3.12 NATIONAL LM1131

3.12.1 General

The National LM1131 is a two-channel device, each channel of which can be switched independently to either encode or decode mode. Dolby Level is 580 mV at the test point and at the output terminals, with a corresponding input sensitivity of about 60 mV. There is no provision for driving a multiplex or low-pass filter, which must be supplied externally. However, in some applications the filter will be already provided in the rest of the unit, as for example in the stereo decoder of an FM tuner.

The close matching between the two processors in each IC may be usefully exploited in three-head cassette recorders, where one package may be used to provide the record and playback processors of one channel with reduced errors in back-to-back (encode-decode) frequency response.

The LM1131 is available in three tolerance selections (see data sheet).

3.12.2 Class of integrated circuit processor

The following classes of processor may be built using the National LM1131 integrated circuit.

Class I Switchable processor with multiplex filter, circuit A2B2635 page 3.12.9. For use in cassette recorders and certain integrated products where a processor is required to operate either in the encode or the decode mode.

Class II Encode processor with multiplex filter, circuit A2B2636, page 3.12.10. For use in tape decks (normally three-head cassette recorders) in which a processor is required to operate only in the encode mode.

Class III Decode processor with recording bias filter, circuit A2B2637 page 3.12.11. For use in tape decks (normally three-head cassette recorders) in which a processor is required to operate only in the decode mode but whose input signal may contain recording bias. If the bias signal has already been filtered out, a Class V processor may suffice in this application (see Engineering Field Bulletin 38 in section 8).

Class IV Decode processor with multiplex filter, circuit A2B2638 on page 3.12.12. For use in products where the decoder receives an FM stereo signal containing multiplex pilot tone, e.g. in FM tuners. If the pilot tone has previously been filtered out, a Class V decoder will suffice in this application.

Class V Decode processor without filter, circuit A2B2639, page 3.12.13. For use in products where there is no danger of spurious high-frequency signals interfering with the processing, e.g. in playback-only tape decks.

All processors require level matching to the equipment in which they are used (see details in sections 4 to 6). No further adjustment is

3.12.3 Power Supply

The National LM1131 integrated circuit processor will operate on supplies in the range of 6.5 to 20 volts, with an overload margin of 10 dB at the lowest voltage increasing to more than 20 dB with a 20 V supply. The current consumption of the package is about 19 mA with a supply of 12 volts, and varies slightly with changing supply and signal levels. For this reason, it is important to design a supply to accept these changes without any rapid changes in voltage which will appear as clicks in the audio output. A regulated supply is therefore recommended.

Either single-ended or bi-polar supplies can be used. The diagrams on pages 3.12.9 to 3.12.13 show bi-polar supplies, but give information to convert to single-ended supplies (see also manufacturer's data sheet on page 3.12.6).

3.12.3 Input Termination

The input impedance on pin 7 (and 14) of the LM1131 is typically 65 Kohm; if a multiplex filter is used before this stage, an external resistor (showns as R201 on the circuit diagrams, and R_S on the data sheets) can be added as the termination. The value of this resistor will depend on the filter used, and the manufacturer's recommendations should be followed.

National Semiconductor

January 1982

LM1131A/LM1131B/LM1131C Dual Dolby B-Type Noise Reduction Processor Preliminary Data Sheet

General Description

The LM1131 is a monolithic integrated circuit specifically designed to realize the Dolby B-Type noise reduction system.

The circuit includes two completely separate noise reduction processors and will operate in both encode and decode modes. It is ideal for stereo applications in compact equipment or for applications in 3-head equipment where two processors with very closely matched internal gains are required.

Features

- Stereo Dolby noise reduction with one IC.
- Wide supply voltage range — 5 to 20V.
- Very high signal/noise ratio — 79dB encode, 90dB decode (CCIR/ARM).
- Very close gain matching for 3-head recorders.
- Close matching to standard Dolby characteristics.
- Very low temperature drift of Dolby characteristics.
- High signal handling capability — > 20dB (Vs = 20V).
- Full wave rectifier in both channels.
- Operates with both single and split supply voltages.
- Excellent transient response characteristics.
- Minimal input switch-on transients.
- Reduced number of external components per channel.
- Improved input protection.

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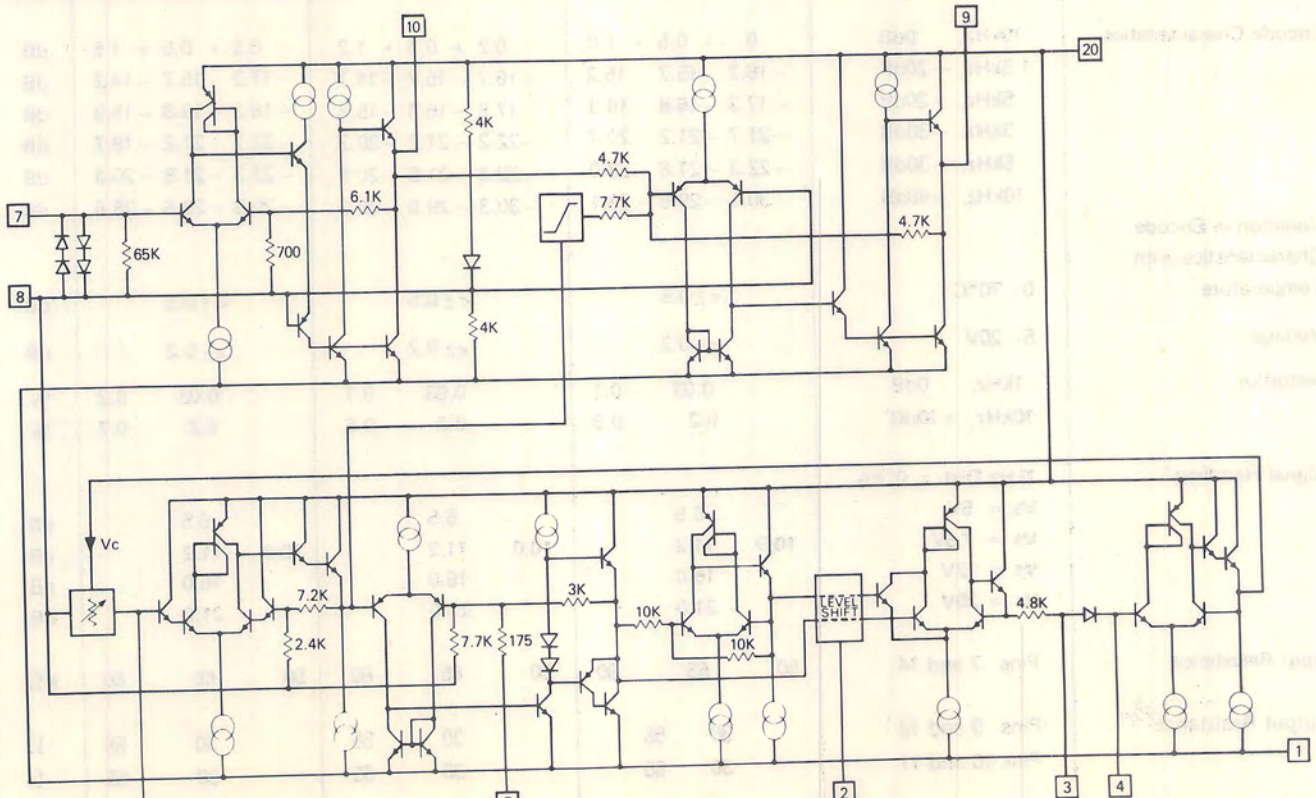
Schematic Diagram (1 Channel shown only)



Absolute Maximum Ratings

Supply Voltage	24V
Operating Temperature Range	−20° to +70°C
Storage Temperature Range	−65°C + 150°C
Lead Temperature (Soldering, 10 seconds)	300°C

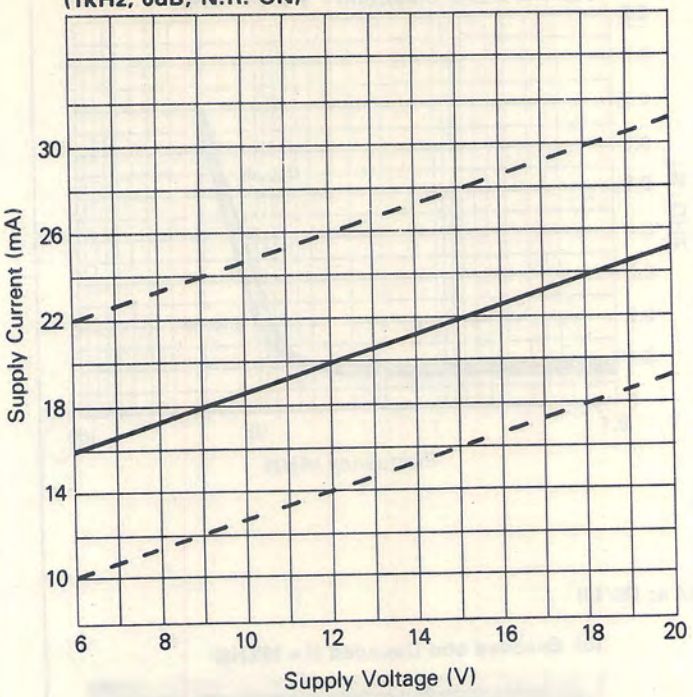
Electrical Characteristics (V_S = 12V, T_A = 25°C, unless otherwise specified)

N.B. 0dB refers to Dolby level and is 580mV measured at TP1 and TP2.

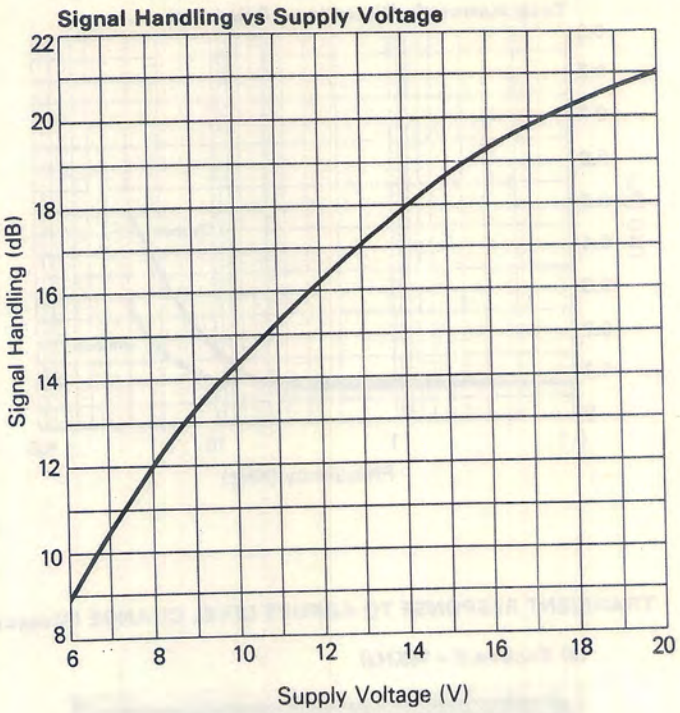
Parameter	Test Conditions	LM1131A			LM1131B			LM1131C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Operational Supply Voltage Range*		5		20	5		20	5		20	V
Supply Current			20			20			20		mA
Voltage Gain	1kHz Decode	19.2	19.7	20.2	18.7	19.7	20.7	18.2	19.7	21.2	dB
(Pins 7−10 and 14−11)	1kHz Decode	−0.5	0	+0.5	−0.5	0	+0.5	−1.0	0	+1.0	dB
(Pins 10− 9 and 11−12)											
Difference in Voltage Gain Between Channels	1kHz Noise Reduction OFF	−0.2	0	+0.2	−0.5	0	+0.5	−1.0	0	+1.0	dB
Crosstalk Between Channels	1kHz, 0dB	60	90		60	90		60	90		dB
Signal/Noise Ratio at Pins 9 and 12											
Encode	Rs = 10kΩ	77	79		75.5	79		74	79		dB
	Rs = 1kΩ		82			82			82		dB
Decode	Rs = 10kΩ		90			90			90		dB
	Rs = 1kΩ		92			92			92		dB
Encode Characteristics	10kHz, 0dB	0	+ 0.5	+ 1.0	− 0.2	+ 0.5	+ 1.2	− 0.5	+ 0.5	+ 1.5	dB
	1.3kHz, −20dB	−16.2	−15.7	−15.2	−16.7	−15.7	−14.7	−17.2	−15.7	−14.2	dB
	5kHz, −20dB	−17.3	−16.8	−16.3	−17.8	−16.8	−15.8	−18.3	−16.8	−15.3	dB
	3kHz, −30dB	−21.7	−21.2	−20.7	−22.2	−21.2	−20.2	−22.7	−21.2	−19.7	dB
	5kHz, −30dB	−22.3	−21.8	−23.0	−22.8	−21.8	−20.8	−23.3	−21.8	−20.3	dB
	10kHz, −40dB	−30.1	−29.6	−29.1	−30.3	−29.6	−28.9	−30.6	−29.6	−28.6	dB
Variation in Encode Characteristics with:-											
Temperature	0−70°C		<±0.5			<±0.5			<±0.5		dB
Voltage	5−20V		<±0.2			<±0.2			<±0.2		dB
Distortion	1kHz, 0dB		0.03	0.1		0.03	0.1		0.03	0.2	%
	10kHz, +10dB		0.2	0.3		0.2	0.5		0.2	0.7	%
Signal Handling*	1kHz Dist = 0.3%										
	Vs = 5V		6.5			6.5			6.5		dB
	Vs = 7.5V	10.0	11.2		10.0	11.2		10.0	11.2		dB
	Vs = 12V		16.0			16.0			16.0		dB
	Vs = 20V		21.0			21.0			21.0		dB
Input Resistance	Pins 7 and 14	50	65	80	50	65	80	50	65	80	kΩ
Output Resistance	Pins 9 and 12		30	55		30	55		30	55	Ω
	Pins 10 and 11		30	55		30	55		30	55	Ω

Typical Performance Characteristics

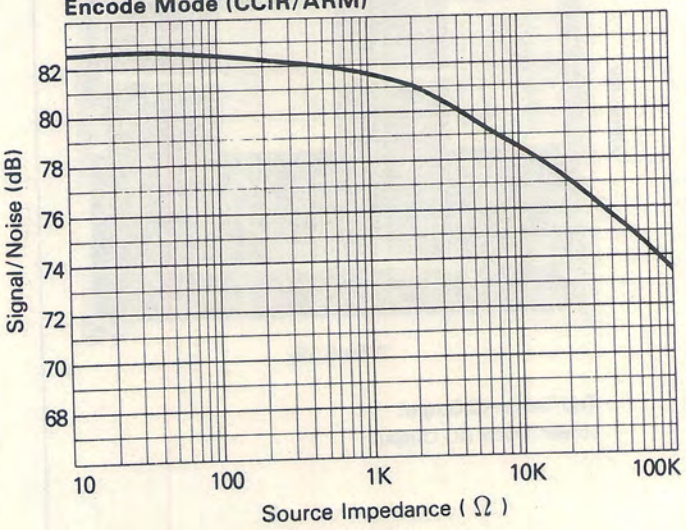
Supply Current vs Supply Voltage (1kHz, 0dB; N.R. ON)



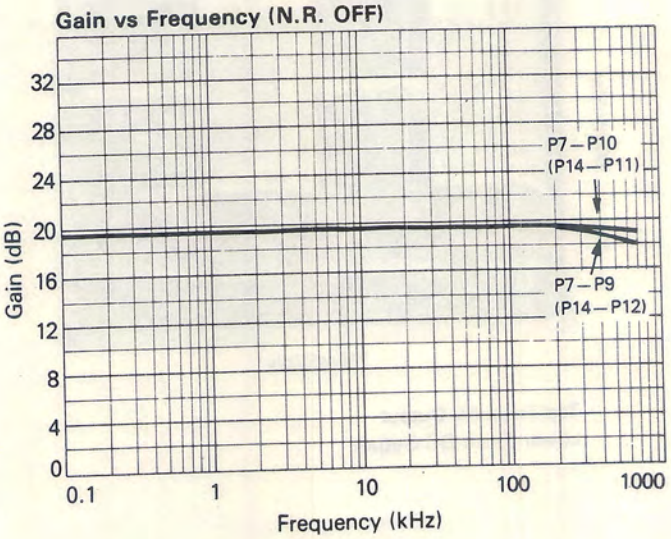
Signal Handling vs Supply Voltage



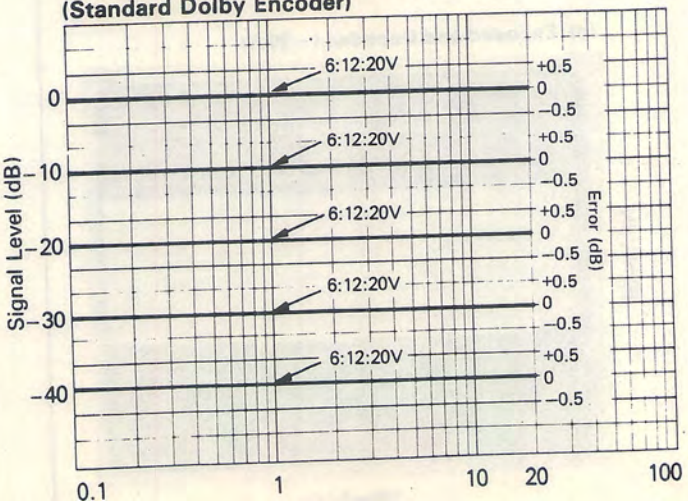
Signal to Noise Ratio vs Source Impedance Encode Mode (CCIR/ARM)



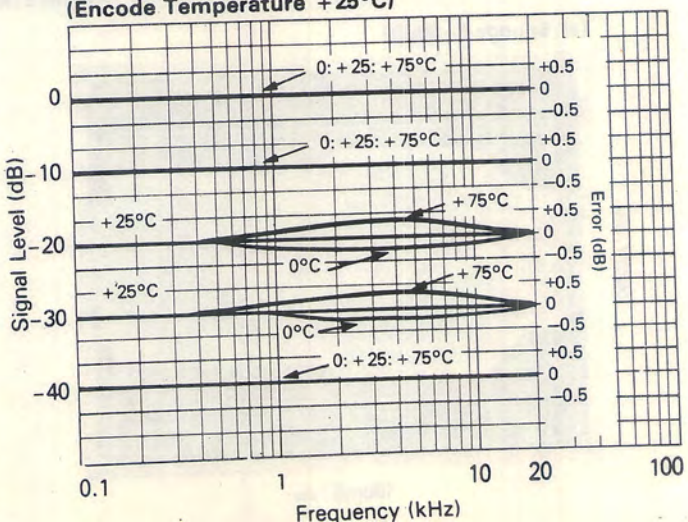
Gain vs Frequency (N.R. OFF)



Back to Back Response Error vs Frequency and Supply Voltage (Standard Dolby Encoder)

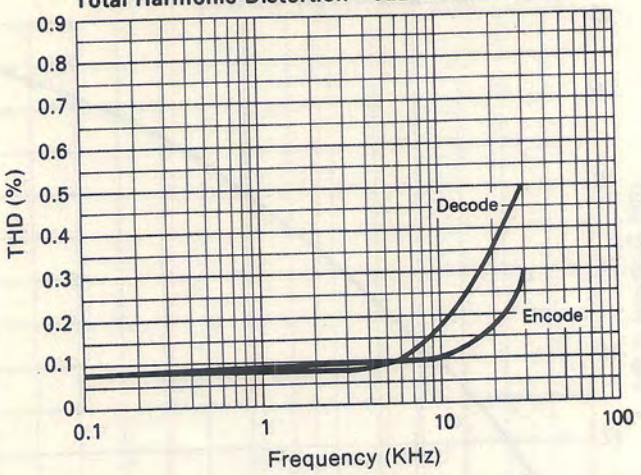


Back to Back Response Error vs Frequency and Temperature (Encode Temperature +25°C)

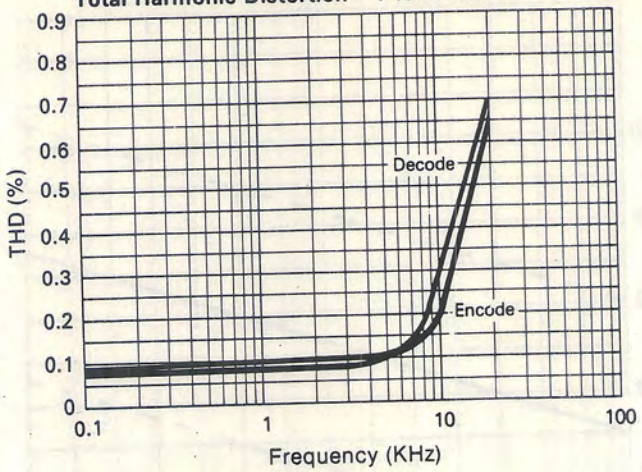


Typical Performance Characteristics

Total Harmonic Distortion — 0dB Level

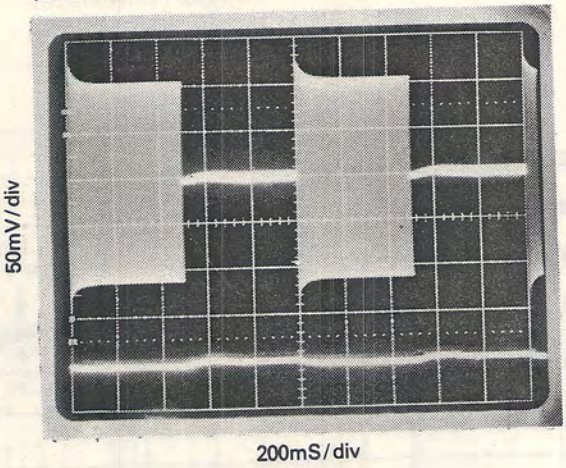


Total Harmonic Distortion — + 10dB Level



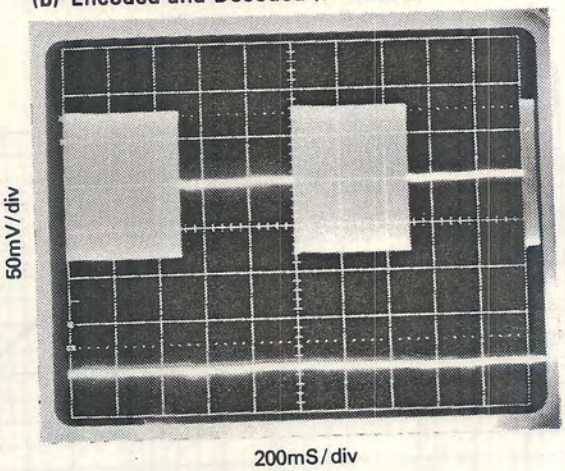
TRANSIENT RESPONSE TO ABRUPT LEVEL CHANGE (Measured at P9/12)

(a) Encode (f = 18KHz)



Top Trace AC Output
Lower Trace DC Output

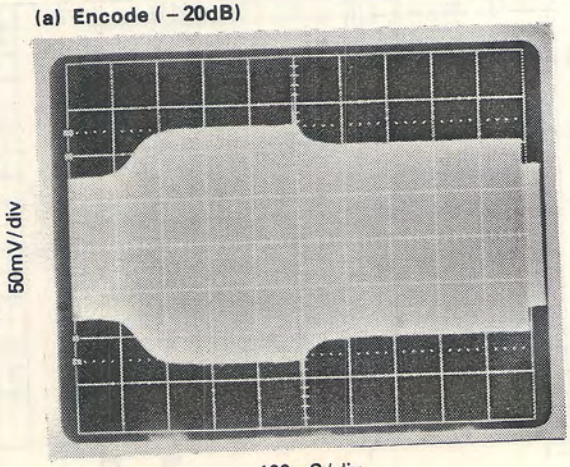
(b) Encoded and Decoded (f = 18KHz)



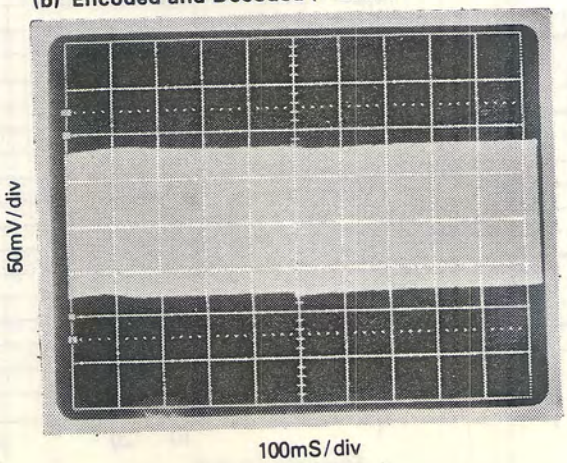
Top Trace AC Output
Lower Trace DC Output

TRANSIENT RESPONSE TO ABRUPT FREQUENCY CHANGE (Measured at P9/12)

(a) Encode (−20dB)



(b) Encoded and Decoded (−20dB)



Application Notes

1. Supply Voltage

LM1131 may operate with either single or split supply voltages.

a) Single Supply Voltage.

Pin 1 is connected to ground, Pin 20 to Vs.

Pins 8 and 13 are internally generated reference voltages set to approximately half-supply. They should be connected together externally.

A 220μF capacitor must be connected between Pins 8 and 13 and ground. Device turn-on time is delayed by the rise time of Pins 8 and 13.

b) Split Supply Voltages

Pin 1 is connected to the negative supply, Pin 20 to the positive supply. Pins 8 and 13 are connected to 0Volts and no capacitor is required. Device turn-on time is delayed only by the rise times of the supply voltages.

2. Signal Gain and Filtering

It should be noted that LM1131 has only one internal preamplifier, — AB — with no provision for interconnection of a low-pass filter to remove bias or multiplex tones. In addition, main chain gain has been reduced by 6dB in comparison with LM1111—LM1011.

If a low pass filter is required it should be connected at the input of the LM1131. Pre-adjustment of Dolby input level may be performed at the input of LM1131 if required.

3. Noise Reduction Switch

Noise Reduction OFF is normally effected by means of a mechanical switch which open circuits the sidechain input.

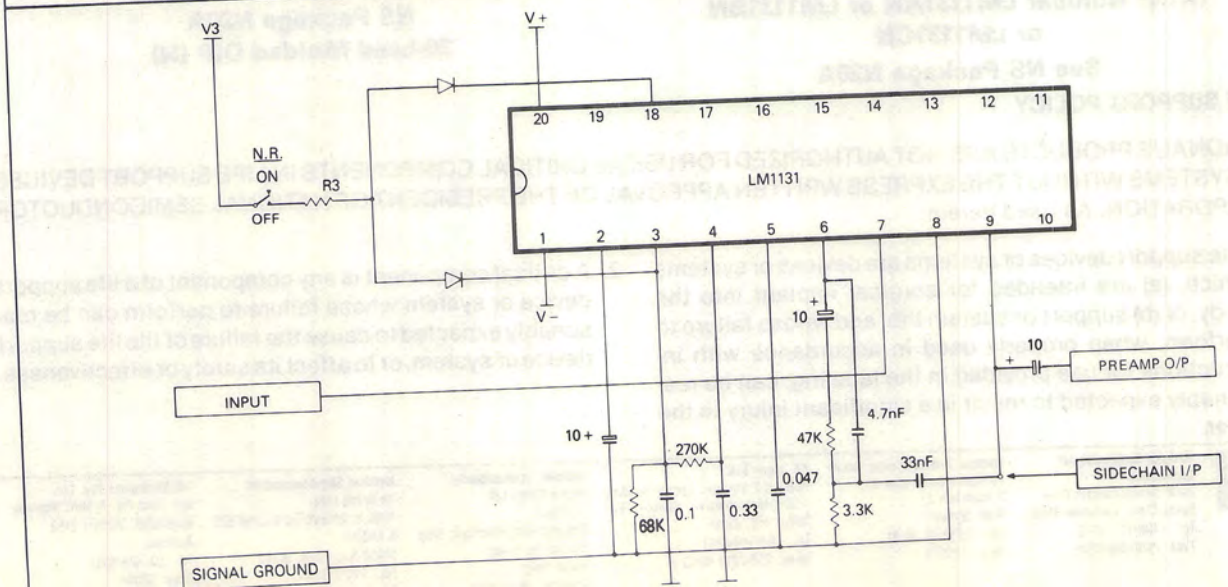
An alternative method which permits the control of NR OFF by means of a dc voltage is shown in Fig 1. The dc control voltage forces the internal impedance to a minimum value and heavily attenuates the sidechain input. When using this circuit the following points should be noted:—

a) Signal boost in encode mode (signal cut in decode) is reduced by increasing dc voltages on Pins 3 and 18. A voltage of approximately 3 Volts above signal ground is adequate to achieve NR OFF.

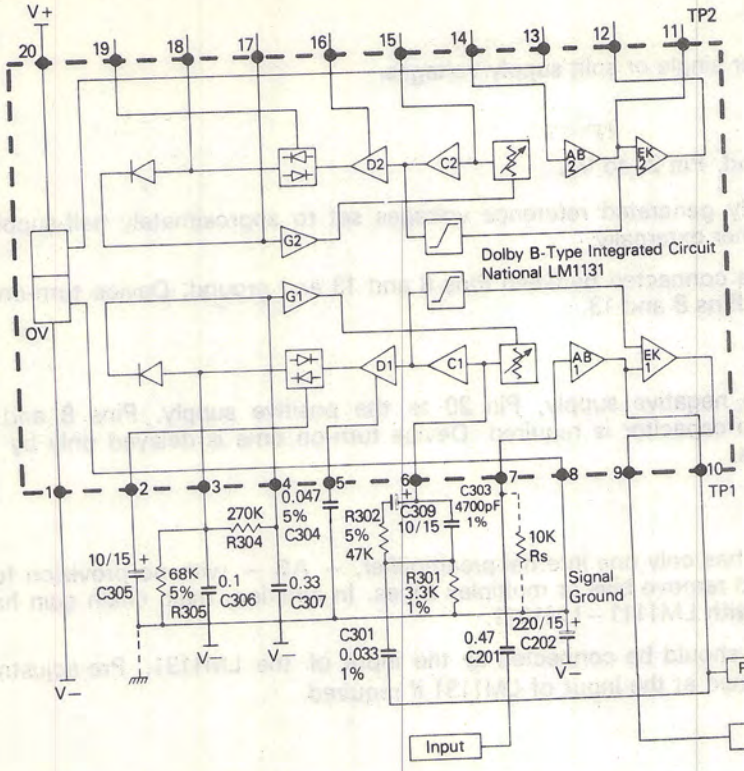
b) Supply current may be increased significantly by high Pin 3/18 forcing voltages. Thus, values for V3 and R3 should ideally be chosen such that Pin 3/18 forced voltage is only 3-5 Volts greater than signal ground. Maximum permissible voltage on Pin 3/18 is equal to supply voltage.

c) When electrical NR switch is used in this way, NR OFF signal level is slightly affected by the restriction that the internal variable impedance cannot achieve zero impedance. Thus, at 10kHz —10dB, a residual boost in encode (or cut in decode) of approximately 0.4dB remains. At lower frequencies this value reduces to insignificant levels.

This is not the case for mechanical NR switching.



Test Circuit, Encode Mode (Components shown for Channel 1 only)

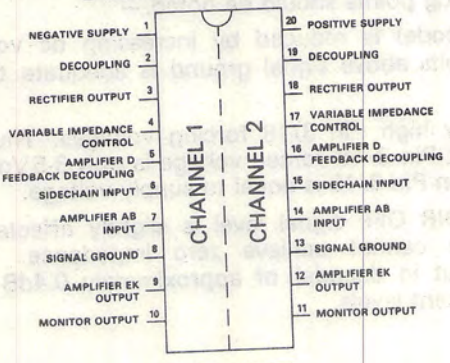


NOTES

1. Where not otherwise specified, component tolerances are ±10%.
2. For LM1131AN use 2% components for C304, R305. (5% components may cause errors up to ±0.3dB.)
3. Unless otherwise specified capacitor values in μF.

Connection Diagram

Dual-in-Line Package

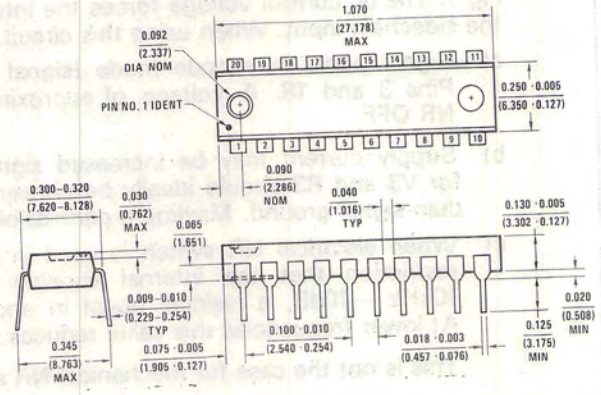


TOP VIEW

Order Number LM1131AN or LM1131BN or LM1131CN

See NS Package N20A

Physical Dimensions



NS Package N20A

20-Lead Molded DIP (N)

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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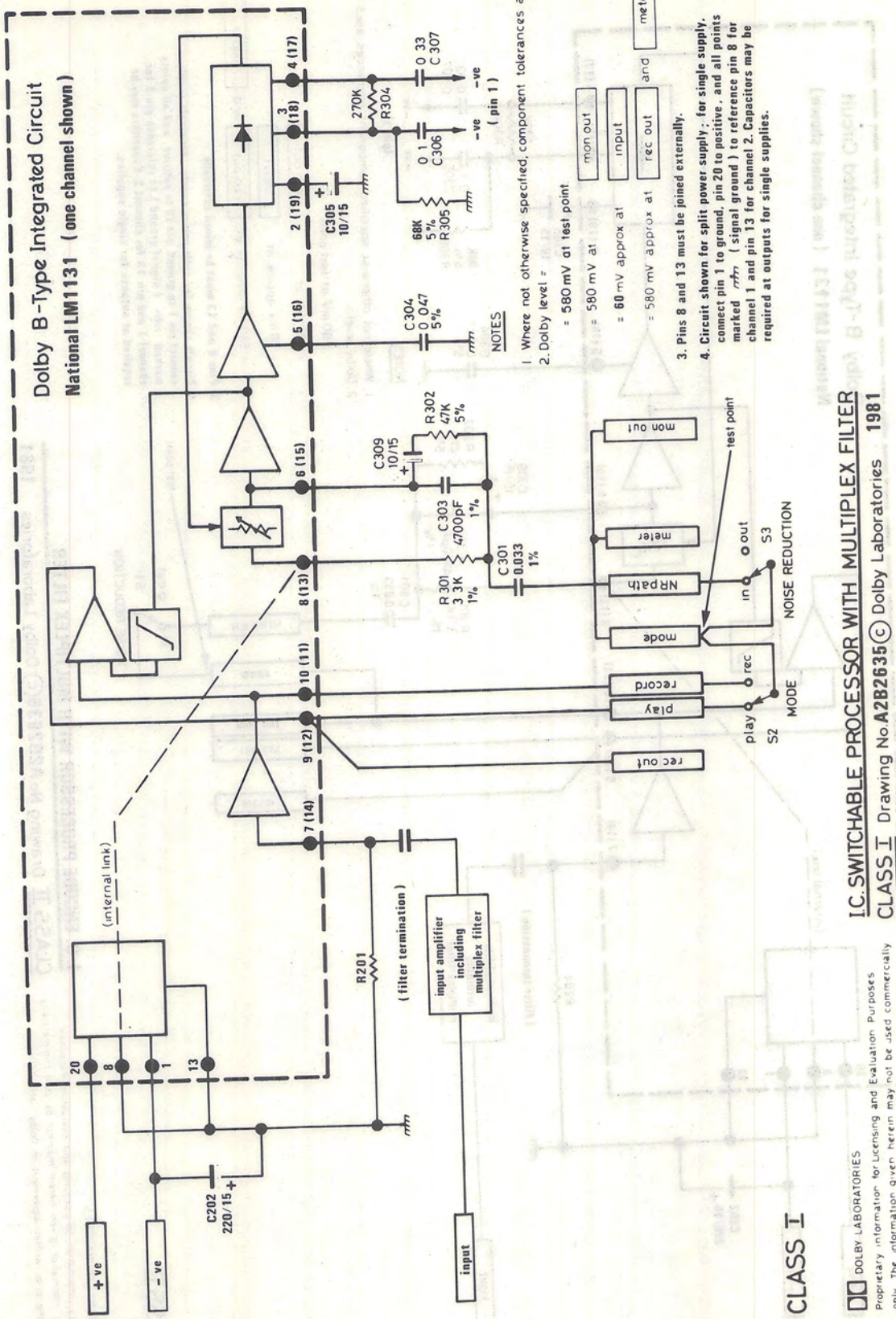
Dolby B-Type Integrated Circuit
National LM1131 (one channel shown)
(internal link)
input amplifier including multiplex filter
(filter termination)
R201
C202 220/15
+ ve
- ve
Supply (7-20 volts)
input
C309 10/15
R 302 47K 5%
C303 4700pF 1%
C301 0.033 1%
R 301 3 3K 1%
C305 10/15
C304 0 047 5%
68K 5% R305
0 1 C306
270K R304
0 33 C307
-ve
-ve (pin 1)
mon out
meter
NRpath
mode
record
play
rec out
test point
in
out
S3
NOISE REDUCTION
rec
play
S2
MODE
NOTES
1. Where not otherwise specified, component tolerances are ± 10%.
2. Dolby level =
= 580 mV at test point
= 580 mV at
= 60 mV approx at
= 580 mV approx at
mon out
input
rec out
and
meter
3. Pins 8 and 13 must be joined externally.
4. Circuit shown for split power supply ; for single supply, connect pin 1 to ground, pin 20 to positive, and all points marked ⏚ (signal ground) to reference pin 8 for channel 1 and pin 13 for channel 2. Capacitors may be required at outputs for single supplies.
I.C. SWITCHABLE PROCESSOR WITH MULTIPLEX FILTER
CLASS I Drawing No. A2B2635 © Dolby Laboratories 1981
CLASS I
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Fig. 3.12.1

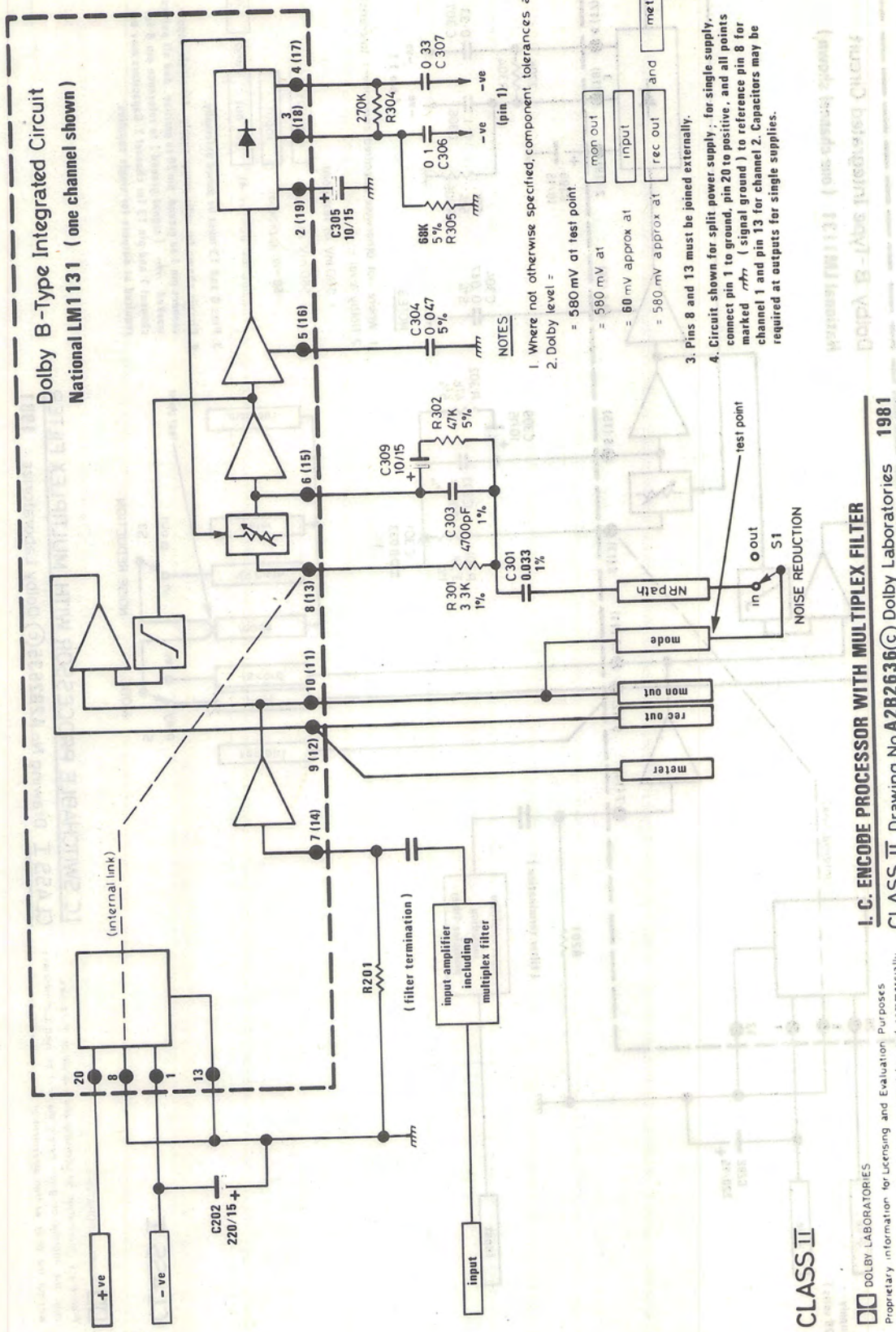
Dolby B-Type Integrated Circuit
National LM1131 (one channel shown)
(internal link)
20
8
1
13
+ve
- ve
Supply
(7-20 volts)
C202
220/15 +
R201
(filter termination)
input amplifier
including
multiplex filter
input
7 (14)
9 (12)
10 (11)
8 (13)
6 (15)
5 (16)
2 (19)
3
(18)
4 (17)
C305
10/15
270K
R304
0 33
C 307
-ve
0 1
C306
-ve
(pin 1)
68K
5%
R305
C304
0 047
5%
C309
10/15
R 302
47K
5%
C303
4700pF
1%
R 301
3 3K
1%
C 301
0.033
1%
NRpath
mode
mon out
rec out
meter
in
out
S1
test point
NOISE REDUCTION
NOTES
1. Where not otherwise specified, component tolerances are ± 10%.
2. Dolby level =
= 580 mV at test point
= 580 mV at
= 60 mV approx at
= 580 mV approx at
mon out
input
rec out
and
meter
3. Pins 8 and 13 must be joined externally.
4. Circuit shown for split power supply ; for single supply, connect pin 1 to ground, pin 20 to positive, and all points marked ⏚ (signal ground) to reference pin 8 for channel 1 and pin 13 for channel 2. Capacitors may be required at outputs for single supplies.
I. C. ENCODE PROCESSOR WITH MULTIPLEX FILTER
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Fig. 3.12.2

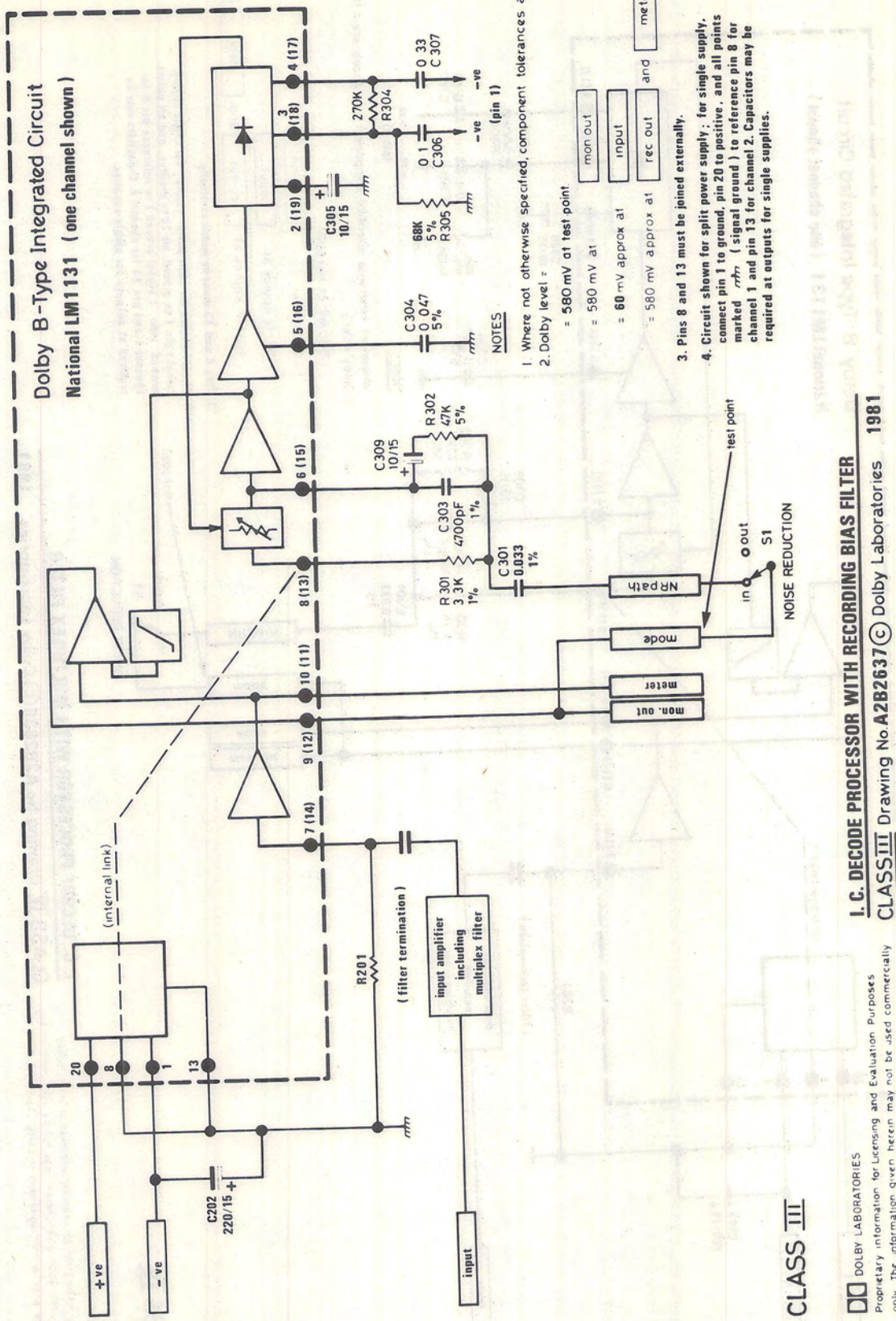
Dolby B-Type Integrated Circuit
National LM1131 (one channel shown)
(internal link)
20
8
1
13
+ve
- ve
Supply
(7-20 volts)
C202
220/15
input
R201
(filter termination)
input amplifier
including
multiplex filter
7 (14)
9 (12)
10 (11)
8 (13)
6 (15)
5 (16)
2 (19)
3
(18)
4 (17)
C305
10/15
270K
R304
0 33
C 307
0 1
C306
68K
5%
R 305
C 304
0 047
5%
C309
10/15
R 302
47K
5%
C303
4700pF
1%
R 301
3 3K
1%
C301
0.033
1%
NR path
mode
meter
mon. out
test point
in
out
S1
NOISE REDUCTION
-ve
(pin 1)
NOTES
1. Where not otherwise specified, component tolerances are ± 10%.
2. Dolby level =
= 580 mV at test point
= 580 mV at
mon out
= 60 mV approx at
input
= 580 mV approx at
rec out
and
meter
3. Pins 8 and 13 must be joined externally.
4. Circuit shown for split power supply ; for single supply, connect pin 1 to ground, pin 20 to positive, and all points marked ⏚ (signal ground) to reference pin 8 for channel 1 and pin 13 for channel 2. Capacitors may be required at outputs for single supplies.
CLASS III
I. C. DECODE PROCESSOR WITH RECORDING BIAS FILTER
CLASS III Drawing No A2B2637 © Dolby Laboratories 1981
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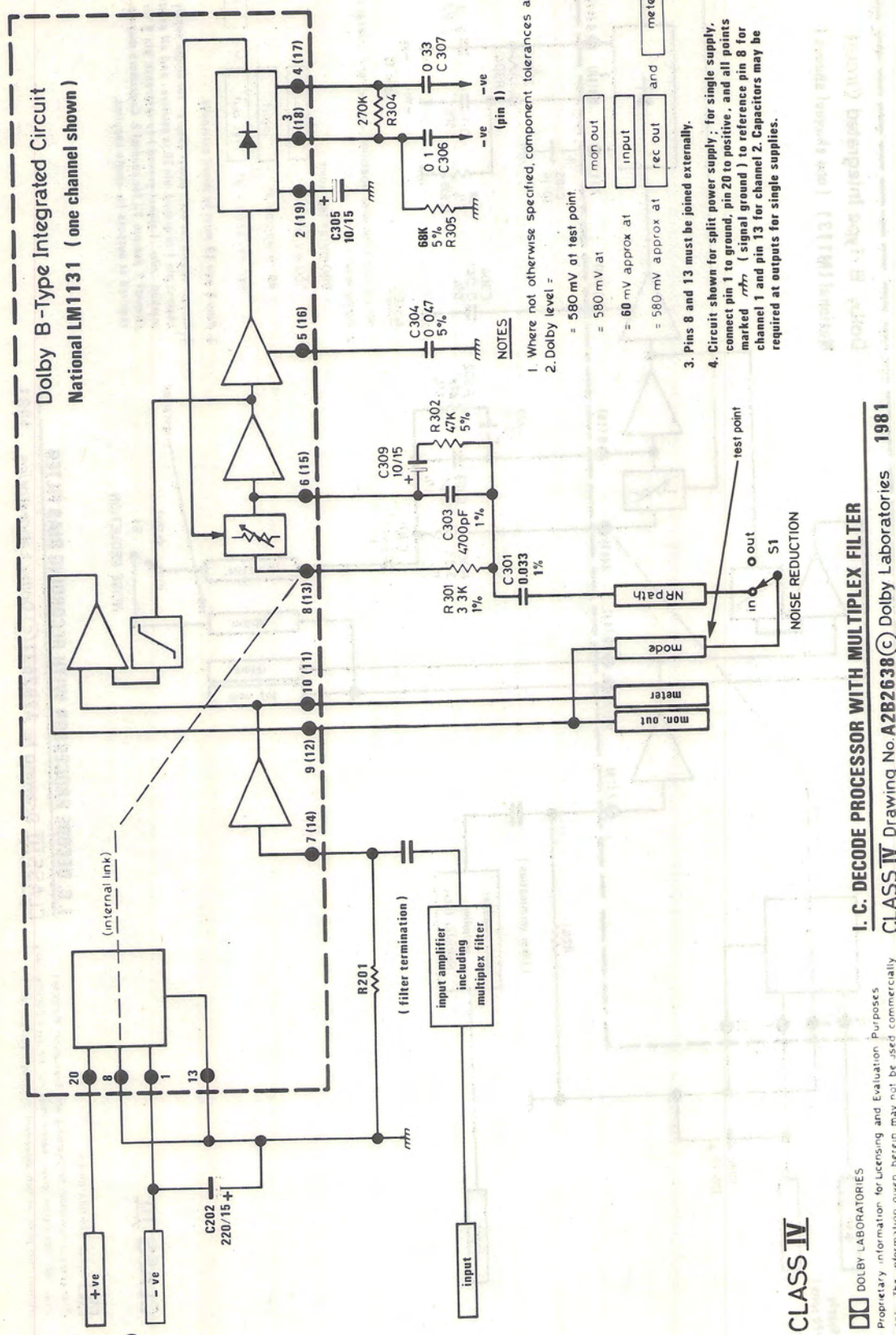
Fig. 3.12.3


Dolby B-Type Integrated Circuit
National LM1131 (one channel shown)
Supply (7–20 volts)
+ve
– ve
C202 220/15 +
(internal link)
20
8
1
13
R201
(filter termination)
input
input amplifier including multiplex filter
7 (14)
9 (12)
10 (11)
8 (13)
6 (15)
5 (16)
2 (19)
3 (18)
4 (17)
C305 10/15
C304 0 047 5%
C309 10/15
R 302 47K 5%
C303 4700pF 1%
R 301 3 3K 1%
C301 0.033 1%
68K 5% R305
0 1 C306
270K R304
0 33 C 307
– ve
– ve (pin 1)
NR path
mode
meter
mon. out
test point
in
out
S1
NOISE REDUCTION
NOTES
1. Where not otherwise specified, component tolerances are ± 10%.
2. Dolby level =
= 580 mV at test point
= 580 mV at mon out
= 60 mV approx at input
= 580 mV approx at rec out and meter
3. Pins 8 and 13 must be joined externally.
4. Circuit shown for split power supply ; for single supply, connect pin 1 to ground, pin 20 to positive , and all points marked ⏚ (signal ground) to reference pin 8 for channel 1 and pin 13 for channel 2. Capacitors may be required at outputs for single supplies.
CLASS IV
DOLBY LABORATORIES
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I. C. DECODE PROCESSOR WITH MULTIPLEX FILTER
CLASS IV Drawing No. A2B2638 © Dolby Laboratories 1981

Fig. 3.12.4

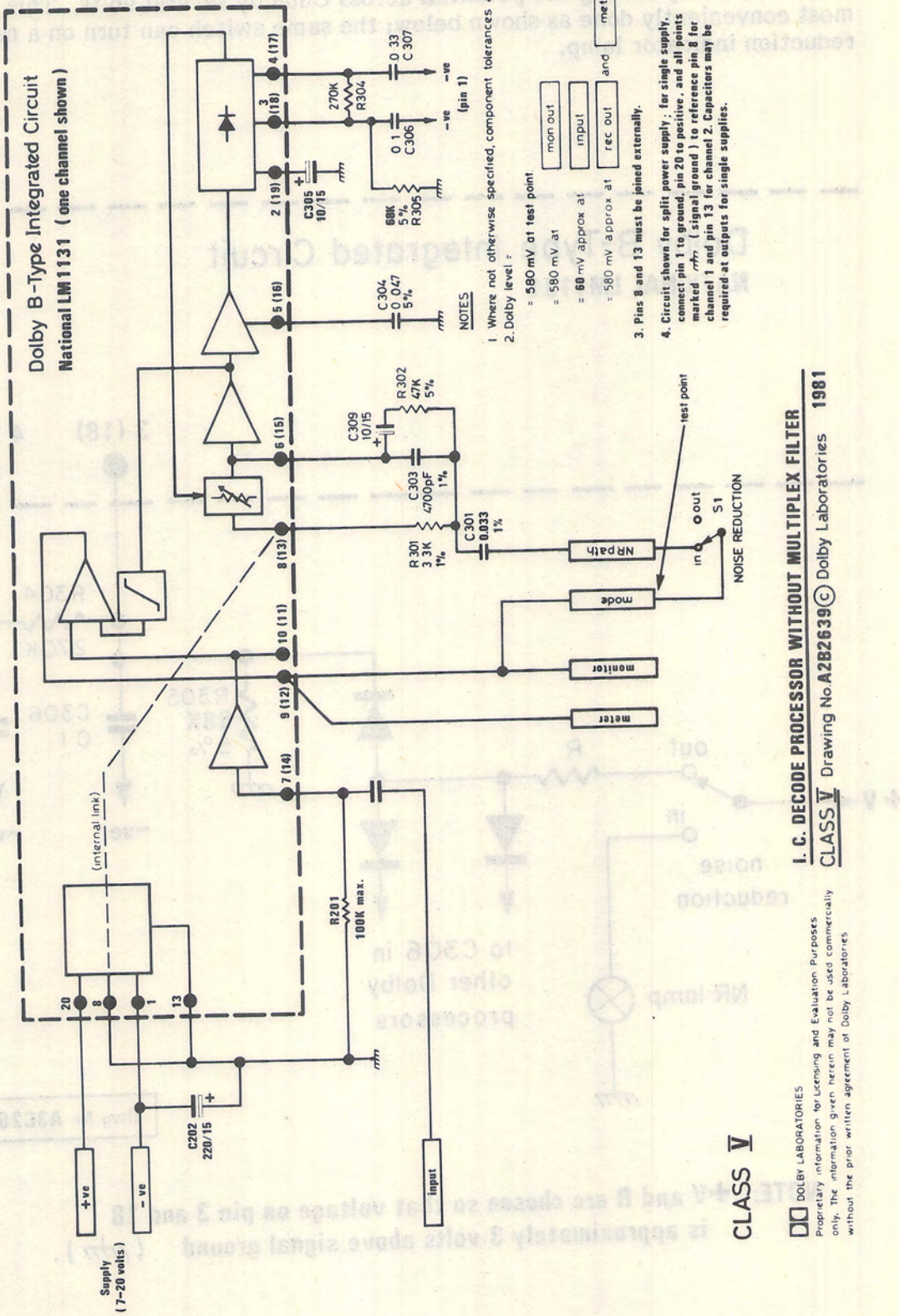
Dolby B-Type Integrated Circuit
National LM1131 (one channel shown)
(internal link)
20
8
1
13
4 (17)
3 (18)
2 (19)
5 (16)
6 (15)
8 (13)
10 (11)
9 (12)
7 (14)
R201 100K max.
C202 220/15
C305 10/15
270K R304
0 1 C306
68K 5% R305
0 33 C 307
C304 0 047 5%
C309 10/15
R 302 47K 5%
C303 4700pF 1%
R 301 3 3K 1%
C 301 0.033 1%
NR path
mode
monitor
meter
in
out
S1
test point
NOISE REDUCTION
+ve
- ve
Supply (7-20 volts)
input
-ve
-ve (pin 1)
NOTES
1. Where not otherwise specified, component tolerances are ± 10%.
2. Dolby level :
= 580 mV at test point
= 580 mV at mon out
= 60 mV approx at input
= 580 mV approx at rec out and meter
3. Pins 8 and 13 must be joined externally.
4. Circuit shown for split power supply ; for single supply, connect pin 1 to ground, pin 20 to positive, and all points marked (signal ground) to reference pin 8 for channel 1 and pin 13 for channel 2. Capacitors may be required at outputs for single supplies.
CLASS V
I. C. DECODE PROCESSOR WITHOUT MULTIPLEX FILTER
CLASS V Drawing No. A282639 © Dolby Laboratories 1981
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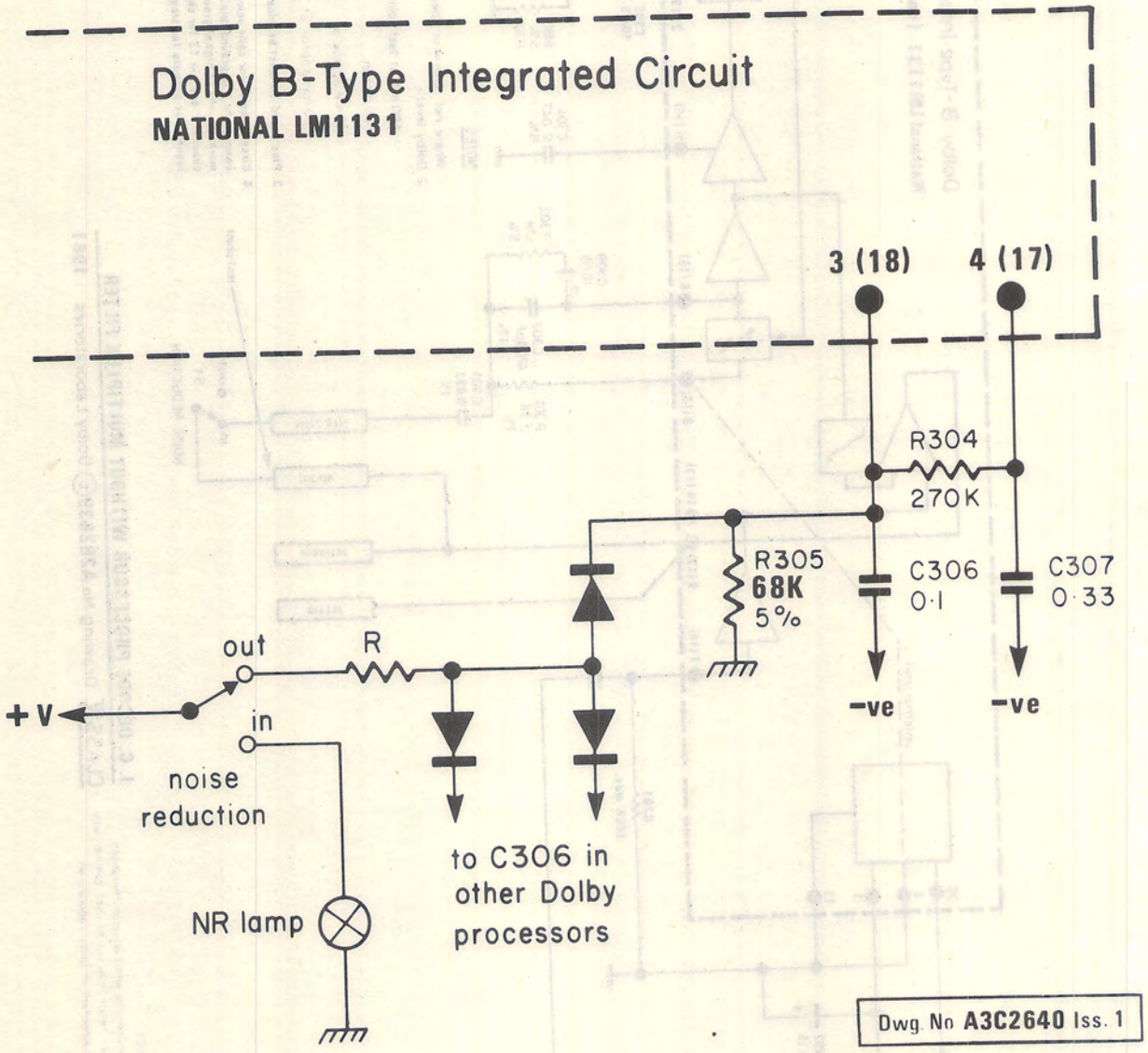
Fig. 3.12.5

Noise reduction switching

Noise reduction is normally switched in and out by a switch in series with the input to the noise reduction path. It is possible alternatively to switch noise reduction off by raising the potential across C306 by several volts. This is most conveniently done as shown below; the same switch can turn on a noise reduction indicator lamp.



NOTE: +V and R are chosen so that voltage on pin 3 and 18 is approximately 3 volts above signal ground (⏚).

Fig. 3.12.6