

# DATA SHEET



## **TEA6849H**

New In Car Entertainment car radio  
tuner IC with Precision Adjacent  
Channel Suppression  
(NICE-PACS)

Product specification

2003 Dec 19

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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## 1 FEATURES

- FM mixer 1 for conversion of FM RF (65 to 108 MHz and US weather band) to IF of 10.7 MHz; the mixer provides inherent image rejection; for European and US FM band/WB (weather band) the mixer is driven with a 'high' injection Local Oscillator (LO); in Japan FM band and East Europe FM band the mixer is driven with a 'low' injection LO
- AM mixer 1 for conversion of AM RF to AM IF1 of 10.7 MHz
- LC tuner oscillator providing mixer frequencies for FM mixer and AM mixer 1
- AM mixer 2 for conversion of AM IF1 to AM IF2 of 450 kHz
- Crystal oscillator providing mixer frequencies for AM mixer 2 and FM mixer 2 and reference for synthesizer PLL, IF count, timing for Radio Data System (RDS) update and reference frequency for car audio signal processor ICs
- Fast synthesizer PLL tuning system with local control for inaudible RDS updating
- Timing function for RDS update algorithm and control signal output for car audio signal processor ICs (TEA688x, SAA77xx, TEF689x)
- I<sup>2</sup>C-bus adjustable FM MPX soft mute
- Digital alignment circuit for bus controlled matching of oscillator tuning voltage to FM antenna tank circuit tuning voltage
- AGC PIN diode drive circuit for FM RF AGC; AGC detection at FM mixer input; the AGC PIN diode drive can be activated by the I<sup>2</sup>C-bus as a local function for search tuning; AGC threshold is a programmable and keyed function switchable via the I<sup>2</sup>C-bus
- FM IF linear amplifier with high dynamic input range
- FM mixer 2 for conversion of FM IF1 to FM IF2 of 450 kHz with inherent image rejection
- Fully integrated dynamic selectivity and FM demodulator at IF2; improved sensitivity with dynamic threshold extension; centre frequency of IF2 selectivity alignment via the I<sup>2</sup>C-bus
- Level detector for AM and FM with temperature compensated output voltage; starting point and slope of level output is programmable via the I<sup>2</sup>C-bus
- AM cascode AGC stage and RF PIN diode drive circuit; AGC threshold detection at AM mixer 1 and IF2 AGC input; threshold for detection at mixer 1 input is programmable via the I<sup>2</sup>C-bus
- AM IF2 AGC and demodulator
- AM AF output switchable to provide AM IF2 for AM stereo decoder
- AM noise blanker with detection at IF1 and blanking at AM IF2
- Software controlled flag output
- Buffer output for weather band flag
- Adjacent channel detector and modulation detector for instantaneous bandwidth control of the integrated filter
- Flag and voltage output indicating the actual bandwidth.



## 2 GENERAL DESCRIPTION

The TEA6849H is a single IC with car radio tuner for AM, FM and Weather Band (WB) intended for microcontroller tuning with the I<sup>2</sup>C-bus. It provides the following functions:

- AM double conversion receiver for LW, MW and SW (31 m, 41 m and 49 m bands) with IF1 = 10.7 MHz and IF2 = 450 kHz
- FM double conversion receiver with integrated image rejection for IF1 and for IF2 capable of selecting US FM, US weather, Europe FM, East Europe FM and Japan FM bands; fully integrated dynamic selectivity at 450 kHz FM IF2; FM demodulator with dynamic threshold extension; centre frequency alignment of IF2 selectivity via the I<sup>2</sup>C-bus
- The tuning system includes VCO, crystal oscillator and PLL synthesizer on one chip.

## 3 ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |                                                                        |          |
|-------------|---------|------------------------------------------------------------------------|----------|
|             | NAME    | DESCRIPTION                                                            | VERSION  |
| TEA6849H    | LQFP80  | plastic low profile quad flat package; 80 leads; body 12 × 12 × 1.4 mm | SOT315-1 |

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## 4 QUICK REFERENCE DATA

| SYMBOL                                                  | PARAMETER                                  | CONDITIONS                                                                                                                                          | MIN.  | TYP. | MAX.   | UNIT |
|---------------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|--------|------|
| $V_{DDA(n)}$                                            | analog supply voltage 1 to 4 and 6         |                                                                                                                                                     | 8     | 8.5  | 9      | V    |
| $I_{DDA(tot)}$                                          | sum of analog supply currents 1 to 4 and 6 | FM mode                                                                                                                                             | 45    | 56   | 67     | mA   |
|                                                         |                                            | AM mode                                                                                                                                             | 40    | 50   | 60     | mA   |
| $V_{DDA5}$                                              | analog supply voltage 5                    |                                                                                                                                                     | 4.75  | 5    | 5.25   | V    |
| $I_{DDA5}$                                              | analog supply current 5                    | FM mode                                                                                                                                             | –     | 7.4  | –      | mA   |
|                                                         |                                            | AM mode                                                                                                                                             | –     | 11   | –      | mA   |
| $V_{DDD}$                                               | digital supply voltage                     |                                                                                                                                                     | 4.75  | 5    | 5.25   | V    |
| $I_{DDD}$                                               | digital supply current                     | FM mode                                                                                                                                             | 21    | 26   | 31     | mA   |
|                                                         |                                            | AM mode                                                                                                                                             | 22    | 27   | 32     | mA   |
| $f_{AM(ant)}$                                           | AM input frequency                         | LW                                                                                                                                                  | 0.144 | –    | 0.288  | MHz  |
|                                                         |                                            | MW                                                                                                                                                  | 0.522 | –    | 1.710  | MHz  |
|                                                         |                                            | SW                                                                                                                                                  | 5.730 | –    | 9.99   | MHz  |
| $f_{FM(ant)}$                                           | FM input frequency                         |                                                                                                                                                     | 65    | –    | 108    | MHz  |
| $f_{FM(WB)(ant)}$                                       | FM weather band input frequency            |                                                                                                                                                     | 162.4 | –    | 162.55 | MHz  |
| $T_{amb}$                                               | ambient temperature                        |                                                                                                                                                     | –40   | –    | +85    | °C   |
| <b>AM overall system parameters; see Figs 12 and 13</b> |                                            |                                                                                                                                                     |       |      |        |      |
| (S+N)/N                                                 | signal plus noise-to-noise ratio           | $m = 0.3$ ; $B_{AF} = 2.15$ kHz                                                                                                                     | –     | 59   | –      | dB   |
| THD                                                     | total harmonic distortion                  | $m = 0.8$ ; $f_{mod} = 1$ kHz                                                                                                                       | –     | 0.3  | –      | %    |
| $V_{sens(rms)}$                                         | sensitivity (RMS value)                    | $m = 0.3$ ; $f_{mod} = 1$ kHz;<br>(S+N)/N = 26 dB;<br>with European dummy<br>aerial 15 pF/60 pF;<br>$B_{AF} = 2.15$ kHz                             | –     | 45   | –      | μV   |
| <b>FM overall system parameters; see Figs 12 and 13</b> |                                            |                                                                                                                                                     |       |      |        |      |
| (S+N)/N                                                 | signal plus noise-to-noise ratio           | $\Delta f = 22.5$ kHz;<br>de-emphasis = 50 μs;<br>$B_{AF} = 300$ Hz to 15 kHz                                                                       | –     | 63   | –      | dB   |
| THD                                                     | total harmonic distortion                  | $\Delta f = 75$ kHz;<br>with $2 \times SFE10.7MS3$                                                                                                  | –     | 0.35 | –      | %    |
| $V_{sens(rms)}$                                         | sensitivity (RMS value)                    | $\Delta f = 22.5$ kHz;<br>$f_{mod} = 1$ kHz;<br>(S+N)/N = 26 dB;<br>de-emphasis = 50 μs;<br>$B_{AF} = 300$ Hz to 15 kHz;<br>with 75 Ω dummy antenna | –     | 1.4  | 2      | μV   |

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## 5 BLOCK DIAGRAM

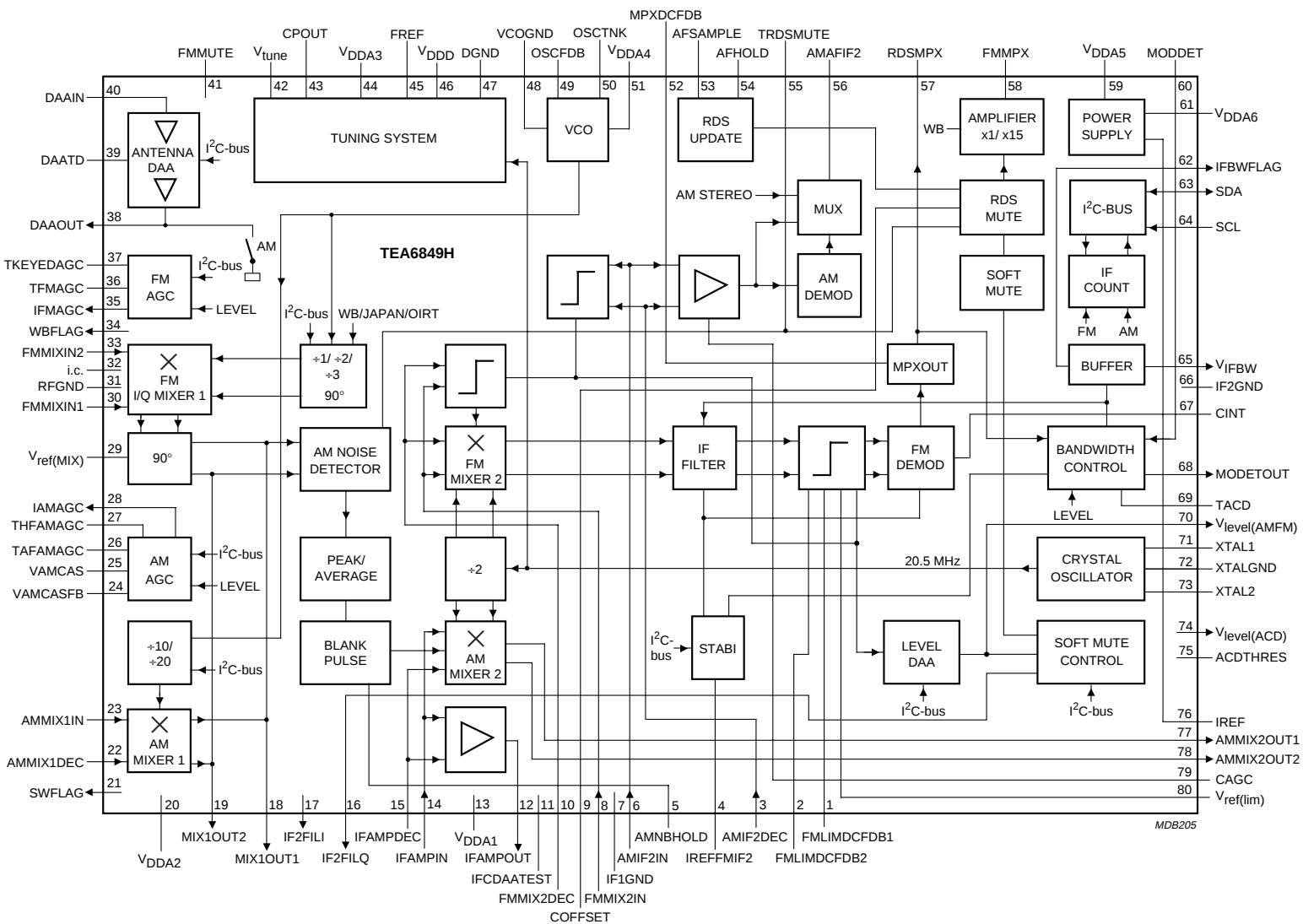


Fig.1 Block diagram.

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## 6 PINNING

| SYMBOL                | PIN | DESCRIPTION                                                                                |
|-----------------------|-----|--------------------------------------------------------------------------------------------|
| FMLIMDCFDB1           | 1   | decoupling in-phase FM limiter                                                             |
| FMLIMDCFDB2           | 2   | decoupling quadrature phase FM limiter                                                     |
| AMIF2DEC              | 3   | decoupling for AM IF2 input                                                                |
| IREFFMIF2             | 4   | reference current for FM IF2                                                               |
| AMNBHOLD              | 5   | AM noise blanker threshold                                                                 |
| AMIF2IN               | 6   | AM IF2 input (450 kHz) for demodulator AGC and AM level detector                           |
| IF1GND                | 7   | AM IF1 ground                                                                              |
| FMMIX2IN              | 8   | FM mixer 2 input                                                                           |
| COFFSET               | 9   | DC feedback for offset compensation RDS mute                                               |
| FMMIX2DEC             | 10  | FM mixer 2 decoupling                                                                      |
| IFCDAATEST            | 11  | test pin for IF centre DAA                                                                 |
| IFAMPOUT              | 12  | IF amplifier output (10.7 MHz)                                                             |
| V <sub>DDA1</sub>     | 13  | analog supply voltage 1 (8.5 V) for FM IF amplifier                                        |
| IFAMPIN               | 14  | FM IF amplifier and AM mixer 2 input (10.7 MHz)                                            |
| IFAMPDEC              | 15  | FM IF amplifier and AM mixer 2 decoupling                                                  |
| IF2FILQ               | 16  | test output quadrature phase FM IF2 filter; time constant FM soft mute                     |
| IF2FILI               | 17  | test output in-phase FM IF2 filter                                                         |
| MIX1OUT1              | 18  | FM mixer and AM mixer 1 IF output 1 (10.7 MHz)                                             |
| MIX1OUT2              | 19  | FM mixer and AM mixer 1 IF output 2 (10.7 MHz)                                             |
| V <sub>DDA2</sub>     | 20  | analog supply voltage 2 (8.5 V) for FM and AM RF                                           |
| SWFLAG                | 21  | output software programmable flag                                                          |
| AMMIX1DEC             | 22  | AM mixer 1 decoupling                                                                      |
| AMMIX1IN              | 23  | AM mixer 1 input                                                                           |
| VAMCASFB              | 24  | feedback for cascode AM AGC                                                                |
| VAMCAS                | 25  | cascode AM AGC                                                                             |
| TAFAMAGC              | 26  | AF time constant of AM front-end AGC                                                       |
| THFAMAGC              | 27  | HF time constant of AM front-end AGC                                                       |
| IAMAGC                | 28  | PIN diode drive current output of AM front-end AGC                                         |
| V <sub>ref(MIX)</sub> | 29  | reference voltage for FM RF mixer                                                          |
| FMMIXIN1              | 30  | FM RF mixer input 1                                                                        |
| RFGND                 | 31  | RF ground                                                                                  |
| i.c.                  | 32  | internal connection                                                                        |
| FMMIXIN2              | 33  | FM RF mixer input 2                                                                        |
| WBFLAG                | 34  | buffered weather band flag output                                                          |
| IFMAGC                | 35  | PIN diode drive current output of FM front-end AGC                                         |
| TFMAGC                | 36  | time constant of FM front-end AGC                                                          |
| TKEYEDAGC             | 37  | time constant of keyed FM front-end AGC                                                    |
| DAAOUT                | 38  | output of digital auto alignment circuit for antenna tank circuit                          |
| DAATD                 | 39  | temperature compensation diode for digital auto alignment circuit for antenna tank circuit |
| DAAIN                 | 40  | input of digital auto alignment circuit for antenna tank circuit                           |

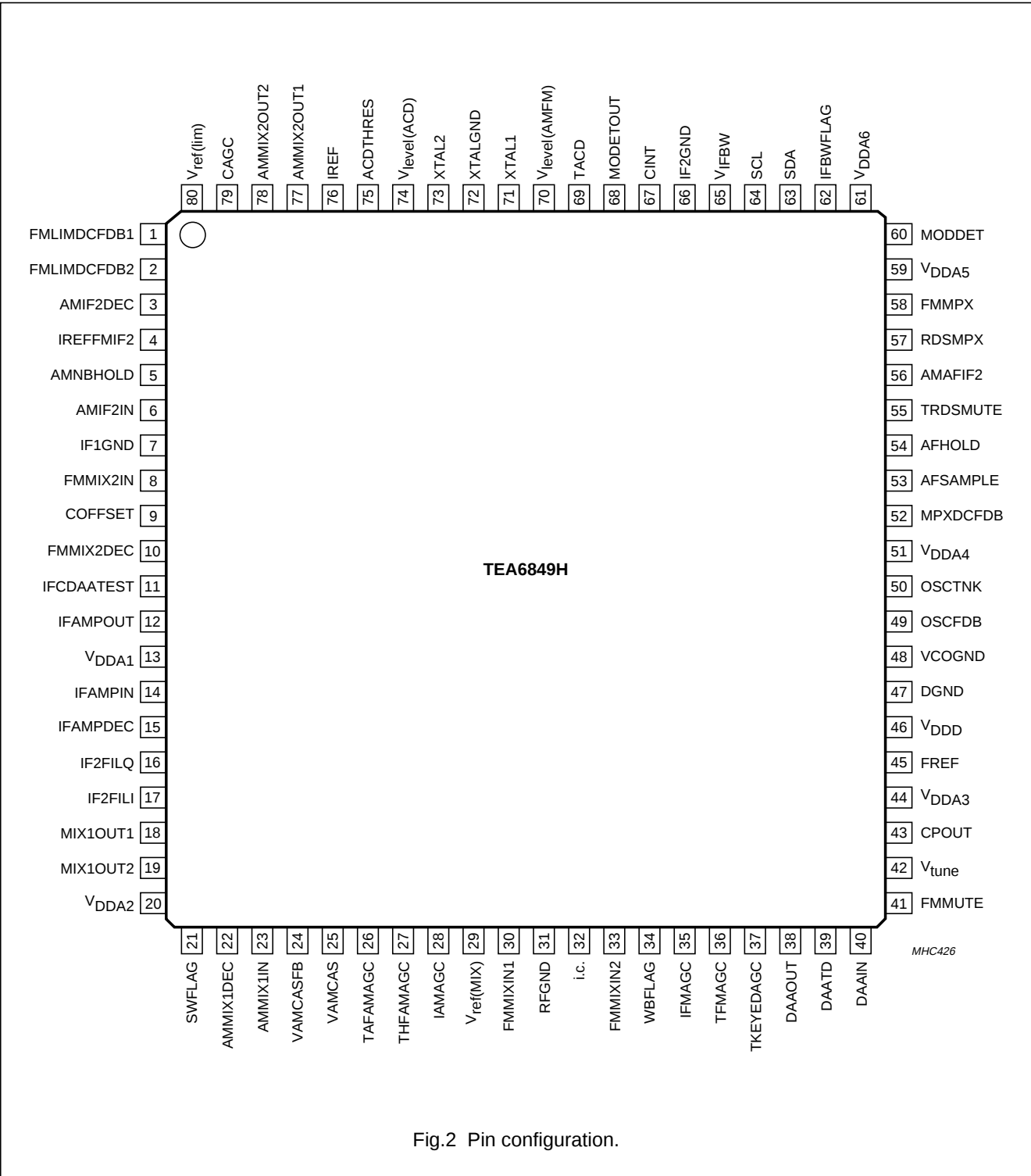
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| SYMBOL                   | PIN | DESCRIPTION                                                                                |
|--------------------------|-----|--------------------------------------------------------------------------------------------|
| FMMUTE                   | 41  | test output for FM soft mute bits                                                          |
| V <sub>tune</sub>        | 42  | tuning voltage                                                                             |
| CPOUT                    | 43  | charge pump output                                                                         |
| V <sub>DDA3</sub>        | 44  | analog supply voltage 3 (8.5 V) for tuning PLL                                             |
| FREF                     | 45  | reference frequency output for signal processor IC                                         |
| V <sub>DDD</sub>         | 46  | digital supply voltage (5 V)                                                               |
| DGND                     | 47  | digital ground                                                                             |
| VCOGND                   | 48  | VCO ground                                                                                 |
| OSCFDB                   | 49  | VCO feedback                                                                               |
| OSCTNK                   | 50  | VCO tank circuit                                                                           |
| V <sub>DDA4</sub>        | 51  | analog supply voltage 4 (8.5 V) for VCO                                                    |
| MPXDCFDB                 | 52  | DC feedback for FM MPX signal path                                                         |
| AFSAMPLE                 | 53  | AF sample flag output for car audio signal processor IC                                    |
| AFHOLD                   | 54  | AF hold flag output for car audio signal processor IC                                      |
| TRDSMUTE                 | 55  | time constant for RDS update mute                                                          |
| AMAFIF2                  | 56  | AM demodulator AF output or IF2 output for AM stereo (multiplexed by I <sup>2</sup> C-bus) |
| RDSMPX                   | 57  | MPX output for RDS decoder and signal processor (not muted)                                |
| FMMPX                    | 58  | FM demodulator MPX output                                                                  |
| V <sub>DDA5</sub>        | 59  | analog supply voltage 5 (5 V) for on-chip power supply                                     |
| MODEDET                  | 60  | modulation detector input                                                                  |
| V <sub>DDA6</sub>        | 61  | analog supply voltage 6 (8.5 V) for on-chip power supply                                   |
| IFBWFLAG                 | 62  | FM IF2 bandwidth flag output                                                               |
| SDA                      | 63  | I <sup>2</sup> C-bus data line input and output                                            |
| SCL                      | 64  | I <sup>2</sup> C-bus clock line input                                                      |
| V <sub>IFBW</sub>        | 65  | monitor voltage for FM IF2 bandwidth                                                       |
| IF2GND                   | 66  | AM IF2 ground                                                                              |
| CINT                     | 67  | demodulator loop filter                                                                    |
| MODETOUT                 | 68  | modulation detector output                                                                 |
| TACD                     | 69  | adjacent channel detector time constant                                                    |
| V <sub>level(AMFM)</sub> | 70  | level voltage output for AM and FM                                                         |
| XTAL1                    | 71  | crystal oscillator 1                                                                       |
| XTALGND                  | 72  | crystal oscillator ground                                                                  |
| XTAL2                    | 73  | crystal oscillator 2                                                                       |
| V <sub>level(ACD)</sub>  | 74  | level voltage output for adjacent channel detector                                         |
| ACDTHRES                 | 75  | adjacent channel detector threshold                                                        |
| IREF                     | 76  | reference current for power supply                                                         |
| AMMIX2OUT1               | 77  | AM mixer 2 output 1 (450 kHz)                                                              |
| AMMIX2OUT2               | 78  | AM mixer 2 output 2 (450 kHz)                                                              |
| CAGC                     | 79  | AM IF AGC capacitor                                                                        |
| V <sub>ref(lim)</sub>    | 80  | limiter reference voltage                                                                  |

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## 7 FUNCTIONAL DESCRIPTION

### 7.1 Oscillators

#### 7.1.1 VCO

The varactor tuned VCO provides the local oscillator signal for both FM and AM mixer 1. It has a frequency range of 162.9 to 248.2 MHz.

#### 7.1.2 PLL

Fast synthesizer PLL tuning system with local control for inaudible RDS updating.

#### 7.1.3 CRYSTAL OSCILLATOR

The crystal oscillator provides a 20.5 MHz signal that is used for:

- Reference frequency for frequency synthesizer PLL
- Local oscillator for AM mixer 2 and FM mixer 2
- Reference frequency for the IF counter
- Timing signal for the RDS update algorithm
- Reference frequency (75.368 kHz) for the TEA688x (car audio signal processor - CASP) or TEF689x (car radio integrated signal processor - CRISP).

### 7.2 DAA

To reduce the number of manual alignments in production the following I<sup>2</sup>C-bus controlled Digital Auto Alignment (DAA) functions are included:

- FM RF DAA
  - 7-bit DAA circuitry for the conversion of the VCO tuning voltage to a controlled alignment voltage for the FM antenna tank circuit
- FM and AM level DAA
  - Level DAA circuitry for alignment of slope (3-bit) and starting point (5-bit) of the level curve
- IF2 centre DAA
  - Centre frequency alignment (7-bit) of integrated FM IF2 dynamic selectivity.

### 7.3 FM signal channel

#### 7.3.1 FM MIXER 1

FM quadrature mixer converts FM RF (65 to 108 MHz and weather band) to IF of 10.7 MHz. The FM mixer provides inherent image rejection and high RF sensitivity.

It is capable of tuning the US FM, US weather, Europe FM, Japan FM and East Europe FM bands:

- US FM = 87.9 to 107.9 MHz
- US weather FM = 162.4 to 162.55 MHz
- Europe FM = 87.5 to 108 MHz
- Japan FM = 76 to 91 MHz
- East Europe FM = 65 to 74 MHz.

#### 7.3.2 BUFFER OUTPUT FOR WEATHER BAND FLAG (PIN WBFLAG)

The buffer output on pin WBFLAG is HIGH for weather band mode.

#### 7.3.3 FM KEYED AGC

The AGC threshold is programmable and the keyed AGC function is switchable via the I<sup>2</sup>C-bus. AGC detection occurs at the input of the first FM mixer. If the keyed AGC function is activated, the AGC is keyed only by the narrow band level. The AGC PIN diode drive can be activated via the I<sup>2</sup>C-bus as a local function for search tuning. The AGC sources a constant 10 mA current into the FM PIN diode in AM mode.

#### 7.3.4 FM IF AMPLIFIER

The FM IF amplifier provides 18 dB amplification with high linearity over a wide dynamic range.

#### 7.3.5 FM MIXER 2

The FM mixer 2 converts 10.7 MHz FM IF1 to 450 kHz FM IF2 in I and Q phase to achieve image rejection in the demodulator.

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### 7.3.6 FM IF2 DYNAMIC SELECTIVITY

The IF bandwidth of the FM IF2 is automatically adjusted depending on modulation and reception conditions. The centre frequency of the selectivity is adjusted by a 7-bit instruction via the I<sup>2</sup>C-bus. The dynamic selectivity mode and three fixed bandwidths (**60, 90 and 130 kHz**) can be selected via the I<sup>2</sup>C-bus. The IF2 bandwidth is set to **13 kHz** in weather band mode.

### 7.3.7 FM QUADRATURE DEMODULATOR

The FM quadrature demodulator is adjustment free.

### 7.3.8 FM MPX SOFT MUTE

Muting depth and start of muting are adjustable via the I<sup>2</sup>C-bus (see Figs 8 and 9).

### 7.3.9 ADJACENT CHANNEL DETECTOR AND THRESHOLD EXTENSION

In the event of breakthrough of a strong neighbouring transmitter, the IF2 bandwidth is reduced dynamically. At low RF input voltages and low modulation levels the IF2 bandwidth is reduced to achieve improved sensitivity by demodulator threshold extension.

### 7.3.10 BANDWIDTH CONTROL 'ACTIVE' FLAG (PIN IFBWFLAG)

Flag output IBFW = 1 from pin IFBWFLAG indicates that the IF2 bandwidth is reduced.

### 7.3.11 BANDWIDTH CONTROL MONITOR VOLTAGE (PIN V<sub>IFBW</sub>)

The actual bandwidth is indicated by a voltage at pin V<sub>IFBW</sub> that is proportional, not linear, to the IF bandwidth.

## 7.4 AM signal channel

### 7.4.1 AM TUNER INCLUDING MIXER 1 AND MIXER 2

The AM tuner is realized in a double conversion technique and is capable of selecting LW, MW and SW bands.

AM mixer 1 converts AM RF to IF1 of 10.7 MHz, while AM mixer 2 converts IF1 of 10.7 MHz to IF2 of 450 kHz:

- LW = 144 to 288 kHz
- MW = 530 to 1710 kHz (US AM band)
- SW = 5.73 to 9.99 MHz (including the 31 m, 41 m and 49 m bands).

### 7.4.2 AM RF AGC

The AM wideband AGC in front of the first AM mixer is realized first by a cascaded NPN transistor, which controls the transconductance of the RF amplifier JFET with 10 dB of AGC range. Second, an AM PIN diode stage with antenna type and frequency dependent AGC range is available. The minimum JFET drain source voltage is controlled by a DC feedback loop (pin VAMCASFB) in order to limit the cascode AGC range to 10 dB. If the cascode AGC is not required, a simple RF AGC loop is possible by using only a PIN diode. In this event pins VAMCASFB and VAMCAS have to be open-circuit. In FM mode, the cascade switches off the JFET bias current to reduce total power consumption. The PIN diode is biased by 1 mA in FM mode.

The AGC detection points for AM AGC are at the first AM mixer input (threshold programmable via the I<sup>2</sup>C-bus) and the IF2 AGC input (fixed threshold).

### 7.4.3 AM DETECTOR

The AM output provides either a detected AM AF or the corresponding AM IF2 signal. The IF2 signal can be used for AM stereo decoder processing. Soft mute function is controlled by the I<sup>2</sup>C-bus in AM mono mode.

### 7.4.4 AM NOISE BLANKER

The detection point for the AM noise blanker is the output stage of AM mixer 1, while blanking is realized at the output of the mixer 2.

Trigger sensitivity can be modified by adding an external resistor at pin AMNBHOLD.

## 7.5 FM and AM level detector

FM and AM level detectors provide the temperature compensated output voltage. The starting points and slopes of the level detector outputs are programmable via the I<sup>2</sup>C-bus.

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## 8 LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL                  | PARAMETER                                                              | CONDITIONS | MIN.  | MAX.  | UNIT |
|-------------------------|------------------------------------------------------------------------|------------|-------|-------|------|
| V <sub>DDA1</sub>       | analog supply voltage 1 for FM IF amplifier                            |            | −0.3  | +10   | V    |
| V <sub>DDA2</sub>       | analog supply voltage 2 for FM and AM RF                               |            | −0.3  | +10   | V    |
| V <sub>DDA3</sub>       | analog supply voltage 3 for tuning PLL                                 |            | −0.3  | +10   | V    |
| V <sub>DDA4</sub>       | analog supply voltage 4 for voltage controlled oscillator              |            | −0.3  | +10   | V    |
| V <sub>DDA5</sub>       | analog supply voltage 5 for on-chip power supply                       |            | −0.3  | +6.5  | V    |
| V <sub>DDA6</sub>       | analog supply voltage 6 for on-chip power supply                       |            | −0.3  | +10   | V    |
| V <sub>DD</sub>         | digital supply voltage                                                 |            | −0.3  | +6.5  | V    |
| ΔV <sub>DD8.5-DD5</sub> | difference between any 8.5 V supply voltage and any 5 V supply voltage | note 1     | −0.3  | –     | V    |
| T <sub>stg</sub>        | storage temperature                                                    |            | −55   | +150  | °C   |
| T <sub>amb</sub>        | ambient temperature                                                    |            | −40   | +85   | °C   |
| V <sub>es</sub>         | electrostatic handling voltage                                         | note 2     | −200  | +200  | V    |
|                         |                                                                        | note 3     | −2000 | +2000 | V    |

### Notes

1. To avoid damage and wrong operation it is necessary to keep all 8.5 V supply voltages at a higher level than any 5 V supply voltage. This is also necessary during power-on and power-down sequences. Precautions have to be provided in such a way that interference cannot pull down the 8.5 V supply below the 5 V supply.
2. Machine model (R = 0 Ω, C = 200 pF).
3. Human body model (R = 1.5 kΩ, C = 100 pF).

## 9 THERMAL CHARACTERISTICS

| SYMBOL               | PARAMETER                                   | CONDITIONS  | VALUE | UNIT |
|----------------------|---------------------------------------------|-------------|-------|------|
| R <sub>th(j-a)</sub> | thermal resistance from junction to ambient | in free air | 54    | K/W  |
| R <sub>th(j-c)</sub> | thermal resistance from junction to case    |             | 9     | K/W  |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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## 10 DC CHARACTERISTICS

$V_{DDA6} = 8.5\text{ V}$ ;  $V_{DDA5} = 5\text{ V}$ ;  $V_{DDD} = 5\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; tested in the circuit of Figs 12 and 13; unless otherwise specified.

| SYMBOL                                                            | PARAMETER                                        | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------------------------------------|--------------------------------------------------|---------------------------------|------|------|------|------|
| <b>Supply voltage</b>                                             |                                                  |                                 |      |      |      |      |
| $V_{DDA(n)}$                                                      | analog supply voltages 1 to 4 and 6              |                                 | 8    | 8.5  | 9    | V    |
| $V_{DDA5}$                                                        | analog supply voltage 5                          |                                 | 4.75 | 5    | 5.25 | V    |
| $V_{DDD}$                                                         | digital supply voltage                           |                                 | 4.75 | 5    | 5.25 | V    |
| <b>Supply current in FM mode</b>                                  |                                                  |                                 |      |      |      |      |
| $I_{DDD}$                                                         | digital supply current                           | Europe/US band                  | 21   | 26   | 31   | mA   |
|                                                                   |                                                  | Japan/East Europe band          | 26.5 | 33   | 39.5 | mA   |
| $I_{DDA1}$                                                        | analog supply current 1 for FM IF amplifier      |                                 | 5.5  | 7.3  | 8.8  | mA   |
| $I_{DDA2}$                                                        | analog supply current 2 for FM RF                |                                 | 4.2  | 5.2  | 6.2  | mA   |
| $I_{DDA3}$                                                        | analog supply current 3 for tuning PLL           |                                 | 3.2  | 4    | 4.8  | mA   |
| $I_{DDA4}$                                                        | analog supply current 4 for VCO                  |                                 | 5.2  | 6.5  | 7.8  | mA   |
| $I_{DDA5}$                                                        | analog supply current 5 for on-chip power supply | Europe/US band                  | –    | 3.8  | –    | mA   |
|                                                                   |                                                  | Japan/East Europe band          | –    | 7.4  | –    | mA   |
| $I_{DDA6}$                                                        | analog supply current 6 for on-chip power supply |                                 | 21.5 | 27   | 32.5 | mA   |
| $I_{MIX1OUT1}$                                                    | bias current of FM mixer output 1                |                                 | 4.8  | 6    | 7.2  | mA   |
| $I_{MIX1OUT2}$                                                    | bias current of FM mixer output 2                |                                 | 4.8  | 6    | 7.2  | mA   |
| <b>Supply current in AM mode</b>                                  |                                                  |                                 |      |      |      |      |
| $I_{DDD}$                                                         | digital supply current                           |                                 | 22   | 27   | 32   | mA   |
| $I_{DDA1}$                                                        | analog supply current 1 for AM mixer 2           |                                 | 100  | 120  | 140  | μA   |
| $I_{DDA2}$                                                        | analog supply current 2 for RF                   |                                 | 1.4  | 1.8  | 2.2  | mA   |
| $I_{DDA3}$                                                        | analog supply current 3 for tuning PLL           |                                 | 1.8  | 2.2  | 2.6  | mA   |
| $I_{DDA4}$                                                        | analog supply current 4 for VCO                  |                                 | 5    | 6.5  | 8    | mA   |
| $I_{DDA5}$                                                        | analog supply current 5 for on-chip power supply |                                 | –    | 11   | –    | mA   |
| $I_{DDA6}$                                                        | analog supply current 6 for on-chip power supply |                                 | 14   | 17.5 | 21   | mA   |
| $I_{MIX1OUT1}$                                                    | bias current of AM mixer 1 output 1              |                                 | 4.8  | 6    | 7.2  | mA   |
| $I_{MIX1OUT2}$                                                    | bias current of AM mixer 1 output 2              |                                 | 4.8  | 6    | 7.2  | mA   |
| $I_{AMMIX2OUT1}$                                                  | bias current of AM mixer 2 output 1              |                                 | 3.6  | 4.5  | 5.4  | mA   |
| $I_{AMMIX2OUT2}$                                                  | bias current of AM mixer 2 output 2              |                                 | 3.6  | 4.5  | 5.4  | mA   |
| <b>On-chip power supply reference current generator: pin IREF</b> |                                                  |                                 |      |      |      |      |
| $V_{O(ref)}$                                                      | output reference voltage                         | $R_{IREF} = 120\text{ k}\Omega$ | 4    | 4.25 | 4.5  | V    |
| $R_O$                                                             | output resistance                                | $R_{IREF} = 120\text{ k}\Omega$ | –    | 10   | –    | kΩ   |
| $I_{O(max)}$                                                      | maximum output current                           | $R_{IREF} = 120\text{ k}\Omega$ | –100 | –    | +100 | nA   |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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## 11 AC CHARACTERISTICS

$V_{DDA(n)} = V_{MIX1OUT1} = V_{MIX1OUT2} = V_{AMMIX2OUT1} = V_{AMMIX2OUT2} = 8.5 \text{ V}$ ;  $V_{DDD} = V_{DDA5} = 5 \text{ V}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ ; tested in the circuit of Figs 12 and 13; all AC values are given in RMS; unless otherwise specified.

| SYMBOL                                        | PARAMETER                                         | CONDITIONS                                                                                                                                                                                            | MIN.  | TYP. | MAX.   | UNIT                                  |
|-----------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|--------|---------------------------------------|
| <b>Voltage controlled oscillator</b>          |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| $f_{osc}$                                     | oscillator frequency                              |                                                                                                                                                                                                       | 162.9 | –    | 248.2  | MHz                                   |
| C/N                                           | carrier-to-noise ratio                            | $f_{osc} = 200 \text{ MHz}$ ; $\Delta f = 10 \text{ kHz}$                                                                                                                                             | –     | 97   | –      | $\frac{\text{dBc}}{\sqrt{\text{Hz}}}$ |
| RR                                            | ripple rejection $\frac{\Delta f_{osc}}{f_{osc}}$ | $f_{ripple} = 100 \text{ Hz}$ ;<br>$V_{DDA4(ripple)} = 100 \text{ mV (RMS)}$ ;<br>$f_{osc} = 200 \text{ MHz}$                                                                                         | 92    | 99   | –      | dB                                    |
| <b>Crystal oscillator</b>                     |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| $f_{xtal}$                                    | crystal frequency                                 |                                                                                                                                                                                                       | –     | 20.5 | –      | MHz                                   |
| C/N                                           | carrier-to-noise ratio                            | $f_{xtal} = 20.5 \text{ MHz}$ ; $\Delta f = 10 \text{ kHz}$                                                                                                                                           | –     | 112  | –      | $\frac{\text{dBc}}{\sqrt{\text{Hz}}}$ |
| CIRCUIT INPUTS: PINS XTAL1, XTALGND AND XTAL2 |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| $V_{o(osc)(rms)}$                             | oscillator output voltage (RMS value)             | note 1                                                                                                                                                                                                | 80    | 100  | 160    | mV                                    |
| $V_{XTAL1}, V_{XTAL2}$                        | DC bias voltage                                   |                                                                                                                                                                                                       | 1.7   | 2.1  | 2.5    | V                                     |
| $R_i$                                         | real part of input impedance                      | $V_{XTAL1} - V_{XTAL2} = 1 \text{ mV}$ ; note 1                                                                                                                                                       | –250  | –    | –      | $\Omega$                              |
| $C_i$                                         | input capacitance                                 | note 1                                                                                                                                                                                                | 8     | 10   | 12     | pF                                    |
| <b>Synthesizer</b>                            |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| PROGRAMMABLE DIVIDER                          |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| $N_{prog}$                                    | programmable divider ratio                        |                                                                                                                                                                                                       | 512   | –    | 32 767 |                                       |
| $\Delta N_{step}$                             | programmable divider step size                    |                                                                                                                                                                                                       | –     | 1    | –      |                                       |
| CHARGE PUMP: PIN CPOUT                        |                                                   |                                                                                                                                                                                                       |       |      |        |                                       |
| $I_{sink(cp1)}$                               | low charge pump 1 sink current                    | $0.4 \text{ V} < V_{CPOUT} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 1,<br>bit 2 = 1 for FM weather band;<br>$f_{VCO} > f_{ref} \times \text{divider ratio}$                              | –     | 300  | –      | $\mu\text{A}$                         |
| $I_{source(cp1)}$                             | low charge pump 1 source current                  | $0.4 \text{ V} < V_{CPOUT} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 1,<br>bit 2 = 1 for FM weather band;<br>$f_{VCO} < f_{ref} \times \text{divider ratio}$                              | –     | –300 | –      | $\mu\text{A}$                         |
| $I_{sink(cp1)h}$                              | high charge pump 1 sink current                   | $0.4 \text{ V} < V_{CPOUT} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 1, bit 1 = 1,<br>bit 2 = 1; AM stereo mode;<br>VCO divider = 10 (LW and MW);<br>$f_{VCO} > f_{ref} \times \text{divider ratio}$ | –     | 1    | –      | mA                                    |

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| SYMBOL                                      | PARAMETER                             | CONDITIONS                                                                                                                                                                                                                 | MIN. | TYP. | MAX. | UNIT          |
|---------------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{\text{source(cp1)h}}$                   | high charge pump 1 source current     | $0.4 \text{ V} < V_{\text{CPOUT}} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 1, bit 1 = 1,<br>bit 2 = 1; AM stereo mode;<br>VCO divider = 10 (LW and MW);<br>$f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$ | –    | –1   | –    | mA            |
| $I_{\text{sink(cp2)}}$                      | charge pump 2 sink current            | $0.3 \text{ V} < V_{\text{CPOUT}} < 7.1 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 0,<br>bit 2 = 0; FM standard mode;<br>$f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$                                | –    | 130  | –    | $\mu\text{A}$ |
| $I_{\text{source(cp2)}}$                    | charge pump 2 source current          | $0.3 \text{ V} < V_{\text{CPOUT}} < 7.1 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 0,<br>bit 2 = 0; FM standard mode;<br>$f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$                                | –    | –130 | –    | $\mu\text{A}$ |
| CHARGE PUMP: PIN $V_{\text{tune}}$          |                                       |                                                                                                                                                                                                                            |      |      |      |               |
| $I_{\text{sink(cp3)}}$                      | charge pump 3 sink current            | $0.4 \text{ V} < V_{\text{tune}} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 0,<br>bit 2 = 0; FM standard mode;<br>$f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$                                 | –    | 3    | –    | mA            |
| $I_{\text{source(cp3)}}$                    | charge pump 3 source current          | $0.4 \text{ V} < V_{\text{tune}} < 7.6 \text{ V}$ ;<br>data byte 3: bit 0 = 0, bit 1 = 0,<br>bit 2 = 0; FM standard mode;<br>$f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$                                 | –    | –3   | –    | mA            |
| <b>Antenna Digital Auto Alignment (DAA)</b> |                                       |                                                                                                                                                                                                                            |      |      |      |               |
| DAA INPUT: PIN DAAIN                        |                                       |                                                                                                                                                                                                                            |      |      |      |               |
| $I_{\text{bias(cp)}}$                       | charge pump buffer input bias current | $V_{\text{DAAIN}} = 0.4 \text{ to } 8 \text{ V}$                                                                                                                                                                           | –10  | –    | +10  | nA            |
| $V_{\text{i(cp)}}$                          | charge pump buffer input voltage      |                                                                                                                                                                                                                            | 0    | –    | 8.5  | V             |
| DAA OUTPUT: PIN DAAOUT; note 2              |                                       |                                                                                                                                                                                                                            |      |      |      |               |
| $V_{\text{O(AM)}}$                          | DAA output voltage in AM mode         | $I_{\text{DAAOUT}} < 100 \mu\text{A}$                                                                                                                                                                                      | –    | –    | 0.3  | V             |
| $V_{\text{O(FM)}}$                          | DAA output voltage in FM mode         | minimum value;<br>data byte 2 = 10000000;<br>$V_{\text{DAAIN}} = 0.5 \text{ V}$ ; $V_{\text{DAATD}} = 0.45 \text{ V}$                                                                                                      | –    | –    | 0.5  | V             |
|                                             |                                       | maximum value;<br>data byte 2 = 11111111;<br>$V_{\text{DAAIN}} = 4.7 \text{ V}$ ; $V_{\text{DAATD}} = 0.45 \text{ V}$                                                                                                      | 8    | –    | 8.5  | V             |
|                                             |                                       | $V_{\text{DAAIN}} = 4 \text{ V}$ ; $V_{\text{DAATD}} = 0.45 \text{ V}$<br>data byte 2 = 10000000                                                                                                                           | –    | 0.65 | –    | V             |
|                                             |                                       | data byte 2 = 11000000                                                                                                                                                                                                     | 3.8  | 4    | 4.2  | V             |
|                                             |                                       | $V_{\text{DAAIN}} = 2 \text{ V}$ ; $V_{\text{DAATD}} = 0.45 \text{ V}$<br>data byte 2 = 11010101                                                                                                                           | 2.3  | 2.6  | 2.9  | V             |
|                                             |                                       | data byte 2 = 10101010                                                                                                                                                                                                     | 1.2  | 1.4  | 1.6  | V             |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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| SYMBOL                                  | PARAMETER                                                    | CONDITIONS                                                                                                                                                                 | MIN.         | TYP.      | MAX.         | UNIT                       |
|-----------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------|--------------|----------------------------|
| $V_{o(n)}$                              | DAA output noise voltage                                     | data byte 2 = 11000000;<br>FM mode; $V_{DAAIN} = 4\text{ V}$ ;<br>$V_{DAATD} = 0.45\text{ V}$ ;<br>$B = 300\text{ Hz to }22\text{ kHz}$                                    | –            | 30        | 100          | $\mu\text{V}$              |
| $\Delta V_{o(T)}$                       | DAA output voltage variation with temperature                | $T_{amb} = -40\text{ to }+85\text{ }^{\circ}\text{C}$ ;<br>data byte 2 = 11000000                                                                                          | –8           | –         | +8           | mV                         |
| $\Delta V_{o(step)}$                    | DAA step accuracy                                            | $n = 0\text{ to }127$ ; FM mode;<br>$V_{DAAOUT} = 0.5\text{ to }8\text{ V}$ ;<br>$V_{DAAIN} = 2\text{ V}$ ; $V_{DAATD} = 0.45\text{ V}$                                    | $0.5V_{LSB}$ | $V_{LSB}$ | $1.5V_{LSB}$ | mV                         |
| $\Delta V_{o(sink)}$                    | DAA output variation caused by sink current                  | $V_{DAAIN} = 4\text{ V}$ ; $I_L = 50\text{ }\mu\text{A}$                                                                                                                   | $-V_{LSB}$   | –         | $+V_{LSB}$   |                            |
| $\Delta V_{o(source)}$                  | DAA output variation caused by source current                | $V_{DAAIN} = 4\text{ V}$ ; $I_L = -50\text{ }\mu\text{A}$                                                                                                                  | $-V_{LSB}$   | –         | $+V_{LSB}$   |                            |
| $t_{st}$                                | DAA output settling time                                     | $V_{DAAOUT} = 0.2\text{ to }8.25\text{ V}$ ;<br>$C_L = 270\text{ pF}$                                                                                                      | –            | 20        | 30           | $\mu\text{s}$              |
| RR                                      | ripple rejection $\frac{V_{DAAOUT}}{V_{DDA3}}$               | data byte 2 = 10101011;<br>FM mode; $V_{DAAIN} = 4\text{ V}$ ;<br>$V_{DAATD} = 0.45\text{ V}$ ; $f_{ripple} = 100\text{ Hz}$ ;<br>$V_{DDA3(ripple)} = 100\text{ mV (RMS)}$ | –            | 65        | –            | dB                         |
| $C_L$                                   | DAA output load capacitance                                  |                                                                                                                                                                            | –            | –         | 270          | pF                         |
| DAA TEMPERATURE COMPENSATION: PIN DAATD |                                                              |                                                                                                                                                                            |              |           |              |                            |
| $I_{source}$                            | compensation diode source current                            | $V_{DAATD} = 0.2\text{ to }1.2\text{ V}$                                                                                                                                   | –50          | –40       | –30          | $\mu\text{A}$              |
| $TC_{source}$                           | temperature coefficient of compensation diode source current | $V_{DAATD} = 0.2\text{ to }1.2\text{ V}$ ;<br>$T_{amb} = -40\text{ to }+85\text{ }^{\circ}\text{C}$                                                                        | –300         | –         | +300         | $\frac{10^{-6}}{\text{K}}$ |
| IF counter (FM IF2 or AM IF2 counter)   |                                                              |                                                                                                                                                                            |              |           |              |                            |
| $N_{IF}$                                | IF counter length for AM and FM                              |                                                                                                                                                                            | –            | 8         | –            | bit                        |
| PINS FMMIX2IN AND FMMIX2DEC; note 3     |                                                              |                                                                                                                                                                            |              |           |              |                            |
| $V_{sens(rms)}$                         | sensitivity voltage (RMS value)                              | FM mode                                                                                                                                                                    | –            | 30        | 100          | $\mu\text{V}$              |
| N                                       | counter result (decimal)                                     | period = 2 ms;<br>$V_{FMMIX2IN-FMMIX2DEC} = 100\text{ }\mu\text{V}$<br>prescaler ratio = 10                                                                                | –            | 90        | –            |                            |
|                                         |                                                              | prescaler ratio = 40                                                                                                                                                       | –            | 22        | –            |                            |
|                                         |                                                              | period = 20 ms;<br>$V_{FMMIX2IN-FMMIX2DEC} = 100\text{ }\mu\text{V}$<br>prescaler ratio = 10                                                                               | –            | 132       | –            |                            |
|                                         |                                                              | prescaler ratio = 40                                                                                                                                                       | –            | 225       | –            |                            |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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| SYMBOL                                                                      | PARAMETER                                                      | CONDITIONS                                                | MIN. | TYP.   | MAX. | UNIT |
|-----------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|------|--------|------|------|
| PINS AMIF2IN AND AMIF2DEC; note 4                                           |                                                                |                                                           |      |        |      |      |
| V <sub>sens(rms)</sub>                                                      | sensitivity voltage (RMS value)                                | AM mode; m = 0                                            | –    | 30     | 70   | μV   |
| N                                                                           | counter result (decimal)                                       | period = 2 ms;<br>V <sub>AMIF2IN-AMIF2DEC</sub> = 200 μV  | –    | 132    | –    |      |
|                                                                             |                                                                | period = 20 ms;<br>V <sub>AMIF2IN-AMIF2DEC</sub> = 200 μV | –    | 40     | –    |      |
| Reference frequency for car signal processor IC TEA688x and TEF689x; note 5 |                                                                |                                                           |      |        |      |      |
| REFERENCE FREQUENCY DIVIDER                                                 |                                                                |                                                           |      |        |      |      |
| N <sub>ref</sub>                                                            | crystal oscillator divider ratio                               |                                                           | –    | 272    | –    |      |
| f <sub>ref</sub>                                                            | reference frequency                                            | f <sub>xtal</sub> = 20.5 MHz                              | –    | 75.368 | –    | kHz  |
| VOLTAGE GENERATOR: PIN FREF                                                 |                                                                |                                                           |      |        |      |      |
| V <sub>o(p-p)</sub>                                                         | AC output voltage (peak-to-peak value)                         | not loaded                                                | 60   | 90     | –    | mV   |
| V <sub>O</sub>                                                              | DC output voltage                                              |                                                           | 3.2  | 3.4    | 3.7  | V    |
| R <sub>O</sub>                                                              | output resistance                                              |                                                           | –    | –      | 50   | kΩ   |
| R <sub>L(min)</sub>                                                         | minimum load resistance for first I <sup>2</sup> C-bus address |                                                           | 1    | –      | –    | MΩ   |
| Weather band flag: pin WBFLAG                                               |                                                                |                                                           |      |        |      |      |
| I <sub>source(max)</sub>                                                    | maximum source current                                         |                                                           | –    | –5     | –    | mA   |
| R <sub>i(shunt)</sub>                                                       | internal shunt resistance to ground                            |                                                           | –    | 50     | –    | kΩ   |
| V <sub>o(max)</sub>                                                         | maximum output voltage for FM mode                             | measured with respect to pin RFGND                        | 0    | –      | 0.2  | V    |
| V <sub>O</sub>                                                              | output voltage for weather band mode                           | measured with respect to pin RFGND                        | 4    | –      | 5    | V    |
| AM signal channel                                                           |                                                                |                                                           |      |        |      |      |
| AM RF AGC STAGE (PIN DIODE DRIVE)                                           |                                                                |                                                           |      |        |      |      |
| V <sub>i(p)</sub>                                                           | RF input voltage for wideband AGC start level (peak value)     | m = 0.3; data byte 4: bit 5 = 0, bit 6 = 0                | –    | 150    | –    | mV   |
|                                                                             |                                                                | m = 0.3; data byte 4: bit 5 = 1, bit 6 = 0                | –    | 275    | –    | mV   |
|                                                                             |                                                                | m = 0.3; data byte 4: bit 5 = 0, bit 6 = 1                | –    | 400    | –    | mV   |
|                                                                             |                                                                | m = 0.3; data byte 4: bit 5 = 1, bit 6 = 1                | –    | 525    | –    | mV   |
| AM IF AGC STAGE INPUT: PIN AMIF2IN                                          |                                                                |                                                           |      |        |      |      |
| V <sub>i(p)</sub>                                                           | IF2 input voltage (peak value)                                 | AGC start level                                           | 0.20 | 0.27   | 0.35 | V    |

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| SYMBOL                                           | PARAMETER                                                                     | CONDITIONS                                                         | MIN. | TYP. | MAX. | UNIT                         |
|--------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------|------|------|------|------------------------------|
| AM RF AGC CURRENT GENERATOR OUTPUT: PIN IAMAGC   |                                                                               |                                                                    |      |      |      |                              |
| $I_{\text{sink(max)}}$                           | maximum AGC sink current                                                      | $V_0 = 2.8 \text{ V}$                                              | 11   | 15   | 19   | mA                           |
| $I_{\text{sink}}$                                | AGC sink current                                                              | FM mode                                                            | 1    | –    | –    | mA                           |
| $R_o$                                            | output resistance                                                             | $I_o = 1 \mu\text{A}$                                              | 0.5  | –    | –    | MΩ                           |
| $C_o$                                            | AM AGC current generator output capacitance                                   |                                                                    | –    | 5    | 7    | pF                           |
| RF CASCODE AGC                                   |                                                                               |                                                                    |      |      |      |                              |
| $I_{\text{cas(off)}}$                            | AM cascode off current                                                        | FM mode                                                            | –    | –    | 100  | nA                           |
| <i>Pin VAMCASFB</i>                              |                                                                               |                                                                    |      |      |      |                              |
| $V_{\text{cas(FB)}}$                             | cascode feedback voltage                                                      | $V_{\text{AMMIX1IN-AMMIX1DEC}}$ above threshold; minimum gain      | –    | 0.26 | –    | V                            |
| $I_{\text{cas(FB)}}$                             | cascode feedback sense current                                                |                                                                    | 0    | –    | 1    | μA                           |
| <i>Pin VAMCAS</i>                                |                                                                               |                                                                    |      |      |      |                              |
| $V_{\text{cas}}$                                 | cascode voltage                                                               | $V_{\text{AMMIX1IN-AMMIX1DEC}}$ below threshold; maximum gain      | –    | 5    | –    | V                            |
| $I_{\text{cas}}$                                 | cascode transistor base current capability                                    |                                                                    | 100  | –    | –    | μA                           |
| AM MIXER 1 (IF1 = 10.7 MHz)                      |                                                                               |                                                                    |      |      |      |                              |
| <i>Mixer inputs: pins AMMIX1DEC and AMMIX1IN</i> |                                                                               |                                                                    |      |      |      |                              |
| $R_i$                                            | input resistance                                                              | note 6                                                             | 15   | 25   | 40   | kΩ                           |
| $C_i$                                            | input capacitance                                                             | note 6                                                             | 2.5  | 5    | 7.5  | pF                           |
| $V_i$                                            | DC input voltage                                                              |                                                                    | 2.3  | 2.7  | 3.1  | V                            |
| $V_{i(\text{max})}$                              | maximum input voltage                                                         | 1 dB compression point of $V_{\text{MIX1OUT1-MIX1OUT2}}$ ; $m = 0$ | 500  | –    | –    | mV                           |
| <i>Mixer outputs: pins MIX1OUT1 and MIX1OUT2</i> |                                                                               |                                                                    |      |      |      |                              |
| $R_o$                                            | output resistance                                                             | note 7                                                             | 100  | –    | –    | kΩ                           |
| $C_o$                                            | output capacitance                                                            | note 7                                                             | –    | 4    | 7    | pF                           |
| $V_{o(\text{max})(\text{p-p})}$                  | maximum output voltage (peak-to-peak value)                                   |                                                                    | 12   | 15   | –    | V                            |
| $I_{\text{bias}}$                                | mixer bias current                                                            | AM mode                                                            | 4.8  | 6    | 7.2  | mA                           |
| <i>Mixer</i>                                     |                                                                               |                                                                    |      |      |      |                              |
| $g_{m(\text{conv})}$                             | conversion transconductance<br>$\frac{I_{\text{MIX1OUT}}}{V_{\text{MIX1IN}}}$ |                                                                    | 2.0  | 2.55 | 3.2  | $\frac{\text{mA}}{\text{V}}$ |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                        | PARAMETER                                                                                                          | CONDITIONS                                                                                                        | MIN. | TYP.                | MAX. | UNIT                   |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------|---------------------|------|------------------------|
| $g_{m(conv)(T)}$                              | conversion transconductance variation with temperature<br>$\frac{\Delta g_{m(conv)}}{g_{m(conv)} \times \Delta T}$ |                                                                                                                   | –    | $-9 \times 10^{-4}$ | –    | K <sup>-1</sup>        |
| IP3                                           | 3rd-order intermodulation                                                                                          | $R_L = 2.6 \text{ k}\Omega$ (AC load between output pins); $\Delta f = 300 \text{ kHz}$                           | 135  | 138                 | –    | dB $\mu$ V             |
| IP2                                           | 2nd-order intermodulation                                                                                          | $R_L = 2.6 \text{ k}\Omega$ (AC load between output pins)                                                         | –    | 170                 | –    | dB $\mu$ V             |
| $V_{i(n)(eq)}$                                | equivalent input noise voltage                                                                                     | band limited noise;<br>$R_{gen} = 750 \text{ }\Omega$ ; $R_L = 2.6 \text{ k}\Omega$ (AC load between output pins) | –    | 5.8                 | 8    | $\frac{nV}{\sqrt{Hz}}$ |
| F                                             | noise figure of AM mixer 1                                                                                         |                                                                                                                   | –    | 4.5                 | 7.1  | dB                     |
| AM MIXER 2 (IF2 = 450 kHz)                    |                                                                                                                    |                                                                                                                   |      |                     |      |                        |
| Mixer inputs: pins IFAMPIN and IFAMPDEC       |                                                                                                                    |                                                                                                                   |      |                     |      |                        |
| $R_i$                                         | input resistance                                                                                                   | note 8                                                                                                            | –    | 330                 | –    | $\Omega$               |
| $C_i$                                         | input capacitance                                                                                                  | note 8                                                                                                            | –    | 5                   | 7    | pF                     |
| $V_I$                                         | DC voltage                                                                                                         |                                                                                                                   | 2.4  | 2.7                 | 3    | V                      |
| $V_{i(max)(p)}$                               | maximum input voltage (peak value)                                                                                 | 1 dB compression point of $V_{AMMIX2OUT1-AMMIX2OUT2}$                                                             | 1.1  | 1.4                 | –    | V                      |
| Mixer outputs: pins AMMIX2OUT1 and AMMIX2OUT2 |                                                                                                                    |                                                                                                                   |      |                     |      |                        |
| $R_o$                                         | output resistance                                                                                                  | note 9                                                                                                            | 50   | –                   | –    | k $\Omega$             |
| $C_o$                                         | output capacitance                                                                                                 | note 9                                                                                                            | –    | 4                   | 7    | pF                     |
| $V_{o(max)(p-p)}$                             | maximum output voltage (peak-to-peak value)                                                                        | $V_{DDA6} = 8.5 \text{ V}$                                                                                        | 12   | 15                  | –    | V                      |
| $I_{bias}$                                    | mixer bias current                                                                                                 | AM mode                                                                                                           | 3.6  | 4.5                 | 5.4  | mA                     |
| Mixer                                         |                                                                                                                    |                                                                                                                   |      |                     |      |                        |
| $g_{m(conv)}$                                 | conversion transconductance<br>$\frac{I_{AMMIX2OUT}}{V_{IFAMPIN}}$                                                 |                                                                                                                   | 1.3  | 1.6                 | 1.9  | $\frac{mA}{V}$         |
| $g_{m(conv)(T)}$                              | conversion transconductance variation with temperature<br>$\frac{\Delta g_{m(conv)}}{g_{m(conv)} \times \Delta T}$ |                                                                                                                   | –    | $-9 \times 10^{-4}$ | –    | K <sup>-1</sup>        |
| IP3                                           | 3rd-order intermodulation                                                                                          | $R_L = 1.5 \text{ k}\Omega$ (AC load between output pins); $\Delta f = 300 \text{ kHz}$                           | 134  | 137                 | –    | dB $\mu$ V             |
| IP2                                           | 2nd-order intermodulation                                                                                          | $R_L = 1.5 \text{ k}\Omega$ (AC load between output pins)                                                         | –    | 170                 | –    | dB $\mu$ V             |
| $V_{i(n)(eq)}$                                | equivalent input noise voltage                                                                                     | $R_{gen} = 330 \text{ }\Omega$ ; $R_L = 1.5 \text{ k}\Omega$ (AC load between output pins)                        | –    | 15                  | 22   | $\frac{nV}{\sqrt{Hz}}$ |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                              | PARAMETER                                   | CONDITIONS                                                                                                                                           | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| F                                                   | noise figure of AM mixer 2                  |                                                                                                                                                      | –    | 16   | 19.5 | dB   |
| I <sub>L</sub>                                      | mixer leakage current                       | FM mode                                                                                                                                              | –    | –    | 10   | μA   |
| AM IF2 AGC STAGE: PINS AMIF2IN AND AMIF2DEC; note 4 |                                             |                                                                                                                                                      |      |      |      |      |
| V <sub>i</sub>                                      | input voltage                               | audio attenuation α = –10 dB                                                                                                                         |      |      |      |      |
|                                                     |                                             | data byte 4: bit 4 = 1; mute on                                                                                                                      | –    | 25   | 40   | μV   |
|                                                     |                                             | data byte 4: bit 4 = 0; mute off                                                                                                                     | –    | 6    | 10   | μV   |
| V <sub>AGC(start)</sub>                             | AGC start voltage                           | input carrier voltage                                                                                                                                | –    | 14   | 30   | μV   |
| V <sub>AGC(stop)</sub>                              | AGC stop voltage                            | maximum input peak voltage                                                                                                                           | 1    | –    | –    | V    |
| V <sub>AGC(ctrl)</sub>                              | AGC control voltage                         | V <sub>i</sub> = 1 mV                                                                                                                                | 4.1  | 4.3  | 4.7  | V    |
| ΔAGC                                                | AGC range                                   | between start and stop of AGC                                                                                                                        | –    | 89   | –    | dB   |
| R <sub>i</sub>                                      | input resistance                            |                                                                                                                                                      | 1.8  | 2    | 2.2  | kΩ   |
| C <sub>i</sub>                                      | input capacitance                           |                                                                                                                                                      | –    | 10   | 15   | pF   |
| AM DETECTOR                                         |                                             |                                                                                                                                                      |      |      |      |      |
| V <sub>sens(rms)</sub>                              | sensitivity voltage<br>(RMS value)          | m = 0.3; f <sub>mod</sub> = 400 Hz;<br>B <sub>AF</sub> = 2.15 kHz; R <sub>gen</sub> = 2 kΩ;<br>note 4                                                |      |      |      |      |
|                                                     |                                             | (S+N)/N = 26 dB                                                                                                                                      | –    | 45   | 65   | μV   |
|                                                     |                                             | (S+N)/N = 46 dB                                                                                                                                      | –    | 600  | 900  | μV   |
| (S+N)/N                                             | maximum signal plus<br>noise-to-noise ratio | m = 0.3; f <sub>mod</sub> = 400 Hz;<br>B <sub>AF</sub> = 2.15 kHz; R <sub>gen</sub> = 2 kΩ                                                           | –    | 60   | –    | dB   |
| THD                                                 | total harmonic distortion                   | B <sub>AF</sub> = 2.15 kHz; C <sub>AGC</sub> = 10 μF;<br>V <sub>AMIF2IN</sub> = 100 μV to 250 mV<br>(RMS)                                            |      |      |      |      |
|                                                     |                                             | m = 0.8; f <sub>mod</sub> = 400 Hz                                                                                                                   | –    | 0.5  | 1    | %    |
|                                                     |                                             | m = 0.8; f <sub>mod</sub> = 100 Hz                                                                                                                   | –    | 1.25 | 2.5  | %    |
| t <sub>sw</sub>                                     | FM to AM switching time                     | V <sub>AMIF2IN</sub> = 100 μV; C <sub>AGC</sub> = 10 μF                                                                                              | –    | 1000 | 1500 | ms   |
| t <sub>st</sub>                                     | AM AGC settling time                        | V <sub>AMIF2IN</sub> = 100 μV to 100 mV                                                                                                              | –    | 400  | 600  | ms   |
|                                                     |                                             | V <sub>AMIF2IN</sub> = 100 mV to 100 μV                                                                                                              | –    | 600  | 900  | ms   |
| Output: pin AMAFIF2                                 |                                             |                                                                                                                                                      |      |      |      |      |
| V <sub>o(rms)</sub>                                 | AM IF2 output voltage<br>(RMS value)        | AM stereo; m = 0; data byte 3:<br>bit 0 = 1, bit 1 = 1, bit 2 = 1                                                                                    |      |      |      |      |
|                                                     |                                             | minimum V <sub>AMIF2IN</sub> = 14 μV                                                                                                                 | 1.5  | 3    | 4.5  | mV   |
|                                                     |                                             | maximum V <sub>AMIF2IN</sub> = 5 mV                                                                                                                  | 130  | 180  | 230  | mV   |
|                                                     |                                             | AM mono; m = 0.3; data byte 3:<br>bit 0 = 1, bit 1 = 0, bit 2 = 1;<br>f <sub>mod</sub> = 400 Hz;<br>V <sub>AMIF2IN</sub> = 100 μV to 500 mV<br>(RMS) | 200  | 250  | 300  | mV   |
| R <sub>o</sub>                                      | output resistance                           | data byte 3: bit 0 = 1, bit 1 = 1,<br>bit 2 = 1; AM stereo                                                                                           | –    | –    | 500  | Ω    |
|                                                     |                                             | data byte 3: bit 0 = 1, bit 1 = 0,<br>bit 2 = 1; AM mono                                                                                             | –    | –    | 500  | Ω    |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                                                 | PARAMETER                                                   | CONDITIONS                                                                | MIN. | TYP. | MAX. | UNIT                              |
|------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------|------|------|------|-----------------------------------|
| C <sub>o</sub>                                                         | output capacitance                                          | data byte 3: bit 0 = 1, bit 1 = 0, bit 2 = 1                              | –    | 5    | 7    | pF                                |
| Z <sub>L</sub>                                                         | load impedance                                              | data byte 3: bit 0 = 1, bit 1 = 0, bit 2 = 1; AM mono                     | 100  | –    | –    | kΩ                                |
|                                                                        |                                                             | data byte 3: bit 0 = 1, bit 1 = 1, bit 2 = 1; AM stereo                   | 10   | –    | –    | kΩ                                |
| RR                                                                     | ripple rejection                                            | V <sub>DDA5(ripple)</sub> = 100 mV (RMS);<br>f <sub>ripple</sub> = 100 Hz | –    | 24   | –    | dB                                |
|                                                                        |                                                             | V <sub>DDA6(ripple)</sub> = 100 mV (RMS);<br>f <sub>ripple</sub> = 100 Hz | –    | 26   | –    | dB                                |
| AM IF2 LEVEL DETECTOR OUTPUT: PIN V <sub>level(AMFM)</sub> ; see Fig.4 |                                                             |                                                                           |      |      |      |                                   |
| V <sub>level(AMFM)</sub>                                               | DC output voltage                                           | V <sub>AMIF2IN</sub> = 10 μV to 1 V                                       | 0    | –    | 7    | V                                 |
|                                                                        |                                                             | V <sub>AMIF2IN</sub> < 1 μV; standard setting of level DAA                | 0.1  | 0.5  | 0.9  | V                                 |
|                                                                        |                                                             | V <sub>AMIF2IN</sub> = 1.4 mV; standard setting of level DAA              | 1.6  | 2.2  | 2.8  | V                                 |
| ΔV <sub>level(AMFM)</sub>                                              | step size for adjustment of level starting point            | V <sub>AMIF2IN</sub> = 0 V; standard setting of level slope               | 30   | 40   | 50   | mV                                |
| V <sub>level(slope)</sub>                                              | slope of level voltage                                      | V <sub>AMIF2IN</sub> = 140 μV to 140 mV; standard setting of level slope  | 650  | 800  | 950  | $\frac{\text{mV}}{20 \text{ dB}}$ |
| ΔV <sub>step</sub>                                                     | step size for adjustment of level slope                     | V <sub>AMIF2IN</sub> = 1.4 mV                                             | 45   | 60   | 75   | $\frac{\text{mV}}{20 \text{ dB}}$ |
| B <sub>level(AMFM)</sub>                                               | bandwidth of level output voltage                           | V <sub>AMIF2IN</sub> = 15 mV; standard setting of level DAA               | 200  | 300  | –    | kHz                               |
| R <sub>o</sub>                                                         | output resistance                                           |                                                                           | –    | –    | 500  | Ω                                 |
| RR                                                                     | ripple rejection $\frac{V_{\text{level}}}{V_{\text{DDA6}}}$ | V <sub>DDA6(ripple)</sub> = 100 mV (RMS);<br>f <sub>ripple</sub> = 100 Hz | –    | 36   | –    | dB                                |
| AM NOISE BLANKER; TEST SIGNAL AND TEST CIRCUIT; see Fig.5              |                                                             |                                                                           |      |      |      |                                   |
| Threshold: pin AMNBHOLD                                                |                                                             |                                                                           |      |      |      |                                   |
| V <sub>O</sub>                                                         | DC output voltage                                           |                                                                           | 4.3  | 4.6  | 5.1  | V                                 |
| t <sub>sup</sub>                                                       | suppression time                                            | V <sub>pulse</sub> = 200 mV (peak);<br>V <sub>level(AMFM)</sub> < 1.8 V   | 6    | 7.5  | 10   | μs                                |
| f <sub>trigger</sub>                                                   | trigger sensitivity frequency                               | V <sub>pulse</sub> = 200 mV (peak);<br>V <sub>level(AMFM)</sub> < 1.8 V   | –    | 1000 | –    | Hz                                |
|                                                                        |                                                             | V <sub>pulse</sub> = 200 mV (peak);<br>V <sub>level(AMFM)</sub> > 2.2 V   | –    | –    | 100  | Hz                                |
|                                                                        |                                                             | V <sub>pulse</sub> = 20 mV (peak);<br>V <sub>level(AMFM)</sub> < 1.8 V    | –    | –    | 100  | Hz                                |
| Noise detector output: pin TRDSMUTE                                    |                                                             |                                                                           |      |      |      |                                   |
| I <sub>sink(AGC)</sub>                                                 | AM noise blanker AGC sink current                           | V <sub>TRDSMUTE</sub> = 3 V                                               | 35   | 50   | 65   | μA                                |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                               | PARAMETER                                              | CONDITIONS                                                                                                                   | MIN. | TYP.  | MAX. | UNIT                   |
|------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|-------|------|------------------------|
| V <sub>AGC</sub>                                     | AM noise blanker AGC voltage                           | AM mixer 1 input V <sub>i</sub> = 0 V                                                                                        | 1.9  | 2.2   | 2.5  | V                      |
| FM signal channel                                    |                                                        |                                                                                                                              |      |       |      |                        |
| FM RF AGC (FM DISTANCE MODE; DATA BYTE 4: BIT 3 = 0) |                                                        |                                                                                                                              |      |       |      |                        |
| Inputs: pins FMMIXIN1 and FMMIXIN2; note 10          |                                                        |                                                                                                                              |      |       |      |                        |
| V <sub>i(RF)(rms)</sub>                              | RF input voltage for start of wideband AGC (RMS value) | data byte 4: bit 5 = 1, bit 6 = 1                                                                                            | –    | 3     | –    | mV                     |
|                                                      |                                                        | data byte 4: bit 5 = 0, bit 6 = 1                                                                                            | –    | 6     | –    | mV                     |
|                                                      |                                                        | data byte 4: bit 5 = 1, bit 6 = 0                                                                                            | –    | 9     | –    | mV                     |
|                                                      |                                                        | data byte 4: bit 5 = 0, bit 6 = 0                                                                                            | –    | 12    | –    | mV                     |
| Pin TFMAGC                                           |                                                        |                                                                                                                              |      |       |      |                        |
| R <sub>source</sub>                                  | source resistance                                      |                                                                                                                              | 4    | 5     | 6    | kΩ                     |
| V <sub>O(ref)</sub>                                  | DC output reference voltage                            | data byte 4: bit 5 = 0, bit 6 = 0; V <sub>FMMIXIN1-FMMIXIN2</sub> = 0 V                                                      | 4.1  | 4.6   | 5.1  | V                      |
| PIN diode drive output: pin IFMAGC                   |                                                        |                                                                                                                              |      |       |      |                        |
| I <sub>sink(AGC)(max)</sub>                          | maximum AGC sink current                               | V <sub>IFMAGC</sub> = 2.5 V; V <sub>TFMAGC</sub> = V <sub>O(ref)</sub> – 0.5 V; data byte 4: bit 5 = 0, bit 6 = 0, bit 7 = 0 | 8    | 11.5  | 15   | mA                     |
| I <sub>source(AGC)(max)</sub>                        | maximum AGC source current                             | V <sub>IFMAGC</sub> = 2.5 V; V <sub>TFMAGC</sub> = V <sub>O(ref)</sub> + 0.5 V; data byte 4: bit 5 = 0, bit 6 = 0, bit 7 = 0 | –15  | –11.5 | –8   | mA                     |
| I <sub>source(AGC)</sub>                             | AGC source current                                     | AM mode                                                                                                                      | –15  | –11.5 | –8   | mA                     |
|                                                      |                                                        | V <sub>IFMAGC</sub> = 2.5 V; data byte 4: bit 3 = 1 (FM local)                                                               | –1.4 | –1.1  | –0.8 | mA                     |
| Level voltage output: pin V <sub>level(AMFM)</sub>   |                                                        |                                                                                                                              |      |       |      |                        |
| V <sub>th</sub>                                      | threshold voltage for narrow-band AGC                  | data byte 4: bit 5 = 0, bit 6 = 0, bit 7 = 1; keyed AGC                                                                      | 500  | 950   | 1400 | mV                     |
| FM RF MIXER                                          |                                                        |                                                                                                                              |      |       |      |                        |
| Reference voltage: pin V <sub>ref(MIX)</sub>         |                                                        |                                                                                                                              |      |       |      |                        |
| V <sub>ref</sub>                                     | reference voltage                                      | FM mode                                                                                                                      | 6.5  | 7.1   | 7.9  | V                      |
|                                                      |                                                        | AM mode                                                                                                                      | 2.7  | 3.1   | 3.4  | V                      |
| Inputs: pins FMMIXIN1 and FMMIXIN2; note 10          |                                                        |                                                                                                                              |      |       |      |                        |
| V <sub>i(RF)(max)</sub>                              | maximum RF input voltage                               | 1 dB compression point of FM mixer output voltage (peak-to-peak value)                                                       | 70   | 100   | –    | mV                     |
| V <sub>i(n)(eq)</sub>                                | equivalent input noise voltage                         | R <sub>gen</sub> = 200 Ω; R <sub>L</sub> = 2.6 kΩ                                                                            | –    | 2.6   | 3.1  | $\frac{nV}{\sqrt{Hz}}$ |
| R <sub>i</sub>                                       | input resistance                                       |                                                                                                                              | 1.4  | 2.8   | 4.2  | kΩ                     |
| C <sub>i</sub>                                       | input capacitance                                      |                                                                                                                              | –    | 5     | 7    | pF                     |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                      | PARAMETER                                                                           | CONDITIONS                                                                                                                                          | MIN. | TYP.                | MAX. | UNIT                                 |
|---------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------|------|--------------------------------------|
| Outputs: pins MIX1OUT1 and MIX1OUT2; note 7 |                                                                                     |                                                                                                                                                     |      |                     |      |                                      |
| R <sub>o</sub>                              | output resistance                                                                   |                                                                                                                                                     | 100  | –                   | –    | kΩ                                   |
| C <sub>o</sub>                              | output capacitance                                                                  |                                                                                                                                                     | 2    | 3.5                 | 5    | pF                                   |
| I <sub>bias</sub>                           | mixer bias current                                                                  | FM mode                                                                                                                                             | 4.8  | 6                   | 7.2  | mA                                   |
| V <sub>o(max)(p-p)</sub>                    | maximum output voltage (peak-to-peak value)                                         |                                                                                                                                                     | 3    | –                   | –    | V                                    |
| FM mixer                                    |                                                                                     |                                                                                                                                                     |      |                     |      |                                      |
| g <sub>m(conv)</sub>                        | conversion transconductance                                                         |                                                                                                                                                     | 8.5  | 12.5                | 18   | $\frac{\text{mA}}{\text{V}}$         |
| g <sub>m(conv)(T)</sub>                     | conversion transconductance variation with temperature                              |                                                                                                                                                     | –    | $-1 \times 10^{-3}$ | –    | K <sup>-1</sup>                      |
| F                                           | noise figure                                                                        |                                                                                                                                                     | –    | 3                   | 4.6  | dB                                   |
| R <sub>gen(opt)</sub>                       | optimum generator resistance                                                        |                                                                                                                                                     | –    | 200                 | –    | Ω                                    |
| IP3                                         | 3rd-order intermodulation                                                           |                                                                                                                                                     | 113  | 116                 | –    | dBμV                                 |
| IRR                                         | image rejection ratio<br>$\frac{V_{\text{MIX1OUTwanted}}}{V_{\text{MIX1OUTimage}}}$ | f <sub>RFwanted</sub> = 87.5 MHz;<br>f <sub>RFimage</sub> = 108.9 MHz                                                                               | 25   | 30                  | –    | dB                                   |
|                                             |                                                                                     | data byte 3 = X010X110;<br>f <sub>RFwanted</sub> = 162.475 MHz;<br>f <sub>RFimage</sub> = 183.875 MHz; weather band mode; f <sub>ref</sub> = 25 kHz | 22   | 30                  | –    | dB                                   |
| IF AMPLIFIER                                |                                                                                     |                                                                                                                                                     |      |                     |      |                                      |
| G                                           | gain                                                                                | R <sub>L</sub> = 330 Ω; V <sub>IFAMPIN</sub> = 1 mV; note 8                                                                                         | 15   | 17                  | 19   | dB                                   |
| F                                           | noise figure                                                                        |                                                                                                                                                     | –    | 10                  | 13   | dB                                   |
| IP3                                         | 3rd-order intermodulation                                                           |                                                                                                                                                     | 113  | 116                 | –    | dBμV                                 |
| Inputs: pins IFAMPIN and IFAMPDEC; note 8   |                                                                                     |                                                                                                                                                     |      |                     |      |                                      |
| V <sub>i(max)(p)</sub>                      | maximum input voltage (peak value)                                                  | 1 dB compression point of IF amplifier output voltage (peak value)                                                                                  | 200  | –                   | –    | mV                                   |
| V <sub>i(n)(eq)</sub>                       | equivalent input noise voltage                                                      | R <sub>gen</sub> = 330 Ω; R <sub>L</sub> = 330 Ω                                                                                                    | –    | 8                   | 10   | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| R <sub>i</sub>                              | input resistance                                                                    |                                                                                                                                                     | 270  | 330                 | 390  | Ω                                    |
| C <sub>i</sub>                              | input capacitance                                                                   |                                                                                                                                                     | –    | 5                   | 7    | pF                                   |
| Output: pin IFAMPOUT                        |                                                                                     |                                                                                                                                                     |      |                     |      |                                      |
| V <sub>o(max)(p)</sub>                      | maximum output voltage (peak value)                                                 |                                                                                                                                                     | 1.2  | 1.5                 | –    | V                                    |
| R <sub>o</sub>                              | output resistance                                                                   |                                                                                                                                                     | 270  | 330                 | 390  | Ω                                    |
| C <sub>o</sub>                              | output capacitance                                                                  |                                                                                                                                                     | –    | 5                   | 7    | pF                                   |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                                     | PARAMETER                                               | CONDITIONS                                                                 | MIN. | TYP. | MAX. | UNIT |
|------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------|------|------|------|------|
| <b>Tunable filter</b>                                      |                                                         |                                                                            |      |      |      |      |
| B <sub>max</sub>                                           | maximum bandwidth                                       | data byte 4: bit 1 = 0, bit 0 = 0; dynamic mode                            | –    | 160  | –    | kHz  |
| B <sub>min</sub>                                           | minimum bandwidth                                       | data byte 4: bit 1 = 0, bit 0 = 0; dynamic mode; V <sub>TACD</sub> = 4.2 V | –    | 25   | –    | kHz  |
| B <sub>13</sub>                                            | bandwidth in weather band mode                          |                                                                            | –    | 13   | –    | kHz  |
| B <sub>60</sub>                                            | bandwidth in narrow band mode                           | data byte 4: bit 1 = 1, bit 0 = 1                                          | –    | 60   | –    | kHz  |
| B <sub>90</sub>                                            | bandwidth in mid band mode                              | data byte 4: bit 1 = 1, bit 0 = 0                                          | –    | 90   | –    | kHz  |
| B <sub>130</sub>                                           | bandwidth in wideband mode                              | data byte 4: bit 1 = 0, bit 0 = 1                                          | –    | 130  | –    | kHz  |
| PIN V <sub>IFBW</sub>                                      |                                                         |                                                                            |      |      |      |      |
| V <sub>o</sub>                                             | monitor output voltage for IF2 bandwidth                | fixed bandwidth = narrow                                                   | –    | 1.35 | –    | V    |
|                                                            |                                                         | fixed bandwidth = mid                                                      | –    | 0.94 | –    | V    |
|                                                            |                                                         | fixed bandwidth = wide                                                     | –    | 0.55 | –    | V    |
| R <sub>o</sub>                                             | output resistance                                       |                                                                            | –    | 5    | –    | kΩ   |
| <b>Adjacent channel detector</b>                           |                                                         |                                                                            |      |      |      |      |
| MODULATION DETECTOR INPUT: PIN MODDET                      |                                                         |                                                                            |      |      |      |      |
| R <sub>i</sub>                                             | input resistance                                        |                                                                            | –    | 40   | –    | kΩ   |
| C <sub>i</sub>                                             | input capacitance                                       |                                                                            | –    | 5    | 7    | pF   |
| MODULATION DETECTOR OUTPUT: PIN MODETOUT                   |                                                         |                                                                            |      |      |      |      |
| R <sub>o</sub>                                             | output resistance                                       |                                                                            | –    | 32   | –    | kΩ   |
| DETECTOR ADJUST: PIN ACDTHRES                              |                                                         |                                                                            |      |      |      |      |
| R <sub>i</sub>                                             | input resistance                                        |                                                                            | 10   | –    | –    | MΩ   |
| C <sub>i</sub>                                             | input capacitance                                       |                                                                            | –    | 5    | 7    | pF   |
| <b>FM demodulator and level detector; see Figs 6 and 7</b> |                                                         |                                                                            |      |      |      |      |
| FM DEMODULATOR                                             |                                                         |                                                                            |      |      |      |      |
| FM mixer 2 input: pins FMMIX2IN and FMMIX2DEC; note 3      |                                                         |                                                                            |      |      |      |      |
| V <sub>start(lim)(rms)</sub>                               | start of limiting of RDS MPX output voltage (RMS value) | α <sub>AF</sub> = –3 dB                                                    | –    | 4.5  | –    | μV   |
| V <sub>o(sens)(rms)</sub>                                  | sensitivity for RDS MPX output voltage (RMS value)      | Δf = 22.5 kHz; f <sub>mod</sub> = 1 kHz; de-emphasis = 50 μs               |      |      |      |      |
|                                                            |                                                         | R <sub>gen</sub> = 165 Ω; (S+N)/N = 26 dB                                  | –    | 11   | –    | μV   |
|                                                            |                                                         | (S+N)/N = 46 dB                                                            | –    | 90   | –    | μV   |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                  | PARAMETER                                                          | CONDITIONS                                                                                                                                                                                                 | MIN. | TYP. | MAX. | UNIT          |
|-----------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <i>RDS MPX output: pin RDSMPX</i>       |                                                                    |                                                                                                                                                                                                            |      |      |      |               |
| (S+N)/N                                 | maximum signal plus noise-to-noise ratio of RDS MPX output voltage | $\Delta f = 22.5 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$ ; $V_{\text{FMMIX2IN}} = 10 \text{ mV}$                                                                  | 65   | 68   | –    | dB            |
| THD                                     | total harmonic distortion of RDS MPX output voltage                | $\Delta f = 75 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$ ; $V_{\text{FMMIX2IN}} = 200 \mu\text{V}$ to 800 mV                                                        | –    | 0.35 | 0.7  | %             |
| $\alpha_{\text{AM}}$                    | AM suppression<br>$\frac{V_{\text{o(rms)}}}{V_{\text{o(AM)(rms)}}$ | FM: $\Delta f = 22.5 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; AM: $m = 0.3$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$<br>$V_{\text{FMMIX2IN}} = 30$ to 70 $\mu\text{V}$ | 20   | 30   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 70$ to 500 $\mu\text{V}$                                                                                                                                                            | 30   | 40   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 500 \mu\text{V}$ to 300 mV                                                                                                                                                          | 35   | 45   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 300 \text{ mV}$ to 1 V                                                                                                                                                              | 30   | 40   | –    | dB            |
| $V_{\text{o(rms)}}$                     | RDS MPX output voltage (RMS value)                                 | $V_{\text{FMMIX2IN}} = 20 \mu\text{V}$ to 1 V; note 3<br>$\Delta f = 5 \text{ kHz}$ ; $f_{\text{mod}} = 57 \text{ kHz}$                                                                                    | 45   | 50   | 55   | mV            |
|                                         |                                                                    | $\Delta f = 22.5 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$                                                                                                                                           | 205  | 230  | 255  | mV            |
| $I_{\text{o(max)(rms)}}$                | maximum RDS MPX output current (RMS value)                         |                                                                                                                                                                                                            | 100  | –    | –    | $\mu\text{A}$ |
| $R_{\text{o}}$                          | output resistance                                                  |                                                                                                                                                                                                            | –    | –    | 500  | $\Omega$      |
| $R_{\text{L}}$                          | load resistance                                                    |                                                                                                                                                                                                            | 20   | –    | –    | k $\Omega$    |
| $C_{\text{L}}$                          | load capacitance                                                   |                                                                                                                                                                                                            | –    | –    | 50   | pF            |
| B                                       | bandwidth RDS MPX output                                           | $C_{\text{L}} = 0$ ; $R_{\text{L}} > 20 \text{ k}\Omega$                                                                                                                                                   | 200  | 300  | –    | kHz           |
| PSRR                                    | power supply ripple rejection                                      | $f_{\text{ripple}} = 100 \text{ Hz}$ to 20 kHz                                                                                                                                                             | –    | 40   | –    | dB            |
| <i>FM MPX output: pin FMMPX; note 3</i> |                                                                    |                                                                                                                                                                                                            |      |      |      |               |
| (S+N)/N                                 | maximum signal plus noise-to-noise ratio of FM MPX output voltage  | $\Delta f = 22.5 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$ ; $V_{\text{FMMIX2IN}} = 10 \text{ mV}$                                                                  | 65   | 68   | –    | dB            |
| THD                                     | total harmonic distortion of FM MPX output voltage                 | $\Delta f = 75 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$ ; $V_{\text{FMMIX2IN}} = 200 \mu\text{V}$ to 800 mV                                                        | –    | 0.1  | –    | %             |
| $\alpha_{\text{AM}}$                    | AM suppression<br>$\frac{V_{\text{o(rms)}}}{V_{\text{o(AM)(rms)}}$ | FM: $\Delta f = 22.5 \text{ kHz}$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; AM: $m = 0.3$ ; $f_{\text{mod}} = 1 \text{ kHz}$ ; de-emphasis = 50 $\mu\text{s}$<br>$V_{\text{FMMIX2IN}} = 30$ to 70 $\mu\text{V}$ | 20   | 30   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 70$ to 500 $\mu\text{V}$                                                                                                                                                            | 30   | 40   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 500 \mu\text{V}$ to 300 mV                                                                                                                                                          | 35   | 45   | –    | dB            |
|                                         |                                                                    | $V_{\text{FMMIX2IN}} = 300 \text{ mV}$ to 1 V                                                                                                                                                              | 30   | 40   | –    | dB            |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                       | PARAMETER                                                                           | CONDITIONS                                                                                                                      | MIN. | TYP. | MAX. | UNIT             |
|----------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|------------------|
| $V_{o(rms)}$                                 | FM MPX output voltage (RMS value)                                                   | $\Delta f = 22.5 \text{ kHz}$ ; $f_{mod} = 1 \text{ kHz}$ ; $V_{FMMIX2IN} = 20 \mu\text{V}$ to $1 \text{ V}$                    | 205  | 230  | 255  | mV               |
|                                              |                                                                                     | $\Delta f = 1.5 \text{ kHz}$ ; $f_{mod} = 1 \text{ kHz}$ ; $V_{FMMIX2IN} = 20 \mu\text{V}$ to $1 \text{ V}$ ; weather band mode | 150  | 230  | 310  | mV               |
| $I_{o(max)}$                                 | maximum FM MPX output current                                                       |                                                                                                                                 | 100  | –    | –    | $\mu\text{A}$    |
| B                                            | bandwidth FM MPX output                                                             | $C_L = 0$ ; $R_L > 20 \text{ k}\Omega$                                                                                          | 200  | –    | –    | kHz              |
| PSRR                                         | power supply ripple rejection                                                       | $f_{ripple} = 100 \text{ Hz}$ to $20 \text{ kHz}$                                                                               | –    | 40   | –    | dB               |
| $R_L$                                        | load resistance                                                                     |                                                                                                                                 | 20   | –    | –    | $\text{k}\Omega$ |
| $R_o$                                        | output resistance                                                                   |                                                                                                                                 | –    | –    | 500  | $\Omega$         |
| $C_L$                                        | load capacitance                                                                    |                                                                                                                                 | –    | –    | 50   | pF               |
| $t_{sw}$                                     | AM to FM switching time                                                             | $V_{FMMIX2IN} = 100 \mu\text{V}$                                                                                                | –    | 100  | 150  | ms               |
| <b>MPX mute</b>                              |                                                                                     |                                                                                                                                 |      |      |      |                  |
| $\alpha_{mute}$                              | muting depth                                                                        | data byte 2: bit 7 = 1 (mute)                                                                                                   | 60   | 80   | –    | dB               |
| $V_{offset(DC)}$                             | DC offset during RDS update mute pin FMMPX<br>$\Delta V = V_{muted} - V_{notmuted}$ |                                                                                                                                 | –30  | –    | +30  | mV               |
| <b>RDS update: pin TRDSMUTE</b>              |                                                                                     |                                                                                                                                 |      |      |      |                  |
| $V_{TRDSMUTE}$                               | voltage at pin TRDSMUTE                                                             | no mute                                                                                                                         | 5.2  | 5.7  | 6.2  | V                |
|                                              |                                                                                     | mute                                                                                                                            | 0.7  | 1.2  | 1.7  | V                |
| $I_{dch}$                                    | discharge current                                                                   | $V_o = 3 \text{ V}$ ; data byte 2: bit 7 = 1                                                                                    | 24   | 32   | 38   | $\mu\text{A}$    |
| $I_{ch}$                                     | charge current                                                                      | $V_o = 3 \text{ V}$ ; data byte 2: bit 7 = 0                                                                                    | –38  | –32  | –24  | $\mu\text{A}$    |
| <b>FM MPX SOFT MUTE: PIN IF2FILQ; note 3</b> |                                                                                     |                                                                                                                                 |      |      |      |                  |
| $V_{mute}$                                   | mute voltage                                                                        | $V_{FMMIX2IN} = 0$ to $1 \text{ V}$                                                                                             | 0    | –    | 3    | V                |
| $V_{offset}$                                 | voltage offset (to $V_{level(AMFM)}$ )                                              | $V_{FMMIX2IN} = 0$ to $100 \mu\text{V}$                                                                                         | –200 | –    | +200 | mV               |
| $I_{dch}$                                    | discharge current                                                                   | $V_{level(AMFM)} < V_i$                                                                                                         | 2.5  | 3.5  | 4.5  | $\mu\text{A}$    |
| $I_{ch}$                                     | charge current                                                                      | $V_{level(AMFM)} > V_i$                                                                                                         | –4.5 | –3.5 | –2.5 | $\mu\text{A}$    |
| $\alpha_{mute}$                              | mute attenuation                                                                    | $V_{FMMIX2IN} = 10 \text{ mV}$ ; $V_i = 400 \text{ mV}$ ; data byte 7 = X1000100                                                | –    | 7.5  | –    | dB               |
| $\Delta\alpha_{mute}$                        | difference to mute attenuation from step to step                                    | $V_{FMMIX2IN} = 10 \text{ mV}$ ; $V_i = 400 \text{ mV}$ data byte 7 = X1001100                                                  | –    | 0.9  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1010100                                                                                                          | –    | 2.5  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1011100                                                                                                          | –    | 3.4  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1100100                                                                                                          | –    | 8.7  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1101100                                                                                                          | –    | 4.4  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1110100                                                                                                          | –    | 8.5  | –    | dB               |
|                                              |                                                                                     | data byte 7 = X1111100                                                                                                          | –    | 5.5  | –    | dB               |
| $\alpha_{mute(off)}$                         | mute off                                                                            | $V_{FMMIX2IN} = 10 \text{ mV}$ ; $V_i = 400 \text{ mV}$ ; data byte 7 = X0111100                                                | –1   | 0    | +1   | dB               |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

| SYMBOL                                                             | PARAMETER                                                                                       | CONDITIONS                                                                                                                                                                                                                                                              | MIN.                                   | TYP.                                   | MAX.                                          | UNIT                                   |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------------|----------------------------------------|
| $\alpha_{\text{mute(max)}}$                                        | maximum mute attenuation                                                                        | $V_{\text{FMMIX2IN}} = 10 \text{ mV}$ ; $V_i = 10 \text{ mV}$ ;<br>data byte 7 = X1111100                                                                                                                                                                               | 36                                     | 42.5                                   | 50                                            | dB                                     |
| $V_{\text{mute(start)}}$                                           | mute start voltage                                                                              | $\alpha_{\text{mute}} = -3 \text{ dB}$ ;<br>$V_{\text{FMMIX2IN}} = 10 \text{ mV}$ ;<br>data byte 7 = X1111000                                                                                                                                                           | 410                                    | 480                                    | 550                                           | mV                                     |
| $\Delta V_{\text{mute(start)}}$                                    | difference to mute start voltage from step to step                                              | $\alpha_{\text{mute}} = -3 \text{ dB}$ ;<br>$V_{\text{FMMIX2IN}} = 10 \text{ mV}$<br>data byte 7 = X1111001<br>data byte 7 = X1111010<br>data byte 7 = X1111011<br>data byte 7 = X1111100<br>data byte 7 = X1111101<br>data byte 7 = X1111110<br>data byte 7 = X1111111 | 80<br>80<br>80<br>80<br>80<br>80<br>80 | 93<br>93<br>93<br>93<br>93<br>93<br>93 | 105<br>105<br>105<br>105<br>105<br>105<br>105 | mV<br>mV<br>mV<br>mV<br>mV<br>mV<br>mV |
| $V_{\text{offset(DC)}}$                                            | DC offset created by soft mute pin FMMPX<br>$\Delta V = V_{\text{muted}} - V_{\text{notmuted}}$ | data byte 7 = X1111111;<br>$V_{\text{FMMIX2IN}} = 10 \text{ mV}$ ;<br>$f_{\text{IF}} = 10.7 \text{ MHz}$ ; unmodulated;<br>$V_i = 1.9 \text{ V}$ versus 0.4 V                                                                                                           | -30                                    | –                                      | +30                                           | mV                                     |
| FM IF LEVEL DETECTOR OUTPUT: PIN $V_{\text{level(AMFM)}}$ ; note 3 |                                                                                                 |                                                                                                                                                                                                                                                                         |                                        |                                        |                                               |                                        |
| $V_{\text{level(AMFM)}}$                                           | DC output voltage                                                                               | $V_{\text{FMMIX2IN}} = 10 \text{ } \mu\text{V}$ to 1 V                                                                                                                                                                                                                  | 0                                      | –                                      | 7                                             | V                                      |
|                                                                    |                                                                                                 | $V_{\text{FMMIX2IN}} < 1 \text{ } \mu\text{V}$ ; standard setting of level DAA                                                                                                                                                                                          | 0.1                                    | 0.35                                   | 0.9                                           | V                                      |
|                                                                    |                                                                                                 | $V_{\text{FMMIX2IN}} = 1 \text{ mV}$ ; standard setting of level DAA                                                                                                                                                                                                    | 1                                      | 1.5                                    | 2.1                                           | V                                      |
| $\Delta V_{\text{level(AMFM)}}$                                    | step size of starting point adjustment                                                          | data byte 5: bit 2 = 1, bit 1 = 0, bit 0 = 0                                                                                                                                                                                                                            | 30                                     | 40                                     | 50                                            | mV                                     |
| $V_{\text{level(slope)}}$                                          | slope of level voltage<br>$\frac{\Delta V_{\text{level(AMFM)}}}{\Delta V_{\text{FMMIX2IN}}}$    | $V_{\text{FMMIX2IN}} = 1$ to 300 mV;<br>standard setting of level slope                                                                                                                                                                                                 | 650                                    | 800                                    | 950                                           | $\frac{\text{mV}}{20 \text{ dB}}$      |
| $\Delta V_{\text{step}}$                                           | step size of slope adjustment                                                                   | $V_{\text{FMMIX2IN}} = 1 \text{ mV}$                                                                                                                                                                                                                                    | 45                                     | 60                                     | 75                                            | $\frac{\text{mV}}{20 \text{ dB}}$      |
| $B_{\text{level(AMFM)}}$                                           | bandwidth of level output voltage                                                               | $V_{\text{FMMIX2IN}} = 10 \text{ mV}$ ; standard setting of level DAA                                                                                                                                                                                                   | 200                                    | 300                                    | –                                             | kHz                                    |
| $I_{\text{source}}$                                                | output source current                                                                           |                                                                                                                                                                                                                                                                         | –                                      | –                                      | -300                                          | $\mu\text{A}$                          |
| $I_{\text{sink}}$                                                  | output sink current                                                                             |                                                                                                                                                                                                                                                                         | 50                                     | –                                      | –                                             | $\mu\text{A}$                          |
| $R_o$                                                              | output resistance                                                                               |                                                                                                                                                                                                                                                                         | –                                      | –                                      | 500                                           | $\Omega$                               |
| RR                                                                 | ripple rejection                                                                                | $f_{\text{ripple}} = 100 \text{ Hz}$ ;<br>$V_{\text{DDA6(ripple)}} = 100 \text{ mV (RMS)}$                                                                                                                                                                              | –                                      | 40                                     | –                                             | dB                                     |
| PIN $V_{\text{level(ACD)}}$                                        |                                                                                                 |                                                                                                                                                                                                                                                                         |                                        |                                        |                                               |                                        |
| $R_o$                                                              | output resistance                                                                               |                                                                                                                                                                                                                                                                         | 6.4                                    | 8                                      | 9.6                                           | k $\Omega$                             |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

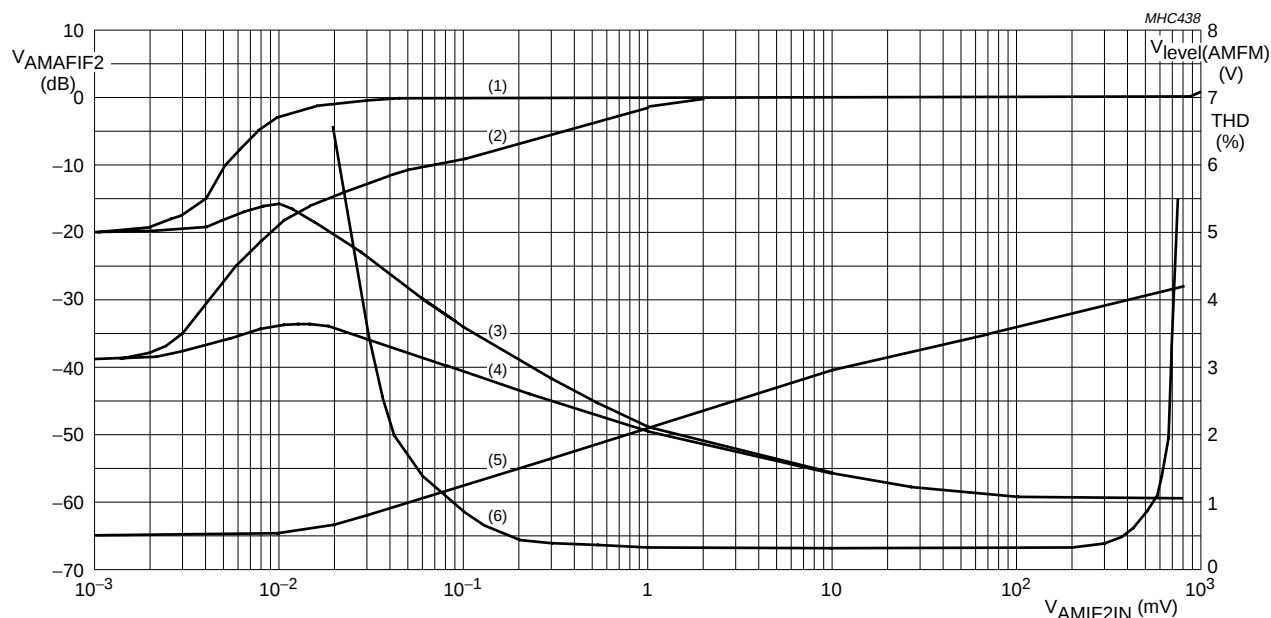
| SYMBOL                      | PARAMETER            | CONDITIONS                                                                                            | MIN. | TYP. | MAX. | UNIT |
|-----------------------------|----------------------|-------------------------------------------------------------------------------------------------------|------|------|------|------|
| <b>RDS update</b>           |                      |                                                                                                       |      |      |      |      |
| <i>Output: pin AFHOLD</i>   |                      |                                                                                                       |      |      |      |      |
| $I_{\text{sink(max)}}$      | maximum sink current | after first bus transmission with data byte 0: bit 7 = 1 (start of RDS update); $V_o = 0.5 \text{ V}$ | 1.0  | 1.2  | 1.4  | mA   |
| <i>Output: pin AFSAMPLE</i> |                      |                                                                                                       |      |      |      |      |
| $I_{\text{sink(max)}}$      | maximum sink current | no RDS update in progress; $V_o = 0.5 \text{ V}$                                                      | 1.0  | 1.2  | 1.4  | mA   |

## Notes

1. Measured between pins XTAL1 and XTAL2.
2. DAA conversion gain formula:  $V_{\text{DAAOUT}} = \left[ 2 \times \left( 0.75 \times \frac{n}{128} + 0.125 \right) \times (V_{\text{DAAIN}} + V_{\text{DAATD}}) \right] - V_{\text{DAATD}}$ ; where  $n = 0$  to 127.
3. Input parameters of FM mixer 2 measured between pins FMMIX2IN and FMMIX2DEC.
4. Input parameters of AM IF2 measured between pins AMIF2IN and AMIF2DEC.
5. Reference frequency pin FREF:  $R_{\text{ext}} = 68 \text{ k}\Omega$  connected to ground activates the 2nd I<sup>2</sup>C-bus address.
6. Input parameters of AM mixer 1 measured between pins AMMIX1DEC and AMMIX1IN.
7. Output parameters of FM mixer and AM mixer 1 measured between pins MIX1OUT1 and MIX1OUT2.
8. Input parameters of AM mixer 2 measured between pins IFAMPIN and IFAMPDEC.
9. Output parameters of AM mixer 2 measured between pins AMMIX2OUT1 and AMMIX2OUT2.
10. Input parameters of FM mixer measured between pins FMMIXIN1 and FMMIXIN2.

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

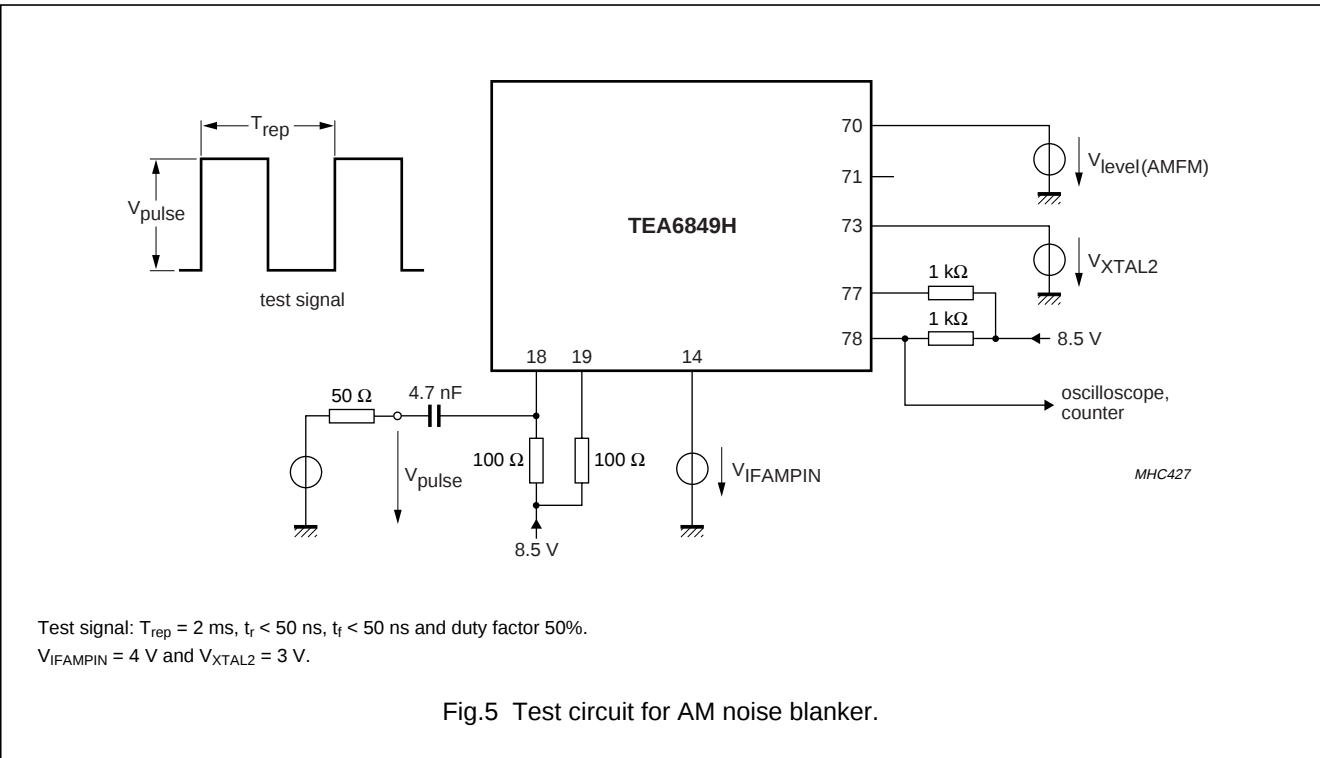
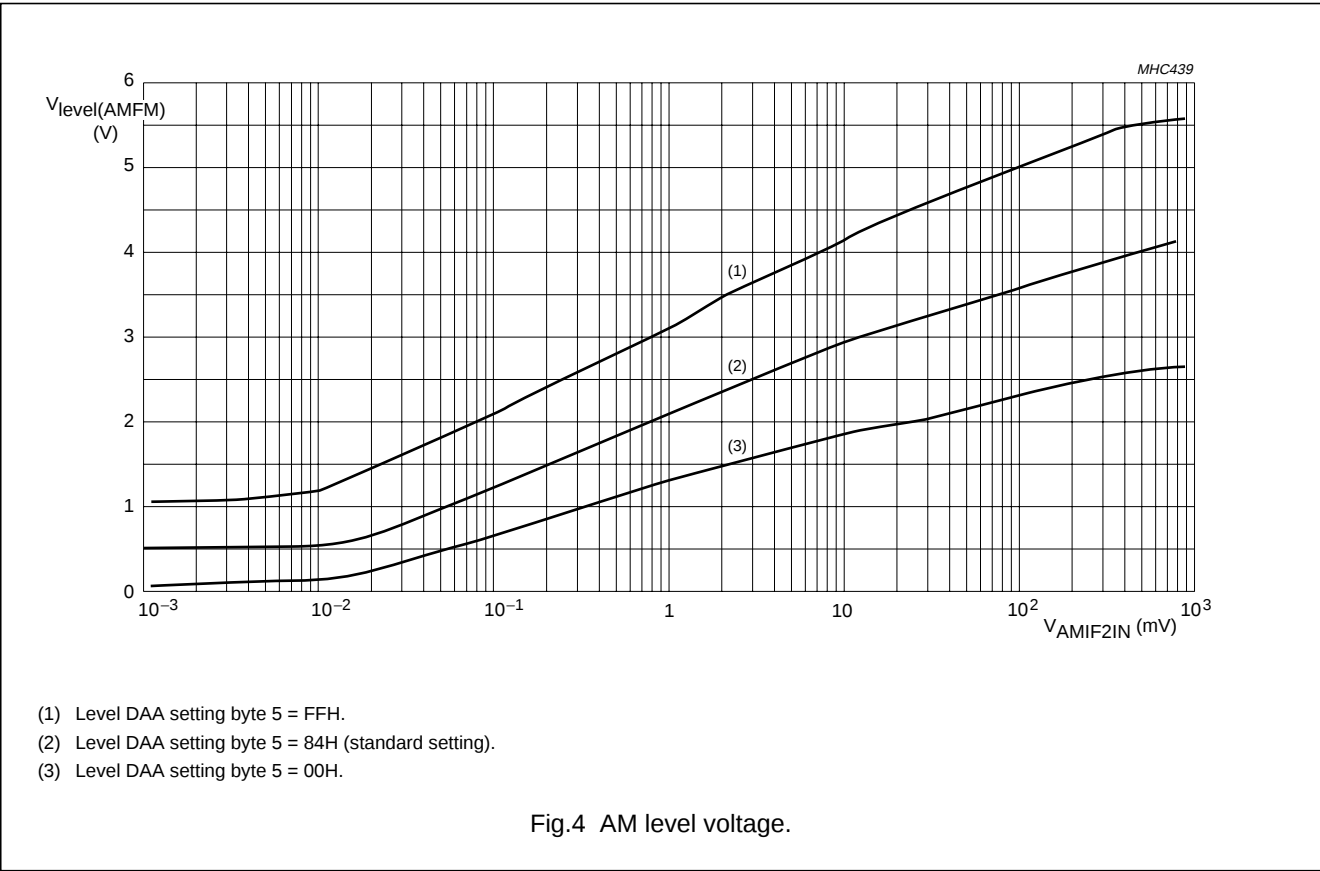


- (1) AF:  $f_{IF} = 450$  kHz;  $m = 0.3$ ;  $f_{mod} = 1$  kHz; soft mute off.
- (2) AF:  $f_{IF} = 450$  kHz;  $m = 0.3$ ;  $f_{mod} = 1$  kHz; soft mute on.
- (3) Noise: unweighted B = 2.15 kHz; soft mute off.
- (4) Noise: unweighted B = 2.15 kHz; soft mute on.
- (5) Level detector output voltage, default setting.
- (6) THD:  $m = 0.8$ .

Fig.3 AM detector and level output.

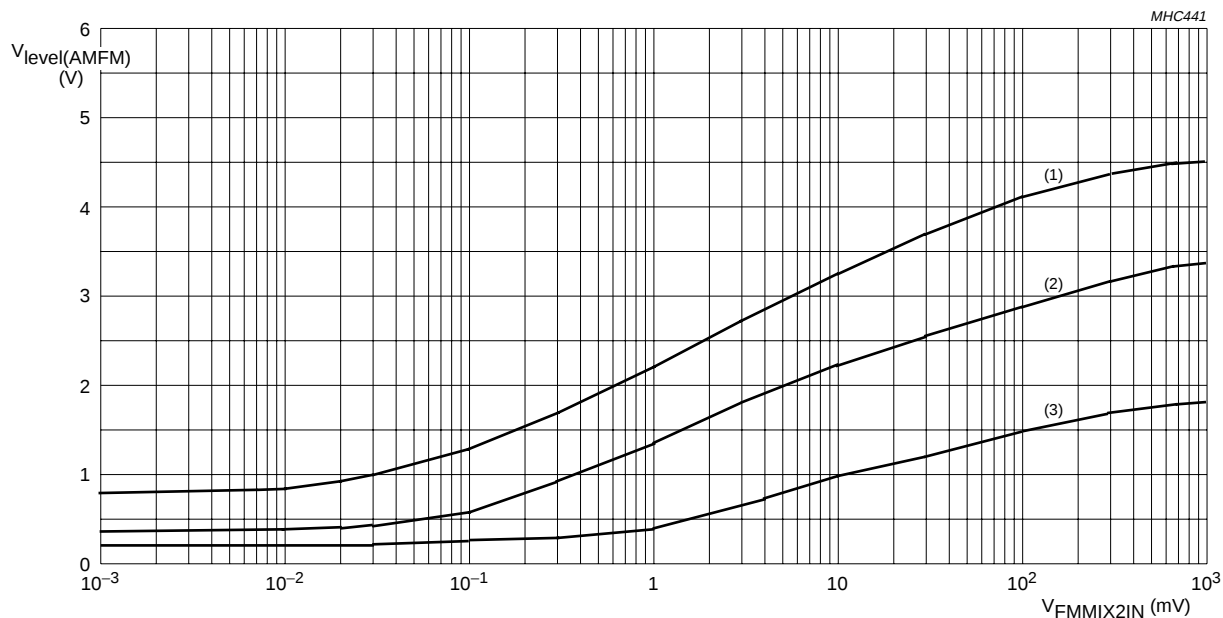
New In Car Entertainment car radio tuner IC with  
Precision Adjacent Channel Suppression (NICE-PACS)

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# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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- (1) Level DAA setting byte 5 = FFH.
- (2) Level DAA setting byte 5 = 84H (standard setting).
- (3) Level DAA setting byte 5 = 00H.

Fig.6 FM level voltage.

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

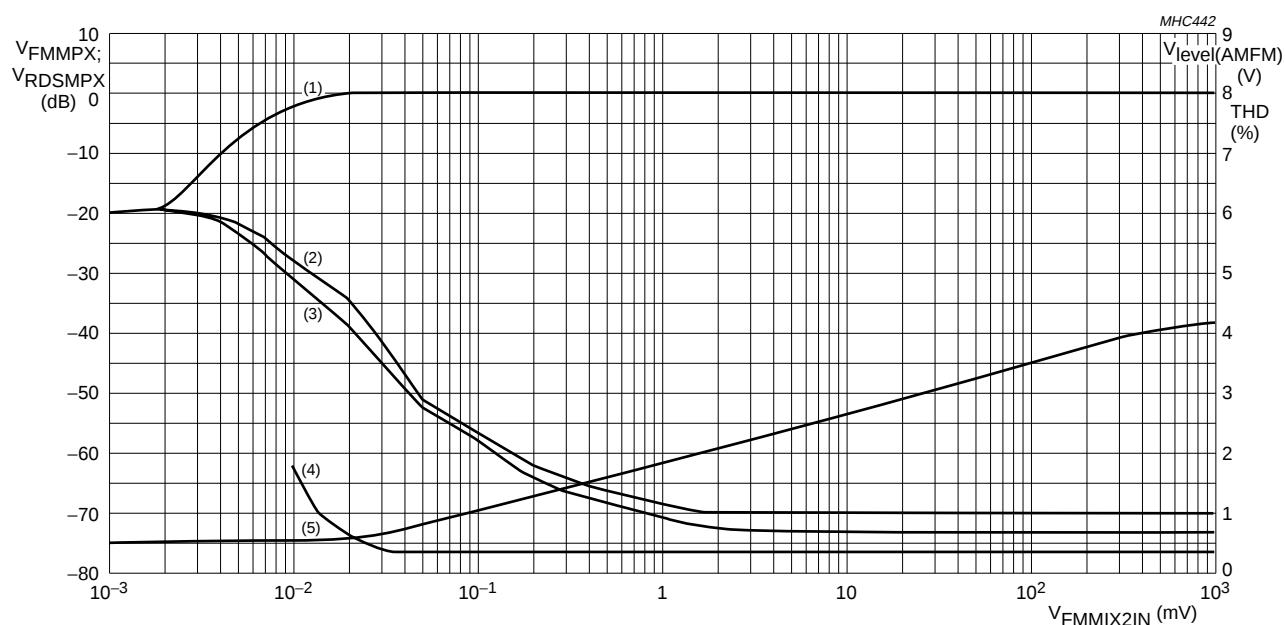


Fig.7 (S+N)/N, THD and level voltage for FM mode as a function of FM demodulator input voltage.

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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FMMPX output voltage,  $\Delta f = 22.5$  kHz,  
setting of mute slope:  $SSL[2:0] = 110$ .

- (1)  $SST[2:0] = 000$ .
- (2)  $SST[2:0] = 001$ .
- (3)  $SST[2:0] = 010$ .
- (4)  $SST[2:0] = 011$ .
- (5)  $SST[2:0] = 100$ .
- (6)  $SST[2:0] = 101$ .
- (7)  $SST[2:0] = 110$ .
- (8)  $SST[2:0] = 111$ .
- (9) Level voltage.

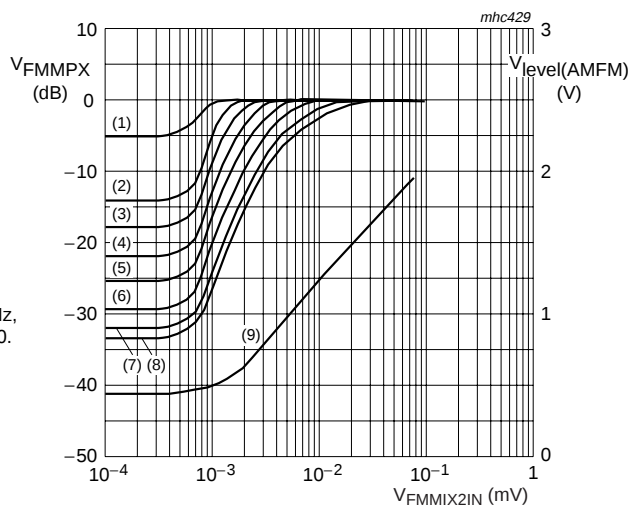


Fig.8 Adjustment of soft mute start level, soft mute slope = constant.

FMMPX output voltage,  $\Delta f = 22.5$  kHz,  
setting of mute start:  $SST[2:0] = 011$ .

- (1)  $SSL[2:0] = 000$ .
- (2)  $SSL[2:0] = 001$ .
- (3)  $SSL[2:0] = 010$ .
- (4)  $SSL[2:0] = 011$ .
- (5)  $SSL[2:0] = 100$ .
- (6)  $SSL[2:0] = 101$ .
- (7)  $SSL[2:0] = 110$ .
- (8)  $SSL[2:0] = 111$ .
- (9) Level voltage.

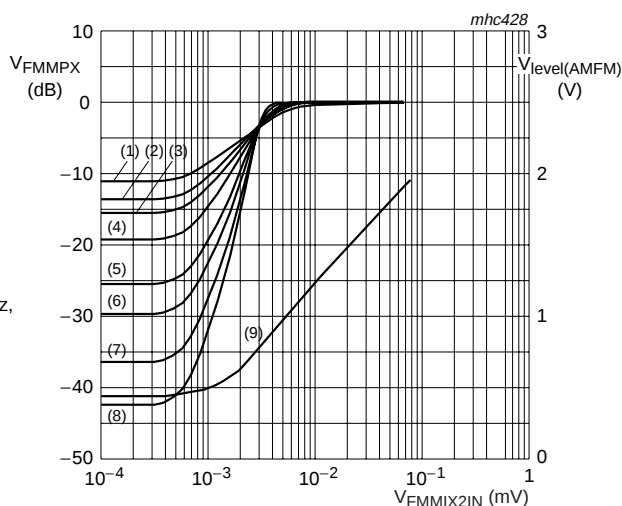


Fig.9 Adjustment of soft mute slope, soft mute start level = constant.

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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## 12 I<sup>2</sup>C-BUS PROTOCOL

### 12.1 I<sup>2</sup>C-bus specification

Information about the I<sup>2</sup>C-bus can be found in the brochure *"The I<sup>2</sup>C-bus and how to use it"* (order number 9398 393 40011).

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

IC addresses:

- 1st IC address C2H: 1100001 R/ $\overline{W}$
- 2nd IC address C0H: 1100000 R/ $\overline{W}$ .

Structure of the I<sup>2</sup>C-bus logic: slave transceiver with auto increment.

Subaddresses are not used.

A second I<sup>2</sup>C-bus address can be selected by connecting pin FREF via a 68 k $\Omega$  resistor to GND.

Exception to the standard I<sup>2</sup>C-bus specification:

- The data hold time  $t_{HD,DAT}$  must be at least 1  $\mu$ s.

#### 12.1.1 DATA TRANSFER

Data sequence: address, byte 0, byte 1, byte 2, byte 3, byte 4, byte 5, byte 6, and byte 7. The data transfer has to be in this order. The LSB = 0 indicates a WRITE operation to the TEA6849H.

Bit 7 of each byte is considered the MSB and has to be transferred as the first bit of the byte.

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 is not completed, this byte is lost and the previous information is available.

#### 12.1.2 I<sup>2</sup>C-BUS PULL-UP RESISTORS

When the IC is used together with the TEA688x or TEF689x and both SCL and SDA lines are connected via the I<sup>2</sup>C-bus to the TEA688x or TEF689x, the pull-up resistors of the tuner IC should be connected to the digital supply voltage of the TEA688x or TEF689x. Otherwise an I<sup>2</sup>C-bus pull-down can occur switching off the tuner IC supply when the I<sup>2</sup>C-bus buffer interface of the TEA688x or TEF689x is enabled for data transfer to the tuner IC.

#### 12.1.3 FREQUENCY SETTING

For new frequency setting, in both AM and FM mode, the programmable divider is enabled by setting bit MUTE = 1. To select an FM frequency, two I<sup>2</sup>C-bus transmissions are necessary:

- First: bit MUTE = 1
- Second: bit MUTE = 0.

#### 12.1.4 DEFAULT SETTINGS

**No default settings at power-on reset.** One I<sup>2</sup>C-bus transmission is required to program the IC.

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## 12.2 I<sup>2</sup>C-bus protocol

### 12.2.1 DATA TRANSFER MODE AND IC ADDRESS

**Table 1** Write mode

|                  |                 |                  |              |                  |                  |
|------------------|-----------------|------------------|--------------|------------------|------------------|
| S <sup>(1)</sup> | address (write) | A <sup>(2)</sup> | data byte(s) | A <sup>(2)</sup> | P <sup>(3)</sup> |
|------------------|-----------------|------------------|--------------|------------------|------------------|

**Notes**

1. S = START condition.
2. A = acknowledge.
3. P = STOP condition.

**Table 2** Read mode

|                  |                |                  |             |
|------------------|----------------|------------------|-------------|
| S <sup>(1)</sup> | address (read) | A <sup>(2)</sup> | data byte 1 |
|------------------|----------------|------------------|-------------|

**Notes**

1. S = START condition.
2. A = acknowledge.

**Table 3** IC address byte

| IC ADDRESS |   |   |   |   |   |                    | MODE               |
|------------|---|---|---|---|---|--------------------|--------------------|
| 1          | 1 | 0 | 0 | 0 | 0 | 0/1 <sup>(1)</sup> | R/W <sup>(2)</sup> |

**Notes**

1. Defined by address pin FREF:
  - a) 1 = 1st IC address
  - b) 0 = 2nd IC address.
2. Read or write mode:
  - a) 0 = write operation to TEA6849H
  - b) 1 = read operation from TEA6849H.

### 12.2.2 WRITE MODE: DATA BYTE 0

**Table 4** Format of data byte 0

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| AF    | PLL14 | PLL13 | PLL12 | PLL11 | PLL10 | PLL9  | PLL8  |

**Table 5** Description of data byte 0 bits

| BIT    | SYMBOL    | DESCRIPTION                                                                                           |
|--------|-----------|-------------------------------------------------------------------------------------------------------|
| 7      | AF        | <b>Alternative frequency.</b> If AF = 0, then normal operation. If AF = 1, then AF (RDS) update mode. |
| 6 to 0 | PLL[14:8] | <b>Setting of programmable counter of synthesizer PLL.</b> Upper byte of PLL divider word.            |

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## 12.2.3 WRITE MODE: DATA BYTE 1

**Table 6** Format of data byte 1

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| PLL7  | PLL6  | PLL5  | PLL4  | PLL3  | PLL2  | PLL1  | PLL0  |

**Table 7** Description of data byte 1 bits

| BIT    | SYMBOL   | DESCRIPTION                                                                                |
|--------|----------|--------------------------------------------------------------------------------------------|
| 7 to 0 | PLL[7:0] | <b>Setting of programmable counter of synthesizer PLL.</b> Lower byte of PLL divider word. |

## 12.2.4 WRITE MODE: DATA BYTE 2

**Table 8** Format of data byte 2

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| MUTE  | DAA6  | DAA5  | DAA4  | DAA3  | DAA2  | DAA1  | DAA0  |

**Table 9** Description of data byte 2 bits

| BIT    | SYMBOL   | DESCRIPTION                                                                                                                                            |
|--------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7      | MUTE     | <b>FM audio mute.</b> If MUTE = 0, then FM audio not muted. If MUTE = 1, then FM audio muted; writing to programmable divider and antenna DAA enabled. |
| 6 to 0 | DAA[6:0] | <b>Setting of antenna digital auto alignment.</b>                                                                                                      |

## 12.2.5 WRITE MODE: DATA BYTE 3

**Table 10** Format of data byte 3

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| IFMT  | FREF2 | FREF1 | FREF0 | IFPR  | BND1  | BND0  | AMFM  |

**Table 11** Description of data byte 3 bits

| BIT     | SYMBOL    | DESCRIPTION                                                                                                                              |
|---------|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| 7       | IFMT      | <b>IF measuring time.</b> If IFMT = 0, then IF measuring time is 20 ms. If IFMT = 1, then IF measuring time is 2 ms.                     |
| 6 to 4  | FREF[2:0] | <b>Reference frequency for synthesizer.</b> These 3 bits determine the reference frequency, see Table 12.                                |
| 3       | IFPR      | <b>IF counter prescaler ratio.</b> If IFPR = 0, then IF prescaler ratio is 40. If IFPR = 1, then IF prescaler ratio is 10.               |
| 2 and 1 | BND[1:0]  | <b>Band switch.</b> These 2 bits select in FM mode band and local or distant, see Table 13; in AM mode band and AM stereo, see Table 14. |
| 0       | AMFM      | <b>AM or FM switch.</b> If AMFM = 0, then FM mode. If AMFM = 1, then AM mode.                                                            |

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**Table 12** Reference frequency setting

| FREF2 | FREF1 | FREF0 | f <sub>ref</sub> (kHz) |
|-------|-------|-------|------------------------|
| 0     | 0     | 0     | 100                    |
| 1     | 0     | 0     | 50                     |
| 0     | 1     | 0     | 25                     |
| 1     | 1     | 0     | 20                     |
| 0     | 0     | 1     | 10                     |
| 1     | 0     | 1     | 10                     |
| 0     | 1     | 1     | 10                     |
| 1     | 1     | 1     | 10                     |

**Table 13** FM mode

| BND1 | BND0 | FREQUENCY BAND | VCO DIVIDER | CHARGE PUMP CURRENT |
|------|------|----------------|-------------|---------------------|
| 0    | 0    | FM standard    | 2           | 130 $\mu$ A + 3 mA  |
| 0    | 1    | FM Japan       | 3           | 130 $\mu$ A + 3 mA  |
| 1    | 0    | FM East Europe | 3           | 1 mA                |
| 1    | 1    | FM weather     | 1           | 300 $\mu$ A         |

**Table 14** AM mode

| BND1 | BND0 | FREQUENCY BAND  | VCO DIVIDER | CHARGE PUMP CURRENT |
|------|------|-----------------|-------------|---------------------|
| 0    | 0    | AM SW mono      | 10          | 1 mA                |
| 0    | 1    | AM SW stereo    | 10          | 1 mA                |
| 1    | 0    | AM LW/MW mono   | 20          | 1 mA                |
| 1    | 1    | AM LW/MW stereo | 20          | 1 mA                |

## 12.2.6 WRITE MODE: DATA BYTE 4

**Table 15** Format of data byte 4

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| KAGC  | AGC1  | AGC0  | AMSM  | LODX  | FLAG  | BW1   | BW0   |

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**Table 16** Description of data byte 4 bits

| BIT     | SYMBOL   | DESCRIPTION                                                                                                                           |
|---------|----------|---------------------------------------------------------------------------------------------------------------------------------------|
| 7       | KAGC     | <b>Keyed FM AGC.</b> If KAGC = 0, then keyed FM AGC is off. If KAGC = 1, then keyed FM AGC is on.                                     |
| 6 and 5 | AGC[1:0] | <b>Wideband AGC.</b> These 2 bits set the start value of wideband AGC. For AM, see Table 17 and for FM, see Table 18.                 |
| 4       | AMSM     | <b>AM soft mute.</b> If AMSM = 0, then AM soft mute is off. If AMSM = 1, then AM soft mute is on (default).                           |
| 3       | LODX     | <b>Local or distance.</b> If LODX = 0, then distance mode is on. If LODX = 1, then local mode is on.                                  |
| 2       | FLAG     | <b>Software programmable flag.</b> If FLAG = 0, then flag output pin SWFLAG is HIGH. If FLAG = 1, then flag output pin SWFLAG is LOW. |
| 1 and 0 | BW[1:0]  | <b>FM IF2 bandwidth setting.</b> See Table 19.                                                                                        |

**Table 17** Setting of wideband AGC for AM (m = 0.3)

| AGC1 | AGC0 | AM MIXER 1 INPUT VOLTAGE (PEAK VALUE)<br>(mV) |
|------|------|-----------------------------------------------|
| 0    | 0    | 150                                           |
| 0    | 1    | 275                                           |
| 1    | 0    | 400                                           |
| 1    | 1    | 525                                           |

**Table 18** Setting of wideband AGC for FM

| AGC1 | AGC0 | FM RF MIXER INPUT VOLTAGE (RMS VALUE)<br>(mV) |
|------|------|-----------------------------------------------|
| 1    | 1    | 3                                             |
| 1    | 0    | 6                                             |
| 0    | 1    | 9                                             |
| 0    | 0    | 12                                            |

**Table 19** FM IF2 bandwidth setting

| BW1 | BW0 | FM IF2 BANDWIDTH B <sub>-3</sub> dB |
|-----|-----|-------------------------------------|
| 0   | 0   | dynamic mode                        |
| 0   | 1   | 130 kHz fixed                       |
| 1   | 0   | 90 kHz fixed                        |
| 1   | 1   | 60 kHz fixed                        |

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## 12.2.7 WRITE MODE: DATA BYTE 5

**Table 20** Format of data byte 5

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| LST4  | LST3  | LST2  | LST1  | LST0  | LSL2  | LSL1  | LSL0  |

**Table 21** Description of data byte 5 bits

| BIT    | SYMBOL   | DESCRIPTION                                                                                                         |
|--------|----------|---------------------------------------------------------------------------------------------------------------------|
| 7 to 3 | LST[4:0] | <b>Setting of level DAA starting point.</b> These 5 bits determine the offset of the level detector output voltage. |
| 2 to 0 | LSL[2:0] | <b>Setting of level DAA slope.</b> These 3 bits determine the steepness of the level detector output voltage.       |

**Table 22** Standard setting of data byte 5 bits

| SETTING OF LEVEL DAA STARTING POINT |      |      |      |      | SETTING OF LEVEL DAA SLOPE |      |      |
|-------------------------------------|------|------|------|------|----------------------------|------|------|
| LST4                                | LST3 | LST2 | LST1 | LST0 | LSL2                       | LSL1 | LSL0 |
| 1                                   | 0    | 0    | 0    | 0    | 1                          | 0    | 0    |

## 12.2.8 WRITE MODE: DATA BYTE 6

**Table 23** Format of data byte 6

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| TE    | CF6   | CF5   | CF4   | CF3   | CF2   | CF1   | CF0   |

**Table 24** Description of data byte 6 bits

| BIT    | SYMBOL  | DESCRIPTION                                                                                                                     |
|--------|---------|---------------------------------------------------------------------------------------------------------------------------------|
| 7      | TE      | <b>Threshold extension.</b> If TE = 0, then threshold extension is off. If TE = 1, then threshold extension is on.              |
| 6 to 0 | CF[6:0] | <b>Setting of FM IF2 centre frequency DAA.</b> The content of CF6 to CF0 determines the centre frequency of the 450 kHz filter. |

## 12.2.9 WRITE MODE: DATA BYTE 7

**Table 25** Format of data byte 7

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 0     | FMSM  | SSL2  | SSL1  | SSL0  | SST2  | SST1  | SST0  |

**Table 26** Description of data byte 7 bits

| BIT    | SYMBOL   | DESCRIPTION                                                                                       |
|--------|----------|---------------------------------------------------------------------------------------------------|
| 7      | –        | This bit is not used and must be set to logic 0.                                                  |
| 6      | FMSM     | <b>FM soft mute.</b> If FMSM = 0, then FM soft mute is off. If FMSM = 1, then FM soft mute is on. |
| 5 to 3 | SSL[2:0] | <b>Setting of FM soft mute slope;</b> 000 is flattest setting; see Fig.8                          |
| 2 to 0 | SST[2:0] | <b>Setting of soft mute start;</b> 000 is lowest setting; see Fig.9                               |

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## 12.2.10 READ MODE: DATA BYTE 0

**Table 27** Format of 1st data byte

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| IFC7  | IFC6  | IFC5  | IFC4  | IFC3  | IFC2  | IFC1  | IFC0  |

**Table 28** Description of data byte 0 bits

| BIT    | SYMBOL   | DESCRIPTION                                                                                             |
|--------|----------|---------------------------------------------------------------------------------------------------------|
| 7 to 0 | IFC[7:0] | <b>IF counter result.</b> These bits contain the least significant eight bits of the IF counter result. |

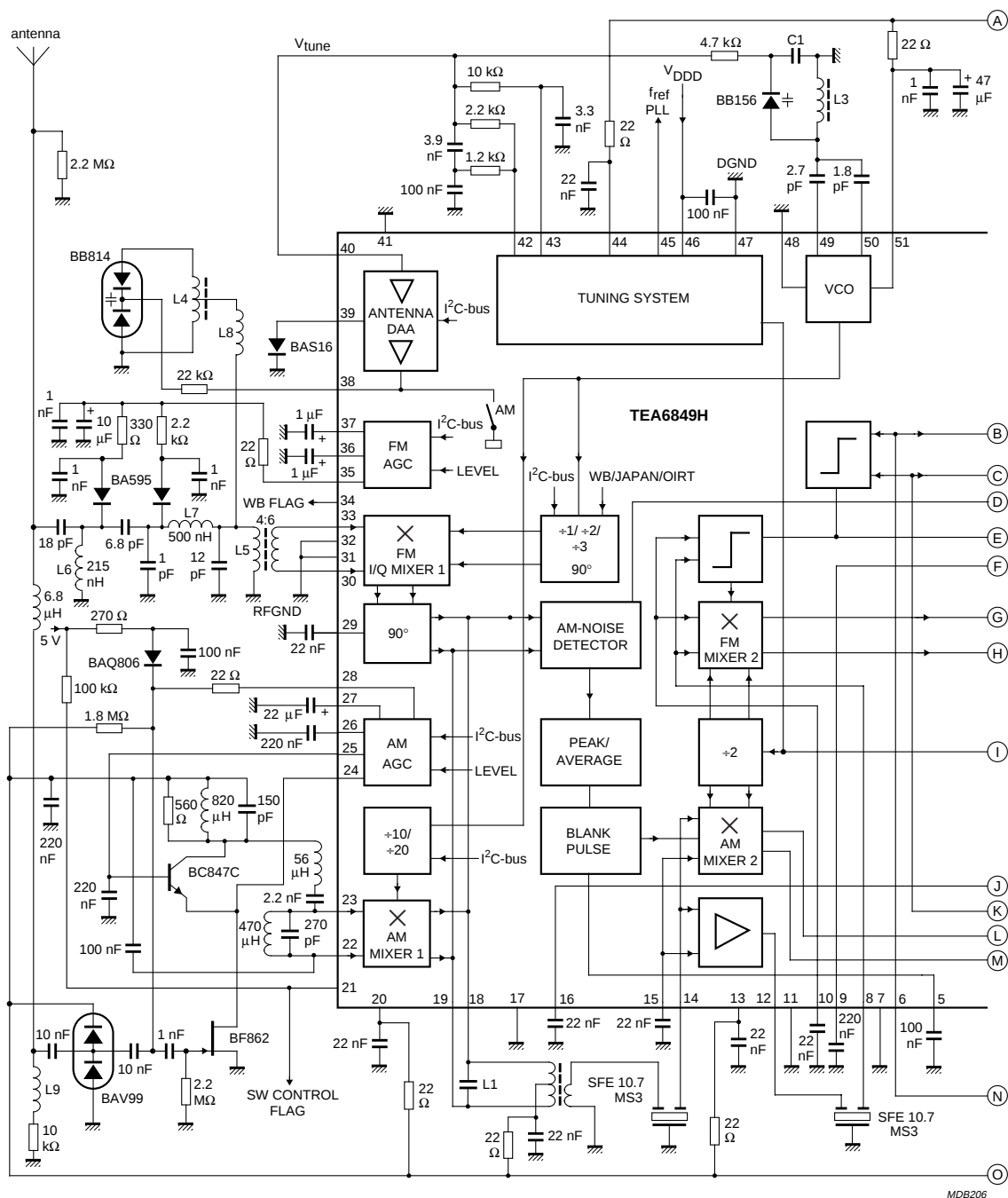
## 13 TEST AND APPLICATION INFORMATION

**Table 29** List of components for test and application circuits (Figs 10, 11, 12 and 13)

| SYMBOL | PARAMETER                | TYPE                    | MANUFACTURER  |
|--------|--------------------------|-------------------------|---------------|
| C1     | capacitor for VCO tuning | 270 pF; type NP0        | –             |
| L1     | 10.7 MHz IF coil         | P7 PSG P826RC 5134N=S   | TOKO          |
| L2     | 450 kHz IF coil          | P7PSGAE-5078D=S         | TOKO          |
| L3     | oscillator coil          | E543SNAS-02010          | TOKO          |
| L4     | FM image rejection       | 611SNS-1066Y            | TOKO          |
| L5     | FM input transformer     | 369INS-3076X            | TOKO          |
| L6     | FM antenna coil          | LQN1HR50; 215 nH        | MURATA        |
| L7     | PIN diode bias           | LQN1HR21; 500 nH        | MURATA        |
| L8     | connection image reject  | wire 10 mm/printed coil | –             |
| L9     | AM input                 | 388BN-1211Z             | TOKO          |
| R4     | resistor for stabilizer  | 3.3 k $\Omega$ ; RC12G  | BC Components |
| –      | crystal 20.5 MHz         | LN-G102-587             | NDK           |

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For list of components see Table 29.

Fig.10 Application diagram (continued in Fig.11).

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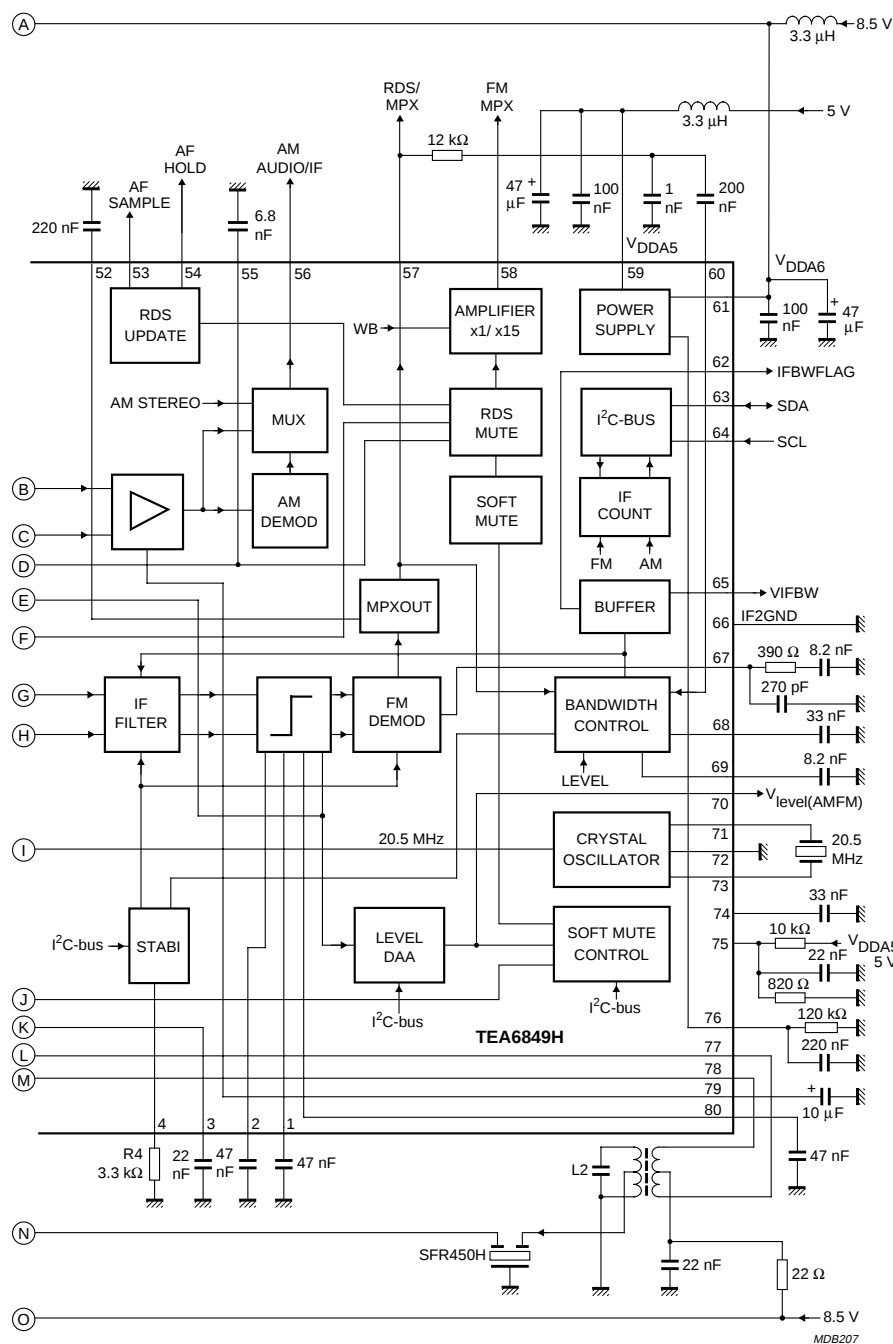
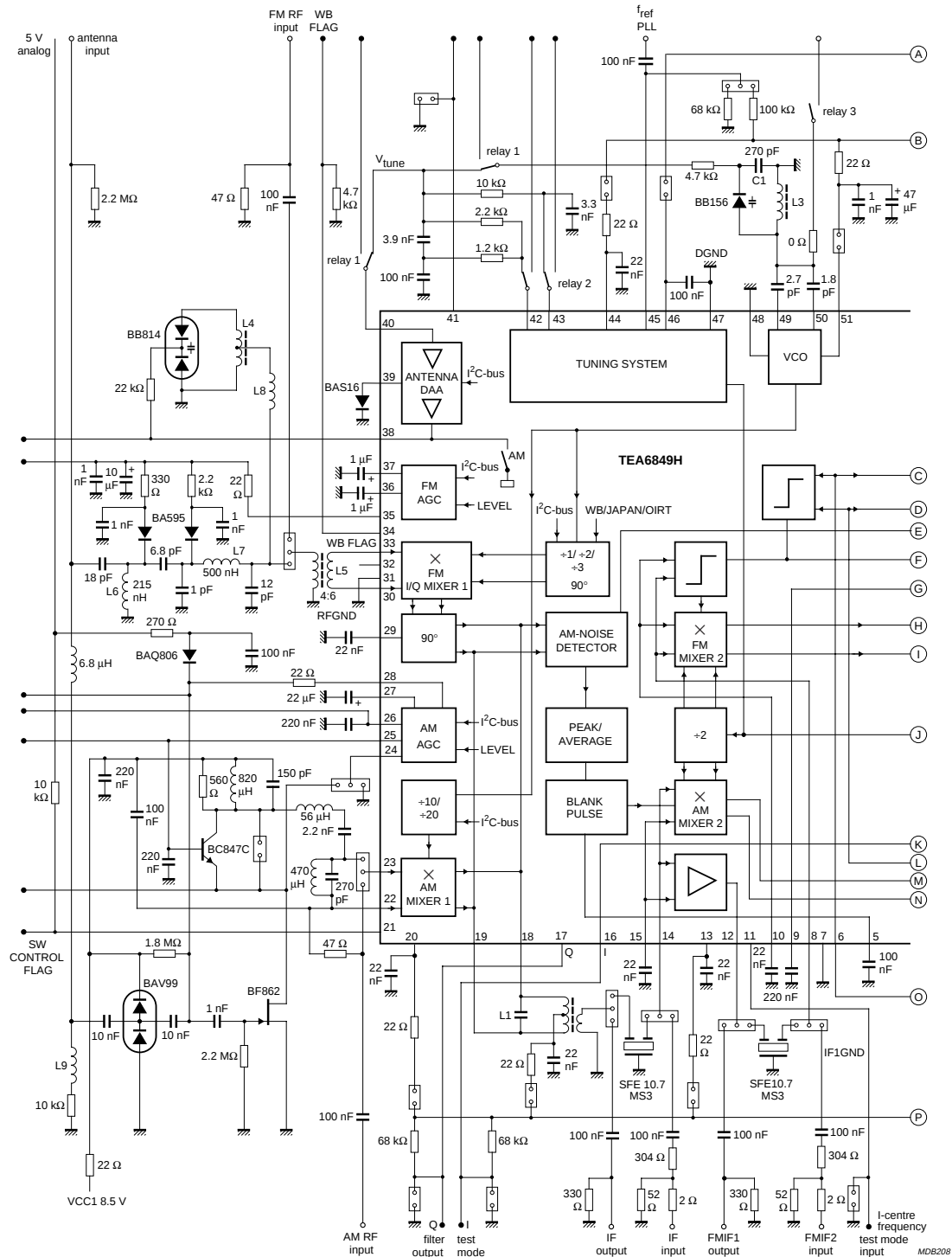


Fig.11 Application diagram (continued from Fig.10).

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## New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

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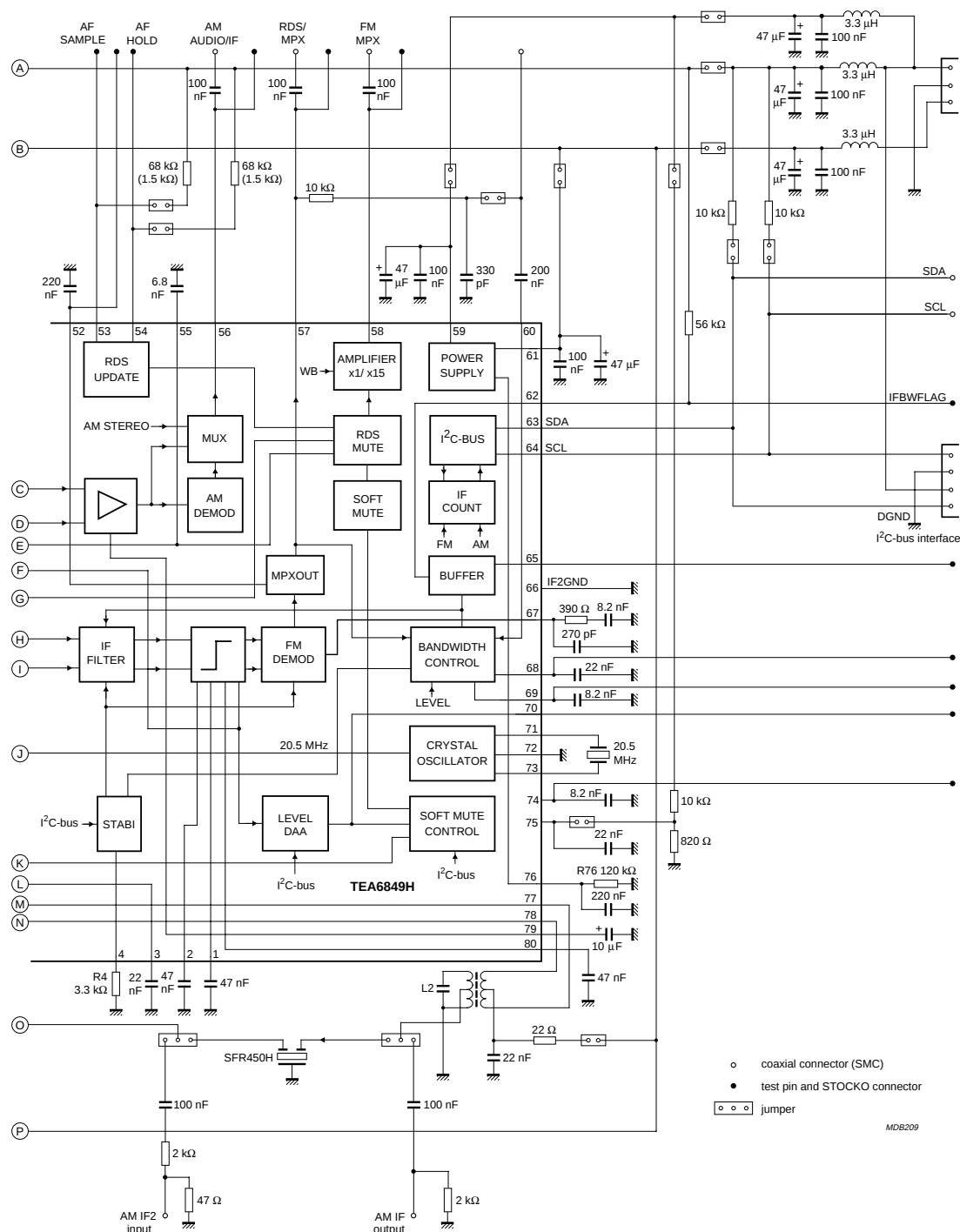


Fig.13 Test circuit (continued from Fig.12).

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**Table 30** DC operating points

| SYMBOL                | PIN | UNLOADED DC VOLTAGE (V)  |      |      |                        |             |                      |
|-----------------------|-----|--------------------------|------|------|------------------------|-------------|----------------------|
|                       |     | AM MODE                  |      |      | FM MODE                |             |                      |
|                       |     | MIN.                     | TYP. | MAX. | MIN.                   | TYP.        | MAX.                 |
| FMLIMDCFDB1           | 1   | floating                 |      |      | 3.7                    | 4.2         | 4.8                  |
| FMLIMDCFDB2           | 2   | floating                 |      |      | 3.7                    | 4.2         | 4.8                  |
| AMIF2DEC              | 3   | 2.4                      | 2.7  | 3.2  | floating               |             |                      |
| IREFFMIF2             | 4   | 0                        |      |      | 0.4                    | 0.55        | 0.7                  |
| AMNBHOLD              | 5   | 4.3                      | 4.6  | 5.1  | 8                      | 8.4         | –                    |
| AMIF2IN               | 6   | 2.4                      | 2.7  | 3.2  | floating               |             |                      |
| IF1GND                | 7   | external 0               |      |      | external 0             |             |                      |
| FMMIX2IN              | 8   | 0                        | 0.1  | –    | 1.5                    | 1.8         | 2.1                  |
| COFFSET               | 9   | floating                 |      |      | 3.5                    | 4           | 4.5                  |
| FMMIX2DEC             | 10  | 0                        | 0.1  | –    | 1.5                    | 1.8         | 2.1                  |
| IFCDAATEST            | 11  | 0                        |      |      | 0                      |             |                      |
| IFAMPOUT              | 12  | 7.2                      | 7.9  | –    | 2.4                    | 3           | 3.6                  |
| V <sub>DDA1</sub>     | 13  | external 8.5             |      |      | external 8.5           |             |                      |
| IFAMPIN               | 14  | 2.4                      | 2.7  | 3    | 1.5                    | 2           | 2.5                  |
| IFAMPDEC              | 15  | 2.4                      | 2.7  | 3    | 1.5                    | 2           | 2.5                  |
| IF2FILQ               | 16  | 0                        |      |      | 0                      |             |                      |
| IF2FILI               | 17  | 0                        |      |      | 0                      |             |                      |
| MIX1OUT1              | 18  | external 8.5             |      |      | external 8.5           |             |                      |
| MIX1OUT2              | 19  | external 8.5             |      |      | external 8.5           |             |                      |
| V <sub>DDA2</sub>     | 20  | external 8.5             |      |      | external 8.5           |             |                      |
| SWFLAG                | 21  | open-collector           |      |      |                        |             |                      |
| AMMIX1DEC             | 22  | 2.3                      | 2.75 | 3.1  | floating               |             |                      |
| AMMIX1IN              | 23  | 2.3                      | 2.75 | 3.1  | floating               |             |                      |
| VAMCASFB              | 24  | 3.7                      | 4.3  | 4.9  | 0                      | 0.1         | 0.2                  |
| VAMCAS                | 25  | 4.5                      | 5    | 5.5  | 0                      | 0.1         | 1                    |
| TAFAMAGC              | 26  | 0                        | 2.8  | 4.6  | 0 (no WB)              | 0.3 (no WB) | 0.5 (no WB)          |
| THFAMAGC              | 27  | 2.5                      | 2.8  | 3.1  | floating               |             |                      |
| IAMAGC                | 28  | 8.5 (external biasing)   |      |      | 1                      | 2           | 3                    |
| V <sub>ref(MIX)</sub> | 29  | 2.7                      | 3.1  | 3.4  | 6.5                    | 7.1         | 7.9                  |
| FMMIXIN1              | 30  | 1                        | 1.3  | 1.6  | 2.3                    | 2.8         | 3.3                  |
| RFGND                 | 31  | external 0               |      |      | external 0             |             |                      |
| i.c.                  | 32  | –                        |      |      | –                      |             |                      |
| FMMIXIN2              | 33  | 1                        | 1.3  | 1.6  | 2.3                    | 2.8         | 3.3                  |
| WBFLAG                | 34  | 0                        |      |      | 4 (WB)                 | 4.5 (WB)    | 5 (WB)               |
|                       |     |                          |      |      | – (FM)                 | <0.5 (FM)   | – (FM)               |
| IFMAGC                | 35  | 5 (external application) |      |      | 0.1 (external biasing) | –           | 4 (external biasing) |

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| SYMBOL                   | PIN | UNLOADED DC VOLTAGE (V) |      |      |                    |                 |                 |
|--------------------------|-----|-------------------------|------|------|--------------------|-----------------|-----------------|
|                          |     | AM MODE                 |      |      | FM MODE            |                 |                 |
|                          |     | MIN.                    | TYP. | MAX. | MIN.               | TYP.            | MAX.            |
| TFMAGC                   | 36  | 7.5                     | 8    | 8.3  | 3.9                | 4.6             | 5.3             |
| TKEYEDAGC                | 37  | floating                |      |      | 1                  | –               | 7               |
| DAAOUT                   | 38  | –                       | 0.2  | 0.3  | 0.2                | –               | 8.25            |
| DAATD                    | 39  | floating                |      |      | 0.2                | –               | 1.5             |
| DAAIN                    | 40  | 0                       | –    | 8.5  | 0                  | –               | 8.5             |
| FMMUTE                   | 41  | –                       |      |      | –                  |                 |                 |
| V <sub>tune</sub>        | 42  | 0                       | –    | 8.5  | 0                  | –               | 8.5             |
| CPOUT                    | 43  | 0                       | –    | 8.5  | 0                  | –               | 8.5             |
| V <sub>DDA3</sub>        | 44  | external 8.5            |      |      | external 8.5       |                 |                 |
| FREF                     | 45  | 3.2                     | 3.4  | 3.7  | 3.2                | 3.4             | 3.7             |
| V <sub>DDD</sub>         | 46  | external 5              |      |      | external 5         |                 |                 |
| DGND                     | 47  | external 0              |      |      | external 0         |                 |                 |
| VCOGND                   | 48  | external 0              |      |      | external 0         |                 |                 |
| OSCFDB                   | 49  | 2.2                     | 2.8  | 3.4  | 2.2                | 2.8             | 3.4             |
| OSCTNK                   | 50  | 5                       | 6.1  | 7.2  | 5                  | 6.1             | 7.2             |
| V <sub>DDA4</sub>        | 51  | external 8.5            |      |      | external 8.5       |                 |                 |
| MPXDCCFDB                | 52  | –                       |      |      | 2                  | 2.4             | 2.8             |
| AFSAMPLE                 | 53  | 0                       | 0.2  | 0.5  | 0                  | 0.2             | 0.5             |
| AFHOLD                   | 54  | open-collector 5        |      |      | open-collector     |                 |                 |
| TRDSMUTE                 | 55  | 1.7                     | 2.2  | 2.7  | 0.7 (muted)        | 1.2 (muted)     | 1.7 (muted)     |
|                          |     |                         |      |      | 5.2 (not muted)    | 5.7 (not muted) | 6.2 (not muted) |
| AMAFIF2                  | 56  | 4                       | 4.3  | 4.6  | floating 3.3       |                 |                 |
| RDSMPX                   | 57  | 0                       |      |      | 3.2                | 4               | 4.8             |
| FMMPX                    | 58  | 0                       | 0.5  | 1    | 3.2                | 4               | 4.8             |
| V <sub>DDA5</sub>        | 59  | external 5              |      |      | external 5         |                 |                 |
| MODEDET                  | 60  | 0                       |      |      | 2                  | 2.5             | 3               |
| V <sub>DDA6</sub>        | 61  | external 8.5            |      |      | external 8.5       |                 |                 |
| IFBWFLAG                 | 62  | open-collector 8.5      |      |      | open-collector 8.5 |                 |                 |
| SDA                      | 63  | 4.8                     | 5    | 5.2  | 4.8                | 5               | 5.2             |
| SCL                      | 64  | 4.8                     | 5    | 5.2  | 4.8                | 5               | 5.2             |
| V <sub>IFBW</sub>        | 65  | 0                       | 0.1  | –    | 0.5                | –               | 4               |
| IF2GND                   | 66  | external 0              |      |      | external 0         |                 |                 |
| CINT                     | 67  | 0                       |      |      | 3.2                | 4               | 4.8             |
| MODETOUT                 | 68  | 0                       |      |      | 2                  | 3               | 4               |
| TACD                     | 69  | 0                       |      |      | 3.5                | 4.2             | 4.9             |
| V <sub>level(AMFM)</sub> | 70  | 0                       | –    | 7    | 0                  | –               | 7               |
| XTAL1                    | 71  | 1.7                     | 2.1  | 2.5  | 1.7                | 2.1             | 2.5             |
| XTALGND                  | 72  | external 0              |      |      | external 0         |                 |                 |

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| SYMBOL                  | PIN | UNLOADED DC VOLTAGE (V) |      |              |              |      |              |
|-------------------------|-----|-------------------------|------|--------------|--------------|------|--------------|
|                         |     | AM MODE                 |      |              | FM MODE      |      |              |
|                         |     | MIN.                    | TYP. | MAX.         | MIN.         | TYP. | MAX.         |
| XTAL2                   | 73  | 1.7                     | 2.1  | 2.5          | 1.7          | 2.1  | 2.5          |
| V <sub>level(ACD)</sub> | 74  | 0.5                     | 1    | 2            | 0.3          | 0.5  | 0.8          |
| ACDTHRES                | 75  | external 0.2            | –    | external 0.5 | external 0.2 | –    | external 0.5 |
| IREF                    | 76  | 4                       | 4.25 | 4.5          | 4            | 4.25 | 4.5          |
| AMMIX2OUT1              | 77  | external 8.5            |      |              | external 8.5 |      |              |
| AMMIX2OUT2              | 78  | external 8.5            |      |              | external 8.5 |      |              |
| CAGC                    | 79  | 3.6                     | 4.3  | 4.8          | 4.1          | 4.6  | 5.1          |
| V <sub>ref(lim)</sub>   | 80  | 0.5                     | 0.8  | 1.2          | 3.6          | 4.2  | 4.8          |

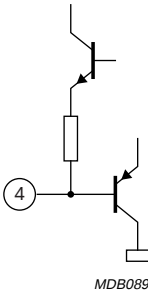
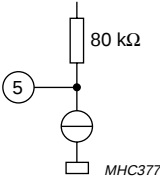
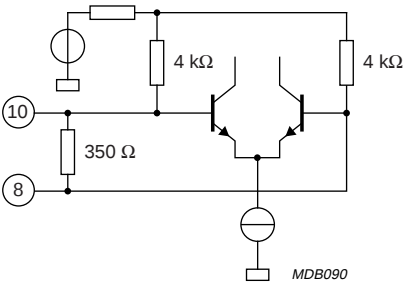
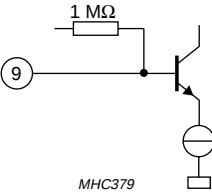
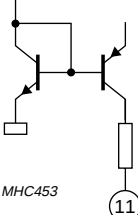
14 INTERNAL CIRCUITRY

Table 31 Equivalent pin circuits

| PIN | SYMBOL      | EQUIVALENT CIRCUIT |
|-----|-------------|--------------------|
| 1   | FMLIMDCFDB1 |                    |
| 2   | FMLIMDCFDB2 |                    |
| 3   | AMIF2DEC    |                    |
| 6   | AMIF2IN     |                    |

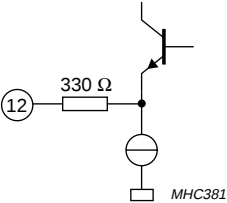
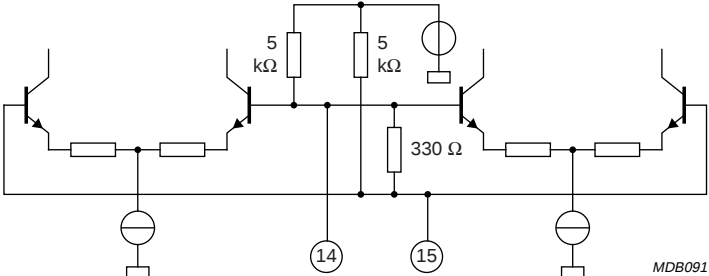
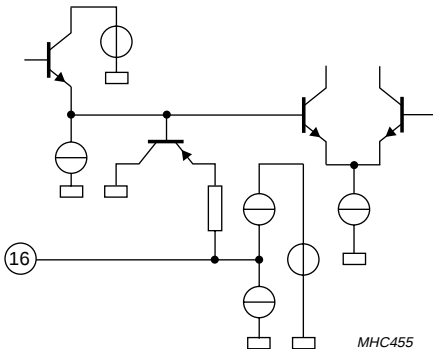
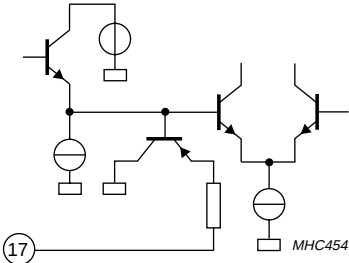
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| PIN | SYMBOL     | EQUIVALENT CIRCUIT                                                                   |
|-----|------------|--------------------------------------------------------------------------------------|
| 4   | IREFFMIF2  |    |
| 5   | AMNBHOLD   |    |
| 7   | IF1GND     |                                                                                      |
| 8   | FMMIX2IN   |  |
| 10  | FMMIX2DEC  |                                                                                      |
| 9   | COFFSET    |  |
| 11  | IFCDAATEST |  |

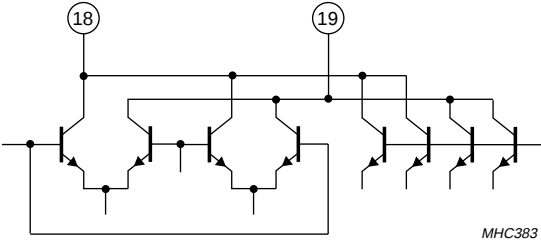
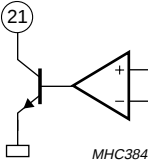
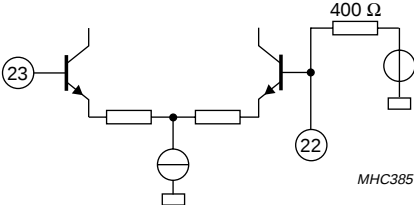
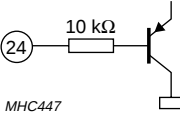
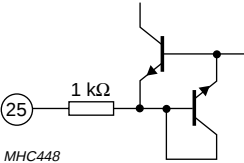
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| PIN | SYMBOL            | EQUIVALENT CIRCUIT                                                                   |
|-----|-------------------|--------------------------------------------------------------------------------------|
| 12  | IFAMPOUT          |    |
| 13  | V <sub>DDA1</sub> |                                                                                      |
| 14  | IFAMPIN           |   |
| 15  | IFAMPDEC          |                                                                                      |
| 16  | IF2FILQ           |  |
| 17  | IF2FILI           |  |

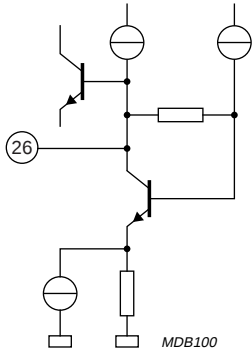
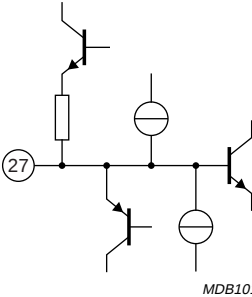
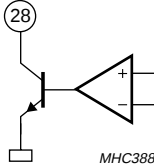
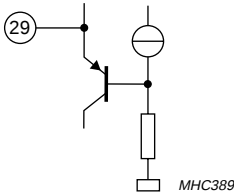
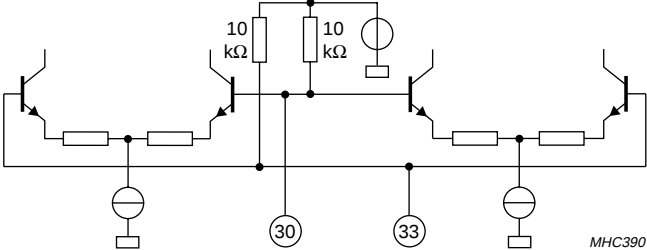
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| PIN | SYMBOL            | EQUIVALENT CIRCUIT                                                                             |
|-----|-------------------|------------------------------------------------------------------------------------------------|
| 18  | MIX1OUT1          | <br>MHC383   |
| 19  | MIX1OUT2          |                                                                                                |
| 20  | V <sub>DDA2</sub> |                                                                                                |
| 21  | SWFLAG            | <br>MHC384   |
| 22  | AMMIX1DEC         | <br>MHC385 |
| 23  | AMMIX1IN          |                                                                                                |
| 24  | VAMCASFB          | <br>MHC447 |
| 25  | VAMCAS            | <br>MHC448 |

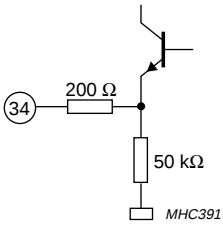
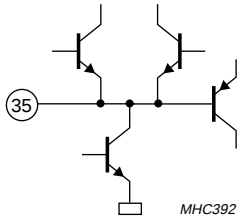
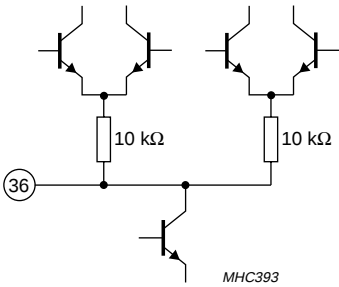
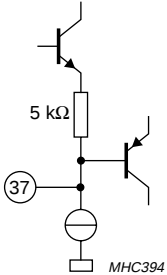
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| PIN | SYMBOL         | EQUIVALENT CIRCUIT                                                                   |
|-----|----------------|--------------------------------------------------------------------------------------|
| 26  | TAFAMAGC       |    |
| 27  | THFAMAGC       |   |
| 28  | IAMAGC         |  |
| 29  | $V_{ref(MIX)}$ |  |
| 30  | FMMIXIN1       |  |
| 33  | FMMIXIN2       |                                                                                      |

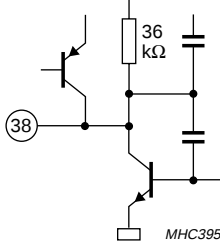
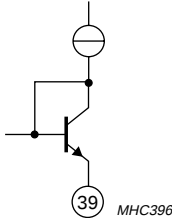
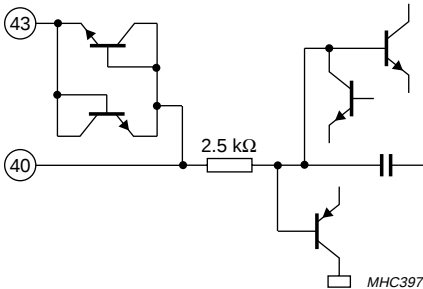
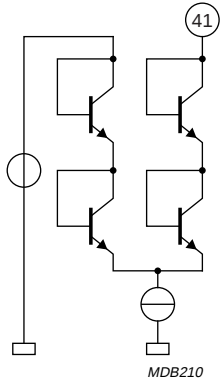
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Precision Adjacent Channel Suppression (NICE-PACS)

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| PIN | SYMBOL    | EQUIVALENT CIRCUIT                                                                   |
|-----|-----------|--------------------------------------------------------------------------------------|
| 31  | RFGND     |                                                                                      |
| 32  | i.c.      |                                                                                      |
| 34  | WBFLAG    |    |
| 35  | IFMAGC    |   |
| 36  | TFMAGC    |  |
| 37  | TKEYEDAGC |  |

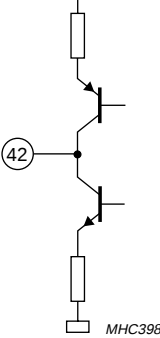
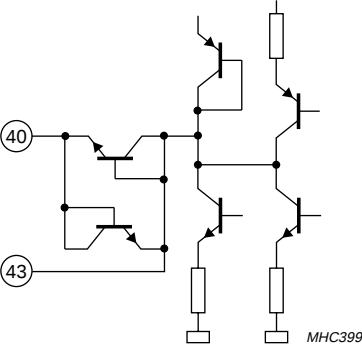
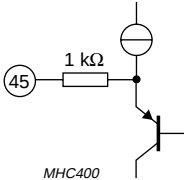
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| PIN | SYMBOL | EQUIVALENT CIRCUIT                                                                   |
|-----|--------|--------------------------------------------------------------------------------------|
| 38  | DAAOUT |    |
| 39  | DAATD  |    |
| 40  | DAAIN  |  |
| 41  | FMMUTE |  |

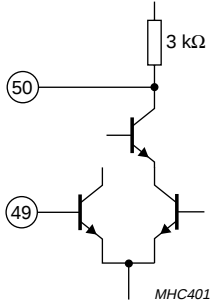
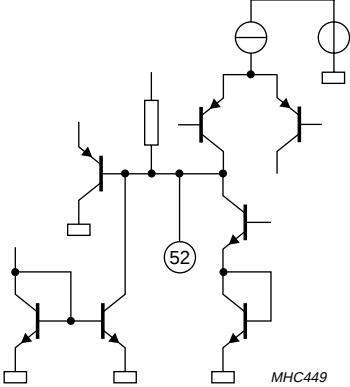
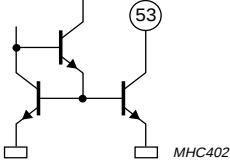
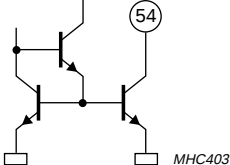
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Precision Adjacent Channel Suppression (NICE-PACS)

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| PIN | SYMBOL            | EQUIVALENT CIRCUIT                                                                             |
|-----|-------------------|------------------------------------------------------------------------------------------------|
| 42  | $V_{\text{tune}}$ | <br>MHC398   |
| 43  | CPOUT             | <br>MHC399  |
| 44  | $V_{\text{DDA3}}$ |                                                                                                |
| 45  | FREF              | <br>MHC400 |
| 46  | $V_{\text{DDD}}$  |                                                                                                |
| 47  | DGND              |                                                                                                |
| 48  | VCOGND            |                                                                                                |

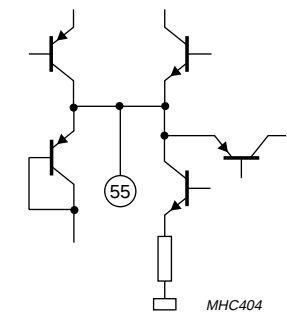
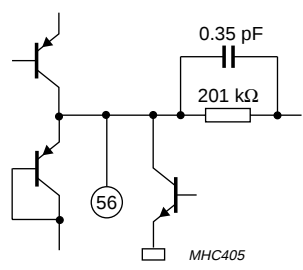
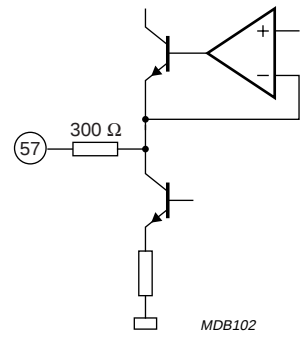
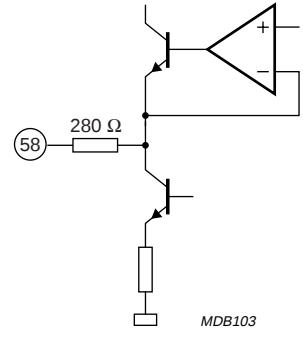
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TEA6849H

| PIN | SYMBOL            | EQUIVALENT CIRCUIT                                                                   |
|-----|-------------------|--------------------------------------------------------------------------------------|
| 49  | OSCFDB            |    |
| 50  | OSCTNK            |                                                                                      |
| 51  | V <sub>DDA4</sub> |                                                                                      |
| 52  | MPXDCFDB          |   |
| 53  | AFSAMPLE          |  |
| 54  | AFHOLD            |  |

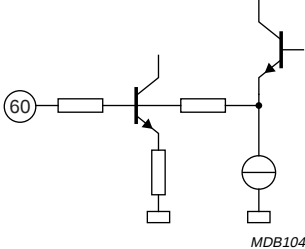
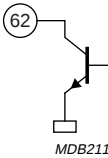
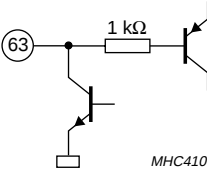
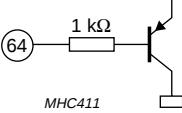
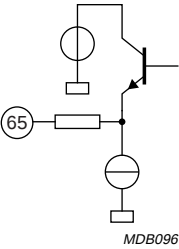
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| PIN | SYMBOL            | EQUIVALENT CIRCUIT                                                                   |
|-----|-------------------|--------------------------------------------------------------------------------------|
| 55  | TRDSMUTE          |    |
| 56  | AMAFIF2           |   |
| 57  | RDSMPX            |  |
| 58  | FMMPX             |  |
| 59  | V <sub>DDA5</sub> |                                                                                      |

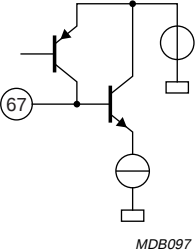
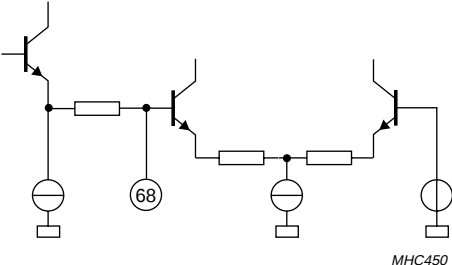
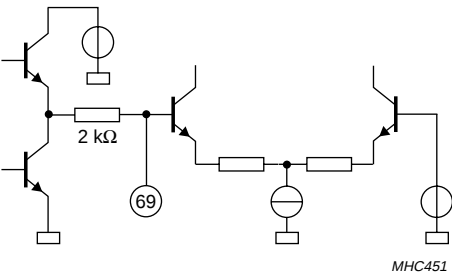
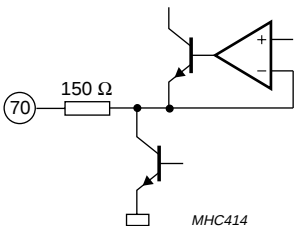
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| PIN | SYMBOL     | EQUIVALENT CIRCUIT                                                                   |
|-----|------------|--------------------------------------------------------------------------------------|
| 60  | MODDET     |    |
| 61  | $V_{DDA6}$ |                                                                                      |
| 62  | IFBWFLAG   |    |
| 63  | SDA        |  |
| 64  | SCL        |  |
| 65  | $V_{IFBW}$ |  |
| 66  | IF2GND     |                                                                                      |

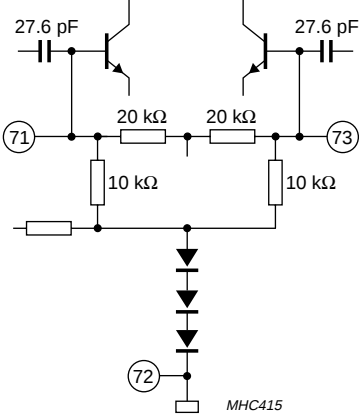
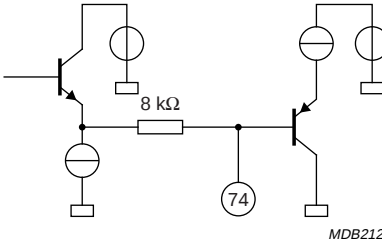
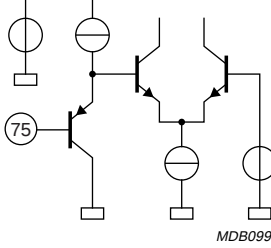
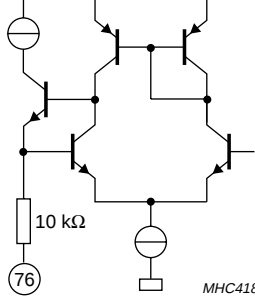
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TEA6849H

| PIN | SYMBOL                    | EQUIVALENT CIRCUIT                                                                             |
|-----|---------------------------|------------------------------------------------------------------------------------------------|
| 67  | CINT                      | <br>MDB097   |
| 68  | MODETOUT                  | <br>MHC450  |
| 69  | TACD                      | <br>MHC451 |
| 70  | V <sub>level</sub> (AMFM) | <br>MHC414 |

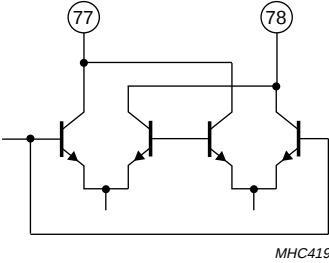
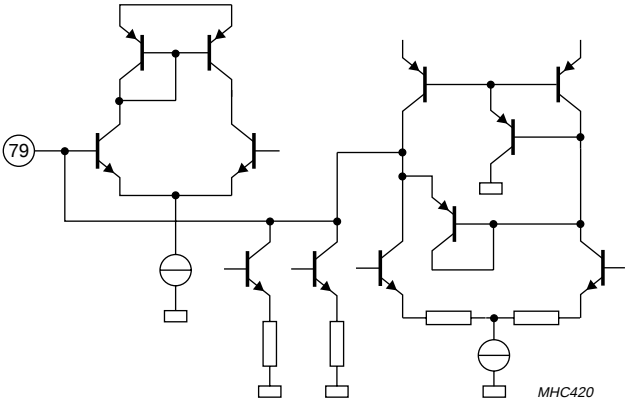
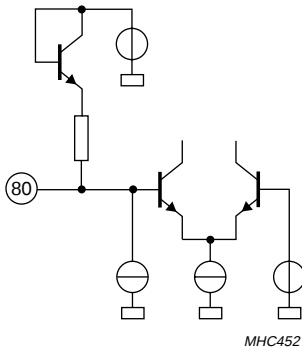
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TEA6849H

| PIN | SYMBOL                  | EQUIVALENT CIRCUIT                                                                   |
|-----|-------------------------|--------------------------------------------------------------------------------------|
| 71  | XTAL1                   |    |
| 72  | XTALGND                 |                                                                                      |
| 73  | XTAL2                   |                                                                                      |
| 74  | V <sub>level(ACD)</sub> |   |
| 75  | ACDTHRES                |  |
| 76  | IREF                    |  |

New In Car Entertainment car radio tuner IC with  
Precision Adjacent Channel Suppression (NICE-PACS)

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| PIN | SYMBOL         | EQUIVALENT CIRCUIT                                                                   |
|-----|----------------|--------------------------------------------------------------------------------------|
| 77  | AMMIX2OUT1     |    |
| 78  | AMMIX2OUT2     |                                                                                      |
| 79  | CAGC           |   |
| 80  | $V_{ref(lim)}$ |  |

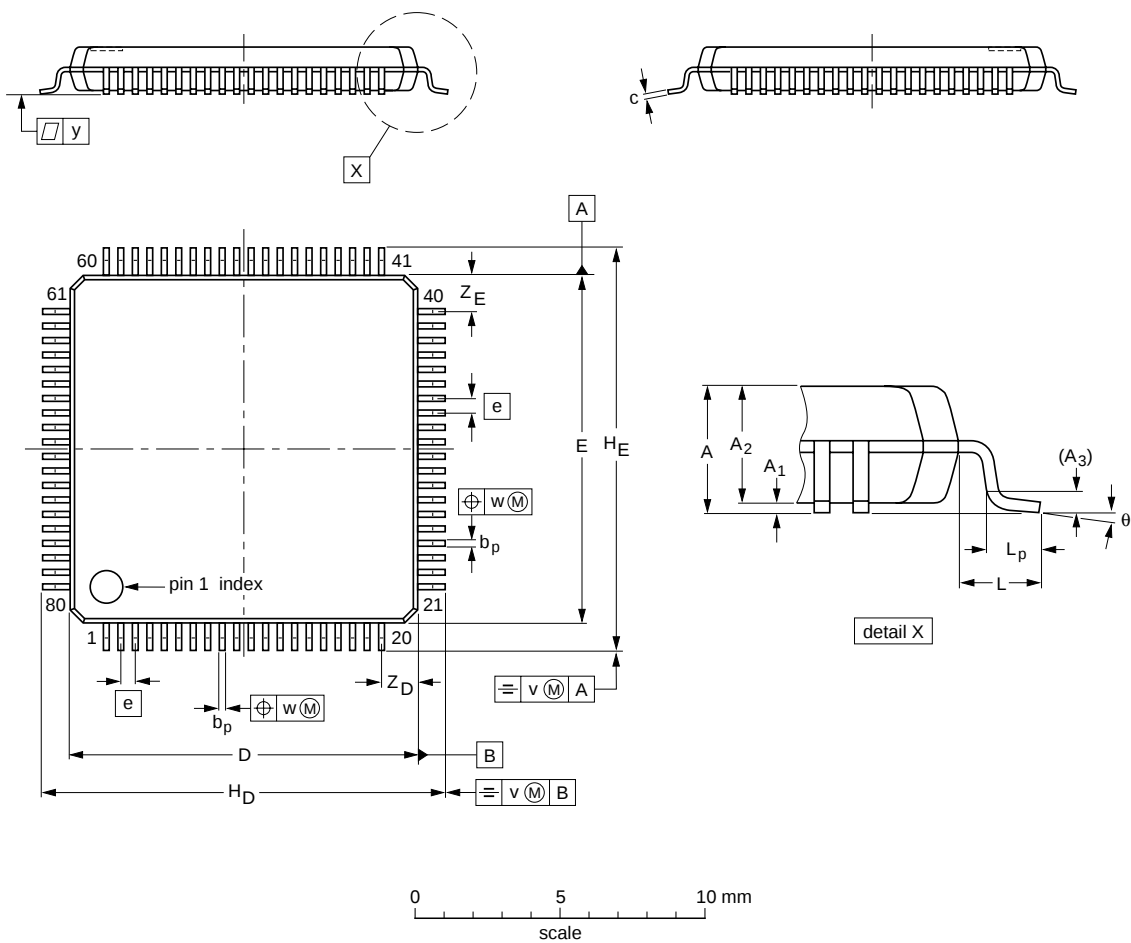
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Precision Adjacent Channel Suppression (NICE-PACS)

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15 PACKAGE OUTLINE

LQFP80: plastic low profile quad flat package; 80 leads; body 12 x 12 x 1.4 mm

SOT315-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | E <sup>(1)</sup> | e   | H <sub>D</sub> | H <sub>E</sub> | L | L <sub>p</sub> | v   | w    | y   | Z <sub>D</sub> <sup>(1)</sup> | Z <sub>E</sub> <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|-----|----------------|----------------|---|----------------|-----|------|-----|-------------------------------|-------------------------------|----------|
| mm   | 1.6       | 0.16<br>0.04   | 1.5<br>1.3     | 0.25           | 0.27<br>0.13   | 0.18<br>0.12 | 12.1<br>11.9     | 12.1<br>11.9     | 0.5 | 14.15<br>13.85 | 14.15<br>13.85 | 1 | 0.75<br>0.30   | 0.2 | 0.15 | 0.1 | 1.45<br>1.05                  | 1.45<br>1.05                  | 7°<br>0° |

Note

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

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT315-1           | 136E15     | MS-026 |       |  |                        | 00-01-19<br>03-02-25 |

# New In Car Entertainment car radio tuner IC with Precision Adjacent Channel Suppression (NICE-PACS)

TEA6849H

## 16 SOLDERING

### 16.1 Introduction to soldering surface mount packages

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"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

### 16.2 Reflow soldering

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. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 220 °C (SnPb process) or below 245 °C (Pb-free process)
  - for all BGA and SSOP-T packages
  - for packages with a thickness  $\geq 2.5$  mm
  - for packages with a thickness  $< 2.5$  mm and a volume  $\geq 350$  mm<sup>3</sup> so called thick/large packages.
- below 235 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness  $< 2.5$  mm and a volume  $< 350$  mm<sup>3</sup> so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

### 16.3 Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

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.

Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

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

### 16.4 Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron 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.

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## 16.5 Suitability of surface mount IC packages for wave and reflow soldering methods

| PACKAGE <sup>(1)</sup>                                                                                                                                                                                                                            | SOLDERING METHOD                                                                                                                                   |                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                   | WAVE                                                                                                                                               | REFLOW <sup>(2)</sup>                                                        |
| BGA, LBGA, LFBGA, SQFP, SSOP-T <sup>(3)</sup> , TFBGA, VFBGA<br>DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP,<br>HTSSOP, HVQFN, HVSON, SMS<br>PLCC <sup>(5)</sup> , SO, SOJ<br>LQFP, QFP, TQFP<br>SSOP, TSSOP, VSO, VSSOP<br>PMFP <sup>(8)</sup> | not suitable<br>not suitable <sup>(4)</sup><br><br>suitable<br>not recommended <sup>(5)(6)</sup><br>not recommended <sup>(7)</sup><br>not suitable | suitable<br>suitable<br><br>suitable<br>suitable<br>suitable<br>not suitable |

### Notes

- For more detailed information on the BGA packages refer to the “(LF)BGA Application Note” (AN01026); order a copy from your Philips Semiconductors sales office.
- All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”.
- These transparent plastic packages are extremely sensitive to reflow soldering conditions and must on no account be processed through more than one soldering cycle or subjected to infrared reflow soldering with peak temperature exceeding  $217\text{ °C} \pm 10\text{ °C}$  measured in the atmosphere of the reflow oven. The package body peak temperature must be kept as low as possible.
- These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
- If wave soldering is considered, then the package must be placed at a  $45^\circ$  angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
- Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
- Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.
- Hot bar or manual soldering is suitable for PMFP packages.

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## 17 DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)(3)</sup> | DEFINITION                                                                                                                                                                                                                                                                                     |
|-------|----------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | Objective data                   | Development                      | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                    |
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## **Contact information**

For additional information please visit <http://www.semiconductors.philips.com>. Fax: **+31 40 27 24825**

For sales offices addresses send e-mail to: [sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com).

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#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.