

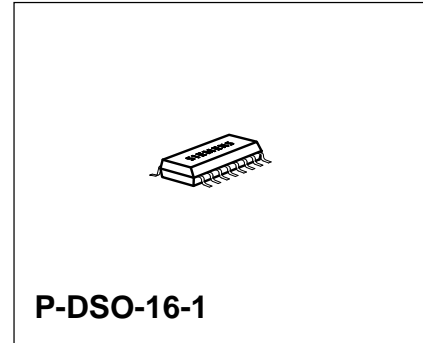
FM-IF with Counter Output, Field Strength Indicator, Noise Detector and MUTE Setting

TDA 4320X

1 Overview

1.1 Features

- 7-stage limiter amplifier
- Coincidence demodulator
- Counter output with request input
- Field strength output
- Multipath identification circuit
- Adjustable muting depth (with full muting ≥ 80 dB)
- This device is ESD protected



| Type | Ordering Code | Package |
|-----------|---------------|------------|
| TDA 4320X | Q67000-A-5000 | P-DSO-16-1 |

1.2 Pin Configuration
(top view)

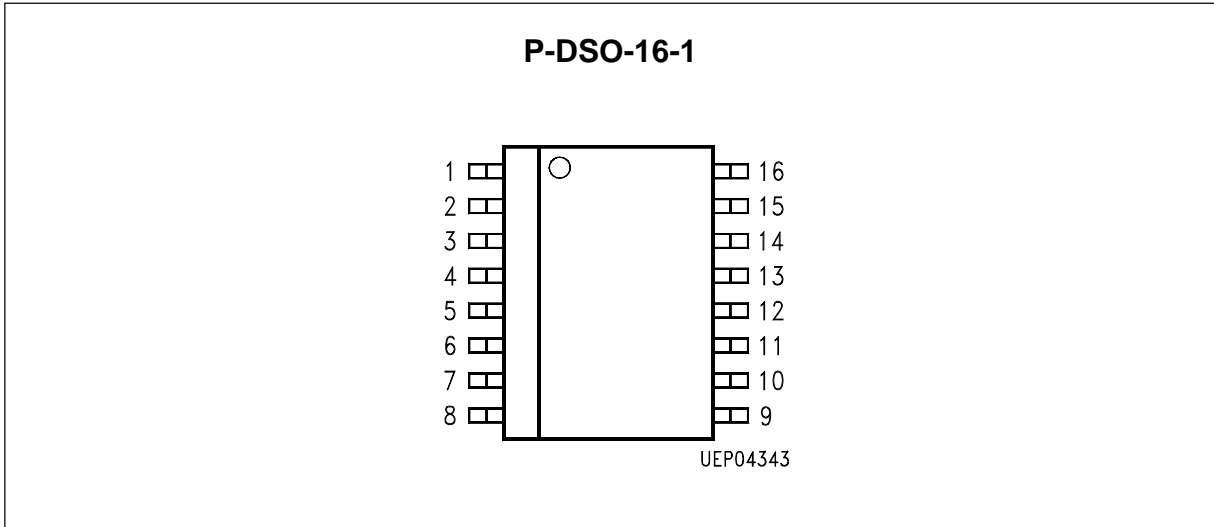


Figure 1

1.3 Pin Definitions and Functions

| Pin No. | Symbol | Function |
|---------|---------------------------------|---|
| 1 | GND | Ground Decoupling capacitors for bias, V_S and V_{REF} Pins are to be connected directly to Pin 1 |
| 2 | Multipath identification input | Multipath identification input High impedance input ($R_i \sim 10\text{ k}\Omega$). This input receives the filtered field strength output (high pass or band pass). |
| 3 | Rectifier time constant | Rectifier time constant Determines the attack and release time of the identification circuit. |
| 4 | Multipath identification output | Multipath identification output Open npn-collector output, which is low during ($V_4/V_1 \leq 0.7\text{ V}$) multipath interference. |
| 5 | MUTE input | MUTE input For DC voltage (usually derived from field strength output voltage) which attenuates the AF output voltage by the setting muting depth (Pin 7). Max. attenuation when $V_5 = 0\text{ V}$, no attenuation when $V_5 \geq 0.5\text{ V}$. |
| 6 | AF output | AF output Demodulated FM-IF. |

1.3 Pin Definitions and Functions (cont'd)

| Pin No. | Symbol | Function |
|---------|--------------------------|---|
| 7 | MUTE depth | MUTE depth Adjustment by connecting a dc voltage to ground the requested muting depth can be set. Maximal attenuation of AF output voltage with $V_7 = 2.4 \text{ V}$ (typ. 38 dB), minimal attenuation with $V_7 = 4.8 \text{ V}$ (typ. 0 dB). Full muting with $V_7 \leq 1 \text{ V}$ ($\geq 80 \text{ dB}$). |
| 8 | Demodulator tank circuit | Demodulator tank circuit Driven via two on-chip capacitors (approx. 15 pF \pm 25 %). The tank circuit voltage should be typ. 400 mVpp. |
| 9 | Demodulator circuit | Demodulator circuit |
| 10 | Reference voltage | Reference voltage Should be RF decoupled to Pin 1. |
| 11 | IF counter output | IF counter output Provides the IF carrier frequency (low impedance output $R_{\text{out}} \approx 1.5 \text{ k}\Omega$). |
| 12 | V_S | Supply voltage RF decoupled to Pin 1 |
| 13 | Field strength output | Field strength output Supplies a DC voltage proportional to the IF input level with very low delay time. |
| 14 | Field strength adjust | Field strength adjust Adjustment of slope and starting point of field strength output voltage |
| 15 | IF input bias | IF input bias To be RF decoupled to Pin 1 |
| 16 | IF input | IF input FM-IF input |

1.4 Functional Block Diagram

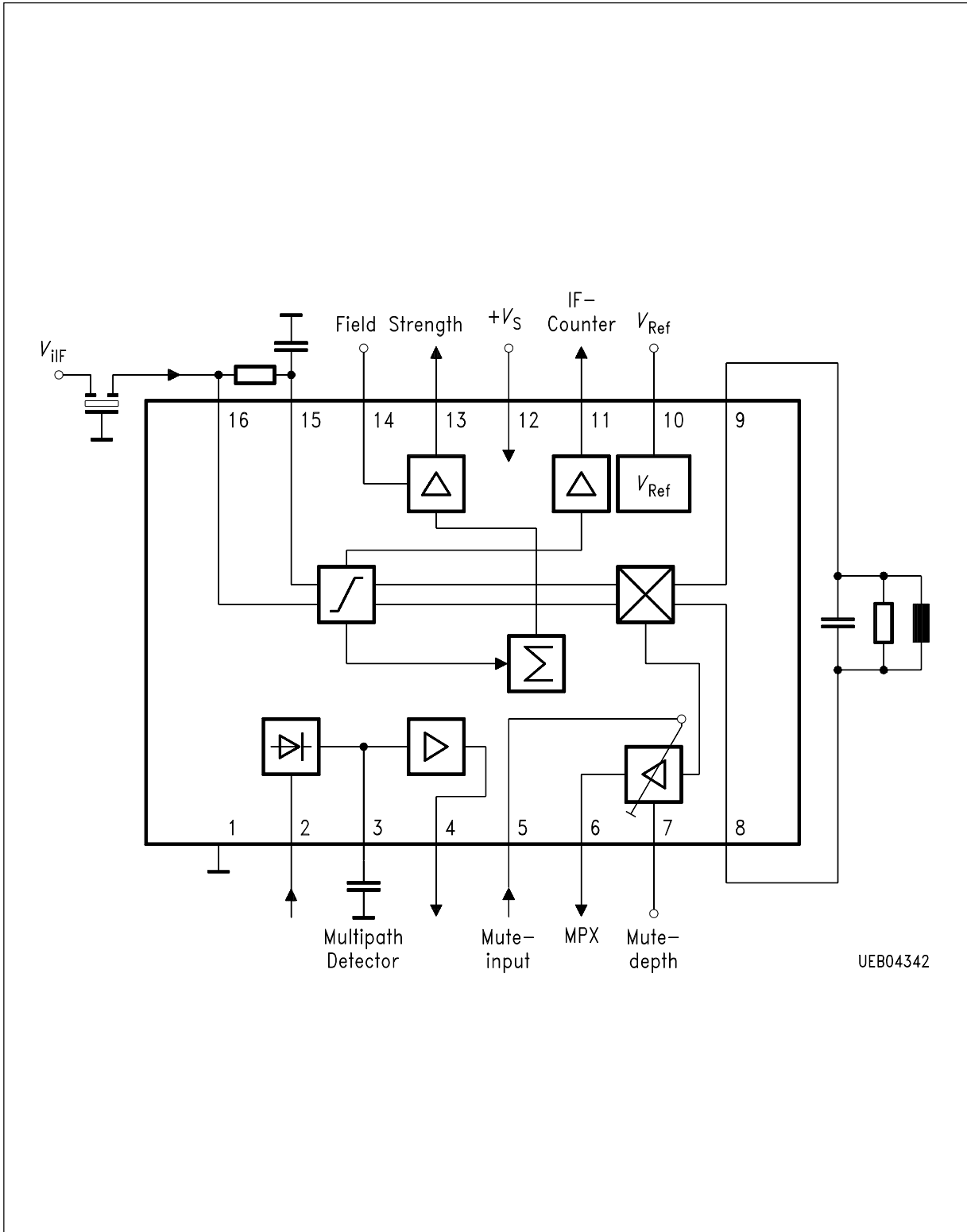


Figure 2

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2 Functional Description

The FM-IF demodulator TDA 4320X has been developed especially for car radio applications. The on-chip multipath identification circuit activates an interference suppression circuit in case of multipath interferences.

3 Circuit Description

The IC includes a 7-stage capacitive coupled limiter amplifier with coincidence demodulator and AF output. The AF output signal can be continuously attenuated to decrease the noise. In case of multipath interferences, the TDA 4320X includes an identification circuitry. There is a field strength output (with min. 76 dB dynamic range, typ. ± 1 dB nonlinearity and typ. ± 3 dB temperature drift), an IF counter output and an adjustable muting (with full muting ≥ 80 dB).

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

$$T_A = -40\text{ °C to }+85\text{ °C}$$

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|-----------------------------------|------------|--------------|------|------|---------|
| | | min. | max. | | |
| Supply voltage | V_S | 0 | 13.2 | V | |
| Junction temperature | T_j | | 150 | °C | |
| Storage temperature | T_S | | 125 | °C | |
| Thermal resistance (system-air) | R_{thSA} | | 105 | K/W | |
| ESD voltage, HBM (1.5 kΩ, 100 pF) | V_{ESD} | -4 | 4 | kV | |

Note: Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

4.2 Operating Range

$$T_A = -40\text{ °C to }+85\text{ °C}$$

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|---------------------|--------|--------------|------|------|---------|
| | | min. | max. | | |
| Supply voltage | V_S | 7.5 | 13.2 | V | |
| Ambient temperature | T_A | -40 | 85 | °C | |

Note: In the operating range the functions given in the circuit description are fulfilled.

4.3 AC/DC Characteristics

$V_S = 10\text{ V}; f_{iF} = 10.7\text{ MHz}; \Delta f = 75\text{ kHz}; f_{mod} = 1\text{ kHz};$
 $V_{iF_{rms}} = 10\text{ mV}; T_A = -40\text{ °C to } +85\text{ °C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|-------------------------------------|-------------|--------------|---------|---------|------------------|--|--------------|
| | | min. | typ. | max. | | | |
| Current consumption | I_{12} | | 30 | | mA | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Stabilized voltage | V_{10} | 4.5 | 4.8 | 5.1 | V | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Field strength output | V_{13} | | | | | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | |
| – Dynamic range | | | 80 | | dB | | D1 |
| – Nonlinearity | | | ± 1 | | dB | | D2 |
| – Temperature drift | | | | ± 3 | dB | | D3 |
| – Load capacitance | | | | 50 | pF | | |
| – Load resistance | | 1 | | | k Ω | | |
| | V_{13} | 5.0 | 5.5 | 6.0 | V | $V_{iF_{rms}} = 200\text{ mV}$ | 1 |
| | V_{13} | 2.2 | 2.7 | 3.2 | V | $V_{iF_{rms}} = 1\text{ mV}$ | 1 |
| | V_{13} | 0 | | 1.2 | V | $V_{iF_{rms}} = 0\text{ mV}$ | 1 |
| Input voltage for limiter threshold | V_{16} | | 30 | | μVrms | $V_{qAF} = -3\text{ dB}$ | 1 |
| AF output voltage | V_{qAF} | 480 | | 840 | mVrms | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Total harmonic distortion | THD_{qAF} | | | 1.2 | % | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| AM suppression | a_{AM} | 60 | | | dB | $m = 80\%$ | 1 |
| | | 76 | | | dB | $m = 30\%$ | 1 |
| Signal-to-noise ratio | $a_{S/N}$ | 76 | | | dB | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Counter output voltage | V_{11} | 50 | | | mVrms | $C_L = 5\text{ pF};$ $R_{111} = 1.5\text{ k}\Omega$ | 1 |
| Noise detector sensitivity | V_2 | | 3.2 | | mVrms | $f_2 = 20\text{ kHz}$ | 1 |
| | V_2 | | 4.3 | | mVrms | $f_2 = 300\text{ kHz}$ | 1 |
| Charge current Pin 3 | I_3 | | 2.5 | | mA | $f_2 = 20\text{ kHz};$ $V_2 \geq 6\text{ mVrms}$ | 1 |
| | | | 2.5 | | mA | $f_2 = 300\text{ kHz};$ $V_2 \geq 7\text{ mVrms}$ | 1 |
| Discharge current Pin 3 | I_3 | | 20 | | μA | $V_{2AC} = 0\text{ V}$ | 1 |

4.3 AC/DC Characteristics (cont'd)

$V_S = 10\text{ V}; f_{iF} = 10.7\text{ MHz}; \Delta f = 75\text{ kHz}; f_{mod} = 1\text{ kHz};$
 $V_{iFrms} = 10\text{ mV}; T_A = -40\text{ °C to } +85\text{ °C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|----------------------|----------|--------------|------|------|------|---|--------------|
| | | min. | typ. | max. | | | |
| AF MUTE | a_{AF} | | 0 | | dB | $V_5 = 4.8\text{ V}; V_7 = 4.8\text{ V}$ | D4 |
| | | -2 | | 2 | dB | $V_5 = 0\text{ V}; V_7 = 4.8\text{ V}$ | D4 |
| | | 30 | 38 | 46 | dB | $V_5 = 0\text{ V}; V_7 = 2.4\text{ V}$ | D4 |
| | | 80 | | | dB | $V_5 = 4.8\text{ V}; V_7 \leq 1.0\text{ V}$ | D4 |
| | | 80 | | | dB | $V_5 = 0\text{ V}; V_7 \leq 1.0\text{ V}$ | D4 |
| Voltage for MUTE OFF | V_5 | 0.7 | | | V | | 1 |
| Voltage for MUTE ON | V_5 | 0 | | | V | | 1 |

$V_S = 10\text{ V}; f_{iF} = 10.7\text{ MHz}; \Delta f = 75\text{ kHz}; f_{mod} = 1\text{ kHz};$
 $V_{iFrms} = 10\text{ mV}; T_A = 25\text{ °C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|-------------------------------------|-------------|--------------|---------|---------|------------------|--|--------------|
| | | min. | typ. | max. | | | |
| Current consumption | I_{12} | | 30 | | mA | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Stabilized voltage | V_{10} | 4.6 | 4.8 | 5.0 | V | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Field strength output | V_{13} | | | | | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | |
| Dynamic range | | 74 | 80 | | dB | | D1 |
| Nonlinearity | | | ± 1 | | dB | | D2 |
| Temperature drift | | | | ± 3 | dB | | D3 |
| Load capacitance | | | | 50 | pF | | |
| Load resistance | | | 1 | | k Ω | | |
| | V_{13} | 5.1 | 5.5 | 5.9 | V | $V_{iFrms} = 200\text{ mV}$ | 1 |
| | V_{13} | 2.3 | 2.7 | 3.1 | V | $V_{iFrms} = 1\text{ mV}$ | 1 |
| | V_{13} | 0 | | 1.1 | V | $V_{iFrms} = 0\text{ mV}$ | 1 |
| Input voltage for limiter threshold | V_{16} | | 30 | 39 | μVrms | $V_{qAF} = -3\text{ dB}$ | 1 |
| AF output voltage | V_{qAF} | 550 | 650 | 750 | mVrms | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| Total harmonic distortion | THD_{qAF} | | | 1.2 | % | $V_5 = 4.8\text{ V}; V_7 = 4\text{ V}$ | 1 |
| AM suppression | a_{AM} | 60 | | | dB | $m = 80\%$ | 1 |
| | | 76 | 82 | | dB | $m = 30\%$ | 1 |

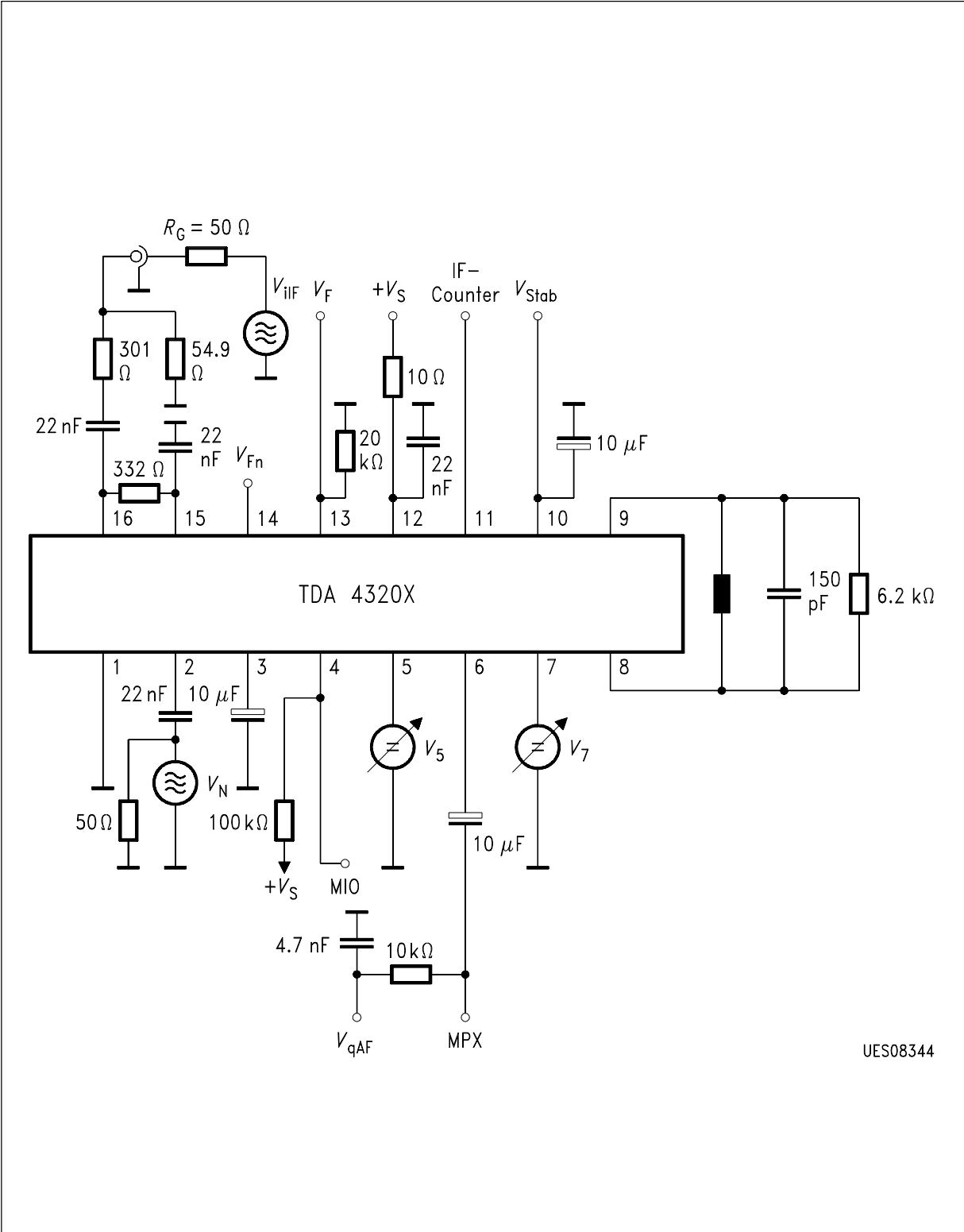
4.3 AC/DC Characteristics (cont'd)

$V_S = 10\text{ V}$; $f_{iF} = 10.7\text{ MHz}$; $\Delta f = 75\text{ kHz}$; $f_{\text{mod}} = 1\text{ kHz}$;

$V_{iF\text{rms}} = 10\text{ mV}$; $T_A = 25\text{ °C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|----------------------------|-----------|--------------|------|------|---------------|---|--------------|
| | | min. | typ. | max. | | | |
| Signal-to-noise ratio | $a_{S/N}$ | 76 | 84 | | dB | $V_5 = 4.8\text{ V}$; $V_7 = 4\text{ V}$ | 1 |
| Counter output voltage | V_{11} | 50 | 80 | | mVrms | $C_L = 5\text{ pF}$; $R_{i11} = 1.5\text{ k}\Omega$ | 1 |
| Noise detector sensitivity | V_2 | 2 | 3.2 | 6 | mVrms | $f_2 = 20\text{ kHz}$ | 1 |
| | V_2 | 2.7 | 4.3 | 7 | mVrms | $f_2 = 300\text{ kHz}$ | 1 |
| Charge current Pin 3 | I_3 | 1.6 | 2.5 | 4 | mA | $f_2 = 20\text{ kHz}$; $V_2 \geq 6\text{ mVrms}$ | 1 |
| | | 1.6 | 2.5 | 4 | mA | $f_2 = 300\text{ kHz}$; $V_2 \geq 7\text{ mVrms}$ | 1 |
| Discharge current Pin 3 | I_3 | 10 | 20 | 40 | μA | $V_{2AC} = 0\text{ V}$ | 1 |
| AF MUTE | a_{AF} | | 0 | | dB | $V_5 = 4.8\text{ V}$; $V_7 = 4.8\text{ V}$ | D4 |
| | | -2 | | 2 | dB | $V_5 = 0\text{ V}$; $V_7 = 4.8\text{ V}$ | D4 |
| | | 32 | 38 | 44 | dB | $V_5 = 0\text{ V}$; $V_7 = 2.4\text{ V}$ | D4 |
| | | 80 | | | dB | $V_5 = 4.8\text{ V}$; $V_7 \leq 1.0\text{ V}$ | D4 |
| | | 80 | | | dB | $V_5 = 0\text{ V}$; $V_7 \leq 1.0\text{ V}$ | D4 |
| Voltage for MUTE OFF | V_5 | 0.5 | | | V | | 1 |
| Voltage for MUTE ON | V_5 | 0 | | 0.1 | V | | 1 |

Test Circuit 1

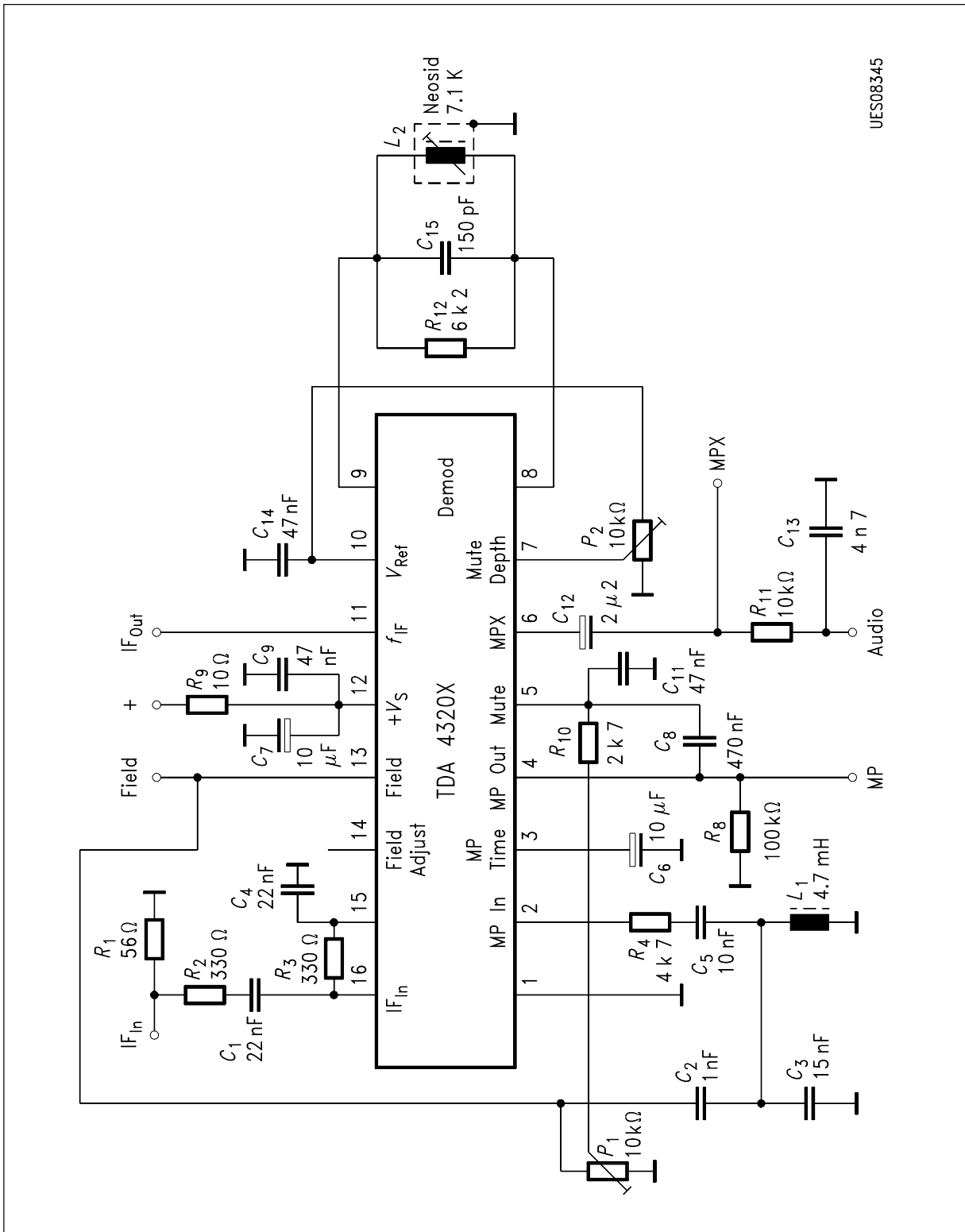


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Figure 3

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Application Circuit

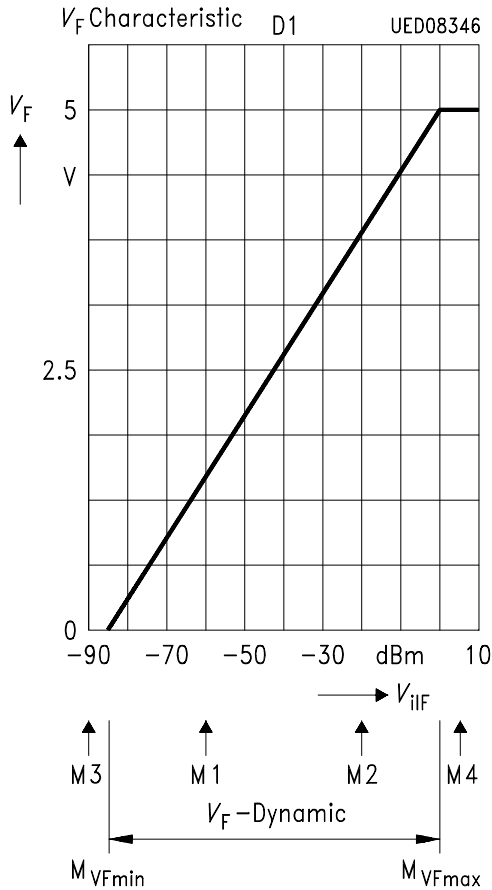


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Figure 4

Diagrams

Diagram D1



V_F Dynamics

The dynamic range of V_F voltage is determined by the test points M1 through M4 as follows:

M1: test point (at $V_{iiF} = -60$ dBm) supplies $V_F(M1)$

M2: test point (at $V_{iiF} = -20$ dBm) supplies $V_F(M2)$

M3: test point (at $V_{iiF} = -90$ dBm) supplies $V_F(M3)$

M4: test point (at $V_{iiF} = +5$ dBm) supplies $V_F(M4)$

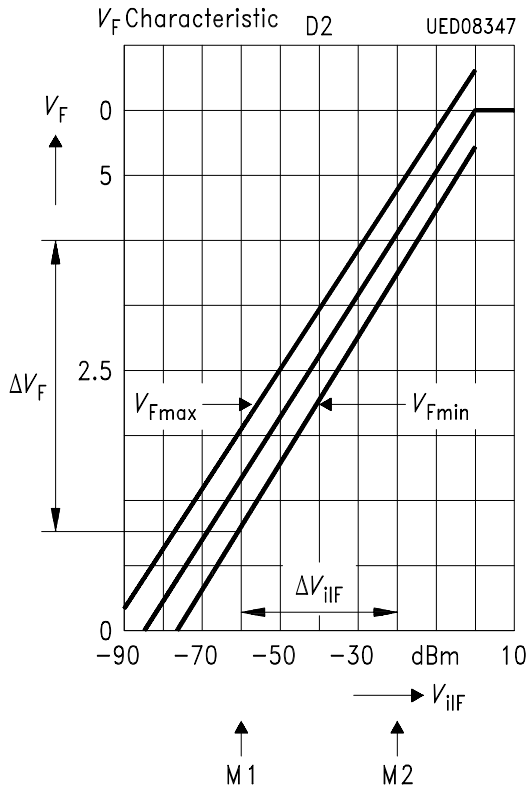
Hence follows:

$$M_{VFmax} := -20 \text{ dBm} + (V_F(M4) - V_F(M2)) / (V_F(M2) - V_F(M1)) \times 40 \text{ dB}$$

$$M_{VFmin} := -60 \text{ dBm} - (V_F(M1) - V_F(M3)) / (V_F(M2) - V_F(M1)) \times 40 \text{ dB}$$

$$V_{F \text{ Dynamics}} = M_{VFmax} - M_{VFmin}$$

Diagram D2



Test points to determine V_F linearity:

V_F is determined at 25 °C

Slope: $m = (V_F(M2) - V_F(M1))/40 \text{ dB}$.

The tolerance range of the V_F -linearity is determined by two parallel lines:

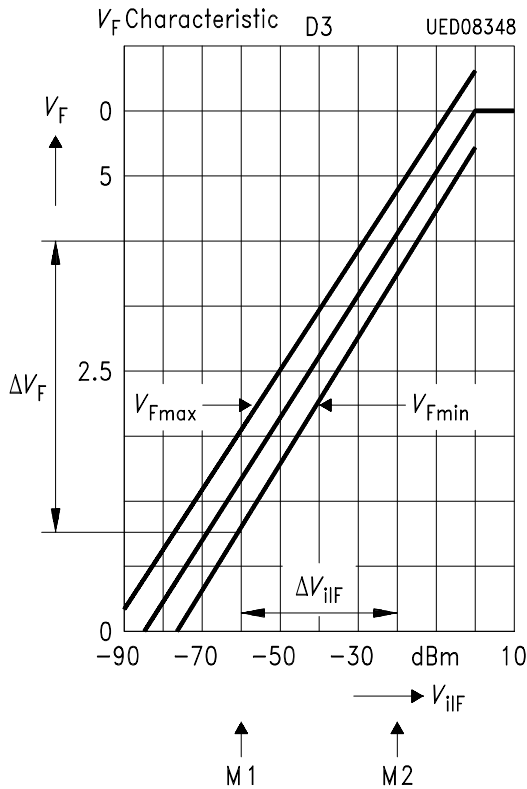
$$V_{F \text{ max}} = V_F(M1) + m(M + 60 \text{ dB} + 1 \text{ dB})$$

$$V_{F \text{ min}} = V_F(M1) + m(M + 60 \text{ dB} - 1 \text{ dB})$$

The V_F values within the V_F dynamic range ($M_{VF \text{ min}} \leq M \leq M_{VF \text{ max}}$) must be inside the predetermined tolerance range:

$$V_{F \text{ min}} \leq V_F(M) \leq V_{F \text{ max}}$$

Diagram D3



Test points to determine V_F temperature drift:

V_F -temperature drift: it is determined within -40 to $+85$ °C.

Slope: $m = (V_F(M2) - V_F(M1))/40$ dB (at 25 °C).

The tolerance range of the V_F -temperature is determined by two parallel lines:

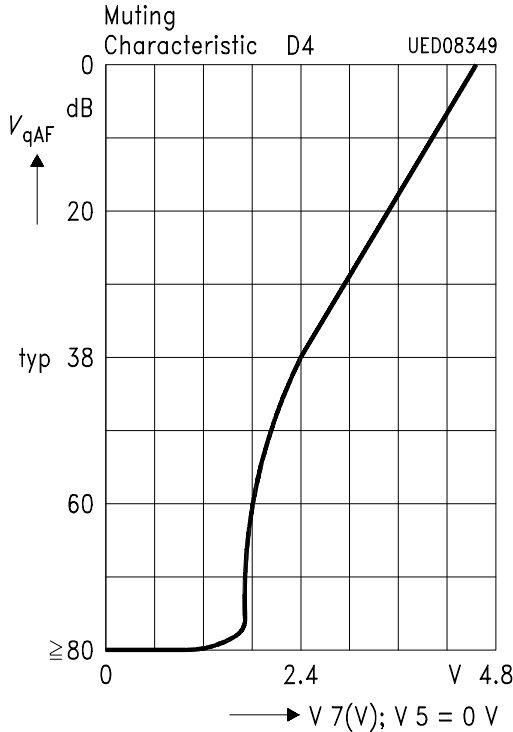
$$V_{F \max} = V_F(M1) + m(M + 60 \text{ dB} + 3 \text{ dB})$$

$$V_{F \min} = V_F(M1) + m(M + 60 \text{ dB} - 3 \text{ dB})$$

The V_F values for temperatures between -40 to $+85$ °C within the V_F dynamic range ($M_{VF \min} \leq V_F \leq M_{VF \max}$) must be inside the predetermined tolerance field:

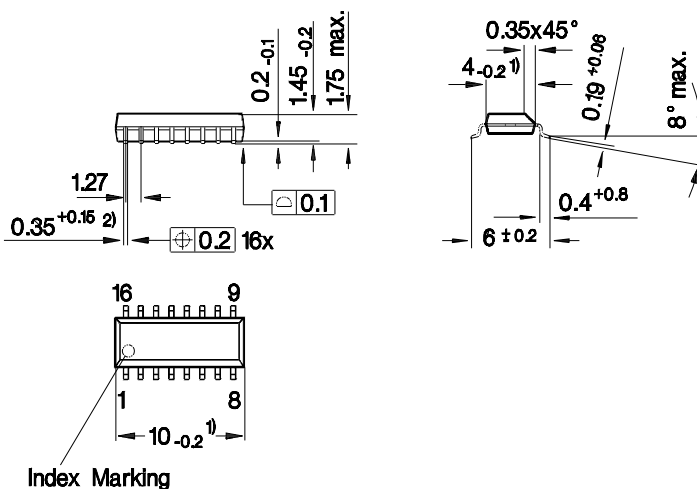
$$V_{F \min} \leq V_F(M) \leq V_{F \max}$$

Diagram D4
Mute Characteristics



5 Package Outlines

P-DSO-16-1
(Plastic Dual Small Outline Package)



- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Does not include dambar protrusion

GPS05119

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm