MPX5

STEREO ENCODER

TECHNICAL MANUAL

CONTENTS

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1 Introduction

The **sbs** MPX5 provides a professional specification stereo encoder for radio broadcast applications. It is ideally suited to both FM broadcast and outside broadcast use. A wide-band input is available to allow simple connection of any RDS/SCA equipment.

The design of the encoder uses high quality, anti-aliasing, group delay compensated digital filters to reduce overshoots, enabling average modulation (and therefore loudness) to be significantly increased compared with other designs without over deviation. The extensive use of digital waveform synthesis techniques ensures long term maintenance free operation. There are no internal adjustments other than for factory preset L/R balance. Single input, output and pilot level controls are accessible from the front panel with all other switches accessible from the rear allowing simple installation.

The overshoot compensator module (fitted as standard) allows peak modulation to be increased 2 - 3dB whilst preventing over deviation. This option is strongly recommended in competitive markets where audio processing is used.

2 Safety, Electrical hazard

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This unit contains high voltages which could be fatal. YOU MUST ALWAYS ISOLATE THE UNIT FROM THE MAINS SUPPLY BY COMPLETELY DISCONNECTING IT BEFORE ATTEMPTING TO OPEN THE CASE.

THIS EQUIPMENT MUST BE EARTHED.

Do not expose this equipment to rain or any other source of water.

In common with all mains operated equipment, only suitably trained competent personnel should attempt to adjust, modify or repair this equipment or operate it with the cover removed. In case of query please contact your local agent or **sbs**.

Any unauthorised adjustment, modification or repair of this equipment may invalidate any warranty and/or safety approvals that apply.

Please read all of this manual and familiarise yourself with the controls before attempting to use this equipment.

To ensure safety, it is the responsibility of the user to install and operate this equipment in a manner that is within the manufacturers specifications.

3 Unpacking

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This package should contain:-

1x MPX5 Stereo encoder
1x IEC Mains lead
1x MPX5 manual

If any items are missing or damaged please inform your supplier immediately.

Initial Checks

Ensure that the MPX5 has been set to the correct mains/line voltage for your country. The standard version is set to 230V.

4 Controls and Connectors

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Front Panel:

POWER LED	Mains power applied.
STEREO LED	Stereo mode.
WIDEBAND INPUT	Switch to disable any input on the rear panel Wide-band input connector when OFF
PILOT LEVEL	Level of 19kHz stereo pilot tone.
PILOT SWITCH	Used to switch the pilot on or off.
INPUT LEVEL	Left/right input level.
INPUT SWITCH	Used to mute the audio input.
OUTPUT LEVEL	Final output level of both MPX outputs. This adjustment does not affect the level of the RDS sub-carrier.

Rear Panel:

Control	9 way female D-type connector. Pin 1 Ground Pin 2 Pilot mute, link to ground for mute Pin 3 Pilot mute, link to +3V to +15V for mute Pin 4 +15V (via 4.7kΩ resistor) Pin 8 Power supply OK (open collector) Pin 9 Ground
Audio inputs	Electronically balanced on 3 way XLR female. Pin 1 Ground, pin 2 HOT and pin 3 COLD. Switchable input impedance 600Ω/20kΩ.
O/P1 & O/P2	Unbalanced on BNC type connector. Individually switchable output impedance 10Ω/75Ω.
Wide-band input	Unbalanced on BNC type connector. Switchable input impedance 10kΩ/75Ω.
Power	Filtered IEC 320 male connector with T250mA fuse in pull out drawer.
Earth point	M4 threaded insert for earth bonding if required.

5 Overshoot Compensator Unit

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The optional overshoot compensator unit has been designed to enable radio stations in competitive markets to increase modulation levels by 2 - 5dB. It achieves this by eliminating some of the undesirable effects of the 15kHz low pass filtering necessary in stereo encoders.

Most radio stations choose to use some form of audio processing to boost loudness and "impact" of their programme material. Invariably this involves some form of clipping. Clipping a sine wave (or any other wave form) reduces its peak level by reducing the fundamental level and adding harmonics.

However the 15kHz low pass filters remove some of the harmonics (all of them where the fundamental is above 5kHz) which causes the peak value to increase by up to 2.1dB. To make matters worse the group delay of the filters inevitably changes dramatically at the cut off point of 15kHz. This can cause the third harmonic of a 5kHz fundamental to shift in phase and add to the peak value rather than subtract from it. The same will happen with the fifth harmonic of a 3kHz fundamental. This can add a further 2 - 3dB to the 2.1dB of overshoots.

The overshoot compensator removes both of these effects without noticeably degrading the signal to noise ratio of the pilot, stereo subcarrier or RDS/SCA subcarriers.

The overshoot compensator can also remove overshoots caused by low-pass filtering in STL's, such as digital links.

The overshoot compensator should not be regarded as a stand alone deviation limiter. If overloaded by excessive amounts of overshoot (from being fed direct from poor land lines for example) it may adversely affect the signal to noise ratio of the pilot, stereo subcarrier or RDS/SCA subcarriers. Similarly it should not be regarded as a clipper for "processing" the programme material. Again it may become overloaded and in any case will add unacceptable amounts of audible distortion.

6 Installation

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Please see section 4 of this manual for a description of the function of the external connectors, switches and adjustments. Set the input/output impedance switches as required by the equipment that the MPX5 is to be connected to.

If different input levels are required then a deviation meter and audio function generator will be required.

All audio and control connections to the MPX5 should be made with high quality screened cable. For the audio inputs and control connectors, the screens should be connected to the metal shells of the connectors.

MPX5 SETUP (With overshoot compensator module and MaXiM deviation limiter)

This procedure is appropriate when the overshoot compensated MPX5 stereo encoder is used with a MaXiM of any modification level. The setting of the MaXiM Long Release control does not affect this procedure. When a MaXiM is used with the overshoot compensated MPX5 stereo encoder it is recommended that Modification 5 is made to the MaXiM (details available on request). This will give at least 1dB of extra 'loudness' without any risk of over deviation.

A deviation meter should be connected such that it can monitor the modulated RF output of the transmission system. Disable any RDS/SCA input to the encoder and ensure that the pilot tone is OFF. Turn the INPUT LEVEL control to minimum (fully anticlockwise). Connect an audio oscillator to both audio inputs of the MPX5, ensuring that the oscillators output impedance is the same as the value selected by the rear panel switch on the MPX5. Temporarily change the switch if required. Set the audio oscillator to give a 5kHz sine-wave at approximately +14dBu. Switch the MPX5's PRE EMPHASIS switch to OFF during this setup procedure. Adjust the MPX5 OUTPUT LEVEL control to give 69kHz deviation less whatever is required for RDS/SCA. This will be 67.5kHz for an RDS level of 2kHz on an otherwise unmodulated carrier (because the RDS carrier is locked to the pilot, they do not add to give 8kHz). It is NOT necessary to allow a guard band.

Disable the audio input and re-enable the pilot tone (remove the link between pins 1 and 2 of the 9-way D-type). Set the PILOT LEVEL control to give a deviation of 6kHz.

Switch off the pilot tone. Connect the audio oscillator to the MaXiM, set to 400Hz sine wave. Set the MaXiM to TEST mode (front panel switch). Monitor the MaXiM output with an oscilloscope. Adjust the oscillator level and/or the MaXiM Input Level at Threshold control to find the exact point at which the MaXiM starts to clip. Leave it at this level. Connect the MaXiM to the MPX5 and now monitor the MPX5 output on the oscilloscope. Increase the setting of the MPX5 INPUT LEVEL control while watching the oscilloscope. Stop adjusting at the point when the MPX5 overshoot compensator starts to clip the waveform. The output clipper

in the MaXiM will now be set to the same level as the clipper in the MPX5 overshoot compensator.

Disable the audio input and mute the pilot tone . Enable any RDS/SCA equipment. This can be connected to the MPX5 WIDEBAND input (remember to set the input impedance switch on the rear panel to the value required). Adjust the output level of the RDS/SCA equipment to give the deviation required. Please note that some deviation monitors can give inaccurate readings with digital subcarriers. Monitoring the multiplex output with an oscilloscope and comparing the subcarrier level to the pilot tone will provide accurate results.

Finally switch the MaXiM back to operate mode, enable any RDS/SCA equipment and enable the pilot tone. Check that with various audio inputs to the MaXiM that the maximum deviation requirements are met.

MPX5 setup for use in BBC/CTI Transmission network distribution

BBC Network transmission systems require the following setup parameters:

Multiplex level for 75kHz peak deviation is 1Vp-p into 75Ω.

Pilot deviation is 6kHz which corresponds to 80mVp-p or 28mVrms

RDS deviation is 2kHz which corresponds to 26.6mVp-p .

Input level for maximum deviation is +8dBu high impedance setting (see below).

Because the RDS carrier is locked to the pilot they do not add to give 8kHz deviation. The actual deviation is 7.5kHz. This assumes that the RDS phase is correctly set-up to be in quadrature to the third harmonic of the 19kHz pilot tone.

Therefore the remaining deviation for use by the stereo multiplex is 67.5kHz, which corresponds to 894mV p-p or 316mVrms.

The input level for the stereo encoder will depend upon the setting of the deviation limiter/processor at Broadcasting House and upon the NICAM decoder output gain at the particular site. The normal peak level is +8dBu, the input gain is therefore set for overshoot clipping to begin at this level.

TEST PROCEDURE

Set the MPX5/OS rear panel switches as follows:- OUTPUT terminations to ON, WIDEBAND INPUT to OFF, PRE-EMPHASIS to ON and INPUT termination to OFF.

Mute the pilot with the front panel switch. Using a Lindos LA101 oscillator apply 315Hz at +8dBu to the inputs. Connect a Lindos measuring set to OUTPUT. A 75Ω load resistor will be required in the lead. Set it to distortion mode and adjust the MPX5 INPUT LEVEL control to give a reading of 0.2% (the overshoot

compensator is now set to begin clipping at +8dBu).
Set the Lindos oscillator to 5kHz at +5dBu (this level allows for the effect of pre-emphasis). Switch the measuring set to wideband (2-100kHz) PPM mode (OPTION 10) and change its displayed units to V (segment U in the configuration menu). Adjust the MPX5 OUTPUT LEVEL control to give a reading of 316mV. Mute the oscillator and unmute the pilot. Adjust the PILOT LEVEL control to give a reading of 28mV.

The MPX5 alignment procedure is now complete. The RDS level and phase can now be adjusted.

7 Specifications

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Input impedance	Switchable 50 kΩ/600Ω
Input level for 75kHz dev.	+ 8dBu (adjustable + /-3dB)
Input CMRR	> 70dB (20Hz-20kHz)
Wideband input level	2.5V p/p ± 0.3dB for 2kHz dev.
Wideband input impedance	Switchable 10 kΩ/75Ω
Output impedance	Switchable 22 Ω/75Ω
Output level - 22 Ω	+ 8dBu (adjustable + 0.5/-5.5dB) for 75kHz dev.
Output level - 75 Ω	1Vp-p (adjustable + 0.5/-5.5dB) for 75kHz dev.
Frequency response	± 0.3dB (20Hz-15kHz)
	< -60dB above 16kHz
Pre-emphasis	50µS
Pilot frequency stability	± 1Hz
19kHz pilot Level	80mVp-p ref 75kHz dev (adjustable + 2/-1dB)
38kHz suppression	< -60dB
All spurii	< -60dB
	< -80dB above 180kHz
Crosstalk	< 42dB (40Hz-15kHz)
	< 50dB (100Hz-10kHz)
Distortion, THD and beats	< -60dB (40Hz-15kHz)
S/N, stereo mode	< 70dB CCIR 468-2 weighted
Power supply	220/230V AC ± 10%
Power consumption	12VA
Dimensions	1Ux260mm

8 How to contact sbs

For all enquiries write to:-

sbs
PO Box 100
Hastings
East Sussex
TN34 3ZS

Or telephone 01424 445588 within the UK, +44 1424 445588 from outside the UK.

Or fax 01424 443388 within the UK, +44 1424 443388 from outside the UK.

Or email sales@sbs.uk.com for sales enquiries or support@sbs.uk.com for technical support.

Alternatively visit our web site: http://www.sbs.uk.com/

9 Technical section

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CONTENTS

9.1 Introduction

The MPX5 stereo encoder circuitry has been designed to require little routine maintenance. This has been achieved by the extensive use of digital waveform synthesis techniques. This approach also allows much better performance than is available from conventional encoders. Only high order harmonics from the digital stages are present in the multiplex, which are filtered out with a simple non-adjustable output filter stage. Because brick-wall filtering of the multiplex is not required there are no group delay problems to degrade the stereo separation performance.

9.2 Circuit diagrams

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The following circuit diagrams are divided into five pages:

1. Inputs/outputs & PSU

   This shows circuitry for the input RFI filters, output drivers and their RFI filters, wideband input with its RFI filter, control connector and power supply.

2. Analogue section

   This shows circuitry for the left/right gain control, filtering and pre-emphasis stages, the switching IC, pilot summing and mute and output filter.

3. Digital

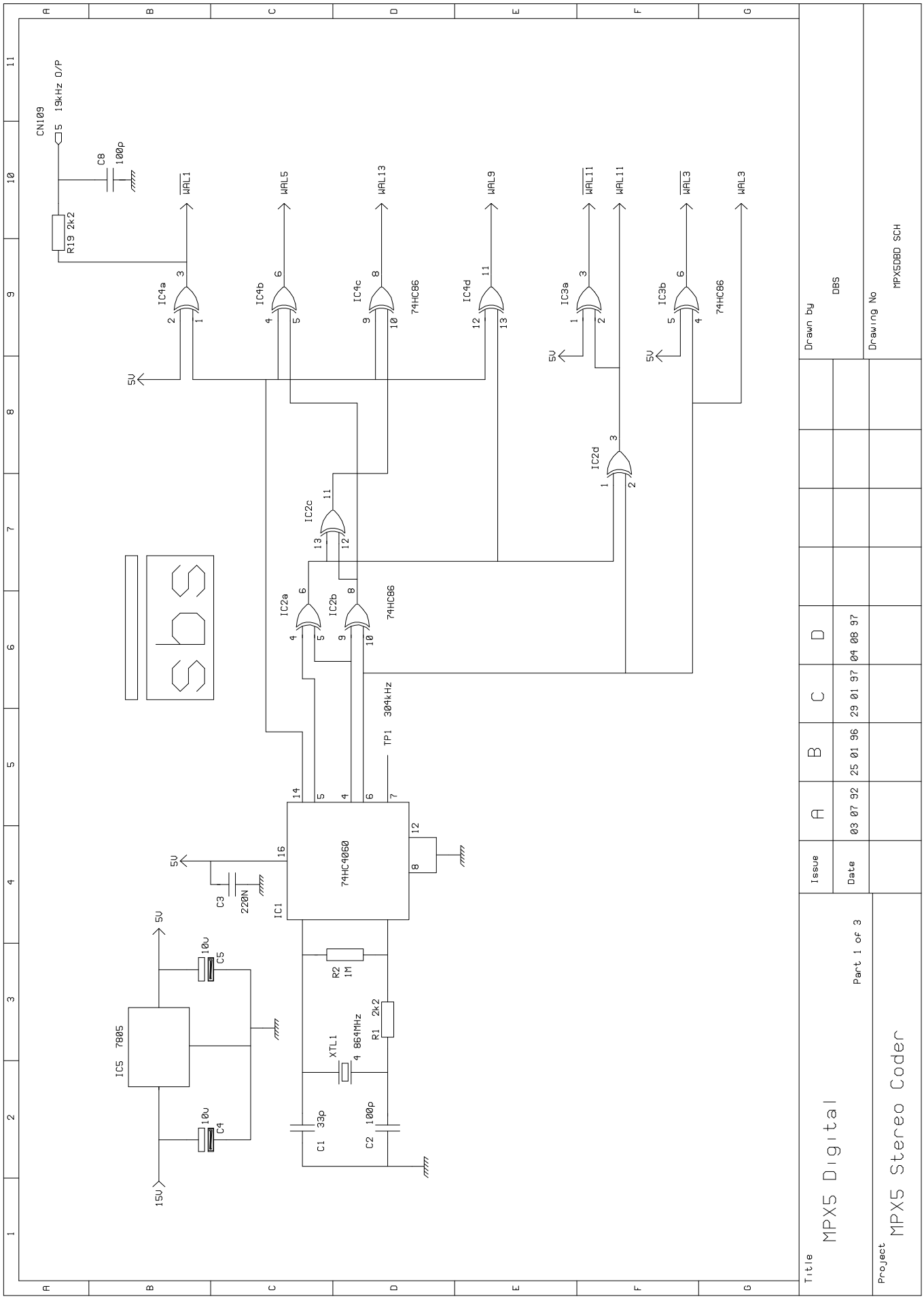
   This shows circuitry for the crystal oscillator/divider and function generating XOR stages.

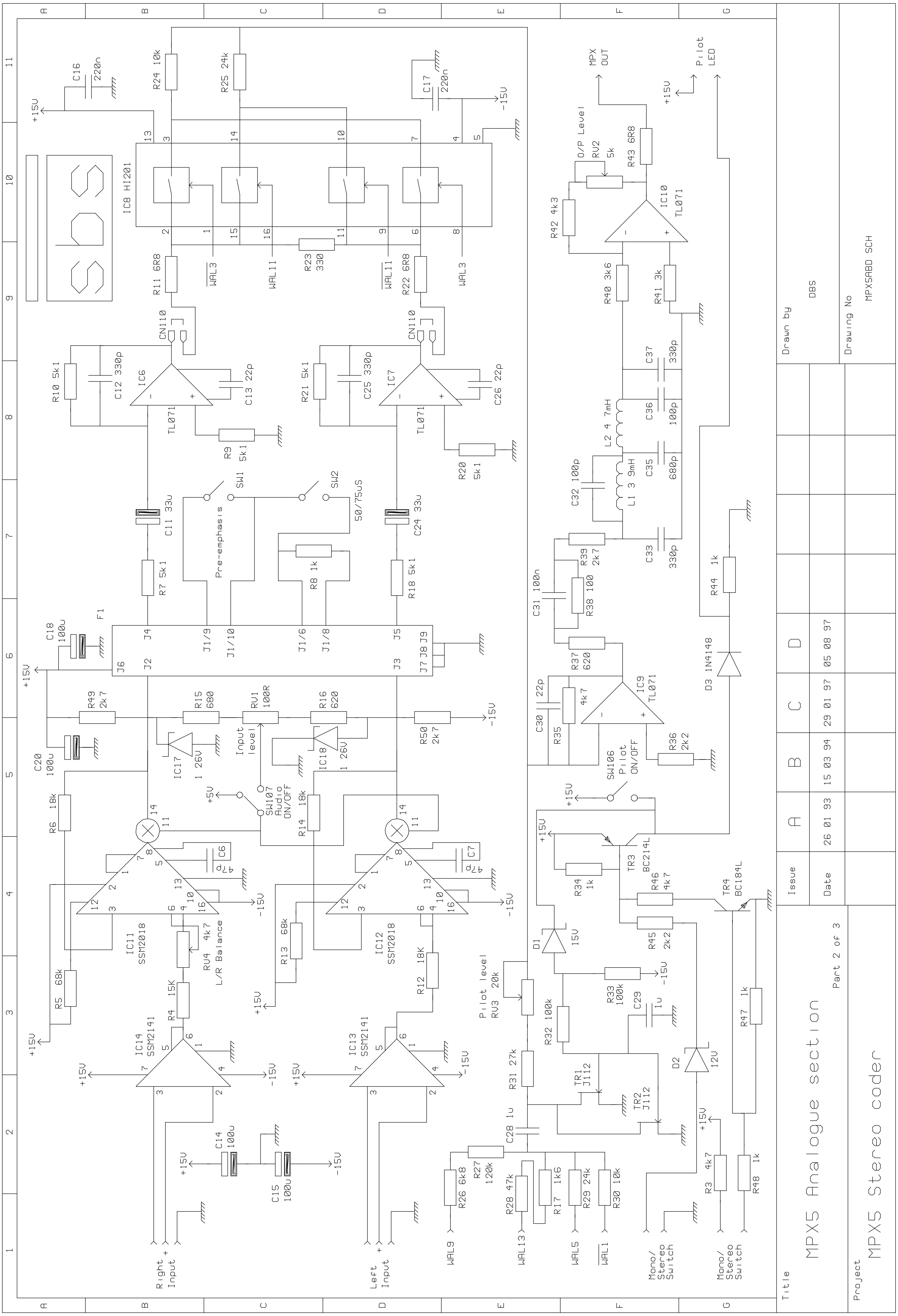
4. Overshoot compensator

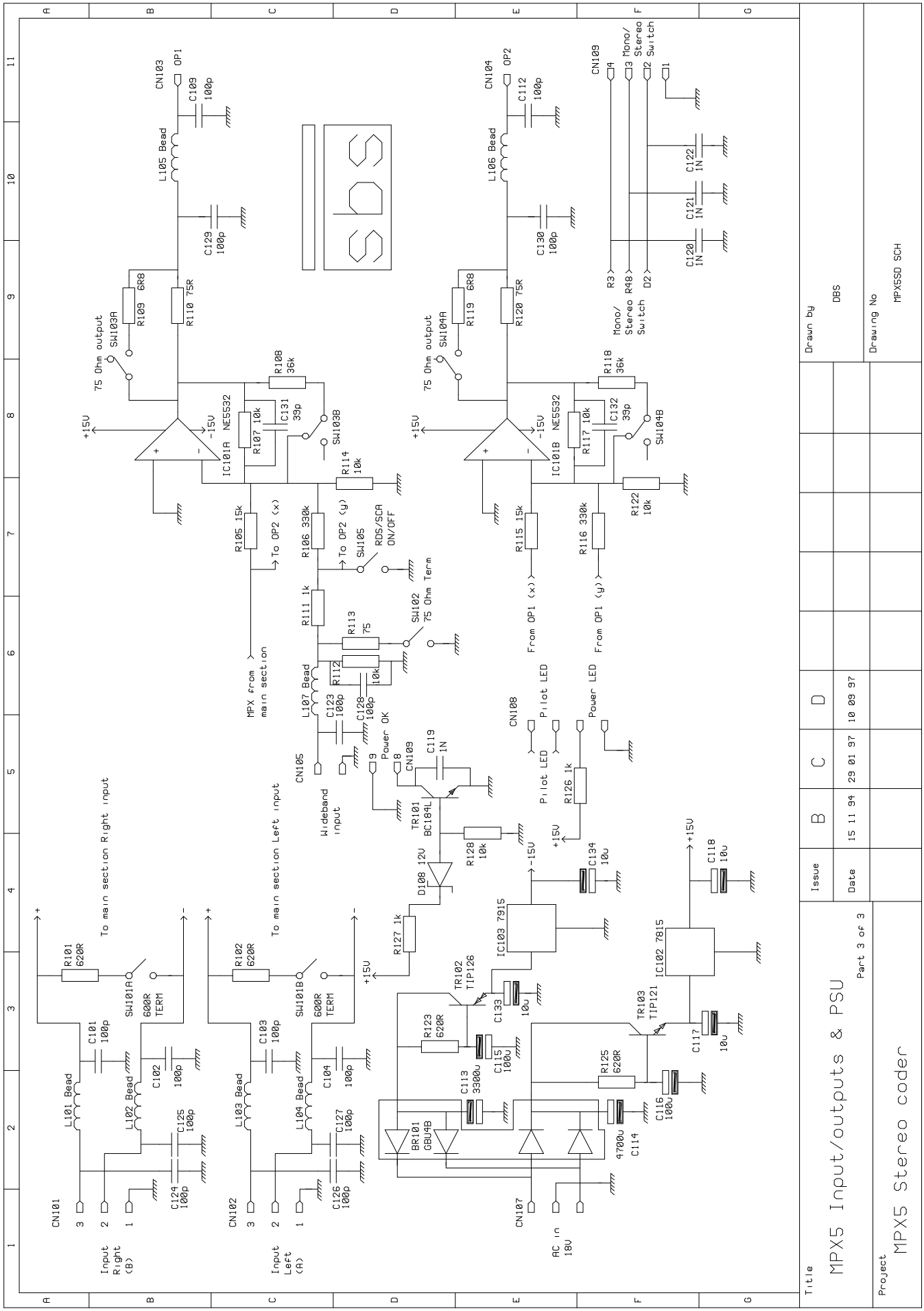
   This shows circuitry for the overshoot compensator PCB.

5. BBC Option board

   The circuitry for the crystal generated 23kHz oscillator and control logic is included on this PCB.


CN109
5 19kHz O/P
C8
100p
R19 2k2
WAL1
WAL5
WAL13
WAL9
WAL11
WAL11
WAL3
WAL3
IC4a
IC4b
IC4c
IC4d
74HC86
IC3a
IC3b
74HC86
5V
IC2d
IC2c
IC2a
IC2b
74HC86
TP1 304kHz
74HC4060
IC1
C3
220N
R2
1M
R1 2k2
XTL1
4 864MHz
C1 33p
C2 100p
IC5 7805
C5
10u
C4
10u
15V
Issue
Date
A
03 07 92
B
25 01 96
C
29 01 97
D
04 08 97
Drawn by
DBS
Drawing No
MPX5DBD SCH
Part 1 of 3
Title
MPX5 Digital
Project
MPX5 Stereo Coder


MPX5 Analogue section
Part 2 of 3
MPX5 Stereo coder
Drawn by
DBS
Drawing No
MPX5ABD SCH
Issue
Date
A 26 01 93
B 15 03 94
C 29 01 97
D 05 08 97
Title
Project


Input Right (B)
Input Left (A)
AC in 18V
To main section Right input
To main section Left input
MPX from main section
Wideband input
To OP2 (x)
To OP2 (y)
RDS/SCA ON/OFF
75 Ohm Term
Power OK
Pilot LED
Power LED
From OP1 (x)
From OP1 (y)
Mono/ Stereo Switch
75 Ohm output
IC101A NE5532
IC101B NE5532
IC102 7815
IC103 7915
TR101 BC184L
TR102 TIP126
TR103 TIP121
BR101 GBU4B
D108 12V
L101 Bead
L102 Bead
L103 Bead
L104 Bead
L105 Bead
L106 Bead
L107 Bead
SW101A 600R TERM
SW101B 600R TERM
SW102 75 Ohm Term
SW103A
SW103B
SW104A
SW104B
SW105 RDS/SCA ON/OFF
Title
MPX5 Input/outputs & PSU
Part 3 of 3
Project
MPX5 Stereo coder
Issue
Date
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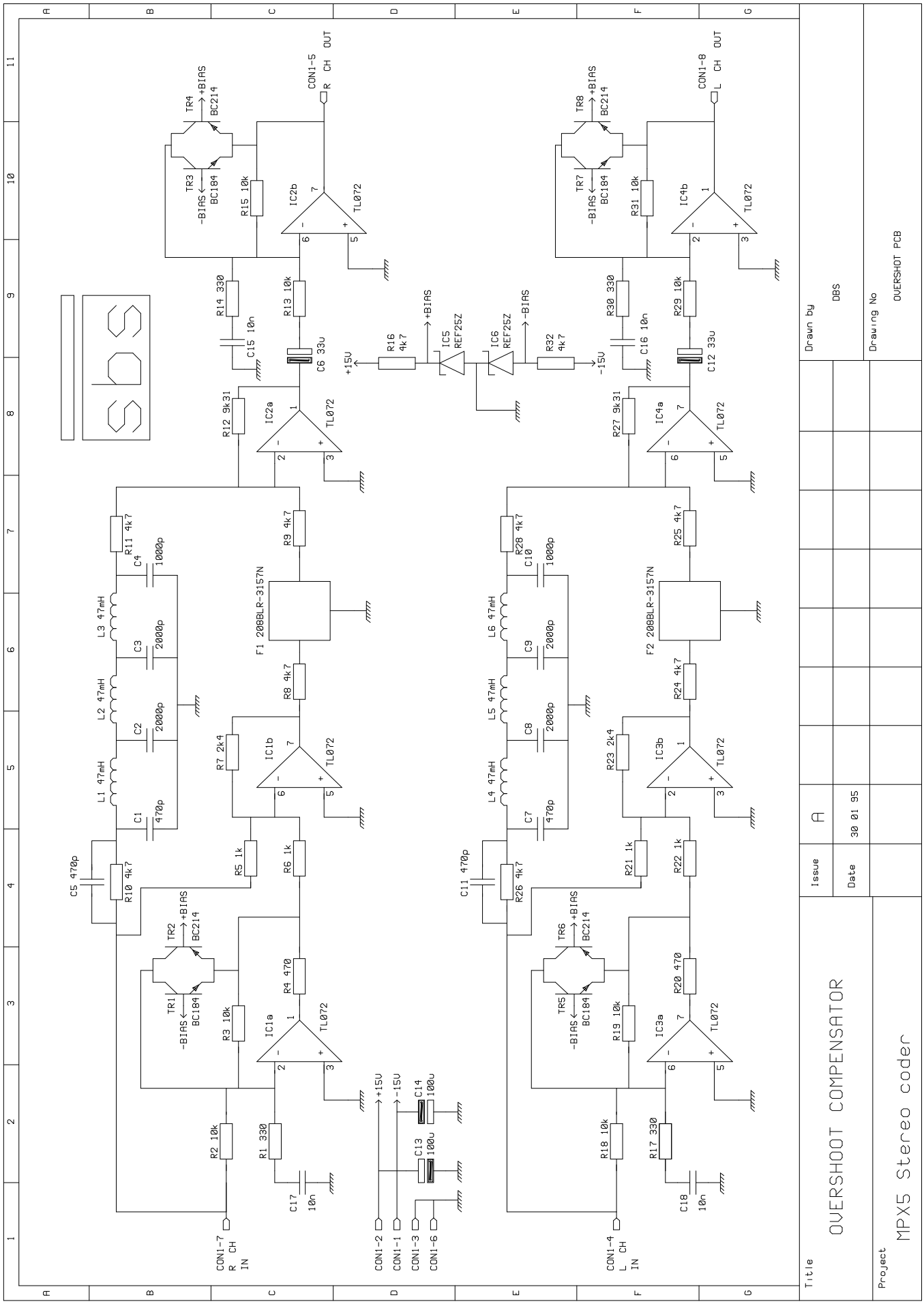
15 11 94
C
29 01 97
D
10 09 97
Drawn by
DBS
Drawing No
MPX5SD SCH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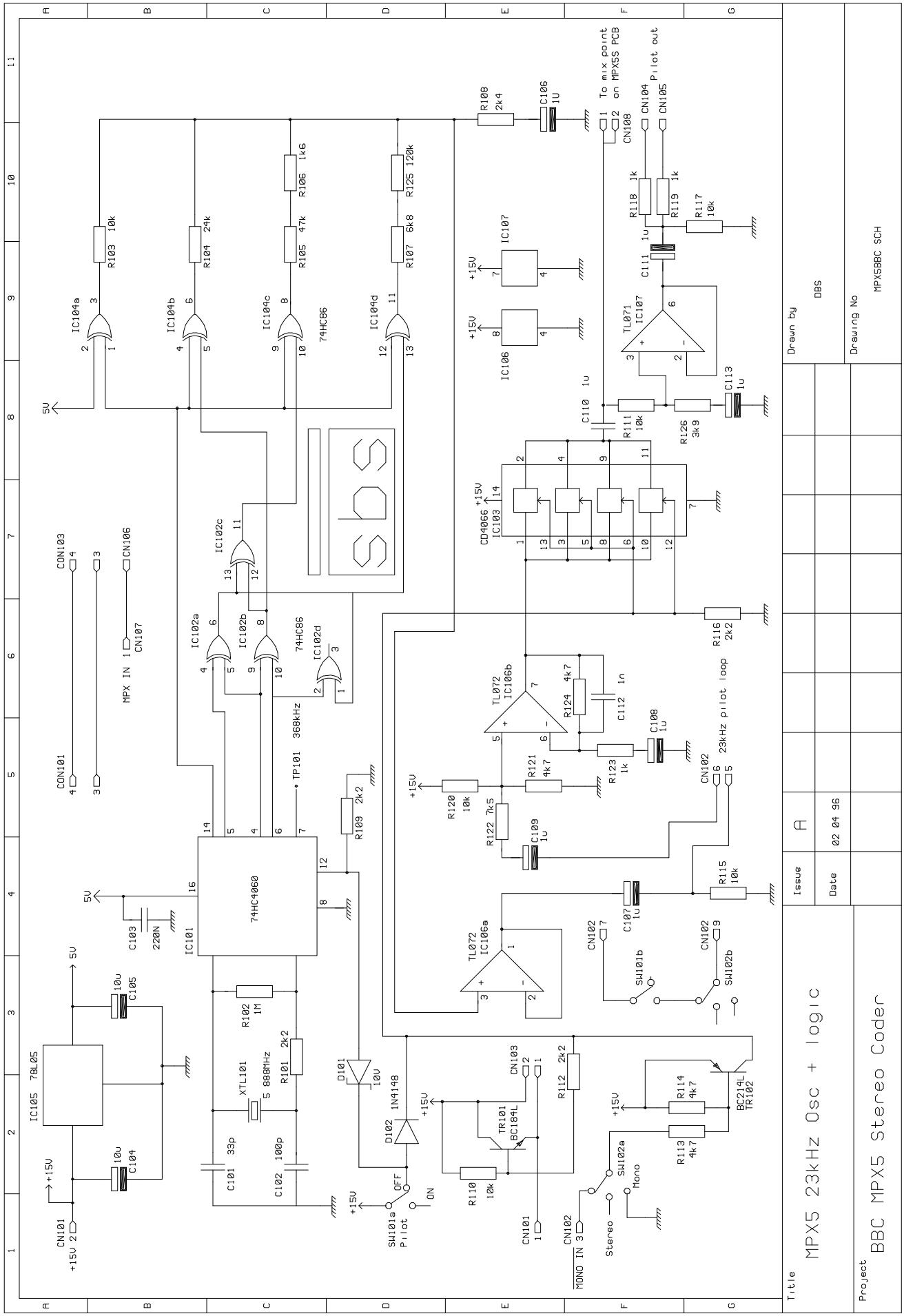
Title
OVERSHOOT COMPENSATOR
Project
MPX5 Stereo coder


MPX5 23kHz Osc + logic
BBC MPX5 Stereo Coder
Drawn by DBS
Drawing No MPX5BBC SCH
Issue A
Date 02 04 96
74HC4060
74HC86
TL072
TL071
CD4066
78L05
368kHz
23kHz pilot loop
To mix point on MPX5S PCB
Pilot out
Stereo
Mono
MONO IN
MPX IN
Pilot
ON
OFF

9.3 Circuit description

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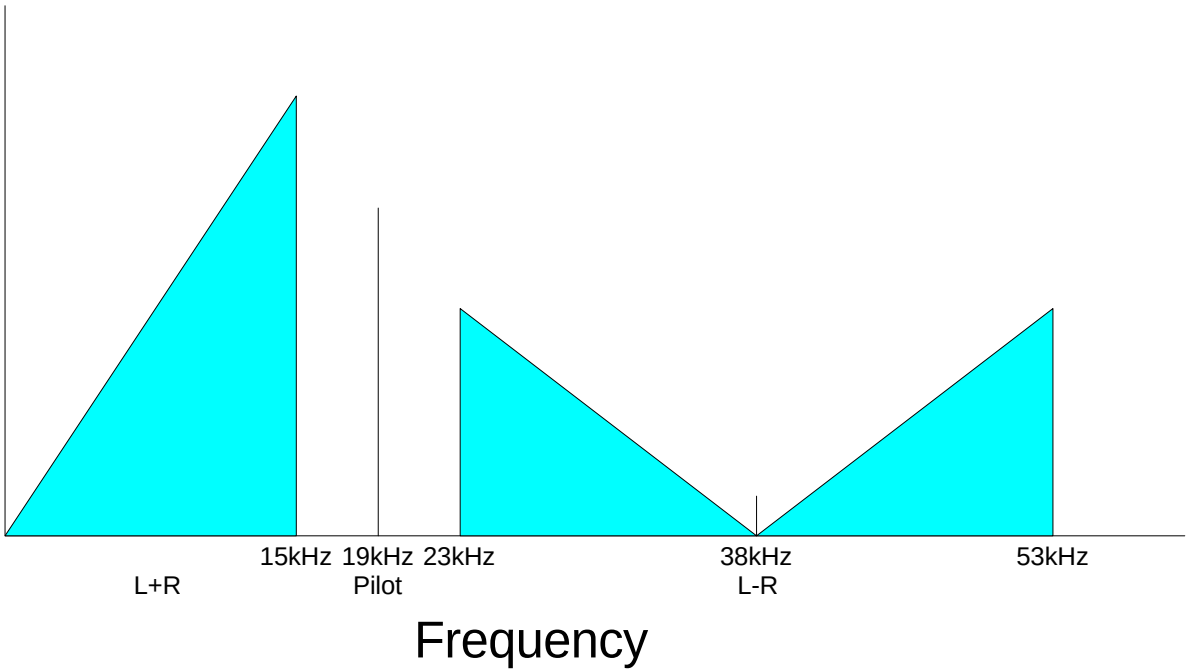
OVERVIEW



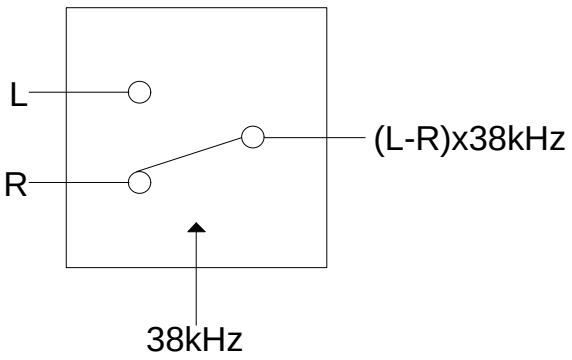
The diagram above shows an example of a theoretical display that one could see on a spectrum analyser connected to the output of a stereo encoder. The L + R section is simply the mono signal generated from the stereo input after filtering with a 15kHz low pass filter.

The 19kHz pilot must be generated by the encoder. The L-R (difference) signal must be amplitude modulated onto a suppressed 38kHz carrier. The phase relationship between the pilot and L-R signals is critical since the pilot is used as the reference for demodulating the difference signal.

Both signals are generated digitally. The 19kHz pilot is derived from a 19kHz square wave. The frequency spectrum of a 19kHz square-wave would show the main 19kHz fundamental frequency with decreasing harmonics at every multiple of 19kHz above that. These harmonics must be removed. One way would be to use a low pass filter. However a very sharp filter would be required to reduce the harmonics to an acceptable level, the effect of this on the phase of the pilot would cause serious problems because of the reason mentioned above.

A far better approach is to cancel each harmonic using a sine-wave of the same frequency and amplitude but opposite phase. Even simpler still a square-wave could be used to cancel each harmonic. Taking as an example, the pilots first harmonic at 38kHz, a 38kHz square-wave can be used to cancel that harmonic. The first harmonic of 38kHz will occur at 76kHz which will mix with the third harmonic of the pilot at that frequency. The resultant can then be cancelled with another square-wave. The same approach is adopted for the second harmonic of

the pilot. By mixing various square-waves using some logic IC's the relative levels of the harmonics can be adjusted. This enables the reduction of some higher order harmonics. Once the lower order harmonics have been removed the highest ones can be removed by a simple filter.



Switching between the left and right audio channels at 38kHz will create the amplitude modulated, suppressed carrier difference signal. It also produces harmonics, the first at 76kHz and so on. This harmonic can be cancelled by adding another difference signal to it that has been switched at 76kHz. This will leave further harmonics starting at 114kHz. Again the 76kHz square-wave can be mixed with other square-waves modifying the relative harmonic levels to cancel some higher harmonics. Those remaining are of sufficiently high order to be filtered out using a low pass filter, the same one used to filter out the high order harmonics of the pilot.

All of the digital waveforms required can be obtained from a single crystal controlled clock by dividing and an assortment of logic chips.

ANALOGUE SECTION

In the following circuit description the left-hand channel will be described, the right is identical.

The balanced audio input passes through an RFI filter stage and is connected to IC14. Switch SW101A provides for 600Ω termination. IC14 is a high performance balanced line receiver. RV4 allows for optimisation of L/R balance. IC11 is a VCA chip with gain control via pin 11. The gain control voltage is common between left and right channels. R5 sets the internal bias currents for the VCA chip. The VCA operates internally in a mode between class A and class AB giving the best noise/distortion performance.

The VCA output drives the 15kHz low pass filter directly. This is a digital group delay compensated filter. C18 and C19 provide additional supply decoupling.
IC6 buffers the output of the digital filter and drives the switching IC or the overshoot compensator if fitted.

R11, R22 and R23 apply a correction to the balance between the L + R and L-R signals (reducing the L-R component). IC8 is a quad analogue switch - a high performance version of the standard HI201 IC. WAL3 and its compliment switch between Left and Right at 38kHz. WAL11 provides the harmonic cancellation, switching the remaining two gates. Resistors R24 and R25 add the L-R signal and the correction signal into the virtual earth point at the input to buffer IC9.

The pilot signal is obtained from 19kHz square-wave WAL1. Resistors R17 and R26-R30 sum it with the harmonic cancelling functions WAL5, WAL9 and WAL13. Capacitor C28 provides DC decoupling and R31/RV3 sums it into buffer IC9.

The circuitry around TR1 and TR2 provides the pilot muting facility. In stereo mode their gates will be held at -7.5V by resistors R32 and R33. TR1 and TR2 will conduct when their gates are at 0V, in mono mode. This mutes the pilot forcing receivers to mono mode. The pilot level will fade up or down when changing between modes because of the effect of the capacitor C29.

The components following IC9 are those associated with the output lowpass filter. This filter has a 3dB point at 80kHz and is 8dB down at 200kHz. RV4 sets the overall output level.

Inverting dual operational amplifier IC101 provides separate buffered multiplex outputs. The wideband input is also summed into this IC.

DIGITAL SECTION

The digital section is very straightforward. All functions are derived from the 4.864MHz crystal oscillator/divider IC1. The clock frequency is divided by sixteen at pin 7. It is divided successively down to 19kHz at pin 14. The assortment of XOR gates combine the different frequencies from the divider to give complex functions with the required harmonic levels.

9.4 Alignment

No routine tests or alignment is recommended. Only one internal adjustment is available for left/right balance. This is factory preset and should not require attention unless the overshoot module is subsequently added, replaced or removed.

To setup this adjustment, mute the pilot by connecting together pins 1 and 2 of the control connector. Disconnect any RDS or SCA equipment from the Wideband input. Connect an audio input to both inputs of the MPX5. Set the frequency between 400Hz and 1kHz. Set the level to 0dBu (ie well below the overshoot compensation threshold). View the multiplex output on an oscilloscope. Set the oscilloscope to show the peak of one cycle of the audio at as high an input gain on the oscilloscope as possible, use the 'Y-Position' control as required. Adjust RV4 to reduce the blurring of the waveform peak to the minimum possible. RV4 can be accessed through the small hole in the right-hand side of the MPX5 baseplate, allowing adjustment without removing the lid.

9.5 Fitting/removing overshoot compensator module

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The overshoot compensator unit is simple to fit and remove. The lid must be removed to gain access to the overshoot compensator. Please read section 2 of this manual - Safety before removing the lid.

REMOVAL

Two 0.1" 'Hand-bag' links will be required. Disconnect the 8-way Molex lead from connector CN110 on the main MPX5 PCB. Fit the two 'Hand-bag' links as shown on the PCB next to CN110. Remove the four screws holding the overshoot compensator in place. A small screwdriver will be required for the two screws at the rear of the PCB. Retain the four screws with their washers. Remove the overshoot compensator and replace the MPX5 lid.

FITTING

Fit the overshoot compensator PCB in place at the rear of the MPX5 with CON1 next to the MPX5 main PCB. Use four M3x6mm pan-head screws with washers. A small screwdriver will be required for the two screws at the rear of the PCB. Remove the two 'Hand-bag' links indicated on the main MPX5 PCB from CN110. Connect the 8-way Molex lead from connector CN110 on the main MPX5 PCB to CON1 on the overshoot compensator PCB. Replace the MPX5 lid.

It will be necessary to check the L/R balance adjustment when the overshoot module is fitted or removed. See section 9.4 of this manual.

9.6 Parts Lists

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ISSUE	DESCRIPTION	AFFECTS APPROVALS
001	MPX5 initial CE compliant release	N/A
002	Main PCB revised to D2, additional front panel controls	Y

DRAWING/SUB ASSEMBLY LIST		PRODUCT: MPX5	ISS. 002
ITEM	DWG/ASSY NO	DESCRIPTION	
1	AB1 Issue 001	MPX5 Package	
2	AB2 Issue B4	MPX5 Unit assembly	
3	AB3 Issue C2	MPX5 Main PCB	
4	AB4 Issue A1	MPX5 LED Assembly	
5	AB5 Issue A2	MPX5/OS Cable	
6	AB6 Issue A4	MPX5 Overshoot compensator module	
7	AB7 Issue A6	MPX5 BBC Sub board	
8	DWG 94/008/1 Iss B	Customisation of casing baseplate	
9	DWG 93/031/2BBC Iss B	Customisation of front/rear panels	
10	DWG 93/031/2/M Iss B	Masking of rear panel prior to paint process	
11	DWG 93/031/2/SBBC Iss B	Silk screen artwork for front/rear panels	
12	DWG 93/031/1/WBBC Iss B	Wiring detail	
13	DWG 94/018 Iss B	Mains transformer wiring	
14	DWG 96/010 Iss A	1U Casing specification	
15	DWG 94/025 Iss A	Earth wire	
16	MPX5S.PCB Iss D3	Main PCB	
17	OVERSHOT.PCB Iss A2	Overshoot compensator PCB	
18	DWG 96/009 Iss A	LED wiring	
19	DWG 94/026 Iss B	Overshoot compensator cable assembly	
20	AB7 Issue C	Digital filter	
21	DWG 96/014 Iss A	Digital filter PCB	
22	DWG 95/009/1 Iss A	Heatsink	
23	MPX5BBC.PCB Iss A3	BBC Sub PCB	

ASSY. TITLE **MPX5 Package**		ISS. **001**	ASSY No. **AB1**		
PROJECT/USED ON **MPX5**			DRAWN BY **DBS**		DATE **13.02.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		MPX5 unit complete		1	
2	Bulgin PZ0100/2M50	IEC mains lead assembly		1	
3	\\Server\wpfshare \MANUALS\MPX 5\MPX5-BBC Technical manual Rev 003.wpd	MPX5 manual		1	
4		Clear polythene bag 460x600mm		1	
5	A1 RM752692	Carton shell/slide c/w profile foam 525x329x69mm		1	
6	sbs	Package label		1	
7					
8					
9					
10					
11					
12					

ASSY. TITLE **MPX5 Unit assembly**		ISS. **B4**	ASSY No. **AB2**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **25.04.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		1U Extruded casing customised & finished	DRG 93/031	1	
2	MPX5S PCB	MPX5S PCB assembled	ASSY AB3	1	
3		30VA 230V/18V Mains transformer ready terminated with mounting kit	DRG 94/018	1	XFMR1
4		Filtered & fused IEC inlet		1	
5		Fuse 20mm 250mA antisurge to comply with IEC127		2	For IEC inlet
6		Screw M4x12 pan head		1	Rear panel earth screw
7		M4 nut		1	For earth wire fixing
8		M4 locking washer		2	For earth wire fixing & rear panel earth screw
9		Equipment wire green/yellow stranded 32/0.2mm	DWG 94/025	100 mm	Earth wire, IEC inlet to baseplate
10		M4 insulated crimp eyelet	DWG 94/025	1	Earth wire
11		0.25" insulated crimp receptical	DWG 94/025	1	Earth wire
12	MPS YH54J	5mm LED clear lens		2	Power & Pilot LED's
13		M3 Screw mount cable tie		1	
14		M3x6mm pan head screw		11	For PCB's and cable ties
15		M3 washer		9	For PCB's
16		Bulgin KIT6 IEC lead retaining kit		1	IEC Inlet
17	sbs OVERSHOT.PCB	Overshoot compensator PCB complete	ASSY AB6	1	
18		MPX5BBC PCB		1	
19		MPX5 BBC LED Assembly	ASSY AB4	1	Front panel LED's
20		8 Way Molex cable assy	ASSY AB5	1	Inter PCB cable

ASSY. TITLE **MPX5 Main PCB**		ISS. **C2**	ASSY No. **AB3**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **27.10.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		Resistor 0.25W 1% Leaded 6R8		5	R43, R11, R22, R109, R119
2		Resistor 0.25W 1% Leaded 75R		3	R110, R113, R120
3		Resistor 0.25W 1% Leaded 100R		1	R38
4		Resistor 0.25W 1% Leaded 470R		1	R23
5		Resistor 0.25W 1% Leaded 620R		6	R37 R16, R101, R102, R123, R125
6		Resistor 0.25W 1% Leaded 680R		1	R15
7		Resistor 0.25W 1% Leaded 1k		8	R8, R34, R44, R47, R48, R111, R126, R127
8		Resistor 0.25W 1% Leaded 1k6		1	R17
9		Resistor 0.25W 1% Leaded 2k2		4	R1, R19, R36, R45,
10		Resistor 0.25W 1% Leaded 2k7		3	R39, R49, R50
11		Resistor 0.25W 1% Leaded 3k		1	R41
12		Resistor 0.25W 1% Leaded 3k6		1	R40
13		Resistor 0.25W 1% Leaded 4k7		3	R3, R35, R46
14		Resistor 0.25W 1% Leaded 5k1		6	R7, R9, R10, R18, R20, R21
15		Resistor 0.25W 1% Leaded 4k3		1	R42
16		Resistor 0.25W 1% Leaded 6k8		1	R26,
17		Resistor 0.25W 1% Leaded 10k		8	R24, R30, R107, R112, R114, R117, R122, R128
18		Resistor 0.25W 1% Leaded 15k		3	R4, R105,R115
19		Resistor 0.25W 1% Leaded 18k		3	R6, R12,R14
20		Resistor 0.25W 1% Leaded 24k		2	R25, R29
21		Resistor 0.25W 1% Leaded 36k		3	R31,R108, R118
22		Resistor 0.25W 1% Leaded 47k		1	R28
23		Resistor 0.25W 1% Leaded 68k		2	R5, R13
24		Resistor 0.25W 1% Leaded 100k		2	R32, R33
25		Resistor 0.25W 1% Leaded 120k		1	R27
26		Resistor 0.25W 1% Leaded 150k		2	R106, R116
27		Resistor 0.25W 1% Leaded 1M		1	R2
28	Farnell 303-458	Capacitor ceramic 22p, 100v, 0.2"		3	C13, C26,C30
29	Farnell 303-495	Capacitor ceramic 47p, 100v, 0.2"		2	C6, C7
30	Farnell 303-483	Capacitor ceramic 39p, 100v, 0.2"		2	C131, C132
31	Farnell 303-471	Capacitor ceramic 33p, 100v, 0.2"		1	C1

ASSY. TITLE **MPX5 Main PCB**		ISS. **C2**	ASSY No. **AB3**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **27.10.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
32	Farnell 303-537	Capacitor ceramic 100p, 100v, 0.2"		16	C2, C8,C101, C102, C103, C104, C109, C112, C123, C124, C125, C126, C127, C128, C129, C130
33	Farnell 303-598	Capacitor ceramic 330p, 100v, 0.2"		2	C12, C25
34	Farnell 303-665	Capacitor ceramic 1n, 100v, 0.2"		4	C119, C120, C121, C122
35	Farnell 106-797	Capacitor Philips 464 series 100p		2	C32, C36
36	Farnell 106-791	Capacitor Philips 463 series 330p		2	C33, C37
37	Farnell 106-793	Capacitor Philips 463 series 680p		1	C35
38		NOT FITTED			
39		NOT FITTED			
40	Farnell 146-079	Capacitor miniature polyester 100n, 63v, 0.2"		1	C31
41	Farnell 146-080	Capacitor miniature polyester 220n, 63v, 0.2"		3	C3, C16, C17
42	RS114-430	Capacitor polyester miniature layer 10mm lead pitch 1u		2	C28, C29
43		Capacitor radial electrolytic 25V 10u		6	C4, C5, C117, C118, C133, C134
44		Capacitor radial electrolytic 25V 33u		2	C11, C24
45		Capacitor radial electrolytic 25V 100u		4	C14, C15, C18, C20
46		Capacitor radial electrolytic 35V 100u		2	C115, C116
47	Philips 05857472	Capacitor PCB mounting electrolytic Philips 40V 4700u		1	C114
48	Philips 05657332	Capacitor PCB mounting electrolytic Philips 40V 3300u		1	C113
49		Zener diode Leaded BZX79C15V		1	D1
50		Zener diode Leaded BZX79C12V		2	D2, D108
51		NOT FITTED			
52		Diode Leaded 1N4148		1	D3
53	Farnell 108-267	Bead inductor Axial		7	L101, L102, L103, L104, L105, L106, L107
54	Bonex 436392	Inductor Toko 181LY392J 3.9mH		1	L1
55	Bonex 436472	Inductor Toko 181LY472J 4.7mH		1	L2
56		Potentiometer Bournes multiturn 3/4" rectangular 100R		1	RV1

ASSY. TITLE **MPX5 Main PCB**		ISS. **C2**	ASSY No. **AB3**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **27.10.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
57		Potentiometer Bournes multiturn 3/4" rectangular 5k		1	RV2
58		Potentiometer Bournes multiturn 3/4" rectangular 20k		1	RV3
59	Bourns VA05H	Potentiometer cermet open with bottom adjust 4k7		1	RV4
60	Farnell J112	Transistor FET J112		2	TR1, TR2
61		Transistor PNP BC214L		1	TR3
62		Transistor NPN BC184L		2	TR4, TR101
63		Transistor darlington PNP TIP126		1	TR102
64		Transistor darlington NPN TIP121		1	TR103
65		DSP Filter	Dwg 96/014	1	F1
66		Bridge rectifier General instruments GBU4B 4A		1	BR101
67	RS334-280	Switch Right angle DPDT		5	SW1, SW101, SW102, SW103, SW104
68		Switch ERG SDC-1-014		1	SW2
69		IC 74HC4060		1	IC1
70		IC 74HC86		3	IC2, IC3, IC4
71		IC TL071		4	IC6, IC7, IC9, IC10
72		IC NE5532N		1	IC101
73		IC SSM2141		2	IC13, IC14
74		IC SSM2018T		2	IC11, IC12
75		IC Harris HI3-0201HS-5		1	IC8
76		IC Voltage regulator 7805 TO220		1	IC5
77		IC Voltage regulator 7815 TO220		1	IC102
78		IC Voltage regulator 7915 TO220		1	IC103
79		Voltage reference TO92 1.26V TC04BZM		2	IC17, IC18
80		DIL IC Socket 8 way		7	IC6, IC7, IC9, IC10, IC13, IC14, IC101
81		DIL IC Socket 14 way		3	IC2, IC3, IC4
82		DIL IC Socket 16 way		4	IC1, IC8, IC11, IC12
83	Golledge MS02304	Crystal 4.864MHz 30pF		1	XTL1
84		Connector XLR Neutrik NC3FD-H		2	CN101, CN102
85	Farnell 152-297	Connector BNC Shielded right angle PCB mounting, Vitelec VBM201		3	CN103, CN104, CN105

ASSY. TITLE **MPX5 Main PCB**		ISS. **C2**	ASSY No. **AB3**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **27.10.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
86	RS 457-484	Connector D-type socket right angle PCB mounting		1	CN109
87	RS 404-008	Horizontal PCB header 3 way		1	CN107
88	RS 402-951	Heatsink 21 C/W		1	IC5
89	Redpoint MR60-1	Heatsink Redpoint MR series cut to 60mm length		1	DRG 95/009/1
90		Clips - Redpoint 4426		4	TR102, TR103, IC102, IC103
91		TO220 insulating washer		4	TR102, TR103, IC102, IC103
92		Molex Header straight with friction lock 2 way		2	CN111, CN102
93		Molex Header straight with friction lock 4 way		1	CN108
94		Molex Header straight with friction lock 8 way		1	CN110
95		Bolt pan head M3 x 6mm		2	For heatsink
96		Bolt pan head M3 x 12mm		1	IC5
97		Nut M3		1	IC5
98		Washer M3		1	IC5
99		Lock washer M3		1	IC5
100		1mm test pin		1	TP1
101	sbs MPX5S.PCB	MPX5 PCB		1	

ASSY. TITLE **MPX5 LED assembly**		ISS. **A1**	ASSY No. **AB4**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **25.04.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		5mm green standard LED		2	Power & Pilot LED's
2		Molex 4 pin plug		1	CN108
3		Molex terminal pin		4	CN108
4		M3 Screw mount cable tie		1	
5		H12 Black sleeve x20mm		4	
6		H15 Black sleeve x20mm		2	
7		Equipment wire stranded 7/0,2mm White		200 mm	
8		Equipment wire stranded 7/0,2mm Pink		200 mm	
9		Equipment wire stranded 7/0,2mm Black		200 mm	
10		Equipment wire stranded 7/0,2mm Red		200 mm	

ASSY. TITLE **MPX5 OS Cable**		ISS. **A2**	ASSY No. **AB5**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **DBS**		DATE **25.04.97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1	Farnell 636-502	IDC Socket, 8 Pin, Single Row		2	CON1 & CN110
2	Farnell 636-691	Ribbon Cable, 0.1" Pitch		A/R	
3					

ASSY. TITLE **MPX5 BBC PCB**		ISS. **A6**	ASSY No. **AB7**		
PROJECT/USED ON **BBC Version MPX5 stereo encoder**			DRAWN BY **BGA**		DATE **5.12.96**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		Resistor 0.25W 1% leaded 1k		3	R118, R119, R123
2		Resistor 0.25W 1% leaded 1k6		1	R106
3		Resistor 0.25W 1% leaded 2k2		4	R101, R109, R112, R116
4		Resistor 0.25W 1% leaded 2k4		1	R108
5		Resistor 0.25W 1% leaded 3k9		1	R126
6		Resistor 0.25W 1% leaded 4k7		4	R113, R114, R121, R124
7		Resistor 0.25W 1% leaded 6k8		1	R107
8		Resistor 0.25W 1% leaded 7k5		1	R122
9		Resistor 0.25W 1% leaded 10k		6	R103, R110, R111, R115, R117, R120
10		Resistor 0.25W 1% leaded 24k		1	R104
11		Resistor 0.25W 1% leaded 47k		1	R105
12		Resistor 0.25W 1% leaded 120k		1	R125
13		Resistor 0.25W 1% leaded 1M		1	R102
14		Capacitor electrolytic radial 35V 1u		6	C106, C107, C108, C109, C111,C113
15		Capacitor electrolytic radial 35V 10u		2	C104, C105
16		Capacitor ceramic Philips 2% Low K 33p		1	C101
17		Capacitor ceramic Philips 2% Low K 100p		1	C102
18		Capacitor ceramic Philips 2% Low K 1n		1	C112
19		Capacitor polyester leaded 0.2" spacing 220n		1	C103
20		Capacitor polyester 1u 63V 10mm spacing		1	C110
21		DIL 8 way IC socket		2	IC106, IC107
22		DIL 16 way IC socket		1	IC101
23		DIL 14 way IC socket		3	IC102, IC103, IC104
24		Zener diode BZX79C10		1	D101
25		Diode 1N4148		1	D102
26	Golledge MS03945	Crystal 5.888MHz		1	XTL101
27	RS 664-301	Switch Mors-Apem TL46WW050		1	SW101
28	RS 664-317	Switch Mors-Apem TL49WW050		1	SW102

ASSY. TITLE **MPX5 BBC PCB**		ISS. **A6**	ASSY No. **AB7**		
PROJECT/USED ON **BBC Version MPX5 stereo encoder**			DRAWN BY **BGA**		DATE **5.12.96**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
29		Molex 2 way PCB header with friction lock		2	CN107, CN108
30		Molex 4 way PCB header with friction lock		2	CN101, CN103
31	FAR 152-297	Connector BNC Shielded right angle PCB mounting.		3	CN104, CN105, CN106
32	FAR 150-750	Connector 9 way D-type Plug, Right-angle PCB mounting with PCB locking lugs and jack posts		1	CN102
33	sbs MPX5BBC.PCB	BBC Printed Circuit Board		1	
34	FAR BC184L	Transistor BC184L		1	TR101
35	FAR BC214L	Transistor BC214L		1	TR102
36	FAR 701-531	IC 74HC4060		1	IC101
37	FAR 701-646	IC 74HC86		2	IC102, IC104
38	FAR 385-451	IC CD4066		1	IC103
39	FAR 701-889	IC 78L05		1	IC105
40	FAR 401-149	IC TL072		1	IC106
41	FAR 400-634	IC TL071		1	IC107
42		1mm Harwin pin, or equiv.		1	TP101

ASSY. TITLE : **MPX5/OS PCB**		ISS. **A5**	ASSY No. **AB6**		
PROJECT/USED ON : **MPX5 Stereo encoder**			DRAWN BY : **DBS**		DATE **06.10.99**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		Resistor 0.25W 1% leaded 330R		4	R1, R14, R17, R30
2		Resistor 0.25W 1% leaded 470R		2	R4, R20
3		Resistor 0.25W 1% leaded 1k		4	R5, R6, R21, R22
4		Resistor 0.25W 1% leaded 2k4		2	R7, R23
5		Resistor 0.25W 1% leaded 4k7		10	R8,R9,R10,R11,R16, R24,R25,R26,R28, R32
6		Resistor 0.25W 1% leaded 10k		8	R2, R3, R13, R15, R18, R19, R29, R31
7		Resistor 0.25W 0.1% leaded (precision) 9k31		2	R12, R27
8	Farnell 106-792	Capacitor Philips 464 series 470p		4	C1, C5, C7, C11
9	Farnell 106-794	Capacitor Philips 464 series 1000p		2	C4, C10
10	Farnell 106-787	Capacitor Philips 462 series 2200p		4	C2, C3, C8, C9
11		Capacitor polyester leaded 0.2" spacing 10n		4	C15, C16, C17, C18
12		Capacitor electrolytic radial 35V 33u		2	C6, C12
13		Capacitor electrolytic radial 35V 100u		2	C13, C14
14		Inductor Toko 33mH		2	L3, L6
15		Inductor Toko 47mH		4	L1, L2, L4, L5
16	Bonex 085110	Toko 15kHz low pass filter 257BLR3618N		2	F1, F2
17		Transistor BC184L		4	TR1, TR3, TR5, TR7
18		Transistor BC214L		4	TR2, TR4, TR6, TR8
19		IC NE5532		2	IC2, IC4
20		IC TL072		2	IC1, IC3
21		DIL 8 way IC socket		4	IC1, IC2, IC3, IC4
22		Molex 8 way PCB header with friction lock		1	CON1
23		sbs OVERSHOOT PCB		1	
24	Farnell 789-203	Voltage Reference ZREF25Z02		2	

ASSY. TITLE **MPX5 Filter Assy**		ISS. **C**	ASSY No. **AB7**		
PROJECT/USED ON **MPX5 Stereo encoder**			DRAWN BY **SWK**		DATE **22-10-97**
ITEM	SUPPLIER OR STOCK CODE	DESCRIPTION	DWG NO/ SUB ASSY NO	QTY	Diag ref
1		IC DSP Microcomputer ADSP-2171KS-133 (Analog Dev)		1	IC1
2		IC Stereo A/D converter AD1877JR (Analog Devices)		1	IC2
3		IC 74HC393 SO16		1	IC3
4		IC EPROM 27C128-20		1	IC4
5		IC Stereo D/A converter CS4331-KS (Crystal) SOIC		1	IC5
6		IC Watch dog timer MAX1232CSA (MaXiM) SO8		1	IC6
7		IC 74HC00 SO16		1	IC7
8		IC LMC6032IM SO8		1	IC8
9	FAR 556-312	Capacitor SM Electrolytic 1u Dia 4		3	C17-19
10	FAR 556-191	Capacitor SM Electrolytic 4u7 Dia 4		2	C11, C12
11	FAR 556-129	Capacitor SM Electrolytic 47u Dia 5		2	C13, C14
12	FAR 556-208	Capacitor SM Electrolytic 10u Dia 5		1	C40
13	FAR 556-166	Capacitor SM Electrolytic 10u Dia 4		3	C41, C36, C37
14		Capacitor Ceramic 4p7 1206		2	C15, C16
15		Capacitor Ceramic 30pF 1206		2	C7, C8
16		Capacitor Ceramic 47pF 1206		2	C21, C28
17		Capacitor Ceramic 470pF NPO 1206		4	C25, C26, C29, C30
18		Capacitor Ceramic 680pF 1206		2	C44, C45
19		Capacitor Ceramic 0.01uF 1206		2	C22, C23
20		Capacitor Ceramic 0.1uF 1206		17	C1-C6, C9, C10, C20, C24, C27, C31, C32, C38, C39, C42, C43
21		Resistor 3K0 0.125W 2% 1206		2	R13, R14
22		Resistor 4K7 0.125W 2% 1206		2	R9, R10
23		Resistor 10K 0.125W 2% 1206		11	R1-R8, R11, R15, R16
24		Resistor 12K 0.125W 2% 1206			R12, R17
25	RS 180-7880	Inductor SM 10uH		1	L1
26		Crystal 14.592 MHz Parallel Fundamental		1	X1
27		Harwin pin 1mm		20	J1-10, IC9 O/P
28		IC socket 28 pin		1	IC4 position
29		PCB	96/014	1	

9.7 Declaration of conformity

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Name of Manufacturer: sbs
Address of Manufacturer: PO Box 100
HASTINGS
East Sussex
TN34 3ZS

Product: MPX5 BBC Stereo encoder, Rev 003

Declaration:

The product described above compiles with the requirements of the Low Voltage Directive (73/23/EEC) and the protection requirements of the EMC Directive (89/336/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Standards:

EN 60065:1993	Safety requirements for mains operated electronic and related apparatus for household and similar general use
EN 50081-1:1992	Electromagnetic compatibility - Generic emission standard Part 1, Residential, commercial and light industry
EN 50082-1:1992	Electromagnetic compatibility - Generic immunity standard Part 1, Residential, commercial and light industry