SOUND IN SYNCS AUDIO EXPANDER CONTROL UNIT UN3/27

Introduction

The UN3/27 forms part of the audio expander system of a sound-in-syncs decoder [1] and is used in conjunction with an Audio Expander Unit AM1/38.

The UN3/27 accepts a 15·625-kHz pilot-tone signal and from this derives a d.c. control voltage which is fed to variable-gain elements in the associated expander unit. Additionally, the unit contains muting and pilot-tone detector circuits which form part of the sound-in-syncs internal monitoring system.

The UN3/27 is constructed on a CH1/12A chassis with index-pin positions 30 and 38. Power supplies at +24V, +12V and −12V are required.

General Specification

Inputs

Pilot Tone	15·625-kHz sine waveform at −36 dB w.r.t. 1 mW
Mute	normally logic level 0

Outputs

Control Voltage	normally within the range 0V to +4V
Pilot Tone Alarm	normally logic level 1, changing to 0 if control voltage exceeds +4V or falls below −1·2V.

Impedances

Pilot Tone Input	600 ohms unbalanced
Control Voltage Output	high w.r.t. 600 ohms

Power Consumption	65 mA at +24V, 12 mA at +12V, 12 mA at −12V.
Logic Levels (TTL)	logic level 1, about +3·5V (+5V max). logic level 0, about 0V (+0·4V max.)

General Description

A simplified block diagram of the UN3/27 is given in Fig. 1. The input amplifier increases the level of the pilot-tone input and the amplified signal is fed to a variable-gain element in the associated AM1/38 unit. Without modulation, the signal fed back to the UN3/27 from the AM1/38 is reduced in level by about 20 dB. Further amplification is provided by a second (post AM1/38) amplifier and the signal is then rectified to produce a d.c. potential which carries a 31·25-kHz ripple. This signal is applied to a comparator where it is compared with a reference potential. The comparator output is a rectangular waveform with a frequency of 31·25 kHz and a mark/space ratio which is proportional to the difference between the reference potential and the rectified signal. This output is integrated to provide a d.c. control potential which is fed to a variable-gain stage in the AM1/38. Thus a closed-loop servo system is formed between the UN3/27 and its associated AM1/38 unit, with the necessary gain being provided by IC1. The servo loop holds the signal applied to the rectifier stage at a constant level by varying the control voltage as required. The mute-detector circuitry

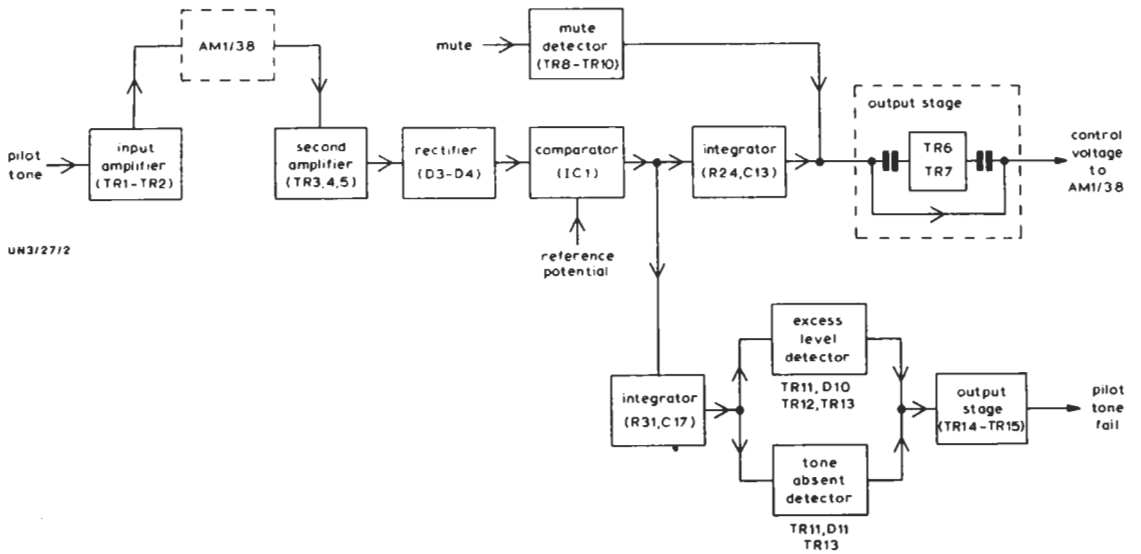

Fig. 1 Simplified Block Diagram of the UN3/27

enables the control voltage to be held at OV (minimum gain condition) for the duration of a *Mute* fault.

The pilot-tone detector examines the pilot-tone level to confirm that it is within the specified limits; in doing this the detector checks almost the whole of the sound-in-syncs audio chain both in the decoder and in the coder.

Circuit Description

A circuit diagram of the UN3/27 is given in Fig. 2.

Input Amplifier

Transistors TR1 and TR2 form a feedback amplifier with a gain, determined by R6 and R5, which is nominally 33 dB. However, when allowance is made for the attenuator formed by R1 and R2, and when the amplifier is feeding the load provided by an AM1/38, the nett gain between PLA 6 and PLA4 is 14·5 dB.

Second (Post AM1/38) Amplifier

The signal returned to the UN3/27 from the AM1/38 is attenuated, without modulation, by about 20 dB. The second amplifier consists of transistors TR3 to TR5 and its gain can be varied, by means of R14, between 41 dB and 56 dB. For normal operating conditions R14 is set for a gain of 49 dB; this corresponds to a signal level of 8·2V p-p at the emitter of TR5.

Rectifier and Comparator

The output of TR5 is fed to a full-wave rectifier circuit; the rectified signal has a mean amplitude of +1·4 volts and consists of d.c. plus 0·5 volts p-p of 31·25-kHz ripple. This signal is fed to pin 2 of comparator stage IC1; a reference potential of +1·45 volts is fed to pin 3 of the comparator. Zener diode D5 prevents the comparator being overloaded during fault conditions and during the initial switching-on period.

The output of the comparator is a rectangular waveform with a nominal mark/space ratio of 1:1 and a p-p amplitude of 22V. This rectangular waveform is integrated by R24 and C13, and the d.c. signal thus produced is fed to the control voltage output of the unit by two paths; directly via R32, and via inverter TR6 and emitter-follower TR7. Because of the inversion provided by TR6 the two signals present at the control voltage output are in antiphase; therefore any ripple components in the signal cancel.

Under quiescent conditions the control voltage output has an amplitude of +200 mV. However, when modulation is applied to the system, the pilot tone is compressed by the action of the limiter (AM6/9) in the coder and the compression variations alter the mark/space ratio of the comparator output; thus the control voltage varies with the compression and the servo loop formed in conjunction with the associated AM1/38 unit maintains a constant level of pilot tone at the emiter of TR5.

In the AM1/38 unit the control voltage is applied also to a variable-gain element which carries the audio signal; it thus provides a means of expanding the audio signal to its original dynamic range.

Muting

Under normal conditions a logic 0 is applied to the *Mute* input at PLA 13. Thereupon transistors TR8 and TR9 both conduct and field-effect transistor TR10 is out off. When a muting (logic 1) signal is applied to the circuit, transistors TR8 and TR9 are cut off and TR10 conducts with the result that the control voltage is effectively short-circuited via the low drain-source resistance of TR10.

When the muting signal has been removed the rectifier and comparator takes a short time (about 5 ms) to return to normal. Because of this TR10 is turned off slowly by the discharge of C21 through R38. The components R39, R40 and D9 safeguard TR10 by preventing the control voltage from exceeding +7V.

Pilot Tone Detector

The presence of pilot tone in the decoder confirms that a large part of the sound-in-syncs system is operating correctly. The main fault possibilities involving pilot tone are:

(a) pilot tone absent
(b) pilot tone at maximum output level from the Digital-to-analogue Converter

The normal operating range for the control voltage is between +200 mV and +4V; any permanent positive excursion which exceeds +4V is caused by fault condition (a).

It is not desirable to operate the decoder expander with a negative control voltage and so the detector provides an alarm when the control voltage becomes more negative than 0·5V to 1·0V. This alarm indicates:

incorrect setting of R14,
a fault in the coder,
fault condition (b).

The operation of the circuit is described below for three conditions: (i) normal operation, (ii) fault condition (a), (iii) fault condition (b).

(i) Normal Operation A signal from IC1 is integrated by R31 and C17 and applied to TR11. The signal developed at the emitter of TR11 is applied, via zener diode D10, to TR12 which conducts. Diodes D11 and D12 are reverse-biased and so transistors TR13 and TR14 are cut off. With TR14 cut off, the base-bias of TR15 is set by the potential divider R50 – R51 to about 5·5V; hence the Pilot Tone Alarm output on PLA 12 is at logic 1.

(ii) Fault (a) When an excessively high level of control voltage is applied to TR11, TR12 is cut off and transistors TR13 and TR14 conduct. Therefore TR15 is cut off and the output level falls to logic 0. Diode D13 prevents the potential at the base of TR15 from going more negative than –0·6V.

(iii) Fault (b) When the control voltage goes negative, transistor TR13 conducts via diode D11 and, as detailed in (ii) above, the output level falls to logic 0.

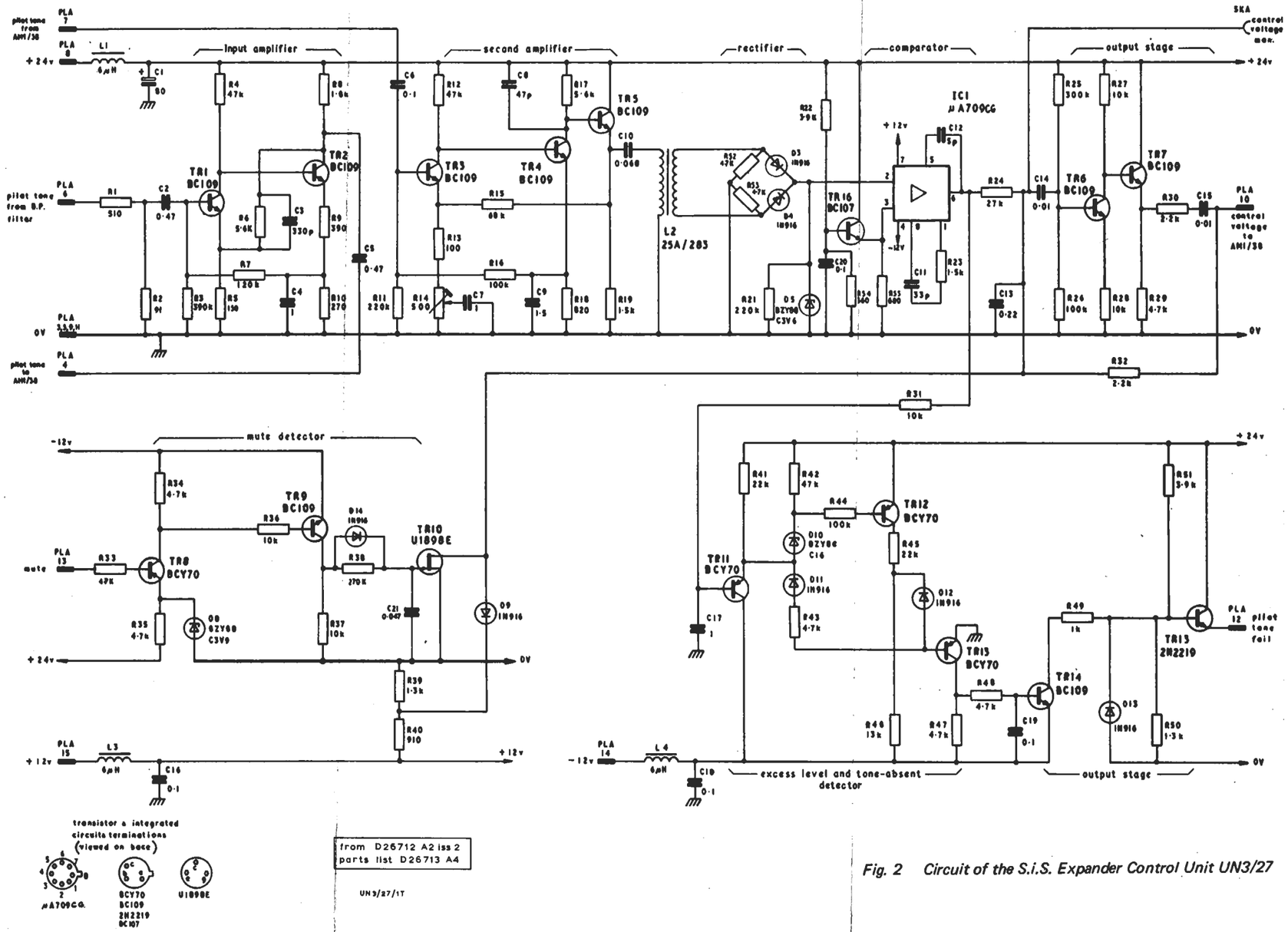

Fig. 2 Circuit of the S.i.S. Expander Control Unit UN3/27

Maintenance

To check the unit, insert it into a decoder in which the associated units are known to function correctly.

Correct operation of the constituent parts of the circuit can be confirmed by reference to the following typical signal levels, measured without modulation.

PLA 6	15·625-kHz sine wave at 57 mV p-p
PLA 4	15·625-kHz wave at 300 mV p-p
PLA 7	15·625-kHz sine wave at 30 mV p-p
TR5 emitter	15·625-kHz sine wave at 8·2V p-p
D5 cathode	+1·4V d.c. (mean value) with about 0·5V p-p of 31·25-kHz ripple
IC1 pin 3	+1·45V d.c.
IC1 pin 6	22V p-p square wave at 31·25 kHz
C13	+200 mV d.c. with about 40 mV p-p of 31·25-kHz ripple.
PLA 10	+200 mV d.c. with about 50 mV of superimposed l.f. noise.

To check the *Mute* facility, remove the UN23/531 Sample and Hold Unit. This action should reduce the control voltage output to 0V and should also operate the pilot tone alarm.

Maladjustment of R14 will provide a negative control voltage which can be used to check the pilot tone alarm circuit for the other fault condition.

Alignment

See parent unit [1].

References to Typical Associated Equipment

1. Sound-in-syncs Decoder CD3M/504.

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