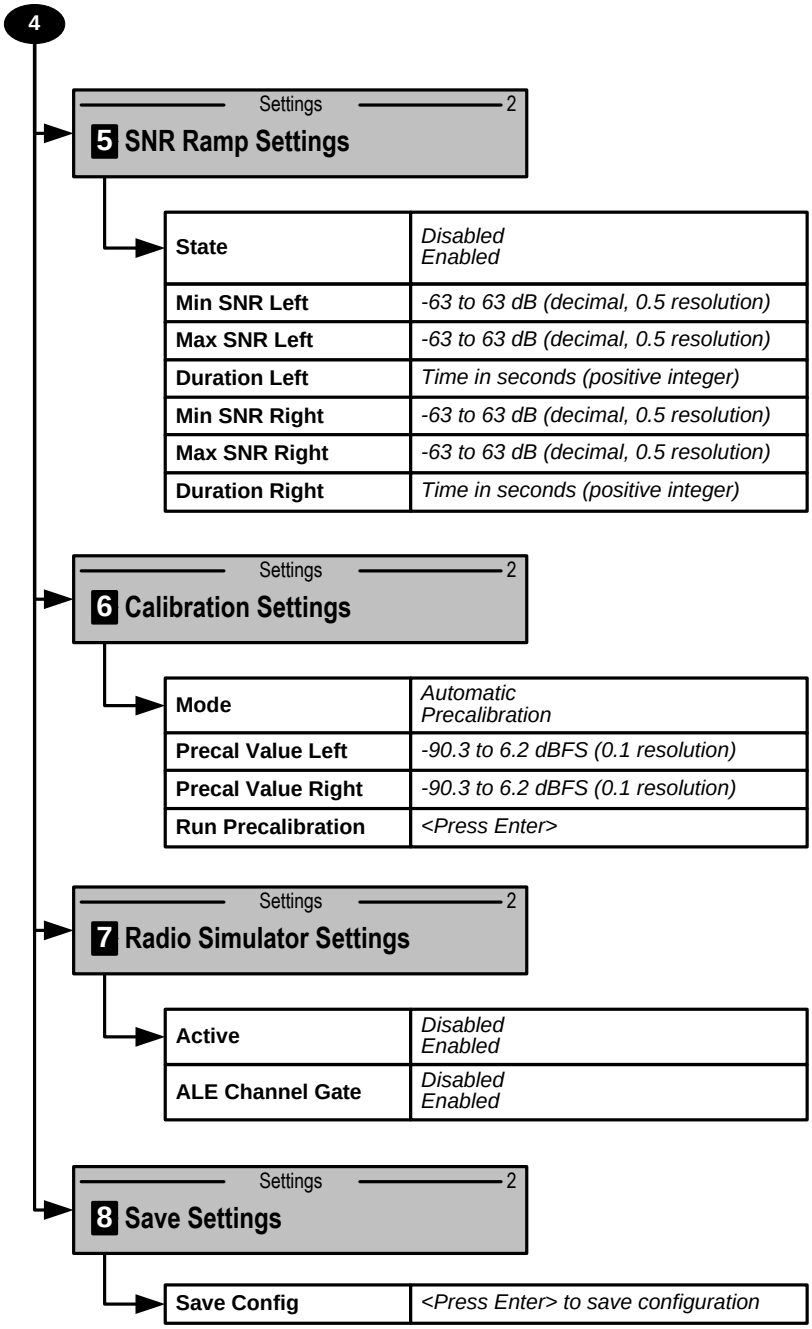
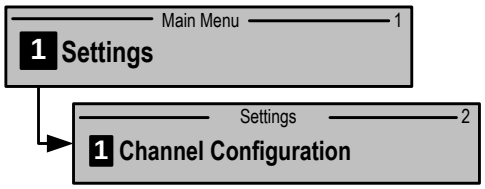


Figure 15: Menu: Settings: Part 5 of 5

5.2 CONFIGURATION

5.2.1 CHANNEL CONFIGURATION

The Channel Configuration is accessed from the Settings menu

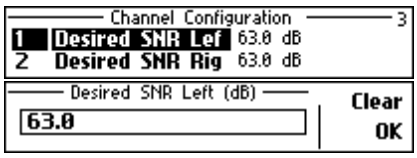


5.2.1.1 DESIRED SNR LEFT AND RIGHT

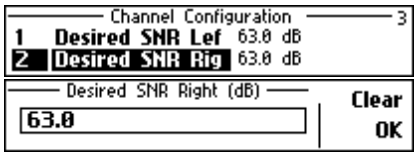
The **RS8** uses two channels, left and right. The SNR for each channel can be independently set. The Desired SNR is the signal-to-noise ratio wanted at the output of the channel simulator.

The Desired SNR can be set with a value in the range of -63 → 63 dB with a resolution of 0.5. The Desired SNR value is set on the fly – meaning the channel simulator engine is not restarted when this value is updated.

The Desired SNR Left value is set using this menu item.



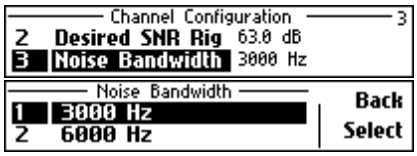
The Desired SNR Right value is set using this menu item.



5.2.1.2 NOISE BANDWIDTH

The Noise Bandwidth can be adjusted to allow narrowband testing. The bandwidth can be set to 3 or 6 kHz for HF channels and to 3, 6, 12 or 24 kHz for V/UHF channels.

The Noise Bandwidth is set using this menu item.

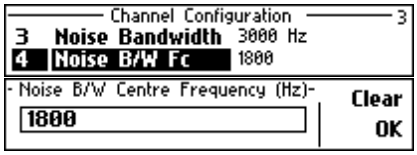


5.2.1.3 NOISE BANDWIDTH CENTRE FREQUENCY

The Noise Bandwidth Centre Frequency can be adjusted to allow narrowband testing which is offset from 0 Hz.

The centre frequency can set with a value in the range of 1800 → 46500 Hz with an integer resolution. The valid range value varies with the noise bandwidth selected so that the whole noise bandwidth falls within 0 → 48 kHz.

The Noise Bandwidth Centre Frequency is set using this menu item.



5.2.1.4 CHANNEL PRESET

A selection of channel presets exist for CCIR and ITU defined channel conditions. A list of available Channel Presets can be found in Table 2.
The Channel Presets set the path parameters to defined values for certain conditions.

The Channel Preset is set via this menu item.

5.2.1.5 RADIO FILTER (HF ONLY)

A Radio Filter can be specified for the **RS8** when in HFCS mode. This adds a filter at the input and output of the channel simulator to simulate the use of radios with modem testing.

Two radio filters options are available – ideal and S4203.

The Radio Filter is set via this menu item.

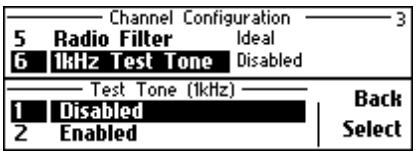
ATTENTION:

- The ***S4203*** radio filter is only available when using a channel bandwidth of **3 kHz**.
- If the **S4203** radio filter is selected and the bandwidth is changes from 3 kHz to another *higher bandwidth*, the radio filter is automatically change to **IDEAL** and a warning message is displayed.

5.2.1.6 1KHZ TEST TONE

A 1kHz Test Tone can be enabled on the **RS8**. This bypasses any input signal and instead inputs a 1 kHz sine wave to the channel simulator. This is used for test purposes and the configuration does not persist. That means that whenever the **RS8** is reset, or turned off and on again, the Test Tone will default back to a disabled value.

The 1kHz Test Tone is set via this menu item.

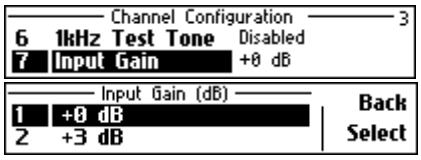


5.2.1.7 INPUT GAIN

The input signal of the **RS8** can be adjusted using the Input Gain parameter. This increases or decreases the input signal in 3dB steps and may be required if the input signal is too low for the RS8. The Intput Gain can be set in the range of 0 → +24 dB in 3dB increments.

The Input Gain is set on the fly – meaning the channel simulator engine is not restarted when this value is updated.

The Input Gain is set via this menu item.

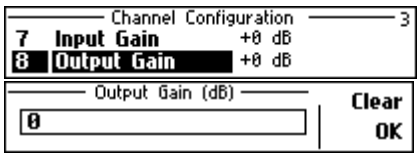


5.2.1.8 OUTPUT GAIN

The output signal of the **RS8** can be adjusted using the Output Gain parameter. This increases or decreases the output signal in 1dB steps and may be required if the output signal is too low or too large for a modem's input. The Output Gain can be set in the range of -20 → +20 dB.

The Output Gain is set on the fly – meaning the channel simulator engine is not restarted when this value is updated.

The Output Gain is set via this menu item.

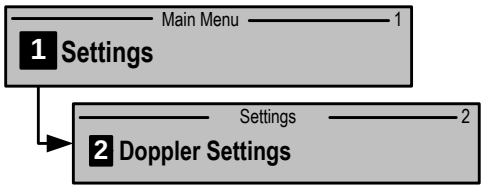


ATTENTION:

- Unless otherwise specified, the channel simulator engine is restarted whenever a parameter is changed. This is to allow resizing and loading of buffers required for various parameters.

5.2.2 DOPPLER SETTINGS

The Doppler Settings is accessed from the Settings menu.

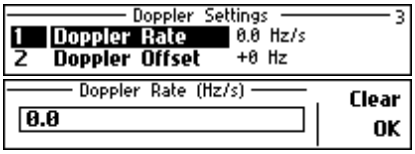


5.2.2.1 DOPPLER RATE

The Doppler Rate specifies the overall Doppler sweep rate of the **RS8**. This is the rate at which the Doppler Offset 'moves' between the minimum and maximum Doppler value.

The Doppler Rate must be in the range of -3.5 → +3.5 Hz/s and has a resolution of 0.1.

The Doppler Rate value is set using this menu item.



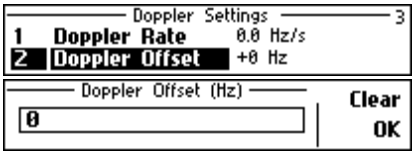
5.2.2.2 DOPPLER OFFSET

An overall Doppler Offset can be applied across all paths of the channel simulator. The Doppler Offset is either a constant value or sweeps between the positive and negative of the specified offset value.

The Doppler Rate determines if the Doppler Offset sweeps or not. When the rate is zero, the offset is constant, while if the rate it is non-zero, the offset sweeps between its limits at the given rate.

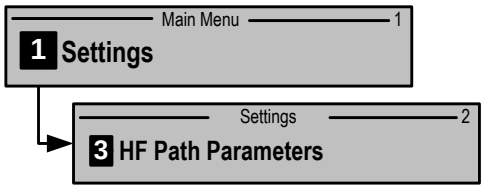
The Doppler Offset is an integer value in the range of ±3000 Hz.

The Doppler Offset is set using this menu item.



5.2.3 HF PATH PARAMETERS (HF ONLY)

The HF Path Parameters is accessed from the Settings menu.



5.2.3.1 PATH 1 – 5 SETTINGS

The Path Parameters of up to 5 paths can be specified for the channel simulator in HFCS mode. When a Channel Preset is used, these parameters are automatically set for the selected conditions. However, the Path Parameters can be manually adjusted to give a custom channel condition.

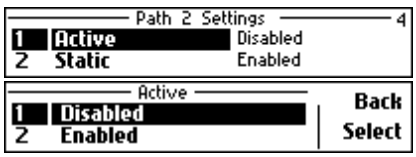
The parameters of each path are adjusted separately.
Path 1 is always active and allows the adjustment of 3 parameters – *Static*, *Doppler spread* and *Power* settings.
Paths 2 – 5 can be enabled or disabled as required. They have 6 parameters which can be adjusted – *Active*, *Static*, *Doppler Spread*, *Multipath Delay*, *Power* and *Differential Doppler Spread*.

Multipath Delay and *Differential Doppler Spread* are relative values specified in terms of Path 1, which is why path 1 does not also set them.

5.2.3.1.1 Active

The Active parameter specifies if a path is enabled or disabled. Since Path 1 is always enabled, this setting is only available for Paths 2 – 5.

The Active parameter is set using this menu item.

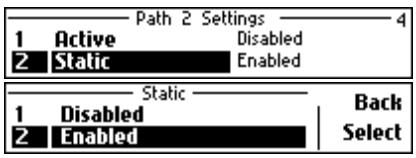


5.2.3.1.2 Static

The Static parameter specifies if a path varies or not, essentially if it has a Doppler Spread or not.

If the Static parameter is Enabled it means that the path remains constant and has a Doppler Spread of 0 Hz.
If the Static parameter is Disabled it indicates that the path conditions can vary and fluctuate with time as specified by the Doppler Spread parameter.

The Static parameter is set using this menu item.

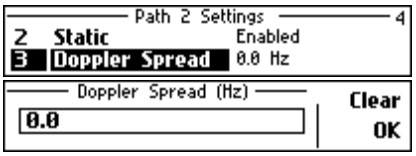


5.2.3.1.3 Doppler Spread

The Doppler Spread determines the extent to which a path varies or fluctuates over time.
A Doppler Spread of 0Hz means that the path is constant and does not change.
A small, non-zero, Doppler Spread value (such as 0.2 Hz) means that the path fluctuates very slowly over time.
A large Doppler Spread value (such as 20 Hz) means that the path fluctuates a lot over a small space of time.

The Doppler Spread value is set in selected increments in the range 0 → 50 Hz.
These increments are 0, 0.1, 0.2, 0.3, 0.4, 0.5, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 25, 30, 35, 40, 45 & 50 Hz.

The Doppler Spread parameter is set using this menu item.

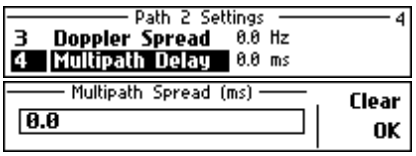


5.2.3.1.4 Multipath Delay

The Multipath Delay is set relative to Path 1, which is why this value is not a parameter of Path 1. It represents a millisecond delay of the signal, when travelling along the specified path, relative to Path 1.

The Multipath Delay parameter is in the range of 0 → 26 ms at a resolution of 0.5.

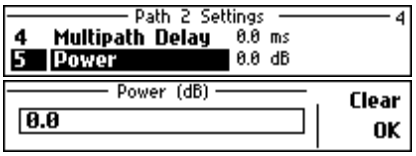
The Multipath Delay parameter is set using this menu item.



5.2.3.1.5 Power

The Power parameter specifies the attenuation experienced by the path.
The value is specified in dB and is in the range -40 → 0 dB with 0.5 resolution.

The Power parameter is set using this menu item.

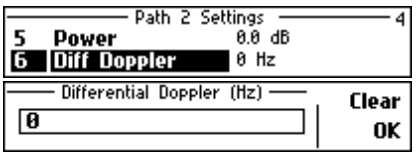


5.2.3.1.6 Differential Doppler Spread

The Differential Doppler Spread parameter is, like the Multipath Delay parameter, set relative to Path 1. It specifies the additional Doppler Spread/frequency shift experienced by the path relative to Path 1.

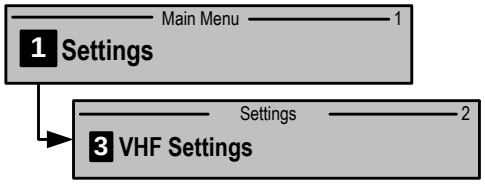
The Differential Doppler Spread is an integer parameter in the range of 0 → 10 Hz.

The Differential Doppler Spread parameter is set using this menu item.



5.2.4 VHF SETTINGS (VHF ONLY)

The VHF Settings is accessed from the Settings menu.



5.2.4.1 VEHICLE SPEED

The Vehicle Speed specifies the overall vehicle speed for the **RS8**. This is used in combination with the Operating Frequency to calculate the maximum Doppler Offset for the current configuration.

The Vehicle Speed must be in the range of 3 → 4000 km/h and has to be an integer.

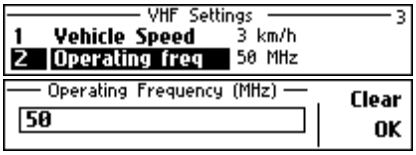
The Vehicle Speed value is set using this menu item.

5.2.4.2 OPERATING FREQUENCY

The Operating Frequency specifies the overall "over-the-air" frequency for the **RS8**. This is used in combination with the Vehicle Speed to calculate the maximum Doppler Offset for the current configuration.

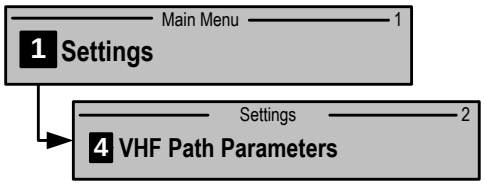
The Operating Frequency must be in the range of 30 → 500 MHz and has to be an integer.

The Operating Frequency is set using this menu item.



5.2.5 VHF PATH PARAMETERS (VHF ONLY)

The VHF Path Parameters is accessed from the Settings menu.



5.2.5.1 PATH 1 – 6 SETTINGS

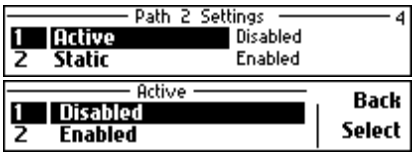
The Path Parameters of up to 6 paths can be specified for the channel simulator in VHFCS mode. When a Channel Preset is used, these parameters are automatically set for the selected conditions. However, the Path Parameters can be manually adjusted to give a custom channel condition.

The parameters of each path are adjusted separately.
Path 1 is always active and allows the adjustment of 4 parameters – *Static*, *Doppler Spectrum, Relative Time* and Relative *Power* settings.
Paths 2 – 5 can be enabled or disabled as required. They have 5 parameters which can be adjusted – *Active*, *Static*, *Doppler Spectrum*, *Relative Time and* Relative *Power*.

5.2.5.1.1 Active

The Active parameter specifies if a path is enabled or disabled. Since Path 1 is always enabled, this setting is only available for Paths 2 – 6.

The Active parameter is set using this menu item.

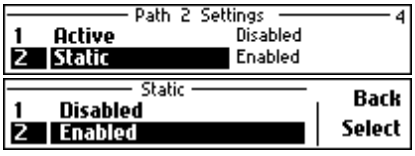


5.2.5.1.2 Static

The Static parameter specifies if a path varies or not, essentially if it has a Doppler Offset or not.

If the Static parameter is Enabled it means that the path remains constant and has a Doppler Offset of 0 Hz.
If the Static parameter is Disabled it indicates that the path conditions can vary and fluctuate with time as specified by the Maximum Doppler Offset value.

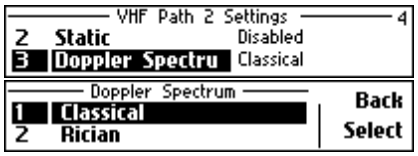
The Static parameter is set using this menu item.



5.2.5.1.3 Doppler Spectrum

The Doppler Spectrum determines whether a path has Classical Doppler or Rician behaviour. A Rician path is the case where a direct or "line of sight" component is added to the fluctuating Classical Doppler path.
For the RS8 VHFCS the Rician K-factor is fixed to 1, meaning the power of the "line of sight" component is equal to that of the Classical Doppler component.
The "line of sight" component is not at 0Hz offset, but rather at 70% of the Maximum Doppler Offset as defined in GSM 05.05

The Doppler Spectrum parameter is set using this menu item.

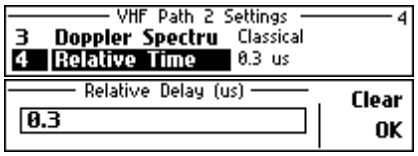


5.2.5.1.4 Relative Time

The Relative Time parameter is used to simulate the delay between paths. This parameter therefore indicates a delay that is implemented on the specific path.

The Relative Time parameter is in the range of 0 → 50 us at a resolution of 0.1.

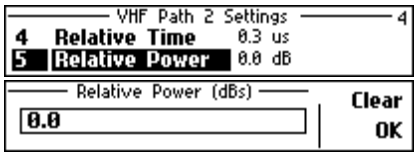
The Relative Time parameter is set using this menu item.



5.2.5.1.5 Relative Power

The Relative Power parameter specifies the attenuation experienced by the path.
The value is specified in dB and is in the range -40 → 0 dB with 0.5 resolution.

The Relative Power parameter is set using this menu item.



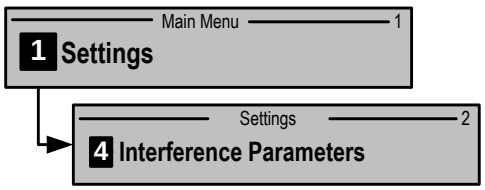
5.2.6 INTERFERENCE PARAMETERS

Three categories of interferers can be set:

- Fixed Frequency (FF) interferer x4
- Swept Continuous Wave (SCW) interferer
- FSK Waveform interferer
- Narrow Band Waveform interferer

The interferers are used to introduce more interference into the channel other than the usual Gaussian noise. This can be very useful when testing the capabilities of modems in various channel conditions.

The Interference Parameters menu is accessed from the Settings menu.



5.2.6.1 FIXED FREQUENCY INTERFERER

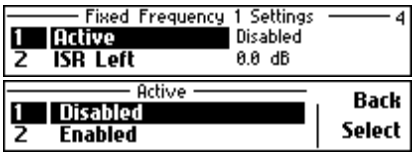
Fixed frequency interference is narrow band interference of a single frequency. Up to 4 Fixed Frequency interferers can be enabled on the **RS8**.

The **RS8** has two audio channels – forward and reverse or 2-ISB. ISR and frequency parameters of the Fixed Frequency interferers can be independently set for each channel.

5.2.6.1.1 Active

The Active parameter specifies if an interferer is enabled or disabled.

The Active parameter is set using this menu item.

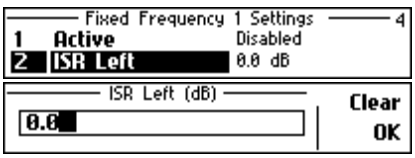


5.2.6.1.2 ISR Left and Right

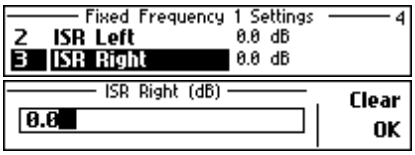
The Interference-to-Signal Ratio (ISR) specifies the extent to which the interference must be 'mixed' with the input. A low value means that there is very little interference compared to the signal, while a large value means there is a lot of interference 'noise' compared to the signal level.

The ISR value is set in the range -63 → 63 dB with a resolution of 0.5 dB.

The ISR Left parameter is set using this menu item.



The ISR Right parameter is set using this menu item.

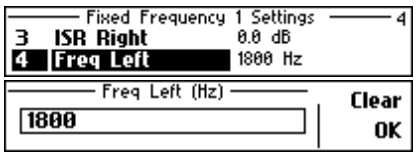


5.2.6.1.3 Frequency Left and Right

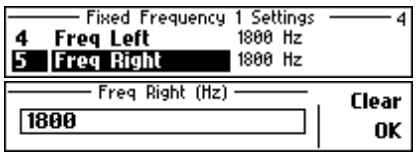
The Frequency parameter specifies the fixed frequency of the interferer. It is the tone which is used to interfere with the signal.

The Frequency parameter is an integer value in the range of 0 → 24 kHz.

The Frequency Left parameter is set using this menu item.



The Frequency Right parameter is set using this menu item.



5.2.6.2 SWEPT CONTINUOUS WAVE INTERFERER

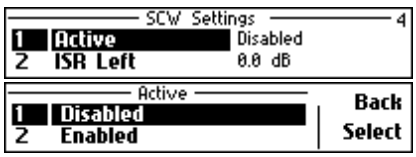
Swept Continuous Wave (SCW) interference is also a form of narrowband interference but where the frequency sweeps between two frequency limits in a triangular fashion.

Like the Fixed Frequency interferers, the left and right channels are independently set by specifying the *ISR*, *low frequency limit*, *high frequency limit* and *sweep rate* for each channel.

5.2.6.2.1 Active

The Active parameter specifies if the interferer is enabled or disabled.

The Active parameter is set using this menu item.

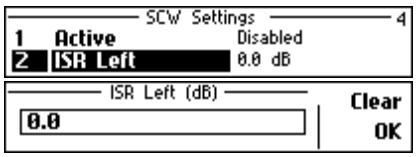


5.2.6.2.2 ISR Left and Right

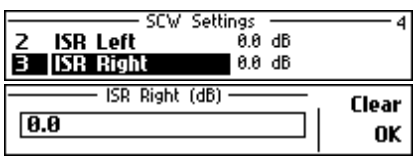
The Interference-to-Signal Ratio (ISR) specifies the extent to which the interference must be 'mixed' with the input. A low value means that there is very little interference compared to the signal, while a large value means there is a lot of interference 'noise' compared to the signal level.

The ISR value is set in the range -63 → 63 dB with a resolution of 0.5 dB.

The ISR Left parameter is set using this menu item.



The ISR Right parameter is set using this menu item.

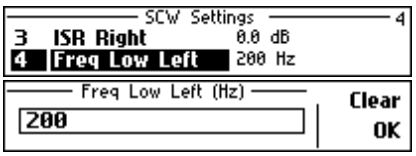


5.2.6.2.3 Frequency Low Left and Right

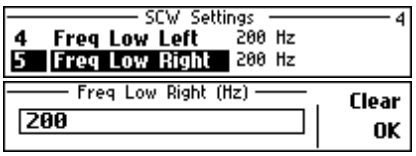
The Low Frequency parameter specifies the minimum frequency limit of the frequency sweep of the interferer.

The Low Frequency parameter is an integer value in the range of 0 → 24 kHz.

The Low Frequency Left parameter is set using this menu item.



The Low Frequency Right parameter is set using this menu item.



5.2.6.2.4 Frequency High Left and Right

The High Frequency parameter specifies the maximum frequency limit of the frequency sweep of the interferer.

The High Frequency parameter is an integer value in the range of 0 → 24 kHz.

The High Frequency Left parameter is set using this menu item.

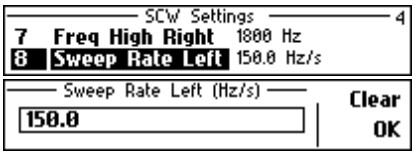
The High Frequency Right parameter is set using this menu item.

5.2.6.2.5 Sweep Rate Left and Right

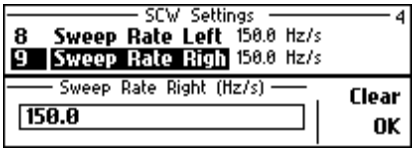
The Sweep Rate parameter specifies the speed at which the interferer frequency moves/sweeps between the minimum and maximum frequency limits.

The Sweep Rate parameter is a value in the range of -48 → +48 kHz/s with a resolution of 0.1 Hz/s.

The Sweep Rate Left parameter is set using this menu item.



The Sweep Rate Right parameter is set using this menu item.



5.2.6.3 FSK INTERFERER (HF ONLY)

FSK Waveform interference simulates the transmission of an FSK signal on the same channel as the input signal. Random data is transmitted for this interferer.

Like the other interferers, the left and right channels are independently set by specifying the *ISR*, *first frequency component*, *second frequency component* and *bit rate* of transmitted data for each channel.

5.2.6.3.1 Active

The Active parameter specifies if the interferer is enabled or disabled.

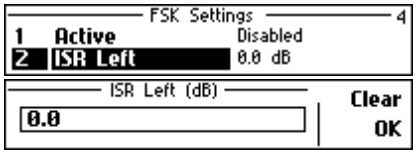
The Active parameter is set using this menu item.

5.2.6.3.2 ISR Left and Right

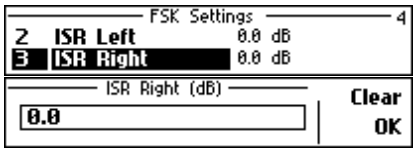
The Interference-to-Signal Ratio (ISR) specifies the extent to which the interference must be 'mixed' with the input. A low value means that there is very little interference compared to the signal, while a large value means there is a lot of interference 'noise' compared to the signal level.

The ISR value is set in the range -63 → 63 dB with a resolution of 0.5 dB.

The ISR Left parameter is set using this menu item.



The ISR Right parameter is set using this menu item.

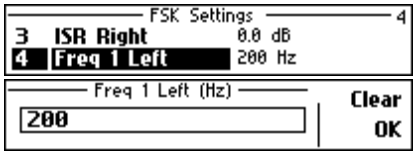


5.2.6.3.3 Frequency 1 Left and Right

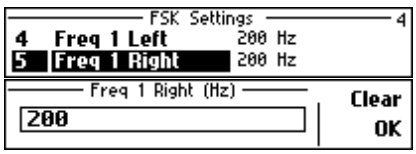
The Frequency 1 parameter specifies the first frequency component of the FSK waveform to be transmitted.

The Frequency 1 parameter is an integer value in the range of 0 → 24 kHz.

The Frequency 1 Left parameter is set using this menu item.



The Frequency 1 Right parameter is set using this menu item.

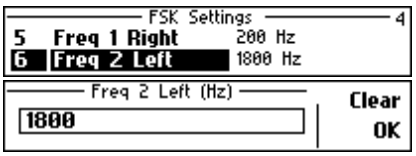


5.2.6.3.4 Frequency 2 Left and Right

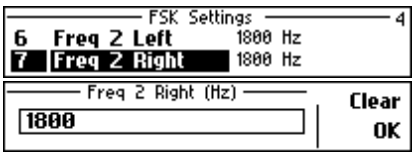
The Frequency 2 parameter specifies the second frequency component of the FSK waveform to be transmitted.

The Frequency 2 parameter is an integer value in the range of 0 → 24 kHz.

The Frequency 2 Left parameter is set using this menu item.



The Frequency 2 Right parameter is set using this menu item.

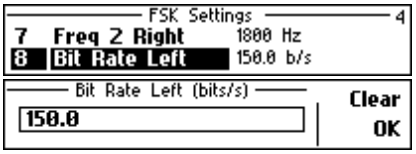


5.2.6.3.5 Bit Rate Left and Right

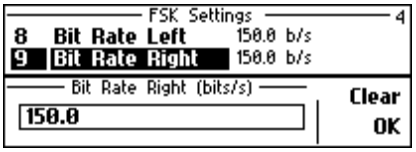
The Bit Rate parameter specifies the speed at which the random data is transmitted as an FSK waveform.

The Bit Rate parameter is a value in the range of -48 → +48 bits/s with a resolution of 0.1 bits/s.

The Bit Rate Left parameter is set using this menu item.



The Bit Rate Right parameter is set using this menu item.



5.2.6.4 NARROW BAND WAVEFORM INTERFERER

NB Waveform interference simulates the transmission of a PSK signal of a specified constellation on the same channel as the input signal. Random data is transmitted for this interferer.

Like the other interferers, the left and right channels are independently set by specifying the *ISR*, *carrier frequency*, *bandwidth* and *constellation* of transmitted data for each channel.

5.2.6.4.1 Active

The Active parameter specifies if the interferer is enabled or disabled.

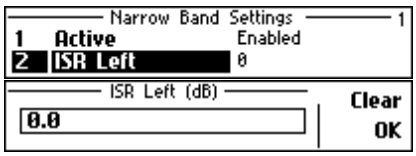
The Active parameter is set using this menu item.

5.2.6.4.2 ISR Left and Right

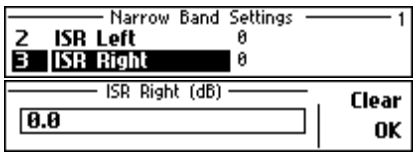
The Interference-to-Signal Ratio (ISR) specifies the extent to which the interference must be 'mixed' with the input. A low value means that there is very little interference compared to the signal, while a large value means there is a lot of interference 'noise' compared to the signal level.

The ISR value is set in the range -63 → 63 dB with a resolution of 0.5 dB.

The ISR Left parameter is set using this menu item.



The ISR Right parameter is set using this menu item.

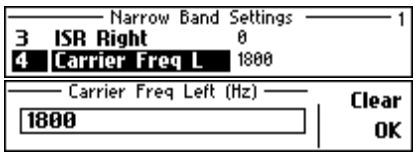


5.2.6.4.3 Carrier Frequency Left and Right

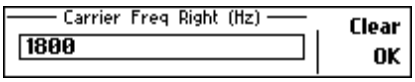
The Carrier Frequency parameter specifies the centre frequency of the of the PSK waveform to be transmitted.

The Carrier Frequency parameter is an integer value in the range of 620 → 47380 Hz depending on the bandwidth selected.

The Carrier Frequency Left parameter is set using this menu item.



The Carrier Frequency Right parameter is set using this menu item.



5.2.6.4.4 Bandwidth Left and Right

The Bandwidth parameter specifies the Bandwidth of the FSK waveform to be transmitted.

The Bandwidth parameter is a selectable item from the list of 1240, 3000, 6000, 9000, 12000, 15000, 18000, 21000 or 24000 Hz.

The Bandwidth Left parameter is set using this menu item.

The Bandwidth Right parameter is set using this menu item.

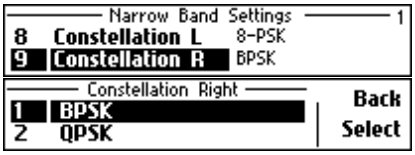
5.2.6.4.5 Constellation Left and Right

The Constellation parameter specifies the constellation type used to modulate the PSK waveform to be transmitted.

The Constellation parameter is a selectable option from a list of BPSK, QPSK, 8-PSK or 16-QAM.

The Constellation Left parameter is set using this menu item.

The Constellation Right parameter is set using this menu item.

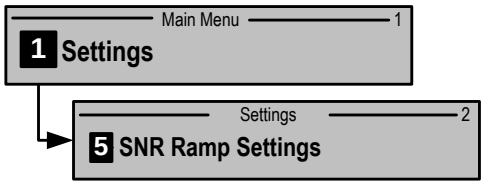


5.2.7 SNR RAMP SETTINGS

The SNR Ramp Setting is used to continuously ramp the SNR of the channel from the minimum to the maximum setting linearly, over the duration specified, and back down again. This happens continuously once it is *Enabled*.

To prevent this setting from being left on accidentally, the SNR Ramp State is not persisted after a power cycle – it returns to its default *Disabled*.

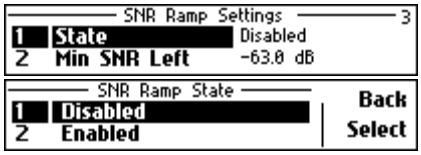
The SNR Ramp Settings menu is accessed from the Settings menu.



5.2.7.1 STATE

The State parameter specifies if the SNR ramp setting is enabled or disabled.
This parameter returns to the default *Disabled* after a power cycle.

The State parameter is set using this menu item.

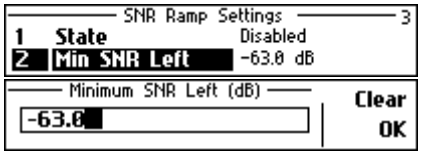


5.2.7.2 MINIMUM SNR LEFT AND RIGHT

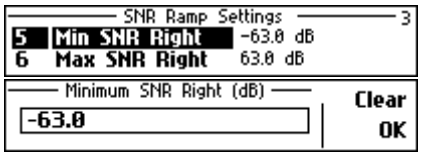
The Minimum SNR parameter specifies the lower minimum SNR limit of the SNR ramp.

The Minimum SNR must be in the range of -63.0 → +63.0 dB and has a resolution of 0.5.

The Minimum SNR Left parameter is set using this menu item.



The Minimum SNR Right parameter is set using this menu item.

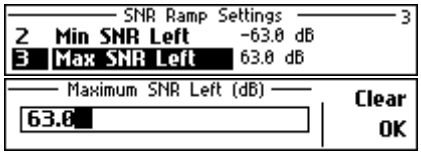


5.2.7.3 MAXIMUM SNR LEFT AND RIGHT

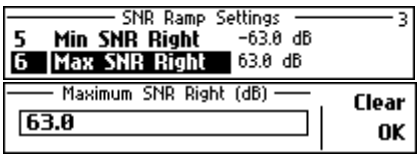
The Maximum SNR parameter specifies the upper maximum SNR limit of the SNR ramp.

The Maximum SNR must be in the range of -63.0 → +63.0 dB and has a resolution of 0.5.
It must also be greater than or equal to the Minimum SNR value.

The Maximum SNR Left parameter is set using this menu item.



The Maximum SNR Right parameter is set using this menu item.

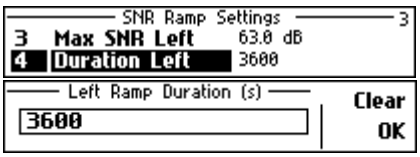


5.2.7.4 DURATION LEFT AND RIGHT

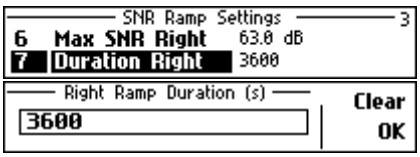
The Duration parameter specifies the time over which the SNR must move from the minimum to maximum SNR limits.

The Duration parameter is a positive integer value specified in seconds (s).

The Duration Left parameter is set using this menu item.



The Duration Right parameter is set using this menu item.



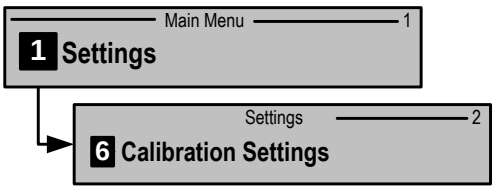
5.2.8 CALIBRATION SETTINGS

The Calibration settings are used to specify the mode used to determine the incoming signal level and hence the level of noise and/or interference that needs to be added to the signal to achieve the desired SNR and/or ISR levels.

For most cases, especially with waveform testing, using the *Automatic Calibration* method is best. This mode continuously measures the incoming signal and adjusts the noise and interference levels accordingly.

For use cases where the signal is intermittent and the level varying, such as analogue voice, it may be required to use the *Precalibration* mode. In this mode, an input level is specified (either manually or via a precalibration step) and the noise and interference levels are adjusted assuming the incoming signal is at that specified level – so no measurements of the incoming signal are performed.

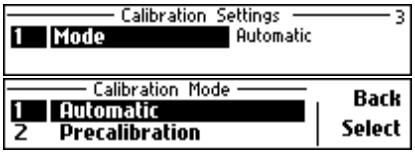
The Calibration Settings menu is accessed from the Settings menu.



5.2.8.1 MODE

The Mode parameter specifies if *Automatic* or *Precalibration* mode is to be used for the incoming signal level measurement.

The Mode parameter is set using this menu item.



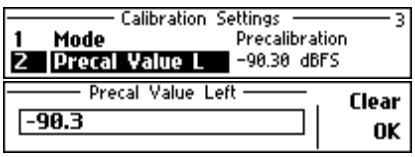
When Precalibration mode is selected, various additional menu items become available. This allows the Precalibration Values to be set manually, if known, or determined automatically based on an incoming signal.

5.2.8.2 PRECAL VALUE LEFT AND RIGHT

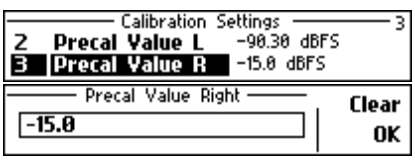
The Precal Value parameter specifies the expected level of the incoming signal and is the signal level to be used to calculate the added noise and interference signal levels.

These levels can be set manually by accessing the parameter menu items as shown below. The Precal Value level must be in the range of -90.3 → +6.3 dB and has a resolution of 0.1.

The Precal Value Left parameter is set using this menu item.



The Precal Value Right parameter is set using this menu item.

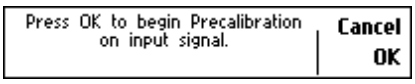


5.2.8.3 RUN PRECALIBRATION

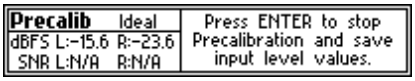
Alternatively, the Precal Value levels can be set by using the *Run Precalibration* function. This function determines the incoming signal level averaged over the full precalibration running period.

To start the Precalibration process press enter on the Run Precalib menu item.

Play a typical signal (at the typical level) into the **RS8** and press OK to begin the precalibration.



While in the precalibration process, the precalibration window is displayed which details the averaged incoming left and right signal levels.
Press Enter once the precalibration is complete and you are happy with the measured average levels.



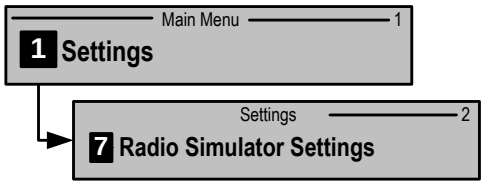
These recorded levels are then saved as the left and right Precal Values and will be used as the incoming signal levels.

5.2.9 RADIO SIMULATOR SETTINGS

The Radio Simulator Setting is used to simulate a radio using Rap1 Commands; the simulator ensures that when the modem is placed in Radio over Rap1 mode it shall receive the appropriate communication required. This happens continuously once it is *Enabled*.

To prevent this setting from being left on accidentally, the Radio Simulator Setting is not persisted after a power cycle – it returns to its default *Disabled*.

The Radio Simulator Setting menu is accessed from the Settings menu.



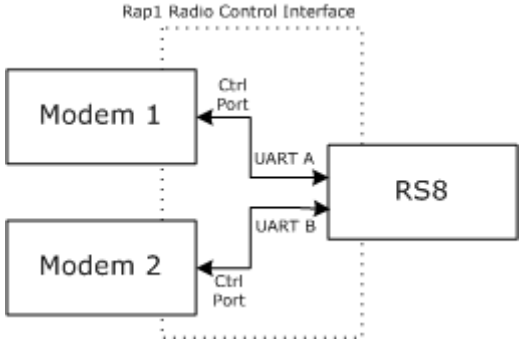
Note: In order for the Radio over Rap1 to function correctly ensure that when sending the SET *RAP1 RADIO REMOTE CONTROL PORT* to the modems the:

- *RAP1 Radio Addr* is set the RS8 Ctrl IP address,
- *RAP1 Radio Port* is set to 20, and
- *RAP1 Radio Rem Ctrl Port Idx is set to 0x00*.

Example:
Send: 0000 00D4 FF 02 00 [RS8 ADDR] 0014 00

The modems are connected to the RS8 via their control ports to UART A and B respectively.

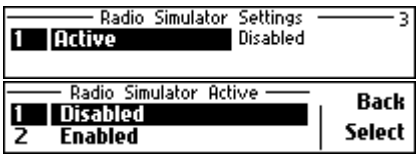
Ensure that the modem only attempts to connect to the "radio" once all the set up commands have been sent and the RS8's radio simulator is active.



5.2.9.1 ACTIVE

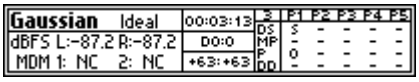
The Active parameter specifies if the Radio Simulator is enabled or disabled.

The Active parameter is set using this menu item.

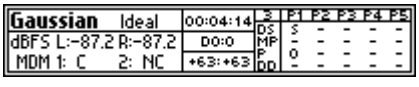


Once the Radio simulator is active the RS8 will not allow a signal to pass through until both modems have successfully connected to the "radio.

This can be monitored from the HFCS operations screen, where the SNR is replaced with the MDM (modems).



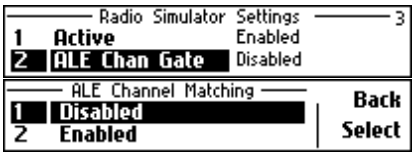
If a modem has been connected the NC (not connected) changes to a C (connected), once both are connected the SNR shall be displayed again and the RS8 will allow the TX signals through.



5.2.9.2 ALE CHAN GATE

The ALE channel gating parameter can be enabled or disabled. This setting ensures that ALE transmissions on different channels are gated; only allowing the signal to pass through when both modems are on the same **Radio** channel.

The ALE Chan Gate parameter is set using this menu item. It is only selectable if the Radio Simulator Active is enabled.



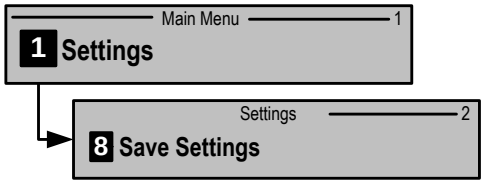
Once enabled and both modems have connected via Rap1 to the Radio simulator, then the HFCS operations screen shall display the current **Radio** channel of each modem, if they differ. If they are the same then the SNR is displayed.

ATTENTION:

- The ALE channel gate takes only the radio channel number into consideration and does not check that the carrier frequencies are the same.

5.2.10 SAVE SETTINGS

The Save Settings option is accessed from the Settings menu.



The **RS8** will save any current configuration to non-volatile memory after about 5 minutes. This does not create a custom preset, but simply saves the current configuration so that it will persist and be restored on the next start-up of the **RS8**.

The user has the option to action the saving of the current configuration immediately and this is achieved by selecting the 'Save Config' option within Save Settings.

6 RS8 CONTROL MENU

6.1 MENU DIAGRAM

The menu for RS8 Control is shown in the figure below. Menu navigation is via the **Navigation (◄►▲▼)**, **ENTER** and **ESC** keys.

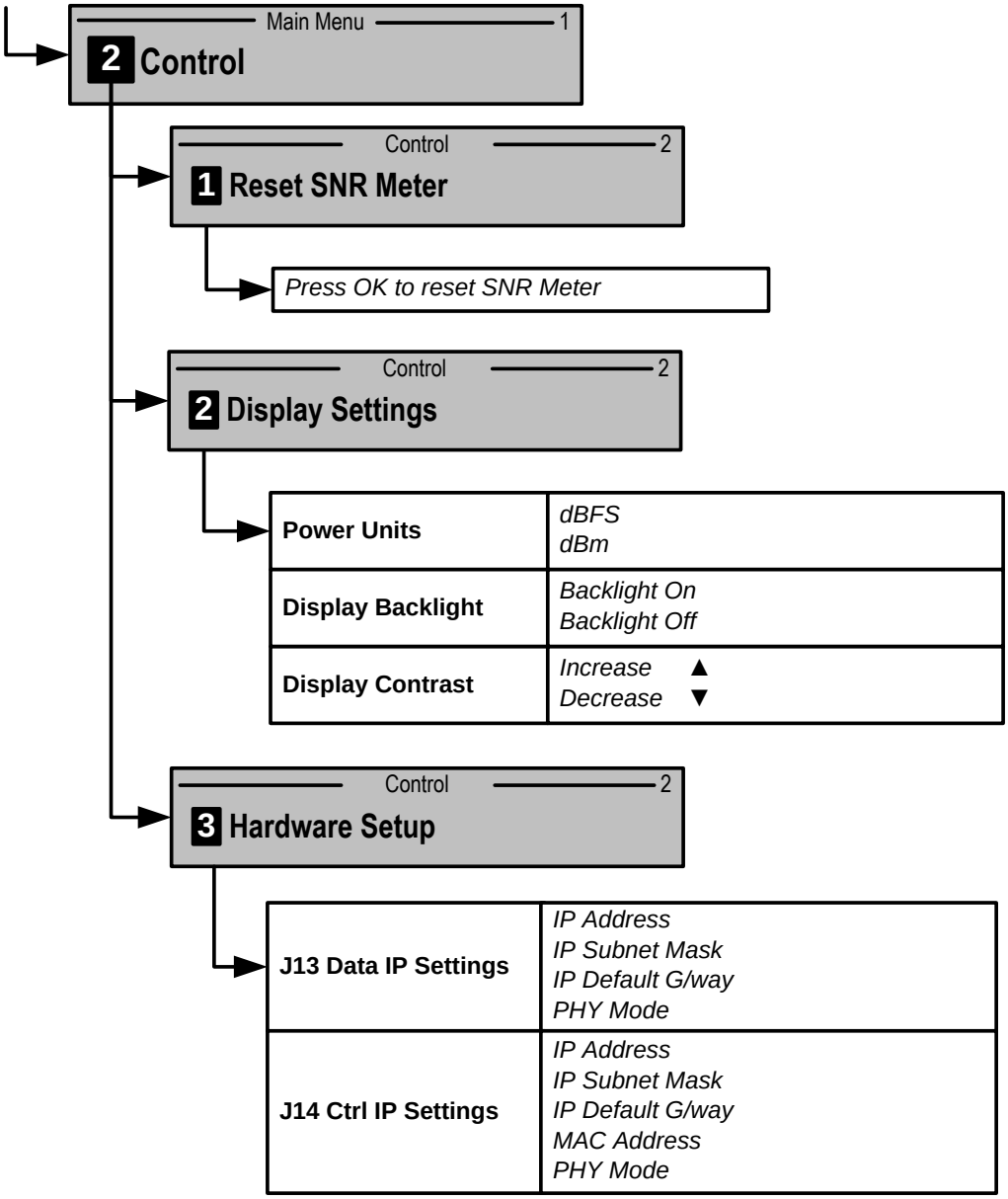
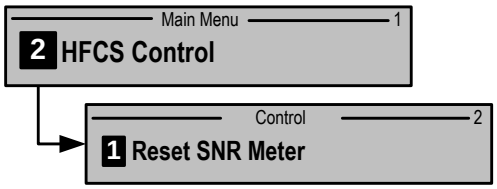


Figure 16: Menu: Control

6.2 CONFIGURATION

6.2.1 RESET SNR METER

The Reset SNR Meter menu is accessed from the Control menu



This is used to reset all the measurement meters involved with the SNR calculations and display. This includes the:

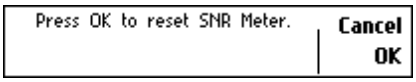
- Input Signal meter
- Input Noise meter
- Output Signal meter
- Output Noise meter

This is automatically performed when the Desired SNR level is changed and when a valid input signal is detected from a low signal. However, it can be manually reset using this menu item if required.

The SNR meter reset can also be performed via a shortcut key when the default WB HFCS or WB VHFCS Operational Screen is displayed. As mentioned in Section 3.3.2, pressing the **ESC** and **LEFT ARROW** keys at the same time will cause the **RS8** to reset the SNR Meter.

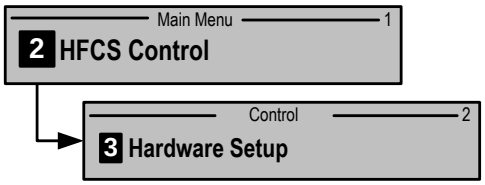
When going into the Reset SNR Meter menu, a message window asks for confirmation that the SNR meter should be reset.

The reset SNR Meter confirmation window.



6.2.2 DISPLAY SETTINGS

The Hardware Settings menu is accessed from the Control menu

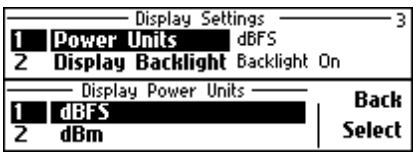


This menu configures the IP settings of the Ctrl and Data Ethernet ports.

6.2.2.1 POWER UNITS

The unit of measurement to use for power measurements can bet set to either dBFS or dBm.

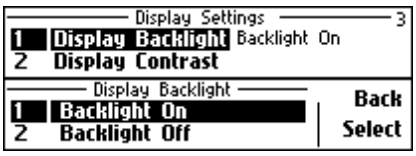
The Power Units is set using this menu item.



6.2.2.2 DISPLAY BACKLIGHT

The backlight illumination of the display screen can be turned on or off.

The Display Backlight is set using this menu item.



6.2.2.3 DISPLAY CONTRAST

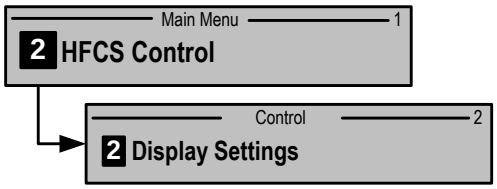
The contrast affects how dark the characters appear on the LCD display screen.

The contrast can be increased and decreased by using the ▲ and ▼ **Navigation** keys when in the Display Contrast menu.

The Display Contrast is adjusted using this menu item.

6.2.3 HARDWARE SETTINGS

The Display Settings menu is accessed from the Control menu



This menu controls the configuration of the Front Panel LCD display screen.

6.2.3.1 IP ADDRESS

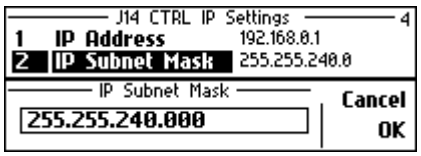
The IP address of the Ethernet ports can bet set as desired.

The IP Address is set using this menu item.

6.2.3.2 IP SUBNET MASK

The IP subnet mask of the Ethernet ports can bet set as desired.

The IP Subnet Mask is set using this menu item.



6.2.3.3 IP DEFAULT GATEWAY

The IP default gateway of the Ethernet ports can bet set as desired.

The IP Default Gateway is set using this menu item.

6.2.3.4 MAC ADDRESS

The MAC address of the Ctrl Ethernet port can be viewed.
Note: this is only a viewable property it cannot be changed.

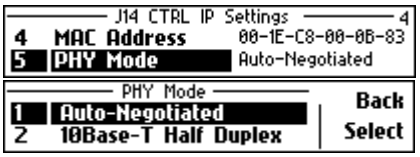
The MAC Address is viewed using this menu item.

6.2.3.5 PHYSICAL MODE

The Physical Mode of the Ethernet ports can bet selected from a set of options.
The available options are:

1. Auto-Negotiated
2. 10 Base-T Half Duplex
3. 10 Base-T Full Duplex
4. 100 Base-T Half Duplex
5. 100 Base-T Full Duplex

The Physical Mode is adjusted using this menu item.



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7 PRESETS MENU

7.1 MENU DIAGRAM

The menu for Presets is shown in the figure below. Menu navigation is via the **Navigation (◄►▲▼)**, **ENTER** and **ESC** keys.

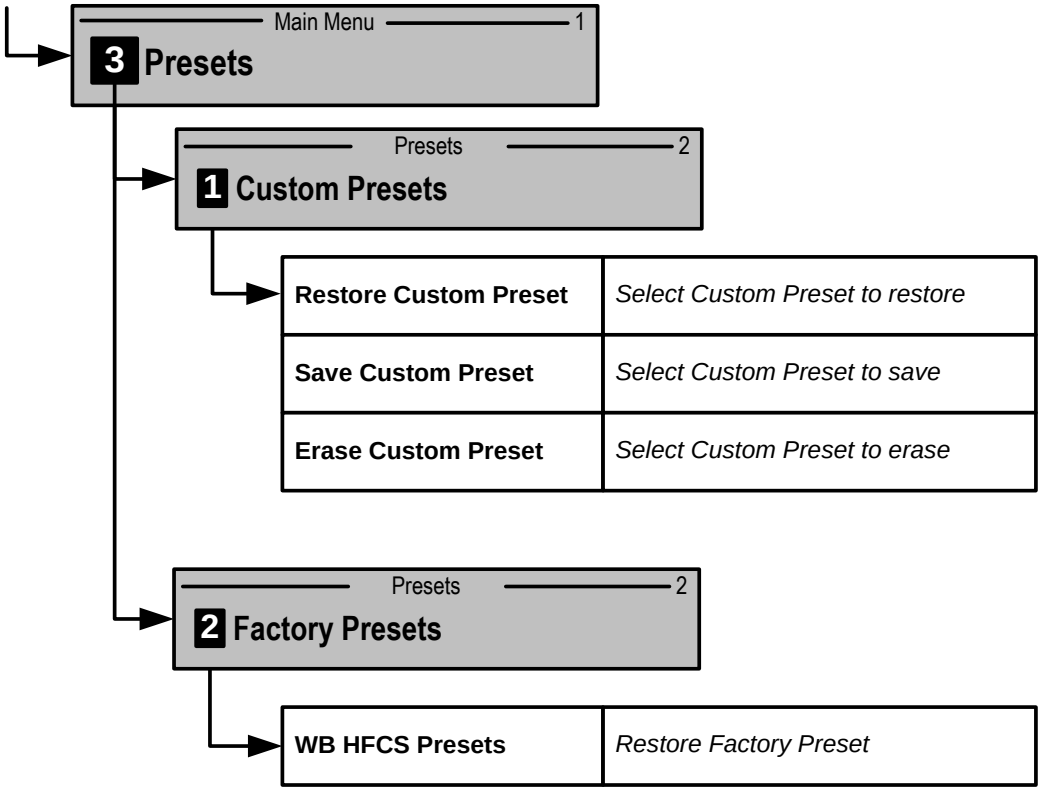
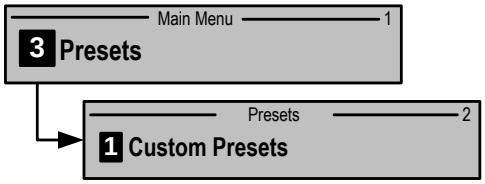


Figure 17: Menu: Presets

7.2 CONFIGURATION

7.2.1 CUSTOM PRESETS

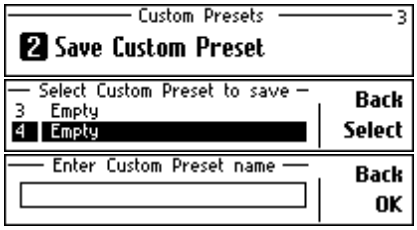
The **RS8** Custom Presets menu is accessed from the Presets menu



Custom Presets allow the user to save a specific configuration of the **RS8** to non-volatile memory in order to be able to restore this Preset at a later stage.

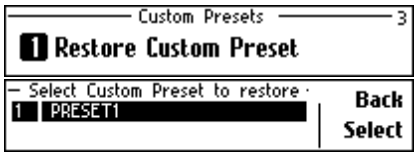
7.2.1.1 SAVE CUSTOM PRESET

In order to save the current settings on the **RS8** select 'Save Custom Preset' from the Custom Presets menu. Next select one of the slots available and specify a name for this particular preset.



7.2.1.2 RESTORE CUSTOM PRESET

In order to restore a previously saved custom preset on the **RS8** select 'Restore Custom Preset' from the Custom Presets menu. Next select the desired preset from the list of available options.

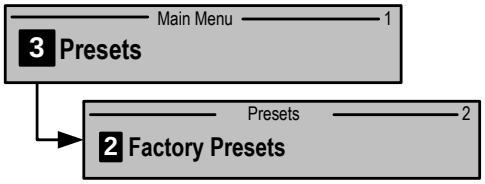


7.2.1.3 ERASE CUSTOM PRESET

In order to erase a previously saved custom preset on the **RS8** select 'Erase Custom Preset' from the Custom Presets menu. Next select the desired preset from the list of available options, or alternatively select 'Erase All' to erase all existing Custom Presets.

7.2.2 FACTORY PRESETS

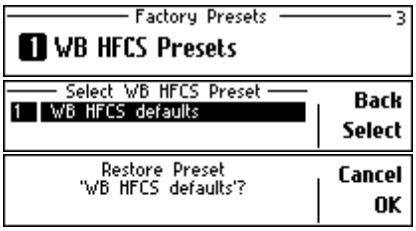
The **RS8** Factory Presets menu is accessed from the Presets menu.



The factory Presets is a preset that can't be erased and is used to reset the **RS8** back to its default 'factory' state.

After the preset is selected, a message window asks for confirmation that the preset should be restored.

The WB HFCS Preset is restored using this menu item and following confirmation window.



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8 INFORMATION MENU

8.1 MENU DIAGRAM

The menu for the Information is shown in the figure below. Menu navigation is via the **Navigation (◄►▲▼)** and **ENTER** and **ESC** keys.

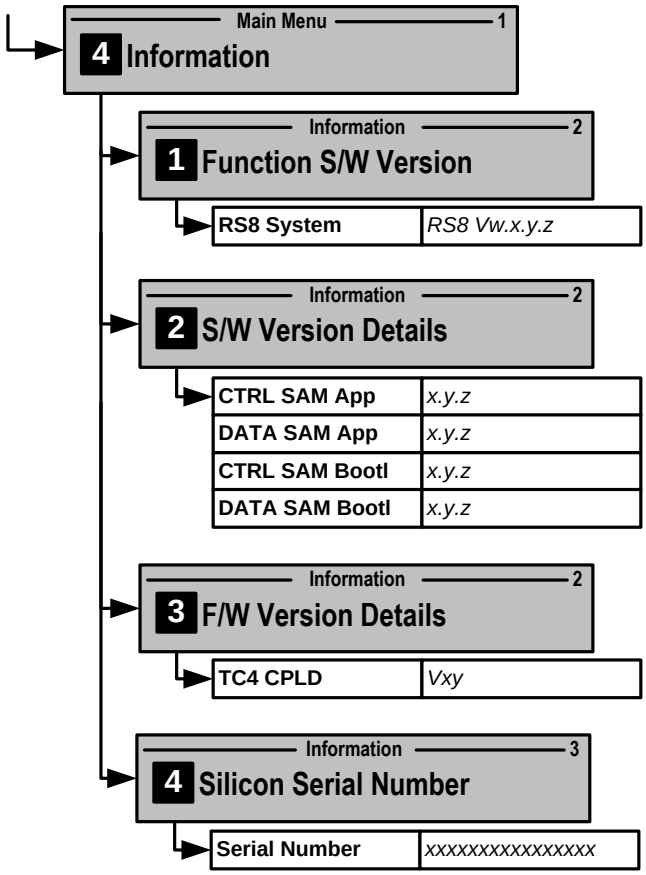
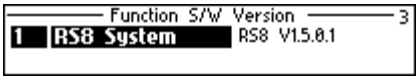


Figure 18: Menu: Information

8.2 CONFIGURATION

8.2.1 FUNCTIONAL S/W VERSION

The Functional Software Version is displayed with this window.



8.2.2 S/W VERSION DETAILS

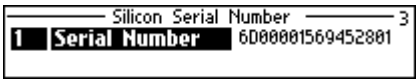
Details of the various Software Versions on the **RS8** is displayed with these windows.

8.2.3 F/W VERSION DETAILS

Details of the Firmware Version on the **RS8** is displayed with this window.

8.2.4 SILICON SERIAL NUMBER

The Silicon Serial Number of the **RS8** Cis displayed with this window.



9 GRAPHICAL USER INTERFACE

9.1 SOFTWARE INSTALLATION

The installation of the **RS8 CS GUI** used to control the ***RS8*** *HF & V/UHF Channel Simulator* is done by using the "RS8 CS GUI_vX.Y.Z_setup.exe" file. Double click on the setup file and follow the Setup Wizard steps.

During the setup procedure, the version of Windows running on the installation PC is checked. It should be **Windows XP Service Pack 3 or above**. If this requirement is not met, an error message detailing this will be displayed and the installation will be cancelled.
If required, the installer will also install the *Microsoft .Net Framework* and the *Microsoft Visual C++ 2005 Redistributable Package* if these are not already found on the system.

Once installed, the **RS8 CS GUI** can be run. It can be run either from the shortcut on the Desktop or Start Menu item. The start menu shortcut can be found under All Program → RapidM → RS8 CS GUI.

To uninstall the **RS8 CS GUI**, use the Control Panel's 'Uninstall a program' menu and select *Rapid Mobile RS8 CS GUI vX.Y.Z* from the list.

9.2 CONNECTING TO RS8

9.2.1 OVERVIEW OF CONNECTION PROCEDURE

An outline of the **RS8 CS GUI** connection procedure is given below:

1. Connect the cable from the RS8 to the PC/network.
2. Run the **RS8 CS GUI.**
3. Make sure the RS8 is turned on and operational.
4. Select the PC COM port or set the TCP/IP address of the **RS8**.

9.2.2 CONNECT THE SERIAL REMOTE CONTROL CABLE

The **RS8 CS GUI** can connect to the **RS8** via the **RS8** 's **J15 Remote Control Port**. A serial cable is connected from the J15 port on the **RS8** to a Serial Port on the PC, see Figure 6.

A Remote Control serial cable (*RM-0120-02: REM CTRL Cable*) is provided with the **RS8** for this purpose.

9.2.3 CONNECT THE ETHERNET CABLE

The **RS8 CS GUI** can connect to the **RS8** via the **RS8** 's **J14 Ctrl Ethernet Port** and a TCP/IP connection. An Ethernet cable is connected from the J14 port on the **RS8** to a network switch/port. Note that it must be connected to the same network that the PC running the GUI is connected to.

The IP address and configuration of the RS8's Ctrl Ethernet Port must be correctly set under the ***Control*** → ***Hardware Setup*** → ***J14 CTRL IP Settings*** menu. See Section 6.2.3 for further information regarding this.

A Remote Control serial cable (*RM-0120-02: REM CTRL Cable*) is provided with the **RS8** for this purpose.

9.2.4 START THE GUI

Once connected, the **RS8 CS GUI** should be run on the PC. A picture of the start-up screen of the GUI is shown in Figure 19.

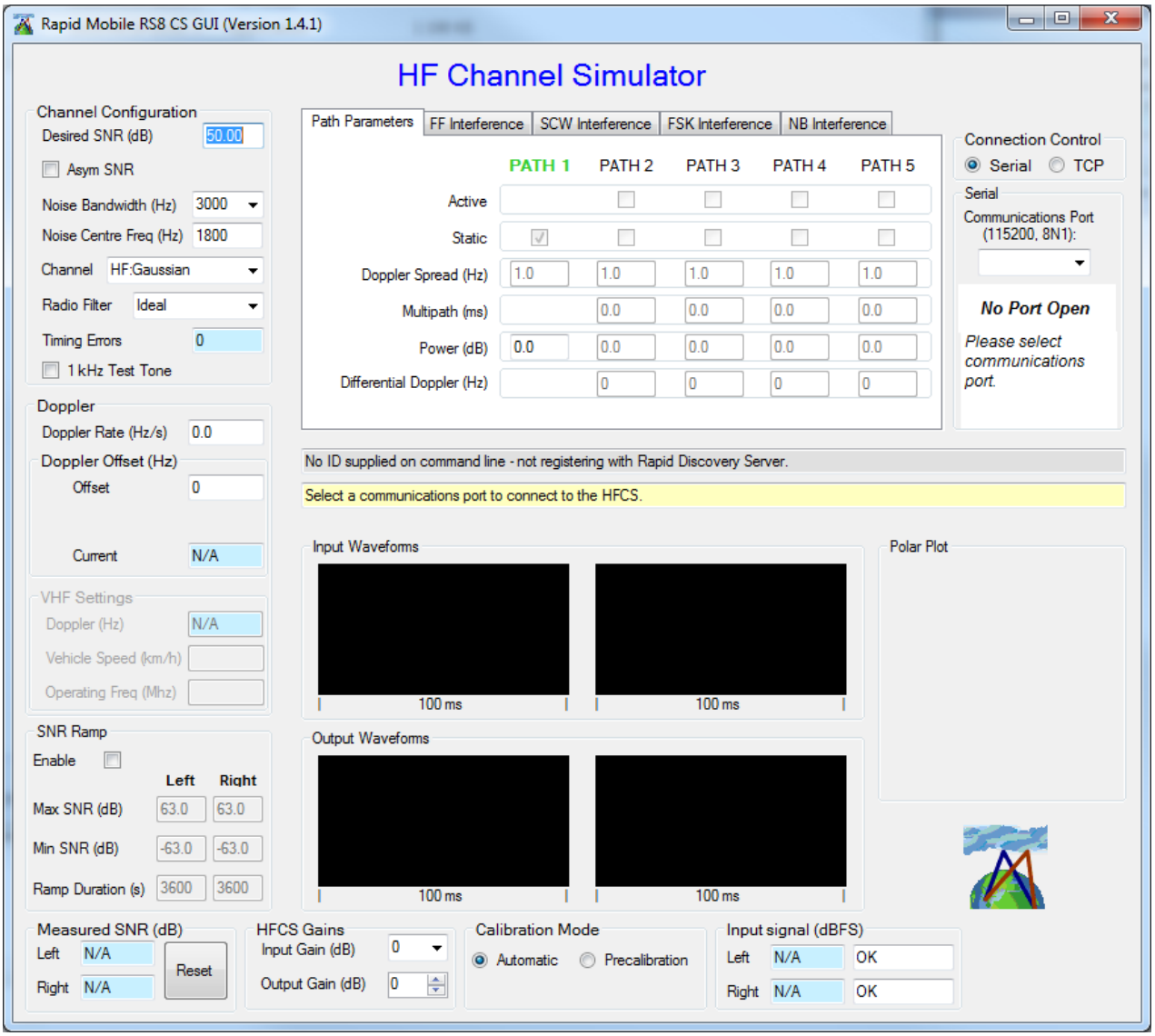


Figure 19: Start-up screen of the RS8 CS GUI

9.2.5 CONNECT TO THE GUI

In the top right corner of the GUI, the *Connection Control* panel can be found (see Figure 20 and Figure 21). To connect to the **RS8**, use the Radio Button in the panel to select the correct connection method – Serial or TCP.

9.2.5.1 SERIAL CONNECTION

With the Serial radio button selected, use the drop down menu in the panel to select the COM Port the Remote Control cable is connected to (see Figure 20b).

If the connection is successful, the Connection Control panel will change to the Process Control panel and the values of the GUI will update to those used by the **RS8** (see Figure 20c). The type of connection and connection setting (COM port used) will be displayed in the connection status block.

If there is a connection error the GUI will indicate this and say that there is "No status from HFCS" (see Figure 20d).

This connection error can be caused due to the:

- incorrect COM port being selected
- COM port already used by another application
- Remote Control cable not securely connected to the PC or **RS8**
- **RS8** not turned on and operational
- some other reason

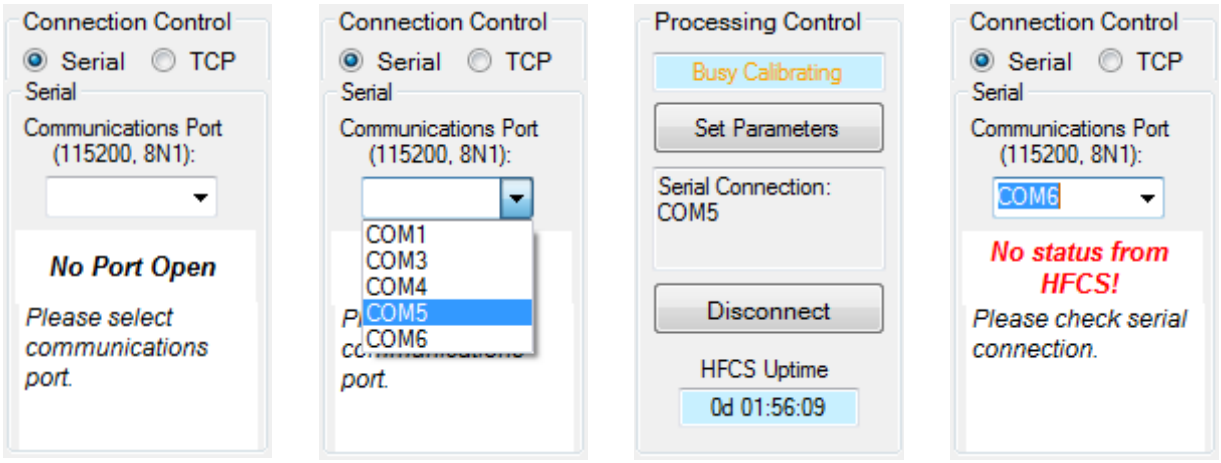


Figure 20: Serial Connection Control Panel - (a) with GUI start-up, (b) selecting the COM port, (c) successful connection, (d) failed connection

9.2.5.2 TCP CONNECTION

With the TCP radio button selected, enter the IP address and port of the **RS8** in the space provided and click *Connect* (see Figure 21b). Unless otherwise specified, the default port of 58001 should be used.

If the connection is successful, the Connection Control panel will change to the Process Control panel and the values of the GUI will update to those used by the **RS8** (see Figure 21c). The type of connection and connection setting (IP address and port used) will be displayed in the connection status block.

If there is a connection error the GUI will indicate this with a pop-up error window saying that the "Connection failed" (see Figure 21d).

This connection error can be caused due to the:

- incorrect IP address or port entered
- PC and **RS8** on different networks
- **RS8** Ctrl Ethernet Port settings are incorrect
- Ethernet cable not securely connected to the PC or **RS8**
- **RS8** not turned on and operational
- some other reason

To confirm that the **RS8** is connecting to the network, ping its IP address from the PC running the GUI.

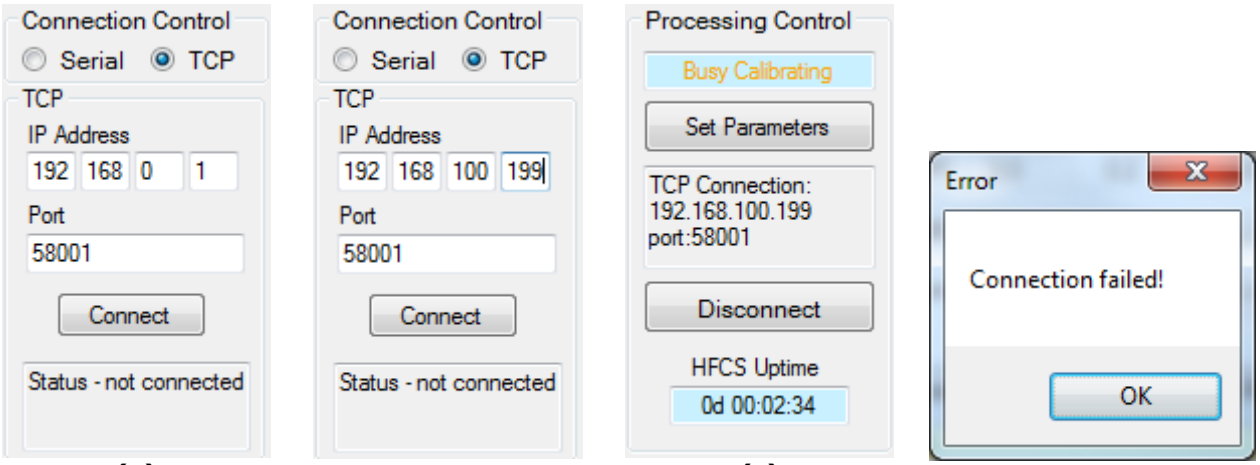


Figure 21: TCP Connection Control Panel - (a) with GUI start-up, (b) entering the IP address and port, (c) successful connection, (d) failed connection

ATTENTION:

- The **RS8** must be turned on and running for the GUI to connect to it. If it is not the GUI will display a connection error.

9.3 Description of GUI

9.3.1 GUI Main Screen

All the important parts of the RS8 CS GUI's main screen are labelled in Figure 22 with a brief description of the parts given below.

All parameter sections are shown with a black label box; these are values which can be changed and updated. The greyed out labels show the indication sections of the screen which give status information about the **RS8**.

For a more in-depth explanation of the parameters and what they do refer to their corresponding **RS8** menu item in Section 5.

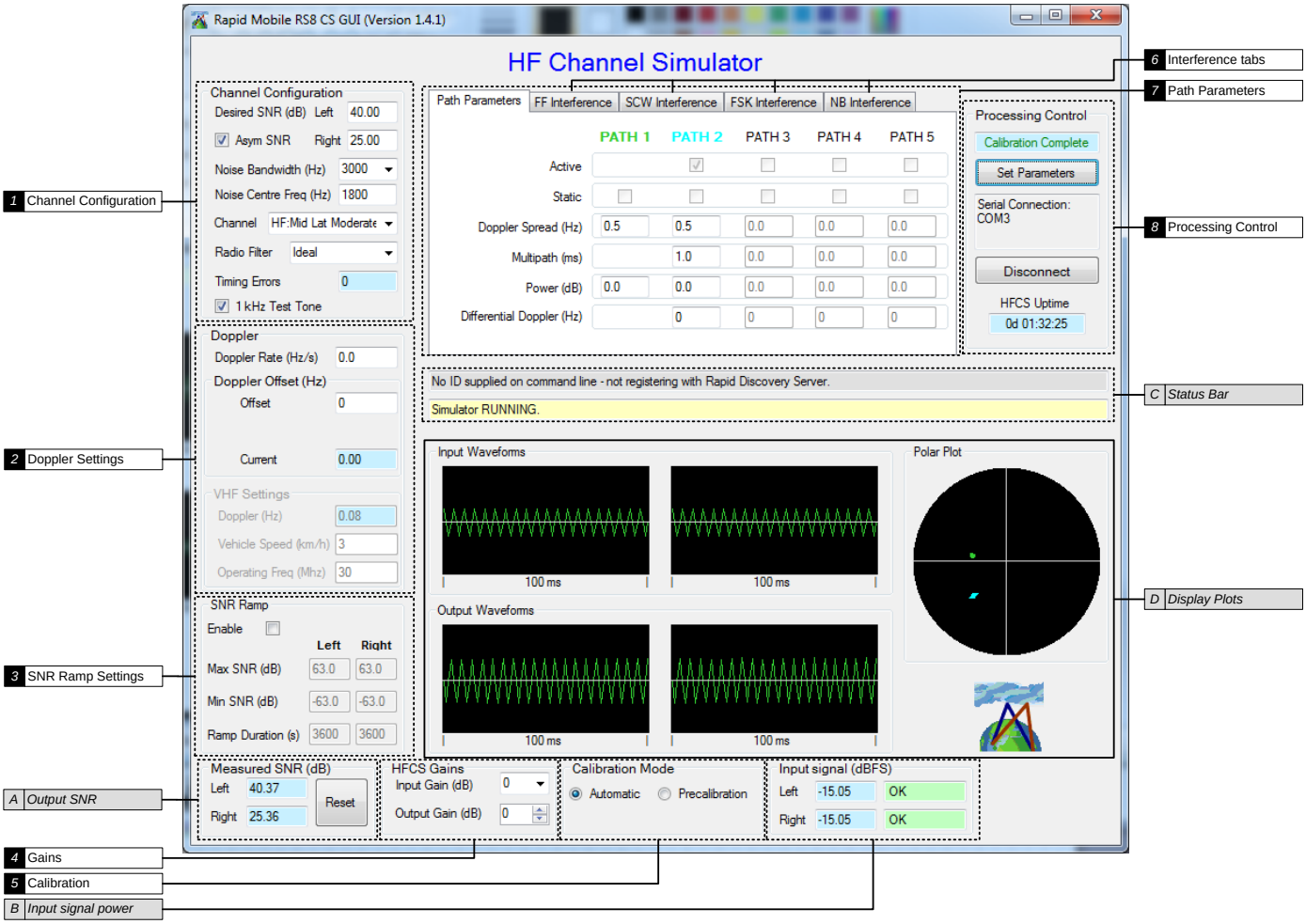


Figure 22: RS8 CS GUI Main Screen

1- Channel Configuration
View and set the channel parameters

2- Doppler Settings
View and set the Doppler parameters and view the current Doppler offset value. Also view and configure the VHF Doppler parameters.

3- SNR Ramp Settings
View and set the SNR Ramp parameters

4- Gains
View and set the input and output gains

5- Calibration Mode
View and set the calibration mode used

6- Interference tabs
Select the tabs to view the various interference

***A*- Output SNR indication**
View the measured output SNR.

***B*- Input Signal Power indication**
View the measured input power

***C*- Status Bar**
View status information about the HFCS.

***D*- Display Plots**
Display input and output waveforms and Doppler Spread polar plot

parameters

7- Path Parameters
View and set the parameters of the 5 paths

8- Processing Control
Connect and send the new parameters down to the RS8 and view the uptime of HFCS in the format *x*d HH:MMSS

ATTENTION:

- The *Asym SNR* tick box in the Channel Configuration section is used to give the left and right Desired SNR values independently or together.
- If it **is not** ticked then they are both updated to the same value.
- If it **is** ticked then the left and right SNR boxes are available to update separately.

9.3.2 GUI VHF Screen

The VHF parameters can be accessed by selecting a VHF type Channel in the Channel Configuration box.

As shown in Figure 23, the VHF Path parameters are now shown in place of the HF Path Parameters. In addition, the VHF Settings box under the Doppler Settings, on the left of the screen, is no longer greyed out. The VHF settings and path parameters can be edited and controlled as with all the other channel simulator parameters.

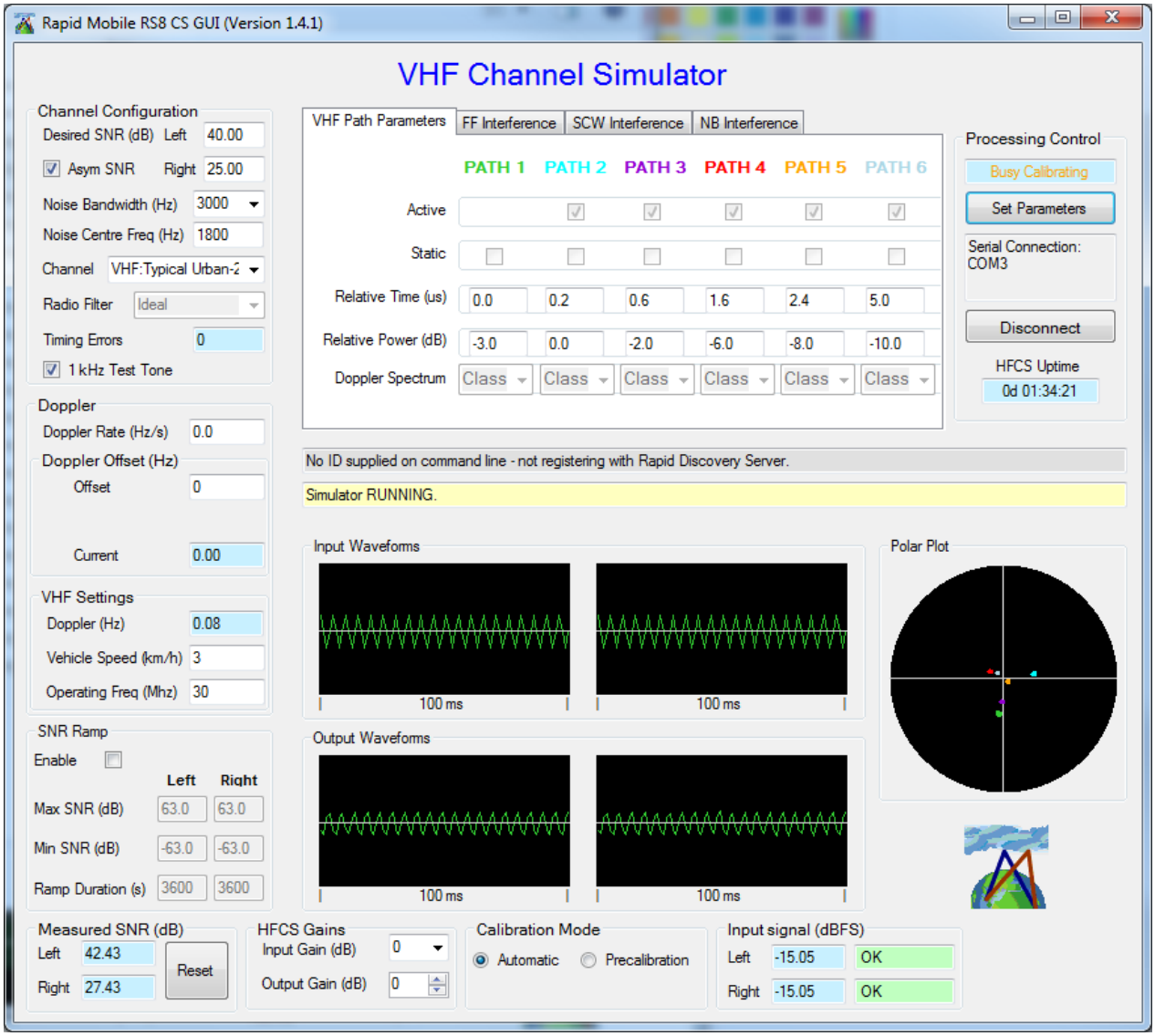


Figure 23: RS8 CS GUI Screen with VHF Parameters shown

9.3.3 GUI INTERFERENCE SCREEN

The interference parameters can be accessed by clicking on the Interference Tabs next to the Path Parameters panel tab. These tabs are used to switch between viewing the Path Parameters and the Interference parameters.

As shown in Figure 24 to Figure 27, the Interference parameters are now shown in place of the Path Parameters. They can be edited and controlled as with all the other parameters and are set and active whether they are being viewed or not.

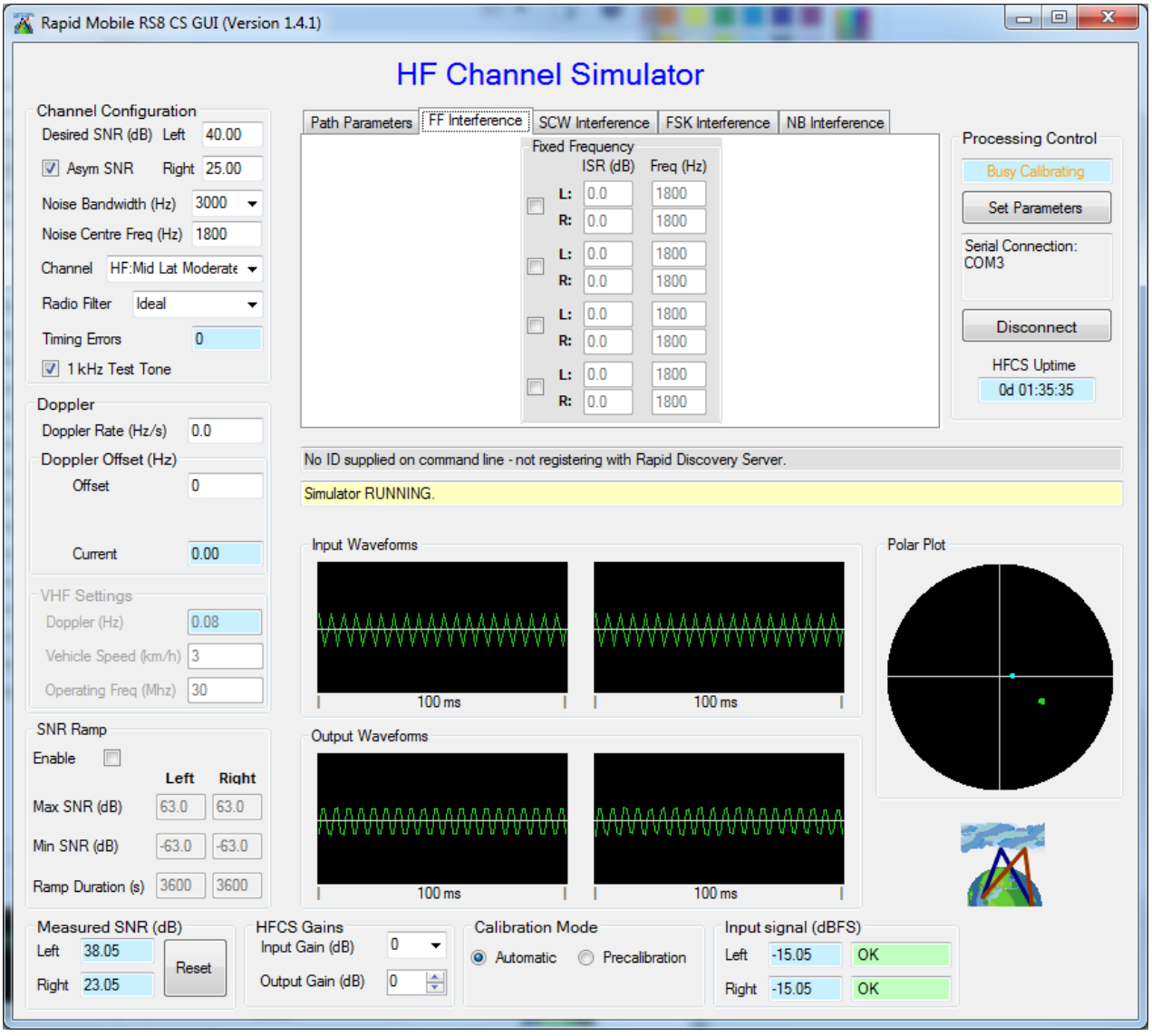


Figure 24: RS8 CS GUI Screen with Fixed Frequency Interference Parameters

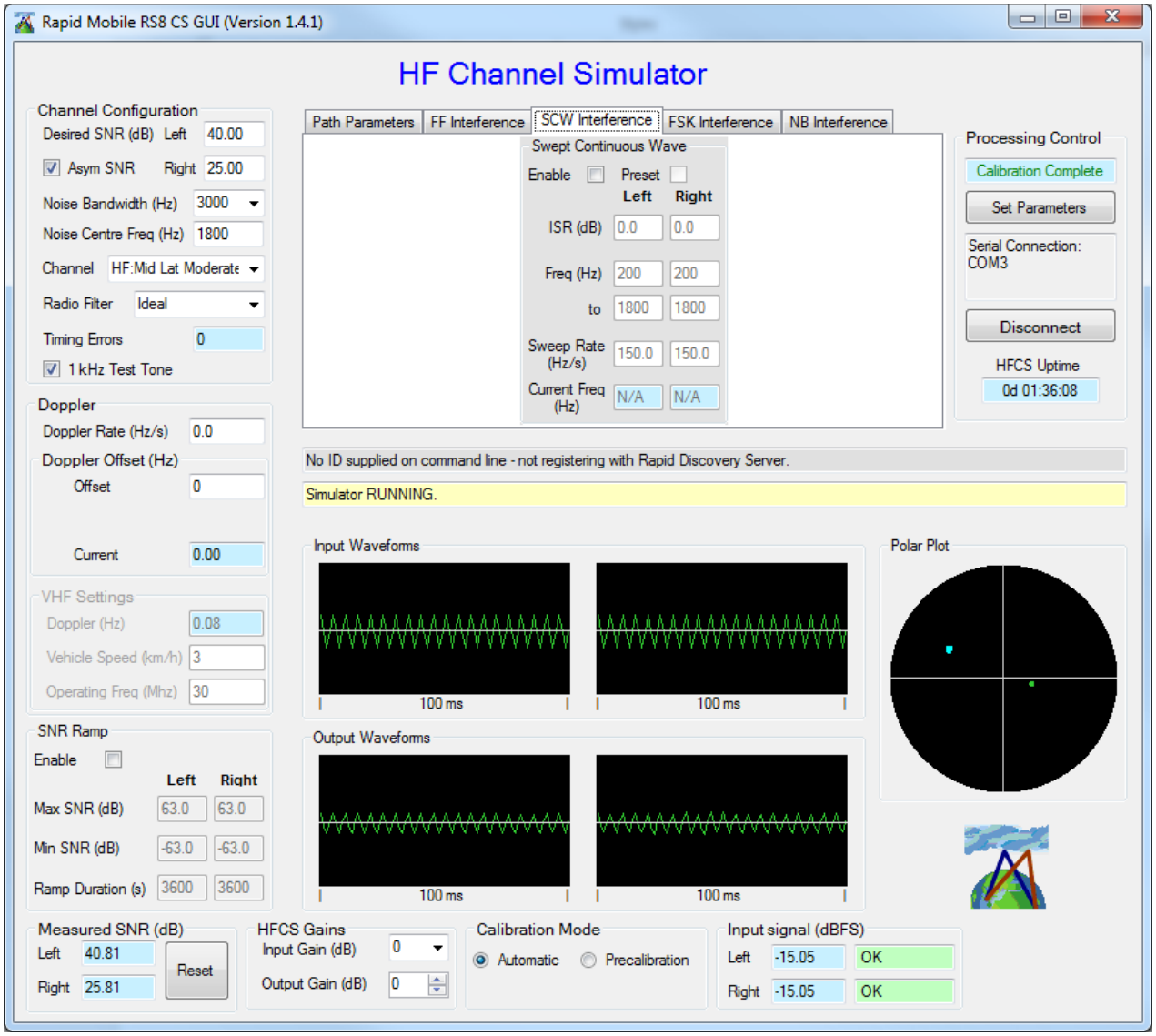


Figure 25: RS8 CS GUI Screen with Swept Continous Wave Interference Parameters

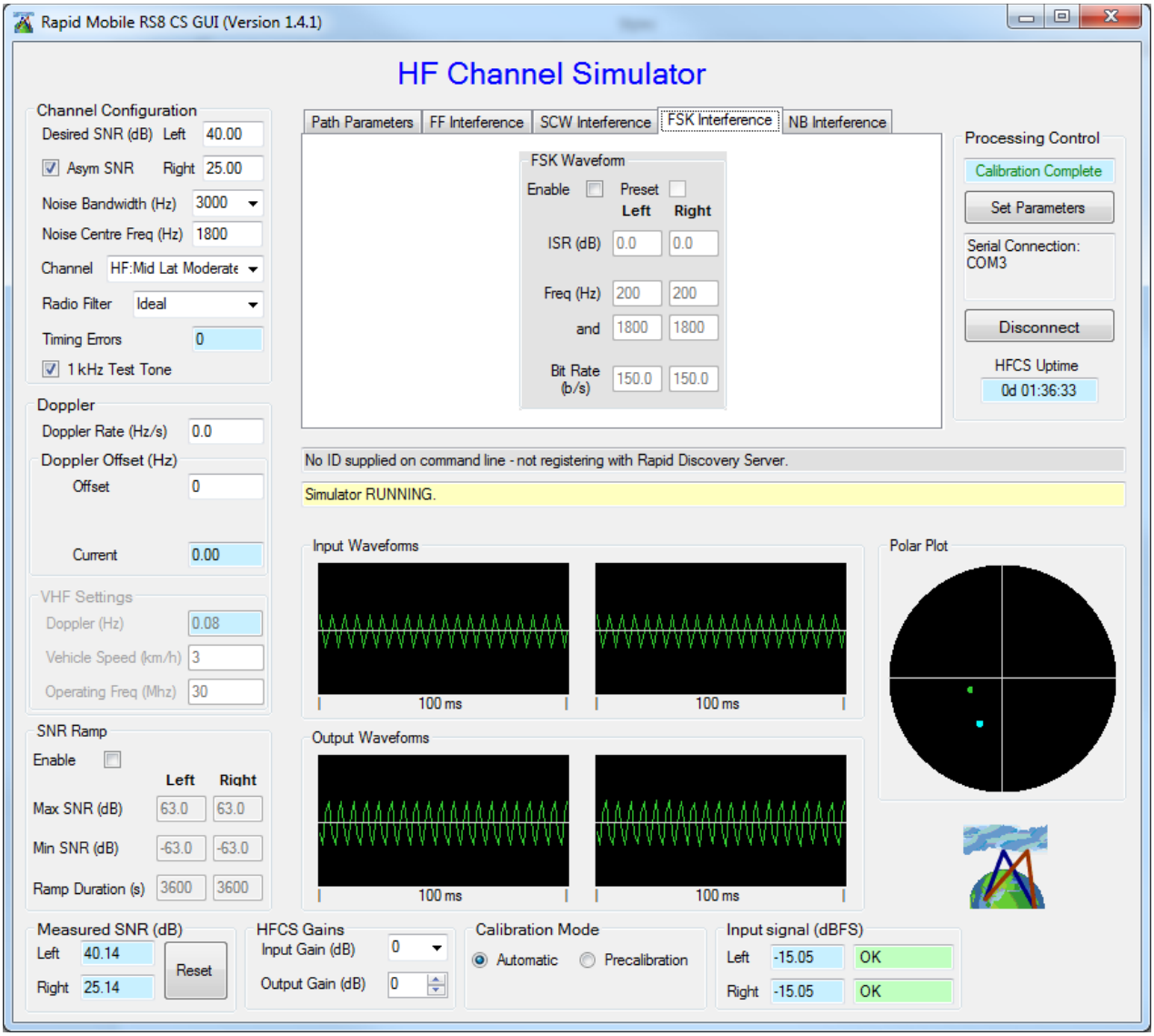


Figure 26: RS8 CS GUI Screen with FSK Waveform Interference Parameters

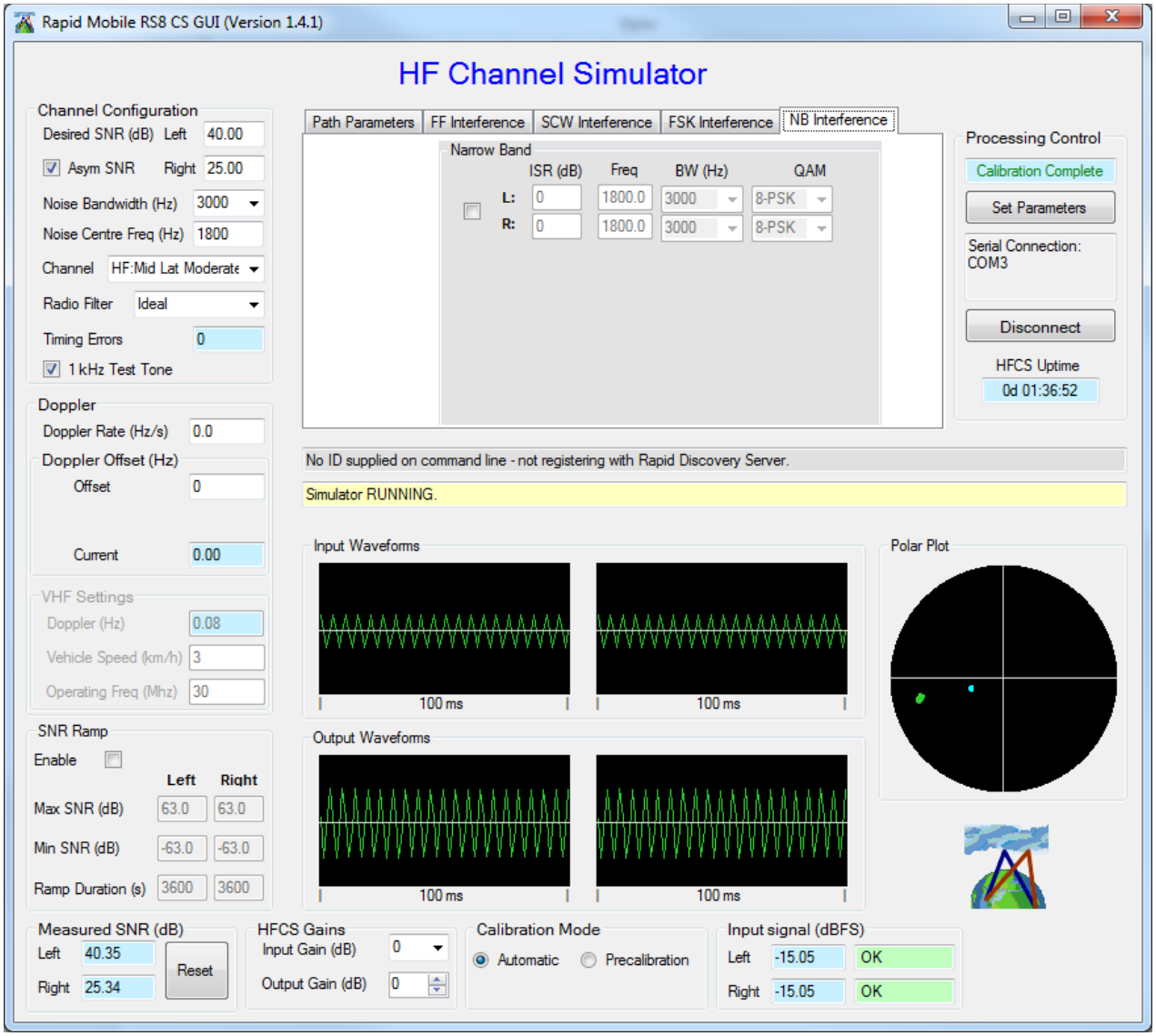


Figure 27: RS8 CS GUI Screen with Narow Band Interference Parameters

9.4 COMMUNICATION

9.4.1 PROTOCOL

The GUI communicates with **RS8** using the RapidM RIPC/RAP1 protocol.

9.4.2 STATUS UPDATES

Once connected, the GUI *requests* all the channel simulator parameters from **RS8**. It uses these parameters to update the GUI's values.

It also sends a *registration message* to register for all HFCS status updates. This allows status information to be received as well as notifications of any parameter changes. Therefore, whenever a parameter is updated from the **RS8** front panel, the GUI will update its display accordingly.

The status information is used to give feedback such as input power and measured SNR as well as to display waveforms of the input and output signals and Doppler spread polar plot.

9.4.3 SETTING PARAMETERS

When parameter values are changed on the GUI they are not automatically sent to the **RS8**. Instead, the user must click the '*Set Parameters*' button when they want this to occur. This then sends all the parameter values down to the **RS8** which updates the values of the V/HFCS. When this occurs the channel simulator briefly stops, updates its parameters and then starts again.

9.4.3.1 ON-THE-FLY

This is true for all except three parameters – the *Desired SNR* values, the *Input Gain* and the *Output Gain*. When these are updated on the GUI, the moment their input box loses focus, a parameter update is immediately sent to the **RS8** and the new parameter set.

Additionally, the channel simulator does not stop briefly to implement the new parameter, they are updated on-the-fly.

10 MAINTENANCE

10.1 INTRODUCTION

Maintenance can be induced through one of the following:

- Preventative Maintenance.
  - None required.
- Hardware Failure induced Maintenance.
  - In the event of any device failure it will be necessary to return the unit to RapidM for repair.

10.2 NATO STOCK NUMBERS

The following NATO Stock Numbers have been issues for the product.

Description	Detail Description
Battery CR2032	• 6135-13-1147522
Fuse Schurter	• 5920-12-1658042

Table 25: Maintenance: NATO Stock Numbers

10.3 Replacing the Fuse

When the fuse (2A slow blow, 250 VAC) of the **RS8** unit needs to be replaced, the following procedure should be followed:

- Ensure the modem is powered off.
- Unplug all power and data cables from the modem.
- Use a small flat-headed screwdriver to remove the cover of the fuse holder found on port J8 (AC Mains Supply).

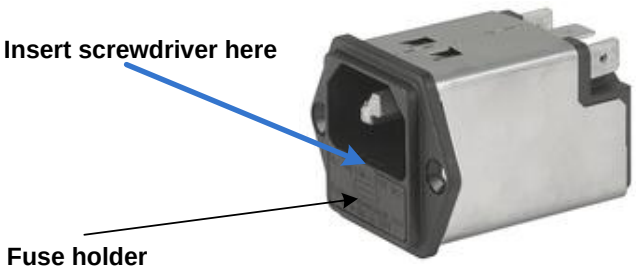


Figure 28: Replacing the fuse

- Remove the faulty fuse using fingers and insert its replacement into the fuse holder.
- Push the fuse holder cover back in place.

CAUTION

Before any servicing on the electric circuitry, ensure that gloves and an electrostatic discharge bracelet with the linked cord of the bracelet connected to an electrical ground are worn. Make sure that all power cables have been disconnected and that the unit is safe to work on. Refer to the safety information at the beginning of this manual for more information.

10.4 Recommended Mating Connectors

The following references (part numbers, descriptions & suppliers) are recommended for mating connectors for the **RS8** units.

- ***J15 REM CTRL / GPS mating connector & back-shell***
  - *Type: D-Sub 9-pin Female*
    - Manufacturer: Norcomp
    - Manufacturer Part Number: 172-009-202R001 or 172-E09-202R001 or equivalent
    - Alternative Manufacturer: Amphenol, Manufacturer Part Number: L77SDE09S
    - Suppliers: www.digikey.com, http://avnetexpress.avnet.com, https://www.verical.com, http://www.newark.com, https://www.mouser.com
  - *Type: D-Sub E-size (9-pin) Metal Back-shell*
    - Manufacturer: FCI
    - Manufacturer Part Number: 8655MH0901BLF or equivalent
    - Suppliers: www.digikey.com, https://www.mouser.com
- ***J11 RADIO CTRL / AUDIO mating connector & back-shell***
  - *Type: D-Sub 25-pin Female*
    - Manufacturer: Norcomp
    - Manufacturer Part Number: 172-025-202R001 or 172-E25-202R001 or equivalent
    - Alternative Manufacturer: Amphenol, Manufacturer Part Number: L77SDB25S
    - Suppliers: www.digikey.com, http://avnetexpress.avnet.com, https://www.mouser.com
  - *Type: D-Sub B-size (25-pin) Metal Back-shell*
    - Manufacturer: FCI
    - Manufacturer Part Number: 8655MH2501BLF or equivalent
    - Supplier: www.digikey.com, https://www.mouser.com
- ***J3 DTE mating connector & back-shell***
  - *Type: D-Sub 25-pin Male*
    - Manufacturer: Norcomp
    - Manufacturer Part Number: 172-025-102R001 or 172-E25-102R001 or equivalent
    - Alternative Manufacturer: Amphenol, Manufacturer Part Number: L717SDB25P
    - Suppliers: www.digikey.com, http://www.newark.com, https://www.mouser.com
  - *Type: D-Sub B-size (25-pin) Metal Back-shell*
    - Manufacturer: FCI
    - Manufacturer Part Number: 8655MH2501BLF or equivalent
    - Supplier: www.digikey.com, https://www.mouser.com

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11 SOFTWARE UPDATE

11.1 INTRODUCTION

This section will provide the information required to update the software installed on the **RS8**

The **RS8** unit has three processors. When a software update is released some or all of these processors will need to be updated depending on the software update. Occasionally all three processors on the unit will need updating, and in this scenario the update order to follow is as presented in the following sections.

In general, most software updates will apply for a single processor in a unit, and in most cases this update will be for the TC4-DSP processor. In this case, the update procedures for the other processors may be ignored.

The three processors in each unit that may require updating are the:

- CTRL-SAM
- DATA-SAM
- TC4-DSP

Each processor is updated via a different cable connection to the updating PC, the details of these connections are specified below in section 11.2.

ATTENTION:

- In the case where all three processors need to be updated, the **order** in which the updates are done is **very important**.
- The **CTRL-SAM** must be updated **first**.
- The **DATA-SAM** must be updated **second**.
- The **TC4-DSP** must be updated **third**. When applicable the **TC4-DSP Application software** must be updated **before** the **TC4-DSP Bootloader** is updated.

11.2 PREPARATION

11.2.1 CABLE CONNECTIONS REQUIRED FOR SOFTWARE UPDATE

Figure 29 illustrates the connections required to update the software for *one* unit of the **RS8**.

1. ***CTRL-SAM Software***,
    a. Programmed using PC and standard COM port (e.g. *COMy*)
    b. Updated via the REM CTRL Port (J15 connector).
    c. Cable used:
        i. RM-0120-02: REM CTRL Cable

2. ***DATA-SAM Software***,
    a. Programmed using PC and standard COM port (e.g. *COMx*)
    b. Updated via the DCE Port (J27 connector).
    c. Cable used:
        i. RM-1942-V01 DSAM Programming Cable

3. ***TC4-DSP Software***,
    a. Programmed using PC and standard COM port (e.g. *COMz*)
    b. Updated via RADIO CTRL Port 1 (J28 connector).
    c. Cables used:
        i. RM-0945-02: UART/Audio Cable
        (or RM-0818-01: Radio Ctrl/Audio Cable)
        ii. RM-0120-02: REM CTRL Cable

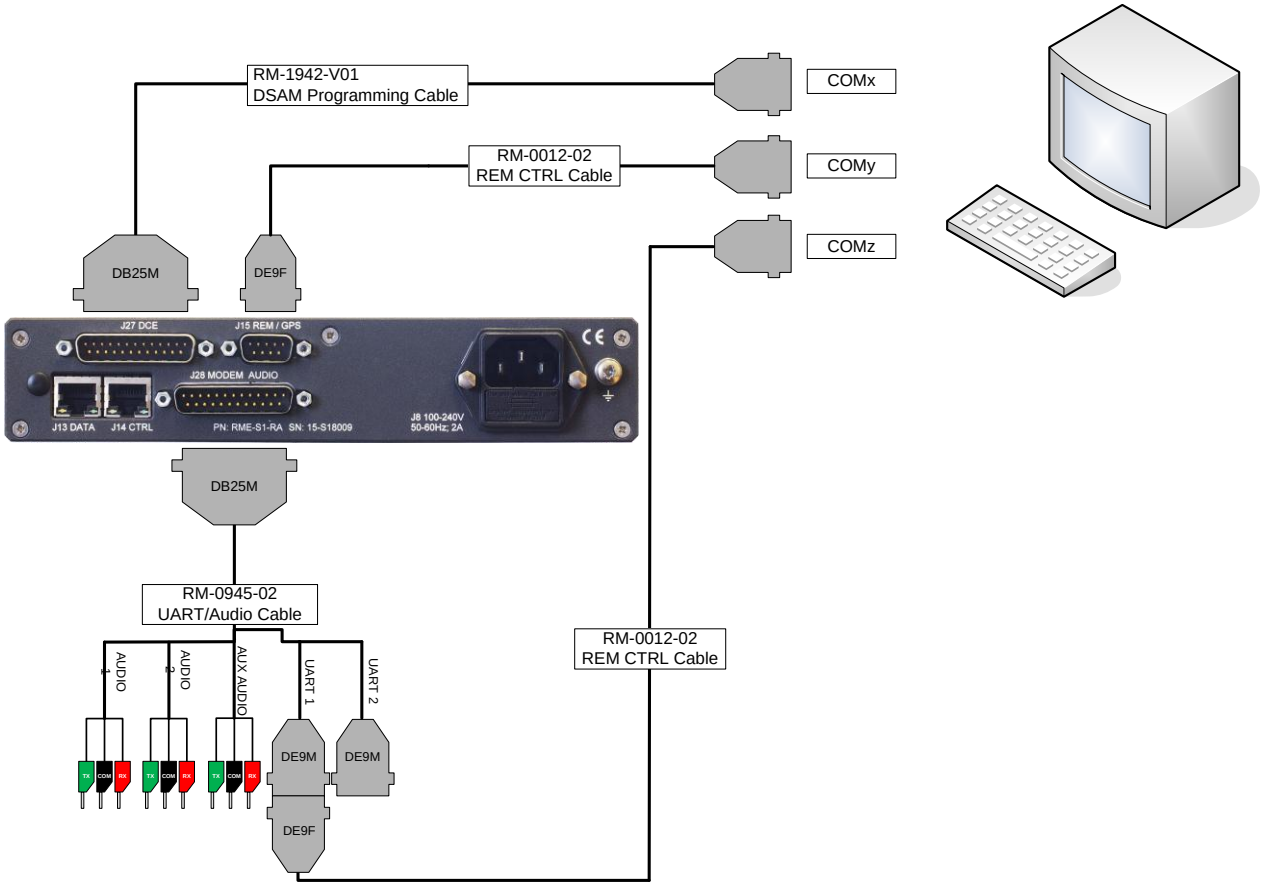

Figure 29: RS8 connections for Software Maintenance

11.2.2 PREPARATION OF THE INSTALL PC

11.2.2.1 COPY INFORMATION ONTO INSTALL PC

It is advised that the entire contents of the new software release are copied to a directory on the PC hard disk. For example:

c:\naval_products\rapidm\....

11.2.2.2 USE OF THE BATCH FILES

To simplify the updating procedure for the CTRL and DATA SAM7 processors batch files are included with the release of each version of software. This section is a short example of how these batch files work and more specifically the required directory structure to allow them to work as designed.

The batch files are used to start the programming utility, sfl_remote.exe, with the correct command line arguments. To do this the batch file needs to have the path to the executable as well as the path to the programming file. The executable and application file are referenced from the location of the batch file to make the batch files work on each and every system, regardless of where the program releases are stored. In the following description of the batch files in Figure 30 and Figure 31 the lines that are applicable to the specific directory structure are broken down into components and explained. If the batch files are not working as expected check if the structure detailed here matches the installation on the PC.

In the following figures, YYYY-MM-DD refers to a date, XXX refers to a document revision number and X.Y.Z refers to a software version number.

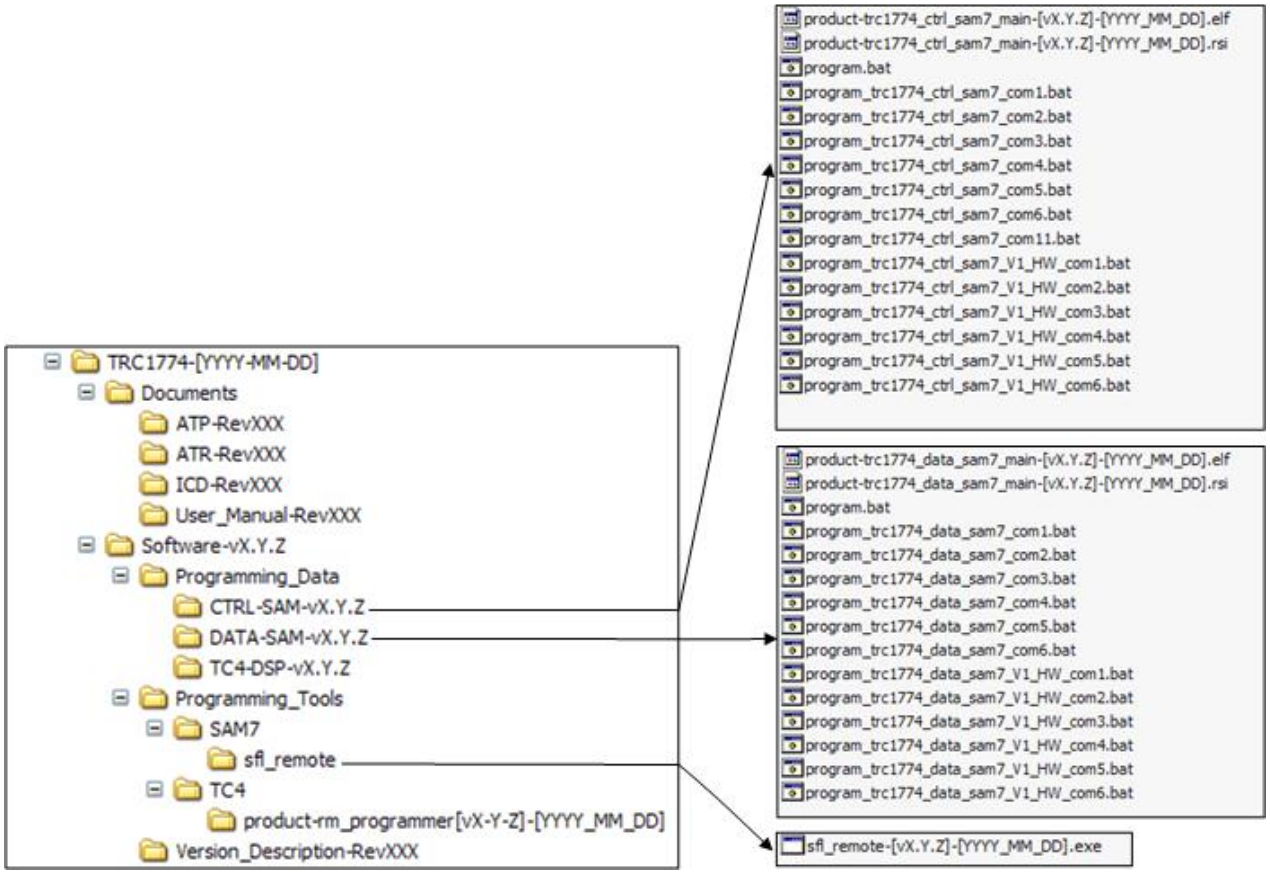

Figure 30: The directory structure and files that are included with each release.

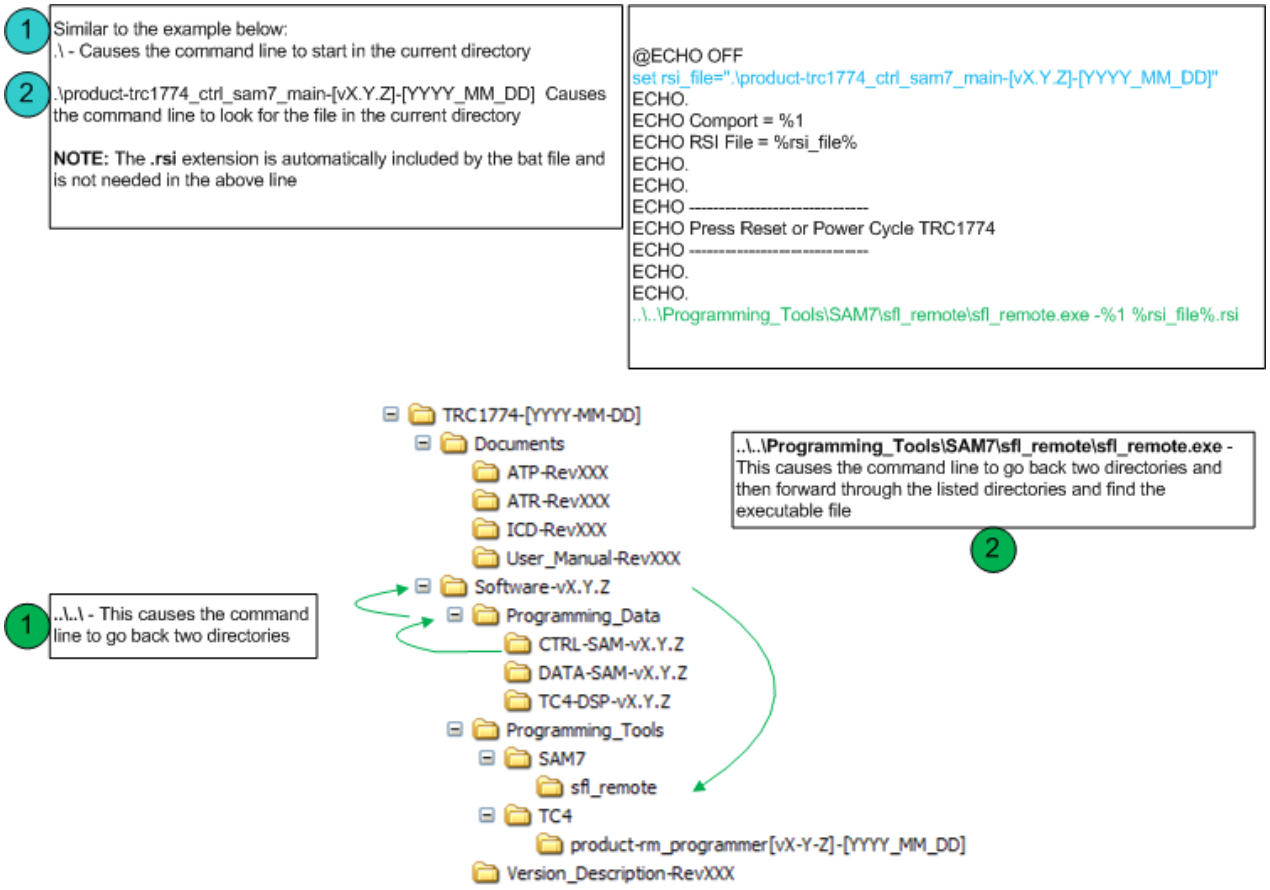

Figure 31: Directory structure and batch file referencing.

11.2.2.3 INSTALLING RM PROGRAMMER ONTO INSTALL PC

To update the TC4-DSP, the RM Programmer application must be installed onto the Install PC. The RM Programmer requires Windows XP Service Pack 3 or higher for it to be installed correctly.

This is done by executing the file:
RM Programmer_vX.Y.Z_setup.exe

This file can be found under:
RS8-[YYYY-MM-DD]\Software-vX.Y.Z\Programming_Tools\TC4\Product-rm_programmer[vX.Y.Z]-[YYYY-MM-DD]

Then follow the on screen instructions during the installation wizard.

ATTENTION:
If an **older version** of RM Programmer is already installed, please note the following:
- If the version number of the RM Programmer is **v1.0.2 or lower**, then that instance of the RM Programmer must be **manually uninstalled** before installing the latest version.
- For versions **v1.0.3 and above** the RM Programmer Installation Wizard may be run without uninstalling the previous version.

11.3 CTRL-SAM CODE PROGRAMMING

11.3.1 GENERAL

The CTRL-SAM processor of the **RS8** is programmed via the **REM CTRL Port (J15)**. Connect the **REM CTRL Cable** between the desired unit and PC as indicated in Figure 29.

The unit's CTRL-SAM Application code is stored in FLASH memory. The FLASH is programmed with the new CTRL-SAM application code (.hex file) with the ***SFL*** Programmer (*Windows Console Application*).

During the **RS8** boot process, the CTRL-SAM Bootloader checks if the ***SFL*** Programmer is trying to connect on the **REM CTRL Port**. If no connection attempt is found, the Bootloader will boot the application program present in the FLASH. If a request from the Programmer to connect is found, the Bootloader will handshake with the Programmer and enter the connected state.

11.3.2 PROGRAMMING STEPS

To program the CTRL-SAM Application software, follow these steps:

1) In Windows Explorer, browse to and execute the appropriate BATCH file:
   a) Directory: ***RS8-[YYYY-MM-DD]\Software-vX.Y.Z\Programming_Data\CTRL-SAM-vX.Y.Z***
   b) BATCH File: **"program_RS8_ctrl_sam7_com#.bat"** where **#** is the PC COM port number that the REM CTRL Cable is connected to.

2) Once the appropriate BATCH file has been executed the SFL Programmer will open a console window and prompt the user to reset the unit being updated. The SFL Programmer will wait for a reset in the state shown in Figure 32.

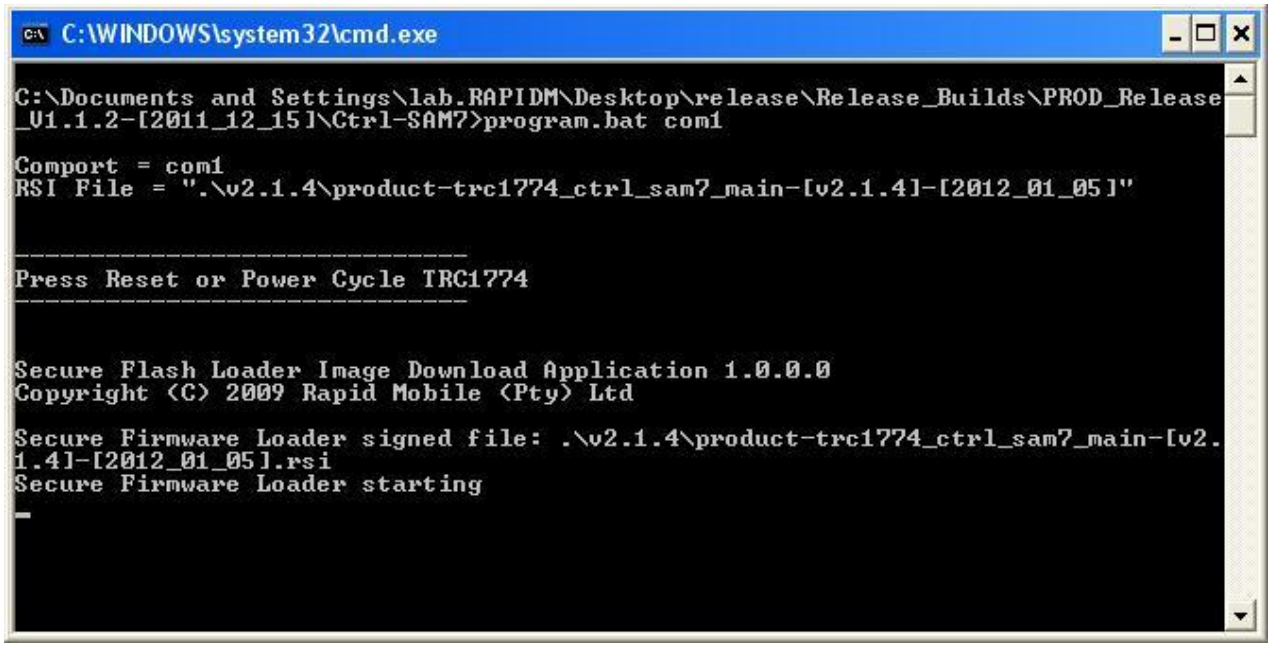

Figure 32: SFL Programmer CTRL-SAM update - waiting for unit reset

3) Reboot the **RS8**

4) The SFL Programmer will now update the software stored on the CTRL-SAM. The final state of the SFL Programmer will appear as in Figure 33

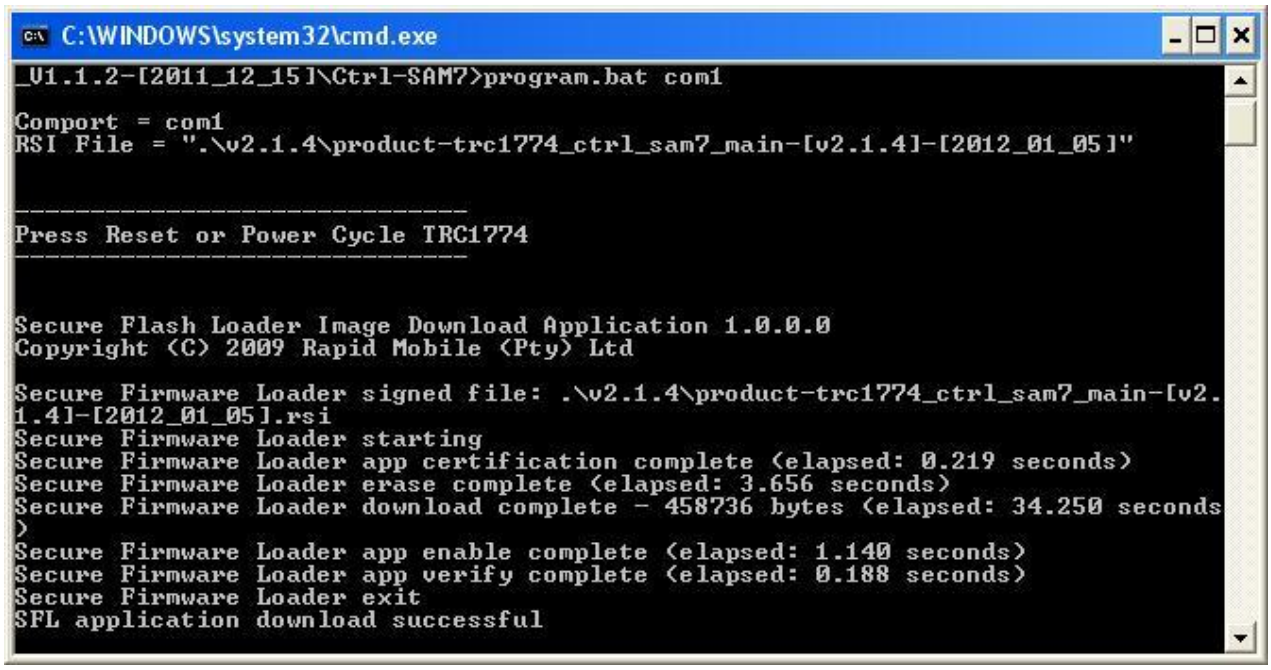

Figure 33: SFL Programmer upon CTRL-SAM update completion

5) The SFL Programmer will wait for a key press before closing automatically.

6) Reboot the **RS8**.

7) The CTRL-SAM update process is now complete.

11.4 DATA-SAM CODE PROGRAMMING

11.4.1 GENERAL

The DATA-SAM processor of the **RS8** is programmed via the **DTE Port (J27)**. Connect the DTE Cable between the desired unit and PC as indicated in Figure 29.

The unit's DATA-SAM Application code is stored in FLASH memory. The FLASH is programmed with the new DATA-SAM application code (.hex file) with the ***SFL*** Programmer (*Windows Console Application*).

During the **RS8** boot process, the DATA-SAM Bootloader checks if the ***SFL*** Programmer is trying to connect on the **DTE Port (J27)**. If no connection attempt is found, the Bootloader will boot the application program present in the FLASH. If a request from the Programmer to connect is found, the Bootloader will handshake with the Programmer and enter the connected state.

11.4.2 PROGRAMMING STEPS

To program the DATA-SAM Application software, follow these steps:

1) In Windows Explorer, browse to and execute the appropriate BATCH file:
   a) Directory: ***RS8-[YYYY-MM-DD]\Software-vX.Y.Z\Programming_Data\DATA-SAM-vX.Y.Z***
   b) BATCH File: **"program_RS8_data_sam7_com#.bat"** where **#** is the PC COM port number that the DTE Port (J3) is connected to.

2) Once the appropriate BATCH file has been executed the SFL Programmer will open a console window and prompt the user to reset the unit being updated. The SFL Programmer will wait for a reset in the state shown in Figure 34.

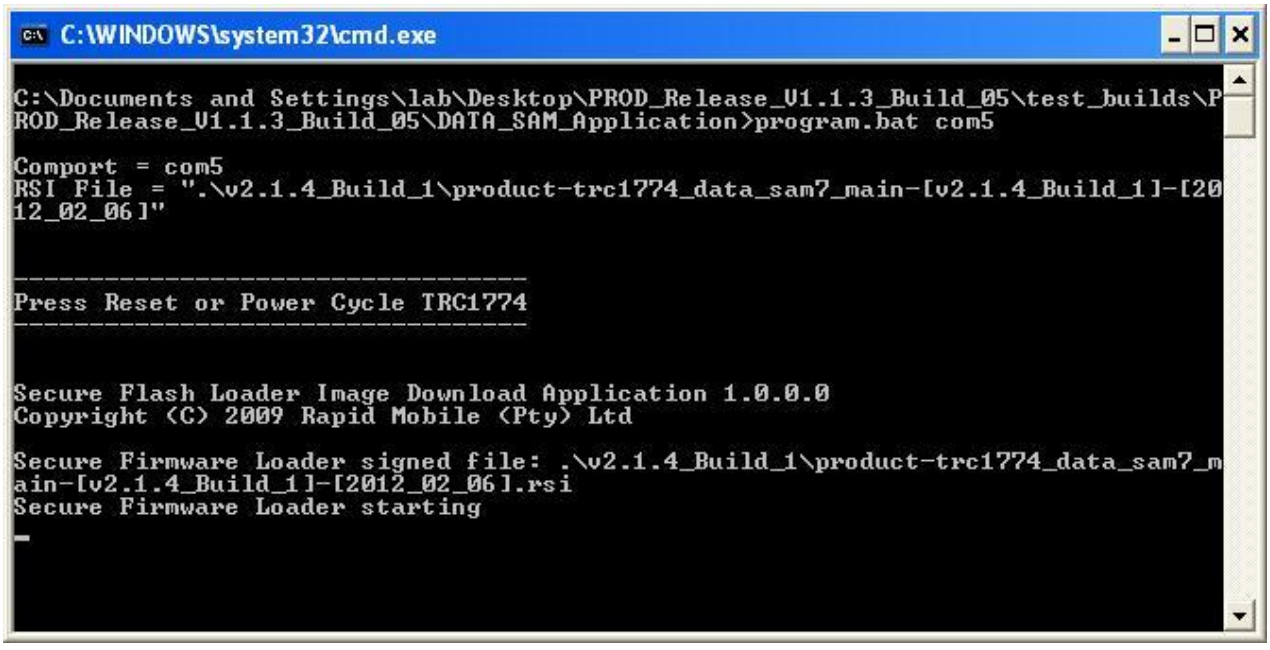

Figure 34: SFL Programmer DATA-SAM update - waiting for unit reset

3) Reboot the **RS8**

4) The SFL Programmer will now update the software stored on the DATA-SAM. The final state of the SFL Programmer will appear as in Figure 35

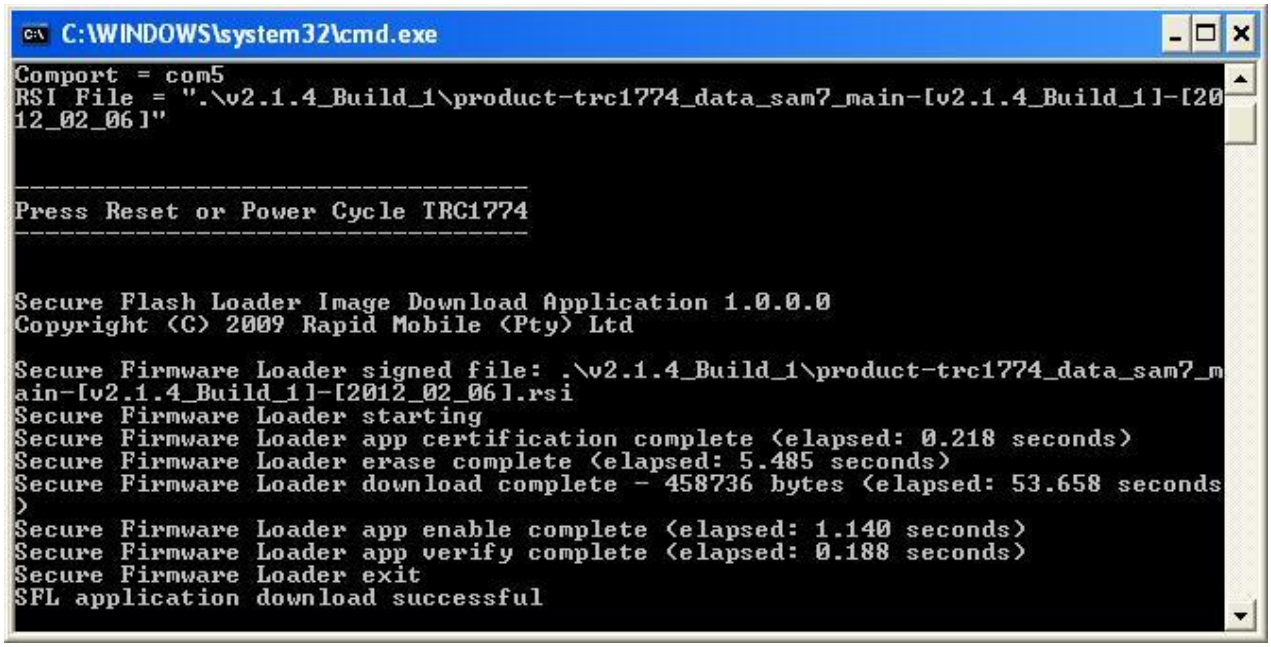

Figure 35: SFL Programmer upon DATA-SAM update completion

5) The SFL Programmer will wait for a key press before closing automatically.

6) Reboot the **RS8**.

7) The DATA-SAM update process is now complete.

11.5 TC4-DSP CODE PROGRAMMING

11.5.1 GENERAL

The DSP processor of the **RS8** is programmed via the **RADIO CTRL1 (J28)** Port**.** Connect the UART/Audio Cable and NULL Modem Cable between the desired ***unit*** and PC as indicated in Figure 29.

The unit's application DSP code is stored in FLASH memory. The FLASH is programmed with the new DSP application code (.hex file) by the **RM Programmer** (*Windows GUI Application*).

During the **RS8** boot process, the DSP Bootloader checks if the ***TC4*** Programmer is trying to connect via the **RADIO CTRL1 (J28)** port. If no connection attempt is found, the Bootloader will boot the application program programmed into FLASH.

If a request from the Programmer to connect is found, the Bootloader will handshake with the Programmer and enter the connected state.

When the FLASH programming is completed, the **RS8** must be reset to start the application code.

In order to fully update the TC4-DSP, two separate updates are required. **First** the **application software** must be updated, **followed by** the **bootloader update**. It is important to update the TC4-DSP in this order otherwise unforeseen errors may occur. The necessary update steps are described in sections 11.5.2 and 11.5.3.

11.5.2 APPLICATION PROGRAMMING STEPS

ATTENTION:
Following the update procedure for the TC4:

- A Safe Mode Reset must be performed. To perform a safe mode reset press the "ESC" and "Right Arrow" keys simultaneously after turning on power to the unit.
- Please note that the baud rate of the connection on the **RADIO CTRL1 (J18)** Port, should match between the unit and XML file loaded by the RM programmer.

To program the new application software to the TC4-DSP, follow these steps:

1) Run the RM Programmer application on the installing PC. If RM Programmer is not installed, please see section 11.2.2.3. The application can be started by using the desktop shortcut if available, or from the Start menu following the order below:

Start → All Programs → RapidM → RM Programmer → RM Programmer

2) Press the 'Load Script' button on the RM Programmer interface as highlighted in Figure 36

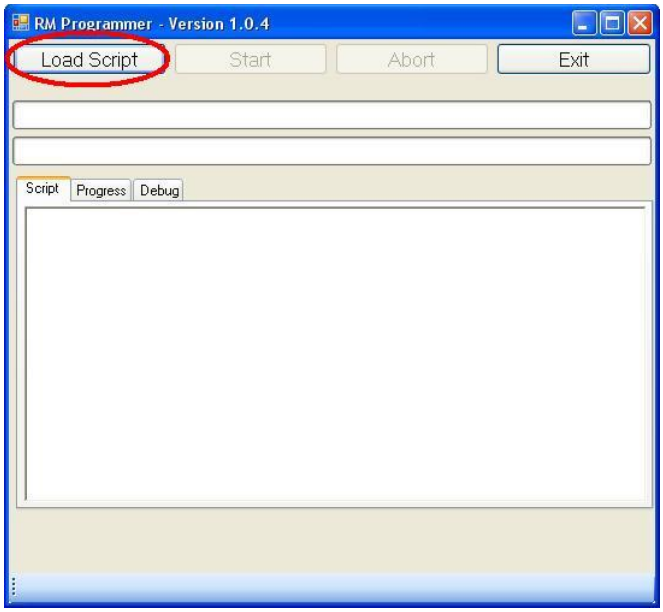

Figure 36: RM Programmer start screen

3) In the explorer window that opens, browse to and open the appropriate XML file:
   a) Directory: ***RS8-[YYYY-MM-DD]\Software-vX.Y.Z\Programming_Data\TC4-DSP-vX.Y.Z***
   b) XML File: **"program_product-RS8_com#_115200"** where **#** is the PC COM port number that the **REM CTRL Cable via the UART/AUDIO Cable** is connected to. The number after the COM number in the XML filename is the baud rate of the connection.

4) The RM Programmer will load the XML file and display the connection settings of the loaded XML file as shown in Figure 37

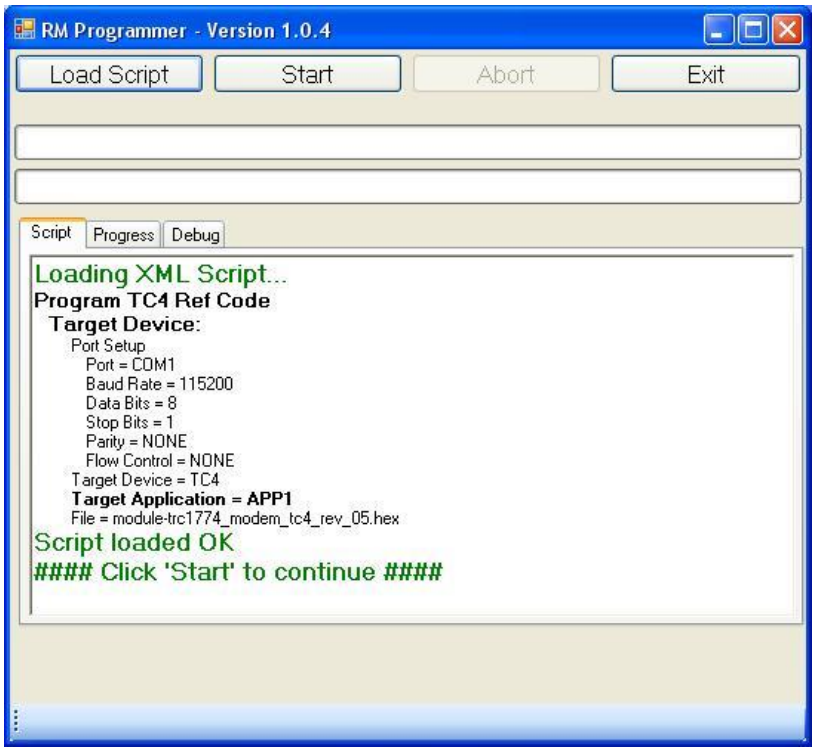

Figure 37: RM Programmer with loaded Application script

5) Verify that the details shown on the screen are correct and press the 'Start' button to begin updating the application code of the TC4-DSP.

6) The RM Programmer will load the HEX file and prepare to flash the TC4-DSP, when it is ready to begin it will prompt the user to restart the unit as shown in Figure 38.

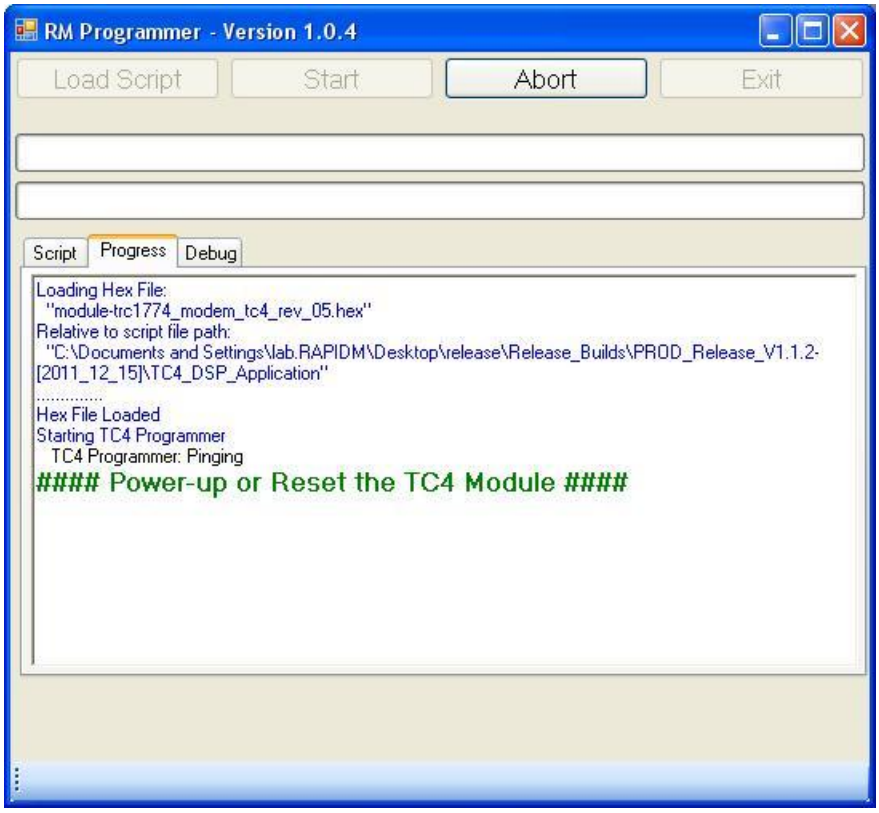

Figure 38: RM Programmer waiting for unit power cycle

7) Reset or power up the unit and the process will begin. During programming the RM Programmer will advance through a number of sectors and the update progress will be displayed as shown in Figure 39.

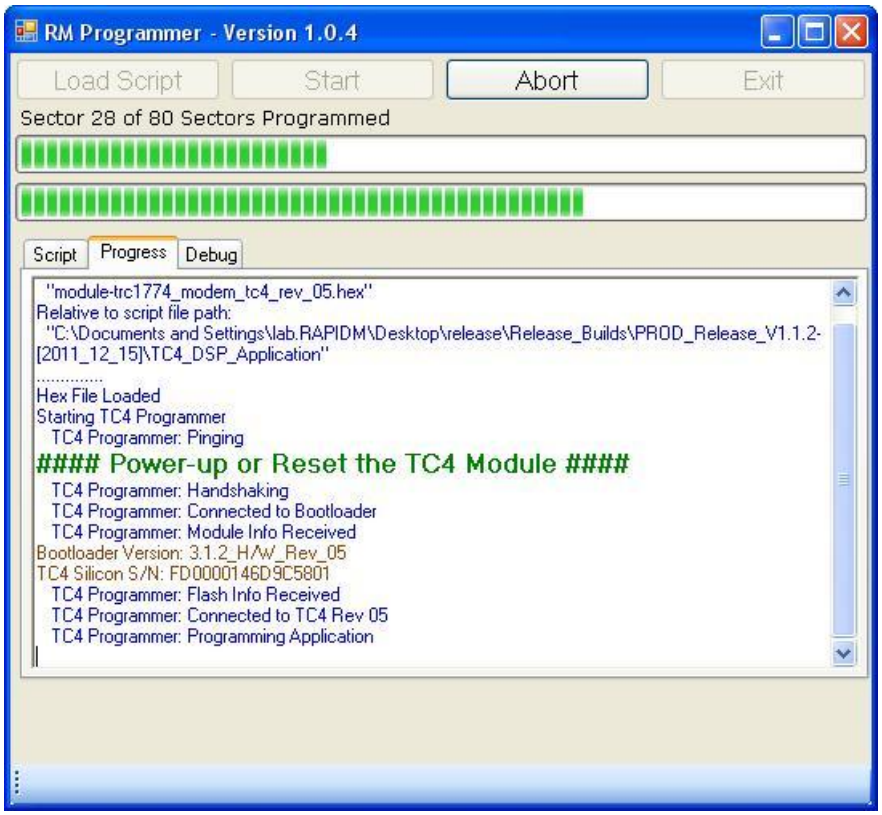

Figure 39: RM Programmer during TC4 Application programming

8) The RM Programmer will indicate when the update process is complete and the unit will reset automatically as shown in Figure 40.

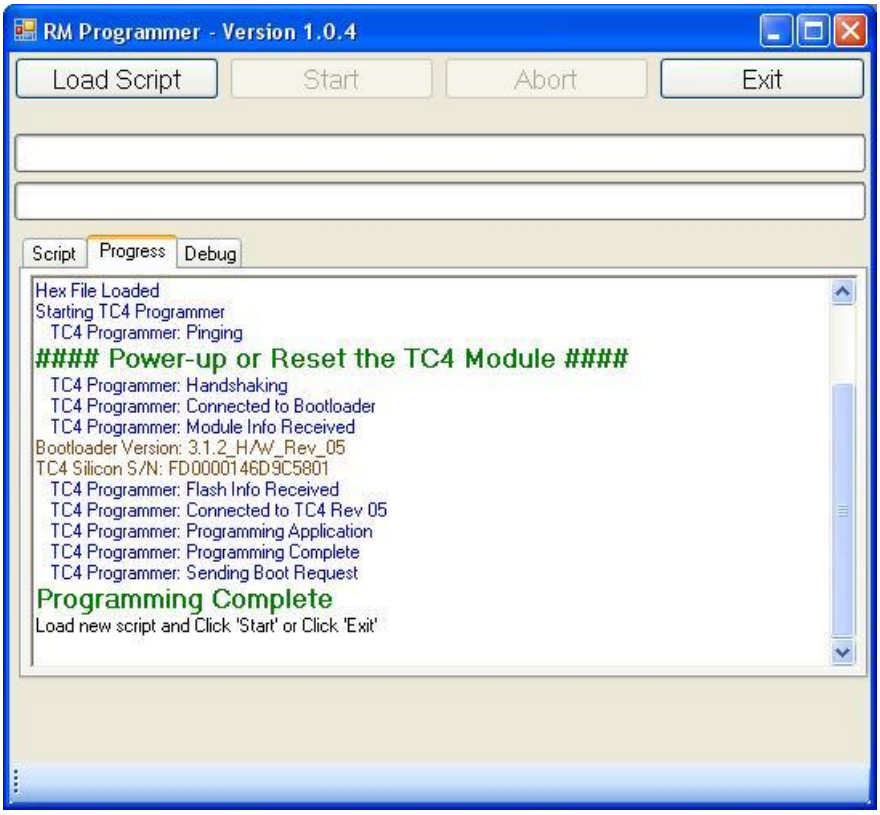

Figure 40: RM Programmer TC4 Application update complete

9) Should the unit not reset, the user can manually reset or power cycle the unit. The TC4-DSP Application update is now complete. The user may exit the RM Programmer.

10) Following the update procedure for the TC4 a Safe Mode Reset must be performed. To perform a safe mode reset press the "ESC" and "Right Arrow" keys simultaneously after turning on power to the unit.

11.5.3 BOOTLOADER PROGRAMMING STEPS

ATTENTION:
Following the update procedure for the TC4:

- A Safe Mode Reset must be performed. To perform a safe mode reset press the "ESC" and "Right Arrow" keys simultaneously after turning on power to the unit.
- Please note that the baud rate of the connection on the **RADIO CTRL1 (J28)** Port, should match between the unit and XML file loaded by the RM programmer.

Before attempting to update the TC4-DSP Bootloader, ensure that the TC4-DSP Application software has already been updated as described in the steps in section 11.5.2. This is very important.

The update process for the Bootloader is similar to the update process for the application software described in section 11.5.2.

1) Run the RM Programmer application on the installing PC.

2) Press the 'Load Script' button on the RM Programmer interface as highlighted in Figure 36.

3) In the explorer window that opens, browse to and open the appropriate XML file:
   a) Directory: ***RS8-[YYYY-MM-DD]\Software-vX.Y.Z\Programming_Data\ TC4-DSP-vX.Y.Z***
   b) XML File: **"program_tc4_rev_05_bootloader_com#_115200"** where **#** is the PC COM port number that the **REM CTRL Cable via the RADIO CTRL/AUDIO Cable** is connected to. The number after the COM number in the XML filename is the baud rate of the connection.

4) The RM Programmer will load the XML file and display the connection settings of the loaded XML file as shown in Figure 41.

5) Verify that the details shown on the screen are correct and press the 'Start' button to begin updating the bootloader of the TC4-DSP.

6) The RM Programmer will load the HEX file and prepare to flash the TC4-DSP, when it is ready to begin it will prompt the user to restart the unit as shown in Figure 38.

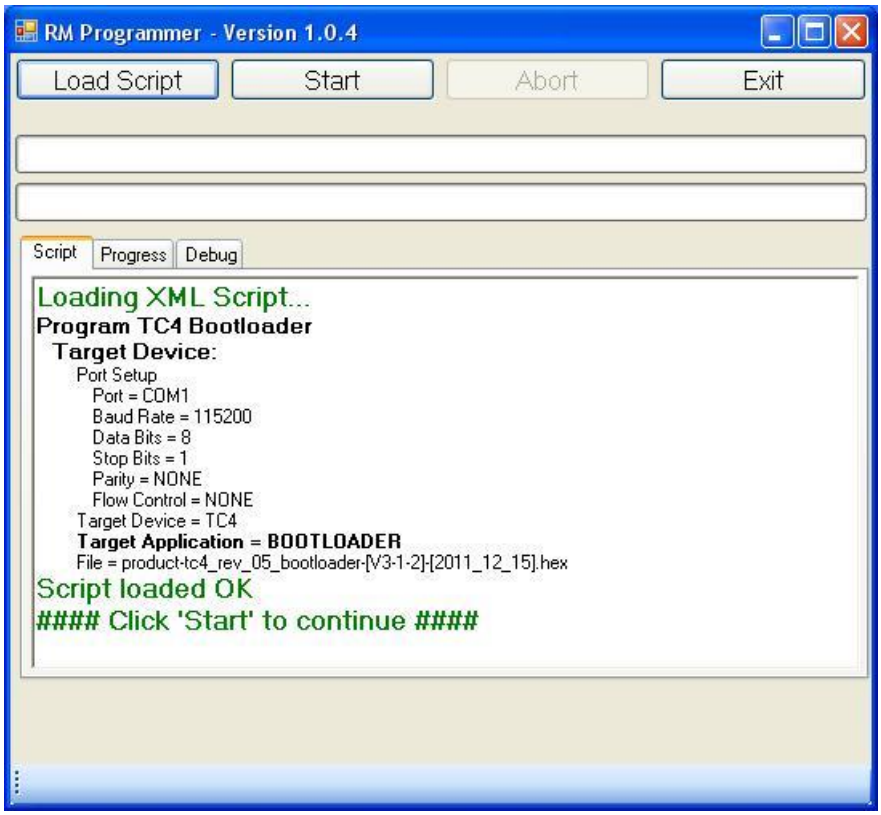

Figure 41: RM Programmer with loaded Bootloader script

7) Reset or power up the unit and the process will begin. During programming the a Programmer will advance through a number of sectors and the update progress will be displayed as shown in Figure 42.

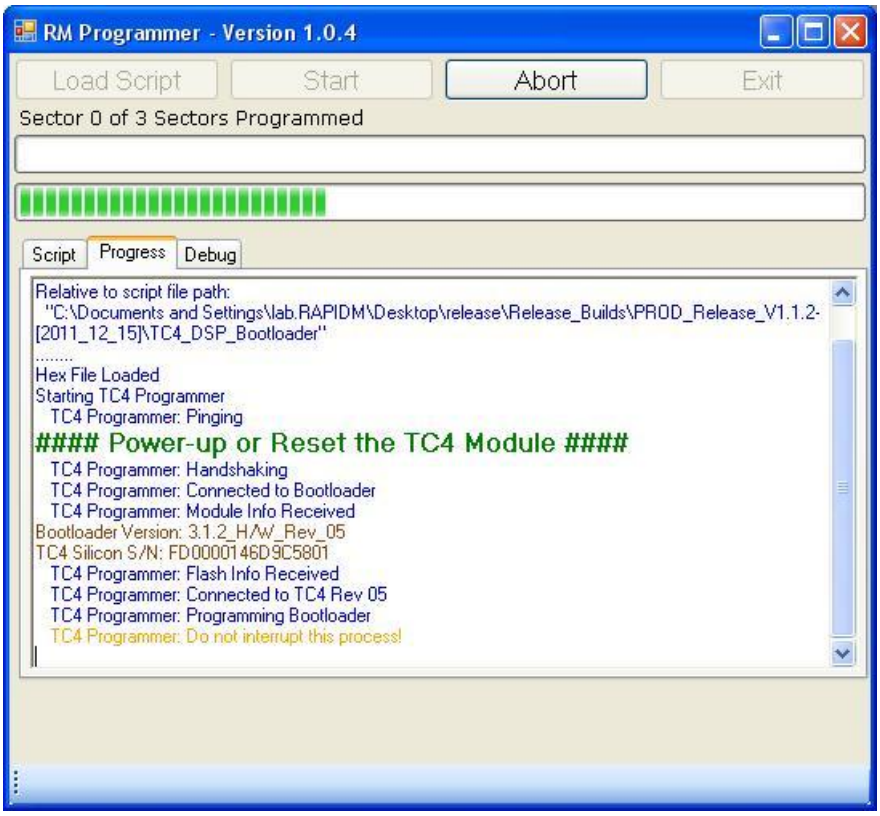

Figure 42: RM Programmer during TC4 Bootloader programming

8) The RM Programmer will indicate when the update process is complete and the unit will reset automatically as shown in Figure 43.

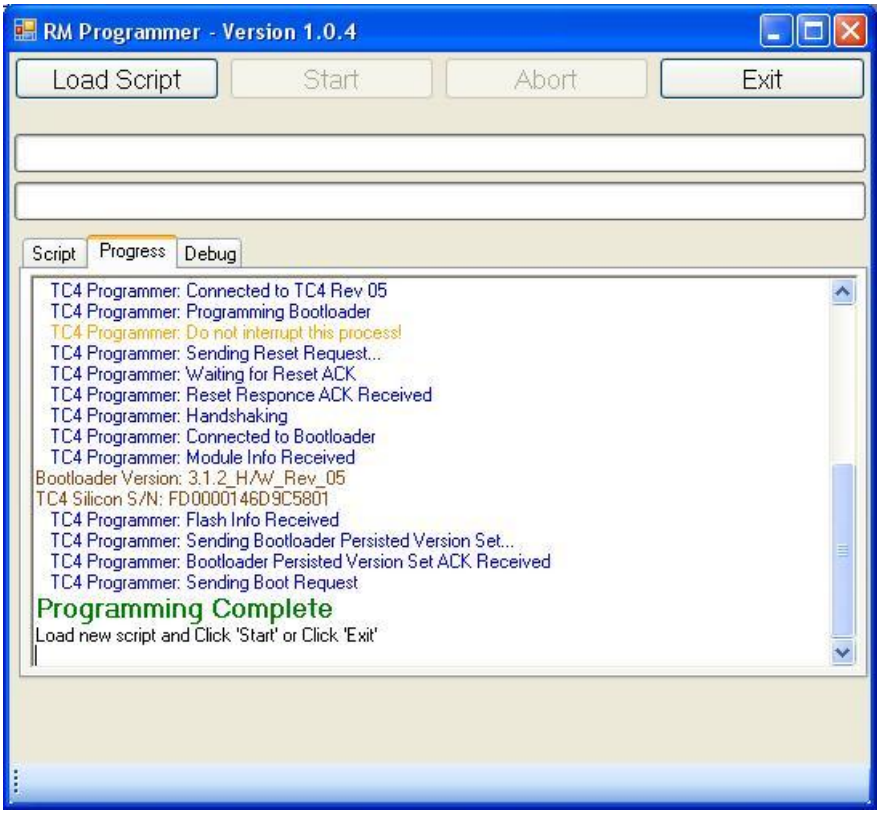

Figure 43: RM Programmer TC4 Bootloader update complete

9) Should the unit not reset, the user can manually reset or power cycle the unit. The TC4-DSP Bootloader update is now complete. The user may exit the RM Programmer.

10) Following the update procedure for the TC4 a Safe Mode Reset must be performed. To perform a safe mode reset press the "ESC" and "Right Arrow" keys simultaneously after turning on power to the unit.

12 FAULT-FINDING

12.1 INTRODUCTION

This section describes how to troubleshoot some common run-time problems. The Fault-Finding procedure is separated into the following:

- Power On Fault-Finding
- Built-in Test (BIT) Fault-Finding
- Operational Fault-Finding

Figure 44 shows the flow diagram of the Fault-Finding process. For power up problems (see section 2.3.2 for the power up procedure) the Power On Fault-Finding procedure in section 12.2 must be followed.

After successful power up the unit will indicate a BIT problem with the **BIT** Status Indicator and any Operational problems with the **ERR**, **FLT** or **FAIL** Status Indicators. For BIT or Operational Problems follow the Fault-Finding procedures in sections 12.3 and 12.4 respectively.

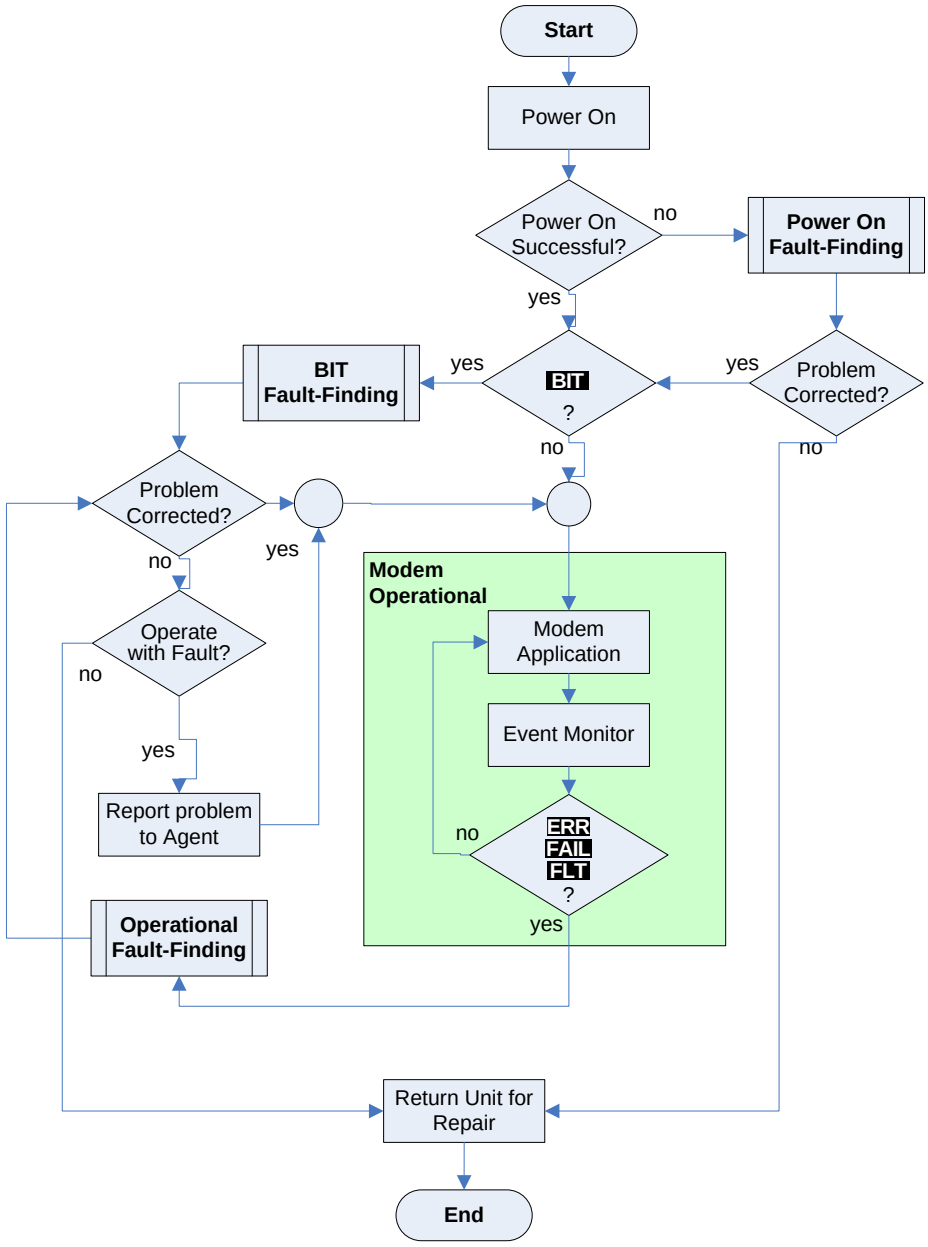

Figure 44: Fault-Finding Process

12.2 Power On Fault-Finding Procedure

12.2.1 Introduction

The Power On Fault-Finding flow diagram is shown in Figure 45. The Power On problems are divided into sections. For the problem descriptions and corrective actions refer to the respective paragraphs in section 12.2.2.

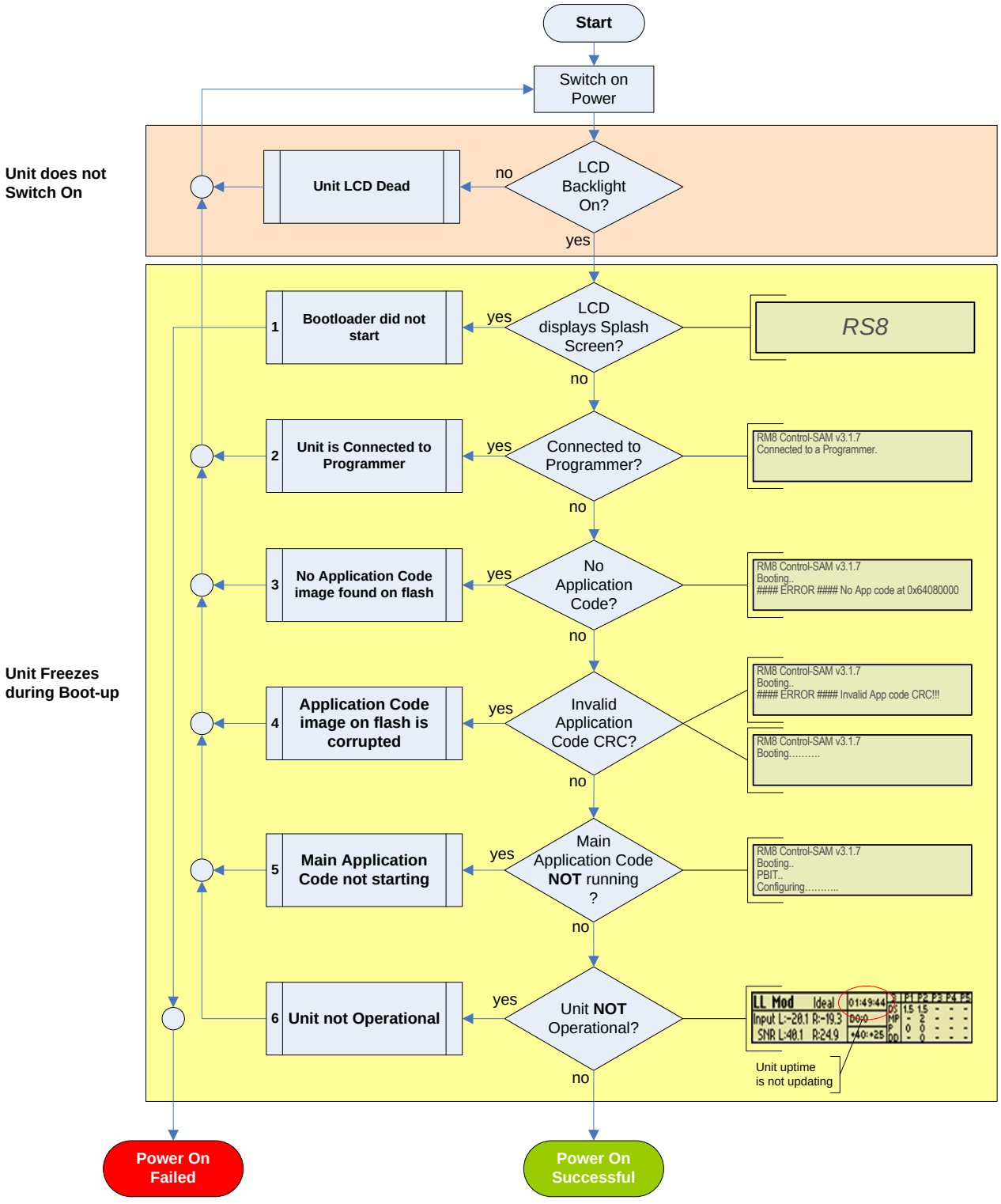

Figure 45: Fault-Finding: Power On Fault-Finding

12.2.2 PROBLEM DESCRIPTION AND CORRECTIVE ACTION

12.2.2.1 UNIT DOES NOT SWITCH-ON

#	Problem	Symptoms	Possible Causes	Corrective Actions
1	**Unit LCD dead**	• LCD Backlight is off.	• No power is applied to the unit. • The Power switch is switched to position '0'.	1. Ensure that the Power Switch is switched to the 'I' position. 2. Ensure that the AC Power cable is plugged in correctly to the Unit's Mains supply. 3. Verify the AC Power Source. 4. Verify that the AC power cable is not damaged. 5. If the problem persists send unit for repair.

Table 26: Fault-Finding: Unit does not switch on

12.2.2.2 UNIT FREEZES DURING BOOT-UP

When the unit freezes during the Boot-Up follow the flow diagram in Figure 45 to identify one of the following problems:

#	Problem	Symptoms	Possible Causes	Corrective Actions
1	**Bootloader did not start**	• LCD displays Splash Screen.	• Bootloader flash sectors are damaged. • The TC4 module did not boot.	1. Send the unit for repair.
2	**Unit is Connected to Programmer**	• LCD displays the message: 'Connected to Programmer'.	• The unit is connected to a PC with a Programmer running and the Programmer attempted to connect to the unit	1. Switch off the unit. 2. Unplug the DTE cable from J27. 3. Switch on the unit.
3	**No Application Code image found on flash**	• LCD displays message: '#### ERROR #### No App code at 0x64080000'.	• A previous attempt to update the application code was not completed. • The application code sectors of the flash are damaged.	1. Switch off the unit 2. Reprogram the Application Code with the latest version.
4	**Application Code image on flash is corrupted**	• LCD displays message: '#### ERROR #### Invalid App code CRC!!!' or 'Booting……'	• A previous attempt to update the application code was not completed. • The application code sectors of the flash are damaged.	1. Switch off the unit 2. Reprogram the Application Code with the latest version.
5	**Main Application Code not starting**	• The unit started the BIT but does not complete and switch to the Operational screen.	• Fatal S/W Error. • Fatal H/W Failure.	1. Switch off the unit. 2. Reprogram the Application code with a previous version. 3. If this solves the problem, report this to the Supplier. 4. If the problem persists, send the unit for repair.
6	**Unit not Operational**	• The time is not updating on the LCD.	• Fatal S/W Error. • Fatal H/W Failure.	1. Switch off the unit. 2. Reprogram the Application code with a previous version. 3. If this solves the problem, report this to the Supplier. 4. If the problem persists, send the unit for repair.

Table 27: Fault-Finding: Unit freezes during Boot-up

12.3 BIT Fault-Finding Procedures

12.3.1 Introduction

After successful power-up and booting the **RS8** unit performs hardware BIT procedures, which test all critical hardware for operational readiness. The following conditions are checked for:

- Memory devices failure (FRAM, Flash, SDRAM)
- Audio ports failure (via CODEC internal loop-back test)
- Control Ports failure (via internal loop-back test)
- DTE Port failure (via internal loop-back test)
- GPS Port failure (via internal loop-back test)
- Modem health (by measuring voltages and temperatures)
- Real-time clock (RTC) failure
- Back-up battery health
- Firmware/Software revisions

When a failure has been detected by the BIT, the **BIT** fault indication will be displayed in the Modem Status Indicator field. The results of the tests are available in the BIT Report.

12.3.2 Error Codes

A list of the BIT error codes and recommended corrective action that should be taken is summarised in the table below.

Error Code	Error Level	Description	Corrective Actions
0x11701	FAIL	AUDIO1 Port Failure	If the failed port is part of the active circuit, the unit is unusable and must be sent for repair.
0x11702	FAIL	AUDIO2 Port Failure	
0x11703	FAIL	RADIO CTRL1 Port Failure	
0x11704	FAIL	RADIO CTRL2 Port Failure	
0x11705	FAIL	REM CTRL Port Failure	
0x11706	FAIL	CTRL Ethernet Port Failure	
0x11707	FAIL	GPS Port Failure	
0x11708	FAIL	DTE Port Failure	
0x11709	FAIL	DATA Ethernet Port Failure	
0x1170a	FAIL	TC4 Module DSP Failure	Switch off and return for repair.
0x1170b	FAIL	CTRL SAM Failure	
0x1170c	FAIL	DATA SAM Failure	
0x1170d	FAIL	SDRAM Failure	
0x1170e	FAIL	EEPROM Failure	
0x11711	FAIL	RTC Device Failure	
0x11712	WARNING	RTC/Backup Battery Warning	Order Part and replace.
0x11713	FAIL	External Clock Failure	If the failed unit is used for processing requiring the external clock source (e.g. coherent sampling), the unit is unusable and must be sent for repair.
0x11714	FAIL	CANBUS Failure	Switch off and return for repair.
0x11715	FAIL	AUDIO BUS Failure	If the failed unit is used for processing requiring the use of the audio bus, the unit is unusable and must be sent for repair.
0x11717	FAIL	CPLD Access Test Failure	Switch off and return for repair.
0x11718	FAIL	CPLD Firmware Outdated	Switch off and return for firmware upgrade.
0x1171a	FAIL	CTRL SAM Software Outdated	Refer to Section 11.3 on how to update the Carrier Card CTRL SAM Software.
0x1171b	FAIL	DATA SAM Software Outdated	Refer to Section 11.4 on how to update the Carrier Card DATA SAM Software.

Table 28: Fault-Finding: BIT Error Codes

12.4 Operational Fault-Finding Procedures

12.4.1 Event Monitor Faults

During normal operation the **RS8** continuously performs Event Monitor procedures to detect and trap operational problems. The following conditions are checked for:

- Invalid program execution,
- Internal and External memory access errors,
- Hardware ports configuration faults, and
- Peripheral devices access errors.

12.4.2 ERROR CODES

A list of the Event Monitor error codes and recommended corrective actions that should be taken are summarised in the table below.

Error Code	Error Level	Description	Corrective Action
0x1171e	ERROR	Internal Memory Error (Leak/Corruption).	Switch off unit and restart in Safe Mode. If problem persist, return for repair.
0x1171f	ERROR	Invalid Execution Path.	
0x11720	ERROR	Internal Communications Error.	
0x11721	ERROR	Front-Panel Communications Error.	
0x11722	ERROR	Peripheral Device Communications Error.	
0x11723	ERROR	EEPROM Access Failure.	
0x11724	FAULT	Set: J15 REM CTRL: (Com) Port Data Format Fault. Clear: Modem Recovered.	Correct the Port Format Settings.
0x11725	FAULT	Set: J15 GPS: (Com) Port Data Format Fault. Clear: Modem Recovered.	Correct the Port Format Settings.
0x11726	FAULT	Set: J27 DTE: (Com) Port Data Format Fault. Clear: Modem Recovered.	Correct the Port Format Settings.
0x11727	FAULT	Set: J28 RADIO CTRL1: (Com) Port Data Format Fault. Clear: Modem Recovered.	Correct the Port Format Settings.
0x11728	FAULT	Set: J28 RADIO CTRL2: (Com) Port Data Format Fault. Clear: Modem Recovered.	Correct the Port Format Settings.
0x11729	FAULT	Set: J28 AUDIO1 or J28 AUDIO2 Input Level Overload Fault. Clear: Overload Corrected.	Reduce the Audio signal input level to the Modem. The Fault may be due to the Radio output level being too high.
0x1172b	FAULT	No response from radio connected to J28 RADIO CTRL1 received. Clear: Modem Recovered.	Correct the Radio Control Settings and check all connections between radio and unit.

Table 29: Fault-Finding: Event Monitor Error Codes: Part 1 of 2

Error Code	Error Level	Description	Corrective Action
0x1172c	FAULT	Set: J27 DTE: No user data received upon RTS/CTS activity. Clear: Modem Recovered.	Check DTE cable and DTE equipment.
0x1172d	FAULT	No response GPS receiver connected to J15 GPS/AUX received. Clear: Modem Recovered.	Check GPS cable and GPS equipment.
0x1172e	FAULT	Data over RAP1 port mode fault.	Correct the Port Mode setting.
0x11800	FAULT	Error in radio control manager.	Check the Radio settings. Check connection between radio and unit. Check the radio equipment.
0x11801	FAULT	Radio not ready.	Check the Radio settings. Check connection between radio and unit. Check the radio equipment.
0x11802 **0x11803** **0x11804**	FAULT	Invalid radio preset/fixed frequency parameter or channel.	Check the Radio settings. Check connection between radio and unit. Check the radio equipment.
0x11805	FAULT	Radio fault.	Check the Radio settings. Check connection between radio and unit. Check the radio equipment.
0x11806	FAULT	Error in programming radio.	Check the Radio settings. Check connection between radio and unit. Check the radio equipment.
0x11807 **…** **0x1180C**	FAULT	Reserved.	N/A.
0x1180D	FAULT	Invalid radio address.	Check the Radio settings.
0x1180E	FAULT	Radio port 1 fault.	Check the Radio settings.
0x1180F	FAULT	Radio port 2 fault.	Check the Radio settings.
0x11811	FAULT	Radio control time-out.	Check the Radio settings.

Table 30: Fault-Finding: Event Monitor Error Codes: Part 2 of 2

12.5 Performing a Safe Mode Reset

The unit can be started up in *Safe Mode* which will restore all preset parameters default values. Perform the following *Safe Mode Reset* procedure to power up the **RS8** in Safe Mode:

- Turn on the power switch. After a short delay the *splash screen* message will be displayed on the LCD.
- While the **RS8** *splash screen* is displayed simultaneously press the **ESC** and ► keys on the front-panel.
- When key presses have been successfully detected the following message will be displayed on LCD

  Control-SAM7 vX.Y.Z
  Startup Keys Saved
  Booting…

- Following the Boot program, the unit will start the power-on Built-in Test (BIT).
- After a few seconds, the following message will be displayed on the LCD

  Starting in Safe Mode

- Following this display, the LCD will show the operational screen reflecting the default operating parameters.
- After a successful power-up sequence, the unit is ready for use.

ATTENTION:

- A Safe Mode Reset can also be performed when an "emergency erasure" of any protected parameters is required.


RapidM