

V19.1.2

# SYNTOVOX 221

speech analyzer/synthesizer  

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electronic effects vocoder

## ALTERATIONS

ON THE LATEST SYNTOVOX 221 MODELS A SWITCH HAS BEEN ADDED TO THE VOICED/UNVOICED DETECTOR. IT PROVIDES INTERNAL INHIBIT SWITCHING FOR THE DETECTOR AND PRIORITY TO VOICED SIGNALS. EVEN WHEN UNVOICED SIGNALS ARE APPLIED TO THE VOCODER THE DETECTOR WILL TRIGGER VOICED SYNTHESIS ACTION. THE SWITCH IS LOCATED UNDER THE AMBER VOICED LED.

BEFORE SWITCHING ON CHECK MAINS REQUIREMENTS! AT RIGHT HAND SIDE OF BACK PANEL SLOT HAS BEEN PROVIDED GIVING ACCESS TO MAINS SELECTOR SWITCH.

## SYNTOVOX 221 MANUAL

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*We reserve the right to change specifications without notice. Alterations will only be made in the interest of improving our products.*

## GENERAL DESCRIPTION

### ANALYZER

Syntovox 221 basically consists of a 20-channel audio analyzer, synthesizer, and a control system.

The analyzer section contains 20 specially designed filters, accurately tuned and trimmed for center frequency, bandwidth, gain and flatness. Center frequencies have approximately 1/4 octave spacing, the filter at the low end of the audio range being a low pass filter, and the filter at the high end being a high pass filter. Filters in between are bandpass filters. This design provides a precise analysis of the audio spectrum between approximately 30 Hz and 16 kHz. Within a dynamic range of 60 dB, frequencies in a complex audio signal can be detected and converted into control voltages, which are fed to a row of 20 LEDs, displaying the energy in each frequency band. The analyzer is located in the upper part of Syntovox 221, constructed on a separate printed circuit board.

The 20 control voltage outputs of the analyzer are directed to a 20x20 matrix system and to the multiway connector at the back panel of Syntovox 221. These outputs have a range of 0...5V and can be used to control external devices. For computer applications a 20 channel multiplexed AD converter should be used to be able to store audio analyses.

### SYNTHESIZER

The 20-channel synthesizer is also composed of one low pass and one high pass filter and 18 band pass filters, identical to the analyzer. The synthesis filter bank has one audio input and one audio output. Each of the 20 filters is followed by a modulator with a control voltage input whose sensitivity can be adjusted by means of the potentiometers in the bottom row of Syntovox 221. These attenuators are numbered 1...20 and are routed to the corresponding matrix columns and the control voltage inputs at the back panel multiway connector. The amount of control voltage fed to the synthesizer modulators can be monitored by means of the LEDs near the control knobs.

### MATRIX

The control connections between analyzer and synthesizer are made via the 20 x 20 matrix system. Any control voltage output can be patched to any control voltage input. Timbre can be changed easily by shifting all analysis information up or down the synthesis filter bank.

In the normal mode all analyzer control outputs are connected to corresponding synthesizer control inputs with the matrix pins in the diagonal position from the upper left corner to the bottom right corner.

A signal applied to the audio input of the synthesizer will be shaped according to the signal which is being examined in the analyzer section.

*It is very important to understand that in this respect the vocoder acts as a modulator which imposes the characteristics of one audio signal upon another audio signal. So, if speech is applied to the analyzer input, the intelligibility characteristics are imposed upon any other signal, fed into the synthesizer, provided that signal does contain a reasonable amount of harmonics - it will not work on a sine wave!*

#### CONTROL SYSTEM

Since speech is a composite of voiced sounds (A,E,I,O,U, etc.), and unvoiced sounds (sibilants, K,P,T, etc.), a detection system to discriminate these phenomena is necessary. When Syntovox 221 is used for speech synthesis this voiced/unvoiced detector feeds noise to the synthesis filter bank when a sibilant is detected, and simultaneously the replacement sound at the synthesizer input is cut off.

Voiced and unvoiced decisions can be used for triggering external devices, and it is also possible to control the operation of the voiced/unvoiced detector externally. In that case the INHIBIT control should be used to block the internal circuit which normally drives the detector. Control inputs and outputs are available at the multiway connector at the back panel.

#### INTERNAL PULSE GENERATOR

Syntovox 221 is equipped with a pulse generator for simple but effective speech synthesis. This pulse generator is voltage controlled and can be modulated externally, or with the built-in low frequency control oscillator and random generator.

The low frequency control oscillator can be used to introduce a vibrato whose speed and depth can be controlled.

The random generator has two outputs to control the pulse frequency. One of the outputs generates a steplike change of frequency each time a short interval in the speech signal is detected; (STEP). A very low frequency random signal is available to create a continuously changing pitch; (VLF).

#### EXTERNAL SOUND SOURCES

External sound sources can be modulated by the analyzer input signal as well. Both UNVOICED and VOICED paths in Syntovox 221 have a separate input (B and C respectively) for applying sound material to the synthesis filter bank, other than the internally generated pulse and noise.

## FILL-IN CONTROL

The FILL-IN control was designed for special speech synthesis purposes. When a replacement sound is to be modulated with speech, for instance, a signal only will appear at the output of Syntovox 221 when there is information from the analysis filter bank. The FILL-IN control is meant to fill the gaps between spoken words by automatically fading-in the replacement sound, so that the origin and character of the replacement sound will not be obscured. Immediately this replacement sound will be faded out when speech is applied to the analyzer. The amount of FILL-IN can be controlled with a potentiometer.

## CLEANFEED

Next to the analyzer input attenuator two controls labelled SYNTH and CLEANFEED are situated. The CLEANFEED control is a direct feed from (speech) input to output, and the SYNTH control feeds the input signal directly to the synthesis filter bank. This facility offers very interesting possibilities when instead of speech the signal of a music synthesizer is processed via the analyzer input. By exclusively feeding noise to both voiced and unvoiced sections, the sound of the music synthesizer will be enriched with additional harmonics, selectively filtered out of pink noise.

## APPLICATIONS

*Analyzing speech;*  
*Synthesizing speech;*  
*Phonetic research;*  
*Formant shifting;*  
*Imposing speech upon sounds of mechanical devices, wind, sea, cries of animals, etc.;*  
*Imposing speech upon sounds of musical instruments, choirs, orchestras etc.;*  
*Imposing speech upon other human voices;*  
*Alternating timbre of instruments;*  
*Imposing characteristics of one instrument upon another one;*  
*Adding harmonic and non-harmonic overtones to instruments;*  
*Generating speech (computer interface optional);*  
*Spoken instructions to computers (interface optional);*  
*Controlling synthesizers and other voltage controlled units.*

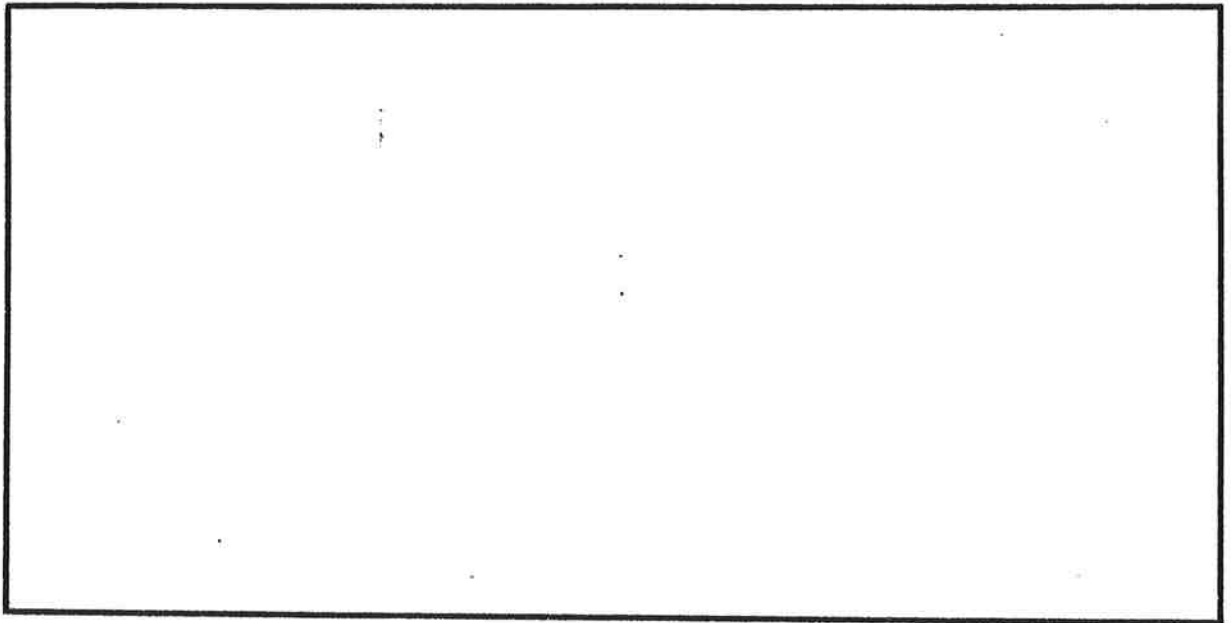
## CHECK LIST

*After unpacking and before plugging in Syntovox 221 it is useful to check the contents of the accompanying small box which should contain following items:*

- 1 mains chord
- 1 spare fuse, 1A/slow blow
- 1 56-way multiconnector
- 22 matrix programming pins (2 spare pins)
  
- 4 self adhesive plastic feet (for free-standing use of unit)

*It is advised to follow carefully the instructions under FIRST TIME OPERATION in this manual.*

WARRANTY



*This warranty covers parts and labour for 1 year from date of purchase.  
Claims will be rejected when the unit has been misused, misadjusted, modified or repaired by unauthorised personnel. Not covered by the warranty are mechanical parts (switches, connectors, potentiometers) and LEDs.  
Carriage to and from Synton Electronics B.V. is to be paid by the owner.  
This warranty is valid only to the original purchaser and is not transferable.*

## FIRST TIME OPERATION

### 1. DO NOT ALTER CONTROL SETTINGS!

*They have been factory-set for a quick step by step starting sequence. The small knobs in the bottom row should be at maximum, all other knobs (P1-P16) at zero.*

*Numbers of control potentiometers refer to block diagram D4.M8.*

- ### 2. CHECK MAINS SUPPLY (220 VAC $\pm$ 10% -50/60Hz) AND SWITCH ON.
- ### 3. CONNECT THE OUTPUT OF SYNTVOX 221 TO A POWER AMPLIFIER, AND CONNECT A LOW IMPEDANCE (50...600 OHMS) MICROPHONE TO MIC INP (A)

*For wiring connections see page M10.*

- ### 4. PLUG IN 20 MATRIX PINS, DIAGONALLY FROM UPPER LEFT CORNER TO LOWER RIGHT CORNER.

*190 Hz is now connected to channel 1, 230 Hz to channel 2, etc. SEE PAGES M11-13 FOR CORRECT USE OF MATRIX.*

- ### 5. TURN UP CONTROL P1 (ANALYZER).

*The VOICED/UNVOICED detector can be checked by saying slowly "SYNTVOX" into the microphone. The "S", "T", and "X" will cause the amber LED under UNVOICED to light up, and the other sounds will trigger the VOICED LED.*

*When the red LED next to the ANALYZER control P1 lights up, reduce gain.*

- ### 6. TURN UP CONTROLS P16 (O/P LEVEL) AND P3 (CLEANFEED).

*Be careful: acoustic feedback may occur! Check if microphone signal comes through. If not, check again for right connections (M10) and/or control settings.*

- ### 7. SET P3 (CLEANFEED) BACK TO ZERO AND TURN UP CONTROL P7 (VCO) TO APPROX. 3/4 OF SCALE. DO THE SAME WITH CONTROL P14 (SYNTHESIS). TURN UP SLOWLY P9 (PRESET) AND KEEP TURNING WHILE TALKING INTO THE MICROPHONE.

*You will hear your synthesized voice raise in pitch while turning the VCO PRESET control. At higher frequencies intelligibility deteriorates, due to the fact that most of the analyzer information will be in a lower spectrum than the synthesized pitch.*

**IF YOU LISTEN CAREFULLY YOU WILL NOTICE THE LACK OF SIBILANTS IN YOUR SYNTHESIZED SPEECH:**



8. TURN UP CONTROL P5 (NOISE) IN SECTION UNVOICED.

*Now all esses and other unvoiced sounds will appear. Notice how intelligibility improves!*

9. SET CONTROL P7 (VCO) TO ZERO, AND TURN UP CONTROL P8 (NOISE).

*Now your voice will be synthesized merely from noise. Whispering into the microphone will be synthesized very accurately by SYNTOVOX 221.*

10. A QUICK LED DISPLAY CHECK CAN BE DONE BY MAKING HISSING SOUNDS OF DIFFERENT "COLOURS".

*You will observe that the LEDs display the changing of peaks in the spectrum at the high end of the audio range.*

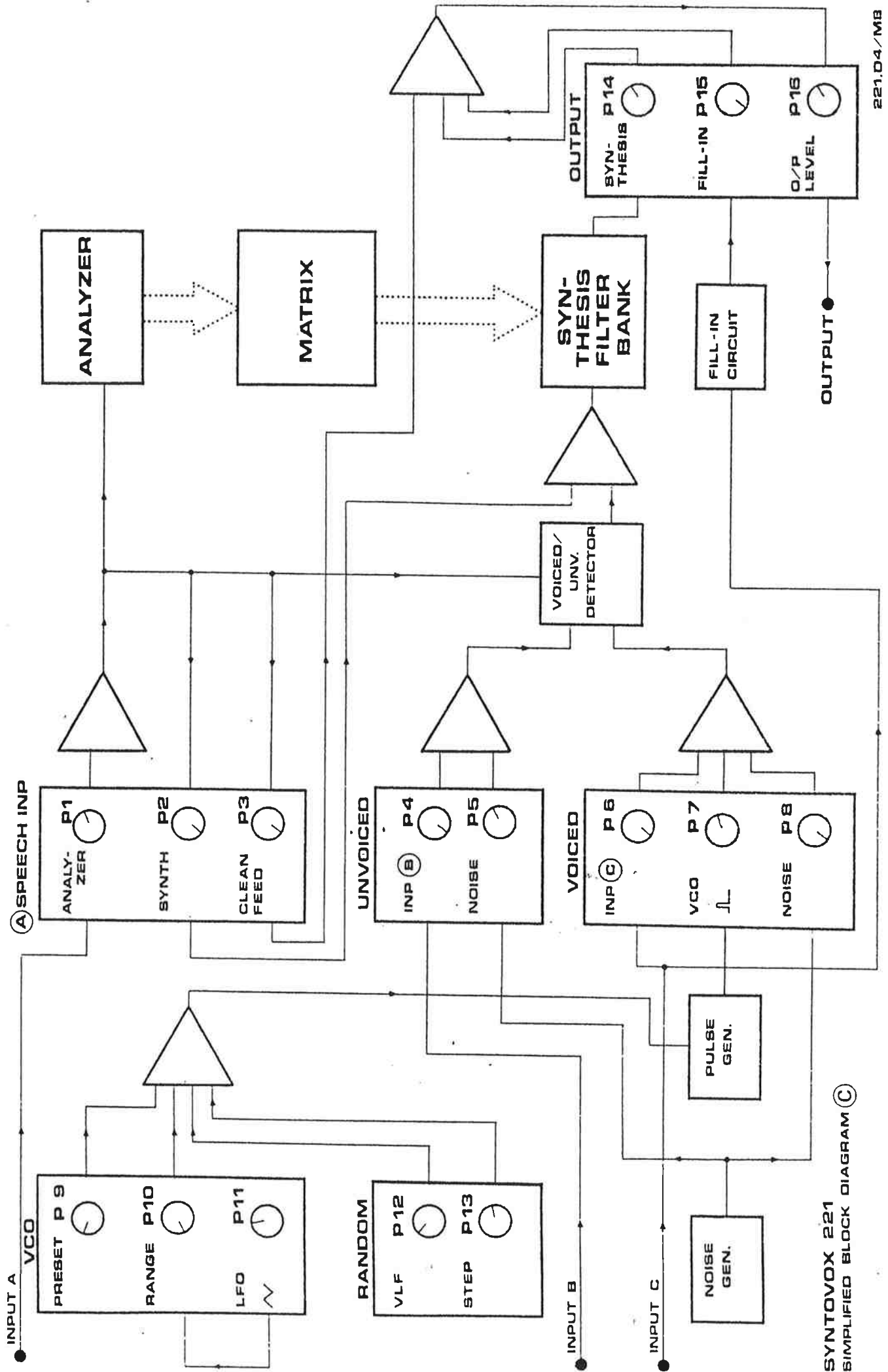
*Voiced sounds of different pitch will cause the LEDs in the lower end of the audio range to light up. Also you will notice that specific LEDs light up with specific voiced sounds.*

*Try A, E, I, O, U etc.*

This concludes a first try out of the unit. It is important to have the block diagram at hand when working with SYNTOVOX 221, since it illustrates clearly all control functions.

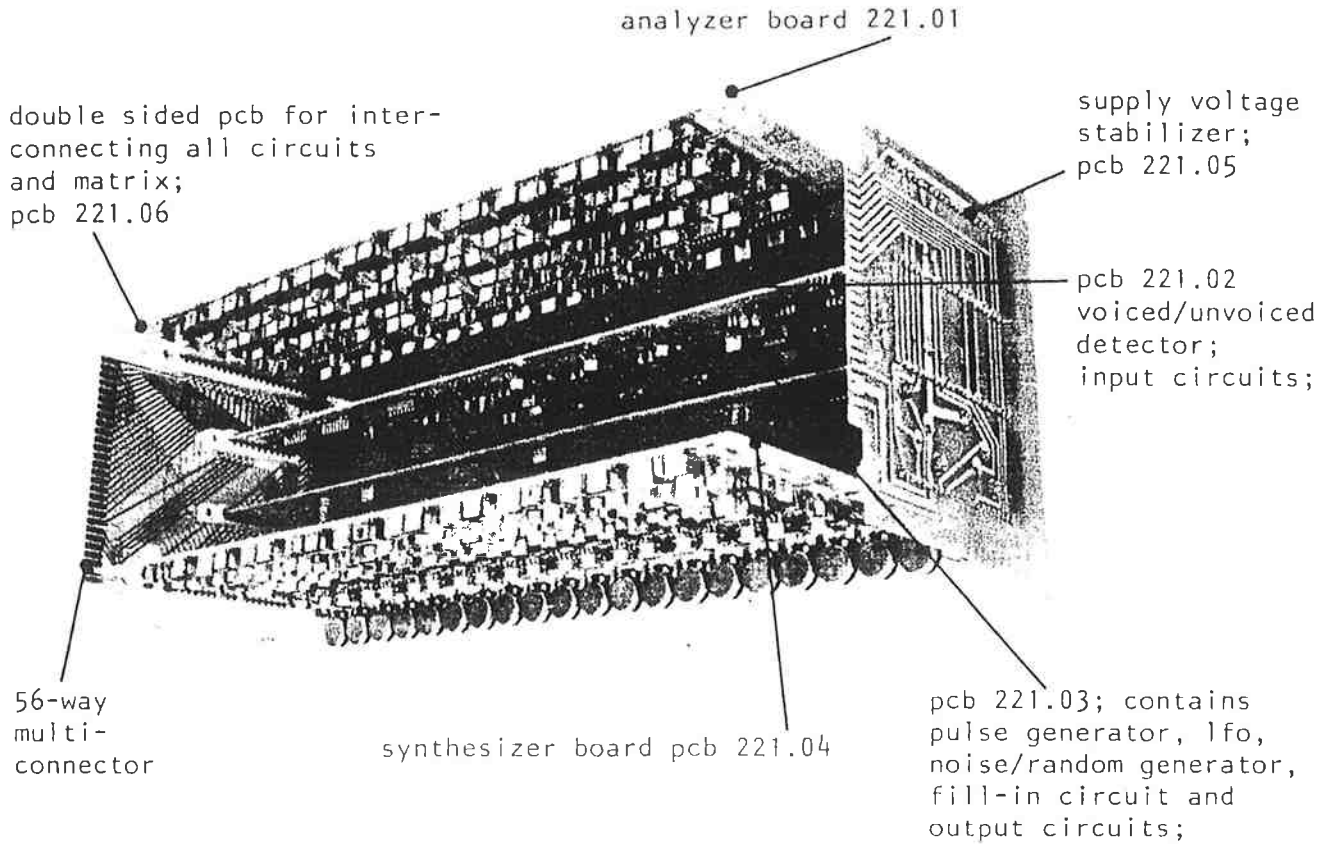
For more information about operating the matrix of SYNTOVOX 221, read section EXAMPLES (M11-13)

**NB: SINCE THE SYNTHESIS FILTER BANK OUTPUT (P14) AND THE FILL-IN CONTROL (P15) ARE FED TO THE OUTPUT MIXER OF WHICH P16 IS THE MASTER CONTROL, IT IS ESSENTIAL THAT THIS CONTROL IS OPENED ALL THE TIME, WHEN THE UNIT IS IN OPERATION.**



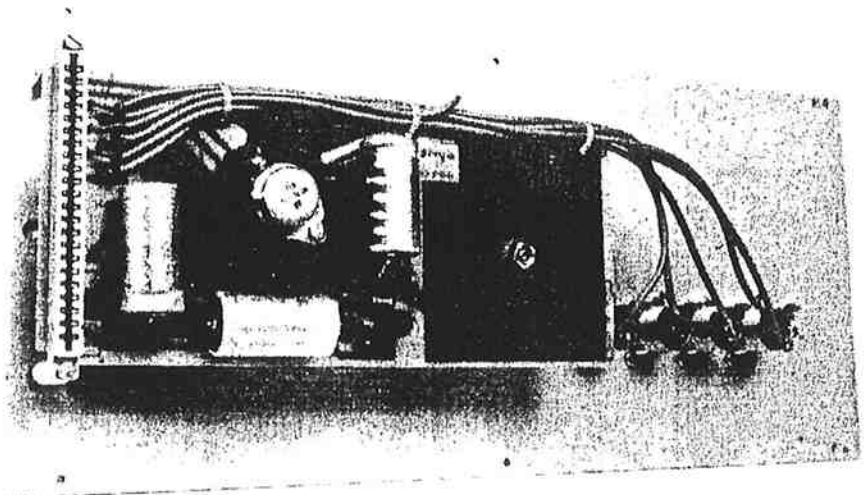
SYNTOVOX 221  
SIMPLIFIED BLOCK DIAGRAM (C)

MECHANICAL CONSTRUCTION



back panel with pcb 221.08  
power supply and LED stabilizer;  
connector fits to pcb 221.05;

except for screened leads to input and output XLRs; no wiring involved!



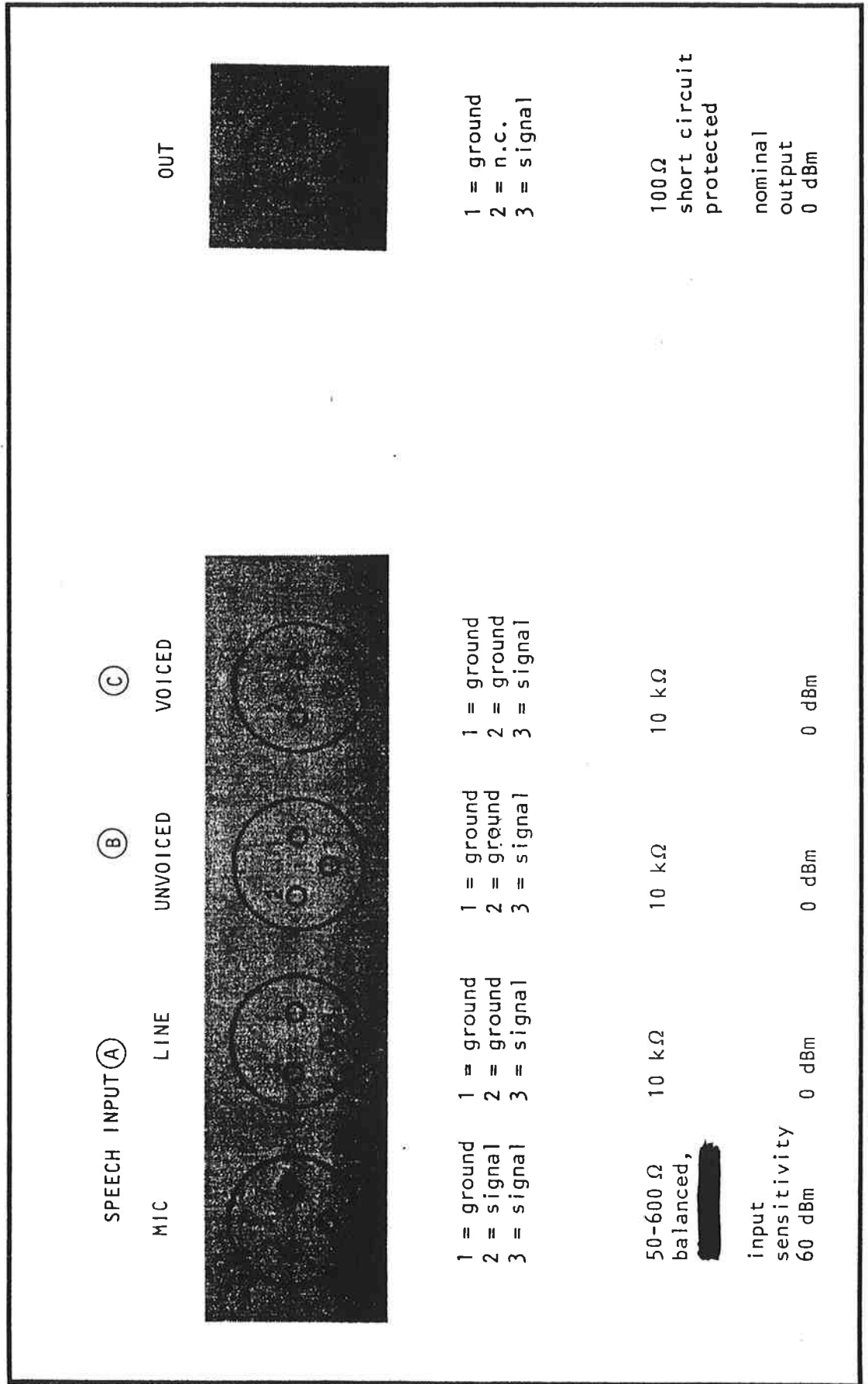
56-way multi-connector



back panel with inputs and output XLRs;  
mains connector, fuse and mains switch;

pcb 221.06 for multiway connector

XLR WIRING CONNECTIONS

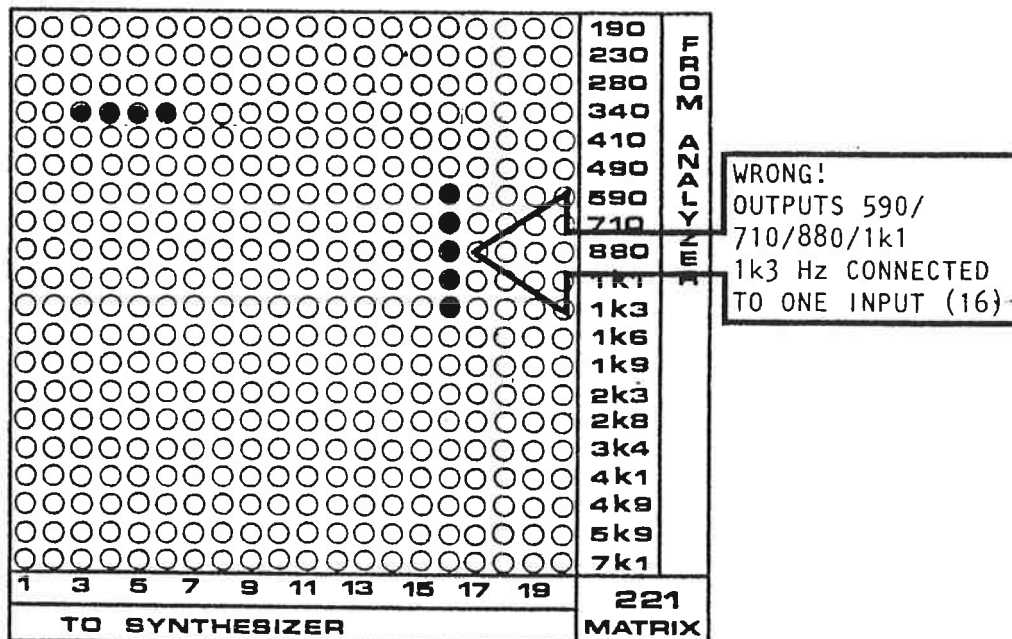


## EXAMPLES/MATRIX OPERATION

In this section only a few of the numerous possibilities of programming the matrix can be given. The small knobs in the bottom row, numbered 1...20 are also important in all applications, since they can attenuate the control voltages fed to the synthesizer inputs. Changing these control voltages has the effect of processing the sound through a channel equalizer, which can be used very effectively in almost all applications.

The first example given below states the right and the wrong way to use the matrix. PINS SHOULD NEVER BE PUT INTO THE SAME VERTICAL COLUMN. THIS WILL CONNECT OUTPUTS OF THE ANALYZER TO ONE POINT. Nothing will be damaged, but it is totally impractical and it may cause unwanted side effects.

OUTPUT 340 Hz IS  
CONNECTED TO INPUTS  
3/4/5/6. SOMETIMES  
IT CAN BE USEFUL TO  
CONNECT MORE INPUTS  
TO ONE OUTPUT.





|                          |     |        |
|--------------------------|-----|--------|
|                          | 180 |        |
|                          | 230 |        |
|                          | 280 |        |
|                          | 340 |        |
|                          | 410 |        |
|                          | 490 |        |
|                          | 590 |        |
|                          | 710 |        |
|                          | 880 |        |
|                          | 1k1 |        |
|                          | 1k3 |        |
|                          | 1k6 |        |
|                          | 1k9 |        |
|                          | 2k3 |        |
|                          | 2k8 |        |
|                          | 3k4 |        |
|                          | 4k1 |        |
|                          | 4k9 |        |
|                          | 5k9 |        |
|                          | 7k1 |        |
| 1 3 5 7 9 11 13 15 17 19 |     | 221    |
| TO SYNTHESIZER           |     | MATRIX |

EX.NR 3

"Inverse mode" patch;  
 this is not very  
 practicable for speech  
 synthesis purposes, since  
 the effect will be almost  
 unintelligible.  
 However, it can make  
 very interesting effects  
 on musical instruments.

- D. INPUT-A LINE, P1, P2,  
 P14, P16, and if wanted  
 P8.

|                          |     |        |
|--------------------------|-----|--------|
| ●                        | 190 |        |
| ●                        | 230 |        |
| ●                        | 280 |        |
|                          | 340 |        |
|                          | 410 |        |
|                          | 490 |        |
|                          | 590 |        |
|                          | 710 |        |
|                          | 880 |        |
|                          | 1k1 |        |
|                          | 1k3 |        |
|                          | 1k6 |        |
|                          | 1k9 |        |
|                          | 2k3 |        |
|                          | 2k8 |        |
|                          | 3k4 |        |
|                          | 4k1 |        |
|                          | 4k9 |        |
|                          | 5k9 |        |
|                          | 7k1 |        |
| 1 3 5 7 9 11 13 15 17 19 |     | 221    |
| TO SYNTHESIZER           |     | MATRIX |

EX.NR 4

This patch is for partly  
 inverting formant areas.  
 340 and 490 Hz inverted,  
 880 and 1k3 Hz inverted,  
 2k3 and 2k8 Hz inverted.

MIC INPUT A; P1, P5, P7,  
 (P12/13) P14, P16.

USE OF INPUTS B and C

These inputs are used when the internal pulse generator and the other modulation generators are not used.

Input B can be used for applying replacement sounds for the unvoiced section, (Wind, sea, murmuring sounds, mechanical sounds etc.) and input C for replacement sounds of the voiced section.

When imposing speech upon these replacement sounds the FILL-IN control P15 can be useful to improve continuity of the sound effect.



# TECHNICAL DATA

## ANALYZER SECTION

|                                       |               |
|---------------------------------------|---------------|
| 20 CHANNELS                           |               |
| 18 band pass filters                  | 54 dB/octave  |
| 1 low pass filter                     | 54 dB/octave  |
| 1 high pass filter                    | 54 dB/octave  |
| 20 envelope followers                 |               |
| 20 low pass filters                   | 18 dB/octave  |
| Dynamic range                         | 60 dB typical |
| Control voltage outputs               | 0 ... +5 V    |
| 20 LEDS (real time analysis read-out) |               |

## SYNTHESIZER SECTION

|   |                    |
|---|--------------------|
| 20 CHANNELS                             |                    |
| 18 band pass filters                    | 54 dB/octave       |
| 1 low pass filter                       | 54 dB/octave       |
| 1 high pass filter                      | 54 dB/octave       |
| 20 voltage controlled amplifiers        |                    |
| VCA dynamic range                       | 58 dB              |
| Filter signal to noise ratio            | 74 dB typical      |
| VOICED replacement signal break-through | -70 dB typical     |
| SPEECH signal break-through             | -68 dB typical     |
| Control voltage inputs                  | 0 ... +5 V         |
| 20 control voltage attenuators          | 10 kOhms impedance |
| 20 LEDS on control voltage inputs       |                    |

## MATRIX SECTION

20 x 20 matrix; 3 mm pitch  
20 programming pins

## SPEECH INPUT (A)

|                                    |                    |
|------------------------------------|--------------------|
| Mic input                          | 600 Ohms, balanced |
| Line input                         | 10 kOhms, unbal.   |
| LED overload indicator             |                    |
| SPEECH to SYNTHESIS control        |                    |
| SPEECH to OUTPUT cleanfeed control |                    |

## VOICED INPUT (C)

|                        |                  |
|------------------------|------------------|
| Line input             | 10 kOhms, unbal. |
| LED overload indicator |                  |

## UNVOICED INPUT (B)

|                        |                  |
|------------------------|------------------|
| Line input             | 10 kOhms, unbal. |
| LED overload indicator |                  |

## INTERNAL CONTROL SOURCES

|   |                        |
|---|------------------------|
| Voltage controlled pulse generator (VCO)            | 16 ... 500 Hz preset   |
| VCO - total range                                   | 16 ... 16 kHz          |
| Low frequency control oscillator                    | 0.05 ... 10 Hz typical |
| Pink noise generator                                |                        |
| Random VLF generator                                |                        |
| Random step generator                               |                        |
| VOICED/UNVOICED detector with LED status indicators |                        |
| Fill-in control                                     |                        |

## BACK PANEL

|  |                            |
|--|----------------------------|
| 56-way multiconnector for external control applications (computer interface) |                            |
| 20 analyzer control voltage outputs  |                            |
| 20 synthesizer control voltage inputs  |                            |
| VOICED/UNVOICED control inputs/outputs                                       | 5V logic                   |
| INHIBIT control  | 5V logic                   |
| VCO control input  | 1V/octave; 0...10V         |
| All inputs and outputs fully protected                                       |                            |
| Cannon/XLR connectors on inputs and output                                   |                            |
| Mains connector, mains switch and fuse                                       | 1A (slow)                  |
| Power requirements   | 220 VAC $\pm$ 10% 50/60 Hz |
| Dimensions   | 483 x 178 x 184 mm         |
| Weight   | 6.5 kg                     |

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE