



Redbox RB-TGHD(B & X) Multi-Channel High Definition Tone Generator

User Handbook



RB-TGHD(B & X) USER HANDBOOK



RB-TGHD(B & X) USER HANDBOOK

This handbook is for use with the following product:
Redbox RB-TGHD(B&X) Multi-Channel High Definition Tone Generator

©Sonifex Ltd, 2009
All Rights Reserved
Revision 1.01, April 2012

Sonifex Ltd, 61, Station Road, Irthlingborough,
Northants, NN9 5QE, England.
Tel: +44 (0)1933 650 700
Fax: +44 (0)1933 650 726
Email: sales@sonifex.co.uk
Website: <http://www.sonifex.co.uk>

Information in this document is subject to change without notice and does not represent a commitment on the part of the vendor. Sonifex Ltd shall not be liable for any loss or damage whatsoever arising from the use of information or any error contained in this manual.

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, information storage and retrieval systems, for any purpose other than the purchaser's personal use, without the express written permission of Sonifex Ltd. Unless otherwise noted, all names of companies, products and persons contained herein are part of a completely fictitious adaptation and are designed solely to document the use of Sonifex product.



CONTENTS



CONTENTS

Warranty	i
Warranty and Liability	i
Unpacking the RB-TGHD	iii
Returning the Warranty Card	iii
Safety Information	iv
Safety of Mains Operated Equipment	iv
Voltage Setting Checks	iv
Fuse Rating	iv
Power Cable and Connection	iv
Ordering the Correct Mains Lead	v
Installation Information	v
Atmosphere	v
Electromagnetic Radiation	v
Fitting Redboxes	v
WEEE & RoHS Directives - Sonifex Statement	vi
Introduction	1
Front Panel Controls & Indicators	2
Channel Active LEDs	2
Channel Button & LEDs	2
Sequence Mode Button & LEDs	2
Sequence Button & LEDs	2
Sequence Loop Button & LEDs	3
DIP Switch Settings	4
Sample Rate – Bank 1 DIP Switches 1-3	4
Sync Mode – Bank 1 DIP Switches 4-5	4
Sample Width – Bank 1 DIP Switch 6	5
Audio Line-Up – Bank 2 DIP Switches 1-5	5
Force Bootloader Mode – Bank 2 DIP Switch 8	6
Reset Button	6
Sequence Details	6
Rear Panel Connections & Operation	12
Mains Power	12
Analogue Audio Outputs	12
Digital Audio Outputs – RB-TGHDX Model	12
Digital Audio Outputs – RB-TGHDB Model	12
Word Clock Input	12
RS232	13
Remote Port	13
Serial Interface Commands & Responses Protocol	15
Serial Data Format	15
RB-TGHD SCi Remote Control Software	19
Download the Latest SCi Software	19
Connecting the RS232 Serial Port	19
Using SCi for the First Time	19
Loaded Launcher	20
SCi for RB-TGHD Tone Generators	20
User Sequence Programming	21
Firmware Updates	23
Installing the Optional Sync Boards	24
Opening the RB-TGHD	25
Technical Specification RB-TGHD (B & X)	26

FIGURES



FIGURES

Figures

Fig A: Packing List	iii
Fig B: Power Connections	iv
Fig C: Mains Lead Table	v
Fig D: RB-RK3 Large Redbox Rear Rack-mount Kit	v
Fig 1-1: RB-TGHDX Front Panel	1
Fig 1-2: Channel Active LEDs	2
Fig 1-3: Channels Button & LEDs	2
Fig 1-4: Sequence Mode Button & LEDs	2
Fig 1-5: Sequence Button & LEDs	2
Table 1-1: Valid Sequences For Channel Configurations	3
Table 1-2: Sequence Restart Button Action	3
Fig 1-6: Sequence Loop Button & LEDs	3
Fig 1-7: DIPSwitch Settings	4
Table 1-3: Digital Sample Rate Settings	4
Table 1-4: Synchronization Mode Settings	4
Table 1-5: Digital Sample Width Settings	5
Table 1-6: Audio Line-Up settings	5
Fig 1-8: RB-TGHDX rear panel	12
Fig 1-9: RB-TGHDB rear panel	12
Table 1-7: Remote Inputs	13
Table 1-8: Remote Outputs	14
Fig 3-1: SCi Launcher	19
Fig 3-2: SCi Device Discovery Panel	19
Fig 3-3: SCi Launcher Loaded	20
Fig 3-4: SCi Main Control Screen	20
Fig 3-5: SCi User Sequence Screen	21
Fig 3-6: SCi Misc Screen	23
Table 3-1: Firmware Upgrade Status LED	24



Warranty

Warranty and Liability

Important: the purchaser is advised to read this clause

- (a) The Company agrees to repair or (at its discretion) replace Goods which are found to be defective (fair wear and tear excepted) and which are returned to the Company within 12 months of the date of despatch provided that each of the following are satisfied:
- (i) notification of any defect is given to the Company immediately upon its becoming apparent to the Purchaser;
 - (ii) the Goods have only been operated under normal operating conditions and have only been subject to normal use (and in particular the Goods must have been correctly connected and must not have been subject to high voltage or to ionising radiation and must not have been used contrary to the Company's technical recommendations);
 - (iii) the Goods are returned to the Company's premises at the Purchaser's expense;
 - (iv) any Goods or parts of Goods replaced shall become the property of the Company;
 - (v) no work whatsoever (other than normal and proper maintenance) has been carried out to the Goods or any part of the Goods without the Company's prior written consent;
 - (vi) the defect has not arisen from a design made, furnished or specified by the Purchaser;
 - (vii) the Goods have been assembled or incorporated into other goods only in accordance with any instructions issued by the Company;
 - (viii) the defect has not arisen from a design modified by the Purchaser;
 - (ix) the defect has not arisen from an item manufactured by a person other than the Company.

In respect of any item manufactured by a person other than the Company, the Purchaser shall only be entitled to the benefit of any warranty or guarantee provided by such manufacturer to the Company.

- (b) In respect of computer software supplied by the Company the Company does not warrant that the use of the software will be uninterrupted or error free.



WARRANTY

WARRANTY



WARRANTY

- (c) The Company accepts liability:
 - (i) for death or personal injury to the extent that it results from the negligence of the Company, its employees (whilst in the course of their employment) or its agents (in the course of the agency);
 - (ii) for any breach by the Company of any statutory undertaking as to title, quiet possession and freedom from encumbrance.
- (d) Subject to conditions (a) and (c) from the time of despatch of the Goods from the Company's premises the Purchaser shall be responsible for any defect in the Goods or loss, damage, nuisance or interference whatsoever consequential economic or otherwise or wastage of material resulting from or caused by or to the Goods. In particular the Company shall not be liable for any loss of profits or other economic losses. The Company accordingly excludes all liability for the same.
- (e) At the request and expense of the Purchaser the Company will test the Goods to ascertain performance levels and provide a report of the results of that test. The report will be accurate at the time of the test, to the best of the belief and knowledge of the Company, and the Company accepts no liability in respect of its accuracy beyond that set out in Condition (a).
- (f) Subject to Condition (e) no representation, condition, warranty or other term, express or implied (by statute or otherwise) is given by the Company that the Goods are of any particular quality or standard or will enable the Purchaser to attain any particular performance or result, or will be suitable for any particular purpose or use under specific conditions or will provide any particular capacity, notwithstanding that the requirement for such performance, result or capacity or that such particular purpose or conditions may have been known (or ought to have been known) to the Company, its employees or agents.
- (g)
 - (i) To the extent that the Company is held legally liable to the Purchaser for any single breach of contract, tort, representation or other act or default, the Company's liability for the same shall not exceed the Price of the Goods.
 - (ii) The restriction of liability in Condition (g)(i) shall not apply to any liability accepted by the Seller in Condition (c).
- (h) Where the Goods are sold under a consumer transaction (as defined by the Consumer Transactions (Restrictions on Statements) Order 1976) the statutory rights of the Purchaser are not affected by these Conditions of Sale.



Unpacking the RB-TGHD

The RB-TGHD is shipped with the following equipment. Please check your packaging to ensure that you have all of the items below. If anything is missing, please contact the supplier of your equipment immediately.

Item	Quantity RB-TGHD
RB-TGHD	1
IEC Mains lead fitted with moulded mains plug	1
Handbook and warranty card	1

Fig A: Packing List

Each RB-TGHD is shipped in protective packaging and should be inspected for damage before use. Where an item is found to have transit damage, notify the carrier immediately with all the relevant details of the shipment. Packing materials should be kept for inspection and also for if the product needs to be returned.

Returning the Warranty Card

In order to register the date of purchase so that we can keep you informed of any design improvements or modifications, it is important to complete the warranty registration document that is enclosed and return it to Sonifex Ltd in the UK.

For your own records you should write down the serial number (which can be found on the rear of the RB-TGHD).

Serial Number
---------------	-------



WARRANTY

SAFETY INFORMATION



Safety Information

Safety of Mains Operated Equipment



This equipment has been designed to meet the safety regulations currently advised in the country of purchase and it conforms to the safety regulations specified by use of the CE Mark.

Warning : There are no user serviceable parts inside the equipment. If you should ever need to look inside the unit, always disconnect the mains supply before removing the equipment covers.

Voltage Setting Checks

Ensure that the machine operating voltage is correct for your mains power supply by checking the box in which your Redbox was supplied. The voltage is shown on the box label. The available voltage settings are 115V, or 230V. Please note that all Redboxes are either switchable between 115V and 230V, or have a universal power supply.

Fuse Rating

The RB-TGHD is supplied with a single fuse in the live conducting path of the mains power input. For reasons of safety it is important that the correct rating and type of fuse is used. Incorrectly rated fuses could present a possible fire hazard, under equipment fault conditions. The fuse rating for the RB-TGHD is:

230 or 115 V operation - 1A 5 x 20mm SB

The active fuse is fitted on the outside rear panel of the unit.

Power Cable and Connection

An IEC power connector is supplied with the RB-TGHD which has a moulded plug attached – this is a legal requirement. If no moulded plug has been supplied with your RB-TGHD, please contact your supplier, because an IEC connector is always supplied from the Sonifex factory.

If for any reason, you need to use the RB-TGHD with a different power cable, you should use the following wiring guidelines.

Wire Colour	Connection
Green, or green and yellow	Earth (E)
Blue, or Black	Neutral (N)
Brown, or Red	Live (L)

Fig B: Power Connections

Connect the equipment in accordance with the connection details and before applying power to the unit, check that the machine has the correct operating voltage for your mains power supply.

Important Note : The terminal marked on the rear panel must be earthed.





Ordering the Correct Mains Lead

When ordering a Redbox from Sonifex, it is helpful if you can specify your required operating voltage and mains lead. After the product code add:

UK, for 230V, UK 3 pin to IEC lead	
EC, for 230V, European Schuko 2 pin to IEC lead	
US, for 115V, 3 pin to IEC lead	
AU for 230V, Australasian 3 pin to IEC lead	

Fig C: Mains Lead Table

E.g. order RB-TGHD UK for a UK IEC lead to be supplied.

Installation Information

Atmosphere

The units should be installed in an area that is not subject to excessive temperature variation (<0°C, >50°C), moisture, dust or vibration.

Electromagnetic Radiation

The cover is connected to earth by means of the fixing screws. It is essential to maintain this earth ground connection to ensure a safe operating environment and provide electromagnetic shielding.

Fitting Redboxes

Redboxes can be fixed to the underside of a mixing desk, or other surfaces using 4.2mm holes in the sides and fixed with 2 x M4 screws or 2 x No. 6 countersink wood screws.

They can also be rack-mounted, with either the front, or rear of the Redbox positioned at the front of the rack:

Rear Mounting The RB-TGHD: The **RB-RK3** 1U rear panel rack kit can be used for large Redboxes such as the RB-TGHD.



Fig D: RB-RK3 Large Redbox Rear Rack-mount Kit

Note: When fitting the rear-mounting rack-kits, a notch has been left on the inside of the right-hand rack-piece for the mains cable to pass through. Make sure that the mains cable has been put through the notch before attaching the right hand rack-piece.

WEEE & ROHS DIRECTIVES



WEEE & ROHS DIRECTIVES

WEEE & RoHS Directives - Sonifex Statement



The Waste Electrical and Electronic Equipment (WEEE) Directive was agreed on 13 February 2003, along with the related Directive 2002/95/EC on Restrictions of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS).

The **Waste Electrical and Electronic Equipment Directive (WEEE)** aims to minimise the impacts of electrical and electronic equipment on the environment during their life times and when they become waste. It applies to a huge spectrum of products. It encourages and sets criteria for the collection, treatment, recycling and recovery of waste electrical and electronic equipment. All products manufactured by Sonifex Ltd have the WEEE directive label placed on the case. It gives a contact for individuals who are unsure about the correct procedure when the product has reached its “end of use”.

Sonifex Ltd will be happy to give you information about local organisations that can reprocess the products, or alternatively all products that have reached “end of use” can be returned to Sonifex and will be reprocessed correctly free of charge.

Sonifex Ltd has phased out the use of certain hazardous substances identified in the European Union’s **Restriction of Hazardous Substances (RoHS)** directive. The RoHS directive limits the use of certain hazardous substances currently used in EEE manufacture, including lead, mercury, cadmium, hexavalent chromium, and halide-containing compounds PBB (polybrominated biphenyl) and PBDE (polybrominated diphenyl ether). Elimination of these substances will result in more environmentally friendly recycling of electronic equipment. For the products which Sonifex manufacture, the main area where products were affected was in the use of lead for manufacturing and assembling electronics circuit boards.

Sonifex Ltd practices lead-free (LF) manufacturing processes. LF solder is used on the surface-mount PCB manufacturing processes and for hand soldering. The printed circuit boards (PCBs) used are either gold plated, or immersion tin plated, both of which use no lead. Historically the PCBs were hot air solder levelled (HASL) PCBs which used tin/lead based solder.

The manufacturing processes include the assembly of purchased components from various sources. Product is offered as RoHS compliant, or LF, only after sufficient evidence is received from the component manufacturers that their components are RoHS compliant. Sonifex Ltd relies solely on the distributor, or manufacturer, of the components for identification of RoHS compliance. Thus whilst every effort is made to ensure compliance, Sonifex Ltd makes no warranty, or certification, or declaration of compliance concerning said components.

Sonifex Ltd defines “Lead Free” as pertaining to any product, which has been manufactured by Sonifex Ltd using components which have been declared by the manufacturers as “Lead Free”. All statements by Sonifex Ltd of RoHS compliance are based on component manufacturer documentation.



Introduction

The RB-TGHD is a 1U rack-mount, 8 channel audio tone generator that provides line identification for multi-channel audio systems, including 5.1 and 7.1 surround sound typically used in high definition television broadcasts. By using a range of widely accepted industry standard tone sequences, channel identification and associated levels can be determined easily. Correct channel configuration in fold-down mixes can also be highlighted when a broadcaster needs to mix several audio channels into a stereo feed.

The RB-TGHD caters for 2, 4, 6 and 8 channel configurations and all of the available audio tone sequences for each channel configuration can be cycled through automatically, or selected manually, and a loop mode allows patterns of tones to be repeated. A bank of 4 pushbuttons on the front panel sets these options and the associated LEDs indicate the current setting. A set of 8 LEDs on the front panel indicate which channel is currently outputting audio.

The audio line-up level can be adjusted from 0dBu to +24dBu in 1dBu steps and the digital sample rate can be set from 32 kHz to 192 kHz in both 16 bit and 24 bit formats. As standard, the RB-TGHD has TTL wordclock input synchronisation. This can optionally be upgraded to a digital audio input or an analogue or digital video input.

The RB-TGHD is available in two variations. Both models provide 8 channels of audio in both analogue and digital formats. The balanced analogue outputs are via 3 pin XLR connectors. The RB-TGHDX has balanced AES/EBU digital outputs via 3 pin XLR connectors. The RB-TGHDB has unbalanced digital outputs via BNC connectors. When using the internally generated master clock, Channel Status information is generated and encoded on the digital output channels with the appropriate bits for sample rate and sample width set accordingly.

The serial port allows the RB-TGHD to be connected to a PC running Sci - the Sonifex Software Control Interface. This allows full control of the unit and the ability to generate a user defined audio tone sequence of up to 60 seconds in duration. In addition, a remote port on the rear provides a simple interface to control the unit and several outputs to indicate which tone sequence is active.

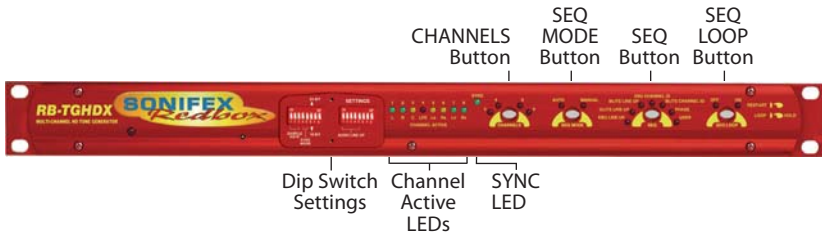


Fig 1-1: RB-TGHDX Front Panel

Front Panel Controls & Indicators



INTRODUCTION

1 FRONT PANEL CONTROLS & INDICATORS



FRONT PANEL CONTROLS & INDICATORS

All of the RB-TGHD's user controls and configuration settings are located on the front panel. Each push button has a range of LEDs associated with it that illuminate to show the current selection.

The LED on the left of the front panel is normally red to indicate that power is present on the unit.

Channel Active LEDs

These 8 LEDs provide a visual indication of which channels are currently outputting audio tones.



Fig 1-2: Channel Active LEDs

Channels Button & LEDs

This button selects the number of channels that output audio, from 2, 4, 6 or 8. If a sequence is active when this setting is changed, the sequence will automatically restart. Otherwise, the sequence will stop. The channel button illuminates red when it is pressed. The default setting is 8 channels.



Fig 1-3: Channels Button & LEDs

Sequence Mode Button & LEDs

This button selects either auto or manual sequence mode. Auto mode cycles through all sequences that are enabled by the current channel setting (see Table 1-1). Manual mode allows individual sequences that are enabled by the current channel setting to be selected. The sequence mode button illuminates red when it is pressed. The default setting is auto mode.



Fig 1-4: Sequence Mode Button & LEDs

Sequence Button & LEDs

This button selects the current sequence when the sequence mode is set to manual. In auto sequence mode, all the available sequences are cycled through and this button is disabled with the LEDs indicating which sequence is currently active. Table 1-1 shows which sequences are available for each channel setting. The sequence button illuminates red when it is pressed. The default setting is a combination of BLITS Channel Identification on channels 1-6 and EBU R49 Stereo Line-up on channels 7-8. The user sequence can only be selected if a valid sequence has been entered using the SCi software. Once entered, the user sequence is stored in internal non-volatile memory and will not be lost when power to the unit is removed.



Fig 1-5: Sequence Button & LEDs

	2 Channels	4 Channels	6 Channels	8 Channels
EBU R49 Stereo Line-up	✓	✓	✓	✓ *
GLITS Stereo Line-up	✓	✓	✓	✓ *
BLITS Stereo Line-up	✓	✓	✓	✓ *
EBU R49 Channel Identification	✗	✗	✓	✓
BLITS Channel Identification	✗	✓	✓	✓
Phase	✓	✓	✓	✓
User	✓	✓	✓	✓

* Stereo Line-up sequence also available on channels 7-8 in combination with BLITS Channel Identification

Table 1-1: Valid Sequences For Channel Configurations

Sequence Loop Button & LEDs

This button enables the sequence loop mode which will continuously loop the selected sequence in manual sequence mode, or cycle through each available sequence in auto sequence mode. Sequence loop mode is enabled or disabled by pressing and holding the button for 1 second. This button has a second function; a momentary press resets the current active sequence. The effect of this depends on the current sequence mode and sequence loop settings as shown below in Table 1-2.



Fig 1-6: Sequence Loop Button & LEDs

	Sequence Mode: Auto	Sequence Mode: Manual
Sequence Loop: Enabled	Restarts current active sequence	Restart current selected sequence
Sequence Loop: Disabled	Restarts the first available sequence	

Table 1-2: Sequence Restart Button Action

The sequence loop button illuminates red when it is pressed, and it flashes green when a sequence is active. The default setting is sequence loop enabled.



1 FRONT PANEL CONTROLS & INDICATORS



DIPSwitch Settings

There are a total of 16 DIPSwitches arranged in 2 banks of 8, located behind a removable panel next to the channel active LEDs.

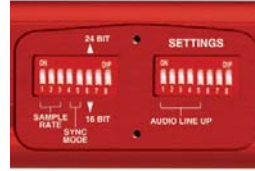


Fig 1-7: DIPSwitch Settings

Sample Rate – Bank 1 DIP Switches 1-3

These switches set the sample rate for the digital outputs when the sync mode is set to internally generated master clock, as follows:

Digital Sample Rate	Bank1 DIP Sw 1	Bank 1 DIP Sw 2	Bank 1 DIP Sw 3
32kHz	Off	Off	Off
44.1kHz	On	Off	Off
48kHz	Off	On	Off
88.2kHz	On	On	Off
96kHz	Off	Off	On
176.4kHz	On	Off	On
196kHz	Off	On	On
Not used	On	On	On

Table 1-3: Digital Sample Rate Settings

Sync Mode – Bank 1 DIP Switches 4-5

These switches configure the RB-TGHD to synchronize the digital audio outputs to either an internally generated master clock, or an external source via an add-on external sync board. The wordclock sync boards is fitted as standard. A range of other sync boards are available allowing synchronization to external analogue and digital video signals, as well as digital audio clocks. Once installed, the RB-TGHD will automatically detect the type of external sync board fitted. The DIP switch settings are as follows:

Synchronization Mode	Bank 1 DIP Sw 4	Bank 1 DIP Sw 5
Internally generated master clock	Off	Off
External synchronization (when using sync board)	On	Off
Not used	Off	On
Not used	On	On

Table 1-4: Synchronization Mode Settings

When using an external sync board, the sync LED will illuminate green when the RB-TGHD has successfully locked. When not locked, this LED will illuminate red.

Sample Width – Bank 1 DIP Switch 6

This switch configures the sample width for the digital outputs as follows:

Digital Sample Width	Bank 1 DIP Sw 6
16 bit	Off
24 bit	On

Table 1-5: Digital Sample Width Settings

Audio Line-Up – Bank 2 DIP Switches 1-5

These switches set the audio line-up level for full scale digits. This setting allows 0dBFS to be set from 0dBu to +24dBu as shown in the following table:

Audio Line-up	DIP Sw 1	DIP Sw 2	DIP Sw 3	DIP Sw 4	DIP Sw 5
0dBFS = 0dBu	Off	Off	Off	Off	Off
0dBFS = +1dBu	On	Off	Off	Off	Off
0dBFS = +2dBu	Off	On	Off	Off	Off
0dBFS = +3dBu	On	On	Off	Off	Off
0dBFS = +4dBu	Off	Off	On	Off	Off
0dBFS = +5dBu	On	Off	On	Off	Off
0dBFS = +6dBu	Off	On	On	Off	Off
0dBFS = +7dBu	On	On	On	Off	Off
0dBFS = +8dBu	Off	Off	Off	On	Off
0dBFS = +9dBu	On	Off	Off	On	Off
0dBFS = +10dBu	Off	On	Off	On	Off
0dBFS = +11dBu	On	On	Off	On	Off
0dBFS = +12dBu	Off	Off	On	On	Off
0dBFS = +13dBu	On	Off	On	On	Off
0dBFS = +14dBu	Off	On	On	On	Off
0dBFS = +15dBu	On	On	On	On	Off
0dBFS = +16dBu	Off	Off	Off	Off	On
0dBFS = +17dBu	On	Off	Off	Off	On
0dBFS = +18dBu	Off	On	Off	Off	On
0dBFS = +19dBu	On	On	Off	Off	On
0dBFS = +20dBu	Off	Off	On	Off	On
0dBFS = +21dBu	On	Off	On	Off	On
0dBFS = +22dBu	Off	On	On	Off	On
0dBFS = +23dBu	On	On	On	Off	On
0dBFS = +24dBu	Off	Off	Off	On	On

Table 1-6: Audio Line-Up Settings



1 FRONT PANEL CONTROLS & INDICATORS



Force Bootloader Mode – Bank 2 DIP Switch 8

This mode should only be used if the unit fails to respond after a firmware upgrade attempt. With this DIP switch On, and all others in Bank 2 set to Off, the RB-TGHD will force the Bootloader to run and allow initiation of an update under any circumstances. Once an update has completed, this switch should be returned to the Off position.

Reset Button

In the unlikely event that the RB-TGHD unit fails to respond, press the recessed reset button via the small hole in the front panel.

Sequence Details

There are 6 pre-defined sequences on the RB-TGHD. Each channel that is used in a sequence is assigned a tone frequency and an audio level. These values remain constant while the sequence is active. When a channel is un-muted, the corresponding LED on the front panel is illuminated. All channels are muted at the start of a sequence. An additional 'user' sequence can be programmed into the unit via the SCi software.

EBU R49 Stereo Line-Up Sequence

Number of channels: 2

Channel 1 configuration: 1kHz at 0dBu

Channel 2 configuration: 1kHz at 0dBu

Total duration: 6.5 seconds

Offset from start of sequence in ms	Action
0	Un-mute channels 1 & 2
3000	Mute channel 1
3250	Un-mute channel 1
6250	Mute channel 1
6500	Mute all channels – End of sequence

GLITS Stereo Line-Up Sequence

Number of channels: 2

Channel 1 configuration: 1kHz at 0dBu

Channel 2 configuration: 1kHz at 0dBu

Total duration: 4.0 seconds

Offset from start of sequence in ms	Action
0	Un-mute channel 2
375	Un-mute channel 1
750	Mute channel 2
1125	Un-mute channel 2
1500	Mute channel 2
1875	Un-mute channel 2
4000	Mute all channels – End of sequence

BLITS Stereo Line-Up Sequence

Number of channels: 2

Channel 1 configuration: 1kHz at 0dBu

Channel 2 configuration: 1kHz at 0dBu

Total duration: 5.3 seconds

Offset from start of sequence in ms	Action
0	Un-mute channels 1 & 2
1000	Mute channel 1
1300	Un-mute channel 1
1600	Mute channel 1
1900	Un-mute channel 1
2200	Mute channel 1
2500	Un-mute channel 1
2800	Mute channel 1
3100	Un-mute channel 1
5300	Mute all channels – End of sequence



1 FRONT PANEL CONTROLS & INDICATORS



FRONT PANEL CONTROLS & INDICATORS

EBU R49 Channel Identification Sequence

Number of channels: 6 or 8

Channel 1 configuration: 1 kHz at 0dBu

Channel 2 configuration: 1 kHz at 0dBu

Channel 3 configuration: 1 kHz at 0dBu

Channel 4 configuration: 80Hz at +10dBu (limited to 0dBFS if 0dBFS is less than +10dBu)

Channel 5 configuration: 1 kHz at 0dBu

Channel 6 configuration: 1 kHz at 0dBu

Channel 7 configuration: 1 kHz at 0dBu (omitted for 6 channel configuration)

Channel 8 configuration: 1 kHz at 0dBu (omitted for 6 channel configuration)

Total duration: 12.0 seconds (6 channels), 14.0 seconds (8 channels)

Offset from start of sequence in ms	Action – 6 Channels
0	Un-mute all channels
3000	Mute channels 1-3 & 5-6
3500	Un-mute channel 1
4000	Mute channel 1
4500	Un-mute channel 2
5000	Mute channel 2
5500	Un-mute channel 3
6000	Mute channel 3
6500	Un-mute channel 5
7000	Mute channel 5
7500	Un-mute channel 6
8000	Mute channel 6
9000	Un-mute channels 1-3 & 5-6
12000	Mute all channels – End of sequence

Offset from start of sequence in ms	Action – 8 Channels
0	Un-mute all channels
3000	Mute channels 1-3 & 5-8
3500	Un-mute channel 1
4000	Mute channel 1
4500	Un-mute channel 2
5000	Mute channel 2
5500	Un-mute channel 3
6000	Mute channel 3
6500	Un-mute channel 5
7000	Mute channel 5
7500	Un-mute channel 6
8000	Mute channel 6
8500	Un-mute channel 7
9000	Mute channel 7
9500	Un-mute channel 8
10000	Mute channel 8
11000	Un-mute channels 1-3 & 5-8
14000	Mute all channels – End of sequence



BLITS Channel Identification Sequence

Number of channels: 4, 6 or 8

Channel 1 configuration: 880Hz at 0dBu

Channel 2 configuration: 880Hz at 0dBu

Channel 3 configuration: 1318.5Hz at 0dBu

Channel 4 configuration: 82.4Hz at 0dBu

Channel 5 configuration: 659.2Hz at 0dBu (omitted for 4 channel configuration)

Channel 6 configuration: 659.2Hz at 0dBu (omitted for 4 channel configuration)

Channel 7 configuration: 329.6Hz at 0dBu (omitted for 4 & 6 channel configurations)

Channel 8 configuration: 329.6Hz at 0dBu (omitted for 4 & 6 channel configurations)

Total duration: 3.15 seconds (4 channels), 4.75 seconds (6 channels), 6.35 seconds (8 channels)

1 FRONT PANEL CONTROLS & INDICATORS



FRONT PANEL CONTROLS & INDICATORS

Offset from start of sequence in ms	Action – 4 Channels
0	Un-mute channel 1
750	Mute channel 1
800	Un-mute channel 2
1550	Mute channel 2
1600	Un-mute channel 3
2350	Mute channel 3
2400	Un-mute channel 4
3150	Mute all channels – End of sequence

Offset from start of sequence in ms	Action – 6 Channels
0	Un-mute channel 1
750	Mute channel 1
800	Un-mute channel 2
1550	Mute channel 2
1600	Un-mute channel 3
2350	Mute channel 3
2400	Un-mute channel 4
3150	Mute channel 4
3200	Un-mute channel 5
3950	Mute channel 5
4000	Un-mute channel 6
4750	Mute all channels – End of sequence



Offset from start of sequence in ms	Action – 8 Channels
0	Un-mute channel 1
750	Mute channel 1
800	Un-mute channel 2
1550	Mute channel 2
1600	Un-mute channel 3
2350	Mute channel 3
2400	Un-mute channel 4
3150	Mute channel 4
3200	Un-mute channel 5
3950	Mute channel 5
4000	Un-mute channel 6
4750	Mute channel 6
4800	Un-mute channel 7
5550	Mute channel 7
5600	Un-mute channel 8
6350	Mute all channels – End of sequence

Phase Sequence

Number of channels: 2, 4, 6 or 8

Channel configuration for all channels: 2kHz at -6dBu

Total duration: 3.3 seconds

Offset from start of sequence in ms	Action – All Channels Configurations
0	Un-mute all active channels
3300	Mute all channels – End of sequence

User Sequence

Number of channels: 2, 4, 6 or 8

Channel configuration for all channels: 20Hz to 16kHz at -48dBu to +24dBu

Total duration: 60 seconds maximum

Sequence can be programmed via the SCi software.

1 REAR PANEL CONNECTIONS & OPERATION



Rear Panel Connections & Operation

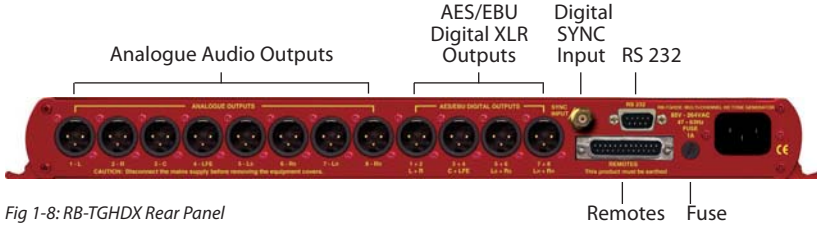


Fig 1-8: RB-TGHDX Rear Panel

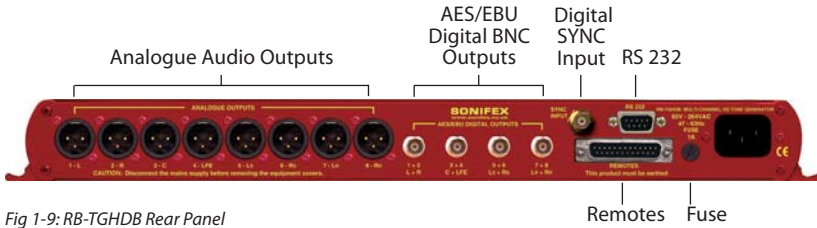


Fig 1-9: RB-TGHDB Rear Panel

Mains Power

Power is applied via a standard three-pin IEC male socket. Mains voltages between 85V and 264V AC and frequencies between 47 and 63Hz are accepted without adjustment. A 1A, 5 x 20mm SB fuse is used. The Earth pin MUST be connected to ensure safety.

Analogue Audio Outputs

The XLR 3 pin analogue audio output plug connectors are electronically balanced with an output impedance of less than 50Ω. They have the following connections:

- Pin 1: Screen
- Pin 2: Phase
- Pin 3: Non-phase

Digital Audio Outputs – RB-TGHDX Model

The XLR 3 pin digital audio output plug connectors have an impedance of 110Ω. They have the following connections:

- Pin 1: Screen
- Pin 2: Phase
- Pin 3: Non-phase

The signals on this connector will comply with the IEC 60968 specification.

Digital Audio Outputs – RB-TGHDB Model

The BNC socket digital audio output connectors have an impedance of 75Ω.

Word Clock Input

The BNC TTL word clock input has an impedance of 50Ω.

RS232

The 9-way 'D' type socket connector carries a standard RS232 interface and allows direct connection to a serial port on a PC via a pin-to-pin cable. The pin assignments are as follows:

Pin 2: Transmit data

Pin 3: Receive data

Pin 5: Ground

All other pins are unused.

Remote Port

The 25-way 'D' type socket connector provides 17 active low inputs and 7 open collector driven outputs. The remote inputs are activated by shorting the relevant pin to Digital Ground (0V) on pin 1 and the functionality is shown in Table 1-7 below:

Pin No.	Function
1	Digital Ground (0V)
2	Select 2 Channels
3	Select 4 Channels
4	Select 6 Channels
5	Select 8 Channels
6	Select Auto Sequence Mode
7	Select Manual Sequence Mode
8	Select Sequence Loop On
9	Select Sequence Loop Off / Restart Current Sequence
10	Select EBU R49 Stereo Line-up Sequence
11	Select GLITS Stereo Line-up Sequence
12	Select BLITS Stereo Line-up Sequence
13	Select EBU R49 Channel ID Sequence
14	Select BLITS Channel ID Sequence
15	Select Phase Sequence
16	Select User Sequence
17	Mute Channels 1 & 2 whilst remote input active
18	Mute All Channels whilst remote input active

Table 1-7: Remote Inputs



1 REAR PANEL CONNECTIONS & OPERATION



REAR PANEL CONNECTIONS & OPERATION

The remote outputs show which sequence is currently active as show in table 8 below:

Pin No.	Function
19	Activated when EBU R49 Stereo Line-up sequence is active
20	Activated when GLITS Stereo Line-up sequence is active
21	Activated when BLITS Stereo Line-up sequence is active
22	Activated when EBU R49 Channel ID sequence is active
23	Activated when BLITS Channel ID sequence is active
24	Activated when Phase sequence is active
25	Activated when User sequence is active

Table 1-8: Remote Outputs

Serial Interface Commands & Responses Protocol

Sonifex SCi remote control software handles all communication with the RB-TGHD via a convenient graphical user interface. However, this protocol is provided for those users who wish to develop their own remote control applications.

For more information on how to install and operate the SCi software, please see page 19.

Serial Data Format

Most of the commands follow the same structure: a 3 letter command followed by a colon, followed by a parameter (if any) and terminated by Carriage Return with optional Line Feed. A Line Feed character may be sent but it will be ignored by the RB-TGHD. Commands are not case sensitive. Responses will be CR & LF terminated.

After the Tone Generator has been powered-up, an initialisation string is sent "Sonifex RB-TGHD" followed by the version number of the currently installed firmware.

Following are the commands and the expected responses:

Command	Description	Response
Bnn:	**Set Baud Rate where: nn = 11 (115200 baud) nn = 57 (57600 baud) nn = 38 (38400 baud) nn = 19 (19200 baud) nn = 96 (9600 baud)	ACK: (at old rate)
BSV:	**Bootloader version request where: n.n = bootloader version	BOOT:Vn.n
DWN:	**Download firmware New firmware installed when correct end of firmware file is received	ACK: (ACK: indicates download can start)
SCH:n	Set number of channels where: n = 0 (2 channels) n = 1 (4 channels) n = 2 (6 channels) n = 3 (8 channels)	ACK: or ERR:
SER:	**Serial number request where: z = serial number (6 digits)	SER:z



2

SERIAL INTERFACE COMMANDS & RESPONSES PROTOCOL



SERIAL INTERFACE COMMANDS & RESPONSES PROTOCOL

Command	Description	Response
SRQ:	**Status request where: p = channel setting q = sequence mode setting r = sequence setting s = sequence loop setting t = sample rate setting u = sample width setting v = audio line-up setting w = sync mode setting x = sync board fitted y = channels currently active z = sync status	STA:p_q_r_s_t_u_v_w_x_y_z (bootloader returns STA: only)
SRS:	Sequence restart	ACK:
SSL:n	Set sequence loop where: n = 0 (sequence loop off) n = 1 (sequence loop on)	ACK: or ERR:
SSM:n	Set sequence mode where: n = 0 (auto sequence mode) n = 1 (manual sequence mode)	ACK: or ERR:
SSQ:n	Set sequence where: n = 0 (EBU R49 stereo line-up) n = 1 (GLITS stereo line-up) n = 2 (BLITS stereo line-up) n = 3 (EBU R49 channel identification) n = 4 (BLITS channel identification) n = 5 (phase) n = 6 (user) n = 7 (BLITS channel identification + EBU stereo line-up) n = 8 (BLITS channel identification + GLITS stereo line-up) n = 9 (BLITS channel identification + BLITS stereo line-up) n = A (load next valid sequence)	ACK: or ERR:
UID:	**Unit id request	UID:RB-TGHD
VER:	**Version number request where: n.nnn = firmware version n.n = bootloader version	VER:Vn.nnn (bootloader returns BOOT:Vn.n)

Command	Description	Response
USQ:0	User sequence control - loads current user sequence into RAM ready for editing	ACK:
USQ:1	User sequence control - reads user sequence from RAM where: d = total duration in ms c = channel (0-7) f = frequency in hz a = amplitude in dBFS n = number of steps defined o = offset in ms t = action type (0=mute, 1=unmute)	USD:d followed by USC:c,f,a,n for each channel, and USS:c,s,o,t for each step on each channel ACK: indicates read complete
USQ:2	User sequence control - saves user sequence after editing	ACK:
USQ:3	User sequence control - deletes user sequence from memory	ACK: or ERR:
USQ:4,d	User sequence control - sets the total sequence duration where: d = duration in milliseconds (max 60000)	ACK: or ERR:
USQ:5,c,f	User sequence control - sets the tone frequency on a channel where: c = channel (0-7) f = frequency in hertz (min 20, max 16000)	ACK: or ERR:
USQ:6,c,a	User sequence control - sets the tone amplitude on a channel where: c = channel (0-7) a = amplitude in dBFS (min: 0=-48dBFS, max: 48=0dBFS)	ACK: or ERR:
USQ:7,c,o	User sequence control - adds an unmute step on a channel where: c = channel (0-7) o = offset in milliseconds (min 0, max 59950)	ACK: or ERR:





Command	Description	Response
USQ:8,c,o	User sequence control - adds a mute step on a channel where: c = channel (0-7) o = offset in milliseconds (min 0, max 59950)	ACK: or ERR:
USQ:9,c,s	User sequence control - deletes a step on a channel where: c = channel (0-7) s = step	ACK: or ERR:
USQ:A,c	User sequence control - clears all settings on a channel where: c = channel (0-7)	ACK: or ERR:
USQ:B,c,d	User sequence control - copies all settings from one channel to another where: c = channel (0-7) d = destination channel (0-7)	ACK: or ERR:

** = these commands also supported in Bootloader mode.

Error Messages

General error messages:

ERR:01 = Returned if command not found

ERR:02 = Returned if invalid command or missing/invalid parameter

ERR:04 = Returned if parameter out of range

User sequence programming error messages:

ERR:10 = Returned if duration is out of range

ERR:11 = Returned if frequency is out of range

ERR:12 = Returned if amplitude is out of range

ERR:13 = Returned if max number of steps are already defined

ERR:14 = Returned if offset is out of range

ERR:15 = Returned if step is out of range

ERR:16 = Returned if channel is invalid

ERR:17 = Returned if command not allowed due to user sequence being active

RB-TGHD SCI Remote Control Software

Sonifex SCI software is free of charge software available to control the RB-TGHD Tone Generators, as well as other Sonifex products, using RS232 connections.

Download the Latest SCI Software

This is located on the Sonifex website in the Software Downloads section: <http://www.sonifex.co.uk/technical/software/index.shtml>

Download and install the software.

Connecting the RS232 Serial Port

Simply connect your RB-TGHD to your computer using a serial cable and you are ready for operation.

Using SCI for the First Time

Once you have connected the serial cable, double click the SCI icon. You will be presented with the SCI Launcher:



Fig 3-1: SCI Launcher

Click on the large 'Plus' button and the software will try and communicate with the relevant serial ports to 'discover' your connected devices.

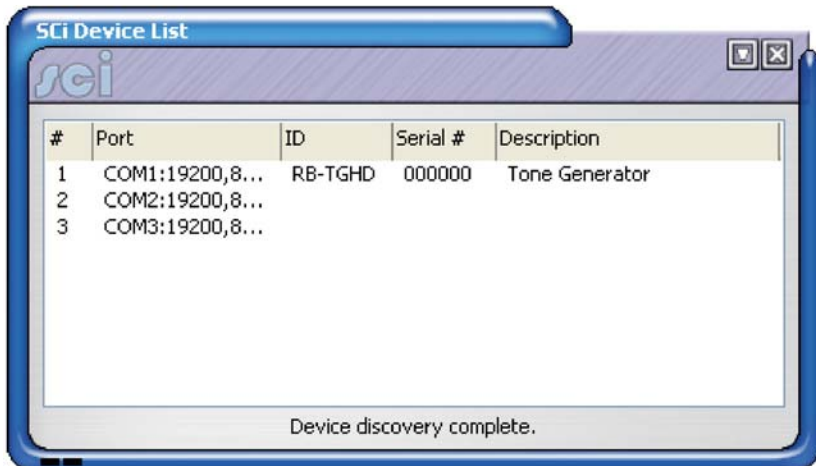


Fig 3-2: SCI Device Discovery Panel

3

RB-TGHD SCI REMOTE CONTROL SOFTWARE



RB-TGHD SCI REMOTE CONTROL SOFTWARE

Your attached RB-TGHD Tone Generator(s) will be shown in the list. If they are not listed, check the cable(s) between the RB-TGHD and your PC. Close the device dialog by clicking on the cross in the top right corner. The Tone Generator now appears in the SCI Launcher.

Loaded Launcher

Double-click on this to gain access to the Tone Generator controls.

Sci for RB-TGHD Tone Generators

The graphical interface allows you to control the RB-TGHD Tone Generator remotely. The controls replicate those on the front panel of the RB-TGHD - channel, sequence mode, sequence and sequence loop settings, as well the sequence restart control can all be accessed from this main panel. The channel active LEDs across the top of the screen show the state of each channel. This screen also shows additional information on the current DIPSwitch settings and details of the type of external sync board that is fitted, if any. Please note that Sci is continuously updated so the images may appear differently to those shown.



Fig 3-3: Sci Launcher Loaded

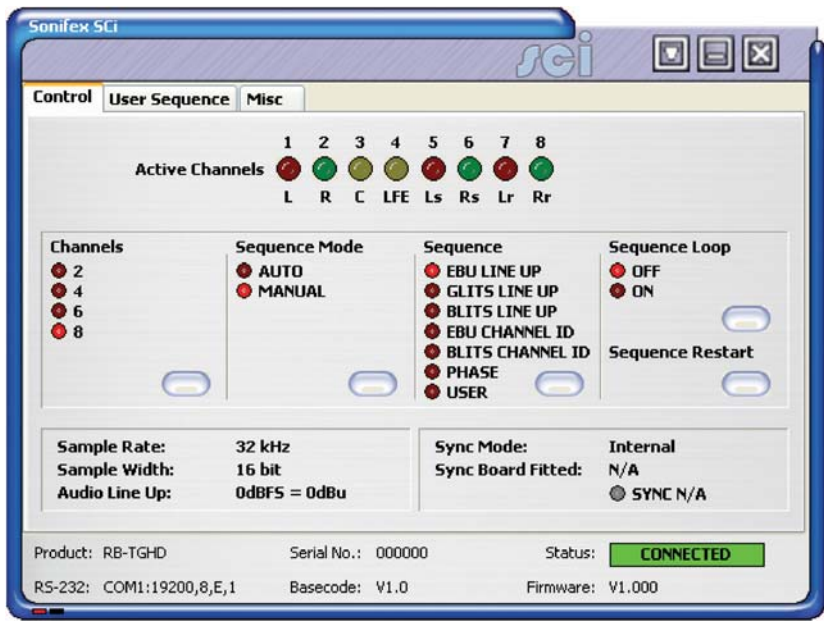


Fig 3-4: Sci Main Control Screen

To change a setting or start the currently selected sequence, simply press the associated button.

User Sequence Programming

This screen allows the user sequence to be easily edited. The sequence consists of up to 8 independently configured channels with a maximum of 50 steps on each channel. The bottom of the screen shows a graphical representation of the current sequence with the coloured regions showing when the channel will be un-muted.

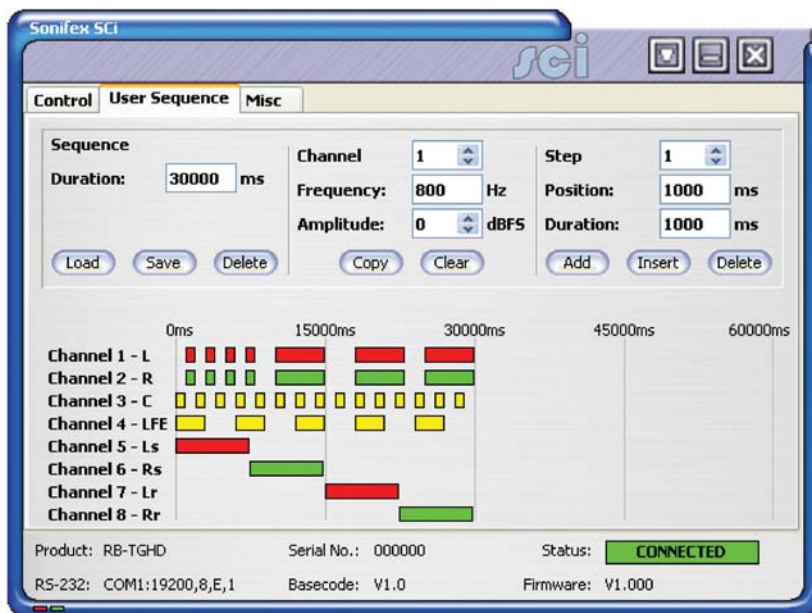


Fig 3-5: SCI User Sequence Screen

The Sequence Load button reads the current user sequence that is currently stored in the RB-TGHD memory and displays the details, overwriting any user sequence that is currently being edited. When the user sequence screen is selected, the current user sequence is automatically loaded.

The Sequence Save button performs a check on the user sequence data before writing the details to the RB-TGHD. Once a valid sequence has been written, it will be available for selection until it is overwritten or deleted.

The Sequence Delete button clears the user sequence currently stored in the RB-TGHD.

The Sequence Duration edit sets the total running time for the sequence in milliseconds. The maximum duration is 60000 ms (60 seconds).



3

RB-TGHD SCI REMOTE CONTROL SOFTWARE



RB-TGHD SCI REMOTE CONTROL SOFTWARE

The Channel selector selects a channel to edit. As the channel is changed, the relevant data will be displayed.

The Channel Frequency edit sets the tone frequency for the selected channel. The Frequency value must be between 20Hz and 16000Hz.

The Channel Amplitude selector sets the audio amplitude for the selected channel between 0 dBFS and -48 dBFS.

The Channel Copy button allows the settings on one channel to be reproduced on a different channel. First select the channel to copy using the Channel selector, then press the Copy button. Now select a channel to copy to by clicking on one of the channel names in the lower half of the screen.

The Channel clear button deletes all the settings for the selected channel.

The Step selector selects a sequence step to edit. Each step is a period where the channel is un-muted.

The Step Position edit sets the point at which the channel un-mutes for the selected step. This value is an offset from the start of the sequence and is measured in milliseconds. The Position value must be between 0 ms and 59950 ms.

The Step Duration edit sets the length of the un-mute period for the selected step in milliseconds.

The Step Add button adds a new step to the selected channel. A maximum of 50 steps can be assigned to each channel.

The Step Insert button inserts a new step at the currently selected step. For example, if there are 5 steps and the step selector is set to 3, a new step will be inserted at position 3 and the current steps at position 3, 4 and 5 will be moved to 4, 5 and 6 respectively.

The Step Delete button removes the currently selected step.

Firmware Updates

The Misc screen shows the Update Firmware option.

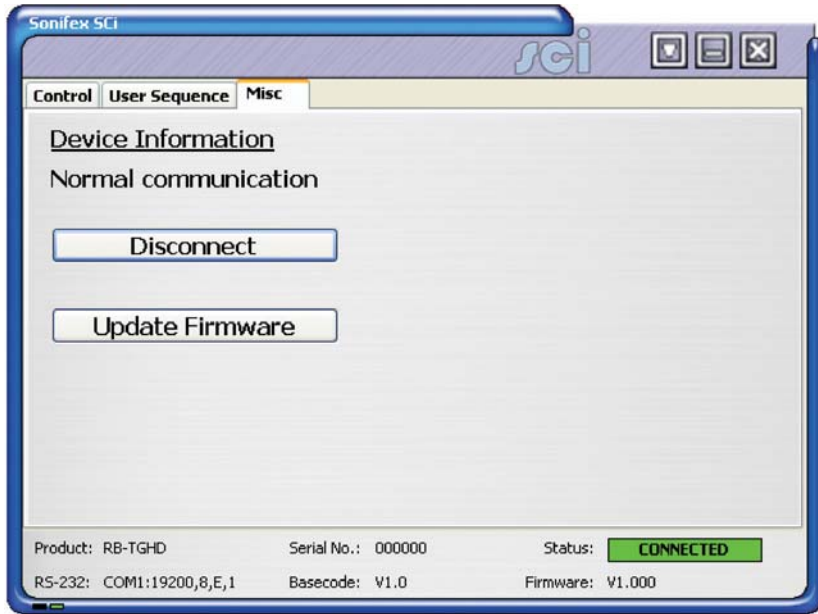


Fig 3-6: Sci Misc Screen

Occasionally, it may be necessary to upgrade the firmware on the RB-TGHD to add new functionality and fix software bugs. New firmware updates will be made available from time to time on the Sonifex website. Visit www.sonifex.co.uk for details.

It is vital that neither the serial connection nor mains power to the RB-TGHD should be interrupted during the update process. If this should happen, or the update is unsuccessful for any other reason, the RB-TGHD will not operate normally and will instead enter a protected Bootloader mode. In this mode, the unit has a limited command set and will await a successful retry of the update process.

Should the firmware update appear to succeed but the unit not behave as expected, the update may be repeated either via the DWN: command (if the unit will respond to commands) or, in extreme circumstances, by setting DIP switch number 8 in Bank 2 to ON. All other DIP switches in Bank 2 must be off. This action will force the Bootloader to run and allow initiation of an update under any circumstances. After completion of the update, the switch should be returned to the OFF position.



3

INSTALLING THE OPTIONAL SYNC BOARDS



To upgrade the firmware on the connected RB-TGHD, click on the Update Firmware button and select the required firmware file. Once the firmware upgrade has started, all of the LEDs on the front panel of the RB-TGHD will turn off except for the sync LED which indicates the status of the upgrade process as shown:

Sync LED State	Status Of Firmware Upgrade
Flashing Amber	Receiving firmware file
Constant Amber	Programming new firmware
Constant Green	New firmware installation successful
Constant Red	New firmware installation failed – try again

Table 3-1: Firmware Upgrade Status LED

The new firmware is transferred, and then the current firmware is erased before programming the update. Please note: Firmware files can take several minutes to transfer to the RB-TGHD at lower baud rates. To speed up the process, select a higher baud rate prior to transferring the new firmware.

Installing the Optional Sync Boards

There are 4 sync boards which can be used to synchronise the outputs of the RB-TGHD. The RB-SYW is installed in the unit as standard, the others are options.

RB-SYW

The Audio Word Clock sync board will accept a distributed clock running at the desired sample frequency between 32 kHz and 192 kHz. The signal can be differential or single ended TTL level.

RB-SYE

The AES/EBU sync board will accept a digital audio input signal with a sample frequency between 32 kHz and 192 kHz. When using the RB-SYE sync board, the Channel Status information that is encoded in the input data signal is copied to all digital output channels on the RB-TGHD.

RB-SYA

The Analogue video sync board will accept a composite signal of NTSC (525), PAL (625) & SECAM (625) signals covered by SMPTE-170-M (NTSC) and ITU-R BT.470-6 (PAL & SECAM). The recovered sample rate is 48 kHz.

RB-SYD

The Digital video sync board will accept 270Mbps SD-SDI and HD-SDI signals covered by SMPTE-259-M-C (SD) and SMPTE-292M (HD). The recovered sample rate is 48 kHz.





Opening the RB-TGHD

Warning: The power must be switched off at the supply or the power lead must be disconnected before attempting to open the unit. Removal of the cover can expose dangerous voltages.

1. Remove the 4 screws in the corners of the rear panel.
2. Remove the 4 screws on the top and bottom panels which hold the rear panel in place (2 on the top and 2 on the bottom).
3. Remove the screw in the centre of the front panel.
4. Slide the rear panel and main PCB backwards out of the metal chassis giving you internal access.
5. Remove the rubber grommet/bung on the rear panel which covers the hole for the sync connector.
6. Remove the 2 screws from the bottom of the sync card pillars and, making sure to keep the plastic washers in place at the bottom of the pillars, fit the 20 way pin header into the 20 way connector on the RB-TGHD motherboard.
7. Underneath the board, insert the 2 screws to fix the board in place.

To put the unit back together, slide the PCB back into the chassis and refit the screws in reverse order.



OPENING THE RB-TGHD



Technical Specification RB-TGHD (B & X)

Audio Specification

Analogue Output Impedance:	< 50 Ω
Digital Output Impedance:	110 Ω balanced AES/EBU (RB-TGHDX) 75 Ω un-balanced AES/EBU (RB-TGHDB)
Dynamic Range:	> 100dB
Maximum Output Level:	+24dBu
Noise:	< -90dB RMS for analogue outputs
Crosstalk:	< -110 dB (20Hz to 20kHz) for analogue outputs

Front Panel Controls

Channels:	2, 4, 6 or 8
Sequence Mode:	Auto or Manual
Sequence:	EBU R49 stereo line-up GLITS stereo line-up BLITS stereo line-up EBU R49 channel ID BLITS channel ID Phase User defined (using SCi)
Sequence Loop Mode:	On or Off (enables looping of current sequence)
Digital Sample Frequency:	32kHz, 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz or 192kHz (via DIP switches)
Digital Sample Width:	16bit or 24bit (via DIP switches)
Audio Line-Up:	0dBu to +24dBu in 1dB steps ref FSD (via DIP switches)
Channel Identification:	LEDs indicating 1-8 and L, R, C, LFE, LS, RS, LR and RR

Rear Panel Connections

Analogue Outputs:	8 x XLR 3 pin male (balanced)
Digital Outputs:	4 x XLR 3 pin male (balanced) (RB-TGHDX) 4 x BNC socket (un-balanced) (RB-TGHDB)

Serial Port:	D-sub 9-pin female
Remote I/O Port:	D-sub 25-pin female 17 inputs, 7 tally outputs
Mains Input:	Filtered 3-pin IEC male, continuously rated 85 – 264VAC, 47 – 63Hz, fused 1A, 60W peak, 30W average

Equipment Type

RB-TGHDB:	Multi-Channel HD Tone Generator with BNC Digital Outputs
RB-TGHDX:	Multi-Channel HD Tone Generator with XLR Digital Outputs

Physical Specification

Dimensions (Raw):	48cm (W) x 15.8cm (D*) x 4.3cm (H) (1U) 19" (W) x 6.2" (D*) x 1.7" (H) (1U)
Dimensions (Boxed):	59cm (W) x 27.4cm (D*) x 10.8cm (H) 23.2" (W) x 10.8" (D*) x 4.3" (H)
Weight:	Nett: 1.3kg Gross: 1.9kg Nett: 2.9lbs Gross: 4.2lbs

Accessories

RB-SYA:	Analogue video sync board (NTSC, PAL & SECAM)
RB-SYD:	Digital video sync board (SD-SDI & HD-SDI)
RB-SYE:	AES/EBU sync board
RB-SYW:	Word clock sync board (included as standard)
RB-RK3:	1U Rear panel rack kit for large Redboxes

* Note that this product is deeper than standard Redboxes



NOTES



NOTES



SONIFEX

www.sonifex.co.uk

t:+44 (0)1933 650 700

f:+44 (0)1933 650 726

sales@sonifex.co.uk

