

## DOLBY NOISE REDUCTION CIRCUIT

NE645/46

## DESCRIPTION

The NE645/646 is a monolithic audio noise reduction circuit designed as a direct replacement device for the NE645B/NE646B in Dolby® B-Type noise reduction systems. The NE645/646 is used to reduce the level of background noise introduced during recording and playback of audio signals on magnetic tape, and to improve the noise level in FM broadcast reception. This circuit is available only to licensees of Dolby Laboratories Licensing Corporation, San Francisco, California.

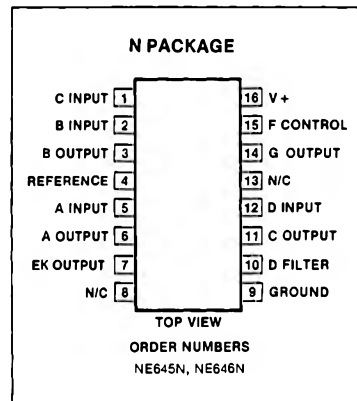
## NOTE

\*T.M. Dolby Laboratories Licensing Corporation.

## FEATURES

- Accurate record mode frequency response
- Excellent frequency response tracking with temperature and  $V_{CC} \pm 0.4$  dB typical
- Excellent back-to-back dynamic response — D.C. shift less than 20 mV typical
- Improved stability of all op amps
- High reliability packaging

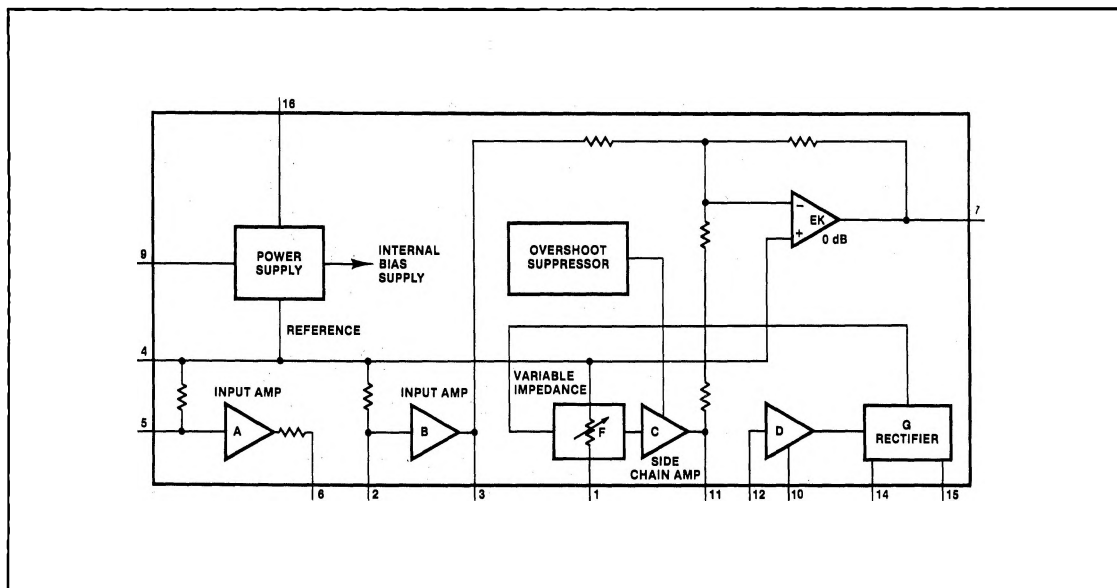
## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                            | RATING      | UNIT |
|--------------------------------------|-------------|------|
| Supply voltage                       | 24          | V    |
| Temperature range                    |             |      |
| Operating                            | 0 to +70    | °C   |
| Storage                              | -65 to +150 | °C   |
| Lead temperature (soldering, 60 sec) | +300        | °C   |

## BLOCK DIAGRAM



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## ELECTRICAL CHARACTERISTICS

 $V_{CC} = 12$  volts,  $f = 20$  Hz to 20 kHz.All levels referenced to 580 mVrms (0 dB) at Pin 3,  $T_A = +25^\circ\text{C}$ 

Unless otherwise noted.

| PARAMETER                                                                                        | TEST CONDITIONS                                             | NE645 |           |       | NE646 |           |       | UNIT       |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------|-----------|-------|-------|-----------|-------|------------|
|                                                                                                  |                                                             | Min   | Typ       | Max   | Min   | Typ       | Max   |            |
| Supply Voltage Range                                                                             |                                                             | 8     |           | 20    | 8     |           | 20    | V          |
| Supply Current, $I_{CC}$                                                                         | $V_{CC} = 12\text{V}$                                       |       | 16        | 24    |       | 16        | 24    | mA         |
| Voltage gain (Pins 5-3)                                                                          | $f = 1$ kHz (Pins 6 and 2 connected)                        | 24.5  | 26        | 27.5  | 24.5  | 26        | 27.5  | dB         |
| Voltage gain (Pins 3-7)                                                                          | $f = 1$ kHz, 0 dB at pin 3, noise reduction out             | -0.5  | 0         | +0.5  | -0.5  | 0         | +0.5  | dB         |
| Distortion<br>THD, 2nd and 3rd harmonic                                                          | $f = 20$ Hz - 10 kHz, 0dB                                   |       | 0.05      | 0.1   |       | 0.05      | 0.2   | %          |
|                                                                                                  | $f = 20$ Hz - 10 kHz, +10 dB                                |       | 0.15      | 0.3   |       | 0.2       | 0.5   | %          |
| Signal handling <sup>1</sup> ( $V_{CC} = 12\text{V}$ )                                           | 1% dist at 1 kHz                                            | +12   | +15       |       | +12   | +15       |       | dB         |
| Signal-to-noise ratio <sup>2</sup>                                                               | Record mode                                                 | 67    | 72        |       | 64    | 72        |       | dB         |
|                                                                                                  | Playback mode                                               | 77    | 82        |       | 74    | 82        |       | dB         |
| Record mode<br>Frequency response<br>(at pin 7) referenced<br>to encode monitor point<br>(pin 3) | $f = 1.4\text{kHz}$<br>0dB                                  | -1    | 0         | +1    | -1.5  | 0         | +1.5  | dB         |
|                                                                                                  | -20dB                                                       | -16.6 | -15.6     | -14.6 | -17.1 | -15.6     | -14.1 | dB         |
|                                                                                                  | -30dB                                                       | -23.5 | -22.5     | -21.5 | -24.0 | -22.5     | -21.0 | dB         |
|                                                                                                  | $f = 5\text{kHz}$<br>0dB                                    | -0.7  | +0.3      | +1.3  | -1.2  | +0.3      | +1.8  | dB         |
|                                                                                                  | -20dB                                                       | -17.8 | -16.8     | -15.8 | -18.3 | -16.8     | -15.3 | dB         |
|                                                                                                  | -30dB                                                       | -22.8 | -21.8     | -20.8 | -23.3 | -21.8     | -20.3 | dB         |
|                                                                                                  | -40dB                                                       | -30.2 | -29.7     | -28.7 | -30.2 | -29.7     | -28.2 | dB         |
|                                                                                                  | $f = 20\text{kHz}$<br>0dB                                   | -0.3  | +0.7      | +1.7  | -0.8  | +0.7      | +2.2  | dB         |
|                                                                                                  | -20dB                                                       | -18.3 | -17.3     | -16.3 | -18.8 | -17.3     | -15.8 | dB         |
|                                                                                                  | -30dB                                                       | -24.5 | -23.5     | -22.5 | -25.0 | -23.5     | -22.0 | dB         |
|                                                                                                  | Back-to-back frequency<br>response                          | -1    | 0         | +1    | -1.5  | 0         | +1.5  | dB         |
|                                                                                                  | Using typical record mode<br>frequency response test points |       |           |       |       |           |       |            |
| Input resistance                                                                                 | Pin 5                                                       | 35    | 50        | 65    | 35    | 50        | 65    | k $\Omega$ |
|                                                                                                  | Pin 2                                                       | 3.1   | 4.2       | 5.3   | 3.1   | 4.2       | 5.3   | k $\Omega$ |
| Output resistance                                                                                | Pin 6                                                       | 1.9   | 2.4       | 3.1   | 1.9   | 2.4       | 3.1   | k $\Omega$ |
|                                                                                                  | Pin 3                                                       |       | 80        | 120   |       | 80        | 120   | $\Omega$   |
|                                                                                                  | Pin 7                                                       |       | 80        | 120   |       | 80        | 120   | $\Omega$   |
| Back-to-back frequency<br>response shift                                                         |                                                             |       |           |       |       |           |       |            |
|                                                                                                  | Versus temperature                                          |       | $\pm 0.4$ |       |       | $\pm 0.4$ |       | dB         |
| Versus supply voltage                                                                            | $0^\circ\text{--}70^\circ\text{C}$<br>8-20V                 |       | $\pm 0.4$ |       |       | $\pm 0.4$ |       | dB         |

## NOTES

1. See maximum signal handling versus supply voltage characteristics.

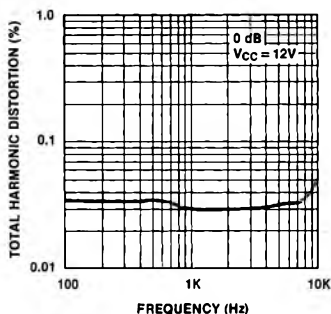
2. All noise levels are measured CCIR/ARM weighted using a 10K source with respect to Dolby level. See Dolby Laboratories Bulletin 19.

## DOLBY NOISE REDUCTION CIRCUIT

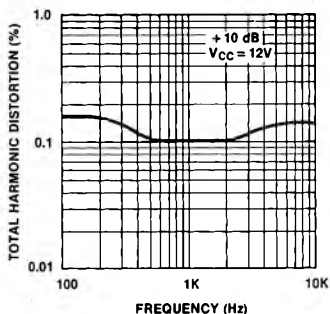
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## PERFORMANCE CHARACTERISTICS

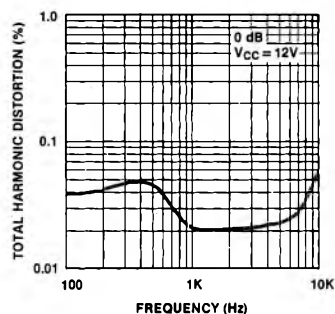
THD vs FREQUENCY RECORD MODE



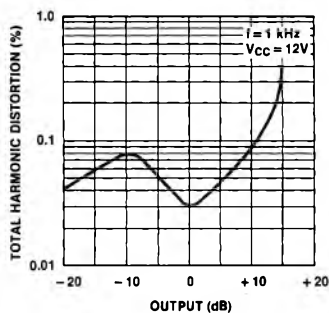
THD vs FREQUENCY RECORD MODE



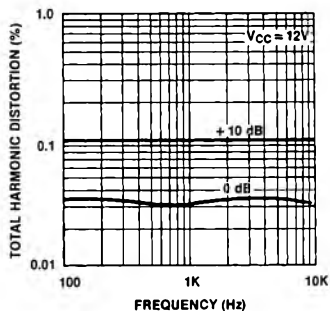
THD vs FREQUENCY PLAY MODE



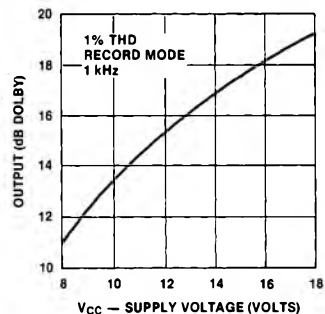
THD vs OUTPUT RECORD MODE



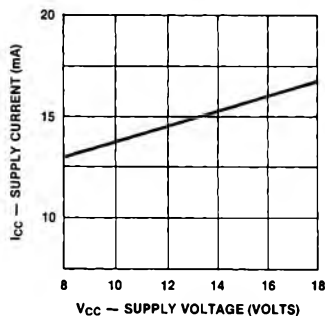
THD vs FREQUENCY NOISE REDUCTION (NR) OFF



MAXIMUM SIGNAL HANDLING vs SUPPLY VOLTAGE



SUPPLY CURRENT vs SUPPLY VOLTAGE



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## APPLICATION INFORMATION

The NE645/646 is a direct replacement for the NE645B/646B. The NE645/646 incorporates improved design techniques to insure excellent performance required in Dolby B and C Type Audio Noise Reduction Systems. Critical component values are unchanged except for C309 on Pin 1 which is now an optional component in specific applications defined by Dolby Laboratories. All circuit parameters are guaranteed at 12V  $V_{CC}$ .

## DOLBY ENCODER Output for constant level input (single tone frequency response)

| Frequency (kHz) | Input Level (dB) |     |     |     |     |     |     |      |      |
|-----------------|------------------|-----|-----|-----|-----|-----|-----|------|------|
|                 | 0 (Dolby Level)  | -5  | -10 | -15 | -20 | -25 | -30 | -35  | -40  |
| 0.1             | 0                | 0.1 | 0   | 0.1 | 0   | 0   | 0   | 0    | 0    |
| 0.14            | 0                | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2  | 0.1  |
| 0.2             | 0                | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.5  | 0.5  |
| 0.3             | 0                | 0.3 | 0.6 | 1.1 | 1.3 | 1.3 | 1.3 | 1.3  | 1.3  |
| 0.4             |                  |     |     |     | 2.0 | 2.1 | 2.2 | 2.3  | 2.1  |
| 0.5             | 0                | 0.3 | 0.8 | 1.8 | 2.6 | 2.9 | 2.9 | 3.0  | 2.9  |
| 0.6             |                  |     |     |     |     | 3.6 | 3.7 | 3.8  | 3.7  |
| 0.7             | 0                | 0.4 | 0.9 | 2.1 | 3.5 | 4.3 | 4.4 | 4.5  | 4.4  |
| 0.8             |                  |     |     |     |     | 4.8 | 5.0 | 5.3  | 5.1  |
| 0.9             |                  |     |     |     |     |     | 5.6 | 5.8  | 5.6  |
| 1.0             | 0                | 0.4 | 1.0 | 2.3 | 4.2 | 5.7 | 6.1 | 6.3  | 6.2  |
| 1.2             |                  |     |     |     |     |     | 6.9 | 7.1  | 7.1  |
| 1.4             | 0                | 0.3 | 0.9 | 2.3 | 4.4 | 6.6 | 7.5 | 7.7  | 7.7  |
| 2.0             | 0.1              | 0.4 | 0.9 | 2.2 | 4.3 | 7.0 | 8.5 | 8.9  | 8.9  |
| 3.0             | 0.2              | 0.6 | 0.9 | 1.9 | 3.9 | 6.6 | 8.8 | 9.7  | 9.7  |
| 5.0             | 0.3              | 0.6 | 1.0 | 1.7 | 3.2 | 5.4 | 8.2 | 10.0 | 10.3 |
| 7.0             | 0.3              | 0.6 | 1.0 | 1.7 | 2.8 | 4.7 | 7.3 | 9.7  | 10.4 |
| 10.0            | 0.4              | 0.7 | 1.1 | 1.7 | 2.6 | 4.2 | 6.5 | 9.1  | 10.4 |
| 14.0            | 0.5              | 0.8 | 1.1 | 1.8 | 2.7 | 4.4 | 6.5 | 8.7  | 10.3 |
| 20.0            | 0.7              | 0.7 | 1.2 | 1.9 | 2.7 | 4.4 | 6.5 | 8.7  | 10.3 |

## NOTE

The figures given in this table are the average response of many of Dolby Laboratories' professional encoders, and are not intended to be taken as required consumer equipment performance characteristics. Thus, no inference should be drawn on the tolerances which licensees must retain in consumer equipment. The figures can, however, be used to plot typical characteristics.

## TEST CIRCUIT NE645/646

