

DATA SHEET



TEA6842H New In Car Entertainment (NICE) extended car radio

Product specification

2003 Dec 19

New In Car Entertainment (NICE) extended car radio

TEA6842H

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1 FEATURES

- FM mixer for conversion of FM RF from 65 to 108 MHz to IF of 10.7 MHz; the mixer provides inherent image rejection
- FM RF mixer can be set to receive weather band radio up to 162.55 MHz
- Buffer output for weather band flag
- 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 reference for synthesizer PLL, IF count, timing for inaudible 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) or car radio integrated signal processor IC (TEF689x)
- Digital auto alignment circuit for conversion of LC oscillator tuning voltage to controlled alignment voltage of FM antenna tank circuit
- AGC PIN diode drive circuit for FM RF AGC; AGC detection at FM mixer input; the AGC PIN diode current can be set to a fixed value to allow local function for search tuning; AGC threshold is a programmable and keyed function switchable via the I²C-bus
- FM IF linear amplifiers with high dynamic input range
- FM quadrature demodulator with automatic centre frequency adjustment and Total Harmonic Distortion (THD) compensation and level driven soft mute; soft mute characteristic is adjustable via the I²C-bus
- Level detector for AM and FM with temperature compensated output voltage; starting point and slope of level output is programmable via the I²C-bus
- AM RF PIN diode drive circuit; AGC threshold detection at AM mixer 1 and IF2 AGC input; threshold is programmable via the I²C-bus; AM IF2 AGC and demodulator
- AM AGC voltage buffer
- AM AF output switchable to provide AM IF2 for AM stereo decoder
- AM noise blanker with blanking at AM IF2
- Ultrasonic noise detector
- Pin for external mute control
- Several test modes available for fast IC and system tests.



2 GENERAL DESCRIPTION

The TEA6842H is a single IC with car radio tuner for AM, FM and Weather Band (WB) intended for microcontroller tuning with the I²C-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 single conversion receiver with integrated image rejection for IF = 10.7 MHz capable of selecting US FM, US weather, Europe FM, East Europe FM and Japan FM bands
- The tuning system includes FM mixer, AM mixer 1, AM mixer 2, crystal oscillator, VCO and PLL synthesizer on one chip.

3 ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|-------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| TEA6842H | 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 |
| $I_{DDA(tot)}$ | total analog supply currents 1 to 4 and 6 and mixer bias currents | FM mode; data byte 5: bit TMS3 = 1 | 45 | 60 | 69 | mA |
| | | AM mode; data byte 5: bit TMS3 = 1 | 39 | 50 | 59 | mA |
| V_{DDA5} | analog supply voltage 5 | | 4.75 | 5 | 5.25 | V |
| I_{DDA5} | analog supply current 5 | FM mode; data byte 5: bit 5 = 0, bit 6 = 0 | 6.5 | 9.3 | 11.2 | mA |
| | | AM mode; data byte 5: bit 5 = 1, bit 6 = 1 | 12.7 | 17.4 | 22.1 | mA |
| V_{DDD} | digital supply voltage | | 4.75 | 5 | 5.25 | V |
| I_{DDD} | digital supply current | FM mode | 18 | 23 | 28 | mA |
| | | AM mode | 18 | 23 | 28 | mA |
| $f_{AM(ant)}$ | AM input frequency | LW | 0.144 | – | 0.288 | MHz |
| | | MW | 0.522 | – | 1.710 | MHz |
| | | SW | 5.85 | – | 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 |

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5 BLOCK DIAGRAM

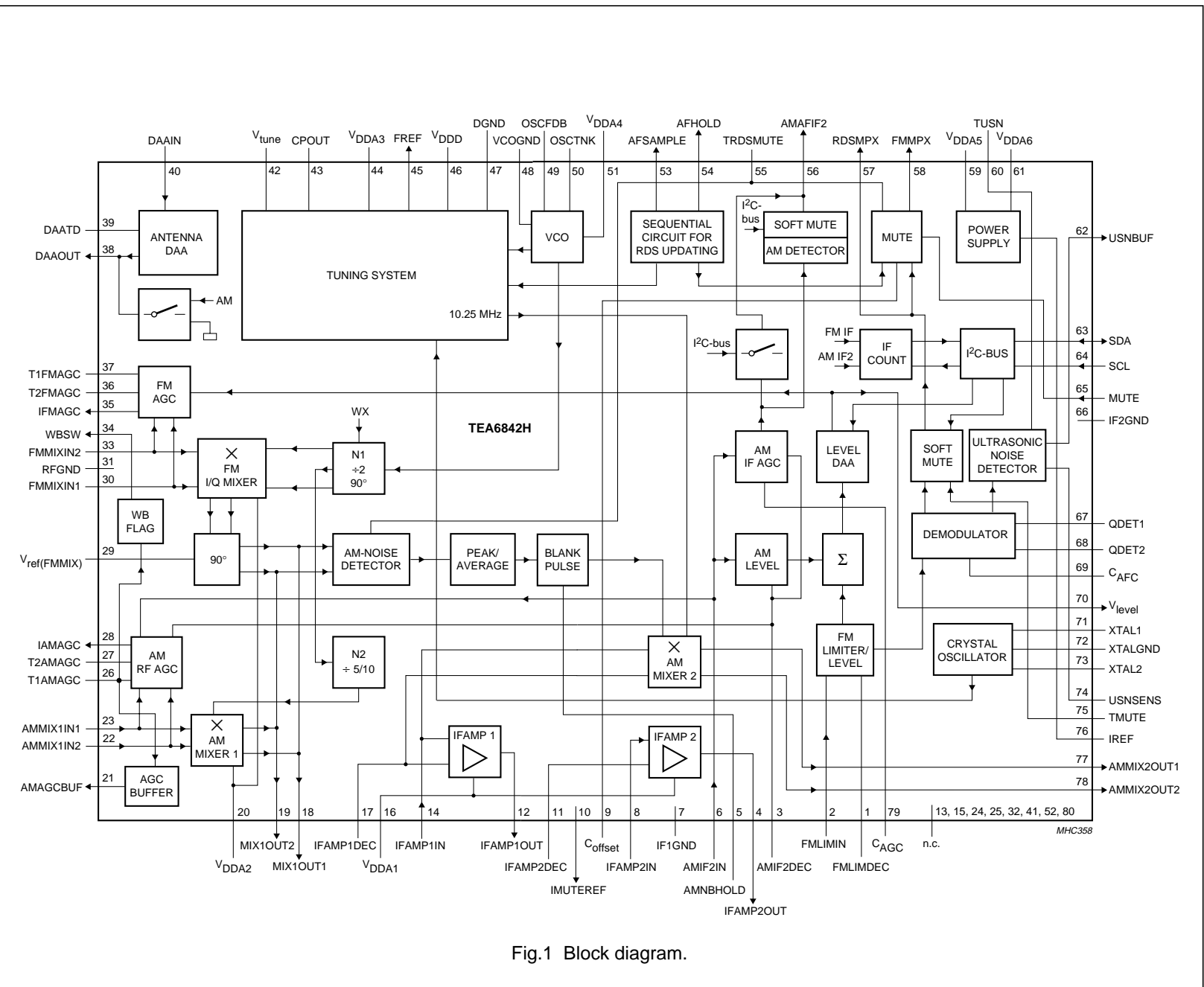


Fig.1 Block diagram.

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6 PINNING

| SYMBOL | PIN | DESCRIPTION |
|-------------------------|-----|--|
| FMLIMDEC | 1 | FM limiter decoupling |
| FMLIMIN | 2 | FM limiter input (10.7 MHz) |
| AMIF2DEC | 3 | decoupling for AM IF2 input |
| IFAMP2OUT | 4 | IF amplifier 2 output (10.7 MHz) |
| 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 |
| IFAMP2IN | 8 | IF amplifier 2 input (10.7 MHz) |
| C _{offset} | 9 | DC feedback for offset compensation RDS mute |
| IMUTEREF | 10 | mute reference current output for testing |
| IFAMP2DEC | 11 | IF amplifier 2 decoupling and AGC capacitor for AM noise blanker |
| IFAMP1OUT | 12 | IF amplifier 1 output (10.7 MHz) |
| n.c. | 13 | not connected |
| IFAMP1IN | 14 | IF amplifier 1 and AM mixer 2 input (10.7 MHz) |
| n.c. | 15 | not connected |
| V _{DDA1} | 16 | analog supply voltage 1 (8.5 V) for IF amplifier 1 and 2 |
| IFAMP1DEC | 17 | AM mixer 2 and FM IF amplifier 1 decoupling |
| 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 _{DDA2} | 20 | analog supply voltage 2 (8.5 V) for FM mixer and AM mixer 1 |
| AMAGCBUF | 21 | buffer output of AM AGC voltage |
| AMMIX1IN2 | 22 | AM mixer 1 input 2 |
| AMMIX1IN1 | 23 | AM mixer 1 input 1 |
| n.c. | 24 | not connected |
| n.c. | 25 | not connected |
| T1AMAGC | 26 | 1st time constant of AM front-end AGC |
| T2AMAGC | 27 | 2nd time constant of AM front-end AGC |
| IAMAGC | 28 | PIN diode drive current output of AM front-end AGC |
| V _{ref(FMMIX)} | 29 | reference voltage for FM I/Q mixer |
| FMMIXIN1 | 30 | FM RF mixer input 1 |
| RFGND | 31 | RF ground |
| n.c. | 32 | not connected |
| FMMIXIN2 | 33 | FM RF mixer input 2 |
| WBSW | 34 | buffered weather band flag output |
| IFMAGC | 35 | PIN diode drive current output of FM front-end AGC |
| T2FMAGC | 36 | 2nd time constant of FM front-end AGC |
| T1FMAGC | 37 | 1st time constant of 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 |
|--------------------|-----|--|
| n.c. | 41 | not connected |
| V _{tune} | 42 | tuning voltage |
| CPOUT | 43 | charge pump output |
| V _{DDA3} | 44 | analog supply voltage 3 (8.5 V) for tuning PLL |
| FREF | 45 | reference frequency output for signal processor IC |
| V _{DDD} | 46 | digital supply voltage (5 V) |
| DGND | 47 | digital ground |
| VCOGND | 48 | VCO ground |
| OSCFDB | 49 | VCO feedback |
| OSCTNK | 50 | VCO tank circuit |
| V _{DDA4} | 51 | analog supply voltage 4 (8.5 V) for VCO |
| n.c. | 52 | not connected |
| 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 ² C-bus) |
| RDSMPX | 57 | MPX output for RDS decoder and signal processor (not muted) |
| FMMPX | 58 | FM demodulator MPX output |
| V _{DDA5} | 59 | analog supply voltage 5 (5 V) for on-chip power supply |
| TUSN | 60 | time constant for ultrasonic noise detector |
| V _{DDA6} | 61 | analog supply voltage 6 (8.5 V) for on-chip power supply |
| USNBUF | 62 | buffer output for ultrasonic noise detector |
| SDA | 63 | I ² C-bus data line input and output |
| SCL | 64 | I ² C-bus clock line input |
| MUTE | 65 | mute control input |
| IF2GND | 66 | AM IF2 ground |
| QDET1 | 67 | quadrature demodulator tank 1 |
| QDET2 | 68 | quadrature demodulator tank 2 |
| C _{AFC} | 69 | FM demodulator AFC capacitor |
| V _{level} | 70 | level voltage output for AM and FM |
| XTAL1 | 71 | crystal oscillator 1 |
| XTALGND | 72 | crystal oscillator ground |
| XTAL2 | 73 | crystal oscillator 2 |
| USNSENS | 74 | sensitivity control of ultrasonic noise detector |
| TMUTE | 75 | time constant for mute control voltage |
| 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) |
| C _{AGC} | 79 | AM IF AGC capacitor |
| n.c. | 80 | not connected |

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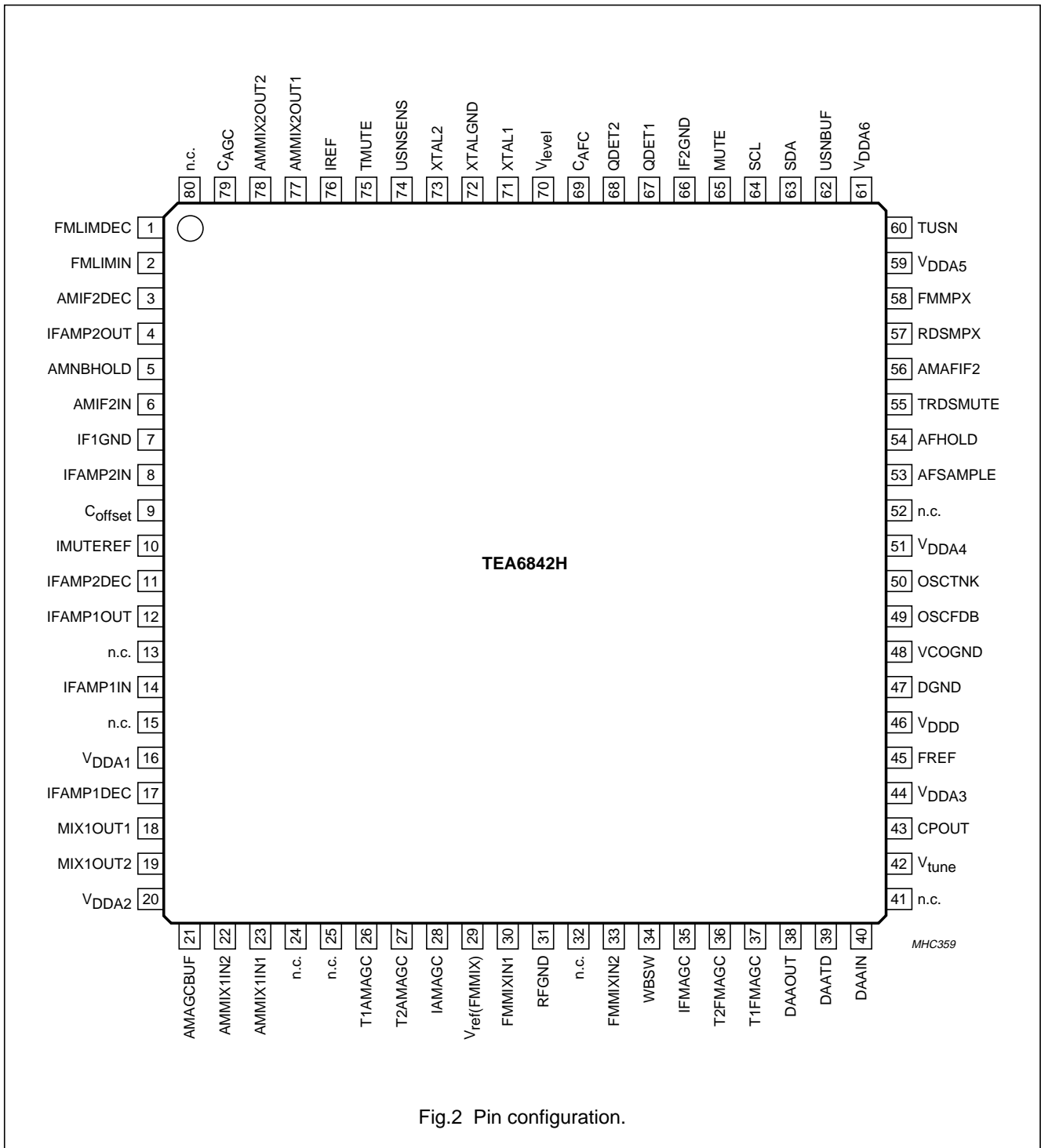


Fig.2 Pin configuration.

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7 FUNCTIONAL DESCRIPTION

7.1 Oscillators

7.1.1 VCO

The L and C tuned VCO provides the local oscillator signal for both FM and AM mixer 1. It has a frequency range of 151.2 to 248.2 MHz.

7.1.2 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
- 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).

7.1.3 PLL

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

7.2 FM signal channel

7.2.1 DAA

FM RF Digital Auto Alignment (DAA) circuitry for the conversion of the VCO tuning voltage to a controlled alignment voltage for the FM antenna tank circuit.

7.2.2 FM I/Q MIXER

FM quadrature mixer converts FM RF (65 to 162.55 MHz) 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 = 65.8 to 74 MHz.

7.2.3 FM KEYED AGC

The AGC threshold is programmable and the keyed AGC function is switchable via the I²C-bus.

If the keyed AGC function is activated, the AGC function is keyed by the narrow band level (IF).

The AGC PIN diode drive can be set via the I²C-bus to local function for search tuning.

7.2.4 FM IF AMPLIFIERS

The two FM IF amplifiers provide 10 dB and 8.5 dB amplification with high linearity and dynamic range.

7.2.5 FM DEMODULATOR

The FM quadrature demodulator includes automatic centre frequency adjustment and THD compensation.

7.2.6 FM MPX SOFT MUTE

Muting depth and start of muting are adjustable via the I²C-bus.

7.2.7 ULTRASONIC NOISE DETECTOR

This is an ultrasonic noise detector with programmable sensitivity by external resistor. The gain of the ultrasonic noise detector also depends of the RF level.

Attack and decay time can be set with an external timing capacitor. The detector has a buffered output.

7.3 AM signal channel

7.3.1 AM TUNER

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 = 522 to 1710 kHz (European and US AM band)
- SW = 5.85 to 9.99 MHz (including the 31 m, 41 m and 49 m bands).

7.3.2 AM RF AGC AND IF2 AGC

The AM RF includes a PIN diode drive circuit. The threshold detection points for AM AGC are performed at AM mixer 1 and AM IF2. AGC thresholds are programmable at AM mixer 1 input via the I²C-bus.

7.3.3 AM AF OR IF2 SWITCH

The AM output provides either a demodulated AM Audio Frequency (AF) or the corresponding AM IF2 signal. The IF2 signal can be used for AM stereo decoder processing.

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7.3.4 AM SOFT MUTE

The AM detector output is either not muted or signal strength dependent soft muted audio. The soft mute function can be switched off via the I²C-bus.

7.3.5 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 changing the resistor value at pin AMNBHOLD.

7.4 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 I²C-bus.

7.5 Input for external mute

A LOW signal at pin MUTE starts muting with 1 ms slope. Mute is active as long as the control voltage is LOW. A HIGH at pin MUTE stops muting with 1 ms slope.

7.6 Buffer output for weather band flag

In weather band mode the output is HIGH.

7.7 Test mode

The test mode of the IC is activated by connecting pin FREF through a 100 k Ω resistor to V_{DDA1}.

The test mode is intended for IC test during IC and radio manufacturing.

In test mode the settling time of the AM IF2 AGC is reduced to less than 100 ms in the nominal application.

8 LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|------------------------|--|------------|-------|-------|------|
| V _{DDA1} | analog supply voltage 1 for IF amplifier 1 and 2 | | -0.3 | +10 | V |
| V _{DDA2} | analog supply voltage 2 for FM mixer and AM mixer 1 | | -0.3 | +10 | V |
| V _{DDA3} | analog supply voltage 3 for tuning PLL | | -0.3 | +10 | V |
| V _{DDA4} | analog supply voltage 4 for VCO | | -0.3 | +10 | V |
| V _{DDA5} | analog supply voltage 5 for on-chip power supply | | -0.3 | +6.5 | V |
| V _{DDA6} | analog supply voltage 6 for on-chip power supply | | -0.3 | +10 | V |
| V _{DDD} | digital supply voltage | | -0.3 | +6.5 | V |
| $\Delta V_{DD8.5-DD5}$ | difference between any 8.5 V supply voltage and any 5 V supply voltage | note 1 | -0.3 | - | V |
| T _{stg} | storage temperature | | -55 | +150 | °C |
| T _{amb} | ambient temperature | | -40 | +85 | °C |
| V _{es} | electrostatic handling voltage | note 2 | -200 | +200 | V |
| | | note 3 | -2000 | +2000 | V |

Notes

- To avoid damages 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 interferences can not pull down the 8.5 V supply below the 5 V supply.
- Machine model (R = 0 Ω , C = 200 pF).
- Human body model (R = 1.5 k Ω , C = 100 pF).

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9 THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------|---|-------------|-------|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | 54 | K/W |

10 DC CHARACTERISTICS

$V_{MIX1OUT} = V_{AMMIX2OUT} = V_{DDA(n)} = 8.5\text{ V}$; $V_{DDA5} = 5\text{ V}$; $V_{DDD} = 5\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|---|---------------------------|------|------|------|---------------|
| Supply voltage | | | | | | |
| $V_{DDA(n)}$ | analog supply voltages 1 to 4 and 6 | | 8 | 8.5 | 9 | V |
| $V_{MIX1OUT}$; $V_{AMMIX2OUT}$ | mixer supply voltages | | 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 |
| Supply current in FM mode | | | | | | |
| I_{DDD} | digital supply current | | 18 | 23 | 28 | mA |
| I_{DDA1} | analog supply current 1 for IF amplifier 1 and 2 | | 11 | 13 | 15 | mA |
| I_{DDA2} | analog supply current 2 for FM mixer and AM mixer 1 | | 4.2 | 5.2 | 6.2 | mA |
| I_{DDA3} | analog supply current 3 for tuning PLL | data byte 5: bit TMS3 = 1 | 2.3 | 3 | 3.6 | 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 | | 6.5 | 9.3 | 11.2 | mA |
| I_{DDA6} | analog supply current 6 for on-chip power supply | | 16 | 20 | 24 | 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 |
| Supply current in AM mode | | | | | | |
| I_{DDD} | digital supply current | | 18 | 23 | 28 | mA |
| I_{DDA1} | analog supply current 1 for AM mixer 2 | | – | 240 | – | μA |
| I_{DDA2} | analog supply current 2 for FM mixer and AM mixer 1 | | 1.6 | 2 | 2.4 | mA |
| I_{DDA3} | analog supply current 3 for tuning PLL | data byte 5: bit TMS3 = 1 | 1.3 | 1.7 | 2.1 | 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 | | 12.7 | 17.4 | 22.1 | mA |
| I_{DDA6} | analog supply current 6 for on-chip power supply | | 15 | 19 | 23 | 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 |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|-------------------------------------|------------|------|------|------|------|
| 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 |
| Power supply reference current generator: pin IREF | | | | | | |
| V _{o(ref)} | output reference voltage | | 4 | 4.25 | 4.5 | V |
| R _o | output resistance | | 8 | 11 | 13 | kΩ |
| I _{o(max)} | maximum output current | | -100 | - | +100 | nA |

11 AC CHARACTERISTICS

V_{MIX1OUT} = V_{AMMIX2OUT} = V_{DDA(n)} = 8.5 V; V_{DDA5} = 5 V; V_{DDD} = 5 V; T_{amb} = 25 °C; see Figs 15 and 16; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---|---|----------|----------|--------|-------------------------|
| Voltage controlled oscillator | | | | | | |
| f _{osc} | oscillator frequency | | 151.2 | - | 248.2 | MHz |
| C/N | carrier-to-noise ratio | f _{osc} = 200 MHz; Δf = 10 kHz; B = 1 Hz | - | 101 | - | dBc |
| RR | ripple rejection $\frac{\Delta f_{osc}}{f_{osc}}$ | f _{ripple} = 100 Hz; V _{DDA4(ripple)} = 100 mV (RMS) f _{osc} = 250 MHz f _{osc} = 200 MHz | 90 92 | 97 99 | - - | dB dB |
| Crystal oscillator: pins XTAL1, XTALGND and XTAL2 | | | | | | |
| f _{osc} | oscillator frequency | | - | 20.5 | - | MHz |
| R _i | real part of input impedance | V _{XTAL1} - V _{XTAL2} = 1 mV | -500 | - | - | Ω |
| C _i | input capacitance | | 8 | 10 | 12 | pF |
| V _{o(osc)(rms)} | oscillator output voltage (RMS value) | | 240 | 350 | 500 | mV |
| C/N | carrier-to-noise ratio | f _{osc} = 20.5 MHz (10.25 MHz); Δf = 10 kHz | - | 112 | - | $\frac{dBc}{\sqrt{Hz}}$ |
| Oscillator divider N1 | | | | | | |
| N1 | oscillator divider ratio | FM mode standard, East Europe and local weather band (WX) | - - | 2 1 | - - | |
| Oscillator divider N2 | | | | | | |
| N2 | oscillator divider ratio | AM mode LW and MW SW | - - | 10 5 | - - | |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------------------------|-----------------------------------|---|-----------------------|-----------------------------------|-----------------------|---------------|
| Synthesizer | | | | | | |
| PROGRAMMABLE DIVIDER | | | | | | |
| N_{prog} | programmable divider ratio | | 512 | – | 32767 | |
| ΔN_{step} | programmable divider step size | | – | 1 | – | |
| REFERENCE FREQUENCY DIVIDER | | | | | | |
| N_{ref} | crystal oscillator divider ratio | $f_{\text{osc}} = 20.5 \text{ MHz}$ $f_{\text{ref}} = 100 \text{ kHz}$ $f_{\text{ref}} = 50 \text{ kHz}$ $f_{\text{ref}} = 25 \text{ kHz}$ $f_{\text{ref}} = 20 \text{ kHz}$ $f_{\text{ref}} = 10 \text{ kHz}$ | – – – – – | 205 410 820 1025 2050 | – – – – – | |
| CHARGE PUMP: PIN CPOUT | | | | | | |
| $I_{\text{sink(cp1)}}$ | low charge pump 1 sink current | $0.4 \text{ V} < V_{\text{CPOUT}} < 7.6 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 1, bit 2 = 1 for FM weather band; $f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$ | – | 300 | – | μA |
| $I_{\text{source(cp1)}}$ | low charge pump 1 source current | $0.4 \text{ V} < V_{\text{CPOUT}} < 7.6 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 1, bit 2 = 1 for FM weather band; $f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$ | – | –300 | – | μA |
| $I_{\text{sink(cp1)h}}$ | high charge pump 1 sink current | $0.4 \text{ V} < V_{\text{CPOUT}} < 7.6 \text{ V}$; data byte 4: bit 0 = 1, bit 1 = 1, bit 2 = 1 for AM IF2 output; $N2 = 10$ (LW and MW); $f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$ | – | 1 | – | mA |
| $I_{\text{source(cp1)h}}$ | high charge pump 1 source current | $0.4 \text{ V} < V_{\text{CPOUT}} < 7.6 \text{ V}$; data byte 4: bit 0 = 1, bit 1 = 1, bit 2 = 1 for AM IF2 output; $N2 = 10$ (LW and MW); $f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$ | – | –1 | – | mA |
| $I_{\text{sink(cp2)}}$ | charge pump 2 sink current | $0.3 \text{ V} < V_{\text{CPOUT}} < 7.1 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 0, bit 2 = 0; FM standard mode; $f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$ | – | 130 | – | μA |
| $I_{\text{source(cp2)}}$ | charge pump 2 source current | $0.3 \text{ V} < V_{\text{CPOUT}} < 7.1 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 0, bit 2 = 0; FM standard mode; $f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$ | – | –130 | – | μA |

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|---|--|---|---------------------|------------------|---------------------|---------------|
| CHARGE PUMP: PIN V_{tune} | | | | | | |
| $I_{\text{sink(cp3)}}$ | charge pump 3 sink current | $0.4 \text{ V} < V_{\text{tune}} < 7.6 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 0, bit 2 = 0; FM standard mode; $f_{\text{VCO}} > f_{\text{ref}} \times \text{divider ratio}$ | – | 3 | – | mA |
| $I_{\text{source(cp3)}}$ | charge pump 3 source current | $0.4 \text{ V} < V_{\text{tune}} < 7.6 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 0, bit 2 = 0; FM standard mode; $f_{\text{VCO}} < f_{\text{ref}} \times \text{divider ratio}$ | – | –3 | – | mA |
| Antenna Digital Auto Alignment (DAA) | | | | | | |
| 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 | | | | | | |
| $V_{\text{o(min)}}$ | minimum DAA output voltage | data byte 3 = 10000000; FM mode; $V_{\text{DAAIN}} = 0.5 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$ | – | – | 0.5 | V |
| $V_{\text{o(max)}}$ | maximum DAA output voltage | data byte 3 = 11111111; FM mode; $V_{\text{DAAIN}} = 4 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$ | 8 | – | 8.5 | V |
| V_{o} | DAA output voltage | $I_{\text{DAAOUT}} < 100 \mu\text{A}$; AM mode | – | – | 0.3 | V |
| | | data byte 3 = 10000000; FM mode; $V_{\text{DAAIN}} = 4 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$; note 1 | – | 1.7 | – | V |
| | | data byte 3 = 11111111; FM mode; $V_{\text{DAAIN}} = 3 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$; note 1 | 6.2 | 6.5 | 6.8 | V |
| $V_{\text{o(n)}}$ | DAA output noise voltage | data byte 3 = 11000000; FM mode; $V_{\text{DAAIN}} = 4 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$; $B = 400 \text{ Hz to } 30 \text{ kHz}$ | – | 30 | 100 | μV |
| $\Delta V_{\text{o(T)}}$ | DAA output voltage variation with temperature | $T_{\text{amb}} = -40 \text{ to } +85 \text{ }^\circ\text{C}$; data byte 3 = 10101011 | –8 | – | +8 | mV |
| $\Delta V_{\text{o(step)}}$ | DAA step accuracy $V_{\text{DAAOUT}(n+1)} - V_{\text{DAAOUT}(n)}$ | $n = 0 \text{ to } 127$; FM mode; $V_{\text{DAAOUT}} < 8 \text{ V}$; $V_{\text{DAAIN}} = 2 \text{ V}$; $V_{\text{DAAATD}} = 0.45 \text{ V}$ | $0.5V_{\text{LSB}}$ | V_{LSB} | $1.5V_{\text{LSB}}$ | mV |
| $\Delta V_{\text{o(sink)}}$ | DAA output variation caused by sink current | $V_{\text{DAAIN}} = 4 \text{ V}$; $I_{\text{L}} = 50 \mu\text{A}$ | $-V_{\text{LSB}}$ | – | $+V_{\text{LSB}}$ | |
| $\Delta V_{\text{o(source)}}$ | DAA output variation caused by source current | $V_{\text{DAAIN}} = 4 \text{ V}$; $I_{\text{L}} = -50 \mu\text{A}$ | $-V_{\text{LSB}}$ | – | $+V_{\text{LSB}}$ | |

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| t_{st} | DAA output settling time | $V_{DAAOUT} = 0.2$ to 8.25 V; $C_L = 270$ pF | – | 20 | 30 | μ s |
| RR | ripple rejection $\frac{V_{DAAOUT}}{V_{DDA3}}$ | data byte 3 = 10101011; FM mode; $V_{DAAIN} = 4$ V; $V_{DAATD} = 0.45$ V; $f_{ripple} = 100$ Hz; $V_{DDA3(ripple)} = 100$ mV | – | 50 | – | dB |
| C_L | DAA output load capacitance | $V_{DAAOUT} < 8$ V; FM mode | – | – | 270 | pF |
| DAA TEMPERATURE COMPENSATION: PIN DAATD | | | | | | |
| I_{source} | compensation diode source current | $V_{DAATD} = 0.2$ to 1.2 V | –50 | –40 | –30 | μ A |
| TC_{source} | temperature coefficient of compensation diode source current | $V_{DAATD} = 0.2$ to 1.2 V; $T_{amb} = -40$ to $+85$ °C | –300 | – | +300 | $\frac{10^{-6}}{K}$ |
| IF counter (FM IF1 or AM IF2 counter) | | | | | | |
| N_{IF} | IF counter length for AM and FM | | – | 8 | – | bit |
| $T_{count(IF)}$ | IF counter period | data byte 4: bit 7 = 1 | – | 2 | – | ms |
| | | data byte 4: bit 7 = 0 | – | 20 | – | ms |
| $R_{precount}$ | FM IF counter prescaler ratio | data byte 4: bit 3 = 1 | – | 10 | – | |
| | | data byte 4: bit 3 = 0 | – | 100 | – | |
| $V_{FMLIMIN(sens)(rms)}$ | FM sensitivity voltage (RMS value) | FM mode | – | 30 | 100 | μ V |
| N | counter result (decimal) | period = 2 ms; $f_{IF1} = 10.7$ MHz; $V_{FMLIMIN} = 100$ μ V (RMS) prescaler ratio = 10 | – | 92 | – | |
| | | | – | 214 | – | |
| | | period = 20 ms; $f_{IF1} = 10.7$ MHz; $V_{FMLIMIN} = 100$ μ V (RMS) prescaler ratio = 10 | – | 152 | – | |
| | | | – | 92 | – | |
| $V_{AMIF2IN(sens)(rms)}$ | AM sensitivity voltage (RMS value) | AM mode; $m = 0$ | – | 50 | 100 | μ V |
| N | counter result (decimal) | period = 2 ms; $f_{IF2} = 450$ kHz; $V_{AMIF2IN} = 200$ μ V (RMS) | – | 133 | – | |
| | | period = 20 ms; $f_{IF2} = 450$ kHz; $V_{AMIF2IN} = 200$ μ V (RMS) | – | 40 | – | |

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| Reference frequency for car signal processor IC; note 2 | | | | | | |
| REFERENCE FREQUENCY DIVIDER | | | | | | |
| N_{ref} | crystal oscillator divider ratio | | – | 272 | – | |
| f_{ref} | reference frequency at pin FREF | $f_{\text{osc}} = 20.5 \text{ MHz}$ | – | 75.368 | – | kHz |
| VOLTAGE GENERATOR: PIN FREF | | | | | | |
| $V_{o(p-p)}$ | AC output voltage (peak-to-peak value) | $R_L = \infty$ | 80 | 130 | 200 | mV |
| V_O | DC output voltage | | 3.2 | 3.4 | 3.7 | V |
| R_o | output resistance | | – | – | 50 | k Ω |
| $R_{L(\text{min})}$ | minimum load resistance for first I ² C-bus address | | 1 | – | – | M Ω |
| AM signal channel | | | | | | |
| RF AGC STAGE INPUTS | | | | | | |
| <i>Pins AMMIX1IN1 and AMMIX1IN2</i> | | | | | | |
| $V_{i(\text{RF})}$ | RF input voltage for AGC start level | data byte 5: bit 5 = 0, bit 6 = 0 | – | 375 | – | mV |
| | | data byte 5: bit 5 = 1, bit 6 = 0 | – | 500 | – | mV |
| | | data byte 5: bit 5 = 0, bit 6 = 1 | – | 625 | – | mV |
| | | data byte 5: bit 5 = 1, bit 6 = 1 | – | 750 | – | mV |
| <i>Pin AMIF2IN</i> | | | | | | |
| $V_{i(\text{IF2})}$ | IF2 input voltage | AGC start level | 280 | 380 | 500 | mV |
| <i>PIN diode drive: pin IAMAGC</i> | | | | | | |
| $I_{\text{sink(max)}}$ | maximum AGC sink current | $V_o = 2.8 \text{ V}$ | 11 | 15 | 19 | mA |
| I_{sink} | AGC sink current | FM mode | 1 | – | – | mA |
| R_o | output resistance | $I_o = 1 \mu\text{A}$ | 1 | – | – | M Ω |
| C_o | AM AGC current generator output capacitance | | – | 5 | 7 | pF |
| AM AGC TRANSCONDUCTANCE BUFFER: PIN AMAGCBUF; note 3 | | | | | | |
| $g_{m(\text{buf})}$ | buffer transconductance | AM mode; $1 \text{ V} < V_{T1\text{AMAGC}} < 4 \text{ V}$ | 150 | 166 | 185 | μS |
| $I_{\text{sink(max)}}$ | maximum sink current | open-collector; AM mode; $V_{T1\text{AMAGC}} = 4 \text{ V}$ | 450 | 500 | 560 | μA |
| $I_{\text{source(max)}}$ | maximum source current | AM mode; $V_{T1\text{AMAGC}} < 1 \text{ V}$ | – | – | –30 | μA |
| $V_{o(n)}$ | buffer output noise voltage | AM mode; $V_{\text{DDA1}} - V_{\text{AMAGCBUF}} = 1 \text{ V};$ $B = 400 \text{ Hz to } 20 \text{ kHz}$ | – | 10 | 15 | μV |

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| AM MIXER 1 (IF1 = 10.7 MHz) | | | | | | |
| <i>Mixer inputs: pins AMMIX1IN1 and AMMIX1IN2</i> | | | | | | |
| R_i | input resistance | | 15 | 25 | 35 | $k\Omega$ |
| C_i | input capacitance | | 2.5 | 4 | 5.5 | pF |
| V_i | DC input voltage | | 2.3 | 2.7 | 3.1 | V |
| $V_{i(max)}$ | maximum input voltage | 1 dB compression point of AM mixer 1 output (peak-to-peak value) | 500 | – | – | mV |
| $V_{i(n)(eq)}$ | equivalent input noise voltage | band limited noise; $R_{gen} = 750 \Omega$; $R_L = 2.8 k\Omega$ | – | 5.8 | 8 | $\frac{nV}{\sqrt{Hz}}$ |
| <i>Mixer outputs: pins MIX1OUT1 and MIX1OUT2</i> | | | | | | |
| R_o | output resistance | | 100 | – | – | $k\Omega$ |
| C_o | output capacitance | | – | 5 | 7 | pF |
| $V_{o(max)(p-p)}$ | maximum output voltage (peak-to-peak value) | | 12 | 15 | – | V |
| $g_{m(conv)}$ | conversion transconductance $\frac{I_{MIX1OUT}}{V_{AMMIX1IN}}$ | | 2.0 | 2.55 | 3.2 | $\frac{mA}{V}$ |
| $g_{m(conv)(T)}$ | conversion transconductance variation with temperature $\frac{\Delta g_{m(conv)}}{g_{m(conv)} \times \Delta T}$ | | – | -9×10^{-4} | – | K^{-1} |
| IP3 | 3rd-order intermodulation | $R_L = 2.8 k\Omega$; $\Delta f = 300 kHz$ | 135 | 138 | – | $dB\mu V$ |
| IP2 | 2nd-order intermodulation | $R_L = 2.8 k\Omega$ | – | 170 | – | $dB\mu V$ |
| F | noise figure of AM mixer 1 | | – | 4.5 | 7.1 | dB |
| I_{bias} | mixer bias current | AM mode | 4.8 | 6 | 7.2 | mA |
| AM MIXER 2 (IF2 = 450 kHz) | | | | | | |
| <i>Mixer inputs: pins IFAMP1IN and IFAMP1DEC</i> | | | | | | |
| R_i | input resistance | | 270 | 330 | 390 | Ω |
| C_i | input capacitance | | – | 5 | 7 | pF |
| V_i | DC input voltage | | 2.4 | 2.8 | 3.2 | V |
| $V_{i(max)(p)}$ | maximum input voltage (peak value) | 1 dB compression point of AM mixer 2 output (peak-to-peak value) | 1.1 | 1.4 | – | V |

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| $V_{i(n)(eq)}$ | equivalent input noise voltage | $R_{gen} = 330 \Omega$; $R_L = 4 \text{ k}\Omega$ | – | 15 | 22 | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| <i>Mixer outputs: pins AMMIX2OUT1 and AMMIX2OUT2</i> | | | | | | |
| R_o | output resistance | | 100 | – | – | $\text{k}\Omega$ |
| C_o | output capacitance | | – | 5 | 7 | pF |
| $V_{o(max)(p-p)}$ | maximum output voltage (peak-to-peak value) | $V_{DDA1} = 8.5 \text{ V}$ | 12 | 15 | – | V |
| $g_{m(conv)}$ | conversion transconductance $\frac{I_{AMMIX2OUT}}{V_{IFAMP1IN}}$ | | 1.3 | 1.6 | 1.9 | $\frac{\text{mA}}{\text{V}}$ |
| $g_{m(conv)(T)}$ | conversion transconductance variation with temperature $\frac{\Delta g_{m(conv)}}{g_{m(conv)} \times \Delta T}$ | | – | -9×10^{-4} | – | K^{-1} |
| IP3 | 3rd-order intermodulation | $R_L = 4 \text{ k}\Omega$; $\Delta f = 300 \text{ kHz}$ | 134 | 137 | – | $\text{dB}\mu\text{V}$ |
| IP2 | 2nd-order intermodulation | $R_L = 4 \text{ k}\Omega$ | – | 170 | – | $\text{dB}\mu\text{V}$ |
| F | noise figure of AM mixer 2 | | – | 16 | 19.5 | dB |
| I_{bias} | mixer bias current | AM mode | 3.6 | 4.5 | 5.4 | mA |
| I_L | mixer leakage current | FM mode | – | – | 50 | μA |
| <i>IF2 AGC STAGE: PINS AMIF2IN AND AMIF2DEC</i> | | | | | | |
| $V_{AGC(start)}$ | AGC start voltage | input carrier voltage | – | 14 | 30 | μV |
| $V_{AGC(stop)}$ | AGC stop voltage | maximum input peak voltage | 1 | – | – | V |
| $V_{AGC(ctrl)}$ | AGC control voltage | $V_{AMIF2IN} = 1 \text{ mV}$ | 4.1 | 4.3 | 4.7 | V |
| ΔAGC | AGC range | between start and stop of AGC | – | 89 | – | dB |
| R_i | input resistance | | 1.8 | 2 | 2.2 | $\text{k}\Omega$ |
| C_i | input capacitance | | – | – | 5 | pF |
| V_i | input voltage | audio attenuation $\alpha = -10 \text{ dB}$ data byte 5: bit 4 = 1; mute on data byte 5: bit 4 = 0; mute off | 10 – | 22 6 | 37 12 | μV μV |
| $V_{sens(rms)}$ | sensitivity voltage (RMS value) | $m = 0.3$; $f_{mod} = 400 \text{ Hz}$; $B_{AF} = 2.5 \text{ kHz}$; $R_{source} = 2 \text{ k}\Omega$ (S+N)/N = 26 dB (S+N)/N = 46 dB | – – | 45 600 | 65 900 | μV μV |

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|--|---|--|------|------|------|--------------------|
| AM DETECTOR OUTPUT: PIN AMAFIF2; see Fig.3 | | | | | | |
| $V_{o(min)(rms)}$ | minimum AM IF2 output level (RMS value) | data byte 4: bit 0 = 1, bit 1 = 1; m = 0; $V_{AMIF2IN} = 14 \mu V$ | 1.5 | 3 | 4.5 | mV |
| $V_{o(max)(rms)}$ | maximum AM IF2 output level (RMS value) | data byte 4: bit 0 = 1, bit 1 = 1; m = 0; $V_{AMIF2IN} = 5 mV$ | 130 | 180 | 230 | mV |
| $V_{o(rms)}$ | AM AF output voltage level (RMS value) | data byte 4: bit 0 = 1, bit 1 = 0; m = 0.3; $f_{mod} = 400 Hz$; $V_{AMIF2IN} = 100 \mu V$ to 500 mV (RMS) | 235 | 285 | 340 | mV |
| R_o | output resistance | data byte 4: bit 0 = 1, bit 1 = 1 | – | – | 500 | Ω |
| C_o | output capacitance | data byte 4: bit 0 = 1, bit 1 = 0 | – | 5 | 7 | pF |
| Z_L | load impedance | data byte 4: bit 0 = 1, bit 1 = 0 | 100 | – | – | k Ω |
| | | data byte 4: bit 0 = 1, bit 1 = 1 | 10 | – | – | k Ω |
| RR | ripple rejection | $f_{ripple} = 100 Hz$; $V_{DDA5(ripple)} = 100 mV$ (RMS) | 30 | 40 | – | dB |
| AM DETECTOR; see Fig.3 | | | | | | |
| (S+N)/N | maximum signal plus noise-to-noise ratio | m = 0.3; $f_{mod} = 400 Hz$; $B_{AF} = 2.5 kHz$; $R_{source} = 2 k\Omega$ | 54 | 60 | 70 | dB |
| THD | total harmonic distortion | $B_{AF} = 2.5 kHz$; $C_{AGC} = 22 \mu F$; $V_{AMIF2IN} = 100 \mu V$ to 250 mV (RMS) | | | | |
| | | m = 0.8; $f_{mod} = 400 Hz$ | – | 0.5 | 1 | % |
| | | m = 0.9; $f_{mod} = 400 Hz$ | – | 1 | 2 | % |
| | | m = 0.8; $f_{mod} = 100 Hz$ | – | 1.25 | 2.5 | % |
| | | m = 0.9; $f_{mod} = 100 Hz$ | – | 1.75 | 3.5 | % |
| t_{sw} | FM to AM switching time | $V_{AMIF2IN} = 100 \mu V$; $C_{AGC} = 22 \mu F$ | – | 1000 | 1500 | ms |
| t_{st} | AM demodulator AGC settling time | $C_{AGC} = 22 \mu F$ | | | | |
| | | $V_{AMIF2IN} = 100 \mu V$ to 100 mV | – | 800 | 1200 | ms |
| | | $V_{AMIF2IN} = 100 mV$ to 100 μV | – | 1200 | 1800 | ms |
| AM IF2 LEVEL DETECTOR: PIN V_{level} ; see Fig.4 | | | | | | |
| V_{level} | level output DC voltage | $V_{AMIF2IN} = 10 \mu V$ to 1 V | 0 | – | 5 | V |
| | | $V_{AMIF2IN} < 1 \mu V$; standard setting of level DAA | 0.1 | 0.35 | 0.8 | V |
| | | $V_{AMIF2IN} = 1.4 mV$; standard setting of level DAA | – | 2.2 | – | V |
| ΔV_{level} | step size of starting point adjustment | standard setting of level slope | 40 | 53 | 70 | mV |
| $V_{level(slope)}$ | slope of level voltage $\frac{\Delta V_{level}}{\Delta V_{AMIF2IN}}$ | $V_{AMIF2IN} = 140 \mu V$ to 140 mV; standard setting of level slope | 800 | 1000 | 1200 | $\frac{mV}{20 dB}$ |

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| ΔV_{step} | step size of slope adjustment | $V_{\text{AMIF2IN}} = 1.4 \text{ mV}$ | 55 | 75 | 95 | $\frac{\text{mV}}{20 \text{ dB}}$ |
| B_{level} | bandwidth of level output voltage | | 200 | 300 | – | kHz |
| R_o | output resistance | | – | – | 500 | Ω |
| RR | ripple rejection $\frac{V_{\text{level}}}{V_{\text{DDA6}}}$ | $f_{\text{ripple}} = 100 \text{ Hz};$ $V_{\text{DDA6(ripple)}} = 100 \text{ mV (RMS)}$ | – | 40 | – | dB |
| AM NOISE BLANKER; see Fig.5 | | | | | | |
| <i>Threshold: pin AMNBHOLD</i> | | | | | | |
| V_o | DC output voltage | | 4.4 | 4.75 | 5.25 | V |
| t_{sup} | suppression time | | 6 | 7.5 | 10 | μs |
| f_{trigger} | trigger sensitivity | $V_{\text{pulse}} = 200 \text{ mV}; V_{\text{level}} < 1.8 \text{ V}$ | – | 1000 | – | Hz |
| | | $V_{\text{pulse}} = 200 \text{ mV}; V_{\text{level}} > 2.2 \text{ V}$ | – | – | 100 | Hz |
| | | $V_{\text{pulse}} = 20 \text{ mV}; V_{\text{level}} < 1.8 \text{ V}$ | – | – | 100 | Hz |
| <i>Noise detector output: pin TRDSMUTE</i> | | | | | | |
| $I_{\text{sink(AGC)}}$ | AM noise blanker AGC sink current | $V_{\text{TRDSMUTE}} = 3 \text{ V}$ | 30 | 45 | 60 | μA |
| V_{AGC} | AM noise blanker AGC voltage | AM mixer 1 input $V_i = 0 \text{ V}$ | 2.1 | 2.45 | 2.85 | V |
| FM signal channel | | | | | | |
| RF AGC (FM DISTANCE MODE) | | | | | | |
| <i>FM mixer inputs: pins FMMIXIN1 and FMMIXIN2</i> | | | | | | |
| $V_{i(\text{RF})(\text{rms})}$ | RF input voltage for start of wideband AGC (RMS value) | data byte 5: bit 5 = 1, bit 6 = 1 | – | 4 | – | mV |
| | | data byte 5: bit 5 = 0, bit 6 = 1 | – | 8 | – | mV |
| | | data byte 5: bit 5 = 1, bit 6 = 0 | – | 12 | – | mV |
| | | data byte 5: bit 5 = 0, bit 6 = 0 | – | 16 | – | mV |
| <i>AGC control: pin T2FMAGC</i> | | | | | | |
| R_{source} | source resistance | | 4 | 5 | 6 | k Ω |
| $V_{o(\text{ref})}$ | DC output reference voltage | data byte 5: bit 5 = 0, bit 6 = 0; $V_{\text{FMMIXIN1-FMMIXIN2}} = 0 \text{ V}$ | 3.8 | 4.1 | 4.4 | V |
| <i>PIN diode drive output: pin IFMAGC</i> | | | | | | |
| $I_{\text{sink(AGC)(max)}}$ | maximum AGC sink current | $V_{\text{IFMAGC}} = 2.5 \text{ V};$ $V_{\text{T2FMAGC}} = V_{o(\text{ref})} - 0.5 \text{ V};$ data byte 5: bit 5 = 0, bit 6 = 0, bit 7 = 0; data byte 4: bit 1 = 0 | 8 | 10.5 | 14 | mA |
| $I_{\text{source(AGC)(max)}}$ | maximum AGC source current | $V_{\text{IFMAGC}} = 2.5 \text{ V};$ $V_{\text{T2FMAGC}} = V_{o(\text{ref})} + 0.5 \text{ V};$ data byte 5: bit 5 = 0, bit 6 = 0, bit 7 = 0; data byte 4: bit 1 = 0 | –14 | –10.5 | –8 | mA |

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| $I_{\text{source(AGC)}}$ | AGC source current | AM mode | -19 | -14 | -10 | mA |
| | | $V_{\text{IFMAGC}} = 2.5 \text{ V}$; data byte 4: bit 0 = 0, bit 1 = 1, bit 2 = 0 (FM local) | -4.4 | -3.7 | -2.7 | mA |
| <i>Level voltage: pin V_{level}</i> | | | | | | |
| V_{th} | threshold voltage for narrow-band AGC | data byte 5: bit 5 = 0, bit 6 = 0, bit 7 = 1 | 600 | 750 | 900 | mV |
| FM RF MIXER | | | | | | |
| <i>FM mixer inputs: pins FMMIXIN1 and FMMIXIN2</i> | | | | | | |
| $V_{\text{i(RF)(max)}}$ | maximum RF input voltage | 1 dB compression point of FM mixer output voltage (peak-to-peak value) | 70 | 140 | – | mV |
| $V_{\text{i(n)(eq)}}$ | equivalent input noise voltage | $R_{\text{gen}} = 200 \Omega$; $R_{\text{L}} = 2.8 \text{ k}\Omega$ | – | 2.6 | 3.1 | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| R_{i} | input resistance | | 1.4 | 2.8 | 4.2 | $\text{k}\Omega$ |
| C_{i} | input capacitance | | – | 5 | 7 | pF |
| <i>FM mixer outputs: pins MIX1OUT1 and MIX1OUT2</i> | | | | | | |
| R_{o} | output resistance | | 100 | – | – | $\text{k}\Omega$ |
| C_{o} | output capacitance | | 2 | 3.5 | 5 | pF |
| I_{bias} | mixer bias current | FM mode | 4.8 | 6 | 7.2 | mA |
| $V_{\text{o(max)(p-p)}}$ | maximum output voltage (peak-to-peak value) | | 3 | – | – | V |
| <i>FM mixer reference voltage: pin $V_{\text{ref(FMMIX)}}$</i> | | | | | | |
| V_{ref} | reference voltage | FM mode | 6.5 | 7.1 | 7.9 | V |
| | | AM mode | 2.7 | 3.1 | 3.4 | V |
| <i>FM mixer</i> | | | | | | |
| $g_{\text{m(conv)}}$ | conversion transconductance $\frac{I_{\text{MIX1OUT}}}{V_{\text{FMMIXIN}}}$ | | 8.5 | 13 | 18 | $\frac{\text{mA}}{\text{V}}$ |
| $g_{\text{m(conv)(T)}}$ | conversion transconductance variation with temperature $\frac{\Delta g_{\text{m(conv)}}}{g_{\text{m(conv)}} \times \Delta T}$ | | – | -1×10^{-3} | – | K^{-1} |
| F | noise figure | | – | 3 | 4.6 | dB |
| $R_{\text{gen(opt)}}$ | optimum generator resistance | | 180 | 240 | 300 | Ω |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---|---|------|------|------|------------------------|
| IP3 | 3rd-order intermodulation | | 116 | 119 | – | dB μ V |
| IRR | image rejection ratio $\frac{V_{MIX1OUTwanted}}{V_{MIX1OUTimage}}$ | $f_{RFwanted} = 87.5$ MHz; $f_{RFimage} = 108.9$ MHz | 25 | 30 | – | dB |
| | | data byte 4 = X010X110; $f_{RFwanted} = 162.475$ MHz; $f_{RFimage} = 183.875$ MHz; weather band mode | 22 | 30 | – | dB |
| IF AMPLIFIER 1 | | | | | | |
| G | gain $\frac{V_{IFAMP1OUT}}{V_{IFAMP1IN}}$ | $R_L = 330 \Omega$; $V_{IFAMP1IN} = 1$ mV | 8.5 | 10.5 | 12.5 | dB |
| F | noise figure | | – | 10 | 13 | dB |
| IP3 | 3rd-order intermodulation | | 117 | 120 | – | dB μ V |
| <i>Inputs: pins IFAMP1IN and IFAMP1DEC</i> | | | | | | |
| $V_{i(max)(p)}$ | maximum input voltage (peak value) | 1 dB compression point of IF amplifier 1 output voltage (peak value) | 250 | – | – | mV |
| $V_{i(n)(eq)}$ | equivalent input noise voltage | $R_{gen} = 330 \Omega$; $R_L = 330 \Omega$ | – | 8 | 10 | $\frac{nV}{\sqrt{Hz}}$ |
| R_i | input resistance | | 270 | 330 | 390 | Ω |
| C_i | input capacitance | | – | 5 | 7 | pF |
| <i>Output: pin IFAMP1OUT</i> | | | | | | |
| $V_{o(max)(p)}$ | maximum output voltage (peak value) | | 1.2 | 1.5 | – | V |
| R_o | output resistance | | 270 | 330 | 390 | Ω |
| C_o | output capacitance | | – | 5 | 7 | pF |
| IF AMPLIFIER 2 | | | | | | |
| G | gain $\frac{V_{IFAMP2OUT}}{V_{IFAMP2IN}}$ | $R_L = 330 \Omega$; $V_{IFAMP2IN} = 1$ mV | 6.5 | 8.5 | 10.5 | dB |
| F | noise figure | | – | 13 | 15 | dB |
| IP3 | 3rd-order intermodulation | | 127 | 130 | – | dB μ V |
| <i>Inputs: pins IFAMP2IN and IFAMP2DEC</i> | | | | | | |
| $V_{i(max)(p)}$ | maximum input voltage (peak value) | 1 dB compression point of IF amplifier 2 output voltage (peak value) | 500 | – | – | mV |
| $V_{i(n)(eq)}$ | equivalent input noise voltage | $R_{gen} = 330 \Omega$; $R_L = 330 \Omega$ | – | 10 | 13 | $\frac{nV}{\sqrt{Hz}}$ |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---|---|-----------|-----------|-----------|------------|
| R_i | input resistance | | 270 | 330 | 390 | Ω |
| C_i | input capacitance | | – | 5 | 7 | pF |
| <i>Output: pin IFAMP2OUT</i> | | | | | | |
| $V_{o(max)(p)}$ | maximum output voltage (peak value) | | 1.2 | 1.5 | – | V |
| R_o | output resistance | | 270 | 330 | 390 | Ω |
| C_o | output capacitance | | – | 5 | 7 | pF |
| FM demodulator and level detector; see Figs 6 and 7 | | | | | | |
| FM DEMODULATOR | | | | | | |
| <i>FM limiter inputs: pins FMLIMIN and FMLIMDEC</i> | | | | | | |
| R_i | input resistance | | 10 | 12 | 14 | k Ω |
| C_i | input capacitance | | – | 5 | 7 | pF |
| $V_{start(lim)(rms)}$ | start of limiting of RDS MPX output voltage (RMS value) | $\alpha_{AF} = -3$ dB; $R_{gen} = 165 \Omega$ | – | 10 | 15 | μ V |
| $V_{o(sens)(rms)}$ | sensitivity for RDS MPX output voltage (RMS value) | $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s $R_{gen} = 165 \Omega$; (S+N)/N = 26 dB (S+N)/N = 46 dB | – | 10 | 15 | μ V |
| $V_{start(lim)(rms)}$ | start of limiting of FM MPX output voltage (RMS value) | $\alpha_{AF} = -3$ dB; $R_{gen} = 165 \Omega$ | – | 10 | 15 | μ V |
| $V_{o(sens)(rms)}$ | sensitivity for FM MPX output voltage (RMS value) | $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s $R_{gen} = 165 \Omega$; (S+N)/N = 26 dB (S+N)/N = 46 dB | – | 10 | 15 | μ V |
| <i>RDS MPX output: pin RDSMPX</i> | | | | | | |
| $V_{o(rms)}$ | RDS MPX output voltage (RMS value) | $V_{FMLIMIN} = 20 \mu$ V to 1 V $\Delta f = 5$ kHz; $f_{mod} = 57$ kHz $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz | 40 180 | 50 230 | 60 280 | mV mV |
| (S+N)/N | maximum signal plus noise-to-noise ratio | $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s; $V_{FMLIMIN} = 10$ mV | 70 | 73 | – | dB |
| THD | total harmonic distortion | $\Delta f = 75$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s; $V_{FMLIMIN} = 200 \mu$ V to 800 mV | – | 0.4 | 0.75 | % |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------------------------|---|---|------|------|------|------------|
| α_{AM} | AM suppression $\frac{V_{o(rms)}}{V_{o(AM)(rms)}}$ | FM: $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; AM: $m = 0.3$; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s $V_{FMLIMIN} = 30$ to 70 μ V | 20 | 30 | – | dB |
| | | $V_{FMLIMIN} = 70$ to 500 μ V | 30 | 40 | – | dB |
| | | $V_{FMLIMIN} = 500$ μ V to 300 mV | 50 | 60 | – | dB |
| | | $V_{FMLIMIN} = 300$ mV to 1 V | 30 | 40 | – | dB |
| $I_{o(max)}$ | maximum output current | | – | – | 100 | μ A |
| R_o | output resistance | | – | – | 500 | Ω |
| R_L | load resistance | | 20 | – | – | k Ω |
| C_L | load capacitance | | – | – | 50 | pF |
| B | bandwidth | $C_L = 0$; $R_L > 20$ k Ω | 200 | 300 | – | kHz |
| PSRR | power supply ripple rejection | $f_{ripple} = 100$ Hz to 20 kHz | – | 40 | – | dB |
| <i>FM MPX output: pin FMMPX</i> | | | | | | |
| $V_{o(rms)}$ | FM MPX output voltage (RMS value) | $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; $V_{FMLIMIN} = 20$ μ V to 1 V | 180 | 230 | 280 | mV |
| | | data byte 4 = X010X110; $\Delta f = 1.5$ kHz; $f_{mod} = 1$ kHz; $V_{FMLIMIN} = 20$ μ V to 1 V; weather band mode | 150 | 230 | 310 | mV |
| (S+N)/N | maximum signal plus noise-to-noise ratio | $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s; $V_{FMLIMIN} = 10$ mV | 66 | 70 | – | dB |
| THD | total harmonic distortion | $\Delta f = 75$ kHz; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s; $V_{FMLIMIN} = 200$ μ V to 800 mV | – | 0.4 | 0.75 | % |
| α_{AM} | AM suppression $\frac{V_{o(rms)}}{V_{o(AM)(rms)}}$ | FM: $\Delta f = 22.5$ kHz; $f_{mod} = 1$ kHz; AM: $m = 0.3$; $f_{mod} = 1$ kHz; de-emphasis = 75 μ s $V_{FMLIMIN} = 30$ to 70 μ V | 20 | 30 | – | dB |
| | | $V_{FMLIMIN} = 70$ to 500 μ V | 30 | 40 | – | dB |
| | | $V_{FMLIMIN} = 500$ μ V to 300 mV | 50 | 60 | – | dB |
| | | $V_{FMLIMIN} = 300$ mV to 1 V | 30 | 40 | – | dB |
| $I_{o(max)}$ | maximum output current | | – | – | 100 | μ A |
| $R_{o(max)}$ | maximum output resistance | | – | – | 500 | Ω |
| $R_{L(min)}$ | minimum load resistance | | 20 | – | – | k Ω |
| $C_{L(max)}$ | maximum load capacitance | | – | – | 50 | pF |
| B | bandwidth | $C_L = 0$; $R_L > 20$ k Ω | 200 | – | – | kHz |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|--|---|---|--|--|
| PSRR | power supply ripple rejection | $f_{\text{ripple}} = 100 \text{ Hz to } 20 \text{ kHz}$ | – | 40 | – | dB |
| t_{sw} | AM to FM switching time | $V_{\text{FMLIMIN}} = 100 \mu\text{V}$ | – | 100 | 150 | ms |
| FM MPX SOFT MUTE | | | | | | |
| <i>Soft mute</i> | | | | | | |
| α_{mute} | mute attenuation | $V_{\text{FMLIMIN}} = 10 \text{ mV};$ $V_{\text{TMUTE}} = 300 \text{ mV}$ data byte 7 = XX000100 data byte 7 = XX001100 data byte 7 = XX010100 data byte 7 = XX011100 data byte 7 = XX100100 data byte 7 = XX101100 data byte 7 = XX110100 data byte 7 = XX111100 | – | 7 8 9.5 11 14 18 25 39 | – | dB dB dB dB dB dB dB dB |
| $\alpha_{\text{mute(off)}}$ | mute off | $V_{\text{FMLIMIN}} = 10 \text{ mV};$ $V_{\text{TMUTE}} = 300 \text{ mV};$ data byte 7 = XXXXX111 | –1 | 0 | +1 | dB |
| $V_{\text{offset(DC)}}$ | DC offset created by soft mute on pin FMMPX $\Delta V = V_{\text{muted}} - V_{\text{notmuted}}$ | | –150 | – | +150 | mV |
| <i>Input: pin TMUTE</i> | | | | | | |
| V_{TMUTE} | mute voltage | $V_{\text{FMLIMIN}} = 0 \text{ to } 1 \text{ V}$ | 0 | – | 5 | V |
| V_{offset} | voltage offset with V_{level} | $V_{\text{FMLIMIN}} = 0 \text{ to } 1 \text{ V}$ | –200 | – | +200 | mV |
| I_{dch} | discharge current | $V_{\text{level}} < V_{\text{TMUTE}}$ | 2.5 | 3.5 | 4.5 | μA |
| I_{ch} | charge current | $V_{\text{level}} > V_{\text{TMUTE}}$ | –4.5 | –3.5 | –2.5 | μA |
| $V_{\text{TMUTE(start)}}$ | mute start voltage | $\alpha_{\text{mute}} = 3 \text{ dB}; V_{\text{FMLIMIN}} = 10 \text{ mV}$ data byte 7 = XX111000 data byte 7 = XX111001 data byte 7 = XX111010 data byte 7 = XX111011 data byte 7 = XX111100 data byte 7 = XX111101 data byte 7 = XX111110 | 300 400 450 520 580 640 680 | 450 550 630 720 800 890 980 | 600 700 810 920 1020 1140 1280 | mV mV mV mV mV mV mV |
| <i>Output: pin V_{level}</i> | | | | | | |
| R_o | output resistance of level output | | – | – | 500 | Ω |
| RR | ripple rejection of level output | $f_{\text{ripple}} = 100 \text{ Hz};$ $V_{\text{DDA1(ripple)}} = 100 \text{ mV (RMS)}$ | – | 40 | – | dB |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------|---|---|------|-------|------|---------------|
| RDS update; see Figs 11 and 12 | | | | | | |
| <i>RDS mute</i> | | | | | | |
| α_{mute} | muting depth | data byte 3: bit 7 = 1 (mute) | 60 | 80 | – | dB |
| $V_{\text{offset(DC)}}$ | DC offset during RDS update mute pin FMMPX $\Delta V = V_{\text{muted}} - V_{\text{notmuted}}$ | | –30 | – | +30 | mV |
| <i>Capacitor: pin TRDSMUTE</i> | | | | | | |
| V_{TRDSMUTE} | voltage at pin TRDSMUTE | no mute | – | 5.7 | – | V |
| | | mute | – | 1.1 | – | V |
| I_{dch} | discharge current | $V_o = 3 \text{ V}$; data byte 3: bit 7 = 1 | 24 | 32 | 38 | μA |
| I_{ch} | charge current | $V_o = 3 \text{ V}$; data byte 3: bit 7 = 0 | –38 | –32 | –24 | μA |
| I_{LI} | input leakage current | mute | –10 | – | +10 | nA |
| <i>Output: pin AFHOLD</i> | | | | | | |
| $I_{\text{sink(max)}}$ | maximum sink current | after first bus transmission with data byte 1: 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 |
| MPX mute input: pin MUTE | | | | | | |
| V_{mute} | mute voltage | mute | – | – | 1.5 | V |
| | | no mute | 3 | – | – | V |
| I_{source} | source current | $V_o = 0 \text{ to } 5 \text{ V}$ | –30 | –50 | –70 | μA |
| R_i | input resistance | | 100 | – | – | k Ω |
| Demodulator AFC | | | | | | |
| OUTPUT: PIN RDSMPX | | | | | | |
| G_{AFC} | AFC gain on V_{RDSMPX} $\frac{\Delta V_{o(\text{AFC})(\text{disabled})}}{\Delta V_{o(\text{AFC})(\text{enabled})}}$ | detuning $\Delta f = 100 \text{ kHz}$; $V_{\text{FMLIMIN}} = 1 \text{ mV}$ | 28 | 32 | – | dB |
| $V_{\text{offset(DC)}}$ | residual DC offset | $L_{\text{demod}} = \text{typical value}$ $V_{\text{FMLIMIN}} = 10 \text{ to } 80 \mu\text{V}$ | – | 0.1 | 1 | V |
| | | $V_{\text{FMLIMIN}} = 80 \mu\text{V to } 800 \text{ mV}$ | – | 10 | 30 | mV |
| | | $L_{\text{demod}} = \pm 6\%$ $V_{\text{FMLIMIN}} = 10 \text{ to } 80 \mu\text{V}$ | – | 0.240 | 1 | V |
| | | $V_{\text{FMLIMIN}} = 80 \mu\text{V to } 800 \text{ mV}$ | – | 25 | 500 | mV |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|---|-------------------|------|-------------------|--------------------|
| CAPACITOR: PIN C _{AFC} | | | | | | |
| I _{dch} | AFC time constant discharge current | V _i = 1.4 to 4.1 V | 90 | 120 | 150 | μA |
| I _{ch} | AFC time constant charge current | V _i = 1.4 to 4.1 V | -150 | -120 | -90 | μA |
| FM IF level detector: pin V_{level} | | | | | | |
| V _{level} | level output DC voltage | V _{FMLIMIN} = 10 μV to 1 V | 0 | – | 5 | V |
| | | V _{FMLIMIN} < 1 μV; standard setting of level DAA | 0.1 | 0.35 | 0.8 | V |
| | | V _{FMLIMIN} = 1 mV; standard setting of level DAA | 1.4 | 2 | 2.4 | V |
| ΔV _{level} | step size of level starting point adjustment | standard setting of level slope; V _{FMLIMIN} = 1 to 300 mV | 40 | 53 | 70 | mV |
| V _{level(slope)} | slope of level voltage $\frac{\Delta V_{level}}{\Delta V_{FMLIMIN}}$ | standard setting of level slope | 800 | 1000 | 1200 | $\frac{mV}{20 dB}$ |
| ΔV _{step} | level slope adjust step size | V _{FMLIMIN} = 1 mV | 55 | 75 | 95 | $\frac{mV}{20 dB}$ |
| ΔV _{level(T)} | level voltage variation with temperature $\frac{\Delta V_{level}}{V_{level} \times \Delta T}$ | V _{FMLIMIN} = 1 mV | -10 ⁻³ | – | +10 ⁻³ | K ⁻¹ |
| B _{level} | bandwidth of level output voltage | V _{FMLIMIN} = 10 mV; standard setting of DAA | 200 | 300 | – | kHz |
| I _{source} | output source current | | – | – | -300 | μA |
| I _{sink} | output sink current | | 50 | – | – | μA |
| R _o | output resistance | | – | – | 500 | Ω |
| RR | ripple rejection | f _{ripple} = 100 Hz; V _{DDA1(ripple)} = 100 mV (RMS) | – | 40 | – | dB |
| Weather band mode | | | | | | |
| WEATHER BAND FLAG: PIN T1AMAGC | | | | | | |
| I _{L(max)} | maximum load current | | -5 | – | +5 | μA |
| V _{o(FM)(max)} | maximum output voltage for FM mode | | 0 | – | 0.5 | V |
| V _{o(WB)} | output voltage for weather band mode | | 5.1 | 6 | 6.9 | V |

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|---|---|--|----------------|----------------|----------------|----------------------|
| WEATHER BAND SWITCH OUTPUT: PIN WBSW | | | | | | |
| $I_{L(max)}$ | maximum load current | | -1000 | - | - | μA |
| $R_{i(shunt)}$ | internal shunt resistance to ground | | - | - | 50 | $k\Omega$ |
| $V_{o(FM)(max)}$ | maximum output voltage for FM mode | | 0 | - | 0.35 | V |
| $V_{o(WB)}$ | output voltage for weather band mode | | 4 | - | 5 | V |
| Ultrasonic noise detector | | | | | | |
| G_{ctrl} | gain control $\frac{\Delta G_{USN}}{\Delta R_{USNSENS}}$ | $f_{mod} = 750 \text{ kHz}; V_{TMUTE} = 2.5 \text{ V}$ | 0.09 | 0.12 | 0.15 | $\frac{dB}{k\Omega}$ |
| α_{50} | 50 kHz attenuation of input filter | $f_{mod} = 50 \text{ kHz};$ $R_{USNSENS} = 82 \text{ k}\Omega;$ $V_{RDSMPX(AC)} = 90 \text{ mV (RMS)}$ | 60 | - | - | dB |
| SENSITIVITY CONTROL: PIN USNSENS | | | | | | |
| $I_{ctrl(source)}$ | ultrasonic noise detector sensitivity control pin source current | $R_{USNSENS} < 162 \text{ k}\Omega$ | -39 | -33 | -27 | μA |
| OUTPUT: PIN TUSN | | | | | | |
| f_{mod} | 3 dB frequency ultrasonic noise detector input filter | $C_{TUSN} < 10 \text{ pF}$ | 300 | 450 | 600 | kHz |
| I_{att} | peak detector attack current | $f_{mod} = 750 \text{ kHz}; V_{TUSN} = 1 \text{ V};$ $V_{RDSMPX(AC)} = 90 \text{ mV (RMS)};$ $R_{USNSENS} = 82 \text{ k}\Omega$ | 30 | 37 | 44 | μA |
| I_{dec} | peak detector decay current | $V_{TUSN} = 4 \text{ V}; V_{RDSMPX(AC)} = 0 \text{ V};$ $R_{USNSENS} = 82 \text{ k}\Omega$ | -14 | -11 | -8 | μA |
| V_o | peak detector output voltage | FM mode; $R_{USNSENS} = 82 \text{ k}\Omega$ $V_{RDSMPX(AC)} = 0 \text{ V}$ $V_{RDSMPX(AC)} = 90 \text{ mV (RMS)};$ $f_{mod} = 750 \text{ kHz}$ | 4.5 0 | 5.0 - | 5.5 1.5 | V V |
| BUFFERED OUTPUT: PIN USNBUF | | | | | | |
| G | gain $20 \log \frac{\Delta V_{USNBUF(DC)}}{\Delta V_{RDSMPX(AC)}}$ | $f_{mod} = 750 \text{ kHz};$ $R_{USNSENS} = 82 \text{ k}\Omega$ $V_{TMUTE} = 700 \text{ mV}$ $V_{TMUTE} = 2.5 \text{ V}$ $V_{TMUTE} = 4 \text{ V}$ | 17 34 44 | 20 39 50 | 23 44 56 | dB dB dB |
| $V_{o(max)}$ | maximum output voltage | $V_{RDSMPX(AC)} = 0 \text{ V};$ $R_{USNSENS} = 82 \text{ k}\Omega$ | 4.5 | 4.75 | 5.0 | V |

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|---------------------------------|-----------------------------|--|-------|-------|------|---------------|
| $V_{o(\min)}$ | minimum output voltage | $f_{\text{mod}} = 750 \text{ kHz};$ $R_{\text{USNSENS}} = 82 \text{ k}\Omega$ $V_{\text{RD SMPX(AC)}} = 90 \text{ mV (RMS)}$ | – | – | 1.5 | V |
| | | $V_{\text{RD SMPX(AC)}} = 120 \text{ mV (RMS)}$ | – | – | 0.5 | V |
| $V_{o(\text{buf})}$ | buffer output voltage | FM mode; $R_{\text{USNSENS}} = 82 \text{ k}\Omega$ $V_{\text{RD SMPX(AC)}} = 0 \text{ V}$ | 4.5 | 4.75 | 5.0 | V |
| | | $V_{\text{RD SMPX(AC)}} = 90 \text{ mV (RMS)};$ $f_{\text{mod}} = 750 \text{ kHz}$ | – | – | 1.5 | V |
| $I_{\text{source(max)}}$ | maximum source current | FM mode; $V_{\text{TUSN}} = 2.5 \text{ V};$ $V_{\text{USNBUF}} = 1.5 \text{ V}$ | –1500 | –1000 | –800 | μA |
| $I_{\text{sink(max)}}$ | maximum sink current | FM mode; $V_{\text{TUSN}} = 2.5 \text{ V};$ $V_{\text{USNBUF}} = 3.5 \text{ V}$ | 200 | 300 | 450 | μA |
| $V_{o(n)(\text{buf})}$ | buffer output noise voltage | FM mode; $B = 400 \text{ Hz to } 20 \text{ kHz}$ | – | – | 500 | μV |
| RR | buffer ripple rejection | FM mode; $f_{\text{ripple}} = 100 \text{ Hz};$ related to V_{DDA6} | 34 | 40 | – | dB |
| $V_{\text{offset}(\text{buf})}$ | buffer offset voltage | FM mode; $ I_{\text{USNBUF}} < 100 \mu\text{A};$ $V_{\text{TUSN}} = 2.5 \text{ V}$ | – | 50 | 100 | mV |
| R_o | output resistance | | 150 | 200 | 250 | Ω |
| $C_{L(\text{max})}$ | maximum load capacitance | | – | – | 100 | pF |

Notes

- DAA conversion gain formula: $V_{\text{DAAOUT}} = \left[2 \times \left(0.75 \times \frac{n}{128} + 0.25 \right) \times (V_{\text{DAAIN}} + V_{\text{DAATD}}) \right] - V_{\text{DAATD}}$; where $n = 0$ to 127.
- Pin FREF: $R_{\text{ext}} = 68 \text{ k}\Omega$ connected to ground activates the 2nd I²C-bus address.
- The AM AGC transconductance buffer delivers a sink current which is proportional to the voltage at pin T1AMAGC.

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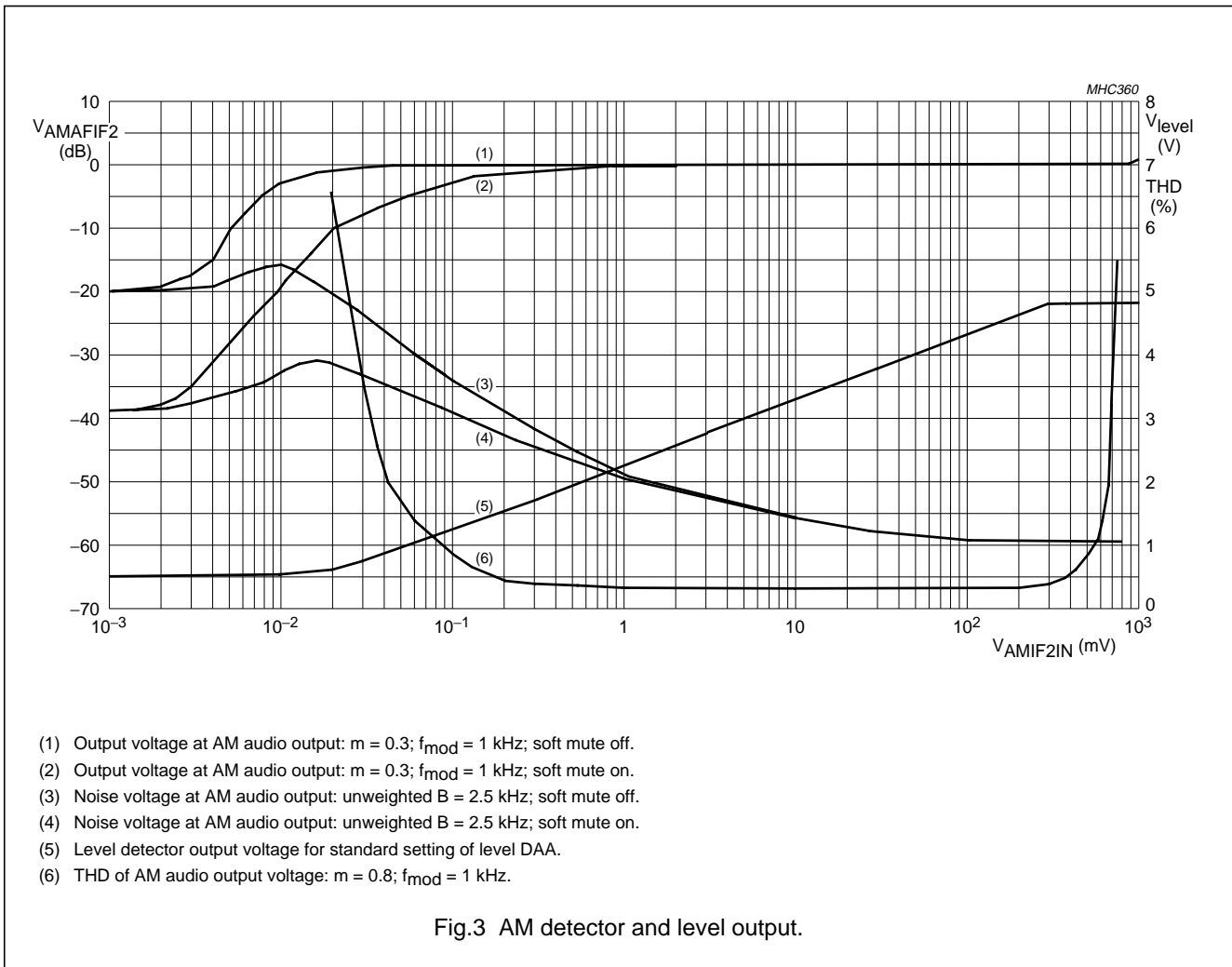
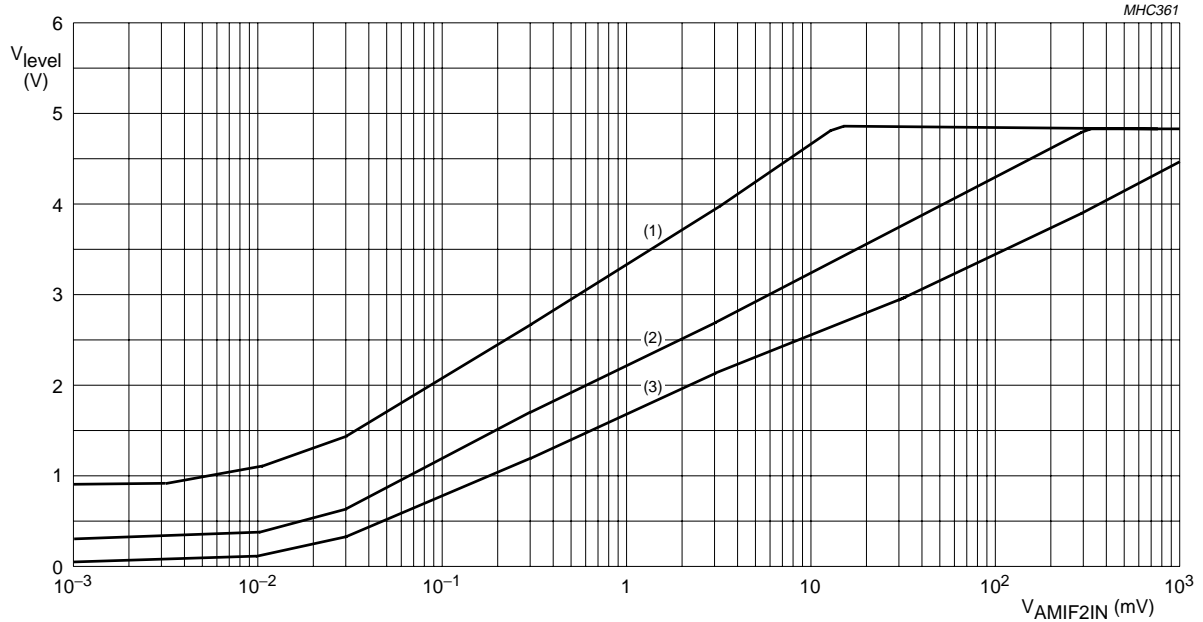


Fig.3 AM detector and level output.

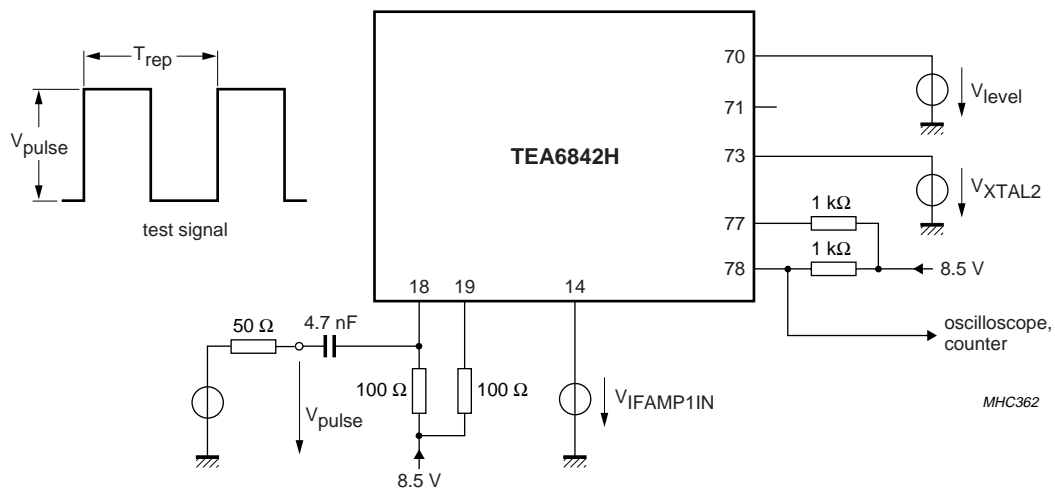
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- (1) Level DAA setting byte 6 = FFH.
- (2) Level DAA setting byte 6 = 84H (standard setting).
- (3) Level DAA setting byte 6 = 00H.

Fig.4 AM level voltage.



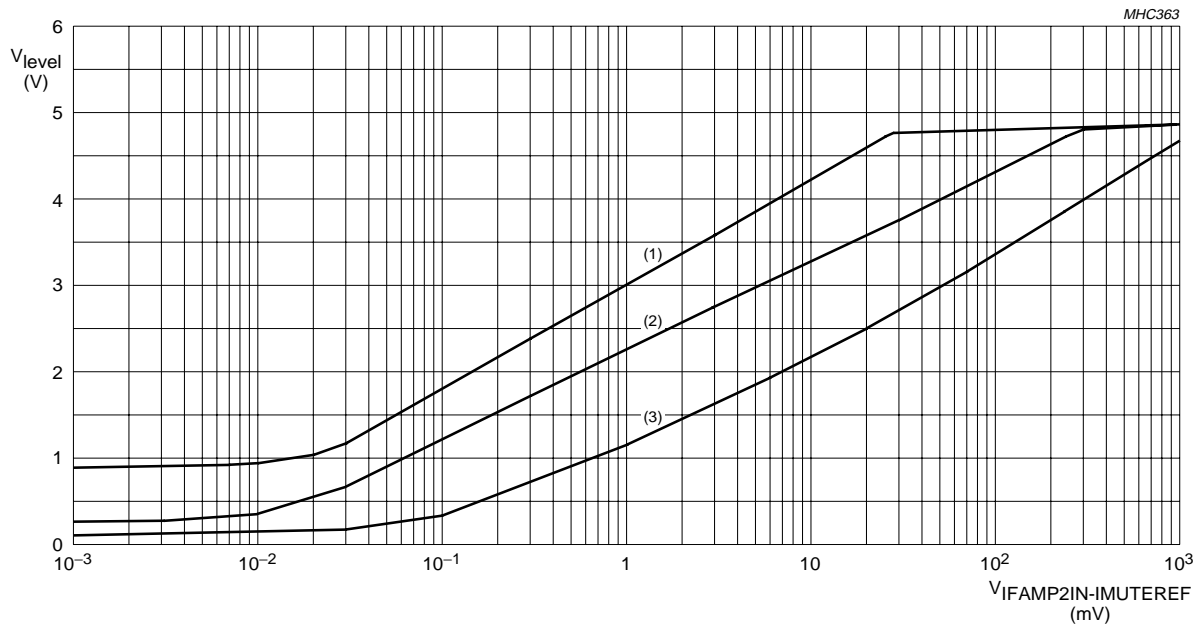
Test signal: $T_{rep} = 2 \text{ ms}$, $t_r < 50 \text{ ns}$, $t_f < 50 \text{ ns}$ and duty factor 50%.

$V_{IFAMP1IN} = 4 \text{ V}$.
 $V_{XTAL2} = 3 \text{ V}$.

Fig.5 Test circuit for AM noise blanker.

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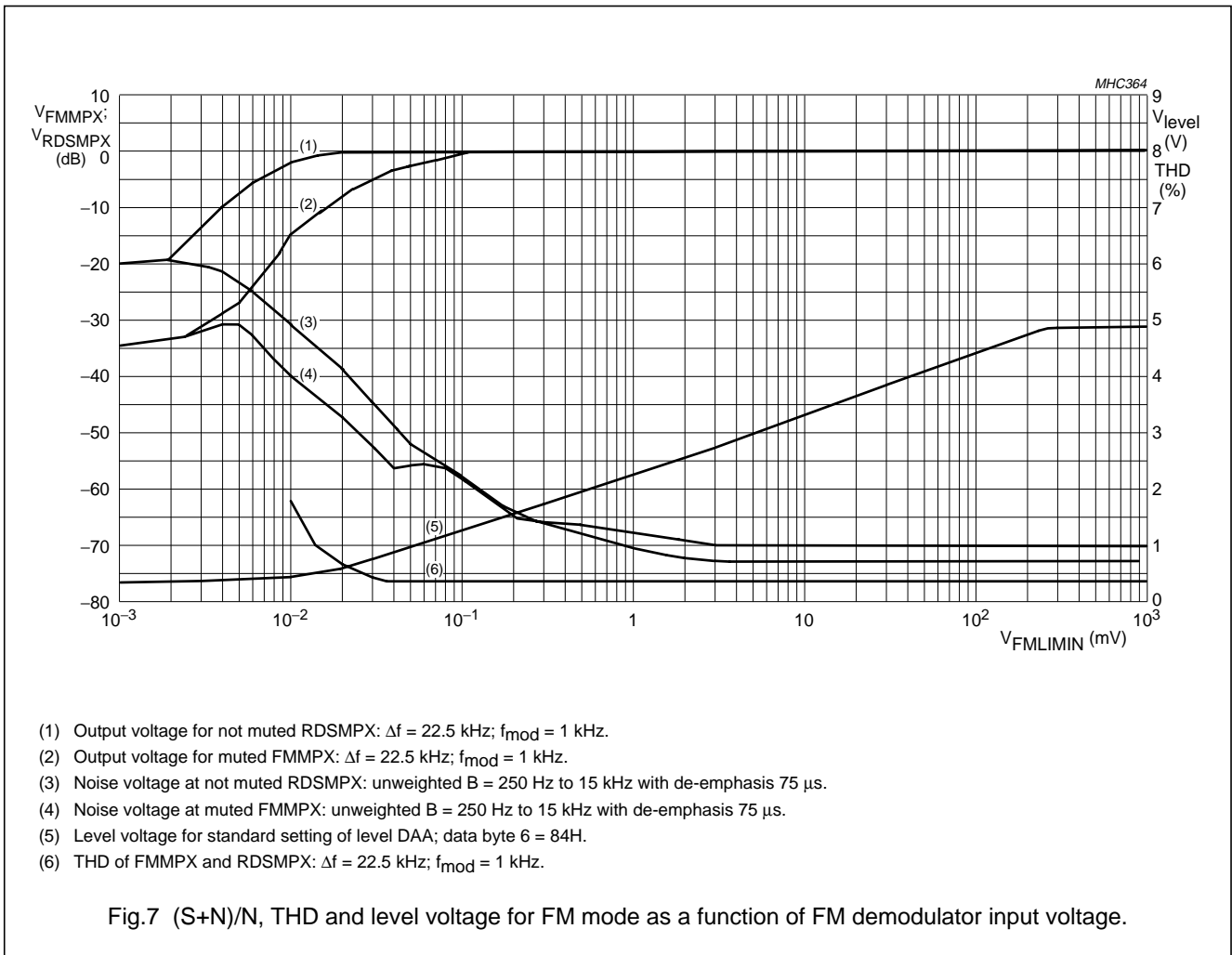


- (1) Level DAA setting byte 6 = FFH.
- (2) Level DAA setting byte 6 = 84H (standard setting).
- (3) Level DAA setting byte 6 = 00H.

Fig.6 FM level voltage.

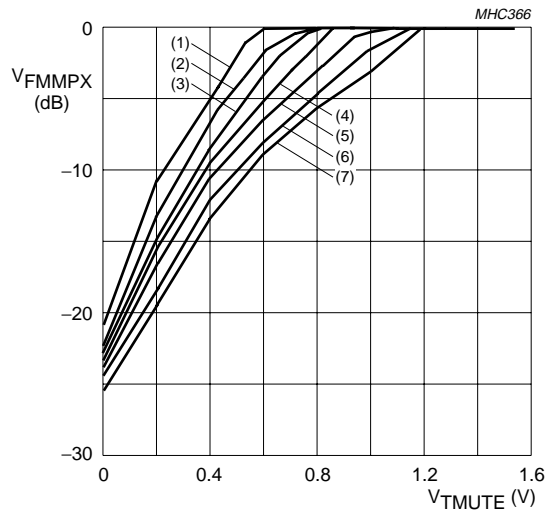
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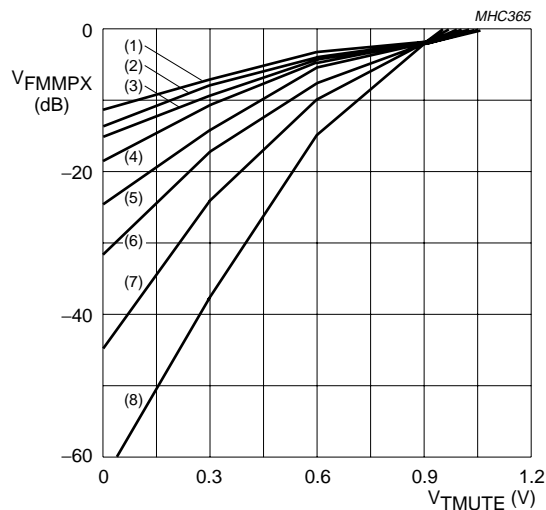


Mute start:

- (1) MD[2:0] = 000.
- (2) MD[2:0] = 001.
- (3) MD[2:0] = 010.
- (4) MD[2:0] = 011.
- (5) MD[2:0] = 100.
- (6) MD[2:0] = 101.
- (7) MD[2:0] = 110.

Mute start adjustment range, mute slope = 100 and $V_{FMLIMIN} = 10$ mV.

Fig.8 Adjustment of soft mute start.



Mute slope:

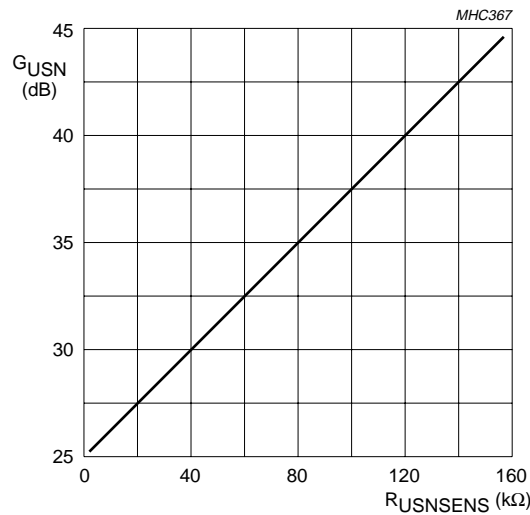
- (1) MS[2:0] = 000.
- (2) MS[2:0] = 001.
- (3) MS[2:0] = 010.
- (4) MS[2:0] = 011.
- (5) MS[2:0] = 100.
- (6) MS[2:0] = 101.
- (7) MS[2:0] = 110.
- (8) MS[2:0] = 111.

Mute slope adjustment range, mute start = 100 and $V_{FMLIMIN} = 10$ mV.

Fig.9 Adjustment of soft mute slope.

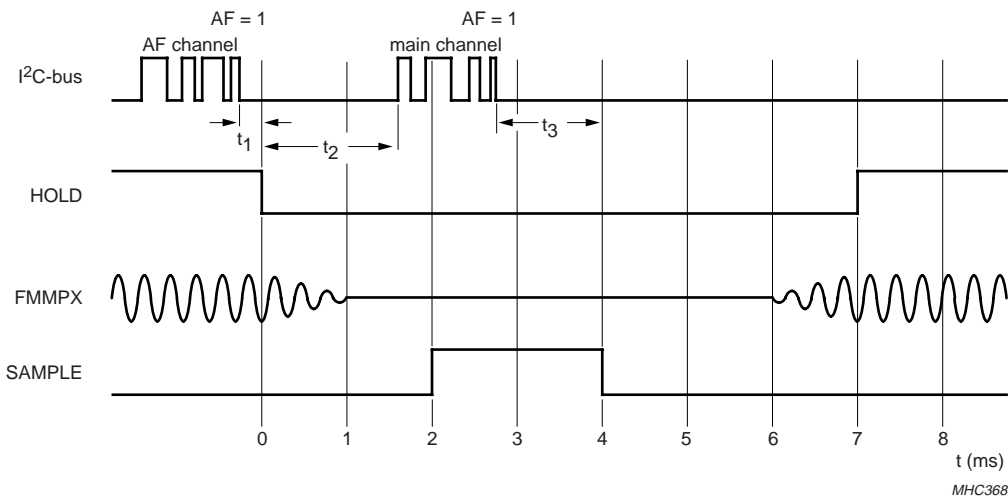
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V_TMUTE = 2.5 V; f_mod = 750 kHz.

Fig.10 Ultrasonic noise detector gain as a function of R_USNSENS.

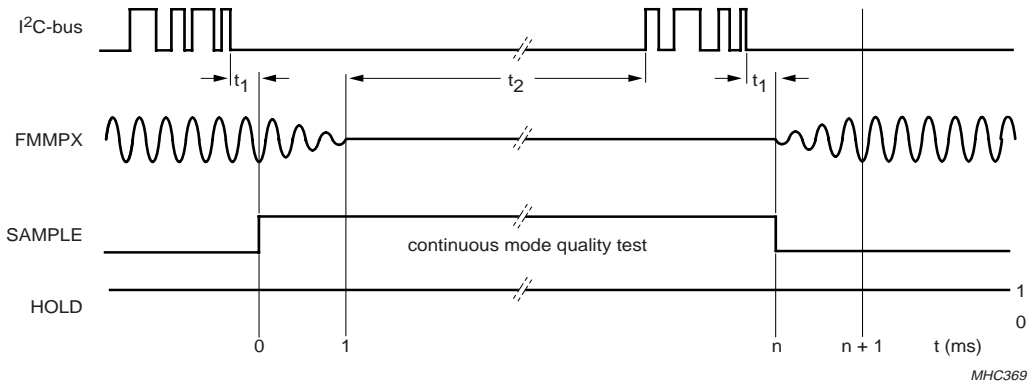


Hold signal is used to hold the quality information for signal processing of the main channel during the alternative frequency jumps.
 Quality measurement can be carried out during sample = 1.
 t₁ is the internal clock related logic delay of 100 μs.
 t₂ should be >1.1 ms to ensure correct loading of PLL for the main channel.
 t₃ should be >0 to ensure inaudible update; t₃ < 0 extends the mute period.

Fig.11 Inaudible RDS update timing diagram.

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MHC369

t_1 is the internal clock related logic delay of 100 μ s.

t_2 should be larger than the required PLL tuning time for the given band: FM = 1 ms and AM = 20 ms.

Fig.12 Preset mode timing diagram.

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12 I²C-BUS PROTOCOL

12.1 I²C-bus specification

The standard I²C-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} .

A second I²C-bus address can be selected by connecting pin FREF via a 68 k Ω resistor to GND.

Structure of the I²C-bus logic: slave transceiver with auto increment.

Subaddresses are not used.

Remark: The I²C-bus operates at a maximum clock rate of 100 kHz. It is not allowed to connect the IC to an I²C-bus operating at a higher clock rate. Maximum LOW level is 1.5 V and minimum HIGH level is 3 V.

12.1.1 DATA TRANSFER

Data sequence: address, 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 TEA6842H.

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.

12.2 I²C-bus protocol

12.2.1 DATA TRANSFER MODE AND IC ADDRESS

Table 1 Write mode

| S ⁽¹⁾ | address (write) | A ⁽²⁾ | data byte(s) | A ⁽²⁾ | P ⁽³⁾ |
|------------------|-----------------|------------------|--------------|------------------|------------------|
|------------------|-----------------|------------------|--------------|------------------|------------------|

Notes

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

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.

In byte 5, 4 bits are reserved for test mode purposes. The state of the test bits, if not in test mode, is don't care.

12.1.2 I²C-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 I²C-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 I²C-bus pull-down can occur switching off the tuner IC supply when the I²C-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 I²C-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 I²C-bus transmission is required to program the IC.

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Table 2 Read mode

| | | | |
|------------------|----------------|------------------|-------------|
| S ⁽¹⁾ | address (read) | A ⁽²⁾ | 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 ⁽¹⁾ |
| | | | | | | R/ \bar{W} ⁽²⁾ |

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 TEA6842H
 - b) 1 = read operation from TEA6842H.

12.2.2 WRITE MODE: DATA BYTE 1

Table 4 Format of data byte 1

| 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 1 bits

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

12.2.3 WRITE MODE: DATA BYTE 2

Table 6 Format of data byte 2

| 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 2 bits

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

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12.2.4 WRITE MODE: DATA BYTE 3

Table 8 Format of data byte 3

| 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 3 bits

| BIT | SYMBOL | DESCRIPTION |
|--------|----------|--|
| 7 | MUTE | FM audio mute. 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] | Setting of antenna digital auto alignment. |

12.2.5 WRITE MODE: DATA BYTE 4

Table 10 Format of data byte 4

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| IFMT | RFS2 | RFS1 | RFS0 | IFPR | BND1 | BND0 | AMFM |

Table 11 Description of data byte 4 bits

| BIT | SYMBOL | DESCRIPTION |
|---------|----------|--|
| 7 | IFMT | IF measuring time. If IFMT = 0, then IF measuring time is 20 ms. If IFMT = 1, then IF measuring time is 2 ms. |
| 6 to 4 | RFS[2:0] | Reference frequency for synthesizer. These 3 bits determine the reference frequency, see Table 12. |
| 3 | IFPR | IF counter prescaler ratio. If IFPR = 0, then IF prescaler ratio is 100. If IFPR = 1, then IF prescaler ratio is 10. |
| 2 and 1 | BND[1:0] | Band switch. These 2 bits select in FM mode band and local or distant, see Table 13; in AM mode band select and output of AM IF2 for AM stereo, see Table 14. |
| 0 | AMFM | AM or FM switch. If AMFM = 0, then FM mode. If AMFM = 1, then AM mode. |

Table 12 Reference frequency setting

| RFS2 | RFS1 | RFS0 | f _{ref} (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 |

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Table 13 FM mode

| BND1 | BND0 | SELECTION |
|------|------|--|
| 0 | 0 | FM standard: dead zone high current charge pump active, FM AGC defined by RF level and threshold level setting by I ² C-bus |
| 0 | 1 | FM local: dead zone high current charge pump active, FM AGC source current set to maximum |
| 1 | 0 | FM East Europe: dead zone high current charge pump switched off, current of low current charge pump set to 1 mA |
| 1 | 1 | FM weather band: N1 divider set to 1 and I and Q phase shift network switched on, WX flag signal activated |

Table 14 AM mode; note 1

| BND1 | BND0 | SELECTION |
|------|------|--|
| 0 | 0 | AM mono; N2 divider set to 5 (SW) |
| 0 | 1 | AM stereo; N2 divider set to 5 (SW) |
| 1 | 0 | AM mono; N2 divider set to 10 (LW, MW) |
| 1 | 1 | AM stereo; N2 divider set to 10 (LW, MW) |

Note

- In AM mode dead zone high current charge pump switched off, current of low current charge pump set to 1 mA.

12.2.6 WRITE MODE: DATA BYTE 5

Table 15 Format of data byte 5

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| KAGC | WBA1 | WBA0 | AMSM | TMS3 | TMS2 | TMS1 | TMS0 |

Table 16 Description of data byte 5 bits

| BIT | SYMBOL | DESCRIPTION |
|---------|----------|--|
| 7 | KAGC | Keyed FM AGC. If KAGC = 0, then keyed FM AGC is off. If KAGC = 1, then keyed FM AGC is on. |
| 6 and 5 | WBA[1:0] | Wideband AGC. These 2 bits set the start value of wideband AGC. For AM, see Table 17 and for FM, see Table 18. |
| 4 | AMSM | AM soft mute. If AMSM = 0, then AM soft mute is off. If AMSM = 1, then AM soft mute is on (default). |
| 3 | TMS3 | In test mode charge pump 3-state. If TMS3 = 0, then 3-state off. If TMS3 = 1, then 3-state on. |
| 2 | TMS2 | In test mode external clock for level and antenna DAA. If TMS2 = 0, then external clock disabled. If TMS2 = 1, then external clock enabled. |
| 1 and 0 | TMS[1:0] | In test mode setting of pin FREF. These 2 bits define the function of pin FREF, see Table 19. |

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Table 17 Setting of wideband AGC for AM

| WBA1 | WBA0 | AM MIXER 1 INPUT VOLTAGE (PEAK VALUE) (mV) |
|------|------|---|
| 0 | 0 | 375 |
| 0 | 1 | 500 |
| 1 | 0 | 625 |
| 1 | 1 | 750 |

Table 18 Setting of wideband AGC for FM

| WBA1 | WBA0 | FM RF MIXER INPUT VOLTAGE (RMS VALUE) (mV) |
|------|------|---|
| 1 | 1 | 4 |
| 1 | 0 | 8 |
| 0 | 1 | 12 |
| 0 | 0 | 16 |

Table 19 Setting function of pin FREF in test mode

| TMS1 | TMS0 | OUTPUT AT PIN FREF |
|------|------|--|
| 0 | 0 | reference frequency of TEA688x or TEF689x |
| 0 | 1 | tuner oscillator frequency divided by division ratio of programmable divider |
| 1 | 0 | PLL synthesizer reference frequency |
| 1 | 1 | not used (no output) |

12.2.7 WRITE MODE: DATA BYTE 6

Table 20 Format of data byte 6

| 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 6 bits

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

Table 22 Standard setting of data byte 6 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 |

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12.2.8 WRITE MODE: DATA BYTE 7

Table 23 Format of data byte 7

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 0 | 0 | MS2 | MS1 | MS0 | MD2 | MD1 | MD0 |

Table 24 Description of data byte 7 bits

| BIT | SYMBOL | DESCRIPTION |
|---------|---------|---|
| 7 and 6 | – | These bits are not used and must be set to logic 0. |
| 5 to 3 | MS[2:0] | Setting of soft mute slope; see Fig.9. |
| 2 to 0 | MD[2:0] | Setting of soft mute start; see Fig.8. |

12.2.9 READ MODE: DATA BYTE 1

Table 25 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 26 Description of data byte 1 bits

| BIT | SYMBOL | DESCRIPTION |
|--------|----------|--|
| 7 to 0 | IFC[7:0] | IF counter result. These bits contain the last eight bits of the IF counter result. |

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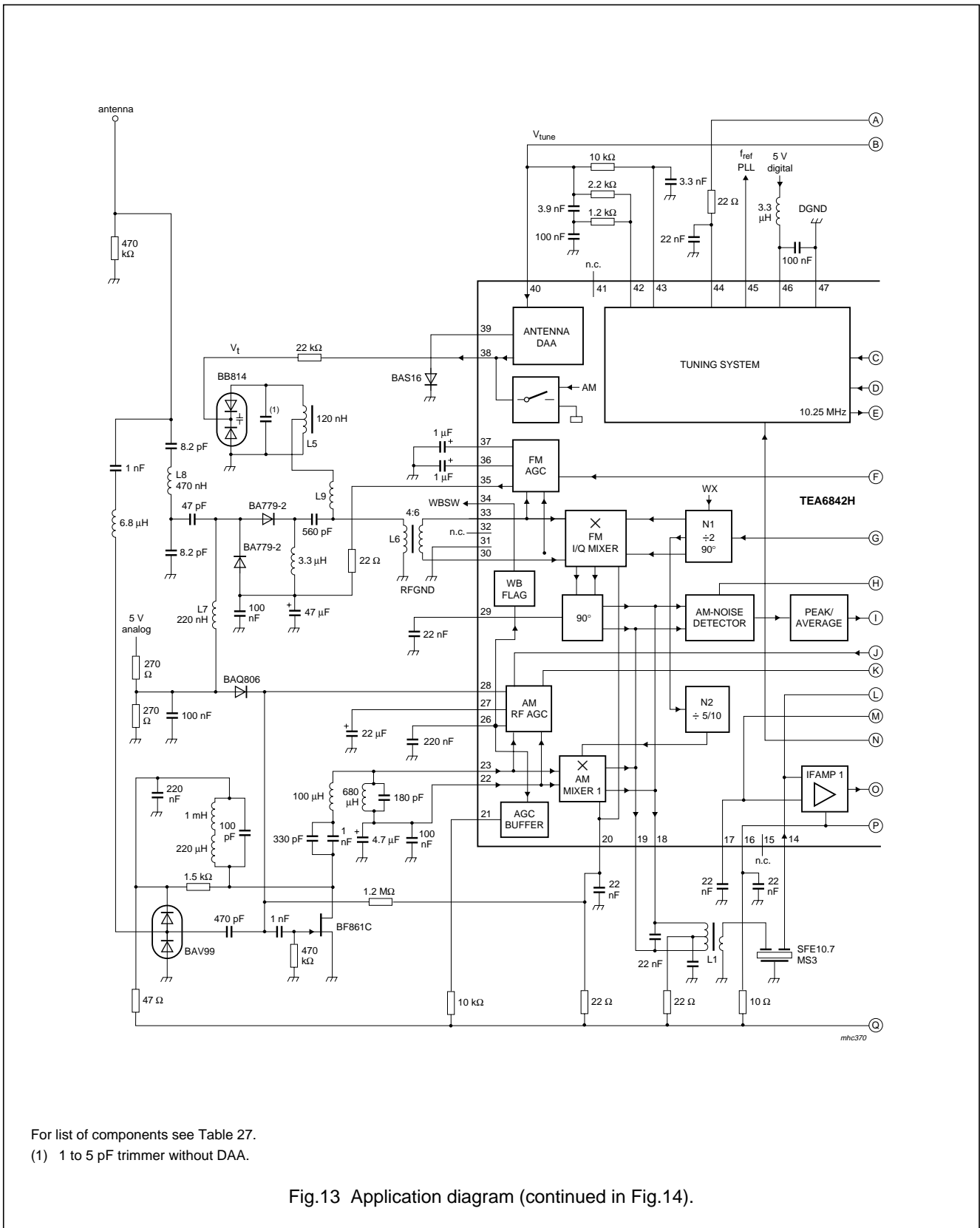
13 TEST AND APPLICATION INFORMATION

Table 27 List of components

| 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 | 10.7 MHz demodulator coil | 392BC-1977Z | TOKO |
| L4 | oscillator coil | E543SNAS-02010 | TOKO |
| L5 | FM image rejection | 611SNS-1066Y | TOKO |
| L6 | FM input transformer | 369INS-3076X | TOKO |
| L7 | – | LQN | MURATA |
| L8 | – | LQN | MURATA |
| L9 | – | Air coil | – |
| – | crystal 20.5 MHz | TQX6238 | Tele Quarz |

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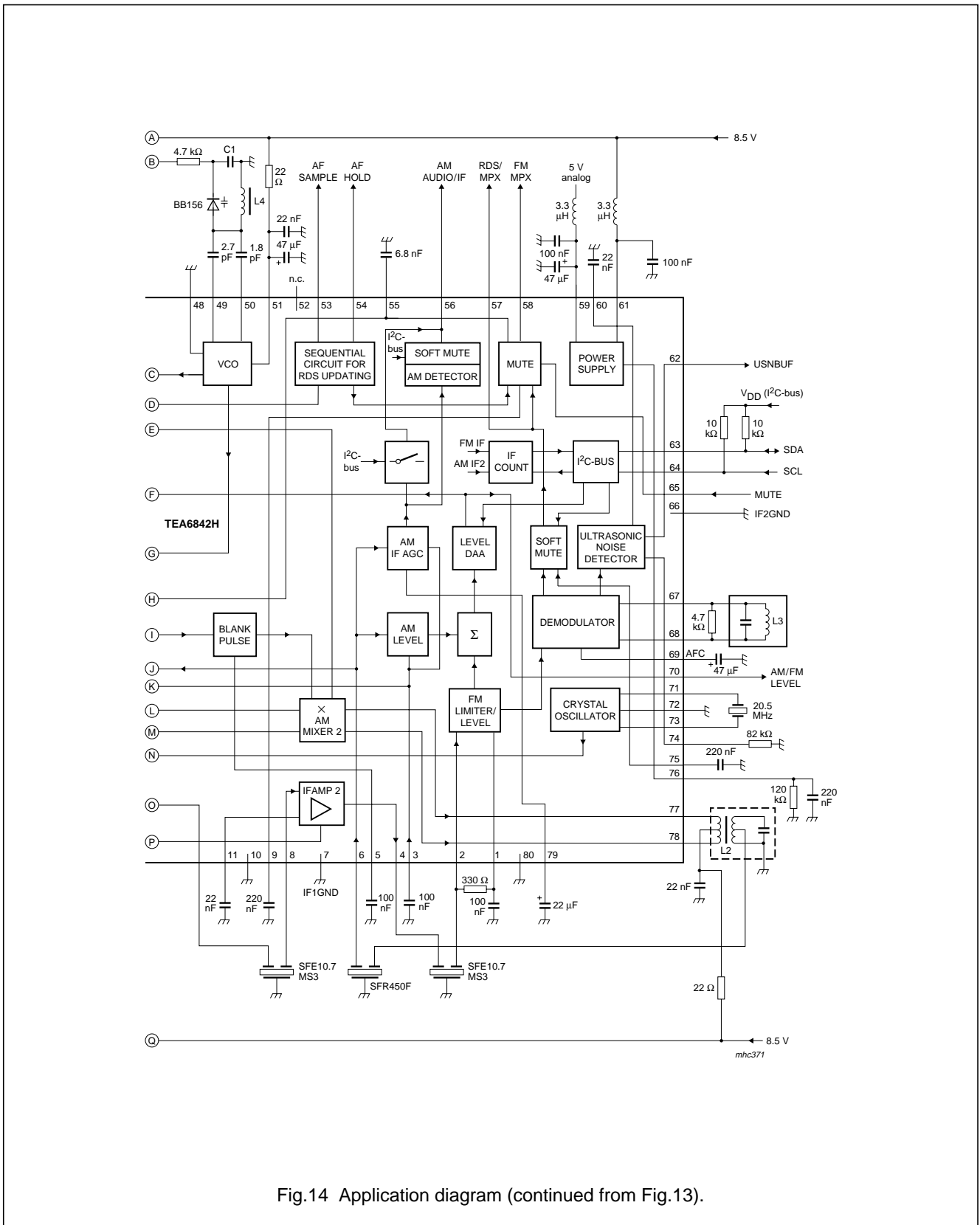
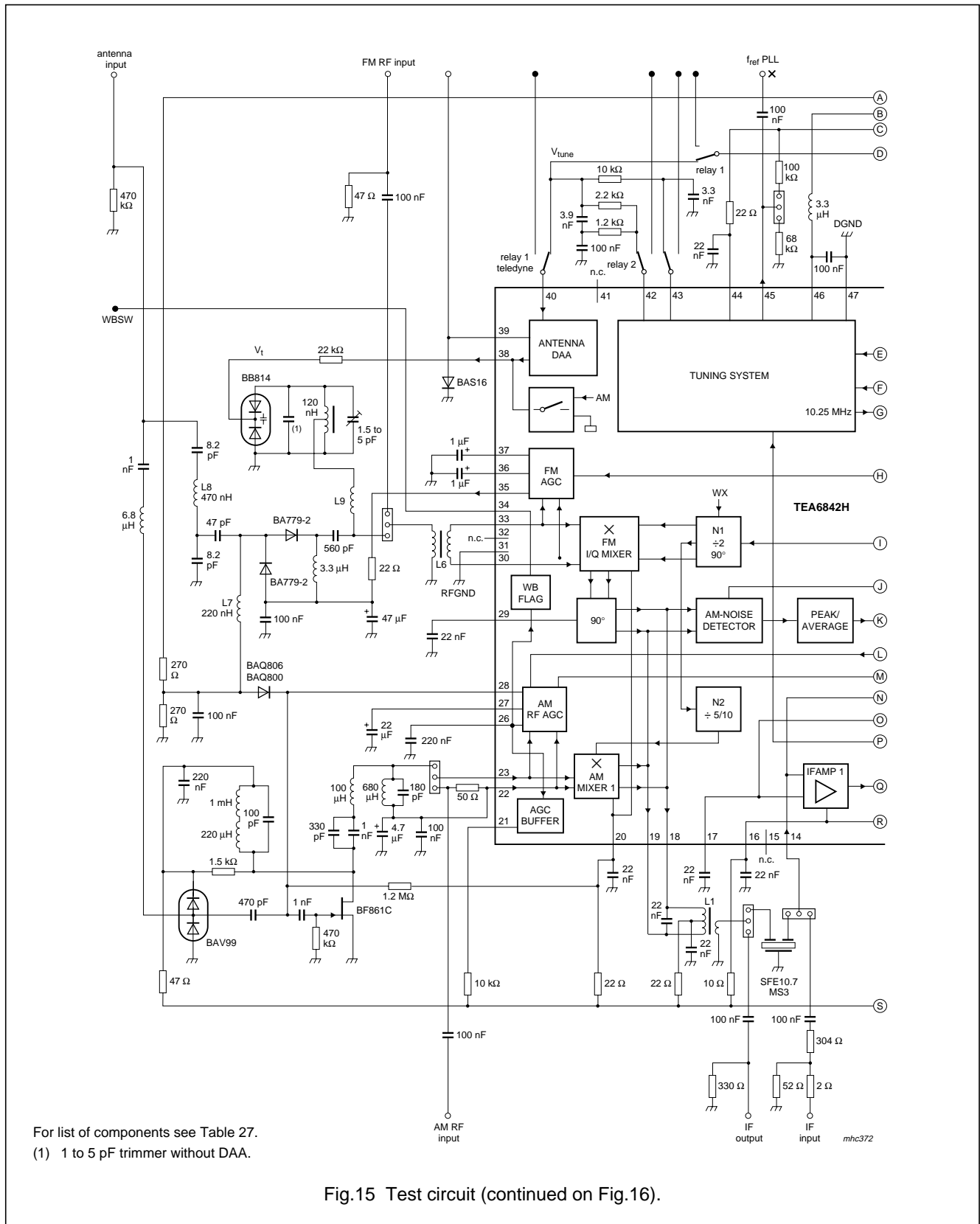


Fig.14 Application diagram (continued from Fig.13).

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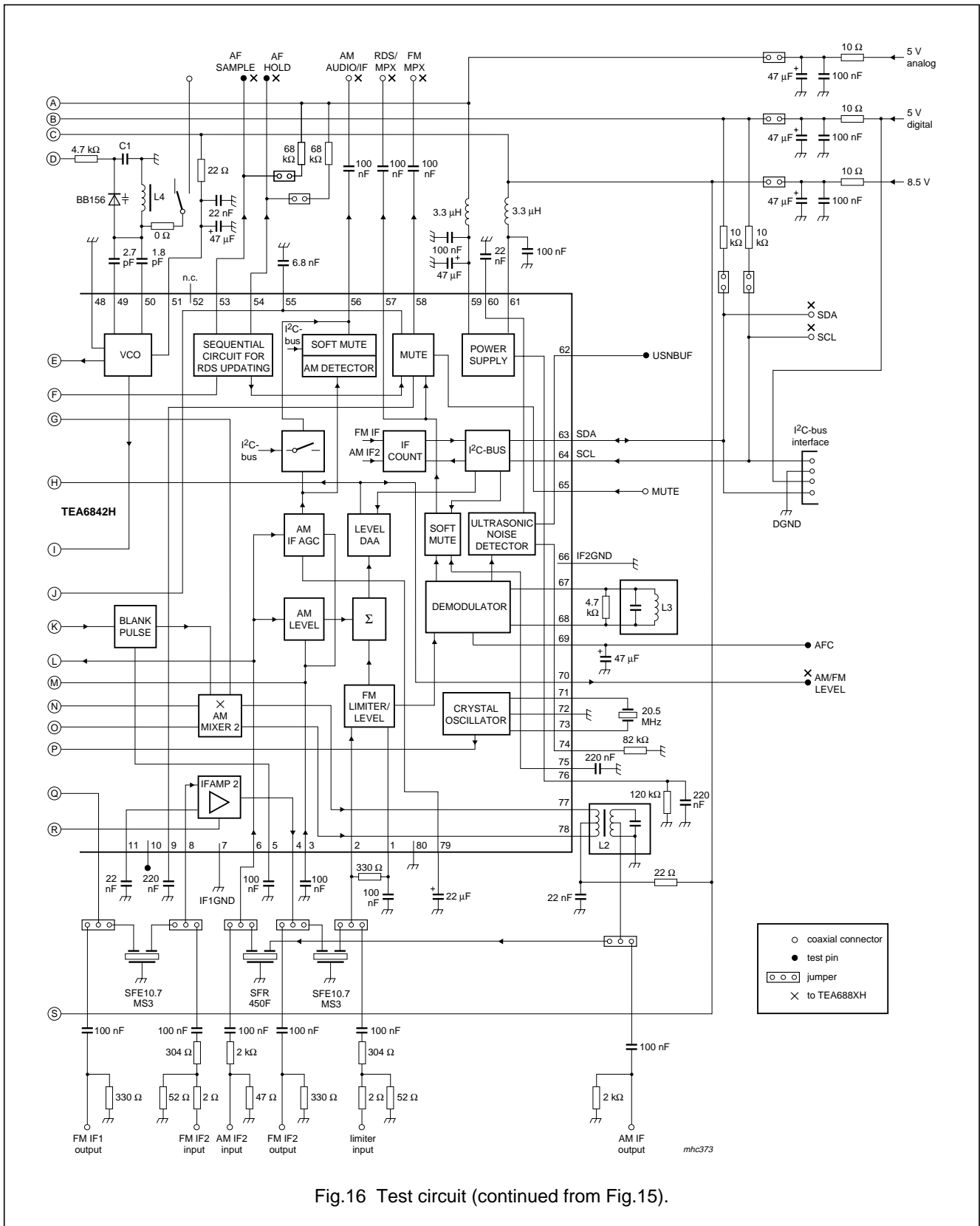


Fig.16 Test circuit (continued from Fig.15).

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Table 28 DC operating points

| SYMBOL | PIN | UNLOADED DC VOLTAGE (V) | | | | | |
|-------------------------|-----|--------------------------|------|------|--------------------------|-------------|----------------------|
| | | AM | | | FM | | |
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| FMLIMDEC | 1 | 2.5 | 3 | 3.5 | 2.5 | 2.8 | 3.1 |
| FMLIMIN | 2 | 2.5 | 3 | 3.5 | 2.5 | 2.8 | 3.1 |
| AMIF2DEC | 3 | 2.4 | 2.7 | 3.2 | floating | | |
| IFAMP2OUT | 4 | 7.2 | 7.9 | – | 3.4 | 3.9 | 4.4 |
| AMNBHOLD | 5 | 4.4 | 4.75 | 5.25 | 8 | 8.4 | – |
| AMIF2IN | 6 | 2.4 | 2.7 | 3.2 | floating | | |
| IF1GND | 7 | external 0 | | | external 0 | | |
| IFAMP2IN | 8 | 3 | 3.4 | 3.8 | 2.7 | 3.1 | 3.5 |
| C _{offset} | 9 | floating | | | 3 | 3.5 | 4 |
| IMUTEREF | 10 | external biased (ground) | | | external biased (ground) | | |
| IFAMP2DEC | 11 | 3 | 3.4 | 3.8 | 2.7 | 3.1 | 3.5 |
| IFAMP1OUT | 12 | 7.2 | 7.9 | – | 3.6 | 4 | 4.4 |
| IFAMP1IN | 14 | 2.4 | 2.8 | 3.2 | 2.3 | 2.7 | 3.1 |
| V _{DDA1} | 16 | external 8.5 | | | external 8.5 | | |
| IFAMP1DEC | 17 | 2.4 | 2.8 | 3.2 | 2.3 | 2.7 | 3.1 |
| MIX1OUT1 | 18 | external 8.5 | | | external 8.5 | | |
| MIX1OUT2 | 19 | external 8.5 | | | external 8.5 | | |
| V _{DDA2} | 20 | external 8.5 | | | external 8.5 | | |
| AMAGCBUF | 21 | external biased | | | floating | | |
| AMMIX1IN2 | 22 | 2.4 | 2.85 | 3.2 | floating | | |
| AMMIX1IN1 | 23 | external biased | | | floating | | |
| T1AMAGC | 26 | 0 | 2.8 | 4.6 | 0 (no WX) | 0.3 (no WX) | 0.5 (no WX) |
| T2AMAGC | 27 | 2.5 | 2.8 | 3.1 | floating | | |
| IAMAGC | 28 | external biased | | | external biased | | |
| V _{ref(FMMIX)} | 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 | | |
| FMMIXIN2 | 33 | 1 | 1.3 | 1.6 | 2.3 | 2.8 | 3.3 |
| WBSW | 34 | floating | | | 4 (WB) | 4.5 (WB) | 5 (WB) |
| | | | | | – (FM) | <0.5 (FM) | – (FM) |
| IFMAGC | 35 | external biased | | | 1.5 (external biasing) | – | 4 (external biasing) |
| T2FMAGC | 36 | 7.5 | 8 | 8.3 | 3.6 | 4.2 | 4.6 |
| T1FMAGC | 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 |

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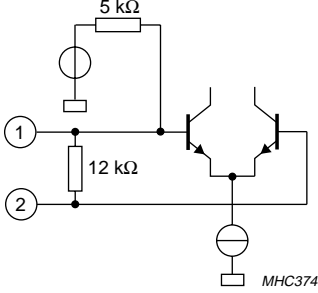
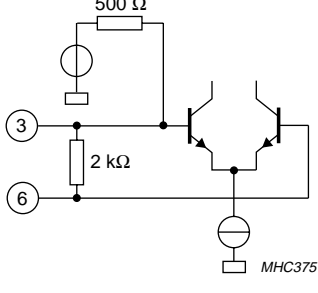
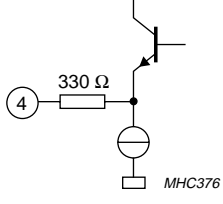
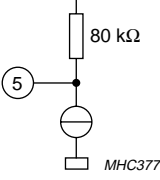
| SYMBOL | PIN | UNLOADED DC VOLTAGE (V) | | | | | |
|--------------------|-----|-------------------------|------|------|-----------------|-----------------|-----------------|
| | | AM | | | FM | | |
| | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| V _{tune} | 42 | 0 | – | 8.5 | 0 | – | 8.5 |
| CPOUT | 43 | 0 | – | 8.5 | 0 | – | 8.5 |
| V _{DDA3} | 44 | external 8.5 | | | external 8.5 | | |
| FREF | 45 | 3.2 | 3.4 | 3.7 | 3.2 | 3.4 | 3.7 |
| V _{DDD} | 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 | 7 | 5 | 6 | 7 |
| V _{DDA4} | 51 | external 8.5 | | | external 8.5 | | |
| AFSAMPLE | 53 | 0 | 0.2 | 0.5 | 0 | 0.2 | 0.5 |
| AFHOLD | 54 | open-collector | | | open-collector | | |
| TRDSMUTE | 55 | 1.9 | 2.2 | 2.5 | 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 | | |
| RDSMPX | 57 | floating | | | 2.6 | 3.1 | 3.3 |
| FMMPX | 58 | floating | | | 3 | 3.5 | 4 |
| V _{DDA5} | 59 | external 5 | | | external 5 | | |
| TUSN | 60 | floating | | | 0.5 | – | 5 |
| V _{DDA6} | 61 | external 8.5 | | | external 8.5 | | |
| USNBUF | 62 | floating | | | 0.5 | – | 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 |
| MUTE | 65 | floating | | | external biased | | |
| IF2GND | 66 | external 0 | | | external 0 | | |
| QDET1 | 67 | floating | | | 3.6 | 4.1 | 4.6 |
| QDET2 | 68 | floating | | | 3.6 | 4.1 | 4.6 |
| C _{AFC} | 69 | floating | | | 1.2 | 3.4 | 4.1 |
| V _{level} | 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 | | |
| XTAL2 | 73 | 1.7 | 2.1 | 2.5 | 1.7 | 2.1 | 2.5 |
| USNSENS | 74 | floating | | | external biased | | |
| TMUTE | 75 | 0 | – | 5 | 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 | | |
| C _{AGC} | 79 | 4.1 | 4.4 | 4.7 | 4 | 4.5 | 5 |

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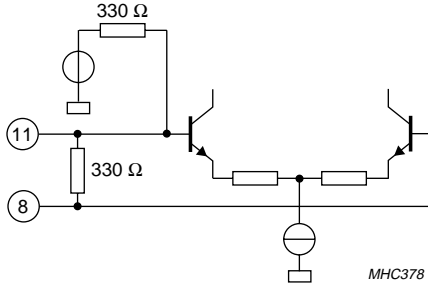
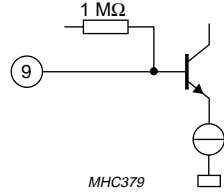
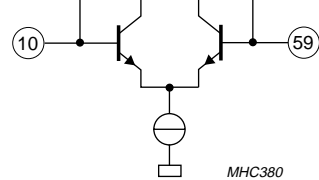
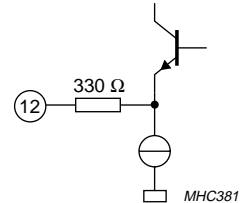
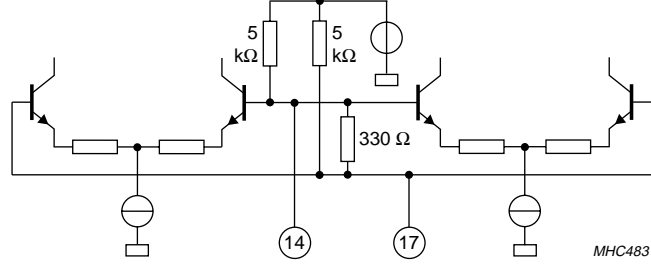
14 INTERNAL CIRCUITRY

Table 29 Equivalent pin circuits

| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|-----------|--|
| 1 | FMLIMDEC |  |
| 2 | FMLIMIN | |
| 3 | AMIF2DEC |  |
| 6 | AMIF2IN | |
| 4 | IFAMP2OUT |  |
| 5 | AMNBHOLD |  |
| 7 | IF1GND | |

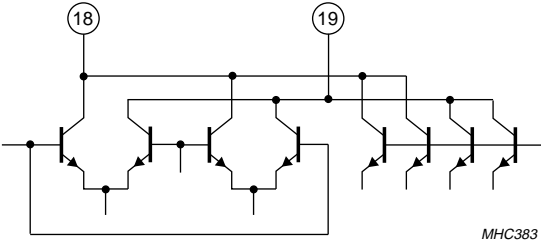
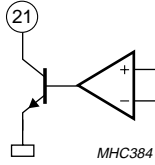
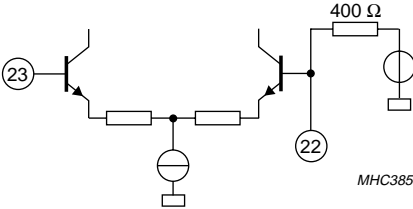
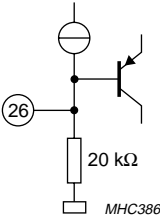
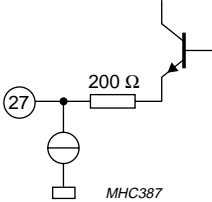
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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|---------------------|--|
| 8 | IFAMP2IN |  |
| 11 | IFAMP2DEC | |
| 9 | C _{offset} |  |
| 10 | IMUTEREF |  |
| 12 | IFAMP1OUT |  |
| 13 | n.c. | |
| 14 | IFAMP1IN |  |
| 17 | IFAMP1DEC | |
| 15 | n.c. | |

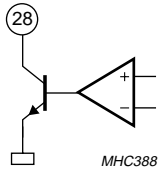
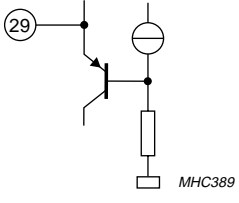
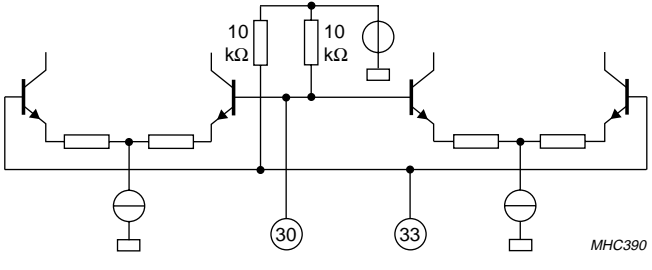
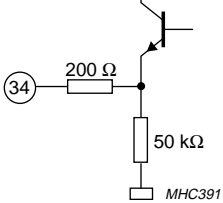
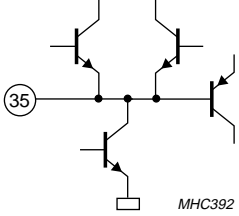
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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|------------|--|
| 16 | V_{DDA1} | |
| 18 | MIX1OUT1 |  <p>MHC383</p> |
| 19 | MIX1OUT2 | |
| 20 | V_{DDA2} | |
| 21 | AMAGCBUF |  <p>MHC384</p> |
| 22 | AMMIX1IN2 |  <p>MHC385</p> |
| 23 | AMMIX1IN1 | |
| 24 | n.c. | |
| 25 | n.c. | |
| 26 | T1AMAGC |  <p>MHC386</p> |
| 27 | T2AMAGC |  <p>MHC387</p> |

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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|------------------|--|
| 28 | IAMAGC |  |
| 29 | $V_{ref(FMMIX)}$ |  |
| 30 | FMMIXIN1 |  |
| 33 | FMMIXIN2 | |
| 31 | RFGND | |
| 32 | n.c. | |
| 34 | WBSW |  |
| 35 | IFMAGC |  |

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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|---------|--------------------|
| 36 | T2FMAGC | |
| 37 | T1FMAGC | |
| 38 | DAAOUT | |
| 39 | DAATD | |

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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|------------|--------------------|
| 40 | DAAIN | |
| 41 | n.c. | |
| 42 | V_{tune} | |
| 43 | CPOUT | |
| 44 | V_{DDA3} | |
| 45 | FREF | |
| 46 | V_{DDD} | |
| 47 | DGND | |

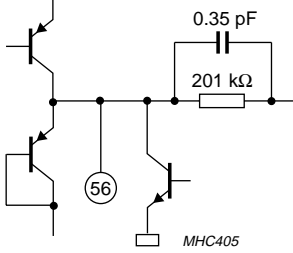
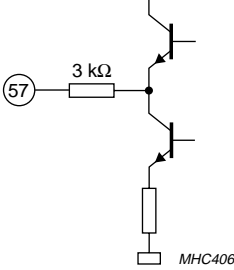
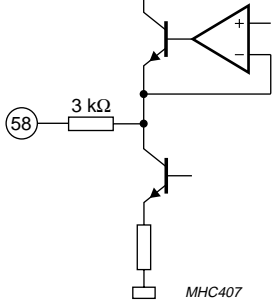
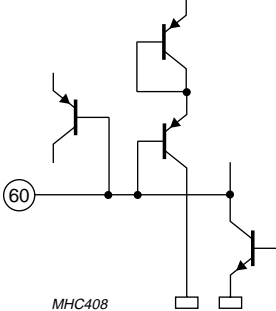
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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|-------------------|--------------------|
| 48 | VCOGND | |
| 49 | OSCFDB | |
| 50 | OSCTNK | |
| 51 | V _{DDA4} | |
| 52 | n.c. | |
| 53 | AFSAMPLE | |
| 54 | AFHOLD | |
| 55 | TRDSMUTE | |

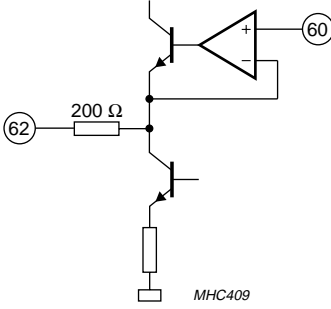
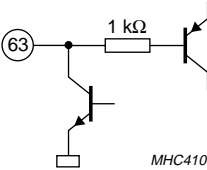
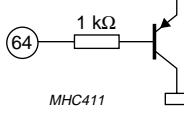
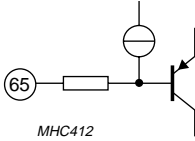
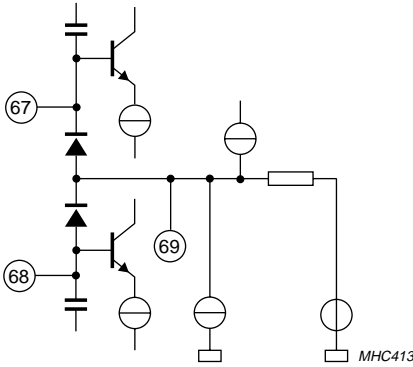
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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|-------------------|--|
| 56 | AMAFIF2 |  |
| 57 | RDSMPX |  |
| 58 | FMMPX |  |
| 59 | V _{DDA5} | |
| 60 | TUSN |  |
| 61 | V _{DDA6} | |

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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|------------------|--|
| 62 | USNBUF |  <p>MHC409</p> |
| 63 | SDA |  <p>MHC410</p> |
| 64 | SCL |  <p>MHC411</p> |
| 65 | MUTE |  <p>MHC412</p> |
| 66 | IF2GND | |
| 67 | QDET1 | |
| 68 | QDET2 | |
| 69 | C _{AFC} |  <p>MHC413</p> |

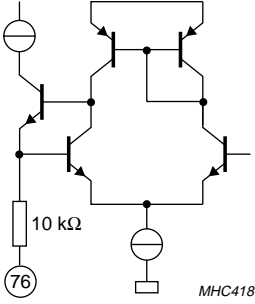
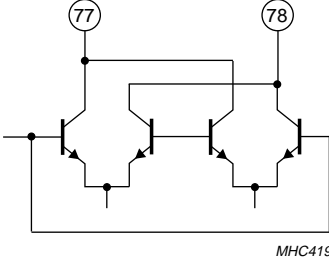
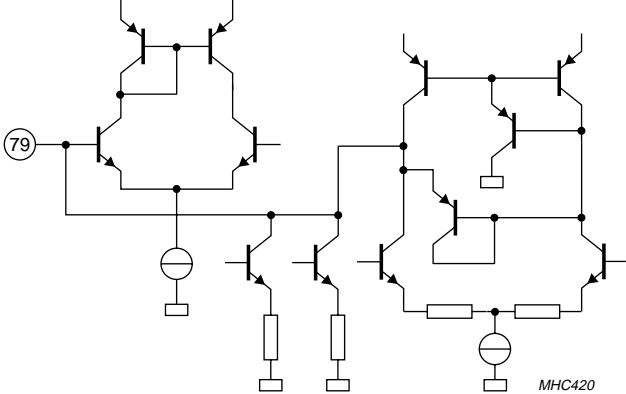
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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|-------------|--------------------|
| 70 | V_{level} | |
| 71 | XTAL1 | |
| 72 | XTALGND | |
| 73 | XTAL2 | |
| 74 | USNSENS | |
| 75 | TMUTE | |

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| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|------------------|--|
| 76 | IREF |  |
| 77 | AMMIX2OUT1 |  |
| 78 | AMMIX2OUT2 | |
| 79 | C _{AGC} |  |
| 80 | n.c. | |

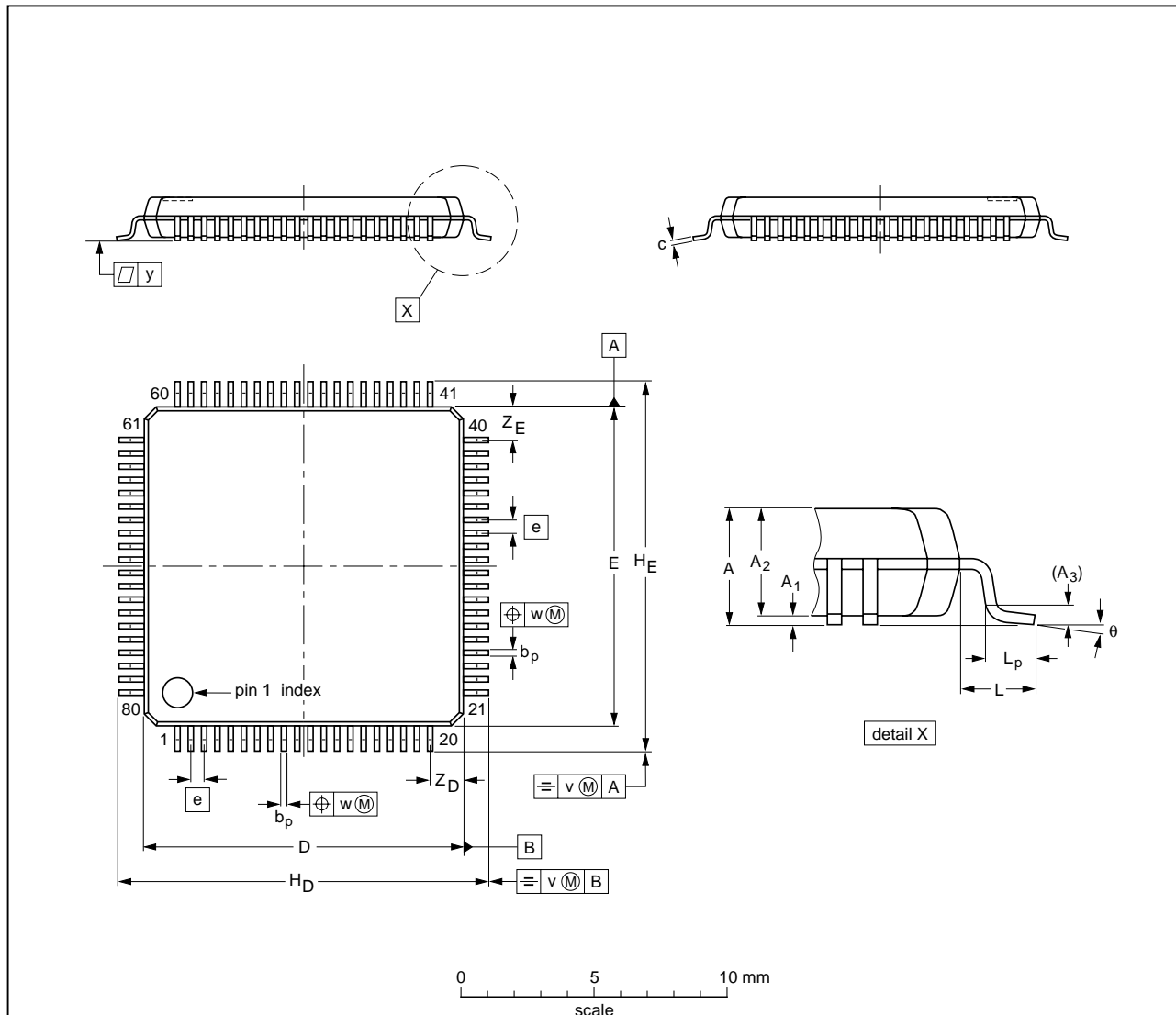
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15 PACKAGE OUTLINE

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

Note

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

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

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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 225 °C (SnPb process) or below 245 °C (Pb-free process)
 - for all BGA, HTSSON-T and SSOP-T packages
 - for packages with a thickness ≥ 2.5 mm
 - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm³ so called thick/large packages.
- below 240 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm³ 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 ⁽¹⁾ | SOLDERING METHOD | |
|--|-----------------------------------|-----------------------|
| | WAVE | REFLOW ⁽²⁾ |
| BGA, HTSSON..T ⁽³⁾ , LBGA, LFBGA, SQFP, SSOP..T ⁽³⁾ , TFBGA, USON, VFBGA | not suitable | suitable |
| DHVQFN, HBCC, HBGA, HLQFP, HSO, HSOP, HSQFP, HSSON, HTQFP, HTSSOP, HVQFN, HVSON, SMS | not suitable ⁽⁴⁾ | suitable |
| PLCC ⁽⁵⁾ , SO, SOJ | suitable | suitable |
| LQFP, QFP, TQFP | not recommended ⁽⁵⁾⁽⁶⁾ | suitable |
| SSOP, TSSOP, VSO, VSSOP | not recommended ⁽⁷⁾ | suitable |
| CWQCCN..L ⁽⁸⁾ , PMFP ⁽⁹⁾ , WQCCN..L ⁽⁸⁾ | not suitable | 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° 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.
- Image sensor packages in principle should not be soldered. They are mounted in sockets or delivered pre-mounted on flex foil. However, the image sensor package can be mounted by the client on a flex foil by using a hot bar soldering process. The appropriate soldering profile can be provided on request.
- Hot bar or manual soldering is suitable for PMFP packages.

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17 DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS ⁽¹⁾ | PRODUCT STATUS ⁽²⁾⁽³⁾ | 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. |
| II | Preliminary data | Qualification | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product. |
| III | Product data | Production | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

18 DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

19 DISCLAIMERS

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TEA6842H**20 PURCHASE OF PHILIPS I²C COMPONENTS**

Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

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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.

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