

# DATA SHEET



## **TEA6823T; TEA6825T** In Car Entertainment (ICE) car radio

Preliminary specification  
File under Integrated Circuits, IC01

1998 Mar 24

**In Car Entertainment (ICE) car radio****TEA6823T; TEA6825T****FEATURES****General**

- FM mixer for conversion from FM-IF<sub>1</sub> = 72.2 MHz to FM-IF<sub>2</sub> = 10.7 MHz
- AM mixer for conversion from AM-IF<sub>1</sub> = 10.7 MHz to AM-IF<sub>2</sub> = 450 kHz
- FM-IF gain stage
- Crystal oscillator providing mixer frequencies and references for IF-count and stereo decoder
- FM quadrature demodulator with automatic centre frequency adjustment and THD compensation
- Level, multi-path and noise detectors
- Soft mute
- Stereo noise cancelling and variable de-emphasis
- PLL stereo decoder
- Noise blanker
- AM IF-amplifier and demodulator
- I<sup>2</sup>C-bus transceiver with interface to enable direct data transfer to radio front-end
- IF-count for AM and FM
- Reference frequency generation for PLL synthesizer.

**Stereo decoder**

- Adjustment-free PLL VCO
- Pilot depending mono/stereo switching
- Analog control of mono/stereo blend
- Adjacent channel noise suppression (114 kHz)
- Pilot cancelled
- Analog control of de-emphasis
- Integrated low-pass filters for 190 kHz adjacent channel interferences and signal delay for interference absorption circuit.

**GENERAL DESCRIPTION**

The TEA6823T together with the TEA6811T and the TEA6825T together with the TEA6810T form an AM/FM electronic tuned car radio in a double conversion receiver concept.

**ORDERING INFORMATION**

| TYPE NUMBER | PACKAGE |   |          |
|-------------|---------|---|----------|
|             | NAME    | DESCRIPTION   | VERSION  |
| TEA6823T    | VSO56   | plastic very small outline package; 56 leads            | SOT190-1 |
| TEA6825T    | VSO56   | plastic very small outline package; 56 leads; face down | SOT190-2 |

## In Car Entertainment (ICE) car radio

## TEA6823T; TEA6825T

## QUICK REFERENCE DATA

| SYMBOL                            | PARAMETER                                | CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------|--|--|------|------|------|------|
| V <sub>DDA1</sub>                 | analog supply voltage 1 (+5 V; pin 5)    | note 1   | 4.5  | 5.0  | 5.5  | V    |
|                                   |  | operating range  | 4.75 | 5.0  | 5.25 | V    |
| I <sub>DDA1</sub>                 | analog supply current 1 (pin 5)          | FM mode  | 17   | 21   | 25   | mA   |
|                                   |  | AM mode  | 14   | 17   | 21   | mA   |
| I <sub>19</sub> + I <sub>20</sub> | total FM mixer output current            |  | 4.8  | 6.0  | 7.2  | mA   |
| I <sub>22</sub> + I <sub>23</sub> | total AM mixer output current            |  | 10   | 12   | 14   | mA   |
| V <sub>DDA2</sub>                 | analog supply voltage 2 (pin 28)         | note 1   | 7.0  | 8.5  | 10   | V    |
|                                   |  | operating range  | 8.1  | 8.5  | 8.9  | V    |
| I <sub>DDA2</sub>                 | analog supply current 2 (pin 28)         | FM mode  | 2.4  | 3.0  | 3.6  | mA   |
| V <sub>DDA3</sub>                 | analog supply voltage 3 (+8.5 V; pin 56) | note 1   | 7.0  | 8.5  | 10   | V    |
|                                   |  | operating range  | 8.1  | 8.5  | 8.9  | V    |
| I <sub>DDA3</sub>                 | analog supply current 3 (pin 56)         | FM mode  | 19   | 24   | 28   | mA   |
|                                   |  | AM mode  | 9.5  | 12   | 15   | mA   |
| V <sub>DDD</sub>                  | digital supply voltage 1 (+5 V; pin 52)  | note 1   | 4.5  | 5.0  | 5.5  | V    |
|                                   |  | operating range  | 4.75 | 5.0  | 5.25 | V    |
| I <sub>DDD</sub>                  | digital supply current (pin 52)          | note 1   | 8    | 10   | 12   | mA   |
| $\frac{S + N}{N}$                 | signal plus noise-to-noise ratio         | FM mode;<br>$\Delta f = 22.5$ kHz at<br>pins 43 and 47 | 66   | 75   | –    | dB   |
|                                   |  | AM mode; m = 0.3                                       | 54   | 60   | –    | dB   |
| THD                               | total harmonic distortion                | FM mode; $\Delta f = 75$ kHz                           | –    | 0.1  | 0.35 | %    |
|                                   |  | AM mode  | –    | 1.5  | 3    | %    |
| $\alpha_{cs}$                     | channel separation (adjusted)            |  | 40   | –    | –    | dB   |
| T <sub>amb</sub>                  | operating ambient temperature            |  | –40  | –    | +85  | °C   |

## Note

1. IC is operating; specified parameters may deviate from limits which are valid for operating range.

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## TEA6823T, TEA6825T

### BLOCK DIAGRAM

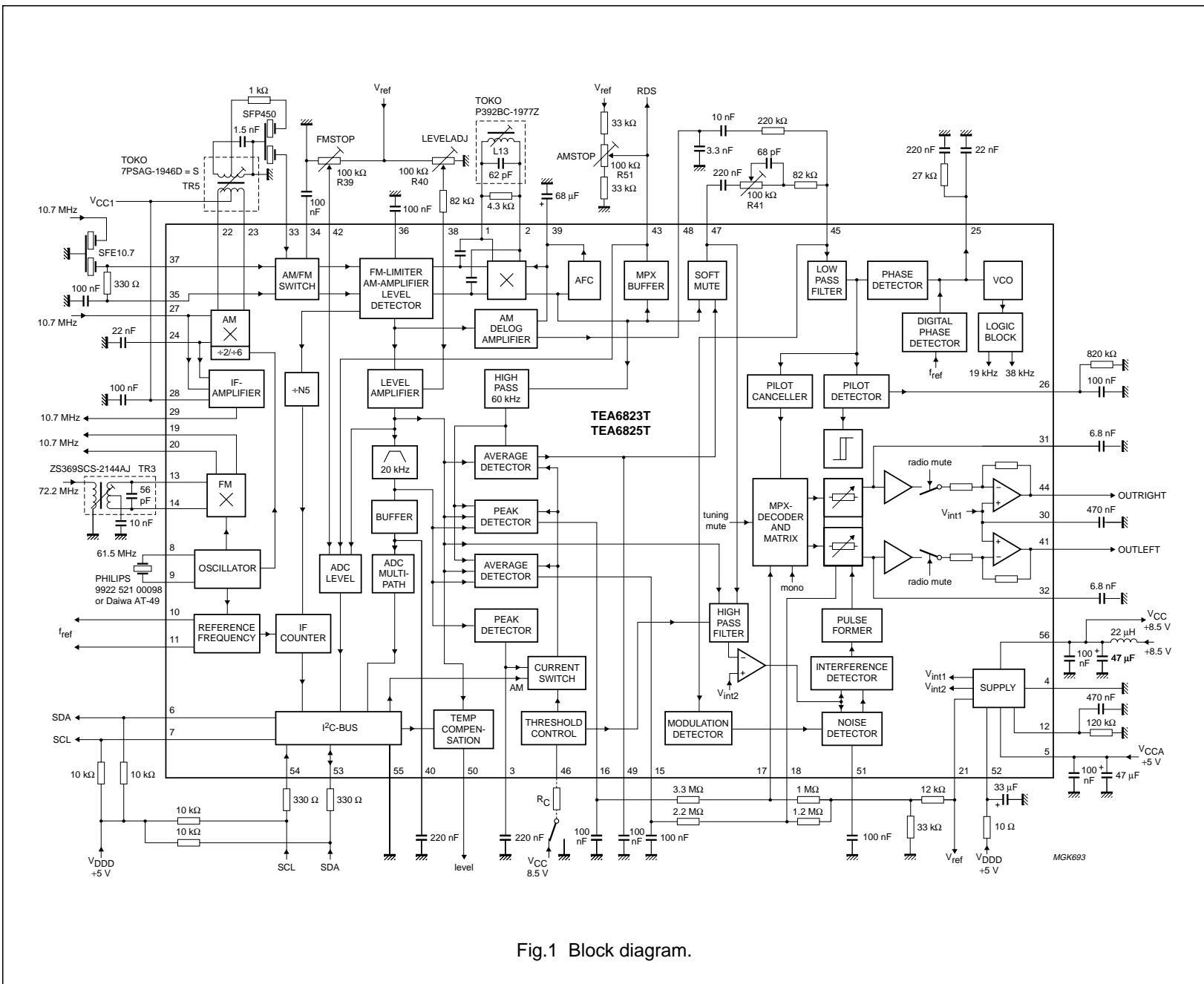


Fig.1 Block diagram.

## In Car Entertainment (ICE) car radio

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## PINNING

| SYMBOL              | PIN | DESCRIPTION                           |
|---------------------|-----|---------------------------------------|
| QDET1               | 1   | demodulator tank 1                    |
| QDET2               | 2   | demodulator tank 2                    |
| TSWITCH             | 3   | time switch input                     |
| AGND                | 4   | analog ground                         |
| V <sub>DDA1</sub>   | 5   | analog supply voltage 1 (+5 V)        |
| HFBUS1              | 6   | HF bus 1 output;<br>pull-up to +5 V   |
| HFBUS2              | 7   | HF bus 2 output;<br>pull-up to +5 V   |
| XTAL1               | 8   | crystal oscillator 1                  |
| XTAL2               | 9   | crystal oscillator 2                  |
| f <sub>ref(p)</sub> | 10  | PLL reference frequency<br>output (p) |
| f <sub>ref(n)</sub> | 11  | PLL reference frequency<br>output (n) |
| I <sub>ref</sub>    | 12  | reference current                     |
| FMIF1IN1            | 13  | 72 MHz FM-IF input 1                  |
| FMIF1IN2            | 14  | 72 MHz FM-IF input 2                  |
| TSDR                | 15  | time constant for SDR                 |
| TSDS                | 16  | time constant for SDS                 |
| V <sub>SDS</sub>    | 17  | SDS control voltage input             |
| V <sub>SDR</sub>    | 18  | SDR control voltage input             |
| FMIF2OUT1           | 19  | FM mixer output 1                     |
| FMIF2OUT2           | 20  | FM mixer output 2                     |
| V <sub>ref</sub>    | 21  | reference voltage output              |
| AMIF2OUT1           | 22  | AM mixer output 1                     |
| AMIF2OUT2           | 23  | AM mixer output 2                     |
| FMAMDEC             | 24  | FM/AM 10.7 MHz decoupling             |
| PHASEDET            | 25  | phase detector output                 |
| PILDET              | 26  | pilot detector output                 |
| FMAM10.7            | 27  | FM/AM 10.7 MHz input                  |
| V <sub>DDA2</sub>   | 28  | analog supply voltage 2               |

| SYMBOL                | PIN | DESCRIPTION                                  |
|-----------------------|-----|--|
| FMIFAMPDOUT           | 29  | FM-IF amplifier output                       |
| AFGND                 | 30  | AF ground                                    |
| DEEMPHR               | 31  | de-emphasis capacitor right                  |
| DEEMPHL               | 32  | de-emphasis capacitor left                   |
| AMIF2IN1              | 33  | AM-IF <sub>2</sub> input 1                   |
| AMIF2IN2              | 34  | AM-IF <sub>2</sub> input 2                   |
| FMIN2                 | 35  | FM limiter input                             |
| DCFEED                | 36  | DC feed FM limiter                           |
| FMIN1                 | 37  | FM limiter input                             |
| LEVELADJ              | 38  | level adjustment input                       |
| C <sub>AFC</sub>      | 39  | AFC capacitor                                |
| MPBUF                 | 40  | multi-path buffer time constant              |
| OUTLEFT               | 41  | AF output left                               |
| FMSTOP                | 42  | FMSTOP adjustment input                      |
| RDS/AMSTOP            | 43  | MPX for RDS/AMSTOP<br>adjustment input       |
| OUTRIGHT              | 44  | AF output right                              |
| MPXIN                 | 45  | stereo decoder MPX input                     |
| THRES                 | 46  | threshold                                    |
| MPXOUT                | 47  | FM demodulator MPX output                    |
| AMAFOUT               | 48  | AM demodulator AF output                     |
| V <sub>mute/AML</sub> | 49  | mute voltage/AM level                        |
| LEVELUNWEIG           | 50  | unweighted level output                      |
| IAC <sub>CONTR</sub>  | 51  | IAC control voltage                          |
| V <sub>DDD</sub>      | 52  | digital supply voltage                       |
| SDA                   | 53  | serial data input/output;<br>pull-up to +5 V |
| SCL                   | 54  | serial clock input;<br>pull-up to +5 V       |
| DGND                  | 55  | digital ground                               |
| V <sub>DDA3</sub>     | 56  | analog supply voltage 3<br>(+8.5 V)          |

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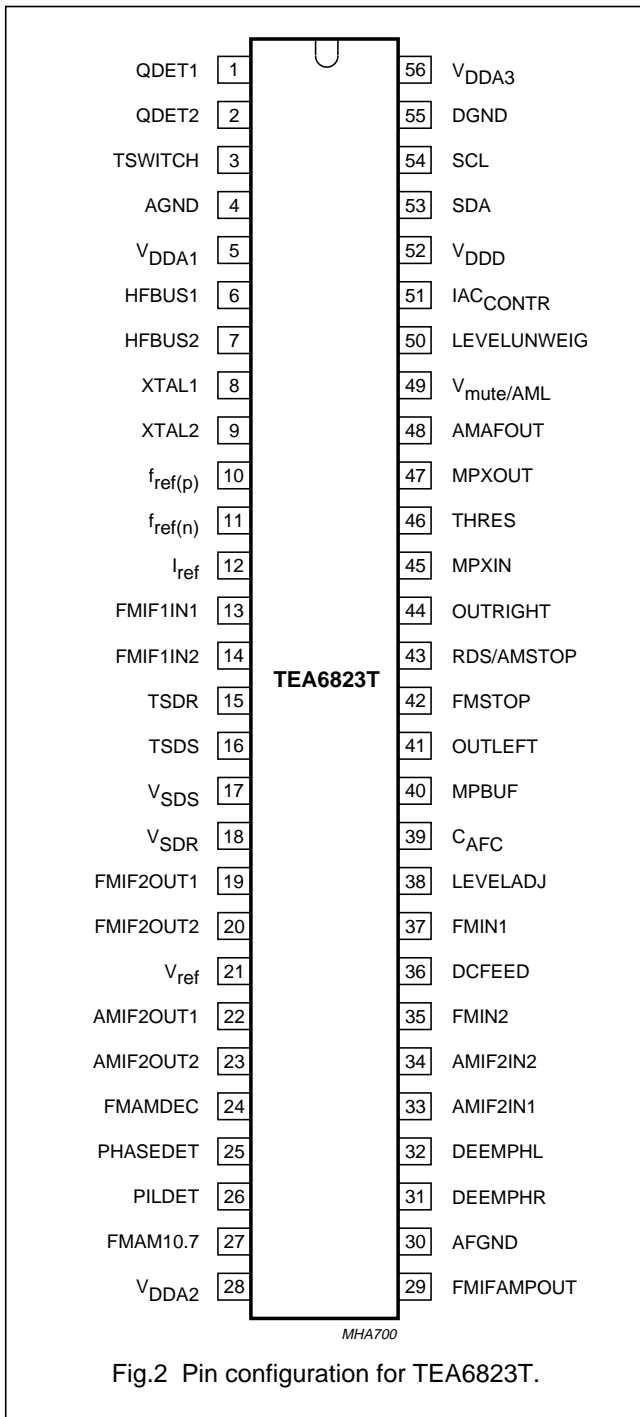


Fig.2 Pin configuration for TEA6823T.

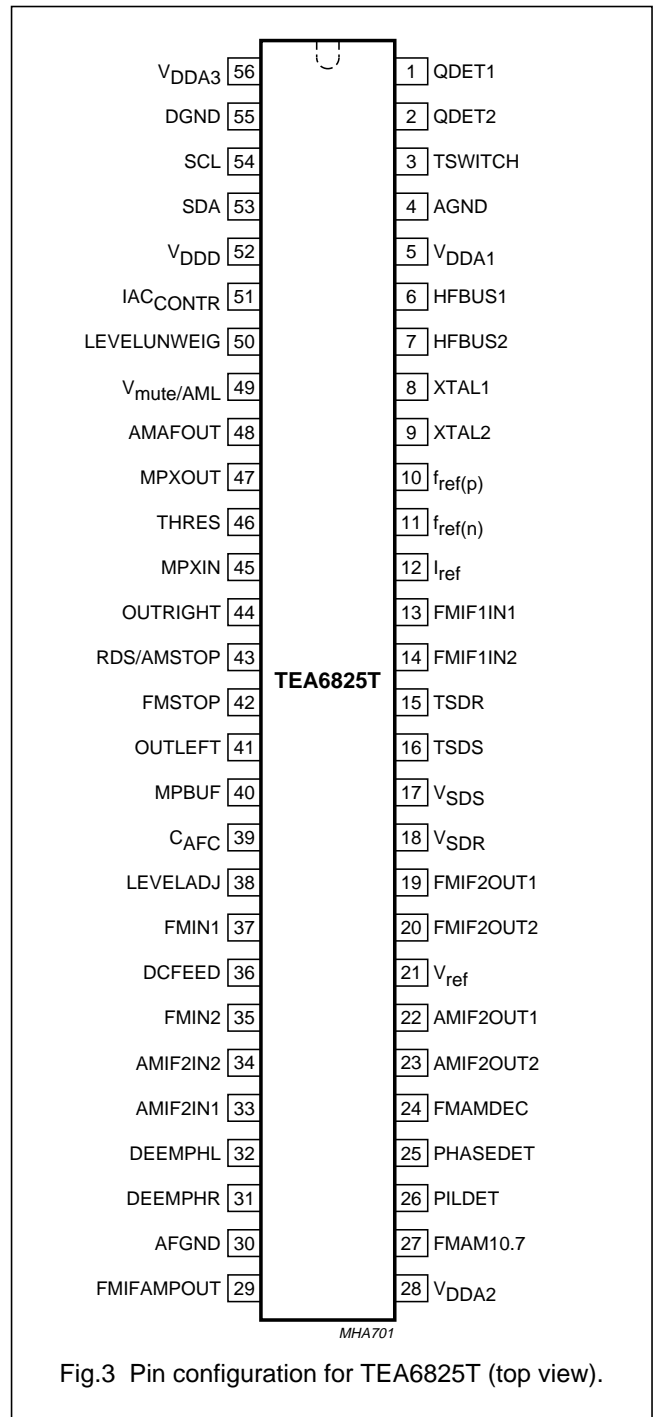


Fig.3 Pin configuration for TEA6825T (top view).

**FUNCTIONAL DESCRIPTION**

**Stereo decoder**

By changing the value of the input resistor at pin 12 the MPX input can be adapted to the level of the FM demodulator output (see Fig.16).

A 3rd order low-pass filter ( $f_g = 90 \text{ kHz}$ ) at the MPX input provides an extra 190 kHz ACI suppression.

An interference gate is connected at the MPX demodulator outputs. For AM the VCO is switched off.

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL            | PARAMETER                        | CONDITIONS | MIN. | MAX. | UNIT |
|-------------------|----------------------------------|------------|------|------|------|
| V <sub>DDA1</sub> | analog supply voltage 1 (pin 5)  |            | -0.3 | +6.5 | V    |
| V <sub>DDA2</sub> | analog supply voltage 2 (pin 28) |            | -0.3 | +12  | V    |
| V <sub>DDA3</sub> | analog supply voltage 3 (pin 56) |            | -0.3 | +12  | V    |
| V <sub>DDD</sub>  | digital supply voltage (pin 52)  |            | -0.3 | +6.5 | V    |
| T <sub>stg</sub>  | storage temperature              |            | -55  | +150 | °C   |
| T <sub>amb</sub>  | operating ambient temperature    |            | -40  | +85  | °C   |
| V <sub>es</sub>   | electrostatic handling           | note 1     |      |      |      |
|                   | pins 8 and 9                     |            | -100 | +100 | V    |
|                   | all other pins                   |            | -300 | +300 | V    |

**Note**

- Charge device model class B: equivalent to discharging a 200 pF capacitor via a 0 Ω series resistor.

**CHARACTERISTICS**

V<sub>56-4</sub> = V<sub>28-4</sub> = 8.5 V; V<sub>5-4</sub> = V<sub>52-55</sub> = 5 V; T<sub>amb</sub> = 25 °C; f<sub>mod</sub> = 1 kHz; deviation = 22.5 kHz; R<sub>g</sub> = 50 Ω; V<sub>37-35</sub> = 10 mV; with de-emphasis = 50 μs; coil quality = 15; unless otherwise specified.

| SYMBOL                                    | PARAMETER  | CONDITIONS     | MIN. | TYP. | MAX. | UNIT |
|---|--|----------------|------|------|------|------|
| <b>Currents</b>                           |  |                |      |      |      |      |
| I <sub>DDA1</sub>                         | analog supply current 1 (pin 5)                    | FM mode        | 17   | 21   | 25   | mA   |
|   |  | AM mode        | 14   | 17   | 21   | mA   |
| I <sub>DDA2</sub>                         | analog supply current 2 (pin 28)                   | FM mode        | 2.4  | 3.0  | 3.6  | mA   |
| I <sub>DDA3</sub>                         | analog supply current 3 (pin 56)                   | FM mode        | 19   | 24   | 28   | mA   |
|   |  | AM mode        | 9.5  | 12   | 15   | mA   |
| I <sub>DDD</sub>                          | digital supply current (pin 52)                    |                | 8    | 10   | 12   | mA   |
| I <sub>19</sub> + I <sub>20</sub>         | total FM mixer output current                      |                | 4.8  | 6.0  | 7.2  | mA   |
| I <sub>22</sub> + I <sub>23</sub>         | total AM mixer output current                      | AM mode        | 10   | 12   | 14   | mA   |
| <b>FM-IF path; see Fig.4</b>              |  |                |      |      |      |      |
| V <sub>19-20 max(p-p)</sub>               | maximum output voltage (peak-to-peak value)        |                | 12.0 | 14.0 | –    | V    |
| I <sub>19</sub> ; I <sub>20</sub>         | mixer bias current                                 |                | 2.4  | 3.0  | 3.6  | mA   |
|   | mixer leakage current                              | in AM position | –    | –    | 2    | μA   |
| I <sub>19IF2</sub> /V <sub>13-14IF1</sub> | conversion gain                                    |                | 1.65 | 1.9  | 2.2  | mS   |
| R <sub>i</sub>                            | input resistance (pins 13 to 14)                   |                | 5    | 7    | –    | kΩ   |
| C <sub>i</sub>                            | input capacitance (pins 13 to 14)                  |                | –    | 3    | 4.5  | pF   |
| R <sub>opt</sub>                          | optimum generator resistance                       |                | –    | 1.2  | –    | kΩ   |
| R <sub>o</sub>                            | output resistance (pins 19 to 20)                  |                | 15   | 20   | –    | kΩ   |
| C <sub>o</sub>                            | output capacitance (pins 19 to 4 and pins 20 to 4) |                | –    | 12   | 14   | pF   |
| IP3                                       | third order intermodulation                        |                | 114  | 124  | –    | dBμV |

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| SYMBOL                             | PARAMETER  | CONDITIONS  | MIN. | TYP.                | MAX. | UNIT            |
|------------------------------------|--|---|------|---------------------|------|-----------------|
| <b>Oscillator</b>                  |  |   |      |                     |      |                 |
| $f_{osc}$                          | oscillator frequency   |   | –    | 61.5                | –    | MHz             |
| $\Delta f_{osc}$                   | oscillator frequency spread                                  |   | –    | –                   | 250  | Hz              |
| $\Delta f_{osc}/\Delta T$          | temperature dependence of oscillator frequency               | crystal type Philips 9922 521 00098                                 | –    | $30 \times 10^{-6}$ | –    | K <sup>-1</sup> |
| $R_1$                              | crystal motional resistance                                  |   | –    | –                   | 70   | $\Omega$        |
| $C_0$                              | crystal shunt capacitance                                    |   | –    | –                   | 5    | pF              |
| <b>FM-IF<sub>2</sub> amplifier</b> |  |   |      |                     |      |                 |
| $V_{27-24 \max(rms)}$              | maximum input voltage for 1 dB compression point (RMS value) |   | 80   | 110                 | –    | mV              |
| $V_{29-4 \max(rms)}$               | maximum output voltage (RMS value)                           |   | 220  | 320                 | –    | mV              |
| $V_{29-4}/V_{27-24}$               | amplifier gain   | $R_L = 330 \Omega$ ; see Fig.5                                      | 9    | 12                  | 15   | dB              |
| $\Delta V_{29-4}/V_{27-24}$        | gain temperature dependence                                  | $-25 \text{ }^\circ\text{C} < T_{amb} < +85 \text{ }^\circ\text{C}$ | –    | 0.1                 | –    | dB/K            |
| $R_i$                              | input resistance (pins 27 to 24)                             |   | 300  | 330                 | 360  | $\Omega$        |
| $C_i$                              | input capacitance (pins 27 to 4)                             |   | –    | –                   | 5    | pF              |
| $R_o$                              | output resistance (pin 29)                                   |   | 300  | 330                 | 360  | $\Omega$        |
| $C_o$                              | output capacitance (pins 29 to 4)                            |   | –    | –                   | 5    | pF              |
| <b>FM-IF<sub>2</sub> limiter</b>   |  |   |      |                     |      |                 |
| $V_{o \ 1-2(p-p)}$                 | limiter output voltage (peak-to-peak value)                  |   | 500  | 700                 | –    | mV              |
| $V_{1-2}/V_{37-35}$                | limiter gain   | see Fig.6   | –    | 80                  | –    | dB              |
| $C_i$                              | input capacitance (pins 37 to 4)                             |   | –    | –                   | 5    | pF              |
| $R_o$                              | output resistance (pins 1 to 2)                              |   | –    | –                   | 1.0  | k $\Omega$      |
| $C_o$                              | output capacitance (pins 1 to 2)                             |   | 10   | 15                  | 20   | pF              |



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| SYMBOL   | PARAMETER  | CONDITIONS  | MIN. | TYP. | MAX. | UNIT       |
|--|--|---|------|------|------|------------|
| <b>FM demodulator</b>                                |  |   |      |      |      |            |
| $V_{47-4(rms)}$                                      | MPX output voltage (RMS value)                                 |   | 160  | 200  | 240  | mV         |
| $V_{43-4(rms)}$                                      | MPX output voltage for RDS (RMS value)                         |   | 160  | 200  | 240  | mV         |
| $V_{37-35(rms)}$                                     | start of limiting voltage (RMS value)                          | $\alpha_{AF} = -3$ dB   | –    | 25   | 40   | $\mu$ V    |
| $V_{37-35(rms)}$                                     | input voltage for signal plus noise-to-noise ratio (RMS value) | see Fig.7 for pin 47 (MPXOUT) and Fig.8 for pin 43 (RDS/AMSTOP)<br><br>$\frac{S+N}{N} = 26$ dB<br><br>$\frac{S+N}{N} = 46$ dB   | –    | 30   | 45   | $\mu$ V    |
| $\Delta V_{43DC}$                                    | residual DC-offset voltage                                     | $\Delta L_{demod} =$ typical value  | –    | 100  | 1000 | mV         |
|  |  | $10 \mu V < V_{37-35} < 80 \mu V$<br>$80 \mu V < V_{37-35} < 800$ mV  | –    | 10   | 30   | mV         |
| $V_{43FM}/V_{43AM}$                                  | AM suppression   | $\Delta f = 22.5$ kHz;<br>$f_{modAM} = 1$ kHz;<br>$m_{AM} = 30\%$ ;<br>$V_{37-35} = 3$ to 300 mV  | 50   | 60   | –    | dB         |
| $V_{47FM}/V_{47AM}$                                  | AM suppression   | $V_{37-35} = 1$ to 300 mV   | 50   | 60   | –    | dB         |
| $\Delta V_{43-44AFCdis} / \Delta V_{43-44AFCactive}$ | demodulator frequency control voltage (AFC) efficiency         | at 100 kHz detune from exact tuning   | 28   | 32   | –    | dB         |
| $R_o$  | output resistance (pin 47)                                     |   | –    | –    | 3    | k $\Omega$ |
|  | output resistance (pin 43)                                     |   | –    | –    | 1.5  | k $\Omega$ |
|  | AF bandwidth (pin 43)  |   | 200  | –    | –    | kHz        |
| $\frac{S+N}{N}$                                      | signal plus noise-to-noise ratio                               |   | 66   | 75   | –    | dB         |
| THD  | total harmonic distortion                                      | detuning $\leq 50$ kHz;<br>$\Delta f = 75$ kHz; $f_{mod} = 1$ kHz<br>without de-emphasis;<br>$L_{demod} =$ typical value<br>pin 43;<br>$V_{37-35} = 300 \mu V$<br>to 800 mV | –    | 0.1  | 0.35 | %          |
|  |  | pin 47;<br>$V_{37-35} = 1$ to 800 mV  | –    | 0.1  | 0.35 | %          |

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| SYMBOL  | PARAMETER                         | CONDITIONS   | MIN.        | TYP.        | MAX.        | UNIT               |
|---|-----------------------------------|--|-------------|-------------|-------------|--------------------|
| <b>Unweighted voltage level</b>   |                                   |  |             |             |             |                    |
| $V_{50-4}$  | unweighted voltage level          | see Fig.9; $V_{38} = 2.52 \text{ V}$<br>$V_{37-35} \leq 2.5 \mu\text{V}$<br>$V_{37-35} = 1.0 \text{ mV}$               | 1.6<br>2.7  | 2.2<br>3.4  | 3.0<br>4.7  | V<br>V             |
| $\Delta V_{50-4}/\Delta V_{37-35}$  | slope of unweighted voltage level | $100 \mu\text{V (RMS)} \leq V_{37-35} < 300 \text{ mV}$<br>temperature compensation off<br>temperature compensation on | 0.75<br>0.6 | 0.9<br>0.75 | 1.05<br>0.9 | V/20 dB<br>V/20 dB |
| $\Delta V_{50-4}/\text{VK}$   | temperature dependence            | $V_{37-35} = 1 \text{ mV}$<br>temperature compensation off<br>temperature compensation on                              | –<br>–      | 5.0<br>2.0  | –<br>–      | mV/VK<br>mV/VK     |
| $I_{50(\text{max})\text{source}}$   | maximum output source current     |  | 0.3         | –           | –           | mA                 |
| $I_{50(\text{max})\text{sink}}$   | maximum output sink current       |  | –50         | –           | –           | $\mu\text{A}$      |
| $R_{o50}$   | output resistance                 |  | –           | –           | 300         | $\Omega$           |
| <b>ADJUSTMENT OF UNWEIGHTED VOLTAGE LEVEL AND <math>V_{\text{mute/AML}}</math>; note 1</b>  |                                   |  |             |             |             |                    |
| $\Delta V_{50}$   | adjusting range voltage           | $V_{37-35} = 10 \text{ mV (RMS)}$  | –1.8        | –           | +1.8        | V                  |
| $V_{38-4}$  | internal bias voltage             |  | –           | 2.6         | –           | V                  |
| $\Delta V_{50-4}/\Delta V_{38-4}$   | adjusting gain                    |  | –           | –0.9        | –           | –                  |
| $R_{i38}$   | input resistance                  |  | –           | 80          | –           | k $\Omega$         |
| <b>MUTING DEPENDENCE ON ADJUST OF LEVEL UNWEIGHTED VOLTAGE; note 2</b>                      |                                   |  |             |             |             |                    |
| $V_{43}/V_{47}$   | start of mute                     | $V_{49}/V_{21} = 0.625$  | 1           | 3           | 7           | dB                 |
| $\frac{\Delta V_{43}/V_{47}}{\Delta V_{49}}$  | mute slope                        | $V_{43}/V_{47} = -6 \text{ dB}$  | –           | 25          | –           | dB/V               |
| <b>Soft mute, time constant control, mono/stereo blend and high-cut control; see Fig.22</b> |                                   |  |             |             |             |                    |
| <b>MUTE VOLTAGE; note 3</b>   |                                   |  |             |             |             |                    |
| $V_{49-4}$  | mute voltage                      | $V_{38} = 2.52 \text{ V}$<br>$V_{37-35} < 2.5 \mu\text{V}$<br>$V_{37-35} = 1.0 \text{ mV}$                             | 1.8<br>2.7  | 2.2<br>3.4  | 3.2<br>4.7  | V<br>V             |
| $\Delta V_{49-4}/\Delta V_{37-35}$  | slope of mute voltage             | $100 \mu\text{V (RMS)} \leq V_{37-35} < 300 \text{ mV}$  | 0.75        | 0.9         | 1.05        | V/20 dB            |
| $\Delta V_{49-4}/\text{VK}$   | temperature dependency            | $V_{37-35} = 1 \text{ mV}$   | –           | 5.0         | –           | mV/VK              |

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| SYMBOL  | PARAMETER   | CONDITIONS   | MIN. | TYP. | MAX. | UNIT          |
|---|---|--|------|------|------|---------------|
| ATTACK AND DECAY TIME FOR MUTE VOLTAGE              |   |  |      |      |      |               |
| $I_{ch}$  | charge current  | pin 3 connected to GND   | –    | 3.5  | –    | $\mu\text{A}$ |
|   |   | pin 3 connected to pin 5   | –    | 150  | –    | $\mu\text{A}$ |
| $I_{dch}$   | discharge current                                     | pin 3 connected to GND   | –    | –4.0 | –    | $\mu\text{A}$ |
|   |   | pin 3 connected to pin 5   | –    | –170 | –    | $\mu\text{A}$ |
| $\Delta f$  | muting activated by 60 kHz FM interference            | $V_{49} < 3 \text{ V}$ ; $V_{37-35} = 3 \text{ mV}$ ;<br>$f_{mod} = 60 \text{ kHz}$<br>pin 3 connected to GND;<br>$V_{43}/V_{47} = 9 \text{ dB}$   | –    | 40   | –    | kHz           |
|   |   | pin 3 connected to pin 5;<br>$V_{43}/V_{47} = 6 \text{ dB}$  | –    | 40   | –    | kHz           |
| $V_{43}/V_{47}$                                     | maximum mute depth by 60 kHz FM interference          | pin 3 connected to GND   | –    | 15   | –    | dB            |
|   |   | pin 3 connected to pin 5   | –    | 10   | –    | dB            |
| TIME CONSTANT FOR MONO/STEREO BLEND VOLTAGE; note 4 |   |  |      |      |      |               |
| $I_{ch}$  | charge current  | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to GND   | –    | 0.6  | –    | $\mu\text{A}$ |
|   |   | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to pin 5   | –    | 23   | –    | $\mu\text{A}$ |
| $I_{dch}$   | discharge current                                     | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to GND   | –    | –17  | –    | $\mu\text{A}$ |
|   |   | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to pin 5   | –    | –750 | –    | $\mu\text{A}$ |
| m   | mono/stereo blend activated by 20 kHz AM interference | $V_{16} < 2 \text{ V}$ ; $V_{37-35} = 3 \text{ mV}$ ;<br>$R_{L16} > 50 \text{ M}\Omega$ ;<br>$f_{mod} = 20 \text{ kHz}$ ;<br>data byte 2 bit 5 = 0 |      |      |      |               |
|   |   | pin 3 connected to GND   | –    | 45   | –    | %             |
|   |   | pin 3 connected to pin 5   | –    | 45   | –    | %             |
|   |   | data byte 2 bit 5 = 1  |      |      |      |               |
|   |   | pin 3 connected to GND   | –    | 55   | –    | %             |
|   |   | pin 3 connected to pin 5   | –    | 55   | –    | %             |
| $\Delta f$  | mono/stereo blend activated by 60 kHz FM interference | $V_{16} < 2 \text{ V}$ ; $V_{37-35} = 3 \text{ mV}$ ;<br>$R_{L16} > 50 \text{ M}\Omega$ ;<br>$f_{mod} = 60 \text{ kHz}$                            |      |      |      |               |
|   |   | pin 3 connected to GND   | –    | 50   | –    | kHz           |
|   |   | pin 3 connected to pin 5   | –    | 50   | –    | kHz           |

## In Car Entertainment (ICE) car radio

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| SYMBOL   | PARAMETER   | CONDITIONS  | MIN. | TYP. | MAX. | UNIT             |
|--|---|---|------|------|------|------------------|
| TIME CONSTANT FOR HIGH-CUT CONTROL VOLTAGE SDR; note 5 |   |   |      |      |      |                  |
| $I_{ch}$   | charge current  | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to GND  | –    | 0.6  | –    | $\mu\text{A}$    |
|  |   | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to pin 5  | –    | 41   | –    | $\mu\text{A}$    |
| $I_{dch}$  | discharge current                                       | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to GND  | –    | –0.7 | –    | $\mu\text{A}$    |
|  |   | $V_{37-35} = 3 \text{ mV}$ ;<br>pin 3 connected to pin 5  | –    | –44  | –    | $\mu\text{A}$    |
| m  | high-cut control activated<br>by 20 kHz AM interference | $V_{15} < 2 \text{ V}$ ; $V_{37-35} = 3 \text{ mV}$ ;<br>$R_{L15} > 50 \text{ M}\Omega$ ;<br>$f_{mod} = 20 \text{ kHz}$<br>pin 3 connected to GND | –    | 45   | –    | %                |
|  |   | pin 3 connected to pin 5  | –    | 45   | –    | %                |
| $\Delta f$   | high-cut control activated<br>by 60 kHz FM interference | $V_{15} < 2 \text{ V}$ ; $V_{37-35} = 3 \text{ mV}$ ;<br>$R_{L15} > 50 \text{ M}\Omega$ ;<br>$f_{mod} = 60 \text{ kHz}$<br>pin 3 connected to GND | –    | 50   | –    | kHz              |
|  |   | pin 3 connected to pin 5  | –    | 50   | –    | kHz              |
| MULTI-PATH DETECTOR                                    |   |   |      |      |      |                  |
| $f_{MP}$   | multi-path detector band-pass<br>centre frequency       |   | –    | 20   | –    | kHz              |
| $B_{MP}$   | band-pass bandwidth                                     |   | 7.0  | –    | –    | kHz              |
| <b>Reference voltage</b>                               |   |   |      |      |      |                  |
| $V_{21-4}$   | output voltage  | $I_{21} = -1 \text{ mA}$  | 4.5  | 5.1  | 5.7  | V                |
| $\Delta V_{21-4}$                                      | temperature dependence                                  |   | –    | 3.3  | –    | mV/VK            |
| $I_{21}$   | output current  |   | –    | –    | 1    | mA               |
| <b>AM-IF path; see Fig.14 and notes 6 and 7</b>        |   |   |      |      |      |                  |
| $V_{22-23 \text{ max(p-p)}}$                           | maximum output voltage<br>(peak-to-peak value)          |   | 12   | 15   | –    | V                |
| $I_{22}, I_{23}$                                       | mixer bias current                                      |   | 5.0  | 6.0  | 7.0  | mA               |
|  | mixer leakage current                                   | in FM position  | –    | –    | 2    | $\mu\text{A}$    |
| $I_{22}I_{F2}/V_{27-24}I_{F1}$                         | conversion transconductance                             |   | 2.2  | 2.7  | 3.4  | mS               |
| $R_{27-24}$  | input resistance  |   | 300  | 330  | 360  | $\Omega$         |
| $C_{27-24}$  | input capacitance                                       |   | –    | 5    | 8    | pF               |
| $R_{22-23}$  | output resistance                                       |   | 10.0 | 20.0 | –    | k $\Omega$       |
| $C_{22-23}$  | output capacitance                                      |   | –    | 5    | 10   | pF               |
| IP3  | third order intermodulation                             |   | –    | 137  | –    | dB $\mu\text{V}$ |

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| SYMBOL                     | PARAMETER  | CONDITIONS  | MIN. | TYP. | MAX. | UNIT          |
|----------------------------|--|---|------|------|------|---------------|
| AM DETECTOR; notes 8 and 9 |  |   |      |      |      |               |
| $V_{48-4(rms)}$            | AF output level (RMS value)                          | $R_{L48} > 500 \text{ k}\Omega$ ;<br>$100 \mu\text{V} \leq V_{33-34} \leq 300 \text{ mV}$ | 190  | 240  | 290  | mV            |
| $V_{33-34(rms)}$           | sensitivity voltage (RMS value)                      | $\frac{S+N}{N} = 26 \text{ dB}$   | –    | 50   | 75   | $\mu\text{V}$ |
|                            |  | $\frac{S+N}{N} = 46 \text{ dB}$   | –    | 200  | 400  | $\mu\text{V}$ |
|                            | AM-IF <sub>2</sub> minimum input voltage (RMS value) | THD $\leq 5\%$ ; $m = 0.8$  | –    | –    | 100  | $\mu\text{V}$ |
|                            | AM-IF <sub>2</sub> maximum input voltage (RMS value) | THD $\leq 5\%$ ; $m = 0.8$  | 800  | –    | –    | mV            |
| $R_{33-34}$                | IF <sub>2</sub> input resistance                     |   | 1.8  | 2.0  | 2.2  | k $\Omega$    |
| $C_{24-23}$                | IF <sub>2</sub> input capacitance                    |   | –    | 10   | 15   | pF            |
| $R_{048}$                  | output resistance                                    |   | 27   | 33   | 39   | k $\Omega$    |
| $C_{048}$                  | output capacitance                                   |   | –    | –    | 10   | pF            |
| $\frac{S+N}{N}$            | signal plus noise-to-noise ratio                     |   | 54   | 60   | –    | dB            |
| THD                        | total harmonic distortion                            | $m = 0.8$ ;<br>$300 \mu\text{V} \leq V_{33-34} \leq 200 \text{ mV}$                       | –    | 1.5  | 3.0  | %             |

**Notes to the characteristics**

- For typical adjusting range see Figs 10 and 13.
- For typical curve see Fig.11.
- The static mute voltage follows the unweighted voltage level as function of FM-IF<sub>2</sub> voltage and level adjustment voltage  $V_{38-4}$ . It additionally depends on multi-path level, noise (adjacent channel interferences) and the position of TSWITCH (pin 3). For typical curve for mute voltage dependence see Fig.12.
- The mono/stereo blend voltage is generated as a function of FM-IF<sub>2</sub> voltage, multi-path level, noise and position of TSWITCH.
- The high-cut control voltage is generated as a function of FM-IF<sub>2</sub> voltage, multi-path level, noise and position of TSWITCH.
- $f_{IF1} = 10.7 \text{ MHz}$ ;  $f_{IF2} = 450 \text{ kHz}$  for AM mixer.
- The AM oscillator signal is generated by division of the 61.5 MHz crystal oscillator. Two divider ratios programmable by the I<sup>2</sup>C-bus: divide by 6 (AM-IF<sub>1</sub> = 10.7 MHz); divide by 2 (AM-IF<sub>1</sub> = 30 MHz).
- For typical AM level curve see Fig.15.
- For AM detector;  $f_{AMIF2} = 450 \text{ kHz}$ ;  $f_{mod} = 400 \text{ Hz}$ ;  $m = 30\%$ .

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**STEREO DECODER CHARACTERISTICS**

Input signal ( $\Delta f = 75$  kHz)  $V_{MPX(p-p)} = 1.7$  V;  $f_{mod} = 1$  kHz; de-emphasis time constant  $t = 50$   $\mu$ s; nominal input resistor (pin 45)  $R_i = 168$  k $\Omega$ ;  $T_{amb} = 25$  °C; unless otherwise specified.

| SYMBOL  | PARAMETER                               | CONDITIONS                            | MIN.                                   | TYP. | MAX. | UNIT       |
|---|---|---------------------------------------|--|------|------|------------|
| $V_{44-4(rms)}$ ;<br>$V_{41-4(rms)}$                          | AF output voltage (RMS value)           |                                       | 800                                    | 900  | 1000 | mV         |
| $V_{44-4}$ ; $V_{41-4}$                                       | DC output voltage                       |                                       | 3.1                                    | 3.6  | 4.1  | V          |
| $I_{44(max)}$ ; $I_{41(max)}$                                 | maximum output current                  |                                       | 150                                    | –    | –    | $\mu$ A    |
| $V_{44-4}/V_{41-4}$   | difference of output voltage            |                                       | –1                                     | –    | +1   | dB         |
| $R_{o(44)}$ ; $R_{o(41)}$                                     | output resistance                       |                                       | –                                      | –    | 600  | $\Omega$   |
| $R_{Lmin}$  | minimum load resistor                   |                                       | 12                                     | –    | –    | k $\Omega$ |
| $\alpha_{cs}$   | channel separation (adjusted)           |                                       | 40                                     | –    | –    | dB         |
| $\frac{S+N}{N}$   | signal plus noise-to-noise ratio        | $f = 20$ Hz to 15 kHz                 | 74                                     | 80   | –    | dB         |
| THD   | total harmonic distortion               |                                       | –                                      | 0.1  | 0.3  | %          |
|   | MPX input overdrive margin              | THD = 1%                              | 4                                      | –    | –    | dB         |
| <b>Carrier and harmonic suppression at the output; note 1</b> |   |                                       |  |      |      |            |
| $\alpha_{19}$   | pilot signal                            | $f = 19$ kHz                          | –                                      | 50   | –    | dB         |
| $\alpha_{38}$   | subcarrier                              | $f = 38$ kHz                          | –                                      | 50   | –    | dB         |
| $\alpha_{57}$   |   | $f = 57$ kHz                          | –                                      | 50   | –    | dB         |
| $\alpha_{76}$   |   | $f = 76$ kHz                          | –                                      | 60   | –    | dB         |
| $\alpha_2$  |   | intermodulation                       | $f_{mod} = 10$ kHz; $f_{spur} = 1$ kHz | –    | 60   | –          |
| $\alpha_3$  | $f_{mod} = 13$ kHz; $f_{spur} = 1$ kHz  |                                       | –                                      | 58   | –    | dB         |
| $\alpha_{57}$   | traffic radio (ARI)                     | $f = 57$ kHz                          | –                                      | 70   | –    | dB         |
| $\alpha_{67}$   | subsidiary communications authorization | $f = 67$ kHz                          | 70                                     | –    | –    | dB         |
| $\alpha_{114}$  | adjacent channel frequency              | $f = 114$ kHz                         | –                                      | 80   | –    | dB         |
| $\alpha_{190}$  |   | $f = 190$ kHz                         | –                                      | 70   | –    | dB         |
| RR  | ripple rejection at output              | $f_r = 100$ Hz; $V_r = 100$ mV (eff.) | –                                      | 30   | –    | dB         |
| <b>Mono/stereo control</b>                                    |   |                                       |  |      |      |            |
| $V_{i(pil)}$  | pilot threshold voltage                 | stereo on                             | –                                      | 24   | 30   | mV         |
|   |   | mono on                               | 8                                      | 20   | –    | mV         |
| $\Delta V_{i(pil)}$   | switch hysteresis $V_{i on}/V_{i off}$  |                                       | –                                      | 2    | –    | dB         |
| <b>External mono/stereo control; note 2</b>                   |   |                                       |  |      |      |            |
| $V_{17} - 0.75V_{21}$   | control voltage channel separation      | see Fig.17                            |  |      |      |            |
|   |   | $V_{43}/V_{47} = 6$ dB                | –                                      | –110 | –    | mV         |
|   |   | $V_{43}/V_{47} = 16$ dB               | –                                      | –40  | –    | mV         |

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| SYMBOL  | PARAMETER  | CONDITIONS   | MIN.  | TYP.  | MAX.  | UNIT              |
|---|--|--|-------|-------|-------|-------------------|
| <b>Muting functions (mute via I<sup>2</sup>C-bus)</b>   |  |  |       |       |       |                   |
| $\Delta V_{44}, \Delta V_{41}$  | DC offset voltage  | tune mute  | -50   | -     | +50   | mV                |
|   |  | radio mute (in combination with tune mute)                 | -400  | -     | +400  | mV                |
| $\alpha_{\text{mute}}$  | tune mute  |  | 60    | -     | -     | dB                |
|   | radio mute (in combination with tune mute)   |  | 80    | -     | -     | dB                |
| <b>High-cut control; see Fig.18</b>   |  |  |       |       |       |                   |
| $V_{18} - 0.75V_{21}$   | control voltage  | note 3   |       |       |       |                   |
|   |  | $t_{\text{de-emph}} = 50 \mu\text{s}$                      | 0     | -     | -     | mV                |
|   |  | $t_{\text{de-emph}} = 80 \mu\text{s}$                      | -300  | -     | -     | mV                |
| $t_{\text{de-emph}}$  | control range of de-emphasis   |  | 50    | -     | 80    | $\mu\text{s}$     |
| <b>Voltage controlled oscillator; note 4</b>  |  |  |       |       |       |                   |
| $f_{\text{osc}}$  | oscillator frequency   |  | 225   | 228   | 231   | kHz               |
| <b>Noise blanker</b>  |  |  |       |       |       |                   |
| INTERFERENCE DETECTION FULLY INTERNAL FROM LEVEL DETECTOR   |  |  |       |       |       |                   |
| $t_{\text{sup}}$  | interference suppression time  |  | 40    | 50    | -     | $\mu\text{s}$     |
| TRIGGER THRESHOLD CONTROL   |  |  |       |       |       |                   |
| $I_{\text{ch}}$   | charge current (into +4 V)   |  | -     | 45    | -     | $\mu\text{A}$     |
| $I_{\text{dch}}$  | discharge current (from +8.5 V)  |  | -     | -900  | -     | $\mu\text{A}$     |
| TRIGGER SENSITIVITY MEASUREMENT WITH PULSED MODULATION OF FM-IF <sub>2</sub> ; see Figs 19 and 20 |  |  |       |       |       |                   |
| $V_{37-35(p)}$  | trigger sensitivity for test signal 1 (peak value)   | $V_{38} = 2.52 \text{ V}$ ; note 5                         | -     | -     | 0.5   | mV                |
|   |  | $V_{38} = 2.52 \text{ V}$ ; note 6                         | 100   | -     | -     | mV                |
|   | trigger sensitivity for test signal 2 (peak value)   | $V_{38} = 2.52 \text{ V}$ ; note 6                         | 5.0   | -     | -     | mV                |
|   |  | $V_{38} = 2.52 \text{ V}$ ; note 6                         | 100   | -     | -     | mV                |
| $V_{51}$  | trigger threshold variation with frequency modulation of FM-IF <sub>2</sub> and $f_{\text{mod}} = 15 \text{ kHz}$ (pin 51) | $V_{37-35} = 100 \text{ mV}$ ; $\Delta f = 0 \text{ kHz}$  | -     | 6.4   | -     | V                 |
| $\Delta V_{51}$   |  | $V_{37-35} = 100 \text{ mV}$ ; $\Delta f = 40 \text{ kHz}$ | -     | 250   | -     | mV                |
| $V_{37\text{th}}/V_{37(3\text{dB})}$  | shift of threshold for triggering from MPX signal  | $I_{46} = 0$   | 14    | 20    | 26    | dB                |
| $\Delta V_{37\text{th}}/\Delta I_{46}$  | shift of threshold as function of $I_{46}$   |  | -0.32 | -0.25 | -0.16 | dB/ $\mu\text{A}$ |
| $V_{46}$  | bias voltage (pin 46)  | $I_{46} < 0$   | 4.0   | 4.3   | 4.7   | V                 |
|   |  | $I_{46} > 0$   | 5.3   | 5.7   | 6.1   | V                 |
| $I_{\text{offset}}$   | gate input offset current at pins 31 and 32 during suppression pulse duration  |  | -     | 20    | 50    | nA                |

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**Notes to the stereo decoder characteristics**

1. The following equations give the values for the carrier and harmonic suppression at the output:

$$\alpha_{27} = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 1 \text{ kHz})} f_s = (2 \times 10 \text{ kHz}) - 19 \text{ kHz}$$

$$\alpha_{33} = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 1 \text{ kHz})} f_s = (3 \times 13 \text{ kHz}) - 38 \text{ kHz}$$

$$\alpha_{57} (\text{ARI}) = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 1 \text{ kHz} \pm 23 \text{ Hz})}$$

$$\alpha_{67} = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 9 \text{ kHz})} f_s = (2 \times 38 \text{ kHz}) - 67 \text{ kHz}$$

$$\alpha_{114} = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 4 \text{ kHz})} f_s = 110 \text{ kHz} - (3 \times 38 \text{ kHz})$$

$$\alpha_{190} = \frac{V_0(\text{signal}) (\text{at } 1 \text{ kHz})}{V_0(\text{spurious}) (\text{at } 4 \text{ kHz})} f_s = 186 \text{ kHz} - (5 \times 38 \text{ kHz})$$

2. The stereo decoder can be set to mono via the I<sup>2</sup>C-bus. Pilot presence indication via the I<sup>2</sup>C-bus.
3. The nominal de-emphasis value can be changed to 75  $\mu\text{s}$  with C<sub>31</sub>; C<sub>32</sub> = 10 nF.
4. The VCO is adjusted by means of a digital auxiliary PLL.
5. Noise blanker does not trigger.
6. Noise blanker triggers.



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**CHARACTERISTICS FOR ANALOG-TO-DIGITAL CONVERTERS (ADCs) FOR LEVEL AND MULTI-PATH VOLTAGES**

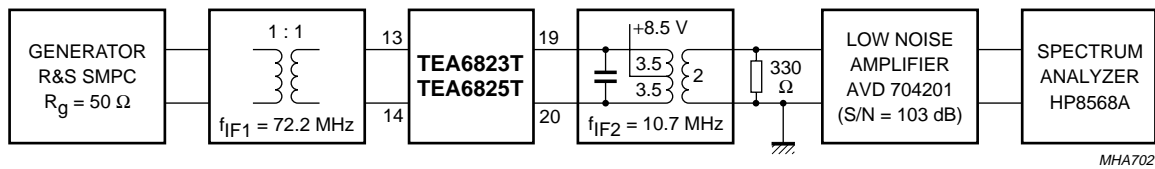
| SYMBOL  | PARAMETER   | CONDITIONS | MIN. | TYP. | MAX. | UNIT    |
|---|---|------------|------|------|------|---------|
| <b>ADC for FM level information; note 1</b>   |   |            |      |      |      |         |
| $\Delta V_{37-35}$                            | analog-to-digital conversion                      |            |      |      |      |         |
|   | step size   |            | 2    | 4    | 8    | dB/step |
|   | level range                                       |            | 43   | 56   | 69   | dB      |
| <b>FM STOP</b>                                |   |            |      |      |      |         |
| $\Delta V_{\text{stop}}$                      | variation of stop level as function of $V_{42-4}$ |            | –    | 16   | –    | dB/V    |
| <b>ADC for AM level information; note 2</b>   |   |            |      |      |      |         |
| $\Delta V_{33-34}$                            | analog-to-digital conversion step size            |            | 2    | 4    | 8    | dB/step |
| $\Delta V_{33-34}$                            | analog-to-digital conversion level range          |            | 43   | 56   | 69   | dB      |
| <b>AM STOP</b>                                |   |            |      |      |      |         |
| $\Delta V_{\text{stop}}$                      | variation of stop level as function of $V_{43-4}$ |            | –    | 16   | –    | dB/V    |
| <b>ADC for multi-path information; note 3</b> |   |            |      |      |      |         |
| m   | multi-path conversion                             | step 0     | –    | –    | 5    | %       |
|   |   | step 1     | –    | 15   | –    | %       |
|   |   | step 2     | –    | 22   | –    | %       |
|   |   | step 3     | –    | 28   | –    | %       |
|   |   | step 4     | –    | 34   | –    | %       |
|   |   | step 5     | –    | 40   | –    | %       |
|   |   | step 6     | –    | 46   | –    | %       |
|   |   | step 7     | –    | 52   | 60   | %       |

**Notes**

1. The FM level information  $V_{50-3}$  is analog-to-digital converted with 4 bits.
2. The AM level information  $V_{49-4}$  is analog-to-digital converted with 4 bits.
3. The multi-path information  $V_{40-4}$  is analog-to-digital converted with 3 bits covering an  $IF_2$  amplitude modulation range  $m \leq 0.6$ ;  $f_{\text{mod}} = 20$  kHz.

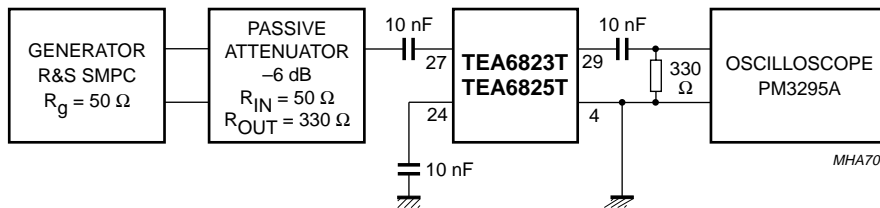
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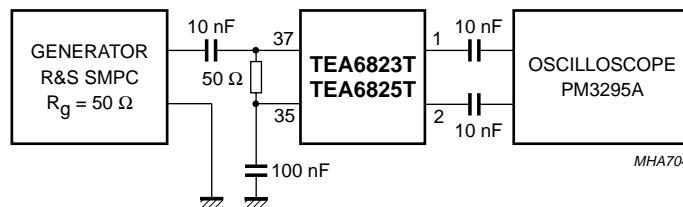
MHA702

Fig.4 Test circuit FM mixer.



MHA703

Fig.5 Test circuit IF-amplifier.

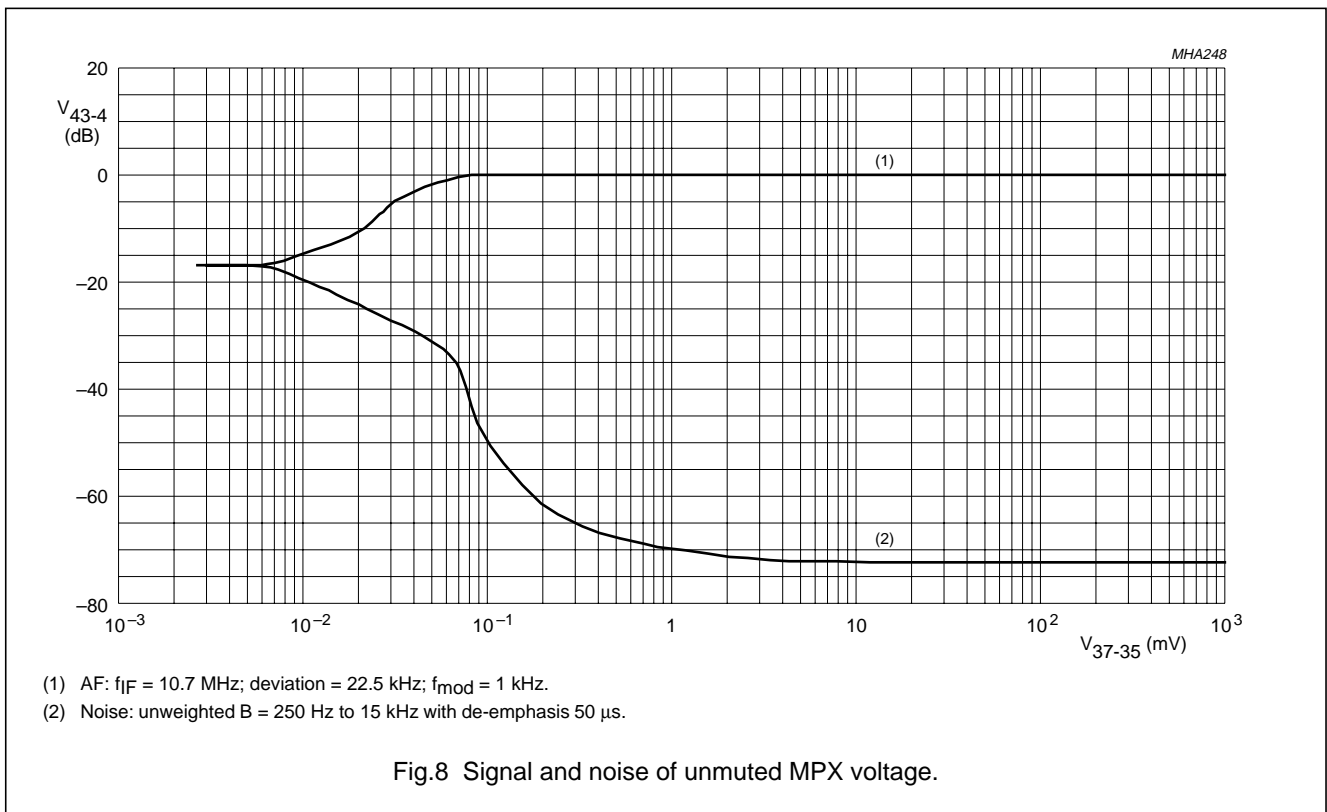
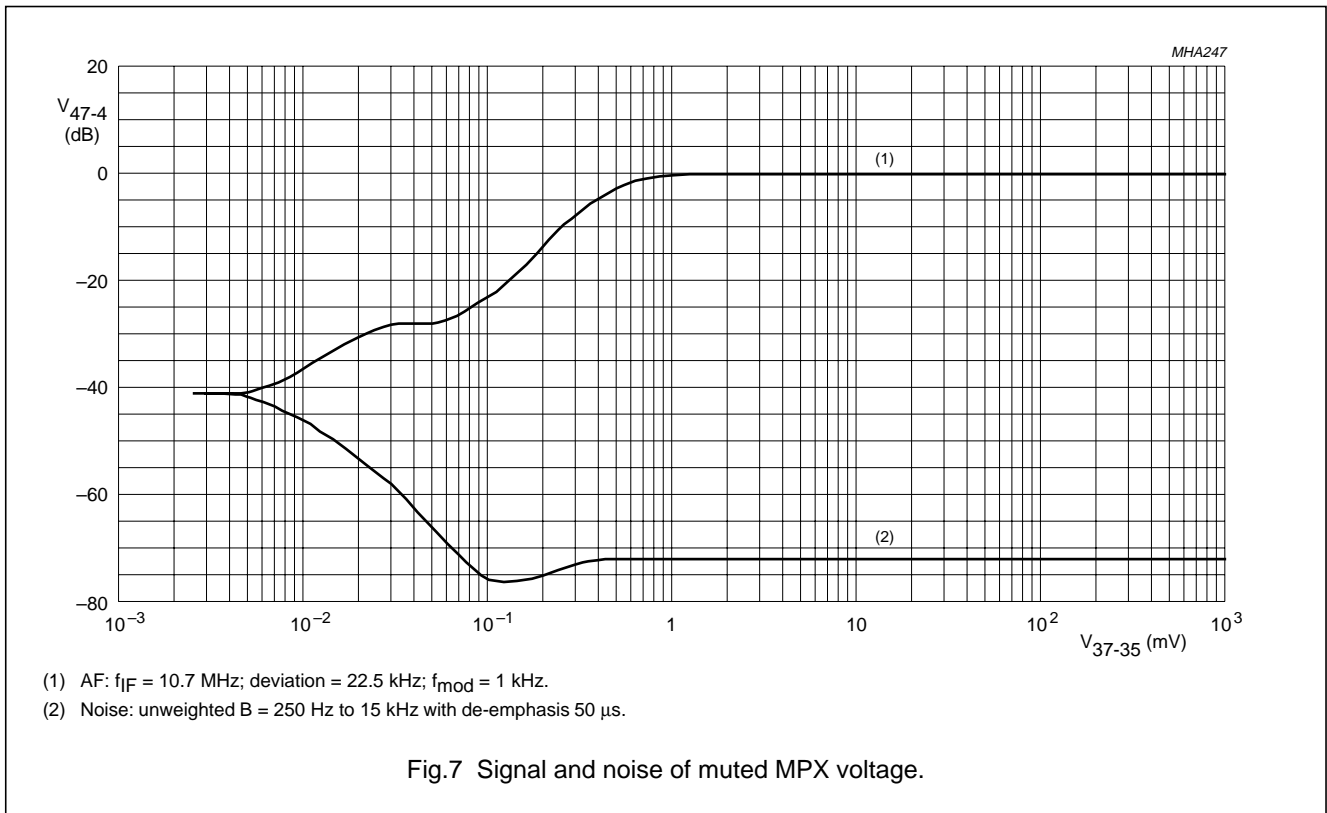


MHA704

Fig.6 Test circuit limiter gain.

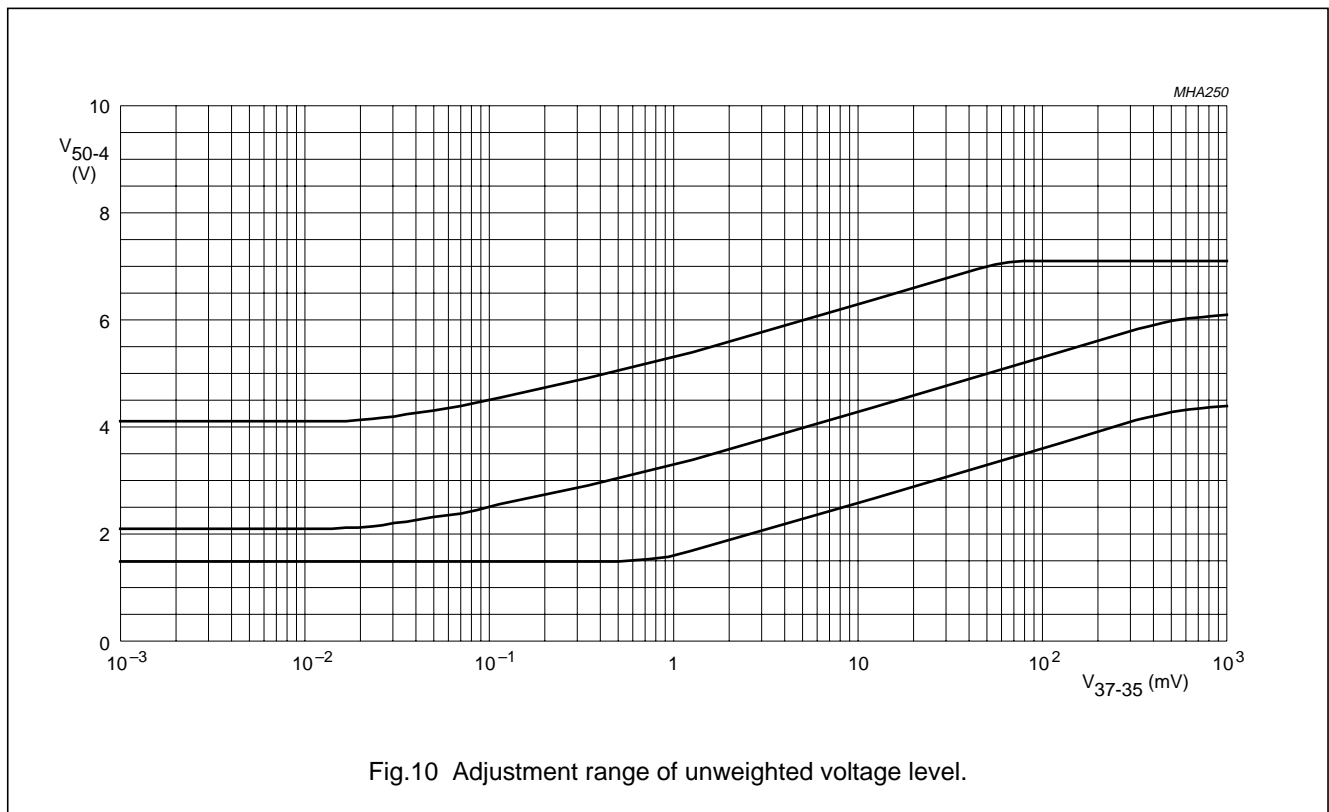
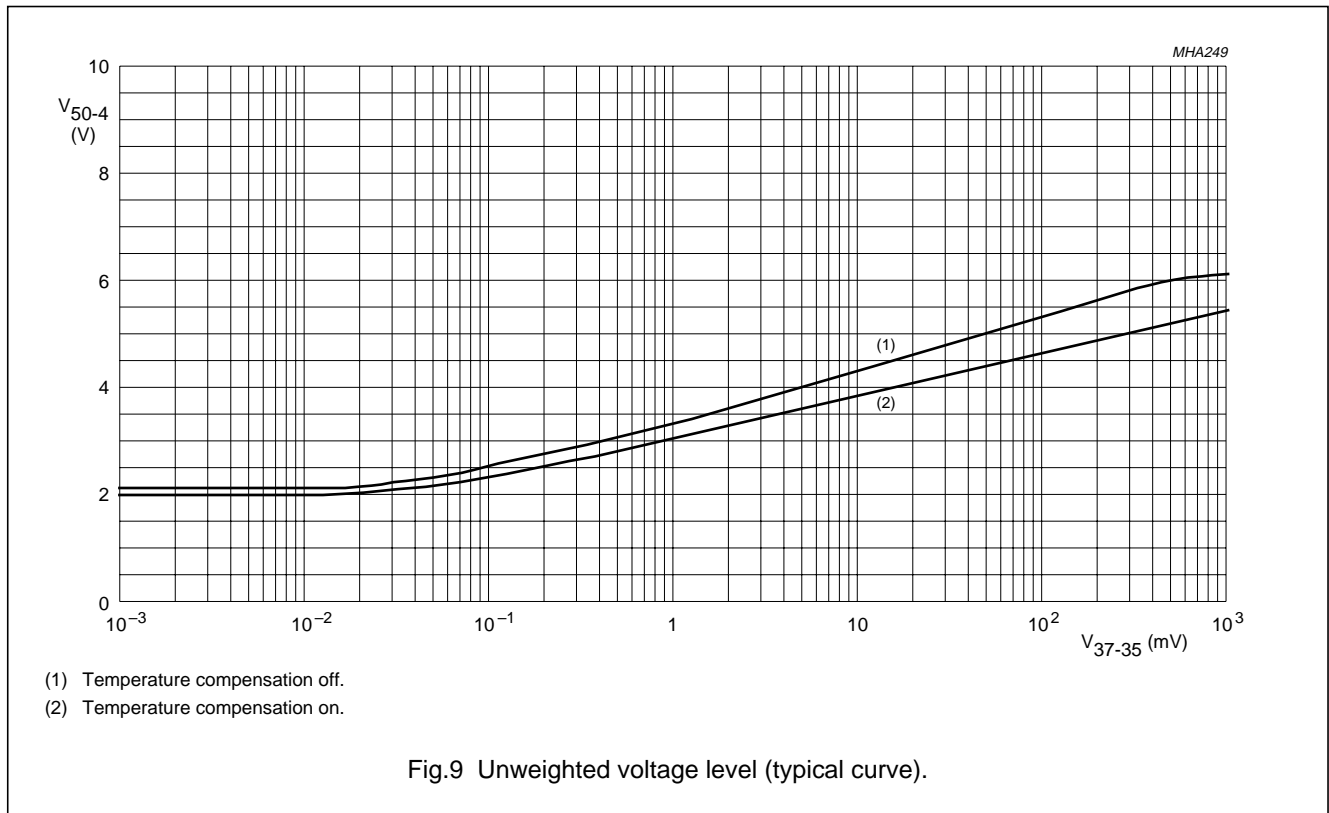
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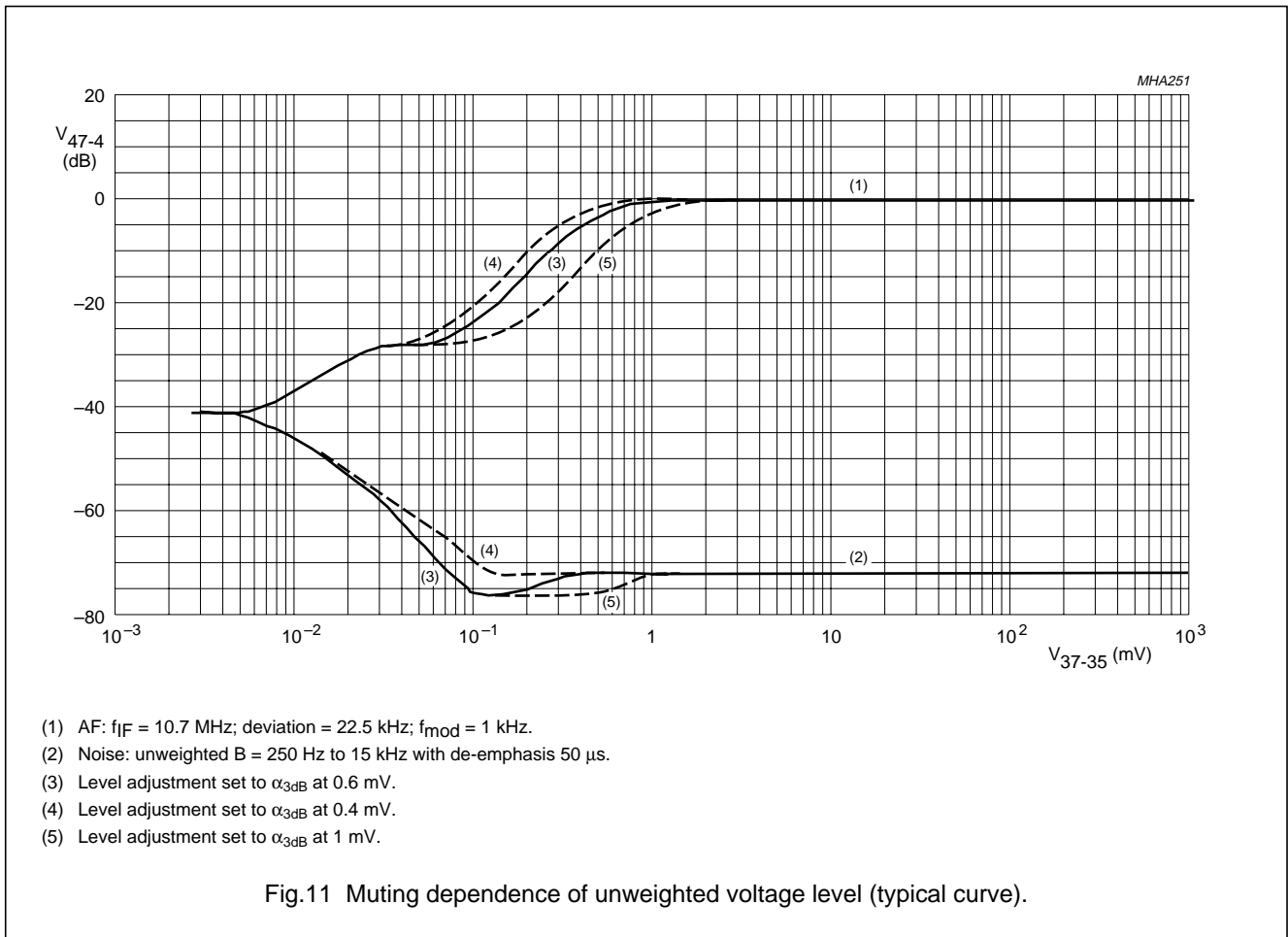
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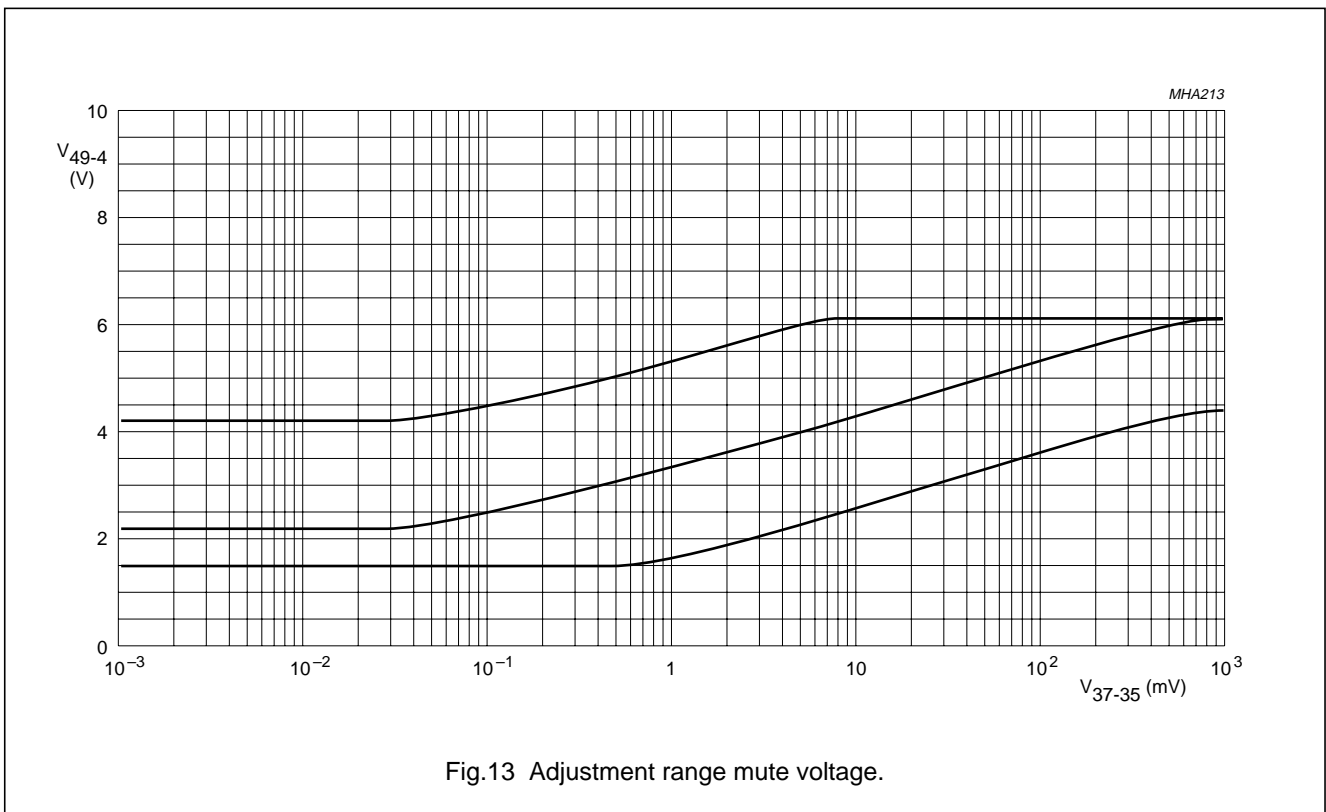
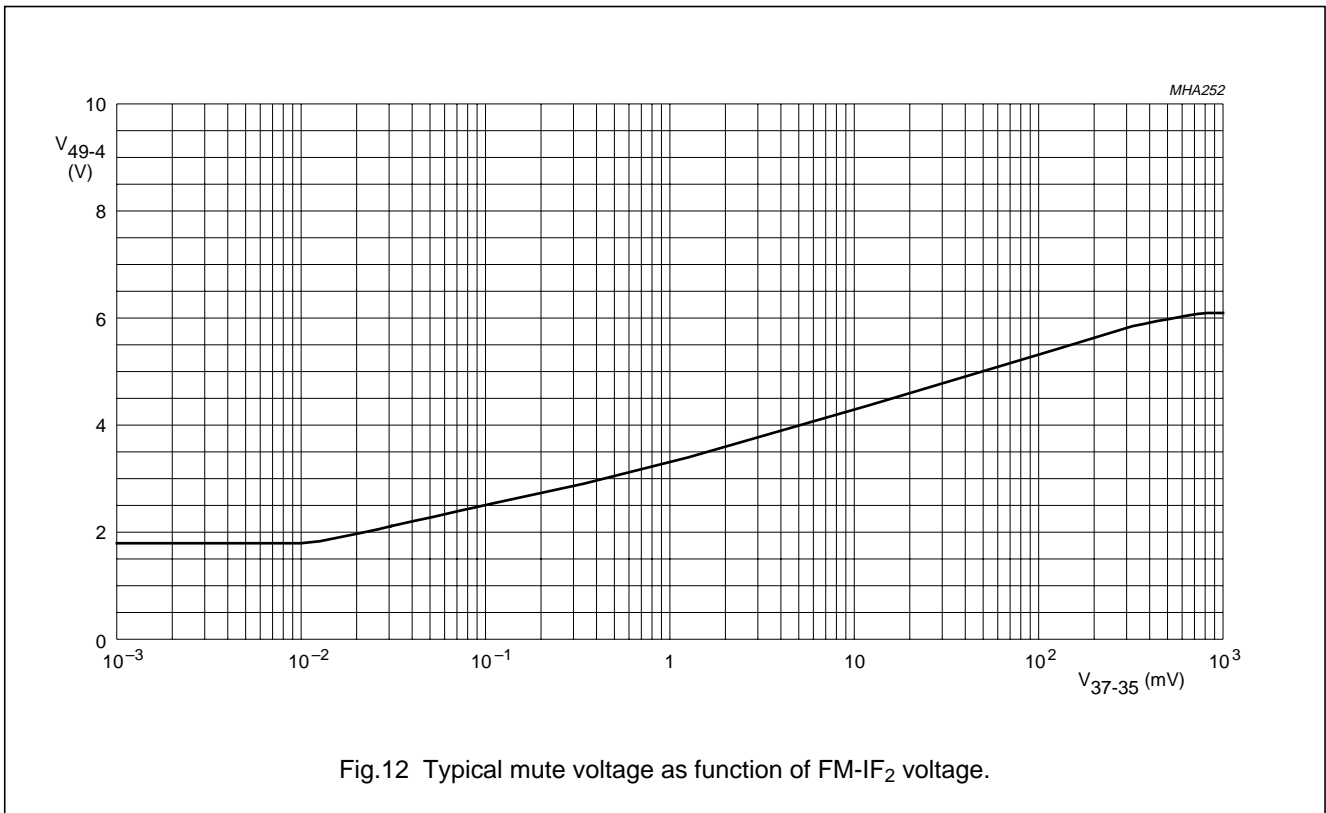
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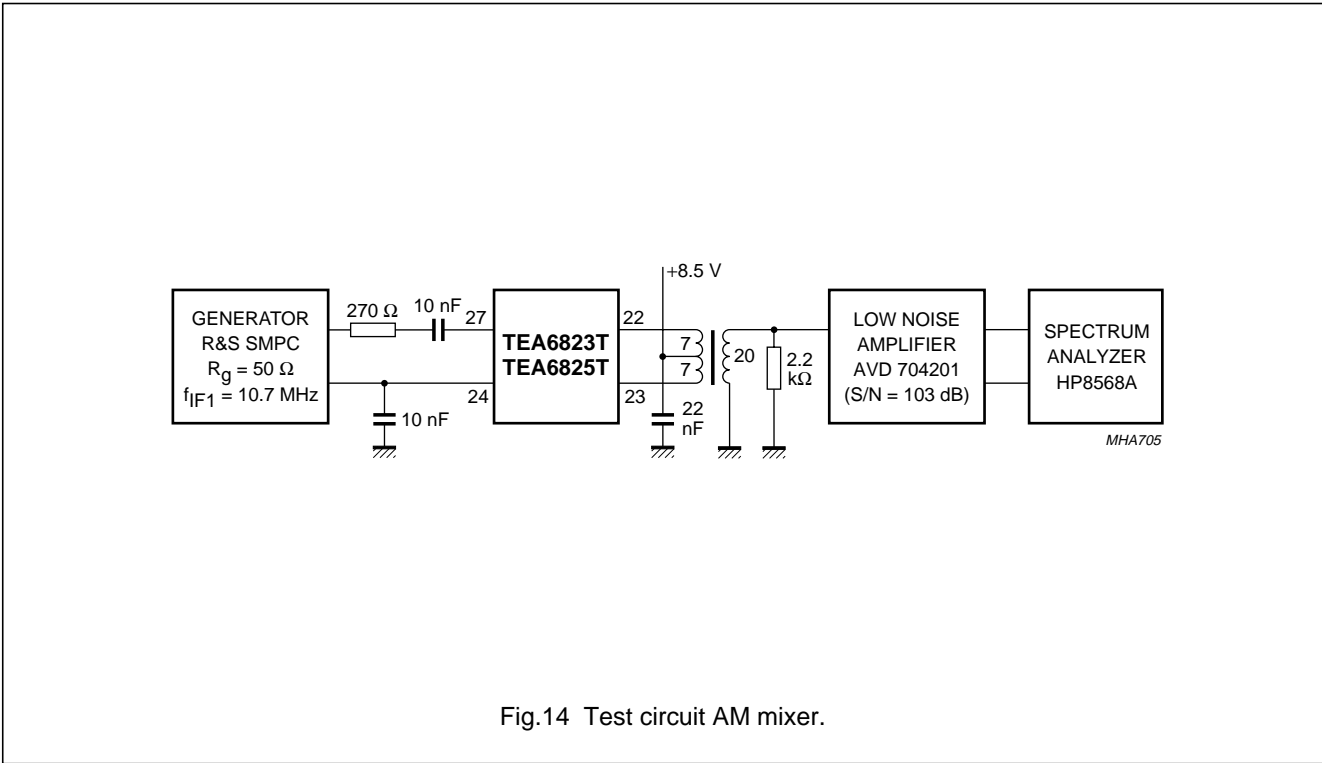


Fig.14 Test circuit AM mixer.

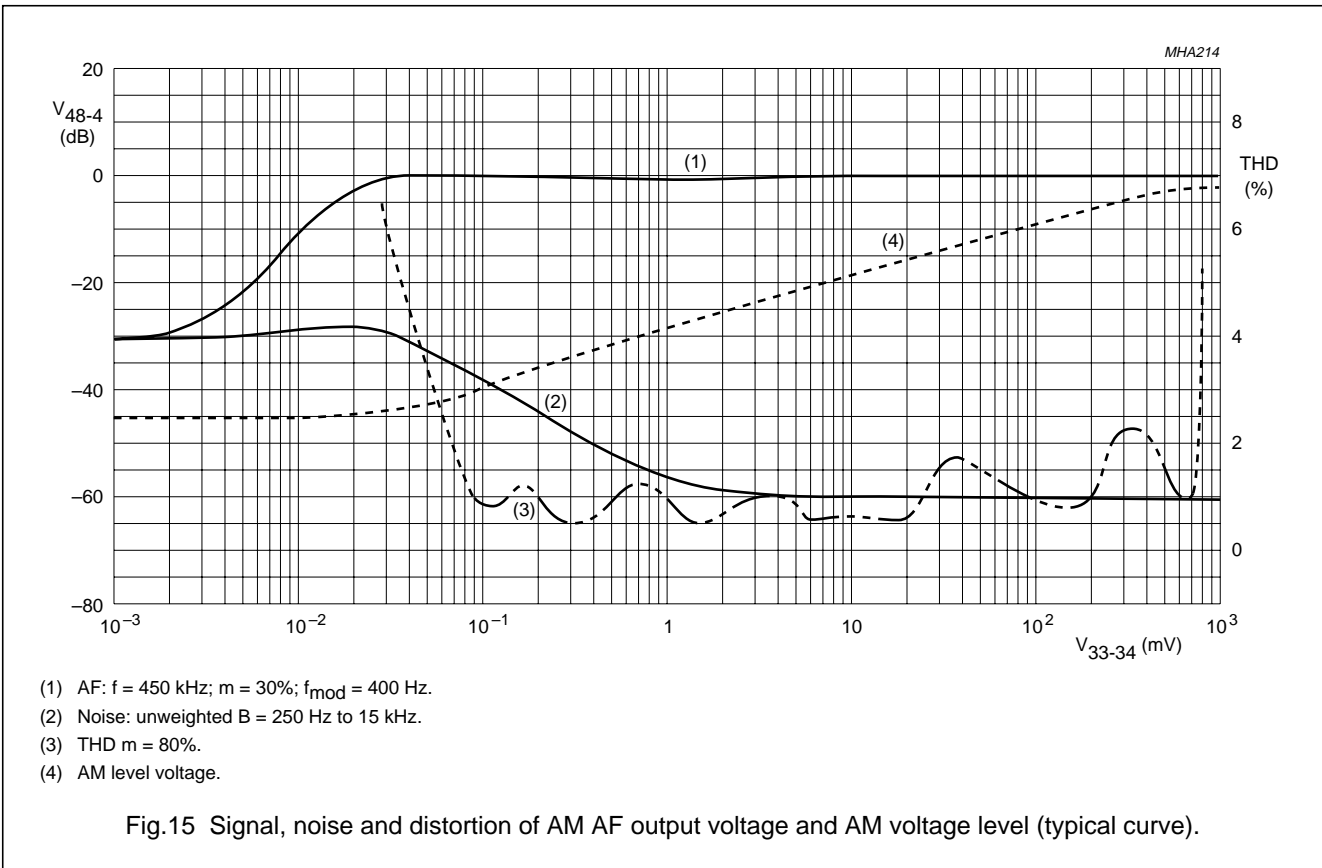
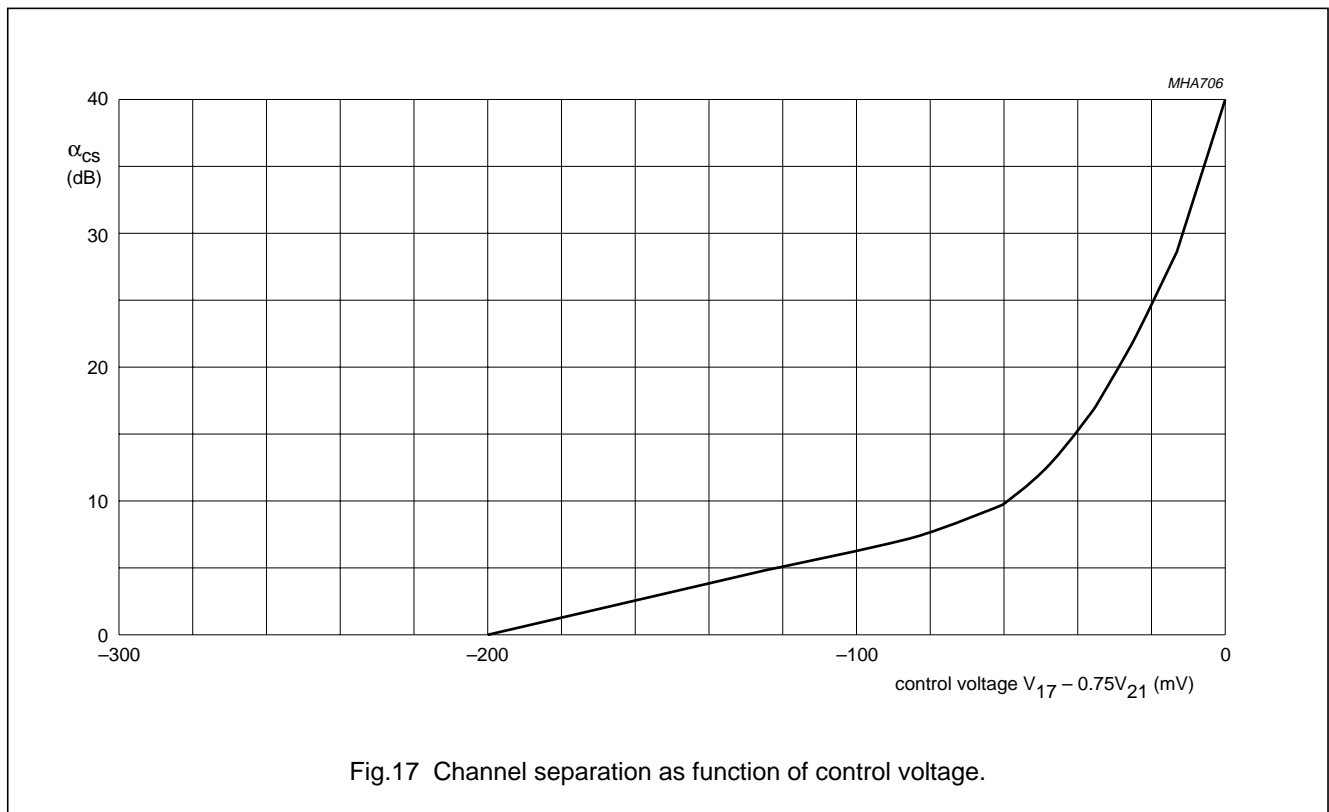
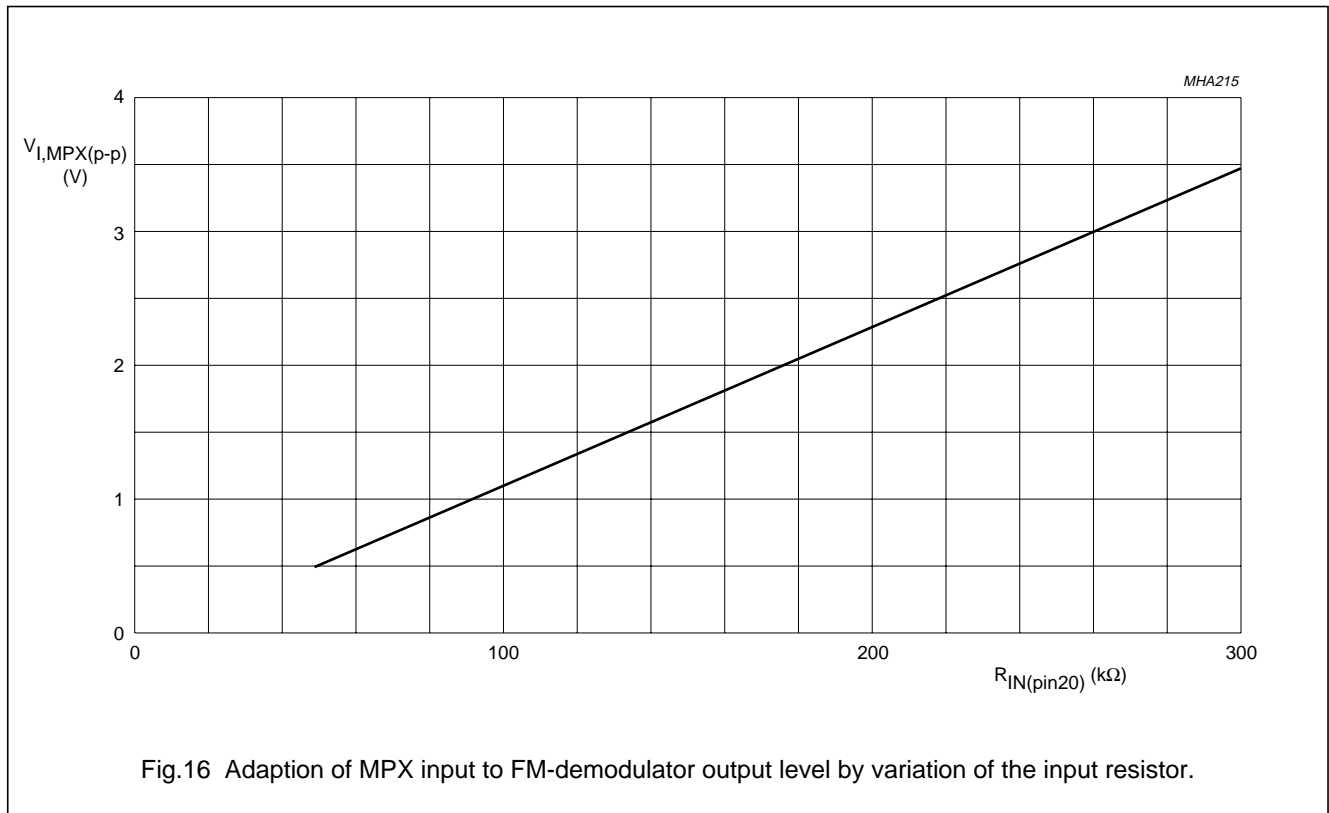


Fig.15 Signal, noise and distortion of AM AF output voltage and AM voltage level (typical curve).

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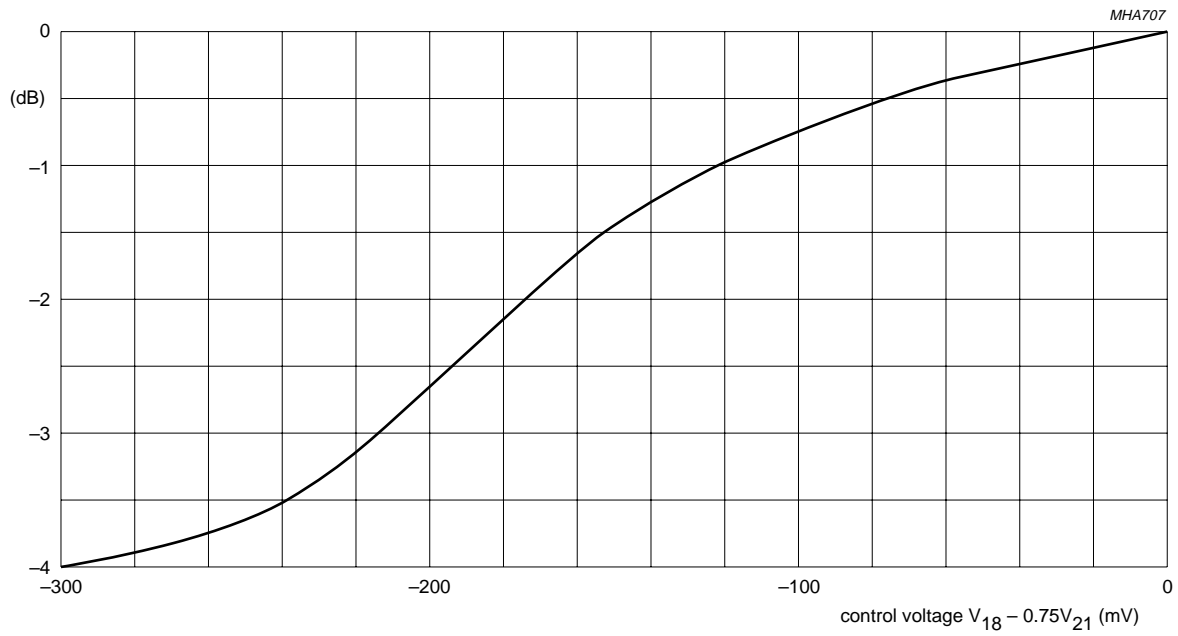
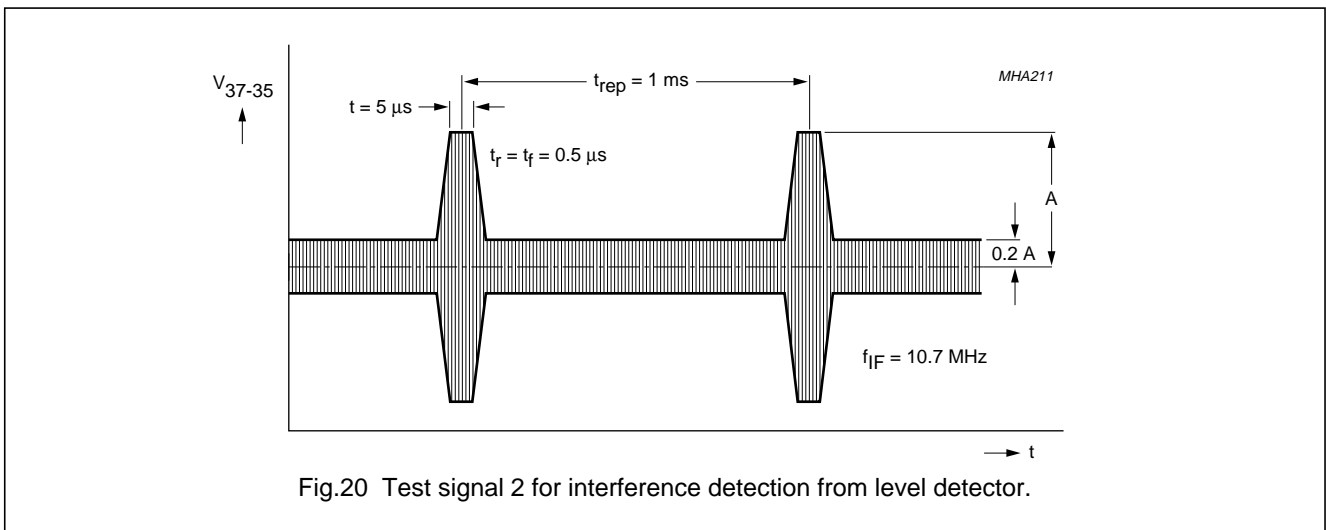
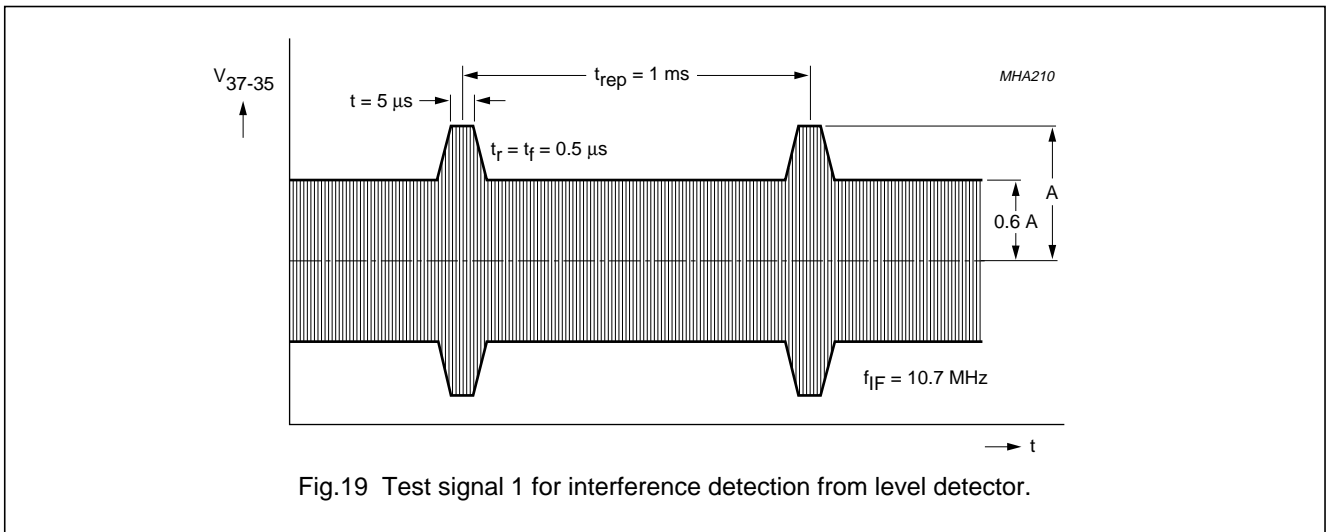


Fig.18 High-cut with  $f_{mod} = 10$  kHz as function of control voltage.

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**I<sup>2</sup>C-BUS AND I<sup>2</sup>C-BUS CONTROLLED FUNCTIONS**

**I<sup>2</sup>C-bus specification**

The standard I<sup>2</sup>C-bus specification is expanded by the following definitions.

Structure of the I<sup>2</sup>C-bus logic: slave transceiver with auto increment and expansion to switch a direct transfer of all transmissions to an output for the radio front-end IC (TEA6810T respectively TEA6811T).

Subaddresses are not used.

**DATA TRANSFER FOR THE TEA6823T AND THE TEA6825T**

Data sequence:

- Address
- Byte 1
- Byte 2.

The data transfer may be in this order only. The transfer direction of the data bytes is defined by the LSB of the address.

The data becomes valid at the output of the internal latches with the acknowledge of each byte. A STOP condition after any byte can shorten transmission times.

When writing to the transceiver by using the STOP condition before completion of the whole transfer:

- The remaining bytes will contain the old information
- If the transfer of a byte was not completed, this byte is lost and the previous information is available.

**DATA TRANSFER TO AN OUTPUT OF THE FRONT-END IC**

A data bit in the transceiver of the TEA6823T or TEA6825T enables or disables a direct transfer of all transmissions to an interface stage for the front-end IC.

For a transmission to the front-end IC the address and the data format of the front-end IC has to be used.

Remark: the pull-up resistors for the front-end interface (pins 6 and 7) should not be connected to the 5 V supply voltage of the front-end IC, otherwise a bus pull-down (pin 53) can occur during switching off the front-end supply when the interface stage is enabled.

**DATA TRANSFER TO THE IF IC**

Data transfer to the IF IC (TEA6823T or TEA6825T) is independent of the state of interface stage for the front-end IC.

**Table 1** Structure of the I<sup>2</sup>C-bus

| DESCRIPTION                                  | SPECIFICATION   |
|--|---|
| Bus address of the TEA6823T and the TEA6825T | 1100001X  |
| Subaddress                                   | not used  |
| Hardware (pin) programmable address bits     | not available   |
| Default settings by power-on reset           | data byte 1 bits 4 to 7 are set to logic 0; all other bits are random |

**Table 2** Data to be received by the IC for data byte 1

| BIT | DESCRIPTION                                | RESULT    |
|-----|--|-----------|
| 0   | switch for mono                            | bit 0 = 1 |
|     | switch for stereo                          | bit 0 = 0 |
| 1   | LSB reference frequency for synthesizer    |           |
| 2   | reference frequency for synthesizer        |           |
| 3   | MSB reference frequency for synthesizer    |           |
| 4   | tuning mute off                            | bit 4 = 1 |
|     | tuning mute on                             | bit 4 = 0 |
| 5   | SDS/SDR hold off                           | bit 5 = 1 |
|     | SDS/SDR hold on                            | bit 5 = 0 |
| 6   | radio mute off                             | bit 6 = 1 |
|     | radio mute on                              | bit 6 = 0 |
| 7   | I <sup>2</sup> C-bus to front-end ENABLED  | bit 7 = 1 |
|     | I <sup>2</sup> C-bus to front-end DISABLED | bit 7 = 0 |

**Table 3** Reference frequency setting in data byte 1; see Table 1

| BIT 3 | BIT 2 | BIT 1 | FREQUENCY SETTING |
|-------|-------|-------|-------------------|
| 0     | 0     | 0     | 3 kHz             |
| 0     | 0     | 1     | 5 kHz             |
| 0     | 1     | 0     | 10 kHz            |
| 0     | 1     | 1     | 15 kHz            |
| 1     | 0     | 0     | 25 kHz            |
| 1     | 0     | 1     | 50 kHz            |
| 1     | 1     | 0     | not defined       |
| 1     | 1     | 1     | not defined       |

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**Table 4** Data to be received by the IC for data byte 2

| BIT | DESCRIPTION  | RESULT    |
|-----|--|-----------|
| 0   | AM/FM; AM mode   | bit 0 = 0 |
|     | AM/FM; FM mode   | bit 0 = 1 |
| 1   | divider for AM mixer; divide by 2  | bit 1 = 0 |
|     | divider for AM mixer; divide by 6  | bit 1 = 1 |
| 2   | measure time IF-count; 40 ms   | bit 2 = 0 |
|     | measure time IF-count; 4 ms  | bit 2 = 1 |
| 3   | SDR off  | bit 3 = 0 |
|     | SDR on   | bit 3 = 1 |
| 4   | IF-prescaler division rate;<br>divide by 200   | bit 4 = 0 |
|     | IF-prescaler division rate;<br>divide by 25  | bit 4 = 1 |
| 5   | sensitivity unchanged  | bit 5 = 0 |
|     | multi-path sensitivity switch; less<br>sensitivity by an offset of $\Delta m = 10\%$   | bit 5 = 1 |
| 6   | temperature compensation of<br>unweighted voltage level;<br>temperature coefficient as specified<br>in Chapter "Characteristics" |           |
|     | temperature compensation off   | bit 6 = 0 |
|     | temperature compensation on  | bit 6 = 1 |
| 7   | noise blanker deactivated by high<br>modulation  | bit 7 = 0 |
|     | noise blanker not deactivated  | bit 7 = 1 |

**Table 5** Data to be transmitted by the IC for data byte 1;  
note 1

| BIT | DESCRIPTION                      |
|-----|----------------------------------|
| 0   | bit 1 level information          |
| 1   | bit 2 level information          |
| 2   | MSB (bit 3) level information    |
| 3   | LSB multi-path information       |
| 4   | multi-path information           |
| 5   | MSB multi-path information       |
| 6   | stereo pilot presence; bit 6 = 1 |
| 7   | LSB (bit 0) level information    |

**Note**

1. The analog-to-digital conversion for multi-path and level will be done during a transmission of any address to the I<sup>2</sup>C-bus.

**Table 6** Data to be transmitted by the IC for data byte 2

| BIT | DESCRIPTION           |
|-----|-----------------------|
| 0   | LSB of the IF-counter |
| 1   | IF-counter            |
| 2   | IF-counter            |
| 3   | IF-counter            |
| 4   | IF-counter            |
| 5   | IF-counter            |
| 6   | IF-counter            |
| 7   | MSB of the IF-counter |

## REFERENCED FREQUENCY GENERATION

**Table 7** Division ratios

| DIVISION RATIO | REFERENCE<br>FREQUENCY<br>(kHz) <sup>(1)</sup> |
|----------------|--|
| 20500          | 3  |
| 12300          | 5  |
| 6150           | 10   |
| 4100           | 15   |
| 2460           | 25   |
| 1230           | 50   |

**Note**

1. All specified frequencies are valid for a crystal oscillator frequency of 61.5 MHz.

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**Table 8** Output signal of reference frequency divider

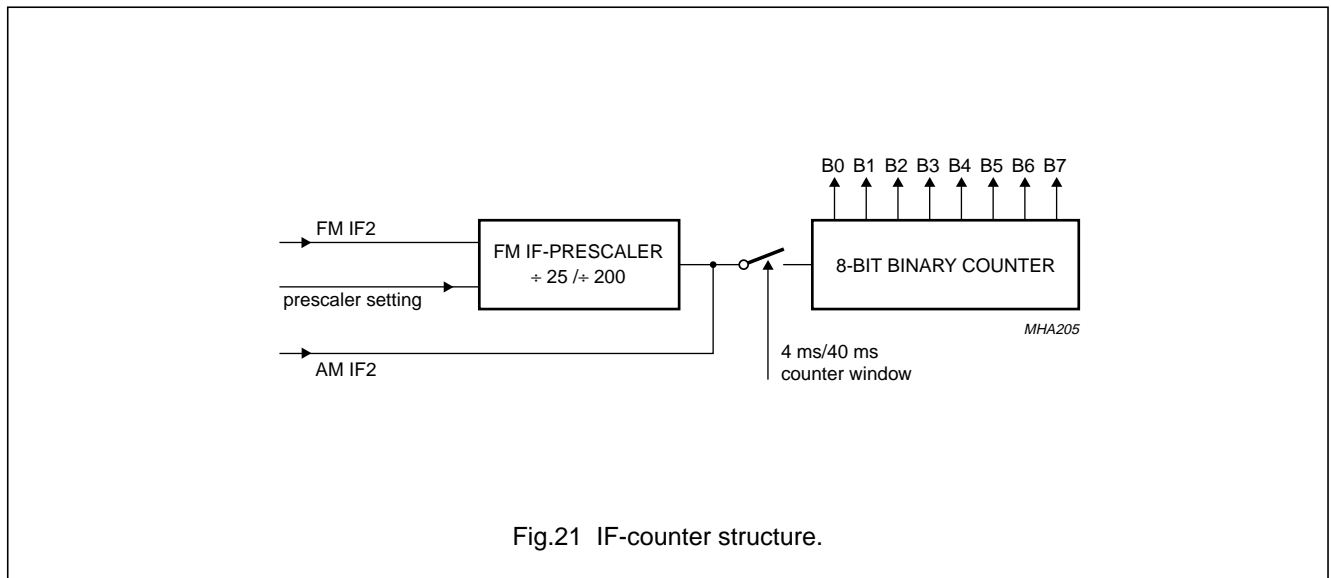
| SYMBOL                               | PARAMETER  | MIN. | TYP. | MAX. | UNIT     |
|--------------------------------------|--|------|------|------|----------|
| $V_{10-11(p-p)}$                     | differential output voltage (peak-to-peak value) | 0.3  | 0.4  | 0.5  | V        |
| $V_{10-4(p-p)}$ ;<br>$V_{11-4(p-p)}$ | single-ended output voltage (peak-to-peak value) | 0.15 | 0.2  | 0.3  | V        |
| $C_{10-4}$ ; $C_{11-4}$              | output capacitance                               | –    | –    | 4    | pF       |
| $R_{10-52}$ ; $R_{11-52}$            | output resistance                                | 800  | 1000 | 1200 | $\Omega$ |

IF-COUNTER

**Table 9** IF-counter sensitivity

| SYMBOL      | PARAMETER              | CONDITIONS       | MIN. | UNIT    |
|-------------|------------------------|------------------|------|---------|
| $V_{33-34}$ | IF-counter sensitivity | AM mode; $m = 0$ | 200  | $\mu V$ |
| $V_{37-35}$ | IF-counter sensitivity | FM mode          | 200  | $\mu V$ |

AM counting windows are 4 or 40 ms. FM counting windows are 4 or 40 ms. AM counting resolution is 250 or 25 Hz. FM counting resolution is 5 kHz, 625 Hz, 50 kHz or 6.25 kHz. AM-IF-prescaler is divisible by 1. FM-IF-prescaler is divisible by 25 or 200.



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*IF-counter read out***IF-counter read out as a function of FM or AM position, counter window and prescaler setting**

| FM/AM             | PRESCALER RATIO | WINDOW (ms) | f <sub>IF</sub> (kHz) | READ OUT | RESOLUTION (Hz/count) | RANGE (kHz) |          |
|-------------------|-----------------|-------------|-----------------------|----------|-----------------------|-------------|----------|
|                   |                 |             |                       |          |                       | MIN.        | MAX.     |
| FM                | 200             | 4           | 10700                 | D6H      | 50000                 | 4300        | 17050    |
| FM                | 200             | 40          | 10700                 | 5CH      | 5000                  | 10065       | 11335    |
| FM                | 25              | 4           | 10700                 | B0H      | 6250                  | 9906.25     | 11493.75 |
| FM <sup>(1)</sup> | 25              | 40          | 10700                 | E0H      | 625                   | 10620.63    | 10779.38 |
| AM                | 1               | 4           | 450                   | 08H      | 250                   | 418.25      | 481.75   |
| AM <sup>(1)</sup> | 1               | 40          | 450                   | 50H      | 25                    | 446.83      | 453.18   |

**Note**

1. In position FM with a prescaler ratio of 25, counter window of 40 ms and in position AM with 40 ms counter window ambiguous counting results within the IF filter bandwidth are obtained. The counting range is 127 counts above and 127 counts below the nominal IF of 10.7 MHz for FM and 450 kHz for AM.

The IF-count windows are valid for a crystal oscillator frequency of 61.5 MHz.

The FM/AM switching is carried out by bit 0 of byte 2 of the received data of the IC.

The IF-counter operates continuously.

The IF-counter and window-counter will be reset when the I<sup>2</sup>C-bus logic detects the address of the IC. This disables changes in the latches for the IF-count, while reading this value. If the transmission to the front-end IC is disabled after the synthesizer loop of the TEA6810T/TEA6811T front-end IC has locked for a new frequency, the IF-count will be available after the set measuring time.

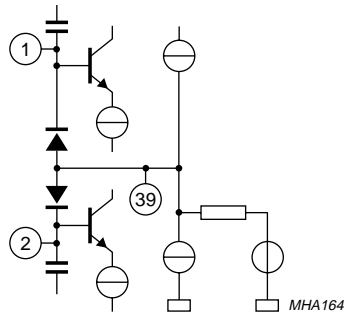
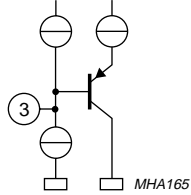
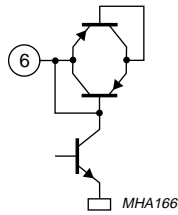
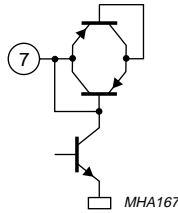
The IF-counter starts at 0. The IF-counter output are the **8 least significant bits** of the counting result.

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INTERNAL CIRCUITRY

Table 10 Equivalent pin circuits and pin voltages

| PIN | SYMBOL            | DC VOLTAGE (V) |            | EQUIVALENT CIRCUIT  |
|-----|-------------------|----------------|------------|---|
|     |                   | AM             | FM         |   |
| 1   | QDET1             | open-circuit   | 4.0        |     |
| 2   | QDET2             | open-circuit   | 4.0        |   |
| 3   | TSWITCH           | open-circuit   | 0.4 to 6.0 |   |
| 4   | AGND              | –              | –          |   |
| 5   | V <sub>DDA1</sub> | 5.0            | 5.0        |   |
| 6   | HFBUS1            | 5.0            | 5.0        |  |
| 7   | HFBUS2            | 5.0            | 5.0        |  |

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| PIN | SYMBOL       | DC VOLTAGE (V) |     | EQUIVALENT CIRCUIT |
|-----|--------------|----------------|-----|--------------------|
|     |              | AM             | FM  |                    |
| 8   | XTAL1        | 4.1            | 4.1 |                    |
| 9   | XTAL2        | 4.1            | 4.1 |                    |
| 10  | $f_{ref(p)}$ | 4.9            | 4.9 |                    |
| 11  | $f_{ref(n)}$ | 4.9            | 4.9 |                    |
| 12  | $I_{ref}$    | 4.3            | 4.3 |                    |
| 13  | FMIF1IN1     | 2.3            | 2.3 |                    |
| 14  | FMIF1IN2     | 2.3            | 2.3 |                    |



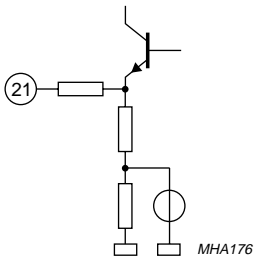
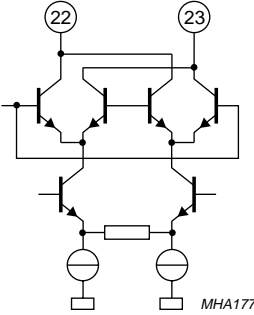
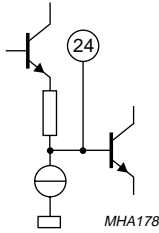
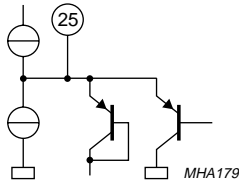
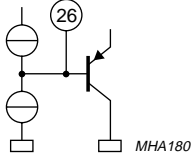
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| PIN | SYMBOL           | DC VOLTAGE (V) |            | EQUIVALENT CIRCUIT |
|-----|------------------|----------------|------------|--------------------|
|     |                  | AM             | FM         |                    |
| 15  | TSDR             | 0.7 to 5.5     | 0.7 to 5.5 | <p>MHA172</p>      |
| 16  | TSDS             | 0.7 to 5.5     | 0.7 to 5.5 | <p>MHA173</p>      |
| 17  | V <sub>SDS</sub> | 3.0 to 5.5     | 3.0 to 5.5 | <p>MHA174</p>      |
| 18  | V <sub>SDR</sub> | 3.0 to 5.5     | 3.0 to 5.5 | <p>MHA175</p>      |
| 19  | FMIF2OUT1        | 8.5            | 8.5        | <p>MHA171</p>      |
| 20  | FMIF2OUT2        | 8.5            | 8.5        |                    |

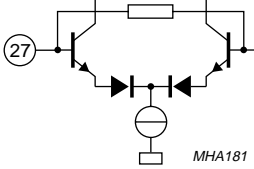
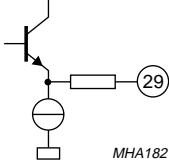
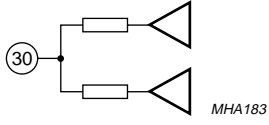
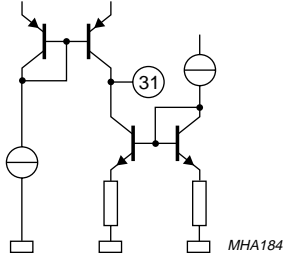
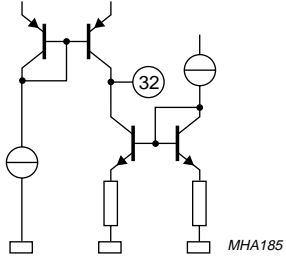
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| PIN | SYMBOL           | DC VOLTAGE (V) |            | EQUIVALENT CIRCUIT  |
|-----|------------------|----------------|------------|---|
|     |                  | AM             | FM         |   |
| 21  | V <sub>ref</sub> | 5.1            | 5.1        |  <p>MHA176</p>    |
| 22  | AMIF2OUT1        | 8.5            | 8.5        |  <p>MHA177</p>   |
| 23  | AMIF2OUT2        | 8.5            | 8.5        |   |
| 24  | FMAMDEC          | 3.0            | 2.5        |  <p>MHA178</p> |
| 25  | PHASEDET         | 2.8 to 7.2     | 2.8 to 7.2 |  <p>MHA179</p>  |
| 26  | PILDET           | 0.4            | 0.4 to 7.0 |  <p>MHA180</p> |

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| PIN | SYMBOL            | DC VOLTAGE (V) |     | EQUIVALENT CIRCUIT   |
|-----|-------------------|----------------|-----|--|
|     |                   | AM             | FM  |  |
| 27  | FMAM10.7          | 3.0            | 2.5 |    |
| 28  | V <sub>DDA2</sub> | 8.5            | 8.5 |  |
| 29  | FMIFAMPOUT        | 6.0            | 6.0 |   |
| 30  | AFGND             | 3.6            | 3.6 |   |
| 31  | DEEMPHR           | 2.3            | 2.3 |  |
| 32  | DEEMPHL           | 2.3            | 2.3 |  |

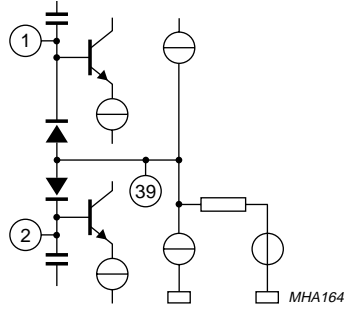
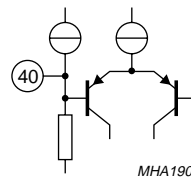
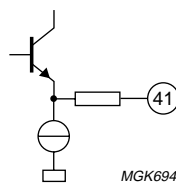
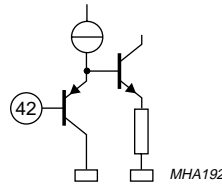
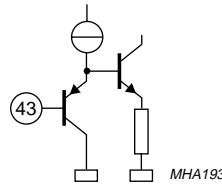
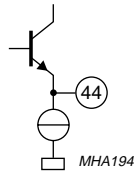
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| PIN | SYMBOL   | DC VOLTAGE (V) |     | EQUIVALENT CIRCUIT |
|-----|----------|----------------|-----|--------------------|
|     |          | AM             | FM  |                    |
| 33  | AMIF2IN1 | 2.7            | 0.7 |                    |
| 34  | AMIF2IN2 | 2.7            | 0.7 |                    |
| 35  | FMIN2    | 0.7            | 2.7 |                    |
| 36  | DCFEED   | 2.7            | 2.7 |                    |
| 37  | FMIN1    | 0.7            | 2.7 |                    |
| 38  | LEVELADJ | 2.6            | 2.6 |                    |

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| PIN | SYMBOL           | DC VOLTAGE (V) |            | EQUIVALENT CIRCUIT  |
|-----|------------------|----------------|------------|---|
|     |                  | AM             | FM         |   |
| 39  | C <sub>AFC</sub> | 1.0 to 2.2     | 1.0 to 7.0 |     |
| 40  | MPBUF            | 0.7 to 6.0     | 0.7 to 6.0 |   |
| 41  | OUTLEFT          | 3.6            | 3.6        |  |
| 42  | FMSTOP           | 0 to 5.2       | 0 to 5.2   |   |
| 43  | RDS/AMSTOP       | 0 to 5.2       | 3.0        |   |
| 44  | OUTRIGHT         | 3.6            | 3.6        |  |

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| PIN | SYMBOL                | DC VOLTAGE (V) |            | EQUIVALENT CIRCUIT |
|-----|-----------------------|----------------|------------|--------------------|
|     |                       | AM             | FM         |                    |
| 45  | MPXIN                 | 2.8            | 2.8        |                    |
| 46  | THRES                 | 4.3/5.7        | 4.3/5.7    |                    |
| 47  | MPXOUT                | 0              | 3.0        |                    |
| 48  | AMAFOUT               | 3.7            | 4.8        |                    |
| 49  | V <sub>mute/AML</sub> | 1.0 to 5.5     | 1.0 to 5.5 |                    |
| 50  | LEVELUNWEIG           | 1.0 to 7.0     | 1.0 to 7.0 |                    |

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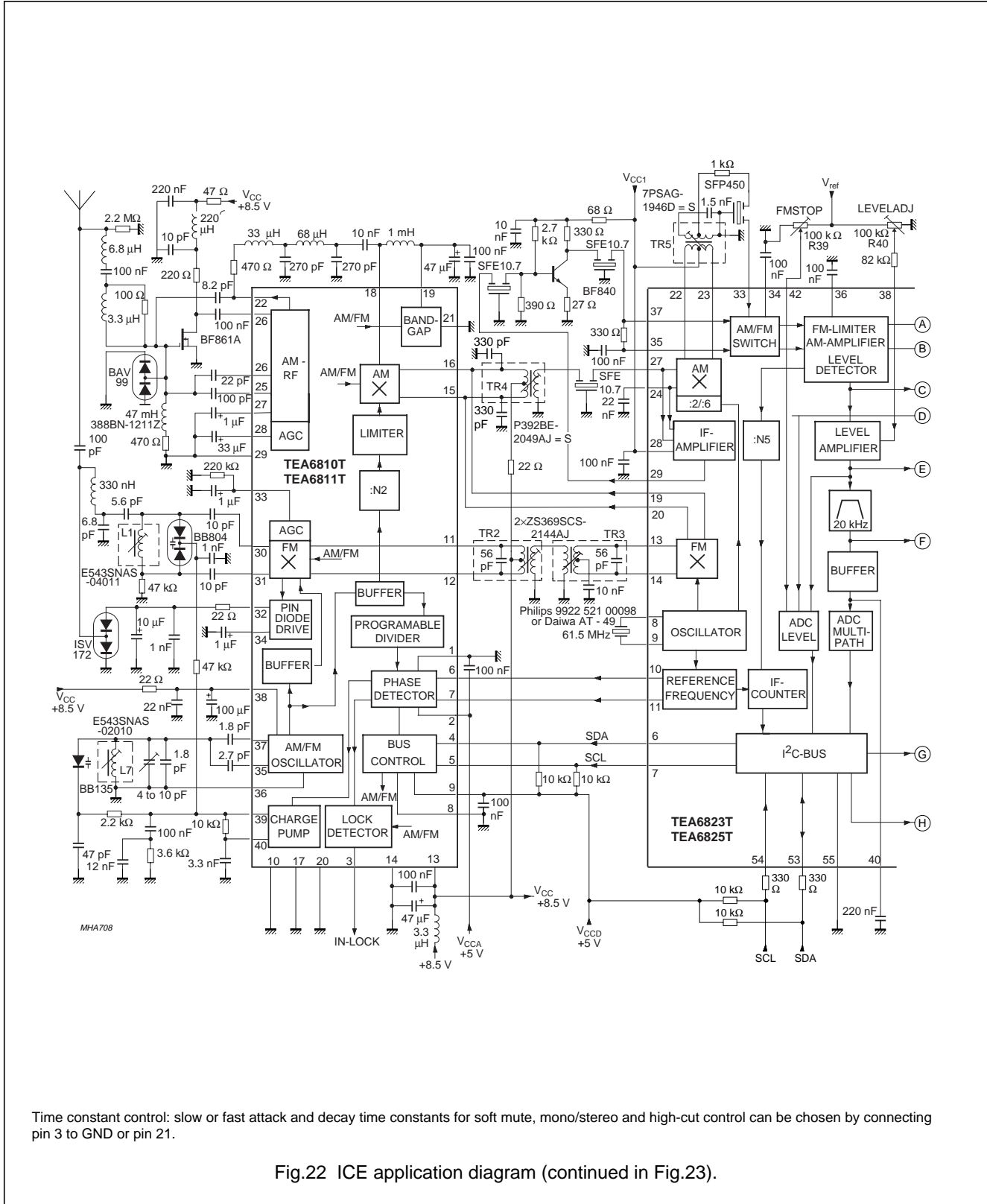
TEA6823T; TEA6825T

| PIN | SYMBOL               | DC VOLTAGE (V) |     | EQUIVALENT CIRCUIT |
|-----|----------------------|----------------|-----|--------------------|
|     |                      | AM             | FM  |                    |
| 51  | IAC <sub>CONTR</sub> | 0              | 6.0 |                    |
| 52  | V <sub>DDD</sub>     | 5.0            | 5.0 |                    |
| 53  | SDA                  | 5.0            | 5.0 |                    |
| 54  | SCL                  | 5.0            | 5.0 |                    |
| 55  | DGND                 | 0              | 0   |                    |
| 56  | V <sub>DDA3</sub>    | 8.5            | 8.5 |                    |

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APPLICATION INFORMATION





# In Car Entertainment (ICE) car radio

# TEA6823T; TEA6825T

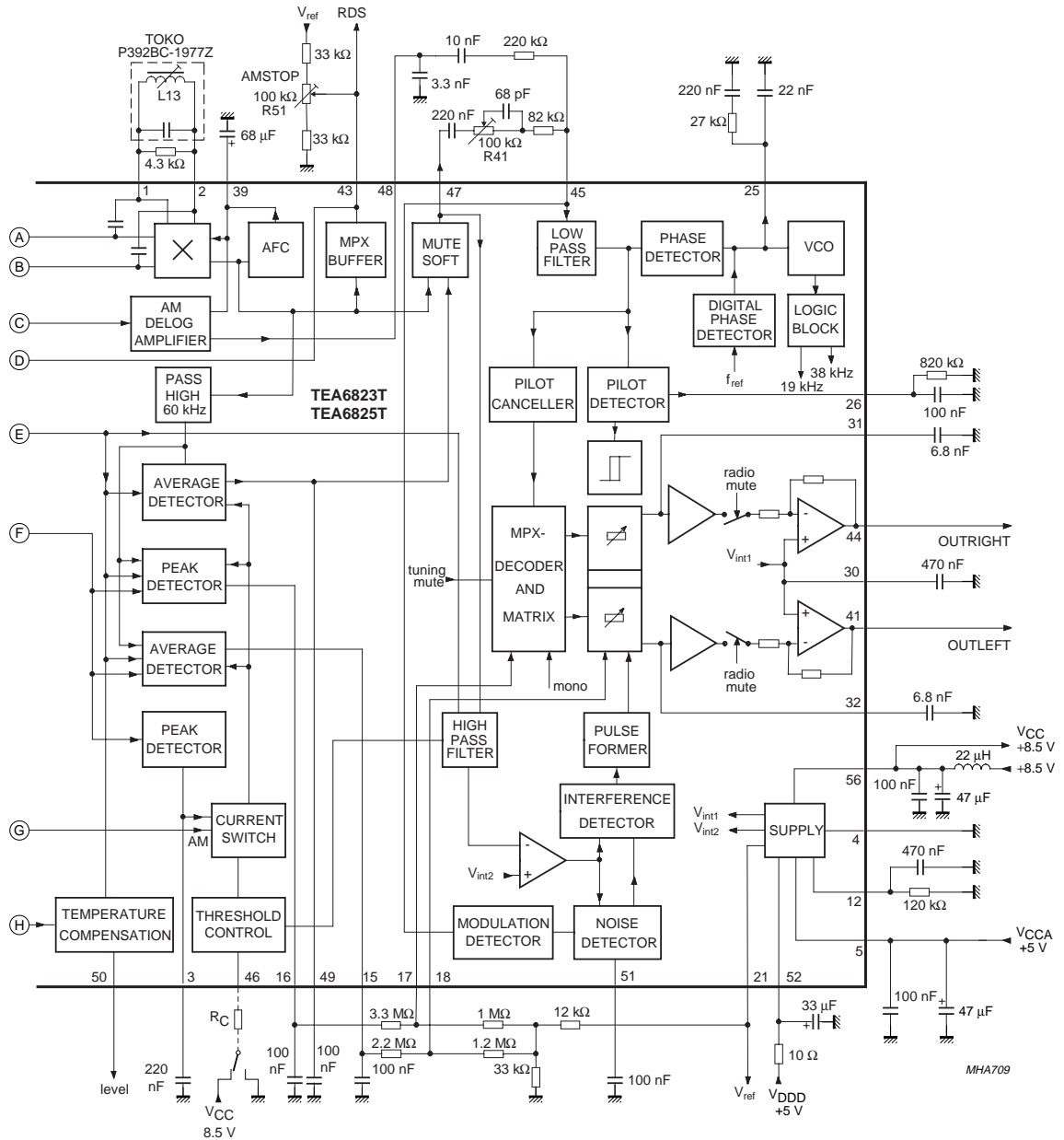


Fig.23 ICE application diagram (continued from Fig.22).

# In Car Entertainment (ICE) car radio

## TEA6823T; TEA6825T

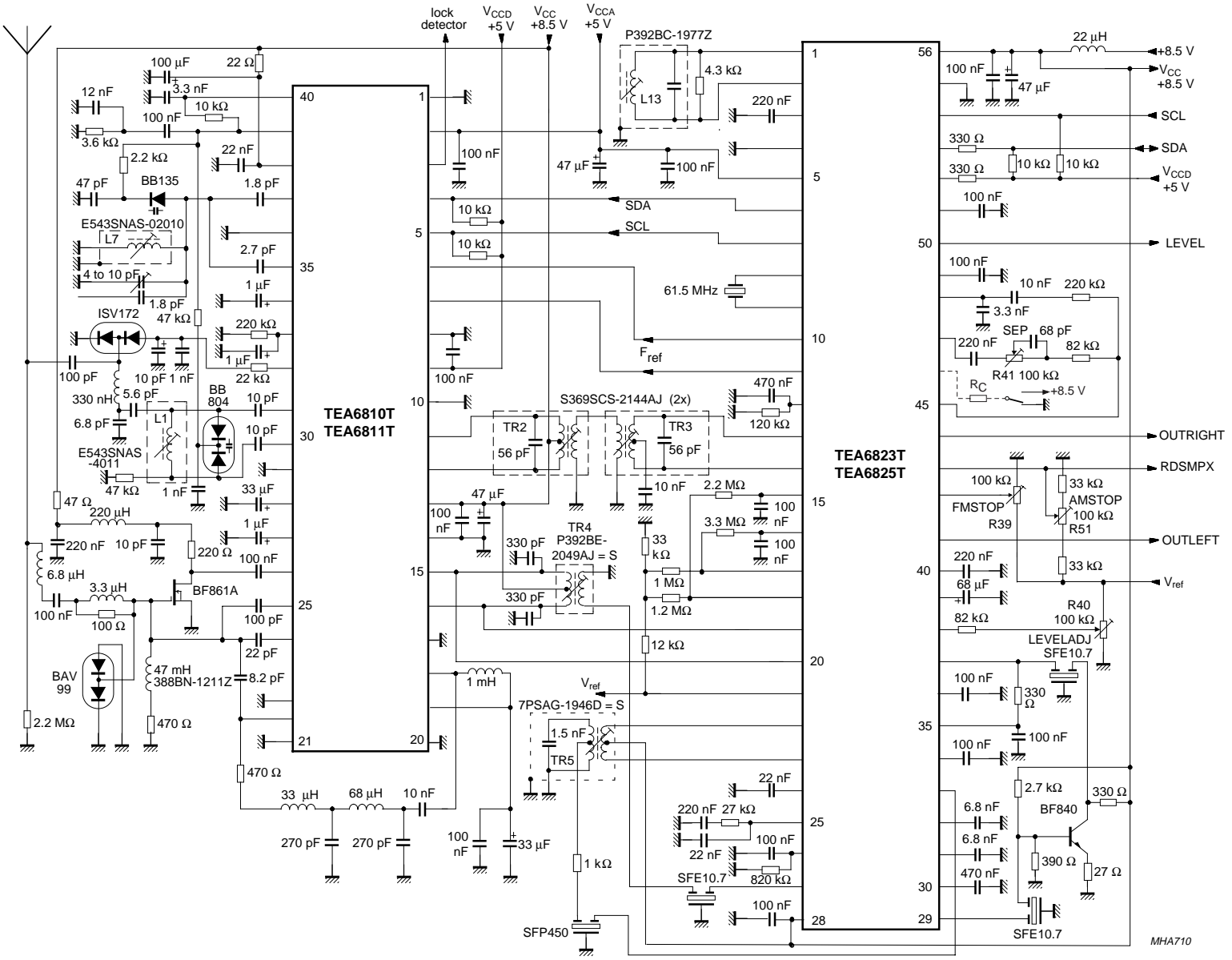


Fig.24 AM/FM car radio receiver with TEA6810T and TEA6825T or TEA6811T and TEA6823T.

MHA710

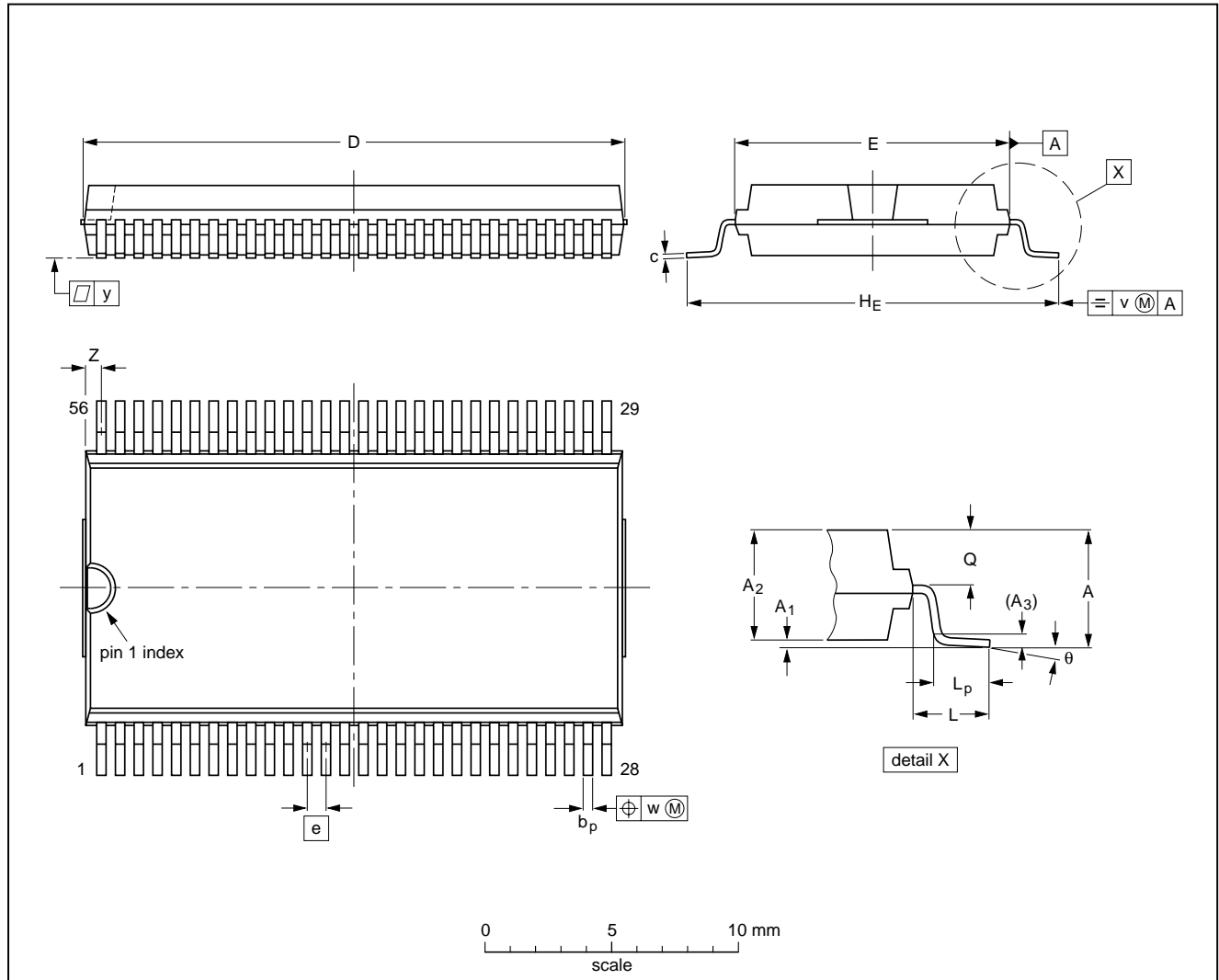
In Car Entertainment (ICE) car radio

TEA6823T; TEA6825T

PACKAGE OUTLINES

VSO56: plastic very small outline package; 56 leads

SOT190-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(2)</sup> | e      | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v     | w     | y     | z <sup>(1)</sup> | θ        |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|--------|----------------|-------|----------------|----------------|-------|-------|-------|------------------|----------|
| mm     | 3.3    | 0.3<br>0.1     | 3.0<br>2.8     | 0.25           | 0.42<br>0.30   | 0.22<br>0.14     | 21.65<br>21.35   | 11.1<br>11.0     | 0.75   | 15.8<br>15.2   | 2.25  | 1.6<br>1.4     | 1.45<br>1.30   | 0.2   | 0.1   | 0.1   | 0.90<br>0.55     | 7°<br>0° |
| inches | 0.13   | 0.012<br>0.004 | 0.12<br>0.11   | 0.01           | 0.017<br>0.012 | 0.0087<br>0.0055 | 0.85<br>0.84     | 0.44<br>0.43     | 0.0295 | 0.62<br>0.60   | 0.089 | 0.063<br>0.055 | 0.057<br>0.051 | 0.008 | 0.004 | 0.004 | 0.035<br>0.022   |          |

Note

1. Plastic or metal protrusions of 0.3 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

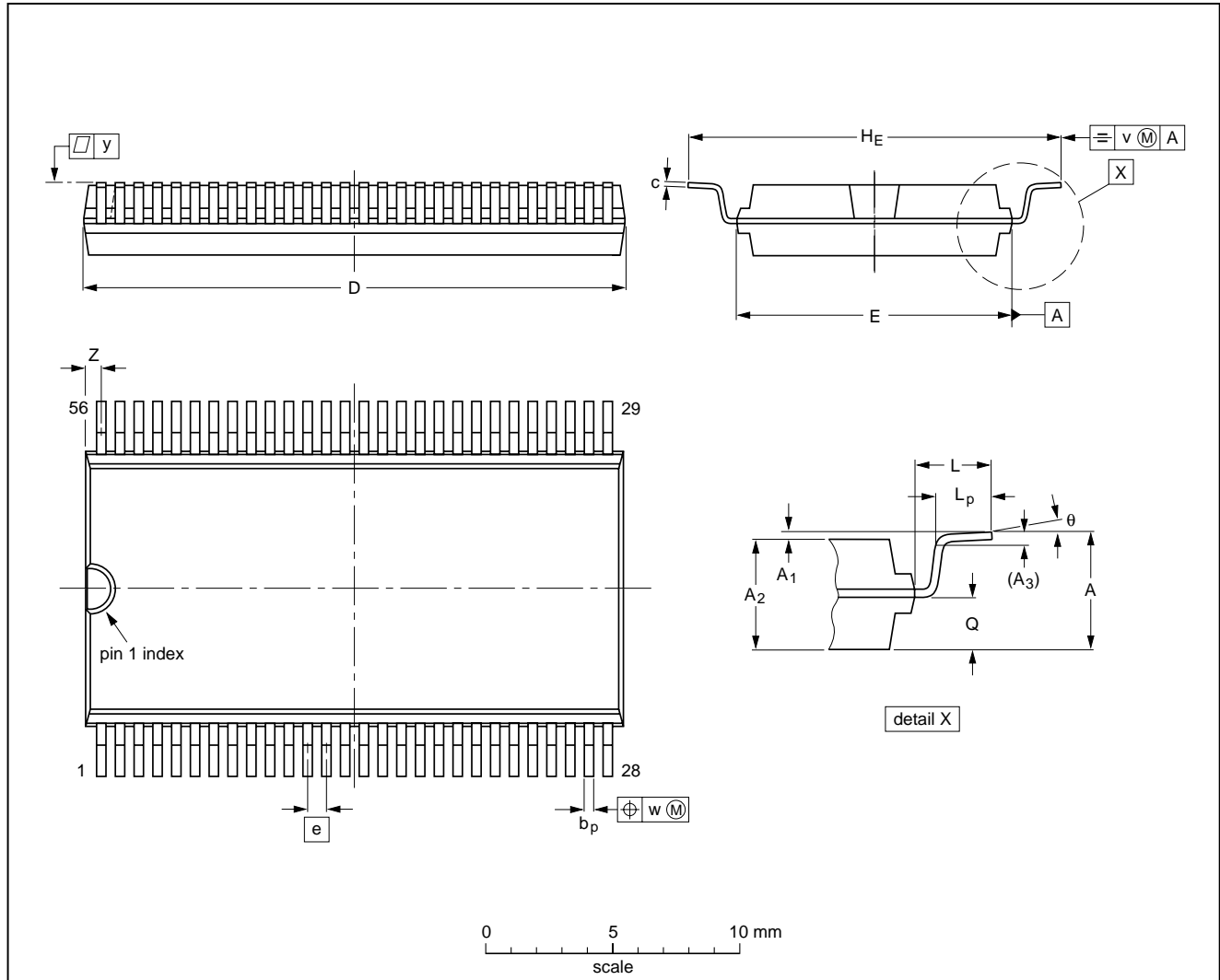
| OUTLINE VERSION | REFERENCES |       |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|-------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |                      |
| SOT190-1        |            |       |      |  |                     | 96-04-02<br>97-08-11 |

In Car Entertainment (ICE) car radio

TEA6823T; TEA6825T

VSO56: plastic very small outline package; 56 leads; face down

SOT190-2



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(2)</sup> | e      | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v     | w     | y     | z <sup>(1)</sup> | θ        |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|--------|----------------|-------|----------------|----------------|-------|-------|-------|------------------|----------|
| mm     | 3.3    | 0.3<br>0.1     | 3.0<br>2.8     | 0.25           | 0.42<br>0.30   | 0.22<br>0.14     | 21.65<br>21.35   | 11.1<br>11.0     | 0.75   | 15.8<br>15.2   | 2.25  | 1.6<br>1.4     | 1.45<br>1.30   | 0.2   | 0.1   | 0.1   | 0.90<br>0.55     | 7°<br>0° |
| inches | 0.13   | 0.012<br>0.004 | 0.12<br>0.11   | 0.01           | 0.017<br>0.012 | 0.0087<br>0.0055 | 0.85<br>0.84     | 0.44<br>0.43     | 0.0295 | 0.62<br>0.60   | 0.089 | 0.063<br>0.055 | 0.057<br>0.051 | 0.008 | 0.004 | 0.004 | 0.035<br>0.022   |          |

Note

1. Plastic or metal protrusions of 0.3 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES |       |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|-------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC | EIAJ |  |                     |                      |
| SOT190-2        |            |       |      |  |                     | 96-04-02<br>97-08-11 |

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## In Car Entertainment (ICE) car radio

## TEA6823T; TEA6825T

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### SOLDERING

#### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (order code 9398 652 90011).

#### Reflow soldering

Reflow soldering techniques are suitable for all VSO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

#### Wave soldering

Wave soldering techniques can be used for all VSO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

## In Car Entertainment (ICE) car radio

TEA6823T; TEA6825T

**DEFINITIONS**

|   |   |
|---|---|
| <b>Data sheet status</b>  |   |
| Objective specification   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification   | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification   | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>  |   |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |   |
| <b>Application information</b>  |   |
| Where application information is given, it is advisory and does not form part of the specification.   |   |

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In Car Entertainment (ICE) car radio

TEA6823T; TEA6825T

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