N10

Electrical Specifications for Sound Control Systems and Units Fourth Edition November 1993

PREFACE.

This document is a fourth, completely revised edition of the Technical Recommendation N 10, from Danmarks Radio, Norsk rikskringkasting, Rikisutvarpid, Sveriges Radio and Yleisradio.

This edition differs from the former editions by specifying electrical and environmental parameters only, and by giving these parameters for complete sound control systems as well as for single units.

Because of the improvements in sound quality made possible by the use of digital recording techniques, the specifications of several electrical parameters have been moved closer to the theoretical limits.

This document supersedes technical recommendations: N 2, N 3, N 9 and previous versions of N 10.

PREFACE

Section 1.
INTRODUCTION.

1-1. Object.

The object of this document is to provide manufacturers and users with a basic set of electrical specifications for both complete sound control systems and single electronic units.

When requested by any of the Nordic Broadcasting Companies, manufacturers or their representatives shall state in detail to which extent their offered equipment complies or differs with N 10.

1-2. Measuring Methods.

Generally, if not otherwise specified, the definitions and measuring methods given in IEC Publication 268-3: "Sound Systems Equipment, Amplifiers" shall be used.

In some cases the definitions, measuring methods and specifications given in IRT Technische Pflichtenheft nr. 3/5 shall be used.

1-3. The Units "dBu" and "dBqps".

In this document, dBu is defined as a voltage level in dB relative to 0.775 V (rms).

The unweighted noise levels are expressed in units of dBu.

Weighted noise levels are expressed in units of dBqps.
This is in accordance with CCIR Recommendation 468.

Section 2.
ELECTRICAL SPECIFICATIONS

2-1. General Requirements.

2-1-1. Frequency Range.

Unless otherwise stated all specifications in this document apply to the frequency range:

31.5 Hz to 20 kHz.

2-1-2. Environment.

All specifications given in this document shall be met in the ambient temperature range from 0°C to +45°C.
At temperatures between -20°C and 0°C and at temperatures between +45°C and +60°C the units shall still be functional, with reduced quality if necessary.
Storage temperatures between -35°C and +70°C must not damage the equipment. All equipment shall withstand normal freight by land, sea or air.

2-1-3. Power Supplies.

The nominal mains voltage shall be 230V ac (50 Hz). All mains driven power supplies shall fulfil the safety requirements given in IEC Publication 65.
All the specifications for mains driven equipment shall be met while the mains voltage is in the range 200 V to 245 V.
The equipment shall comply with existing relevant standards within the European Community.

Note: Units using a dual dc voltage supply shall withstand the continuous absence of one of the supply voltages without being destroyed.
Pluggable units shall not sustain any damage upon removal and replacement with its power supplies present.

2-2. Specifications for Programme Inputs.

2-2-1. Input Impedance.

For all high level inputs, the input impedance shall be:-

$$Z \geq 10\ k\Omega.$$

For microphone inputs, the input impedance shall be:-

$$Z \geq 1\ k\Omega.$$

The impedance deviation within the frequency range shall be less than 20% of the impedance at 1 kHz.

2-2-2. Source Impedance.

All specifications given in this document (except gain tolerance specifications), shall be met with source impedances:

For high level inputs in the range 0 to 600 Ω.
For microphone inputs in the range 0 to 200 Ω.

2-2-3. Input Levels.

The nominal input levels for all high level inputs, shall be +6 dBu. The inputs shall accept a level of at least +21 dBu with a resulting distortion of less than 1% THD.

Without pad, microphone inputs shall accept an input level of at least 0 dBu with a resulting distortion of less than 1% THD.

With pad, microphone inputs shall accept an input level of at least +16 dBu with a resulting distortion of less than 1% THD.

2-2-4. Balanced Inputs.

Line and microphone inputs shall be balanced. The input common mode rejection is defined as:-

$$CMRR = 20 \log_{10} (U1/U2) + A,$$

where A is the amplifier gain in dD.

The input common mode rejection up to 15 kHz shall be at least 60 dB.

Microphone inputs shall also meet this specification with phantom power switched on.

The measurement method is given in figure 1:-

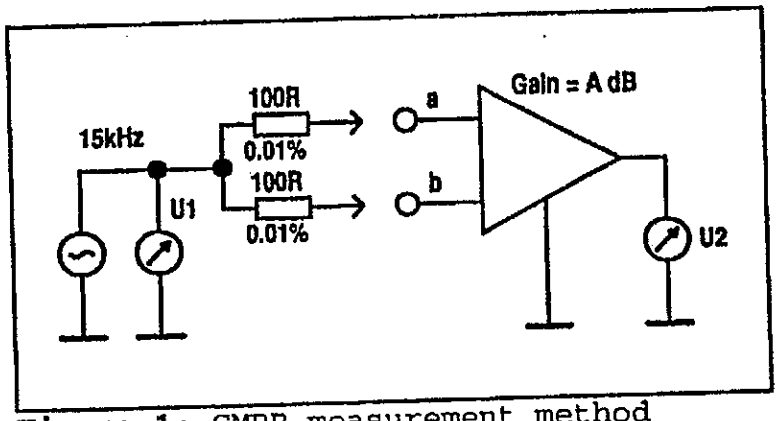

Figure 1: CMRR measurement method

2-2-5. Common Mode Voltages.

Electronically balanced inputs shall be able to function when subjected to a common mode voltage of 5 V rms ac 50 Hz and 50 V dc simultaneously. Transformer coupled inputs shall be able to function when subjected to a common mode voltage of 10 V rms ac 50 Hz and 50 V dc simultaneously.

The equipment shall otherwise comply with existing relevant EMC standards within the European Community.

2-2-6. Imunity to Radio Frequency Signals.

Inputs shall withstand a common mode RF signal: 300 mV rms, 70% AM modulated 1 kHz from 150 kHz to 30 MHz. With this signal directly exposed to the input terminals, the demodulated 1 kHz signal may not contribute by more than 3 dB to the channel noise as specified in 2-8-3.

The measuring method is shown in figure 2:-

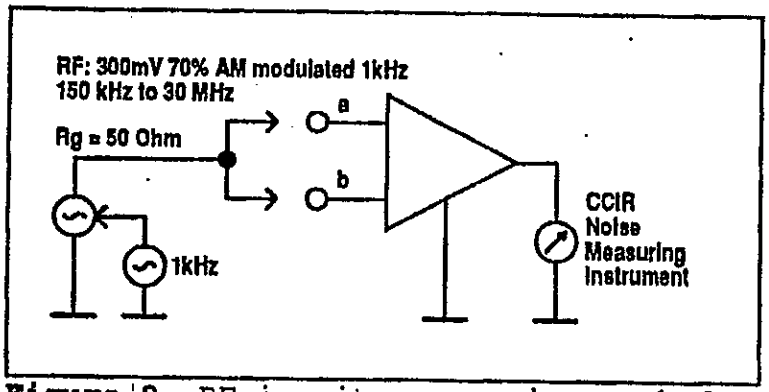

Figure 2: RF imunity measuring method

2-3. Specifications for Programme Outputs.

2-3-1. Output Impedance.

All high level outputs shall have an output impedance of:-

$0 < Z \leq 40\ \Omega$.

2-3-2. Load Impedance.

All high level outputs shall meet the specifications given in this document (except gain tolerance specifications), when the load impedance is either:-

a) 300 Ω resistor.
b) A dummy load consisting of a resistor of 10 kΩ in parallel with a capacitor of 68 nF.

2-3-3. Short Circuiting of Outputs.

All outputs shall be able to withstand a continuous short circuit at maximum output level, without sustaining any damage.

For balanced outputs both output terminals shall be connected to ground during testing.

2-3-4. Output Levels.

For all high level outputs, the nominal output level shall be +6 dBu.

The output level at 1% THD shall be at least +21 dBu.

2-3-5. Balanced Outputs.

All high level outputs shall be balanced, but able to drive unsymmetrical loads. Loading either one or the other of the output terminals with an impedance of 0 - 600 Ω to ground shall not alter the output level by more than 0.1 dB.

With one output terminal shorted to ground the output level at 1% THD shall be at least +15 dBu.

The output common mode rejection is defined as:-

$$CMRR = 20 \log_{10} (U1/U2),$$

where U1 is the differential mode output level and U2 is the common mode output level.

The output symmetry shall be better than 40 dB up to 15 kHz.
The measurement method is given in figure 3.

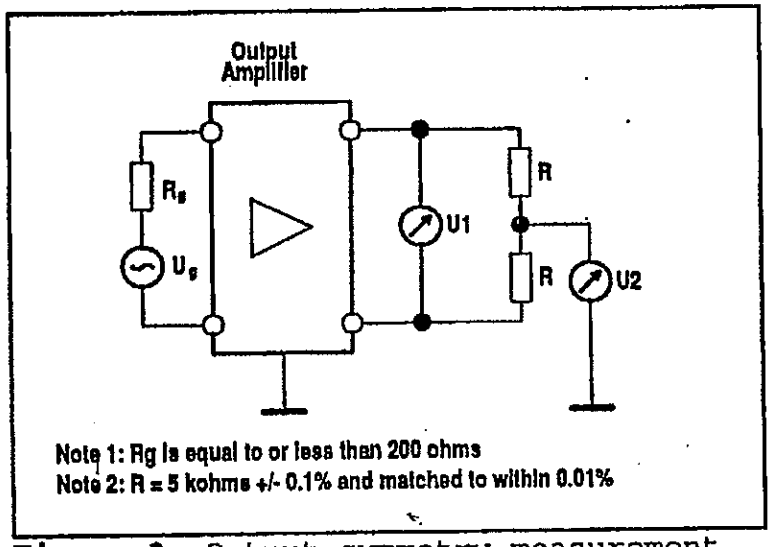

Figure 3: Output symmetry measurement

2-3-6. Common Mode Voltages.

Electronically balanced outputs shall be able to function when exposed to a common mode voltage of 5 V rms ac and 10 V dc simultaneously. Transformer outputs shall be able to function when exposed to a common mode voltage of 10 V rms ac and 10 V dc simultaneously.

The equipment shall otherwise comply with existing relevant EMC standards within the European Community.

2-4. Gain Tolerances.

2-4-1. Measurement of Gain.

Normally the gain shall be measured with a load impedance of 10 kΩ and a source impedance of 40 Ω, except for microphone amplifiers where the source impedance shall be 200 Ω.

2-4-2. Calibrated Stepped Gain Settings.

The gain accuracy for amplifiers with stepped gain settings shall be within 0.5 dB of the indicated value.

2-4-3. Primary Faders.

The normal fader position is at 0 dB gain. This corresponds to 10 to 15 dB below the maximum position. Gain and attenuation relative to the normal position is given in dB.
The normal fader operating range is specified as the upper 30 dB.

The gain accuracy of primary faders shall correspond to the following definitions:

1. In the normal fader operating range: Within 0.5 dB of the marked value.
2. In the subsequent 30 dB: Within 1.5 dB of the marked value.
3. In the remaining fader travel: Within 5 dB of the marked value.

2-4-4. Secondary Faders.

The difference in gain between equal programme paths, with secondary faders (potentiometers) adjusted to the same scale settings, shall not exceed 2 dB in the normal fader operating range.

2-4-5. Multichannel Faders.

The tracking in gain between mechanically or electronically coupled multichannel faders shall be better than 0.5 dB in the normal fader operation range.

2-5. Headroom.

The input and output headroom of equipment is defined as the difference in dB between the maximum input/output level and the nominal level (+6 dBu). The equipment may have lower internal levels than the nominal level.

Headroom shall be at least 15 dB.

2-6. Frequency and Phase Response.

2-6-1. Frequency Response.

From any input to any output, the frequency response shall be within:

± 0.3 dB from 31.5 Hz to 20 kHz
± 0.1 dB from 100 Hz to 8 kHz.

The response shall have a constant roll-off outside this frequency range.

2-6-2. Phase Response.

For equal programme paths, the difference in phase response shall not exceed 5 degrees in the frequency range 100 Hz to 8 kHz, and not more than 15 degrees in the frequency range 31.5 Hz to 20 kHz.

For equalizers with equal settings, a difference in phase response of 15 degrees can be tolerated in the frequency range 100 Hz to 8 kHz.

2-6-3. Group Delay.

Since the subjective perception of group delay distortion is not fully documented, N 10 does not specify this parameter for the time being.

2-6-4. Programme Signal Polarity.

All programme paths, including insert points, shall have the same signal polarity. Equipment using the standard XLR 3-pin connector shall use pin 2 as the positive polarity terminal, and pin 3 as the negative polarity terminal. Pin 1 is shield or ground.

2-7. Distortion.

2-7-1. Total Harmonic Distortion.

From any input to any output, the total harmonic distortion (THD) shall not exceed:-

1. Line inputs and outputs, at nominal level: 0.01%.
2. Microphone inputs, at 15 dB below maximum input level and at nominal output level: 0.01%.
3. For an input level of 1 dB below maximum input level and output level of +20 dBu: 0.1%.

2-7-2. Difference Frequency Distortion.

The reference level Uref of the total measuring signal is defined as:

$$Uref=\sqrt{2}\times\sqrt{Uf1^2+Uf2^2}$$

where Uf1 and Uf2 are the amplitudes of the two frequency components. The two frequency components shall have equal amplitudes.

The measurement signal reference level is defined in this way (3 dB above the rms value of the combined signal) to correspond to the rms level of a single tone having the same peak level as the measurement signal used for THD measurements.

The recommended frequency difference is 80 Hz.
All measurement signal levels given below are actual rms values. From any input to any output, no difference frequency distortion products of any order shall exceed:-

1. Line inputs and outputs, at 3 dB below nominal level: 0.03%.
2. Microphone inputs, at 18 dB below maximum input level and at nominal output level: 0.03%
3. For an input level of 4 dB below maximum input level and output level of +17 dBu: 0.3%.

2-7-3. Other Distortion Products.

Distortion products not covered by 2-7-1 and 2-7-2, such as aliasing products in digital audio equipment and other spurious components, shall not exceed the values given in 2-7-1.

Manufacturers shall specify their measurement methods.

2-8. Noise.

2-8-1. Measurement of Noise.

Two measurements are required:

1. Noise level measured according to the specifications given in CCIR Rec. 468, expressed in units of dBqps (in this document called weighted peak noise level).

2. Noise level measured with unweighted frequency response (22 Hz to 23 kHz noise bandwidth) and rms indicating meter, expressed in units of dBu (in this document called unweighted rms noise level).

The unweighted rms noise level shall be at least 7 dB below the weighted peak noise level.

2-8-2. System Noise.

System noise is measured with the input channels routed to a main output, the channel faders at minimum gain, but not closed, and the output fader at 0 dB gain.

The output weighted peak noise level shall not exceed the noise levels given in figure 4:-

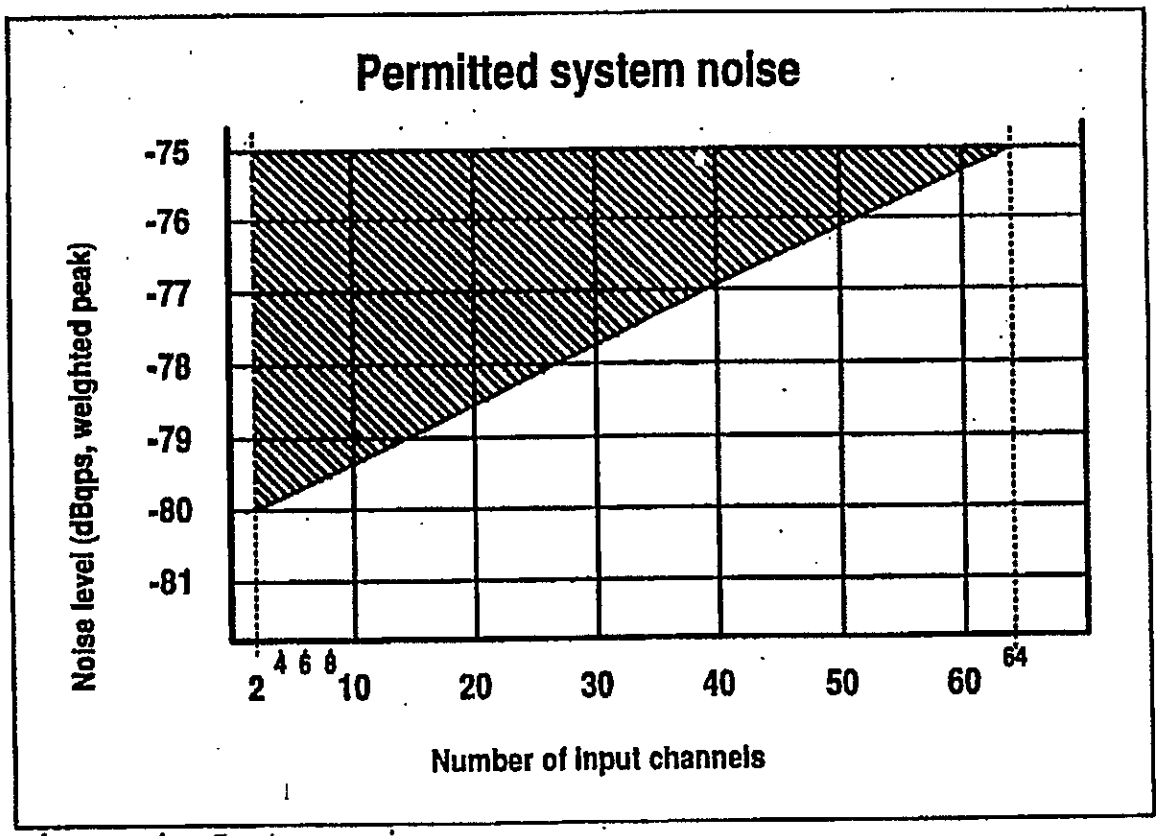

Figure 4: System noise

2-8-3. Channel Noise.

Channel noise is measured with one microphone input channel connected to a source impedance of 200 Ω, at maximum gain, routed to a main output at 0 dB gain.

The weighted peak noise level, referred to the input, shall be equal to or less than -116 dBqps.

Note: -116 dBqps corresponds to a noise figure of approx. 2.4 dB (measured weighted peak).
The unweighted rms noise level of a 200 Ω resistor at 20°C is -129.1 dBu, the weighted peak noise level is -118.4 dBqps.

2-8-4. Noise Versus Gain.

Noise is measured at different gains with one input channel connected to a source impedance of 200 Ω and routed to a main output. The channel fader and output fader shall be at 0 dB gain positions (equalizers bypassed).
The output weighted peak noise level shall not exceed the curve shown in figure 5 when the microphone channel gain is varied between its maximum an minimum values.

The same noise levels shall also apply to line inputs.

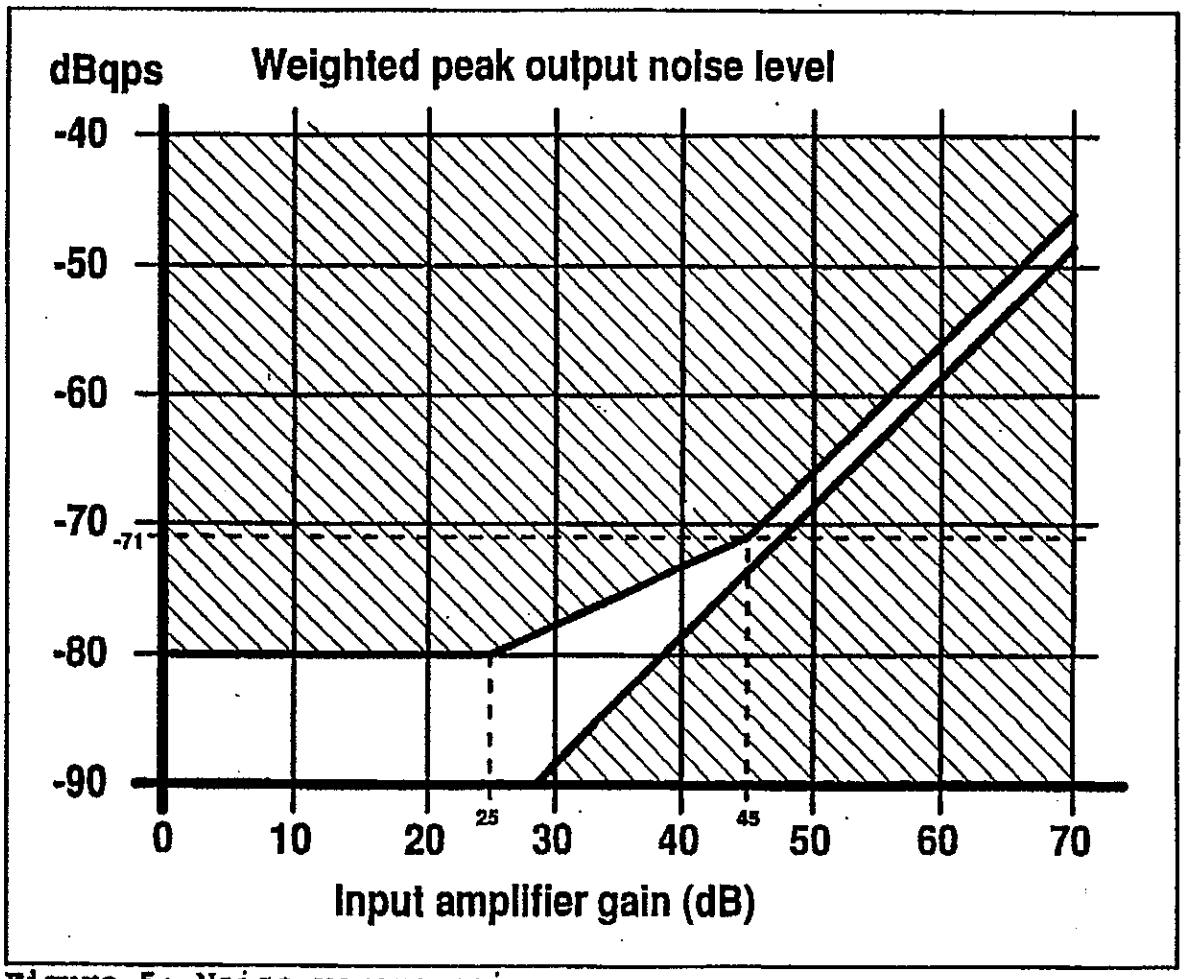

Figure 5: Noise versus gain

2-8-5. Noise from General Active Units.

All active units without signal processing and with a gain of 0 dB, shall have an output weighted peak noise level less than -90 dBqps.

2-8-6. Noise from Equalizers.

All equalizers and filters set to flat frequency response and 0 dB gain, shall have an output weighted peak noise level less than -80 dBqps.

2-8-7. Noise from Companders.

All companders with 0 dB gain shall have an output weighted peak noise level less than -80 dBqps.

2-8-8. Switch Operation Noise.

Normal operation of controls must not cause audible clicks or other spurious noises. Switching noise is measured using a PPM-reading meter according to IEC 268-10 with a suitable front-end amplifier. See also 2-13.

When switching input- and output routing, mutes, PFLs, solos, panpots etc, or when inserting EQs, dynamics etc. into the signal chain, the peak switch noise shall not exceed -60 dBu.

When switching input routing with microphone amplifier gain greater than 30 dB, the peak switch noise shall not exceed -30 dBu.

When switching gain in microphone amplifiers the peak switch noise shall not exceed -50 dBu.

2-8-9. Microphony.

When the equipment is exposed to a sound pressure level of 94 dB SPL, microphony shall be negligible.

Note: 0 dB SPL is equal to 2×10^{-5} N/m^2 (20 uPa). A simulated program signal in accordance with IEC Publ. 268-1 may be used for this test.

The normal operation of controls shall not cause audible microphonic effects.

2-9. Crosstalk attenuation.

Crosstalk attenuation is measured from 40 Hz to 15 kHz using source impedances of 200 Ω for microphone inputs and 40 Ω for line inputs. The load impedances shall range from 300 Ω to 10 kΩ on the line outputs.

Crosstalk attenuation shall be equal to or better than the following specifications:

1.	Between two adjacent signal paths .....:	90 dB
2.	From line input to microphone input in the same channel .....:	120 dB
3.	In matrix and switching equipment .....:	100 dB
4.	Across closed primary faders, relative to the gain with the faders in 0 dB positions: .....:	90 dB
5.	Across closed secondary faders (potentiometers), relative to the gain with the faders in 0 dB positions .....:	80 dB
6.	Onto summing busses .....:	85 dB
7.	Across the open contacts .....:	90 dB
8.	Across pan-pots .....:	70 dB
9.	From talkback to programme circuits .....:	90 dB
10.	Between the channels in a stereo pair .....:	70 dB

2-10. EMC and Interference.

The equipment shall comply with existing standards within the European community.

2-11. Connection of XLR-type connectors.

Equipment using the 3 pin "XLR" type connector, the attribution of the pins should comply with the following:

Pin-number	Attribution
1	Screen *
2	Audio signal (+)
3	Audio signal (-) **

* At insertion pin 1 makes contact first.

** If the audio signal is unbalanced, pin 3 should be connected to the reference potential (earth).

This pin attribution complies with IEC Publication 268-12 and EBU Technical Recommendation R 50-1989.

2-12. Specifications for microphone phantom power.

These specifications for microphone phantom powering comply only in part with IEC document 268-15: "Preferred matching values for the interconnection of sound system components".

The phantom power supply voltage shall be 48 V +/- 4 V.
The positive pole of the supply voltage shall be connected to the electrical centre of the signal conducters, the negative pole to the screen of the cable. The available phantom power supply current from each channel shall be at least 10 mA.

The unweighted rms noise voltage as defined in section 2-8-1 shall not exceed 100 µV. The noise on mixing console phantom power supplies shall be measured under full load conditions.

The circuit diagrams are shown in figure 6.

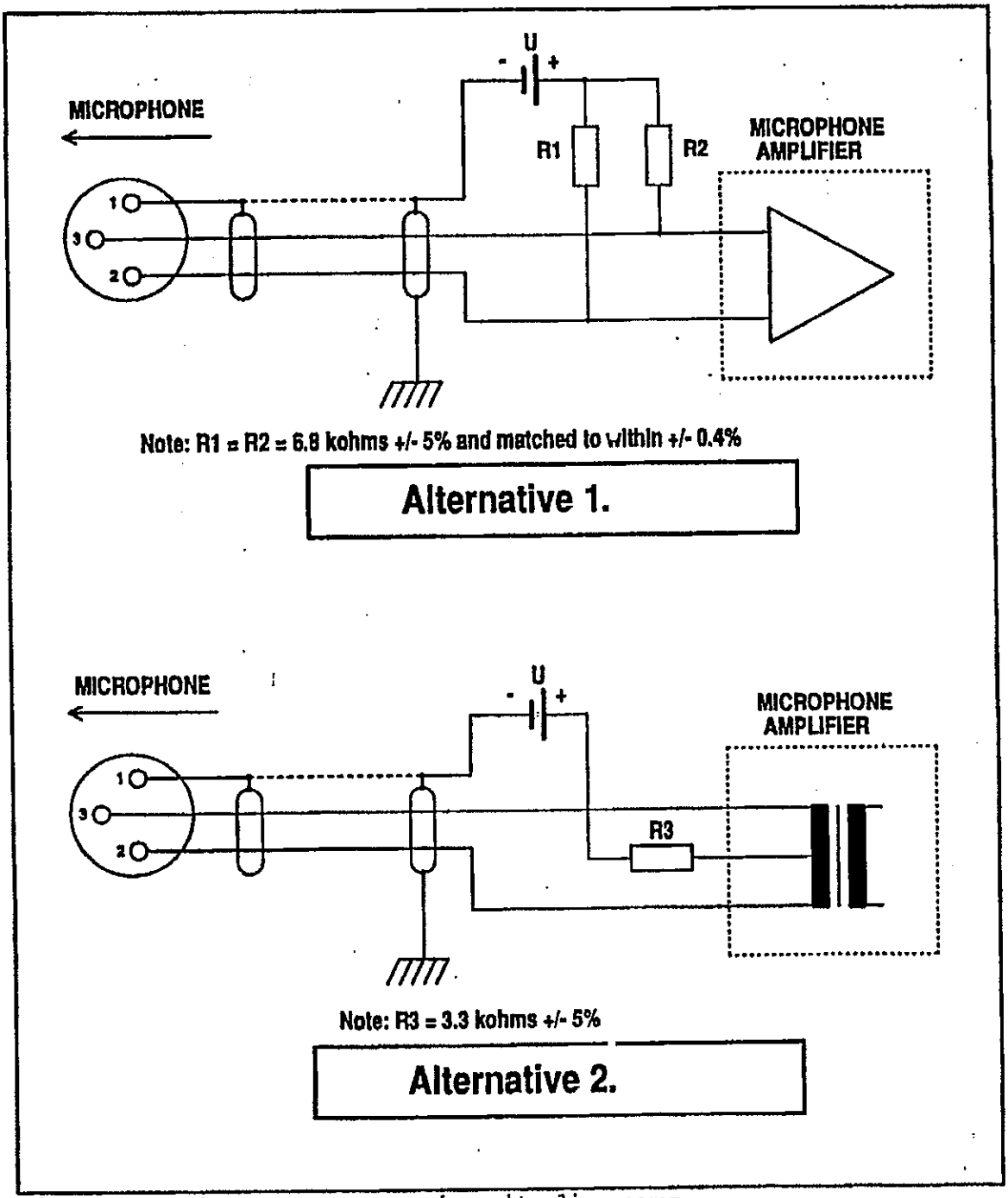

Figure 6: Phantom power circuit diagrams

2-13. Nordic PPM scale.

PPM-type programme level meters shall comply with IEC Publication 268-10: "Programme level meters", with the exeption of the scale layout and markings, which should be as shown in figure 7. All levels are in units of dBu.

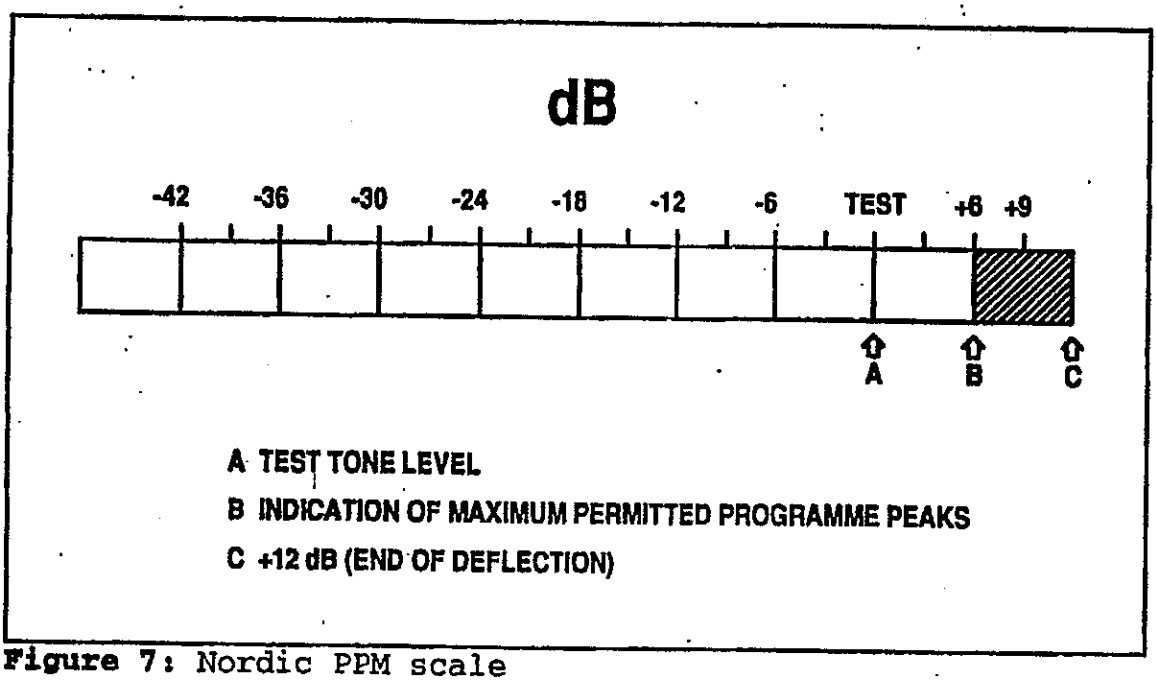

Figure 7: Nordic PPM scale

The levels defined by EBU and CCITT J.15 are listed below for comparison purposes only:

ML	Mesurement level:	-12 dBu
AL	Alignment level:	0 dBu
PML	Permitted maximum level:	+9 dBu