



TDA7540N

AM/FM car radio tuner IC with stereo decoder and intelligent selectivity system (ISS)

Features

FM-part

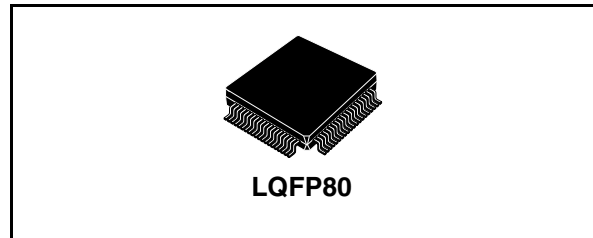
- RF AGC generation by RF and IF detection
- I/Q mixer for 1st FM IF 10.7MHz with image rejection
- Mixer for 2nd IF 450kHz
- Internal 450kHz bandpass filter with bandwidth control by ISS
- Fully integrated FM-demodulator with spike cancellation

AM-part

- Wide and narrow AGC generation
- Mixer for 1st IF 10.7MHz, AM upconversion
- Mixer for 2nd IF 450kHz, AM downconversion
- Integrated AM-demodulator
- AM IF- and audio noise blanking

Stereodecoder

- PLL with adjustment free, fully integrated VCO
- Automatic pilot dependent mono/stereo switching
- Programmable ROLL-OFF compensation
- High cut and stereo blend-characteristics programmable
- Dedicated RDS-mute
- Internal noise blanker with several threshold controls



Additional features

- VCO for world tuning range
- High performance fast PLL for RDS-System
- IF counter for FM and AM with search stop signal
- Quality detector for level, deviation, adjacent channel and multipath
- ISS (intelligent selectivity system) for cancellation of adjacent channel and noise influences
- Adjacent channel mute
- Fully electronic alignment
- All functions I²C-Bus controlled

Description

The TDA7540N is a high performance tuner circuit for AM/FM car radio. It contains mixer, IF amplifier, demodulator for AM and FM, stereodecoder, quality detection, ISS filter and PLL synthesizer with IF counter on a single chip. Use of BICMOS technology allows the implementation of several tuning functions and a minimum of external components.

Table 1. Device summary

| Order code | Temp range, °C | Package | Packing |
|------------|----------------|----------------------|---------------|
| TDA7540N | -40 to 85°C | LQFP80 (14x14x1.4mm) | Tube |
| TDA7540NTR | -40 to 85°C | LQFP80 (14x14x1.4mm) | Tape and reel |

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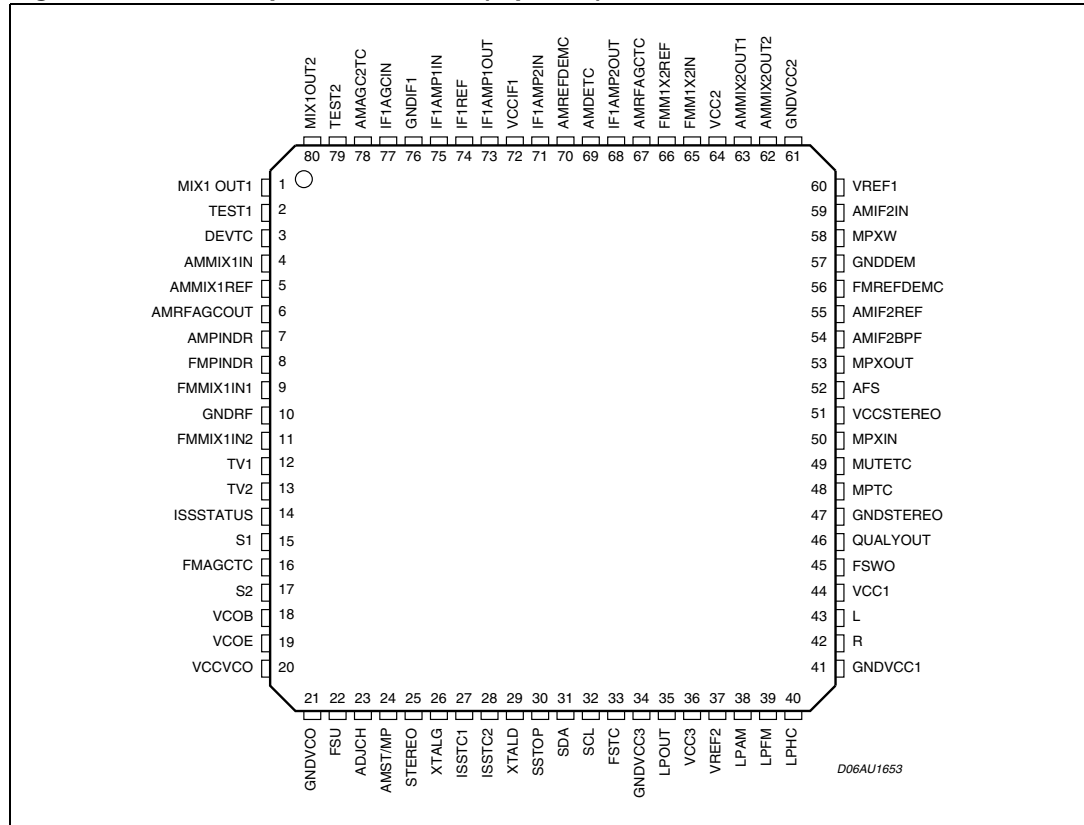
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2 Pins description and connection diagrams

2.1 LQFP80 pins connection diagram

Figure 2. LQFP80 pins connection (top view)



2.2 Pin description

Table 2. Pin description

| Pin # | Pin name | Function |
|-------|------------|----------------------------------|
| 1 | MIX1OUT1 | Mixer tank 10.7MHz |
| 2 | TEST1 | Testing I/O pin |
| 3 | DEVTC | Deviation detector time constant |
| 4 | AMMIX1IN | AM mixer1 input |
| 5 | AMMIX1REF | AM mixer1 reference |
| 6 | AMRFAGCOUT | Output AM RF AGC |
| 7 | AMPINDR | AM pin diode driver output |
| 8 | FMPINDR | FM pin diode driver output |
| 9 | FMMIX1IN1 | FM mixer1 input1 |

Table 2. Pin description (continued)

| Pin # | Pin name | Function |
|-------|-----------|---|
| 10 | GDRF | RF ground |
| 11 | FMMIX1IN2 | FM mixer1 input2 |
| 12 | TV1 | Tuning voltage preselection1 |
| 13 | TV2 | Tuning voltage preselection2 |
| 14 | ISSSTATUS | ISS filter status output |
| 15 | S1 | Free programmable switching output |
| 16 | FMAGCTC | FM AGC time constant |
| 17 | S2 | Free programmable switching output |
| 18 | VCOB | VCO input base |
| 19 | VCOE | VCO output emitter |
| 20 | VCCVCO | VCO supply |
| 21 | GNDVCO | VCO ground |
| 22 | FSU | Unweighted fieldstrength output |
| 23 | ADJCH | Ident. adjacent channel output |
| 24 | AMST/MP | AM stereo output / ident. multipath output |
| 25 | STEREO | Stereo information indication output |
| 26 | XTALG | Xtal oscillator to MOS gate |
| 27 | ISSTC1 | Time constant1 ISS filter switch |
| 28 | ISSTC2 | Time constant2 ISS filter switch |
| 29 | XTALD | Xtal oscillator to MOS drain |
| 30 | SSTOP | Search stop output |
| 31 | SDA | I ² C-Bus data |
| 32 | SCL | I ² C-Bus clock |
| 33 | FSTC | S-meter filtering capacitor |
| 34 | GNDVCC3 | VCC3 ground |
| 35 | LPOUT | Op amp output to PLL loop filters |
| 36 | VCC3 | Supply tuning voltage |
| 37 | VREF2 | Voltage reference for PLL op amp |
| 38 | LPAM | Op amp input to PLL loop filters AM |
| 39 | LPFM | Op amp input to PLL loop filters FM |
| 40 | LPHC | High current PLL loop filter input |
| 41 | GNDVCC1 | Digital ground |
| 42 | R | Stereodecoder output right |
| 43 | L | Stereodecoder output left |
| 44 | VCC1 | Digital supply |
| 45 | FSWO | Weighted fieldstrength output with programmable DC offset |
| 46 | Qualyout | Stereodecoder quality output |

Table 2. Pin description (continued)

| Pin # | Pin name | Function |
|-------|------------|------------------------------------|
| 47 | GNDSTEREO | Stereodecoder ground |
| 48 | MPTC | Multipath time constant |
| 49 | MUTETC | Weak signal mute time constant |
| 50 | MPXIN | Stereodecoder Input |
| 51 | VCCSTEREO | Stereodecoder supply |
| 52 | AFS | Alternative frequency search drive |
| 53 | MPX/AFAM | MPX output / AM AF output |
| 54 | AMIF2BPF | AM IF2 bandpass filter |
| 55 | AMIF2REF | Reference voltage AM IF2 amplifier |
| 56 | FMREFDEMC | FM demodulator reference |
| 57 | GNDDEM | Ground FM demodulator |
| 58 | MPXW | MPX Output without ISS filtering |
| 59 | AMIF2IN | Input AM IF2 |
| 60 | VREF1 | Reference 5V |
| 61 | GNDVCC2 | Analog ground |
| 62 | AMMIX2OUT2 | AM Tank 450kHz |
| 63 | AMMIX2OUT1 | AM Tank 450kHz |
| 64 | VCC2 | Analog supply |
| 65 | FMMIX2IN | FM IF1 mixer2 input |
| 66 | FMMIX2REF | FM IF1 mixer2 reference |
| 67 | AMRFAGCTC | AM RF AGC time constant |
| 68 | IF1AMP2OUT | IF1 amplifier2 output |
| 69 | AMDETC | AM detector capacitor |
| 70 | AMREFDEMC | AM demodulator reference |
| 71 | IF1AMP2IN | IF1 amplifier2 input |
| 72 | VCCIF1 | IF1 supply |
| 73 | IF1AMP1OUT | IF1 amplifier1 output |
| 74 | IF1REF | IF1 amplifier reference |
| 75 | IF1AMP1IN | IF1 amplifier1 input |
| 76 | GNDIF1 | IF1 ground |
| 77 | IF1AGCIN | IF1 AGC input |
| 78 | AMAGC2TC | AM AGC2 time constant |
| 79 | TEST2 | Testing I/O pin |
| 80 | MIX1OUT2 | Mixer tank 10.7MHz |

3 Electrical specifications

3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

| Symbol | Parameter | Value | Units |
|-----------|---------------------|------------|-------|
| V_S | Supply voltage | 9.5 | V |
| T_{amb} | Ambient temperature | -40 to 85 | °C |
| T_{stg} | Storage temperature | -55 to 150 | °C |

3.2 Thermal data

Table 4. Thermal data

| Symbol | Parameter | Value | Unit |
|-----------------|--|---------|------|
| $R_{th(j-amb)}$ | Thermal resistance junction to ambient | Max. 55 | °C/W |

3.3 Electrical characteristics

3.3.1 Globals

Table 5. Globals electrical characteristics

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|------------------------|-----------------|------|------|------|------|
| Supply | | | | | | |
| V_{CC1} | Digital supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CC2} | Analog supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CC3} | Analog tuning voltage | | 7.7 | 8.5 | 9 | V |
| V_{CCVCO} | VCO supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CCMIX1} | MIX1 supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CCMIX2} | MIX2 supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CCIF1} | IF1 supply voltage | | 7.7 | 8.5 | 9 | V |
| V_{CCST} | Stereo supply voltage | | 7.7 | 8.5 | 9 | V |
| I_{CC1} | Supply current | FM ON | | 10 | 12 | mA |
| I_{CC1} | Supply current | AM ON | | 10 | 12 | mA |
| I_{CC2} | Supply current | FM ON / VCO:3 | | 65 | 78 | mA |
| I_{CC2} | Supply current | AM ON | | 75 | 90 | mA |

Table 5. Globals electrical characteristics (continued)

($T_{amb} = 25^{\circ}C$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V$, $f_{Xtal} = 10.25MHz$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|----------------------------|------------------|------|------|------|---------|
| I_{CC3} | Supply current | | | 2 | 3 | mA |
| I_{CCVCO} | Supply current | | | 8 | 10 | mA |
| I_{CCMIX1} | Supply current | FM ON | | 8 | 10 | mA |
| I_{CCMIX1} | Supply current | AM ON | | 7 | 8.5 | mA |
| I_{CCMIX2} | Supply current | AM ON | | 7 | 8.5 | mA |
| I_{CCIF1} | Supply current | | | 5 | 6.5 | mA |
| I_{CCST} | Supply current | | | 12 | 13.5 | mA |
| Reference voltages | | | | | | |
| V_{REF1} | Internal reference voltage | $I_{REF1} = 0mA$ | 4.8 | 5 | 5.2 | V |
| V_{REF2} | Internal reference voltage | $I_{REF2} = 0mA$ | 2.4 | 2.5 | 2.6 | V |
| I²C-Bus interface | | | | | | |
| f_{SCL} | Clock frequency | | | | 400 | kHz |
| V_{IL} | Input low voltage | | | | 1 | V |
| V_{IH} | Input high voltage | | 3 | | 5 | V |
| I_{IN} | Input current | | -5 | | 5 | μA |
| V_O | Output acknowledge voltage | $I_O = 1.6mA$ | | | 0.4 | V |

3.3.2 FM section

Table 6. FM section electrical characteristics

($T_{amb} = 25^{\circ}C$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V$, $f_{RF} = 98MHz$, $dev = 40kHz$, $f_{MOD} = 1kHz$, $f_{Xtal} = 10.25MHz$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---------------------------------|---|------|------|------|--------------|
| Wide band RF AGC | | | | | | |
| V_{9-11} | Lower threshold start | $V_{16} = 2.5V$ | 83 | 85 | 87 | $dB_{\mu V}$ |
| V_{9-11} | Upper threshold start | $V_{16} = 2.5V$ | 94 | 96 | 98 | $dB_{\mu V}$ |
| Narrow band IF & keying AGC | | | | | | |
| V_{77} | Lower threshold start | KAGC = off, $V_{9-11} = 0mV_{RMS}$ | 84 | 86 | 88 | $dB_{\mu V}$ |
| V_{77} | Upper threshold start | KAGC = off, $V_{9-11} = 0mV_{RMS}$ | 96 | 98 | 100 | $dB_{\mu V}$ |
| V_{77} | Lower threshold start with KAGC | KAGC = max, $V_{9-11} = 0mV_{RMS}$, $\Delta f_{IF} = 300KHz$ | 96 | 98 | 100 | $dB_{\mu V}$ |

Table 6. FM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $\text{dev} = 40\text{kHz}$, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------------------------------|-----------------------------|--|-------|-------|-----------------------------------|------------------|
| V_{22} | Startpoint KAGC | KAGC = max, $V_{9-11} = 0\text{mV}_{\text{RMS}}$, $\Delta f_{IF} = 300\text{kHz}$ f_{IF1} generates FS level at V_{22} | | 2.2 | | V |
| Δ | Control range KAGC | $\Delta V_{22} = +0.8\text{V}$ | | 16 | | dB |
| R_{IN} | Input resistance | | 10 | 13 | 16 | $\text{k}\Omega$ |
| C_{IN} | Input capacitance | | | 2.5 | | pF |
| AGC time constant output | | | | | | |
| V_{16} | Max. AGC output voltage | $V_{9-11} = 0\text{mV}_{\text{RMS}}$ | | | $V_{\text{REF1}} + V_{\text{BE}}$ | V |
| V_{16} | Min. AGC output voltage | $V_{9-11} = 50\text{mV}_{\text{RMS}}$ | | | 0.5 | V |
| I_{16} | Min. AGC charge current | $V_{9-11} = 0\text{mV}_{\text{RMS}}$, $V_{16} = 2.5\text{V}$ | -16.5 | -12.5 | -8.5 | μA |
| I_{16} | Max. AGC discharge current | $V_{9-11} = 50\text{mV}_{\text{RMS}}$, $V_{16} = 2.5\text{V}$ | 0.8 | 1.25 | 1.68 | mA |
| AGC pin diode driver output | | | | | | |
| I_8 | AGC OUT, current min. | $V_{9-11} = 0\text{mV}_{\text{RMS}}$, $V_8 = 2.5\text{V}$ | | 12 | | μA |
| I_8 | AGC OUT, current max. | $V_{9-11} = 50\text{mV}_{\text{RMS}}$, $V_8 = 2.5\text{V}$ | -22 | -17 | -12 | mA |
| I/Q Mixer1 (10.7MHz) | | | | | | |
| R_{IN} | Input resistance | differential | | 10 | | $\text{k}\Omega$ |
| C_{IN} | Input capacitance | differential | | 4 | | pF |
| R_{OUT} | Output resistance | differential | 100 | | | $\text{k}\Omega$ |
| $V_{9,11}$ | Input DC bias | | 2.2 | 2.5 | 2.8 | V |
| g_m | Conversion transconductance | | | 17 | | ms |
| F | Noise figure | 400 Ω generator resistance | | 3 | | dB |
| $CP_{1\text{dB}}$ | 1dB compression point | referred to diff. mixer input | | 100 | | dB μV |
| IIP3 | 3rd order intermodulation | | | 122 | | dB μV |
| IQP | I/Q phase adjust | PH | -7 | | +8 | $^{\circ}$ |
| IRR | Image rejection ratio | ratio wanted/image | 30 | 40 | | dB |
| IRR | Image rejection ratio | with phase adjust | 40 | 46 | | dB |
| IF1 Amplifier1 +2 (10.7MHz) | | | | | | |
| G2 | Gain | | 5 | 6 | 7 | dB |
| $G_{1\text{min}}$ | Min. gain | IFG1 | 7.5 | 9 | 10.5 | dB |
| $G_{1\text{max}}$ | Max. gain | IFG1 | 16 | 18 | 20 | dB |

Table 6. FM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $\text{dev} = 40\text{kHz}$, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---------------------------|--|------|------|------|-------------------|
| R_{IN} | Input resistance | | 260 | 330 | 400 | W |
| R_{OUT} | Output resistance | | 260 | 330 | 400 | W |
| CP_{1dB} | 1dB compression point | referred to 330 Ω input | | 105 | | dB μ V |
| IIP3 | 3rd order Intermodulation | ref. to 330 Ω input, 9dB gain | | 126 | | dB μ V |
| Mixer2 (450kHz) | | | | | | |
| R_{IN} | Input impedance | | 260 | 330 | 400 | Ω |
| V_{65} | Max. input voltage | | | 119 | | dB μ V |
| V_{65} | Limiting sensitivity | S/N = 20dB | | 28 | | dB μ V |
| G | Mixer gain | | | 18 | | dB |
| Limiter 1 (450kHz) | | | | | | |
| $G_{Limiter}$ | Gain | | | 80 | | dB |
| Demodulator, audio output | | | | | | |
| THD | | Dev.= 75kHz, $V_{65} = 10\text{mV}_{RMS}$ | | | 0.1 | % |
| V_{MPX} | MPX output signal | Dev.= 75kHz | 400 | 500 | 600 | mV_{RMS} |
| R_{OUT} | Output impedance | | | 50 | | Ω |
| $ \Delta V _{min}$ | DC offset fine adjust | DEM, MENA=1 | | 8.5 | | mV |
| $ \Delta V _{max}$ | DC offset fine adjust | DEM, MENA=1 | | 264 | | mV |
| S/N | | Dev.= 40kHz, $V_{65} = 10\text{mV}_{RMS}$ | | 76 | | dB |
| V_{MPXW} | MPXW output signal | Dev.= 75kHz | 280 | 350 | 420 | mV_{RMS} |
| Quality detection | | | | | | |
| S-meter, unweighted fieldstrength | | | | | | |
| V_{65} | Min. input voltage MIX2 | | | 30 | | dB μ V |
| V_{22} | Fieldstrength output | $V_{65} = 20\text{dB}\mu\text{V}$ | | 0.1 | | V |
| V_{22} | Fieldstrength output | $V_{65} = 80\text{dB}\mu\text{V}$, SMSL = 0 | 2.2 | 2.6 | 3.0 | V |
| ΔV_{22} | Voltage per decade | SMSL = 0 | 0.8 | 1 | 1.2 | V |
| ΔV_{22} | Voltage per decade | SMSL = 1 | 1.2 | 1.5 | 1.8 | V |
| ΔV_{22} | S-meter offset | SL, SMSL=1 | -15 | | 15 | dB |
| R_{OUT} | Output impedance | | 280 | 400 | 520 | Ω |
| T_K | Coefficient temperature | | | 0 | | ppm/K |

Table 6. FM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $\text{dev} = 40\text{kHz}$, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|-------------------------|-----------------------------------|------|------|------|------------|
| Adjacent channel gain | | | | | | |
| G_{min} | Gain minimum | ACG=0 | | 32 | | dB |
| G_{max} | Gain maximum | ACG=1 | | 38 | | dB |
| Adjacent channel filter | | | | | | |
| f_{HP} | -3dB frequency highpass | ACF=0 | | 100 | | kHz |
| f_{BP} | Centre frequency | ACF=1 | | 100 | | kHz |
| f_{-20dB} | Attenuation 20dB | | | 70 | | kHz |
| Adjacent channel output | | | | | | |
| V_{23} | Output voltage low | | | 0.1 | | V |
| V_{23} | Output voltage high | | | 4.9 | | V |
| R_{OUT} | Output resistance | | 3.5 | 4.5 | 5.5 | k Ω |
| Multipath channel gain | | | | | | |
| G_{min} | Gain minimum | MPG=0 | | 12 | | dB |
| G_{max} | Gain maximum | MPG=1 | | 23 | | dB |
| Multipath bandpass filter | | | | | | |
| f_{BP19} | Centre frequency | MPF=0 | | 19 | | kHz |
| f_{BP31} | Centre frequency | MPF=1 | | 31 | | kHz |
| Q | Quality factor | | 5 | 8 | 10 | |
| Multipath output | | | | | | |
| V_{24} | Output voltage low | | | 0.1 | | V |
| V_{24} | Output voltage high | | | 4.9 | | V |
| R_{OUT} | Output resistance | | | 3 | | k Ω |
| ISS (intelligent Selectivity System) | | | | | | |
| Filter 450kHz | | | | | | |
| f_{centre} | Centre frequency | $f_{REF_intern} = 450\text{kHz}$ | | 450 | | kHz |
| BW 3dB | Bandwidth, -3dB | ISS80 = 1 | 70 | 80 | 90 | kHz |
| BW 20dB | Bandwidth, -20dB | ISS80 = 1 | 132 | 150 | 168 | kHz |
| BW 3dB | Bandwidth, -3dB | ISS80 = 0 | 106 | 120 | 135 | kHz |
| BW 20dB | Bandwidth, -20dB | ISS80 = 0 | 220 | 250 | 280 | kHz |
| BW 3dB | Bandwidth weather band | ISS30 = 1 | 20 | 30 | 40 | kHz |
| BW 20dB | -20dB weather band | ISS30 = 1 | 56 | 80 | 104 | kHz |

Table 6. FM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}C$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V$, $f_{RF} = 98MHz$, $dev = 40kHz$, $f_{MOD} = 1kHz$, $f_{Xtal} = 10.25MHz$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|----------------------------|------------------|------|------|------|---------|
| Adjacent channel ISS filter threshold | | | | | | |
| V_{NTH} | Internal low threshold | ACNTH | | 0 | | V |
| V_{NTH} | Internal high threshold | ACNTH | 0.24 | 0.3 | 0.36 | V |
| V_{WTH} | Internal low threshold | ACWTH | 0.2 | 0.25 | 0.3 | V |
| V_{WTH} | Internal high threshold | ACWTH | 0.76 | 0.95 | 1.14 | V |
| Multipath threshold | | | | | | |
| V_{THMP} | Internal low threshold | MPTH | 0.40 | 0.50 | 0.60 | V |
| V_{THMP} | Internal high threshold | MPTH | 1.0 | 1.25 | 1.5 | V |
| ISS filter time constant | | | | | | |
| $I_{27, I_{28}}$ | Charge current low mid | TISS, ISSCTL = 1 | -96 | -74 | -54 | μA |
| $I_{27, I_{28}}$ | Charge current high mid | TISS, ISSCTL = 1 | | -60 | | μA |
| $I_{27, I_{28}}$ | Charge current low narrow | TISS, ISSCTL = 1 | -165 | -124 | -87 | μA |
| $I_{27, I_{28}}$ | Charge current high narrow | TISS, ISSCTL = 1 | | -110 | | μA |
| $I_{27, I_{28}}$ | Discharge current low | TISS, ISSCTL = 0 | -0.4 | 1 | 2.0 | μA |
| $I_{27, I_{28}}$ | Discharge current high | TISS, ISSCTL = 0 | 10 | 15 | 20 | μA |
| $V_{27, V_{28}}$ | Low voltage | ISSCTL = 0 | | 0.1 | 0.2 | V |
| $V_{27, V_{28}}$ | High voltage | ISSCTL = 1 | 4.6 | 4.9 | | V |
| ISS filter switch threshold | | | | | | |
| $V_{27, V_{28}}$ | Threshold ISS on | ISSCTL = 0 | | 3 | | V |
| $V_{27, V_{28}}$ | Threshold ISS off | ISSCTL = 0 | | 1 | | V |
| $V_{27, V_{28}}$ | Threshold ISS narrow on | ISSCTL = 0 | | 4 | | V |
| $V_{27, V_{28}}$ | Threshold ISS narrow off | ISSCTL = 0 | | 2 | | V |
| I_3 | Charge current low | TDEV | -20 | -32 | -40 | μA |
| I_3 | Charge current high | TDEV | -30 | -39 | -48 | μA |
| I_3 | Discharge current low | TDEV | 0.5 | 1 | 1.5 | μA |
| I_3 | Discharge current high | TDEV | 5.5 | 8 | 10.5 | μA |
| DEV_{WTH} | Internal low threshold | DWTH | | 30 | | kHz |
| DEV_{WTH} | Internal high threshold | DWTH | | 75 | | kHz |
| $RATIO_{min}$ | Referred to threshold | DTH | | 1 | | |
| $RATIO_{max}$ | Referred to threshold | DTH | | 1.5 | | |

Table 6. FM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $dev = 40\text{kHz}$, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|--|--|------|-------|------|------------------------|
| Softmute | | | | | | |
| V_{ANT} | Upper startpoint | SMTH, SMD, SLOPE = 0 | | 10 | | $\text{dB}\mu\text{V}$ |
| V_{ANT} | lower startpoint | SMTH, SMD, SLOPE = 0 | | 3 | | $\text{dB}\mu\text{V}$ |
| a_{SMmin} | Min. softmute depth | SMD, SLOPE = 0, SMTH _{Upper} | | 18 | | dB |
| a_{SMmax} | Max. softmute depth | SMD, SLOPE = 0, SMTH _{Upper} | | 36 | | dB |
| $a_{SMTHISS}$ | Mute depth threshold for ISS filter on | SMCTH | 0.2 | 1 | 2 | dB |
| V_{ACTH} | Internal AC mute threshold | ACM | 60 | | 340 | mV |
| a_{SMAC} | AC mute depth | ACMD | 4 | | 10 | dB |
| I_{49} | Charge current | | -65 | -47.5 | -30 | μA |
| I_{49} | Discharge current | | 1.5 | 2.5 | 4.0 | μA |
| S/N MPX | | | | | | |
| (S+N)/N | | $V_{ANT} = 60\text{dB}\mu\text{V}$, dev.= 40kHz, LP=15KHz deemphasis t = 50 μs | 66 | 69 | | dB |

3.3.3 AM section

Table 7. AM section electrical characteristics

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $m = 30\%$, $f_{MOD} = 400\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------------|---------------------------|---|------|--------------------------|------|------------------------|
| Global | | | | | | |
| V_{ANT_us} | Usable sensitivity | (S+N)/N = 26 dB | 25 | 19 | | $\text{dB}\mu\text{V}$ |
| ΔV_{ANT} | IF2 AGC Range | Ref.: $V_{INRF} = 60\text{dB}\mu\text{V}$, | 50 | 52 | | dB |
| (S+N)/N | Signal to Noise Ratio | Ref.: $V_{INRF} = 60\text{dB}\mu\text{V}$ | 50 | 55 | | dB |
| a_{IF} | IF rejection | Ref: $V_{INRF} = 60\text{dB}\mu\text{V}$, IF = 10.7MHz | 70 | 80 | | dB |
| f_{AF} | Frequency response | Ref.: $V_{INRF} = 60\text{dB}\mu\text{V}$, $\Delta V_{AF} = -3\text{ dB}$ | | 3.6 | | kHz |
| THD | Total Harmonic Distortion | $V_{INRF} = 60\text{dB}\mu\text{V}$, m = 0.8 m = 0.3 $V_{INRF} = 120\text{dB}\mu\text{V}$, m = 0.8 m = 0.3 | | 0.5 0.3 1.0 0.3 | | % |
| V_{53} | AF output level | $V_{INRF} = 60\text{dB}\mu\text{V}$ | 160 | 180 | 200 | mV_{RMS} |

Table 7. AM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}C$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V$, $f_{RF} = 98MHz$, $m = 30\%$, $f_{MOD} = 400kHz$, $f_{Xtal} = 10.25MHz$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------------------------------|---------------------------|----------------------------------|------|------|------|------------|
| V_{24} | IF output level | $V_{INRF} = 60dB\mu V$, $m=off$ | | 190 | | mV_{RMS} |
| V_4 | Min. RF AGC threshold | WAGC | | 97 | | $dB\mu V$ |
| | Max. RF AGC threshold | | | 109 | | $dB\mu V$ |
| V_{71} | Min. IF AGC threshold | WAGC | | 96.5 | | $dB\mu V$ |
| | Max. IF AGC threshold | | | 109 | | $dB\mu V$ |
| V_{71} | Min. DAGC threshold | DAGC | | 74 | | $dB\mu V$ |
| | Max. DAGC threshold | | | 96 | | $dB\mu V$ |
| I_{I78max} | AGC2 charge current | seek | 80 | 100 | 120 | μA |
| CCR | Charge current ratio | seek/seek off | | 30 | | |
| AGC voltage driver output | | | | | | |
| V_6 | Max. AGC output voltage | | 3.5 | | | V |
| V_6 | Min. AGC output voltage | | | | 0.5 | V |
| I_{I6} | AGC current | | | 100 | | μA |
| AGC pin diode driver output | | | | | | |
| I_7 | AGC driver current | | -2.6 | -2 | -1.4 | mA |
| AM Mixer1 (10.7MHz) | | | | | | |
| R_{IN} | Input resistance | differential | 100 | | | $k\Omega$ |
| C_{IN} | Input capacitance | differential | | 4 | | pF |
| R_{OUT} | Output impedance | differential | 100 | | | $k\Omega$ |
| CP_{1dB} | 1dB compression point | referred to diff. mixer input | | 112 | | $dB\mu V$ |
| IIP3 | 3rd order intermodulation | | | 132 | | $dB\mu V$ |
| F | Noise figure | | | 8 | | dB |
| A | Gain | | | 26 | | dB |
| C_{min} | Min. capacitance step | IF1T | | 0.55 | | pF |
| C_{max} | Max. capacitance | IF1T | | 8.25 | | pF |
| C_{1-80} | | IF1T | | 2 | | pF |
| AM Mixer2 (450kHz) | | | | | | |
| R_{71} | Input resistance | | 260 | 330 | 400 | W |
| C_{71} | Input capacitance | | | 2.5 | | pF |
| CP_{1dB} | 1dB compression point | referred to diff. mixer input | | 120 | | $dB\mu V$ |
| IIP3 | 3rd order intermodulation | | | 132 | | $dB\mu V$ |
| F | Noise figure | | | 12 | | dB |

Table 7. AM section electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, $m = 30\%$, $f_{MOD} = 400\text{kHz}$, $f_{xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------------------|------------------------------|--------------------|------|-------|------|---------------|
| A | Max. gain | Mixer2 tank output | | 34 | | dB |
| ΔA | Gain control range | | | 20 | | dB |
| C_{min} | Min. cap step | IF2T | | 1.6 | | pF |
| C_{max} | Max. cap | IF2T | | 24 | | pF |
| C_{62-63} | | IF2T | | 2 | | pF |
| IF noise blanking | | | | | | |
| t_{bl} | Min. blanking time | | | 8 | | μs |
| t_{bl} | Max. blanking time | | | 17 | | μs |
| V_{th} | Min internal threshold | | 10 | 12.5 | 15 | mV |
| V_{th} | Max. internal threshold | | 150 | 187.5 | 225 | mV |
| V_{thstep} | Threshold step | | 10 | 12.5 | 15 | mV |
| V_{desth} | Min. desensitivity threshold | | 2.9 | 3.2 | 3.5 | V |
| V_{desth} | Max. desensitivity threshold | | 3.6 | 4 | 4.4 | V |

3.3.4 Stereodecoder

Table 8. Stereodecoder electrical characteristics

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $V_{MPX} = 500\text{mV}_{rms}$ mono, $f = 1\text{kHz}$, deemphasis = $50\mu\text{s}$, $f_{xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------|------------------------------------|---|------|------|------|-----------|
| Stereodecoder | | | | | | |
| V_{in} | MPX input level | STD Gain = 2.5 dB | | 0.5 | 0.93 | V_{rms} |
| R_{in} | Input resistance | | 70 | 100 | 130 | $k\Omega$ |
| G_{min} | Min. Stereodecoder gain | | -0.5 | 0 | 0.5 | dB |
| G_{max} | Max. Stereodecoder gain | | 3.15 | 3.75 | 4.35 | dB |
| G_{step} | Stereodecoder gain step resolution | | 1 | 1.25 | 1.5 | dB |
| SVRR | Supply voltage ripple rejection | $V_{ripple} = 100\text{mV}$, $f = 1\text{kHz}$ | 54 | 60 | | dB |
| a | Max. channel separation | $V_{MPX} = 500\text{mV}_{rms}$ stereo only L/R | | 50 | | dB |
| THD | Total harmonic distortion | | | 0.02 | 0.3 | % |
| (S+N)/N | Signal plus Noise to Noise ratio | A-weighted, 19kHz notch | | 85 | | dB |

Table 8. Stereodecoder electrical characteristics (continued)

($T_{amb} = 25^{\circ}C$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V$, $V_{MPX} = 500mV_{rms}$ mono, $f = 1kHz$, deemphasis = $50\mu s$, $f_{xtal} = 10.25MHz$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|------------------------------|---|------|------|------|------------|
| V_{puafs} | Pull up voltage for AFS pin | | 3.1 | 3.3 | 3.5 | V |
| R_{puafs} | Pull up resistor for AFS pin | | | 25 | | $k\Omega$ |
| V_{TH1} | 1. threshold for AFS PIN | | 2.2 | 2.4 | 2.6 | V |
| V_{TH2} | 2. threshold for AFS PIN | | 0.6 | 0.8 | 1.0 | V |
| Mono/stereo-switch | | | | | | |
| V_{PTHST1} | Pilot threshold voltage | for Mono->Stereo, PTH = 1 | 6 | 10 | 15 | mV_{rms} |
| V_{PTHST0} | Pilot threshold voltage | for Mono->Stereo, PTH = 0 | 10 | 14 | 19 | mV_{rms} |
| V_{PTHMO1} | Pilot threshold voltage | for Stereo->Mono, PTH = 1 | 4 | 8 | 12 | mV_{rms} |
| V_{PTHMO0} | Pilot threshold voltage | for Stereo->Mono, PTH = 0 | 7 | 12 | 16 | mV_{rms} |
| 19kHz PLL | | | | | | |
| f_{lock} | PLL lock range | Pilot magnitude $20 mV_{rms} = 4\%$ | 18.9 | | 19.1 | kHz |
| DP | Pilot deviation | Pilot frequency 19kHz | 4 | | 30 | % |
| Deemphasis- and highcut | | | | | | |
| t_{HC50} | Deemphasis time constant | DEEMP = 0, DESFT = 1 $V_{LEVEL} \gg V_{HCH}$ | | 50 | | μs |
| t_{HC75} | Deemphasis time constant | DEEMP = 1, DESFT = 1 $V_{LEVEL} \gg V_{HCH}$ | | 75 | | μs |
| t_{HC25} | Deemphasis time constant | DEEMP = 0, DESFT = 0 $V_{LEVEL} \gg V_{HCH}$ | | 25 | | μs |
| t_{HC37} | Deemphasis time constant | DEEMP = 1, DESFT = 0 $V_{LEVEL} \gg V_{HCH}$ | | 37.5 | | μs |
| t_{HC50} | Highcut time constant | DEEMP = 0, DESFT = 1 $V_{LEVEL} \ll V_{HCL}$ | | 150 | | μs |
| t_{HC75} | Highcut time constant | DEEMP = 1, DESFT = 1 $V_{LEVEL} \ll V_{HCL}$ | | 225 | | μs |
| F_{AMCMin} | Min. AM corner frequency | DEEMP = 0, DESFT = 1 AMCF | | 1.06 | | kHz |
| F_{AMCMin} | Max. AM corner frequency | DEEMP = 0, DESFT = 1 AMCF | | 3.18 | | kHz |
| Stereoblend- and highcut-control | | | | | | |
| L_{Gmin} | Min. level gain | LG | -0.5 | 0 | 0.5 | dB |
| L_{Gmax} | Max. level gain | LG | 4.0 | 4.7 | 5.2 | dB |
| L_{Gstep} | Level gain step resolution | LG | 0.4 | 0.67 | 0.9 | dB |

Table 8. Stereodecoder electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$,
 $V_{MPX} = 500\text{mV}_{\text{rms}}$ mono, $f = 1\text{kHz}$, deemphasis = $50\mu\text{s}$, $f_{\text{xtal}} = 10.25\text{MHz}$, in application
circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|------|------|-------------------------|
| $VSBL_{\text{min}}$ | Min. voltage for mono | SBC | | 29 | 33 | $\%V_{\text{REF1}}$ |
| $VSBL_{\text{max}}$ | Max. voltage for mono | SBC | 54 | 58 | | $\%V_{\text{REF1}}$ |
| $VSBL_{\text{step}}$ | Step resolution | SBC | | 4.2 | | $\%V_{\text{REF1}}$ |
| $VHCH_{\text{min}}$ | Min. voltage for no highcut | VHCH | | 42 | 46 | $\%V_{\text{REF1}}$ |
| $VHCH_{\text{max}}$ | Max. Voltage for no highcut | VHCH | 61 | 66 | | $\%V_{\text{REF1}}$ |
| $VHCH_{\text{step}}$ | Step resolution | VHCH | | 8 | | $\%V_{\text{REF1}}$ |
| $VHCL_{\text{min}}$ | Min. voltage for full high cut | VHCL, MAXHC = 11 | | 11 | 15 | $\%VHCH$ |
| $VHCL_{\text{max}}$ | Max. voltage for full high cut | VHCL, MAXHC = 11 | 31 | 33 | | $\%VHCH$ |
| $VHCL_{\text{step}}$ | Step resolution | VHCL, MAXHC = 11 | | 7.3 | | $\%VHCH$ |
| Carrier and harmonic suppression at the output | | | | | | |
| a19 | Pilot signal $f=19\text{kHz}$ | $V_{\text{pilot}} = 50\text{mV}_{\text{rms}}$ | | 50 | | dB |
| a38 | Subcarrier $f=38\text{kHz}$ | | | 75 | | dB |
| a57 | Subcarrier $f=57\text{kHz}$ | | | 62 | | dB |
| a76 | Subcarrier $f=76\text{kHz}$ | | | 90 | | dB |
| Intermodulation⁽¹⁾ | | | | | | |
| a2 | $f_{\text{mod}}=10\text{kHz}$, $f_{\text{spur}}=1\text{kHz}$ | | | 65 | | dB |
| a3 | $f_{\text{mod}}=13\text{kHz}$, $f_{\text{spur}}=1\text{kHz}$ | | | 75 | | dB |
| Traffic radio⁽²⁾ | | | | | | |
| a57 | Signal $f=57\text{kHz}$ | | | 70 | | dB |
| SCA - Subsidiary communications authorization⁽³⁾ | | | | | | |
| a67 | Signal $f=67\text{kHz}$ | | | 75 | | dB |
| ACI - adjacent channel interference⁽⁴⁾ | | | | | | |
| a114 | Signal $f=114\text{kHz}$ | | | 95 | | dB |
| a190 | Signal $f=190\text{kHz}$ | | | 84 | | dB |
| FM noise blanker | | | | | | |
| V_{TRMIN} | Min. trigger threshold ⁽⁵⁾ | $V_{\text{PEAK}}=0.8\text{V}$, NBLTH | | 147 | | mV_{OP} |
| V_{TRMAX} | Max. trigger threshold ⁽⁵⁾ | $V_{\text{PEAK}}=0.8\text{V}$, NBLTH | | 280 | | mV_{OP} |
| V_{TRSTEP} | Trigger threshold step ⁽⁰⁾ | | | 19 | | mV_{OP} |
| V_{TRNOISE} | Min. noise controlled trigger threshold ⁽⁵⁾ | $V_{\text{PEAK}}=1.5\text{V}$, NBCTH | | 450 | | mV_{OP} |
| V_{TRNOISE} | Max. noise controlled trigger threshold ⁽⁵⁾ | $V_{\text{PEAK}}=1.5\text{V}$, NBCTH | | 1200 | | mV_{OP} |

Table 8. Stereodecoder electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $V_{MPX} = 500\text{mV}_{rms}$ mono, $f = 1\text{kHz}$, deemphasis = $50\mu\text{s}$, $f_{xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|-----------|------|-------------------------|
| V_{PEAK} | Peak voltage | NBRR = 00, $V_{MPX}=0\text{mV}$ | 0.5 | 0.8 | 1.0 | V |
| V_{PEAK} | Peak voltage | $V_{MPX}=50\text{mV}$, $f=150\text{kHz}$ | 1.6 | 1.9 | 2.1 | V |
| V_{PEAK} | Peak voltage | $V_{MPX}=200\text{mV}$, $f=150\text{kHz}$ | 2.2 | 2.5 | 2.7 | V |
| $V_{PEAKDEV}$ | Min. deviation dependent peak voltage | $V_{MPX}=500\text{mV}$, NBDTH = 11 | 0.5 | 0.8 (off) | 1.0 | V_{OP} |
| $V_{PEAKDEV}$ | Max. deviation dependent peak voltage | $V_{MPX}=500\text{mV}$, NBDTH= 00 | 1.7 | 2.0 | 2.2 | V_{OP} |
| V_{PEAKFS} | Min. fieldstrength controlled peak voltage | $V_{MPX}=0\text{mV}$, $V_{LEVEL} \ll V_{SBL}$ (fully mono), NBFS = 11 | 0.5 | 0.8 (off) | 1.0 | V |
| V_{PEAKFS} | Max. fieldstrength controlled peak voltage | $V_{MPX}=0\text{mV}$, $V_{LEVEL} \ll V_{SBL}$ (fully mono), NBFS = 00 | 1.7 | 2.0 | 2.2 | V |
| T_S | Min. blanking time | Signal HOLDN in testmode, NBT | | 22 | | μs |
| T_S | Max. blanking time | Signal HOLDN in testmode, NBT | | 38 | | μs |
| SR_{PEAK} | Noise rectifier charge | Signal PEAK in testmode, NBPC=0 | | 10 | | $\text{mV}/\mu\text{s}$ |
| SR_{PEAK} | Noise rectifier charge | Signal PEAK in testmode, NBPC=1 | | 20 | | $\text{mV}/\mu\text{s}$ |
| $V_{RECTADJ}$ | Noise rectifier discharge adjustment | Signal PEAK in testmode, NBRR=00, NBSMP=0, MPPC=0 | | 0.3 | | V/ms |
| $V_{RECTADJ}$ | Noise rectifier discharge adjustment | Signal PEAK in testmode, NBRR=01, NBSMP=0, MPPC=0 | | 0.8 | | V/ms |
| $V_{RECTADJ}$ | Noise rectifier discharge adjustment | Signal PEAK in testmode, NBRR=10, NBSMP=0, MPPC=0 | | 1.3 | | V/ms |
| $V_{RECTADJ}$ | Noise rectifier discharge adjustment | Signal PEAK in testmode, NBRR=11, NBSMP=0, MPPC=0 | | 2.0 | | V/ms |
| V_{ADJMP} | Noise rectifier adjustment by multipath | Signal PEAK in testmode, $V_{MPTC}=1\text{V}$, NBSMP=0, MPPC=1, NBRR=01 | | 2.5 | | V/ms |
| V_{ADJMP} | Noise rectifier adjustment by strong multipath influence | Signal PEAK in testmode, $V_{MPTC}=1\text{V}$, NBSMP=1, MPPC=0, NBRR=01 | | 3.3 | | V/ms |
| V_{ADJMP} | Noise rectifier adjustment by multipath and strong multipath influence | Signal PEAK in testmode, $V_{MPTC}=1\text{V}$, NBSMP=1, MPPC=1A, NBRR=01 | | 4.5 | | V/ms |

Table 8. Stereodecoder electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$,
 $V_{MPX} = 500\text{mV}_{\text{rms}}$ mono, $f = 1\text{kHz}$, deemphasis = $50\mu\text{s}$, $f_{\text{xtal}} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------------------|--|-------------------------------------|------|------|------|---------------|
| G_{AMdelay} | AM delay filter attenuation | $f = 2.2\text{kHz}$ | | 2.0 | | dB |
| Multipath detector | | | | | | |
| f_{CMP} | Center frequency of multipath-bandpass | stereo decoder locked on pilot tone | | 19 | | kHz |
| G_{BPMP} | Min. band pass gain | MPBPG | 4 | 6 | 8 | dB |
| G_{BPMP} | Max. band pass gain | MPBPG | 10 | 12 | 14 | dB |
| G_{RECTMP} | Min. rectifier gain | MPRG | -1 | 0 | 1 | dB |
| G_{RECTMP} | Max. rectifier gain | MPRG | 4.5 | 7.6 | 9.5 | dB |
| I_{CHMP} | Rectifier charge current | MPCC = 0 | 0.5 | 0.8 | 1.2 | μA |
| I_{CHMP} | Rectifier charge current | MPCC = 1 | 0.2 | 0.4 | 0.6 | μA |
| I_{DISMP} | Rectifier discharge current | | 0.3 | 0.6 | 0.8 | mA |
| Quality detector | | | | | | |
| a | Min. MP influence factor | QDC | 0.5 | 0.6 | 0.7 | |
| a | Max. MP influence factor | QDC | 0.9 | 1.05 | 1.2 | |
| A | Min. noise influence factor | QNG | | 6 | | dB |
| A | Max. noise influence factor | QNG | | 15 | | dB |

1. Intermodulation Suppression

$$a2 = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @1\text{kHz}) ; f_s = (2 \times 10\text{kHz}) - 19\text{kHz}$$

$$a3 = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @1\text{kHz}) ; f_s = (3 \times 13\text{kHz}) - 38\text{kHz}$$

measured with: 91% stereo signal; 9% pilot signal; $f_m = 10\text{kHz}$ or 13kHz .

2. Traffic Radio (V.F.) Suppression

$$a57(V,W,F) = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @1\text{kHz} \pm 23\text{kHz})$$

measured with: 91% stereo signal; 9% pilot signal; $f_m = 1\text{kHz}$; 5% sub carrier ($f = 57\text{kHz}$, $f_m = 23\text{Hz}$ AM, $m = 60\%$)

3. SCA (Subsidiary Communications Authorization)

$$a67 = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @9\text{kHz}) ; f_s = (2 \times 38\text{kHz}) - 67\text{kHz}$$

measured with: 81% mono signal; 9% pilot signal; $f_m = 1\text{kHz}$; 10%SCA – sub carrier ($f_s = 67\text{kHz}$, unmodulated).

4. ACI (Adjacent Channel Interference)

$$a114 = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @4\text{kHz}) ; f_s = 110\text{kHz} - (3 \times 38\text{kHz})$$

$$a190 = V_{\text{O}}(\text{signal}, @1\text{kHz}) / V_{\text{O}}(\text{spurious}, @4\text{kHz}) ; f_s = 186\text{kHz} - (5 \times 38\text{kHz})$$

measured with: 90% mono signal; 9% pilot signal; $f_m = 1\text{kHz}$; 1% spurious signal ($f_s = 110\text{kHz}$ or 186kHz , unmodulated).

5. All thresholds are measured in Testmode at the quality output. The thresholds are calculated by

$$V_{\text{NBTH}} - V_{\text{PEAK}}$$

V_{PEAK} is adjusted by applying a 150kHz sinewave at MPXIN.

Figure 3. Trigger threshold vs. V_{PEAK}

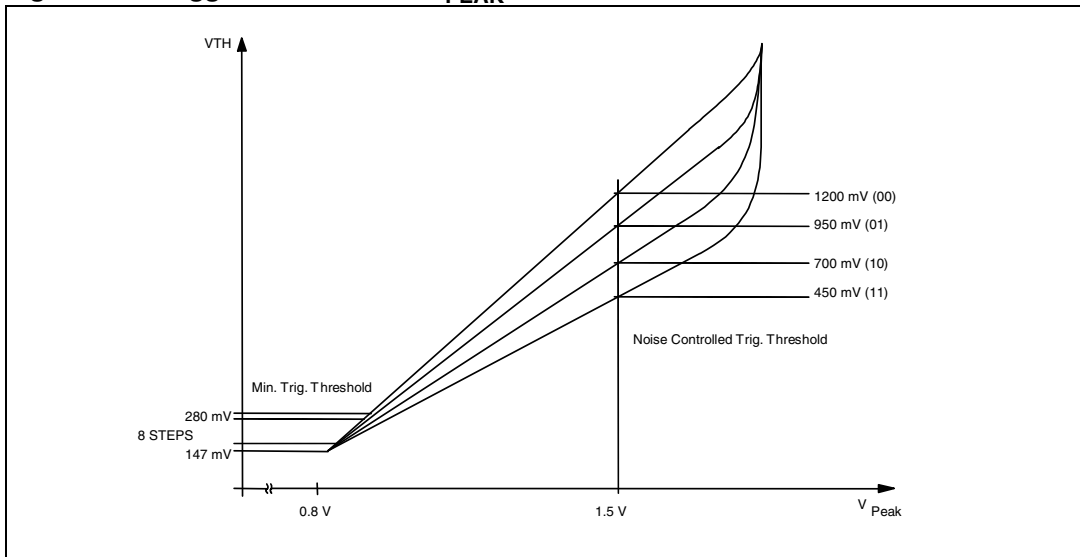


Figure 4. Deviation controlled trigger adjustment

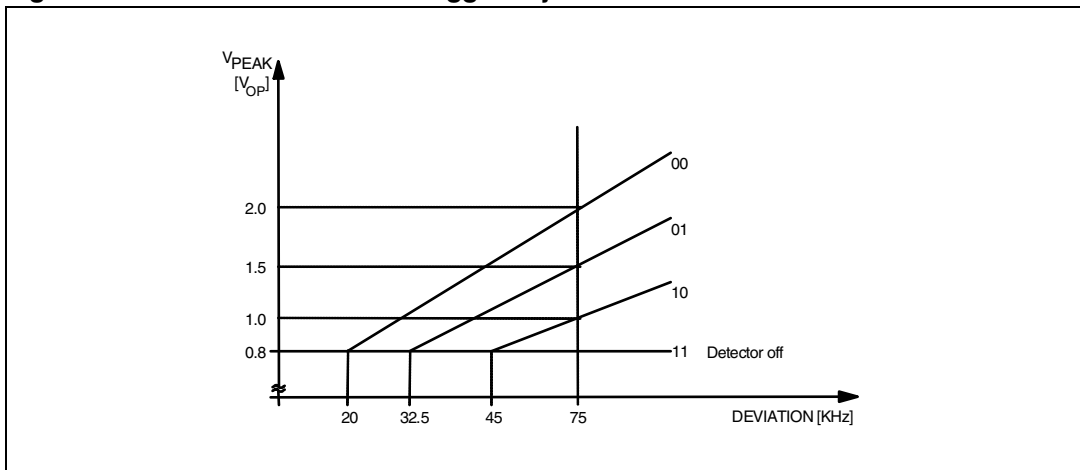
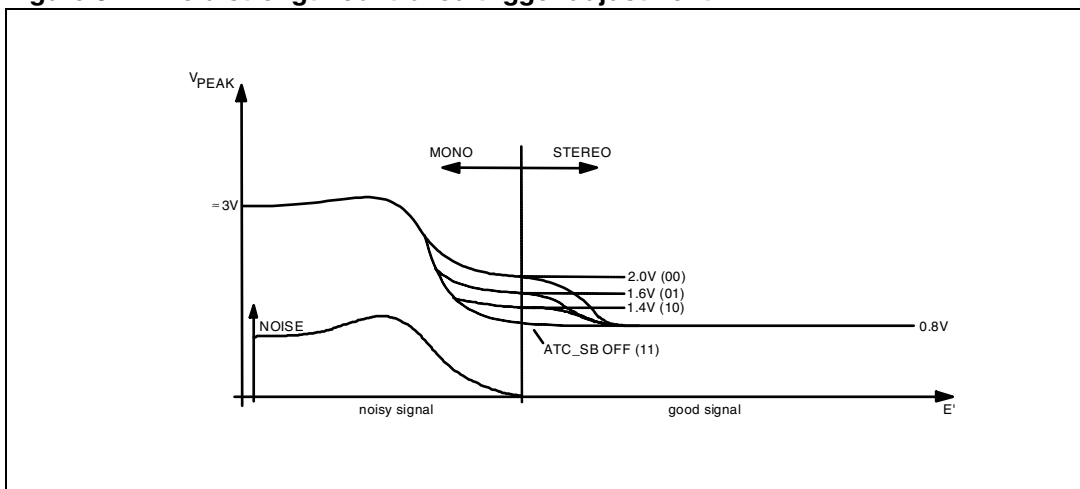


Figure 5. Field strength controlled trigger adjustment



3.3.5 PLL Section

Table 9. PLL electrical characteristics

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, dev. = 40kHz, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|------------------------|--|---------------|----------------|---------------|---------------|
| Output of tuning voltages (TV1,TV2) | | | | | | |
| V_{OUT} | Output voltage | TV0 | 0.5 | | $V_{CC3}-0.5$ | V |
| R_{OUT} | Output impedance | TVMODE=0 | 32 | 40 | 48 | k Ω |
| R_{OUT} | Output impedance | TVMODE=1 | 16 | 20 | 24 | k Ω |
| Xtal reference oscillator | | | | | | |
| f_{LO} | Reference frequency | $C_{Load} = 15\text{pF}$ | | 10.25 | | MHz |
| C_{Step} | Min. cap step | XTAL | | 0.75 | | pF |
| C_{max} | Max. cap | XTAL | | 23.25 | | pF |
| $\Delta f/f$ | Deviation versus VCC2 | $\Delta V_{CC2} = 1\text{V}$ | | 1.5 | | ppm/V |
| $\Delta f/f$ | Deviation versus temp | $-40^{\circ}\text{C} < T < +85^{\circ}\text{C}$ | | 0.2 | | ppm/K |
| Loop filter input/output | | | | | | |
| $-I_{IN}$ | Input leakage current | $V_{IN} = \text{GND}$, $PD_{OUT} = \text{Tristate}$ | -0.1 | | 0.1 | μA |
| I_{IN} | Input leakage current | $V_{IN} = V_{REF1}$ $PD_{OUT} = \text{Tristate}$ | -0.1 | | 0.1 | μA |
| V_{OL} | Output voltage Low | $I_{OUT} = -0.2\text{mA}$ | | 0.05 | 0.5 | V |
| V_{OH} | Output voltage High | $I_{OUT} = 0.2\text{mA}$ | $V_{CC3}-0.5$ | $V_{CC3}-0.05$ | | V |
| I_{OUT} | Output current, sink | $V_{OUT} = 1\text{V}$ to $V_{CC3}-1\text{V}$ | | | 10 | mA |
| I_{OUT} | Output current, source | $V_{OUT} = 1\text{V}$ to $V_{CC3}-1\text{V}$ | -10 | | | mA |
| Voltage controlled oscillator (VCO) | | | | | | |
| f_{VCOmin} | Minimum VCO frequency | | 50 | | | MHz |
| f_{VCOmax} | Maximum VCO frequency | | | | 260 | MHz |
| C/N | Carrier to Noise | $f_{VCO} = 200\text{MHz}$, $\Delta f = 1\text{KHz}$, $B = 1\text{Hz}$, closed loop | | 80 | | dBc |
| SSTOP, INLOCK, ISSSTATUS outputs (open collector) | | | | | | |
| V | Output voltage low | $I = -200\mu\text{A}$ | | 0.2 | 0.5 | V |
| V | Output voltage high | | | | 5 | V |
| -I | Output leakage current | $V = 5\text{V}$ | -0.1 | | 0.1 | μA |
| I | Output current, sink | $V = 0.5\text{V}-5\text{V}$ | | | 1 | mA |
| Switching outputs S1, S2 (open collector SMODE=1) | | | | | | |
| V | Output voltage low | $I = -5\text{mA}$ | | 0.2 | 0.5 | V |

Table 9. PLL electrical characteristics (continued)

($T_{amb} = 25^{\circ}\text{C}$, $V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5\text{V}$, $f_{RF} = 98\text{MHz}$, dev. = 40kHz, $f_{MOD} = 1\text{kHz}$, $f_{Xtal} = 10.25\text{MHz}$, in application circuit, unless otherwise specified).

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|------------------------|--------------------------|------|-------------|-----------|---------------|
| V | Output voltage high | | | | V_{CC1} | V |
| -I | Output leakage current | $V = 5\text{V}$ | -0.5 | | 0.5 | μA |
| I | Output current, sink | $V = 0.5\text{V}-V_{CC}$ | | | 7 | mA |
| Switching outputs S1, S2 (Open emitter SMODE=0) | | | | | | |
| V | Output voltage low | $I = 0\mu\text{A}$ | | 0.1 | 0.3 | V |
| V | Output voltage high | $I = 1\text{mA}$ | | $V_{CC1}-1$ | | V |
| I | Output current, sink | $V = 5\text{V}$ | | | 7 | mA |

4 Functional description

4.1 FM section

4.1.1 Mixer1, AGC and 1.IF

FM quadrature I/Q-mixer converts FM RF to IF1 of 10.7MHz. The mixer provides inherent image rejection and wide dynamic range with low noise and large input signal performance. The mixer1 tank can be adjusted by software (IF1T). For accurate image rejection the phase-error of I/Q can be compensated by software (PH)

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 = 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

The AGC operates on different sensitivities and bandwidths in order to improve the input sensitivity and dynamic range. AGC thresholds are programmable by software (RFAGC,IFAGC,KAGC). The output signal is a controlled current for pin diode attenuator.

A 10.7MHz programmable amplifier (IFG1) correct the IF ceramic insertion loss and the costumer level plan application.

4.1.2 Mixer2, limiter and demodulator

In this 2nd mixer stage the first 10.7MHz IF is converted into the second 450kHz IF. A multi-stage limiter generates signals for the complete integrated demodulator including spike cancellation (DNB). MPX output DC offset versus noise DC level is correctable by software (DEM), if tuner softmute is activated.

4.1.3 Quality detection and ISS

Fieldstrength

Parallel to mixer2 input a 10.7MHz limiter generates a signal for digital IF counter and a fieldstrength output signal. This internal unweighted fieldstrength is used for keying AGC, adjacent channel and multipath detection and is available at PIN22 (FSU) after +6dB buffer stage. It is possible to combine the IF counter result with this FSU via programmable comparator (SSTH). The behaviour of FSU signal can be corrected for DC offset (SL) and slope (SMSL). The generated unweighted fieldstrength is externally filtered and used for softmute function and generation of ISS filter switching signal for weak input level (sm).

Adjacent channel detector

The input of the adjacent channel detector is AC coupled from internal unweighted fieldstrength. A programmable highpass or bandpass (ACF) and amplifier (ACG) as well as rectifier determines the influences. This voltage is compared with adjustable comparator1 thresholds (ACWTH, ACNTH). The output signal of this comparator generates a DC level at PIN27 by programmable time constant. Time control (TISS) for a present adjacent channel

is made by charge and discharge current after comparator1 in an external capacitance. The charge current is fixed and the discharge current is controlled by I²C Bus. This level produces digital signals (ac, ac+) in an additional comparator4. The adjacent channel information is available as analog output signal after rectifier and +8dB output buffer.

Multipath detector

The input of the multipath detector is AC coupled from internal unweighted fieldstrength. A programmable bandpass (MPF) and amplifier (MPG) as well as rectifier determines the influences. This voltage is compared with an adjustable comparator2 thresholds (MPTH). The output signal of this comparator2 is used for the "Milano" effect. In this case the adjacent channel detection is switched off. The "Milano" effect is selectable by I²C Bus (MPOFF). The multipath information is available as analog output signal after rectifier and +8dB output buffer.

450kHz IF narrow bandpass filter (ISS filter)

The device gets an additional 450KHz IF narrow bandpass filter for suppression of noise and adjacent channel signal influences. This narrow filter has three switchable bandwidths, narrow range of 80kHz, mid range of 120kHz and 30KHz for weather band information. Without ISS filter the IF bandwidth (wide range) is defined only by ceramic filter chain. The filter is located between mixer2 and 450kHz limiter stage. The centre frequency is matched to the demodulator center frequency.

Deviation detector

In order to avoid distortion in audio output signal the narrow ISS filter is switched OFF for present overdeviation. Hence the demodulator output signal is detected. A lowpass filtering and peak rectifier generates a signal that is defined by software controlled current (TDEV) in an external capacitance.

This value is compared with a programmable comparator3 thresholds (DWTH, DTH) and generates two digital signals (dev, dev+). For weak signal condition deviation threshold is dependent on FSWO.

ISS switch logic

All digital signals coming from adjacent channel detector, deviation detector and softmute are acting via switching matrix on ISS filter switch. The IF bandpass switch mode is controlled by software (ISSON, ISS30, ISS80, CTLOFF). The switch ON of the IF bandpass is also available by external manipulation of voltage at PIN27. Two application modes are available (APPM).

The conditions are described in [Table 52](#).

4.1.4 Soft mute control

The filtered fieldstrength (FSWO) signal is the reference for mute control. The startpoint and mute depth are programmable (SMTH, SMD) in a wide range. The time constant is defined by external capacitance. Additional adjacent channel mute function is supported. A highpass filter with -3dB threshold frequency of 100kHz, amplifier and peak rectifier generates an adjacent noise signal from MPX output with the same time constant for softmute. This value is compared with comparator5 thresholds (ACM). For present strong adjacent channel the MPX signal is additional attenuated (ACMD).

4.2 AM section

The up/down conversion is combined with gain control circuit sensing three input signals, narrow band information at PIN 54, upconversion signal (IF2AGC) at PIN 71 and wide band information (RFAGC) at PIN 4. This gain control gives two output signals. The first one is a current for pin diode attenuator and the second one is a voltage for preamplifier. Time constant of RF- and IF-AGC is defined by internal 100k resistor and external capacitor at PIN 67. The intervention points for AGC (DAGC, WAGC) are programmable by software.

In order to avoid a misbehaviour of AGC intervention point it is important to know that the DAGC threshold has to be lower than WAGC threshold !

The oscillator frequency for upconversion-mixer1 is generated by dividing the VCO frequency after VCO divider (VCOD) and AM predivider (AMD).

Two 10,7MHz ceramic filters before mixer2 input increases 900KHz attenuation. In mixer2 the IF1 is down converted into the IF2 450kHz. After filtering by ceramic filter a 450kHz amplifier is included with an additional gain control of IF2 below DAGC threshold. Time constant is defined by capacitance at PIN 78.

Mixer1 and mixer2 tanks are software controlled adjustable (IF1T, IF2T).

The demodulator is a peak detector to generate the audio output signal.

A separate output is available for AMIF stereo (AMST).

AM IF noise blanker

In order to remove in AM short spikes a noise cancellation conception is used in 450KHz IF AM level. The advantage is to avoid long narrow AGC- and demodulator- time constants, which enlarge spike influences on audio signal and makes difficult to remove it in audio path.

The 10.7MHz AM IF signal generates before 10.7 MHz ceramic filter via limitation an unweighted field strength signal including slope of noise spike. The comparison of these detected slope between fast and slow rectifier ignores audio modulation whereby the threshold of slow rectifier is programmable (AINBT). A comparator activates a pulse generator.

The duration of this pulse is software programmable (AINT) and is smooth blanking out the spikes in 450KHz AM mixer2. Additionally this functionality is controlled by narrow AM field strength (AINBD).

4.3 Stereodecoder

4.3.1 Decoder

The stereo decoder-part of the TDA7540N (see [Figure 14](#)) contains all functions necessary to demodulate the MPX-signal like pilot tone-dependent MONO/STEREO-switching as well as "stereoblend" and "highcut". Adaptations like programmable input gain, roll-off compensation, selectable deemphasis time constant and a programmable field strength input allow easy adaption to different applications.

The 4th order input filter has a corner frequency of 80kHz and is used to attenuate spikes and noise and acts as an anti-aliasing filter for the following switch capacitor filters.

Demodulator

In the demodulator block the left and the right channel are separated from the MPX-signal. In this stage also the 19-kHz pilot tone is canceled. For reaching a high channel separation the TDA7540 offers an I²C-bus programmable roll-off adjustment, which is able to compensate the low pass behavior of the tuner section. Within the compensation range an adjustment to obtain at least 40dB channel separation is possible. The bits for this adjustment are located together with the level gain adjustment in one byte. This gives the possibility to perform an optimization step during the production of the car radio where the channel separation and the header are trimmed.

In addition to that the FM signal can be inverted.

Deemphasis and highcut

The deemphasis low pass allows to choose between a time constant of 50 μ s/ 75 μ s (DEEMP) and 25 μ s/37.5 μ s (DESFT). The highcut control range will be in both cases $\tau_{HC} = 2 \times \tau_{Deemp}$. Inside the highcut control range (between VHCH and VHCL) the LEVEL signal is converted into a 5-bit word, which controls the low pass time constant between $\tau_{Deemp} \dots 3 \times \tau_{Deemp}$. Thereby the resolution will remain always 5 bits independently of the absolute voltage range between the VHCH- and VHCL-values.

The highcut function can be switched off by I²C-bus .

In AM mode (AMON = 1) the bits DEEMP and DESFT together with the AM corner frequency bits (AMCF1...5) can be used as programmable AM frequency response. The maximum corner frequency is defined by τ_{Deemp} , the minimum is defined by $3 \times \tau_{Deemp}$

19kHz PLL and pilot tone detector

The PLL has the task to lock on the 19kHz pilot tone during a stereo-transmission to allow a correct demodulation. The included pilot tone-detector enables the demodulation if the pilot tone reaches the selected pilot tone threshold V_{PTHST} . Two different thresholds are available. The status of the detector output can be checked by reading the status byte of the TDA7540N via I²C-bus or by reading the STEREO pin (pin 25).

Field strength control

The field strength input is used to control the highcut- and the stereoblend-function. In addition the signal can be also used to control the noise blanker thresholds and as input for the multipath detector.

Level-input and -gain

As level input for the stereo decoder is used the FSU voltage (pin22). Applying a capacitor at FSTC (pin33) a desired time constant can be reached together with the internal resistor of 10k between FSU pin and FSTC pin.

In addition to that the LEVEL signal is low pass filtered internally in order to suppress undesired high frequency modulation on the highcut- and stereoblend-function . The filter is a combination of a 1st-order RC-low pass at 53kHz (working as anti-aliasing filter) and a 1st-order switched capacitor low pass at 2.2kHz. The second stage is a programmable gain stage to adapt the LEVEL signal internally . The gain is widely programmable in 8 steps from 0dB to 4,7dB (step=0.67dB). These 3bits are located together with the Roll-Off bits in the "Stereo decoder 8"-byte to simplify a possible adaptation during the production of the car radio.

Stereoblend control

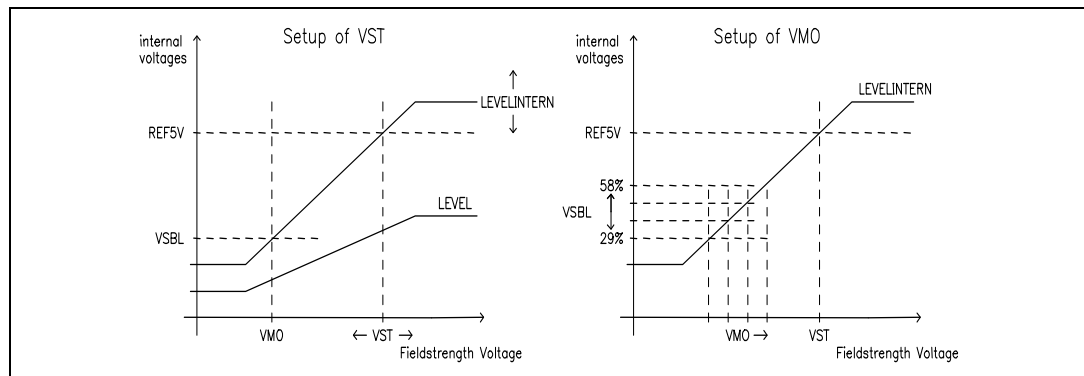
The stereoblend control block converts the internal LEVEL-voltage into a demodulator compatible analog signal, which is used to control the channel separation between 0dB and the maximum separation. Internally this control range has a fixed upper limit, which is the internal reference voltage V_{REF1} . The lower limit can be programmed between 29 and 58% of V_{REF1} in 4% steps (see [Figure 6](#)).

To adjust the external LEVEL-voltage to the internal range two values must be defined: the LEVEL gain L_G and VSBL. To adjust the voltage where the full channel separation is reached (VST) the LEVEL gain L_G has to be defined. The following equation can be used to estimate the gain:

$$L_G = V_{REF1}/FSU@full\ stereo$$

The MONO-voltage VMO (0dB channel separation) can be chosen selecting VSBL.

Figure 6. Relation between internal and external level-voltagees and setup of stereoblend

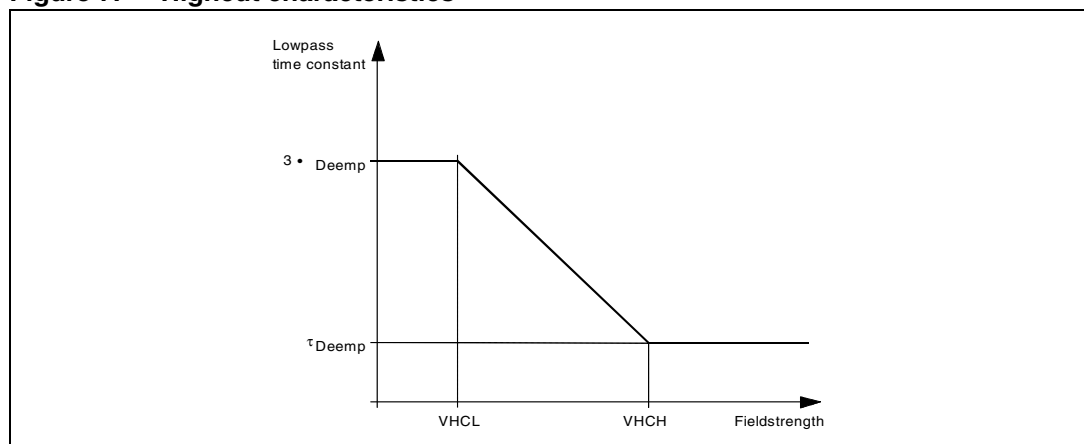


The stereo blend function can be switched ON/OFF using bit Addr25<d2>. Please note that in AM it must be switched in forced mono!

Highcut control

The highcut control set-up is similar to the stereoblend control set-up: the starting point VHCH can be set with 2 bits to be 42, 50, 58 or 66% of V_{REF1} whereas the range can be set to be 11, 18.3, 25.7 or 33% of VHCH (see [Figure 7](#)).

Figure 7. Highcut characteristics



4.3.2 Functional description of the noise blanker

In the automotive environment spikes produced by the ignition or for example the wiper-motor disturb the MPX-signal. The aim of the noise blanker part is to cancel the audible influence of the spikes. Therefore the output of the stereo decoder is held at the actual voltage for a time between 22 μ s and 38 μ s (programmable). The block diagram of the noise blanker is given in [Figure 15](#).

In a first stage the spikes must be detected but to avoid a wrong triggering on high frequency (white) noise a complex trigger control is implemented. Behind the trigger stage a pulse former generates the "blanking"-pulse. An own biasing circuit supplies the noise blanker in order to avoid any cross talk to the signal path.

Trigger path

The incoming MPX signal is high pass filtered, amplified and rectified. This second order high pass filter has a corner-frequency of 140kHz. The rectified signal, RECT, is low pass filtered to generate a signal called PEAK. Also noise with a frequency 140kHz increases the PEAK voltage. The resulting voltage can be adjusted by use of the noise rectifier discharge current. The PEAK voltage is fed to a threshold generator, which adds to the PEAK-voltage a DC-dependent threshold VTH. Both signals, RECT and PEAK+VTH are fed to a comparator, which triggers a re-triggerable monoflop. The monoflop's output activates the sample-and-hold circuits in the signal path for the selected duration.

Automatic noise controlled threshold adjustment ([Figure 3](#))

There are mainly two independent possibilities for programming the trigger threshold:

1. the low threshold in 8 steps (NBLTH)
2. and the noise adjusted threshold in 4 steps (NBCTH).

The low threshold is active in combination with a good MPX signal without any noise; the PEAK voltage is less than 1V. The sensitivity in this operation is high.

If the MPX signal is noisy (low fieldstrength) the PEAK voltage increases due to the higher noise, which is also rectified. With increasing of the PEAK voltage the trigger threshold increases, too. This particular gain is programmable in 4 steps (NBCTH).

Automatic threshold control by the stereoblend voltage ([Figure 5](#))

Besides the noise controlled threshold adjustment there is an additional possibility for influencing the noise blanker trigger threshold using the bits NBFS. This influence depends on the stereoblend control.

The point where the MPX signal starts to become noisy is fixed by the RF part. This point is also the starting point of the normal noise-controlled trigger adjustment. But in some cases the noise blanker can create a wrong triggering, which create distortion, already in the region of mono/stereo transition. Therefore a opportunity to control the PEAK voltage by the stereo blend function it is implemented.

Over deviation detector ([Figure 4](#))

If the system is tuned to stations with a high deviation the noise blanker can trigger on the higher frequencies of the modulation. To avoid this wrong behavior, which causes noise in the output signal, the noise blanker offers a deviation-dependent threshold adjustment. By rectifying the MPX signal a further signal representing the actual deviation is obtained. It is

used to increase the PEAK voltage. Offset and gain of this circuit are programmable in 3 steps (NBDTH) of the stereo decoder-byte (the first step turns off the detector).

Multipath-level

To react on high repetitive spikes caused by a Multipath-situation, the discharge-time of the PEAK voltage can be decreased depending on the voltage-level at Pin MPout. There are two ways to do this. One way is to switch on the linear influence of the Multipath-Level on the PEAK-signal. In this case the discharge slew rate is 1V/ms¹⁾. The second possibility is to activate a function, which switches to the 18k discharge if the Multipath-Level is below 2.5V. If multipath influence on noise blanker is switched ON than MPF bit has to be set to 0.

¹⁾ The slew rate is measured with $R_{Discharge}=\infty$ and $V_{MPout}=2.5V$

AM Mode of Noise Blanker

The TDA7540N offers an AM audio noise blanker too.

If the AM noise blanker is used the AM audio delay filter and the AM audio filter must be switched on. It is not recommended to use the AM noise blanker without to use the AMIF noiseblanker inside the tuner.

The noise blanker is activated if the spike is bigger than a fixed threshold

In order to blank the whole spike in AM mode the hold time of the S&H circuit is much longer than in FM mode (640µs - 1.2ms).

4.3.3 Functional description of the multipath-detector

Using the internal Multipath-Detector the audible effects of a multipath condition can be minimized. A multipath-condition is detected by rectifying the 19kHz spectrum in the fieldstrength signal. An external capacitor is used to define the attack- and decay-times (see block diagram, [Figure 16](#)). The MP_OUT-pin is used as detector-output connected to a capacitor of about 47nF. Using this configuration an external adaptation to the user's requirement is possible without affecting the "normal" fieldstrength input (LEVEL) for the stereo decoder.

To keep the old value of the Multipath Detector during an AF-jump, the MP-Hold switch can disconnect the external capacitor. This switch is controlled directly by the AFS-Pin.

Selecting MPION the channel separation is automatically reduced during a multipath condition according to the voltage appearing at the MP_OUT-pin.

Programming

To obtain a good multipath performance an adaptation is necessary. Therefore the gain of the first 19kHz-bandpass is programmable in two steps (MPG), the gain of the second 19kHz-bandpass is programmable in four steps (MPBPG) and the rectifier gain is programmable in four steps(MPRG). Please note that the frequency of the first multipath bandpass (MPF) must be set to 19kHz! The attack- and decay-times can be set by the external capacitor value and the multipath detector charge current MPCC.

4.3.4 Quality detector

The TDA7540N offers a quality detector output, which gives a voltage representing the FM-reception conditions. To calculate this voltage the MPX-noise and the multipath-detector output are summed according to the following formula:

$$V_{Qual} = 0.8b (V_{Noise} - 0.8 V) + a (V_{REF1} - V_{Mpout}).$$

The noise-signal is the PEAK-signal without additional influences (see noise blanker description). The factor 'a' can be programmed from 0.6 to 1.05(QDC) and the factor b can be programmed from 6dB to 15dB (QNG). The output is a low impedance output able to drive external circuitry as well as simply fed to an AD-converter for RDS applications.

4.3.5 AFS control and stereo decoder mute

The TDA7540N is supplied with several functionality to support AF-checks using the stereo decoder. The additional pin (AFS) is implemented in order to speed up the stereo decoder AF-functions compared to IIC controlling.

The block diagram of AFS function is shown in [Figure 17](#).

In order to separate the different functions of the AFS pin, two different logic thresholds are implemented. Below the higher threshold voltage (2.4V) only the multipath-detector is switched into small time constant (internal logical signal MPfast).

Below the lower threshold voltage (0.8V) the full AFS function is activated. The MPXIN pin is switched into high impedance mode (internal signal AFSMute), which avoids any clicks during the jump condition. If the stereo decoder is not muted, it is possible at the same time to evaluate the noise- and multipath-content of the alternate frequency using the Quality detector output.

Furthermore the AFS pin does also freeze the condition of pilot locking and magnitude (internal signal PDhold). The Pdhld signal is defined by V_{th1} or V_{th2} , dependent on the PDH signal.

4.4 PLL and IF counter section

4.4.1 PLL frequency synthesizer block

This part contains a frequency synthesizer and a loop filter for the radio tuning system. Only one VCO is required to build a complete PLL system for FM world tuning and AM upconversion ([Figure 9](#)). For auto search stop operation an IF counter system is available.

The PLL counter works in a two stages configuration. The first stage is a swallow counter with a two modulus (32/33) precounter. The second stage is an 11-bit programmable counter.

The circuit receives the scaling factors for the programmable counters and the values of the reference frequencies via an I²C-Bus interface. The reference frequency is generated by an adjustable internal (XTAL) oscillator followed by the reference divider. The main reference and step-frequencies are free selectable (RC, PC).

Output signals of the phase detector are switching the programmable current sources. The loop filter integrates their currents to a DC voltage.

The values of the current sources are programmable by 6 bits also received via the I²C Bus (A, B, CURRH, LPF).

To minimize the noise induced by the digital part of the system, a special guard configuration is implemented.

The loop gain can be set for different conditions by setting the current values of the chargepump generator.

Frequency generation for phase comparison

The RF signals applies a two modulus counter (32/33) pre-scaler, which is controlled by a 5-bit A-divider. The 5-bit register (PC0 to PC4) controls this divider. In parallel the output of the prescaler connects to an 11-bit B-divider. The 11-bit PC register (PC5 to PC15) controls this divider

Dividing range behind VCO divider:

$$f_{VCOdiv} = [33 \times A + (B + 1 - A) \times 32] \times f_{REF}$$

$$f_{VCOdiv} = (32 \times B + A + 32) \times f_{REF}$$

Important: For correct operation: $A \leq 32$; $B \geq A$

Three state phase comparator

The phase comparator generates a phase error signal according to phase difference between f_{SYN} and f_{REF} . This phase error signal drives the charge pump current generator.

Charge pump current generator

This system generates signed pulses of current. The phase error signal decides the duration and polarity of those pulses. The current absolute values are programmable by A register for high current and B register for low current.

Inlock detector

Switching the chargepump in low current mode can be done either via software or automatically by the inlock detector, by setting bit LDENA to "1".

After reaching a phase difference about lower than 40nsec the chargepump is forced in low current mode. A new PLL divider alternation by I²C-Bus will switch the chargepump in the high current mode.

Low noise CMOS op-amp

An internal voltage divider at pin VREF2 connects the positive input of the low noise op-amp. The charge pump output connects the negative input. This internal amplifier in cooperation with external components can provide an active filter. The negative input is switchable to three input pins, to increase the flexibility in application. This feature allows two separate active filters for different applications.

While the high current mode is activated LPHC output is switched on.

4.4.2 IF counter block

The aim of IF counter is to measure the intermediate frequency of the tuner for AM and FM mode. The input signal for FM and AM upconversion is the same 10.7MHz IF level after limiter. AM 450KHz signal is coming from narrow filtered IF2 before demodulation. A switch controlled by IF counter mode (IFCM) is choosing the input signal for IF counter.

The grade of integration is adjustable by eight different measuring cycle times. The tolerance of the accepted count value is adjustable, to reach an optimum compromise for search speed and precision of the evaluation.

The IF-counter mode

The IF counter works in 3 modes controlled by IFCM register.

Sampling timer

A sampling timer generates the gate signal for the main counter. The basically sampling time are in FM mode 6.25kHz ($t_{TIM}=160\mu s$) and in AM mode 1kHz ($t_{TIM}=1ms$). This is followed by an asynchronous divider to generate several sampling times.

Intermediate frequency main counter

This counter is a 11 - 21-bit synchronous autoreload down counter. Five bits (CF) are programmable to have the possibility for an adjust to the centre frequency of the IF-filter. The counter length is automatic adjusted to the chosen sampling time and the counter mode (FM, AM-UPC, AM).

At the start the counter will be loaded with a defined value which is an equivalent to the divider value ($t_{Sample} \times f_{IF}$).

If a correct frequency is applied to the IF counter frequency input at the end of the sampling time the main counter is changing its state from 0h to 1FFFFFFh.

This is detected by a control logic and an external search stop output is changing from LOW to HIGH. The frequency range inside which a successful count result is adjustable by the EW bits.

$$\begin{aligned} t_{CNT} &= (CF + 1696+1) / f_{IF} && \text{FM mode} \\ t_{CNT} &= (CF + 10688+1) / f_{IF} && \text{AM up conversion mode} \\ t_{CNT} &= (CF + 488+1) / f_{IF} && \text{AM mode} \end{aligned}$$

Counter result succeeded:

$$t_{TIM} \geq t_{CNT} - t_{ERR}$$

$$t_{TIM} \leq t_{CNT} + t_{ERR}$$

Counter result failed:

$$t_{TIM} > t_{CNT} + t_{ERR}$$

$$t_{TIM} < t_{CNT} - t_{ERR}$$

t_{TIM} = IF timer cycle time (sampling time)

t_{CNT} = IF counter cycle time

t_{ERR} = discrimination window (controlled by the EW registers)

The IF counter is only started by inlock information from the PLL part. It is enabled by software (IFENA).

Adjustment of the measurement sequence time

The precision of the measurements is adjustable by controlling the discrimination window. This is adjustable by programming the control registers EW.

The measurement time per cycle is adjustable by setting the registers IFS.

Adjust of the frequency value

The center frequency of the discrimination window is adjustable by the control registers CF.

4.5 I²C-Bus interface

The TDA7540N supports the I²C-Bus protocol. This protocol defines any device that sends data onto the bus as a transmitter, and the receiving device as the receiver. The device that controls the transfer is a master and device being controlled is the slave. The master will always initiate data transfer and provide the clock to transmit or receive operations.

Data transition

Data transition on the SDA line must only occur when the clock SCL is LOW. SDA transitions while SCL is HIGH will be interpreted as START or STOP condition.

Start condition

A start condition is defined by a HIGH to LOW transition of the SDA line while SCL is at a stable HIGH level. This "START" condition must precede any command and initiate a data transfer onto the bus. The device continuously monitors the SDA and SCL lines for a valid START and will not respond to any command if this condition has not been met.

Stop condition

A STOP condition is defined by a LOW to HIGH transition of the SDA while the SCL line is at a stable HIGH level. This condition terminates the communication between the devices and forces the bus-interface of the device into the initial condition.

Acknowledge

Indicates a successful data transfer. The transmitter will release the bus after sending 8 bits of data. During the 9th clock cycle the receiver will pull the SDA line to LOW level to indicate it receive the eight bits of data.

Data transfer

During data transfer the device samples the SDA line on the leading edge of the SCL clock. Therefore, for proper device operation the SDA line must be stable during the SCL LOW to HIGH transition.

Device addressing

To start the communication between two devices, the bus master must initiate a start instruction sequence, followed by an eight bit word corresponding to the address of the device it is addressing.

The most significant 6 bits of the slave address are the device type identifier.

The TDA7540N device type is fixed as "110001".

The next significant bit is used to address a particular device of the previous defined type connected to the bus.

The state of the hardwired PIN 59 defines the state of this address bit. So up to two devices could be connected on the same bus. When PIN 59 is connected to VCC2 and a resistor at PIN 55 versus ground of about 5.6k Ohm the address bit "1" is selected. In this case the AM part doesn't work. Otherwise the address bit "0" is selected (FM and AM is working). Therefor a double FM tuner concept is possible.

The last bit of the start instruction defines the type of operation to be performed:

- When set to "1", a read operation is selected
- When set to "0", a write operation is selected

The TDA7540N connected to the bus will compare their own hardwired address with the slave address being transmitted, after detecting a START condition. After this comparison, the TDA7540N will generate an "acknowledge" on the SDA line and will do either a read or a write operation according to the state of R/W bit.

Write operation

Following a START condition the master sends a slave address word with the R/W bit set to "0". The device will generate an "acknowledge" after this first transmission and will wait for a second word (the word address field). This 8-bit address field provides an access to any of the 64 internal addresses.

Upon receipt of the word address the TDA7540N slave device will respond with an "acknowledge". At this time, all the following words transmitted to the TDA7540N will be considered as Data. The internal address will be automatically incremented up to hex40 in page mode. Than again subadresse hex60 has to be transmitted for following registers above 32.

After each word receipt the TDA7540N will answer with an "acknowledge".

Read operation

If the master sends a slave address word with the R/W bit set to "1", the TDA7540N will transit one 8-bit data word. This data word includes the following informations:

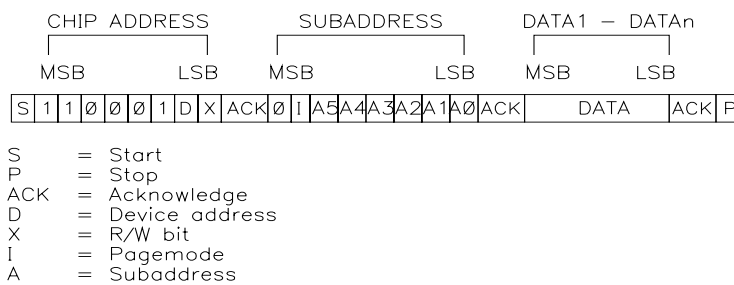
- bit0 (ISS filter, 1 = ON, 0 = OFF)
- bit1 (ISS filter bandwidth, 1 = 80kHz, 0 = 120kHz)
- bit2 (STEREO, 1 = STEREO, 0 = MONO)
- bit3 (1 = PLL is locked in , 0 = PLL is locked out).
- bit4 (fieldstrength indicator, 1 = lower as softmute threshold, 0 = higher as softmute threshold)
- bit5 (adjacent channel indicator, 1 = adjacent channel present, 0 = no adjacent channel)
- bit6 (deviation indicator, 1 = strong overdeviation present, 0 = no strong overdeviation)
- bit7 (deviation indicator, 1 = overdeviation present, 0 = no overdeviation)

5 Software specification

The interface protocol comprises:

- start condition (S)
- chip address byte
- subaddress byte
- sequence of data (N bytes + Acknowledge)
- stop condition (P)

The pagermode is only working up to byte 31. After byte 31 it is need to send again the chip address followed by the subaddress 32 and the databytes starting from 32 up to 39!



5.1 Address organization

Table 10. Address organization

| Function | Addr | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------------|------|--------|--------|--------|--------|--------|-------|-------|--------|
| CHARGE PUMP | 0 | FMSEEK | CURRH | B1 | B0 | A3 | A2 | A1 | A0 |
| PLL COUNTER | 1 | PC7 | PC6 | PC5 | PC4 | PC3 | PC2 | PC1 | PC0 |
| | 2 | PC15 | PC14 | PC13 | PC12 | PC11 | PC10 | PC9 | PC8 |
| TV1 | 3 | TV1O7 | TV1O6 | TV1O5 | TV1O4 | TV1O3 | TV1O2 | TV1O1 | TV1O0 |
| TV2 | 4 | TV2O7 | TV2O6 | TV2O5 | TV2O4 | TV2O3 | TV2O2 | TV2O1 | TV2O0 |
| IFC CTRL 1 | 5 | LDENA | CASF | IFCM1 | IFCM0 | IFENA | IFS2 | IFS1 | IFS0 |
| IFC CTRL 2 | 6 | EW2 | EW1 | EW0 | CF4 | CF3 | CF2 | CF1 | CF0 |
| AM CTL | 7 | LM | TVMODE | TV2WB | TV1WB | AMD1 | AMD0 | AMST | AMSEEK |
| QUALITY ISS | 8 | TISS2 | TISS1 | TISS0 | --- | ISS30 | ISS80 | ISSON | CTLOFF |
| QUALITY AC | 9 | ACNTH1 | ACNTH0 | ACWTH2 | ACWTH1 | ACWTH0 | ACG | ACF | --- |
| QUALITY MP | 10 | MPAC | APPM2 | APPM1 | MPTH1 | MPTH0 | MPG | MPF | MPOFF |
| QUALITY DEV | 11 | BWCTL | DTH1 | DTH0 | DWTH1 | DWTH0 | TDEV2 | TDEV1 | TDEV0 |
| MUTE1 | 12 | MENA | SMD3 | SMD2 | SMD1 | SMD0 | SMTH2 | SMTH1 | SMTH0 |
| MUTE2 | 13 | F100K | ACM3 | ACM2 | ACM1 | ACM0 | ACMD1 | ACMD0 | SMCTH |
| VCO/PLLREF | 14 | LPF | AMON | RC2 | RC1 | RC0 | VCOD2 | VCOD1 | VCOD0 |

Table 10. Address organization (continued)

| Function | Addr | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| FMAGC | 15 | RFKAGC | KAGC2 | KAGC1 | KAGC0 | IFAGC1 | IFAGC0 | RFAGC1 | RFAGC0 |
| AMAGC | 16 | DAGC3 | DAGC2 | DAGC1 | DAGC0 | WAGC3 | WAGC2 | WAGC1 | WAGC0 |
| DEM ADJ | 17 | DNB1 | DNB0 | DEM5 | DEM4 | DEM3 | DEM2 | DEM1 | DEM0 |
| LEVEL | 18 | ODSW | ODCUR | SMSL | SL4 | SL3 | SL2 | SL1 | SL0 |
| IF1/XTAL | 19 | XTAL4 | XTAL3 | XTAL2 | XTAL1 | XTAL0 | IFG11 | IFG10 | XTLIM |
| TANK ADJ | 20 | IF1T3 | IF1T2 | IF1T1 | IF1T0 | IF2T3 | IF2T2 | IF2T1 | IF2T0 |
| I/Q ADJ | 21 | SMO1 | SMO0 | --- | --- | PH3 | PH2 | PH1 | PH0 |
| AMIFNB | 22 | AIN1 | AIN0 | AINBD1 | AINBD0 | AINBT3 | AINBT2 | AINBT1 | AINBT0 |
| SCTRL | 23 | SSTH3 | SSTH2 | SSTH1 | SSTH0 | S2MODE | S2 | S1MODE | S1 |
| STD1 | 24 | STVCO1 | STVCO0 | NBT1 | NBT0 | SI | TFCKL | NBFT | TSMA |
| STD2 | 25 | STING1 | STING0 | DEEMP | PTH | NBPC | MS | STDON | STDM |
| STD3 | 26 | NBDTH1 | NBDTH0 | NBON | NBCTH1 | NBCTH0 | NBLTH2 | NBLTH1 | NBLTH0 |
| STD4 | 27 | NBSMP | VHCL1 | VHCL0 | VHCH1 | VHCH0 | MAXHC1 | MAXHC0 | HCON |
| STD5 | 28 | MPPC | QDC1 | QDC0 | NBFS1 | NBFS0 | SBC2 | SBC1 | SBC0 |
| STD6 | 29 | MPRG1 | MPRG0 | MPCC | MPION | MPBPG1 | MPBPG0 | NBRR1 | NBRR0 |
| STD7 | 30 | AMAF | LG2 | LG1 | LG0 | ROC3 | ROC2 | ROC1 | ROC0 |
| STD8 | 31 | AMNBD | AMNBFO | AMNBHP | PDH | AFSM | AFSON | QNG1 | QNG0 |
| STD9 | 32 | AMCF4 | AMCF3 | AMCF2 | AMCF1 | AMCF0 | DESFT | --- | --- |
| TESTTU1 | 33 | OUT20 | ISSIN | TOUT | TIN1 | CLKSEP | TEST3 | TEST2 | TEST1 |
| TESTTU2 | 34 | OUT7 | OUT6 | OUT5 | OUT4 | OUT3 | OUT2 | OUT1 | OUT0 |
| TESTTU3 | 35 | --- | TINACM | TINMP | TINAC | OUT11 | OUT10 | OUT9 | OUT8 |
| TESTTU4 | 36 | OUT19 | OUT18 | OUT17 | OUT16 | OUT15 | OUT14 | OUT13 | OUT12 |
| TESTTU5 | 37 | TIN2 | OUT27 | OUT26 | OUT25 | OUT24 | OUT23 | OUT22 | OUT21 |
| TESTSTD | 38 | --- | --- | MUXST3 | MUXST2 | MUXST1 | MUXST0 | --- | TST |
| FMDEMSB | 39 | VCOM | PCM | --- | SBSH | SBA | SBTO | SBW | SBT |

5.2 Control register function

Table 11. Control register function

| Register Name | Function |
|---------------|--|
| A | Charge pump high current |
| ACF | Adjacent channel filter select |
| ACG | Adjacent channel filter gain |
| ACM | Threshold for startpoint adjacent channel mute |
| ACMD | Adjacent channel mute depth |

Table 11. Control register function (continued)

| Register Name | Function |
|---------------|---|
| ACNTH | Adjacent channel narrow band threshold |
| ACWTH | Adjacent channel wide band threshold |
| AFSM | AFS influence on stereodecoder mute |
| AFSON | AFS Pin enable |
| AINBD | AM IF noise blanker desensitivity |
| AINBT | AM IF noise blanker threshold |
| AINNT | AM IF noise blanking time |
| AMAF | AM audio filter |
| AMD | AM prescaler |
| AMCF | AM corner frequency |
| AMIN | AM IF1 input select |
| AMNBD | AM audio delay for noise blanking |
| AMON | AM-FM switch |
| AMSEEK | Set short time constant of AGC in AM seek mode |
| AMST | AM stereo select |
| APPM | Application mode quality detection |
| B | Charge pump low current |
| BWCTL | ISS filter fixed bandwidth (ISS80) in automatic control |
| CASF | Check alternative station frequency |
| CF | Center frequency IF counter |
| CLKSEP | Clock separation (only for testing) |
| CTLOFF | Switch off automatic control of ISS filter |
| CURRH | Set current high charge pump |
| DAGC | AM narrow band AGC threshold |
| DEEMP | Stereodecoder deemphasis |
| DEM | Demodulator offset |
| DESFT | Stereodecoder deemphasis shift |
| DEVM | Deviation detector mode |
| DNB | Demodulator spike blanking threshold |
| DTH | Deviation detector threshold for ISS filter "OFF" |
| DWTH | Deviation detector threshold for ISS filter narrow/wide |
| EW | Frequency error window IF counter |
| F100K | Corner frequency of AC-mute high pass filter |
| FMSEEK | ISS time constant change in FM seek mode |
| HCON | High cut enable |

Table 11. Control register function (continued)

| Register Name | Function |
|---------------|---|
| IF1T | FM/AM mixer1 tank adjust |
| IF2T | AM mixer2 tank adjust |
| IFAGC | FM IF AGC |
| IFCM | IF counter mode |
| IFENA | IF counter enable |
| IFG | IF1 amplifier gain (10.7MHz) |
| IFS | IF counter sampling time |
| ISSIN | Test input for ISS filter |
| ISSON | ISS filter "ON" |
| ISS30 | ISS filter 30KHz weather band |
| ISS80 | ISS filter narrow/mid switch |
| KAGC | FM keying AGC |
| LDENA | Lock detector enable |
| LG | Level gain adjust in stereodecoder |
| LM | Local mode FM seek stop |
| LPF | Loop filter input select |
| MAXHC | Maximum high cut |
| MENA | Softmute enable |
| MPAC | Adjacent channel control by multipath |
| MPCC | Multipath detector charge current |
| MPBPG | Multipath detector bandpass filter gain |
| MPF | Multipath filter frequency |
| MPG | Multipath filter gain |
| MPION | Multipath internal influence enable |
| MPOFF | Multipath control "OFF" |
| MPPC | Multipath influence on peak discharge current |
| MPRG | Multipath detector rectifier gain |
| MPTH | Multipath threshold |
| MS | Mono/Stereo switch automatically |
| MUXST | Test multiplexer output stereodecoder |
| NBCTH | Noise blanker noise controlled threshold |
| NBDTH | Noise blanker deviation controlled threshold |
| NBFS | Field strength controlled noise blanker |
| NBFT | AM noise blanker fixed threshold |
| NBLTH | Noise blanker low threshold |

Table 11. Control register function (continued)

| Register Name | Function |
|---------------|--|
| NBON | Noise blanker enable |
| NBPC | Noise blanker peak charge current |
| NBRR | Noise blanker rectifier discharge resistor |
| NBSMP | Strong multipath influence on noise blanker on/off |
| NBT | Noise blanker time |
| ODCUR | Current for overdeviation-correction |
| ODSW | Overdeviation-correction enable |
| OUT | Test output (only for testing) |
| PC | Counter for PLL (VCO frequency) |
| PCM | Pilot cancellation mode |
| PDH | PD hold activation |
| PH | I/Q mixer phase adjust |
| PTH | Pilot threshold |
| QDC | Quality detector coefficient |
| QNG | Quality noise gain |
| RC | Reference counter PLL |
| RFAGC | FM RF AGC |
| RFKAGC | FM RF keying AGC |
| ROC | Roll-Off compensation |
| S | Two mode switching output enable |
| SBA | FM demodulator spike blanker attack mode |
| SBC | Stereoblend control |
| SBSH | FM demodulator spike blanker sample&hold mode |
| SBT | FM demodulator spike blanker test mode |
| SBTO | FM demodulator spike blanker toggle mode |
| SBW | FM demodulator spike blanker window mode |
| SI | Signal inversion |
| SL | S meter slider |
| SMODE | Two mode switching output |
| SMCTH | Softmute capacitor threshold for ISS "ON" |
| SMD | Softmute depth threshold |
| SMO | Softmute reference voltage offset |
| SMSL | S meter slope |
| SMTH | Softmute startpoint threshold |
| SSTH | Unweighted fieldstrength threshold for seek stop |

Table 11. Control register function (continued)

| Register Name | Function |
|---------------|--|
| STDON | Stereodecoder on/off if muted |
| STDM | Stereodecoder mute enable |
| STING | Stereodecoder ingain |
| STVCO | Stereodecoder VCO adjust |
| TDEV | Time constant for deviation detector |
| TEST | Testing PLL/IFC (only for testing) |
| TFCKL | Fast clock for testing audioprocessor |
| TIN | Switch FSU PIN to TEST input (only for testing) |
| TINAC | Test input adjacent channel (only for testing) |
| TINACM | Test input adjacent channel mute (only for testing) |
| TINMP | Test input multipath(only for testing) |
| TISS | Time constant for ISS filter "ON"/"OFF" |
| TMSA | Test mode stereodecoder and audioprocessor |
| TOUT | Switch FSU PIN to Test output (only for testing) |
| TST | Test stereodecoder enable |
| TVMODE | Tuning voltage offset mode |
| TVO | Tuning voltage offset for prestage |
| TVWB | Tuning voltage offset for prestage (weather band mode) |
| VCOD | VCO divider |
| VCOM | Stereodecoder VCO mode |
| VCOON | Enable Stereo Decoder VCO |
| VHCH | Start level high cut |
| VHCL | Stop level high cut |
| WAGC | AM wide band AGC |
| XTAL | Xtal frequency adjust |
| XTLIM | Xtal amplitude limitation |

Table 12. Subaddress

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---------------------|
| I | A5 | A4 | A3 | A2 | A1 | A0 | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Charge pump control |
| | - | - | - | - | - | - | - | - |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | STD9 |
| | - | - | - | - | - | - | - | - |
| | 1 | 0 | 0 | 1 | 1 | 1 | 1 | FMDEMBSB |
| 0 | | | | | | | | Page mode "OFF" |
| 1 | | | | | | | | Page mode enable |

5.2.1 Data byte specification

Table 13. Addr 0 Charge Pump Control

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | High current = 0mA |
| | | | | 0 | 0 | 0 | 1 | High current = 0.5mA |
| | | | | 0 | 0 | 1 | 0 | High current = 1mA |
| | | | | 0 | 0 | 1 | 1 | High current = 1.5mA |
| | | | | - | - | - | - | - |
| | | | | 1 | 1 | 1 | 1 | High current = 7.5mA |
| | | 0 | 0 | | | | | Low current = 0μA |
| | | 0 | 1 | | | | | Low current = 50μA |
| | | 1 | 0 | | | | | Low current = 100μA |
| | | 1 | 1 | | | | | Low current = 150μA |
| 0 | | | | | | | | Select low current |
| 1 | | | | | | | | Select high current |
| 0 | | | | | | | | ISS time constant at PIN 27 available, FMSEEK "OFF" |
| 1 | | | | | | | | ISS time constant at PIN 28 available, FMSEEK "ON" |

Table 14. Addr 1 PLL counter 1 (LSB)

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|-----------|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | LSB = 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | LSB = 1 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | LSB = 2 | |
| - | - | - | - | - | - | - | - | - | |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | LSB = 252 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | LSB = 253 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | LSB = 254 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | LSB = 255 | |

Table 15. Addr 2 PLL counter 2 (MSB)

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|-------------|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | MSB = 0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | MSB = 256 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | MSB = 512 | |
| - | - | - | - | - | - | - | - | - | |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | MSB = 64768 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | MSB = 65024 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | MSB = 65280 | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | MSB = 65536 | |

Swallow mode: $f_{VCO}/f_{SYN} = LSB + MSB + 32$

Table 16. Addr 3,4 TV1,2

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|---------------------------|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Tuning Voltage Offset = 0 | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 1 | TVO = 25mV | |
| | 0 | 0 | 0 | 0 | 0 | 1 | 0 | TVO = 50mV | |
| - | - | - | - | - | - | - | - | - | |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | TVO = 3175mV | |
| 0 | | | | | | | | -TVO | |
| 1 | | | | | | | | +TVO | |

Table 17. Addr 5 IF counter control 1

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | 0 | 0 | $t_{\text{Sample}} = 20.48\text{ms (FM)128ms (AM)}$ |
| | | | | | 0 | 0 | 1 | $t_{\text{Sample}} = 10.24\text{ms (FM)64ms (AM)}$ |
| | | | | | 0 | 1 | 0 | $t_{\text{Sample}} = 5.12\text{ms (FM)32ms (AM)}$ |
| | | | | | 0 | 1 | 1 | $t_{\text{Sample}} = 2.56\text{ms (FM)16ms (AM)}$ |
| | | | | | 1 | 0 | 0 | $t_{\text{Sample}} = 1.28\text{ms (FM)8ms (AM)}$ |
| | | | | | 1 | 0 | 1 | $t_{\text{Sample}} = 640\mu\text{s (FM)4ms (AM)}$ |
| | | | | | 1 | 1 | 0 | $t_{\text{Sample}} = 320\mu\text{s (FM)2ms (AM)}$ |
| | | | | | 1 | 1 | 1 | $t_{\text{Sample}} = 160\mu\text{s (FM)1ms (AM)}$ |
| | | | | 0 | | | | IF counter disable / stand by |
| | | | | 1 | | | | IF counter enable |
| | | 0 | 0 | | | | | Not valid |
| | | 0 | 1 | | | | | IF counter FM mode |
| | | 1 | 0 | | | | | IF counter AM mode (450KHz) |
| | | 1 | 1 | | | | | IF counter AM mode (10.7MHz) |
| | 0 | | | | | | | Disable mute & AGC on hold in FM mode |
| | 1 | | | | | | | Enable mute & AGC on hold in FM mode |
| 0 | | | | | | | | Lock detector disable |
| 1 | | | | | | | | Lock detector enable |

Table 18. Addr 6 IF counter control 2

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | 0 | 0 | 0 | 0 | 0 | $f_{\text{Center}} = 10.60625\text{MHz (FM)} / 10.689\text{MHz} ; 449\text{KHz (AM)}$ |
| | | | 0 | 0 | 0 | 0 | 1 | $f_{\text{Center}} = 10.61250\text{MHz (FM)} / 10.690\text{MHz} ; 450\text{KHz (AM)}$ recommended |
| - | - | - | - | - | - | - | - | - |
| | | | 0 | 1 | 0 | 1 | 1 | $f_{\text{Center}} = 10.67500\text{MHz (FM)} / 10.700\text{MHz} ; 460\text{KHz (AM)}$ |
| - | - | - | - | - | - | - | - | - |
| | | | 0 | 1 | 1 | 1 | 1 | $f_{\text{Center}} = 10.70000\text{MHz (FM)} / 10.704\text{MHz} ; 464\text{KHz (AM)}$ recommended |
| - | - | - | - | - | - | - | - | - |
| | | | 1 | 1 | 1 | 1 | 1 | $f_{\text{Center}} = 10.80000\text{MHz (FM)} / 10.720\text{MHz} ; 480\text{KHz (AM)}$ |
| 0 | 0 | 0 | | | | | | Not valid |
| 0 | 0 | 1 | | | | | | Not valid |

Table 18. Addr 6 IF counter control 2 (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 0 | 1 | 0 | | | | | | Not valid |
| 0 | 1 | 1 | | | | | | $\Delta f = 6.25\text{kHz}$ (FM) 1kHz (AM) not recommended |
| 1 | 0 | 0 | | | | | | $\Delta f = 12.5\text{kHz}$ (FM) 2kHz (AM) not recommended |
| 1 | 0 | 1 | | | | | | $\Delta f = 25\text{kHz}$ (FM) 4kHz (AM) |
| 1 | 1 | 0 | | | | | | $\Delta f = 50\text{kHz}$ (FM) 8kHz (AM) |
| 1 | 1 | 1 | | | | | | $\Delta f = 100\text{kHz}$ (FM) 16kHz (AM) |

Table 19. Addr 7 AM control

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | Normal AGC time constant |
| | | | | | | | 1 | Short time constant for AM seek stop |
| | | | | | | 0 | | Multipath information available FM at PIN 24 |
| | | | | | | 1 | | AM stereo output available at PIN 24 |
| | | | | 0 | 0 | | | Prescaler ratio 10 |
| | | | | 0 | 1 | | | Prescaler ratio 8 |
| | | | | 1 | 0 | | | Prescaler ratio 6 |
| | | | | 1 | 1 | | | Prescaler ratio 4 |
| | | 0 | 0 | | | | | Disable additional TV1, 2 offset |
| | | 0 | 1 | | | | | Enable additional TV1 offset +3.175V (for weather band) |
| | | 1 | 0 | | | | | Enable additional TV2 offset +3.175V (for weather band) |
| | | 1 | 1 | | | | | Enable additional TV1, 2 offset +3.175V (for weather band) |
| | 0 | | | | | | | TV is tracking with PLL |
| | 1 | | | | | | | TV is independent on PLL |
| 0 | | | | | | | | Disable local mode |
| 1 | | | | | | | | Enable local mode (PIN diode current = 0.5mA) |

Table 20. Addr 8 quality ISS filter

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-------------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | ISS filter control "ON" recommended |
| | | | | | | | 1 | ISS filter control "OFF" |
| | | | | | | 0 | | Switch ISS filter "OFF" |
| | | | | | | 1 | | Switch ISS filter "ON" |

Table 20. Addr 8 quality ISS filter (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | | | Switch "OFF" ISS filter 120kHz |
| | | | | | 1 | | | Switch "ON" ISS filter 80kHz |
| | | | | 0 | | | | Switch "OFF" ISS filter 30KHz for weatherband |
| | | | | 1 | | | | Switch "ON" ISS filter 30KHz for weatherband |
| 0 | 0 | 0 | | | | | | discharge current1 μ A, charge current mid 74 μ A narrow124 μ A |
| 0 | 0 | 1 | | | | | | discharge current3 μ A, charge current mid 72 μ A narrow122 μ A |
| 0 | 1 | 0 | | | | | | discharge current5 μ A, charge current mid 70 μ A narrow120 μ A |
| 0 | 1 | 1 | | | | | | discharge current7 μ A, charge current mid 68 μ A narrow118 μ A |
| - | - | - | | | | | | - |
| 1 | 1 | 1 | | | | | | discharge current15 μ A,charge current mid 60 μ A narrow110 μ A |

Table 21. Addr 9 quality detection adjacent channel

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | dc-coupling deviation detector (has to be 0 in AM mode) |
| | | | | | | | 1 | ac-coupling deviation detector (recommended mode) |
| | | | | | | | 0 | AC highpass frequency 100kHz |
| | | | | | | | 1 | AC bandpass frequency 100kHz |
| | | | | | 0 | | | AC gain 32dB |
| | | | | | 1 | | | AC gain 38dB |
| | | 0 | 0 | 0 | | | | AC wide band threshold 0.25V |
| | | 0 | 0 | 1 | | | | AC wide band threshold 0.35V |
| | | 0 | 1 | 0 | | | | AC wide band threshold 0.45V |
| | | - | - | - | | | | - |
| | | 1 | 1 | 1 | | | | AC wide band threshold 0.95V |
| 0 | 0 | | | | | | | AC narrow band threshold 0.0V |
| 0 | 1 | | | | | | | AC narrow band threshold 0.1V |
| 1 | 0 | | | | | | | AC narrow band threshold 0.2V |
| 1 | 1 | | | | | | | AC narrow band threshold 0.3V |

Table 22. Addr 10 quality detection multipath

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | Multipath control "ON" |
| | | | | | | | 1 | Multipath control "OFF" |
| | | | | | | 0 | | MP bandpass frequency 19KHz if MPION=1, NBSMP=1, MPPC=1, than has to be 0 |
| | | | | | | 1 | | MP bandpass frequency 31KHz |
| | | | | | 0 | | | MP gain 12dB |
| | | | | | 1 | | | MP gain 23dB |
| | | | 0 | 0 | | | | MP threshold 0.50V |
| | | | 0 | 1 | | | | MP threshold 0.75V |
| | | | 1 | 0 | | | | MP threshold 1.00V |
| | | | 1 | 1 | | | | MP threshold 1.25V |
| | 0 | 0 | | | | | | Application mode 1 |
| | 0 | 1 | | | | | | Application mode 2 |
| 0 | | | | | | | | Multipath eliminates ac |
| 1 | | | | | | | | Multipath eliminates ac and ac+ |

Table 23. Addr 11 quality deviation detection

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | 0 | 0 | charge current 39µA, discharge current 1µA |
| | | | | | 0 | 0 | 1 | charge current 38µA, discharge current 2µA |
| | | | | | 0 | 1 | 0 | charge current 37µA, discharge current 3µA |
| | | | | | 0 | 1 | 1 | charge current 36µA, discharge current 4µA |
| | | | | | - | - | - | - |
| | | | | | 1 | 1 | 1 | charge current 32µA, discharge current 8µA |
| | | | 0 | 0 | | | | DEV threshold for ISS narrow/wide 30kHz |
| | | | 0 | 1 | | | | DEV threshold for ISS narrow/wide 45kHz |
| | | | 1 | 0 | | | | DEV threshold for ISS narrow/wide 60kHz |
| | | | 1 | 1 | | | | DEV threshold for ISS narrow/wide 75kHz |
| | 0 | 0 | | | | | | DEV threshold for ISS filter "OFF" ratio 1.5 |
| | 0 | 1 | | | | | | DEV threshold for ISS filter "OFF" ratio 1.4 |
| | 1 | 0 | | | | | | DEV threshold for ISS filter "OFF" ratio 1.3 |
| | 1 | 1 | | | | | | DEV threshold for ISS filter "OFF" ratio 1 |

Table 23. Addr 11 quality deviation detection

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 0 | | | | | | | | Disable ISS filter to fixed bandwidth (ISS80) in automatic control |
| 1 | | | | | | | | Enable ISS filter to fixed bandwidth (ISS80) in automatic control |

Table 24. Addr 12 softmute control 1

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | 0 | 0 | Startpoint mute 0 in application about 3dB μ V antenna level |
| | | | | | 0 | 0 | 1 | Startpoint mute 1 in application about 4dB μ V antenna level |
| | | | | | - | - | - | - |
| | | | | | 1 | 1 | 1 | Startpoint mute 7 in application about 10dB μ V antenna level |
| | 0 | 0 | 0 | 0 | | | | Mute depth 0 in application 18dB |
| | 0 | 0 | 0 | 1 | | | | Mute depth 1 in application 20dB |
| | 0 | 0 | 1 | 0 | | | | Mute depth 2 in application 22dB |
| | 0 | 0 | 1 | 1 | | | | Mute depth 3 in application 24dB |
| | - | - | - | - | | | | - (logarithmically behaviour) |
| | 1 | 1 | 1 | 1 | | | | Mute depth 15 in application 36dB |
| 0 | | | | | | | | FM mute disable, (has to be 0 in AM mode) |
| 1 | | | | | | | | FM mute enable |

Table 25. Addr 13 softmute control 2

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | Disable mute threshold for ISS filter "ON" |
| | | | | | | | 1 | Enable mute threshold for ISS filter "ON" |
| | | | | | 0 | 0 | | AC mute depth 10dB |
| | | | | | 0 | 1 | | AC mute depth 8dB |
| | | | | | 1 | 0 | | AC mute depth 6dB |
| | | | | | 1 | 1 | | AC mute depth 4dB |
| | 0 | 0 | 0 | 0 | | | | AC mute threshold 60mV |
| | 0 | 0 | 0 | 1 | | | | AC mute threshold 80mV |
| | 0 | 0 | 1 | 0 | | | | AC mute threshold 100mV |
| | - | - | - | - | | | | - |
| | 0 | 1 | 1 | 1 | | | | AC mute threshold 340mV |

Table 25. Addr 13 softmute control 2

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-----------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | 1 | 1 | 1 | 1 | | | | AC mute "OFF" |
| 0 | | | | | | | | AC mute filter 110KHz |
| 1 | | | | | | | | AC mute filter 100KHz |

Table 26. Addr 14 VCODIV/PLLREF

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | 0 | 0 | not valid (only for testing) |
| | | | | | | 0 | 1 | VCO frequency divided by 2 |
| | | | | | | 1 | 0 | VCO frequency divided by 3 |
| | | | | | | 1 | 1 | original VCO frequency |
| | | | | | 0 | | | VCO "I" signal 0 degree |
| | | | | | 1 | | | VCO "I" signal 180 degree |
| | | 1 | 0 | 0 | | | | PLL reference frequency 50KHz |
| | | 1 | 0 | 1 | | | | PLL reference frequency 25KHz |
| | | 1 | 1 | 0 | | | | PLL reference frequency 10KHz |
| | | 1 | 1 | 1 | | | | PLL reference frequency 9KHz |
| | | 0 | 0 | 0 | | | | PLL reference frequency 2KHz |
| | 0 | | | | | | | Select FM mode |
| | 1 | | | | | | | Select AM mode |
| 0 | | | | | | | | Select PLL low pass filter FM |
| 1 | | | | | | | | Select PLL low pass filter AM |

Table 27. Addr 15 FM AGC

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | 0 | 0 | RFAGC threshold $V_{9-11TH} = 85(77 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | | | 0 | 1 | RFAGC threshold $V_{9-11TH} = 90(82 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | | | 1 | 0 | RFAGC threshold $V_{9-11TH} = 94(86 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | | | 1 | 1 | RFAGC threshold $V_{9-11TH} = 96(88 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | 0 | 0 | | | IFAGC threshold $V_{77TH} = 86(60 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | 0 | 1 | | | IFAGC threshold $V_{77TH} = 92(66 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | 1 | 0 | | | IFAGC threshold $V_{77TH} = 96(70 \text{ ANT})\text{dB}\mu\text{V}$ |
| | | | | 1 | 1 | | | IFAGC threshold $V_{77TH} = 98(72 \text{ ANT})\text{dB}\mu\text{V}$ |

Table 27. Addr 15 FM AGC

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-----------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | 0 | 0 | 0 | | | | | KAGC threshold 80dB μ V |
| | 0 | 0 | 1 | | | | | KAGC threshold 82dB μ V |
| | 0 | 1 | 0 | | | | | KAGC threshold 84dB μ V |
| | 0 | 1 | 1 | | | | | KAGC threshold 86dB μ V |
| | 1 | 0 | 0 | | | | | KAGC threshold 88dB μ V |
| | 1 | 0 | 1 | | | | | KAGC threshold 90dB μ V |
| | 1 | 1 | 0 | | | | | KAGC threshold 92dB μ V |
| | 1 | 1 | 1 | | | | | Keying AGC "OFF" |
| 0 | | | | | | | | RF KAGC"OFF" |
| 1 | | | | | | | | RF KAGC"ON" |

Table 28. Addr 16 AM AGC

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | not valid |
| | | | | 0 | 0 | 0 | 1 | not valid |
| | | | | 0 | 0 | 1 | 0 | WAGC $V_{4TH}= 97dB\mu$ $V_{71TH}= 96.5dB\mu$ |
| | | | | 0 | 0 | 1 | 1 | WAGC $V_{4TH}= 98.5dB\mu$ $V_{71TH}= 98.5dB\mu$ |
| | | | | 0 | 1 | 0 | 0 | WAGC $V_{4TH}= 100dB\mu$ $V_{71TH}= 100dB\mu$ |
| | | | | 0 | 1 | 0 | 1 | WAGC $V_{4TH}= 101.5dB\mu$ $V_{71TH}= 101dB\mu$ |
| | | | | 0 | 1 | 1 | 0 | WAGC $V_{4TH}= 102.5dB\mu$ $V_{71TH}= 102.5dB\mu$ |
| | | | | 0 | 1 | 1 | 1 | WAGC $V_{4TH}= 103.5dB\mu$ $V_{71TH}= 103.5dB\mu$ |
| | | | | 1 | 0 | 0 | 0 | WAGC $V_{4TH}= 104.5dB\mu$ $V_{71TH}= 104dB\mu$ |
| | | | | 1 | 0 | 0 | 1 | WAGC $V_{4TH}= 105dB\mu$ $V_{71TH}= 105dB\mu$ |
| | | | | 1 | 0 | 1 | 0 | WAGC $V_{4TH}= 106dB\mu$ $V_{71TH}= 105.5dB\mu$ |
| | | | | 1 | 0 | 1 | 1 | WAGC $V_{4TH}= 106.5dB\mu$ $V_{71TH}= 106.5dB\mu$ |
| | | | | 1 | 1 | 0 | 0 | WAGC $V_{4TH}= 107dB\mu$ $V_{71TH}= 107dB\mu$ |
| | | | | 1 | 1 | 0 | 1 | WAGC $V_{4TH}= 108dB\mu$ $V_{71TH}= 107.5dB\mu$ |
| | | | | 1 | 1 | 1 | 0 | WAGC $V_{4TH}= 108.5dB\mu$ $V_{71TH}= 108dB\mu$ |
| | | | | 1 | 1 | 1 | 1 | WAGC $V_{4TH}= 109dB\mu$ $V_{71TH}= 108.5dB\mu$ |
| 0 | 0 | 0 | 0 | | | | | DAGC $V_{71TH}= 74dB\mu$ |
| 0 | 0 | 0 | 1 | | | | | DAGC $V_{71TH}= 77dB\mu$ |
| 0 | 0 | 1 | 0 | | | | | DAGC $V_{71TH}= 79dB\mu$ |
| 0 | 0 | 1 | 1 | | | | | DAGC $V_{71TH}= 80.5dB\mu$ |

Table 28. Addr 16 AM AGC (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-----------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| 0 | 1 | 0 | 0 | | | | | DAGC $V_{71TH} = 82dB\mu$ |
| 0 | 1 | 0 | 1 | | | | | DAGC $V_{71TH} = 83.5dB\mu$ |
| 0 | 1 | 1 | 0 | | | | | DAGC $V_{71TH} = 85dB\mu$ |
| 0 | 1 | 1 | 1 | | | | | DAGC $V_{71TH} = 86.5dB\mu$ |
| 1 | 0 | 0 | 0 | | | | | DAGC $V_{71TH} = 88dB\mu$ |
| 1 | 0 | 0 | 1 | | | | | DAGC $V_{71TH} = 89dB\mu$ |
| 1 | 0 | 1 | 0 | | | | | DAGC $V_{71TH} = 90dB\mu$ |
| 1 | 0 | 1 | 1 | | | | | DAGC $V_{71TH} = 91dB\mu$ |
| 1 | 1 | 0 | 0 | | | | | DAGC $V_{71TH} = 92dB\mu$ |
| 1 | 1 | 0 | 1 | | | | | DAGC $V_{71TH} = 93dB\mu$ |
| 1 | 1 | 1 | 0 | | | | | DAGC $V_{71TH} = 94dB\mu$ |
| 1 | 1 | 1 | 1 | | | | | DAGC $V_{71TH} = 96dB\mu$ |

Table 29. Addr 17 FM demodulator fine adjust

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0mV |
| | | 0 | 0 | 0 | 0 | 0 | 1 | +8.5mV |
| | | 0 | 0 | 0 | 0 | 1 | 0 | +17mV |
| | | - | - | - | - | - | - | - |
| | | 0 | 1 | 1 | 1 | 1 | 1 | +263.5mV |
| | | 1 | 0 | 0 | 0 | 0 | 0 | 0mV |
| | | 1 | 0 | 0 | 0 | 0 | 1 | -8.5mV |
| | | 1 | 0 | 0 | 0 | 1 | 0 | -17mV |
| | | - | - | - | - | - | - | - |
| | | 1 | 1 | 1 | 1 | 1 | 1 | -263.5mV |
| 0 | 0 | | | | | | | Spike cancelation "OFF" |
| 0 | 1 | | | | | | | Threshold for spike cancelation 750mV |
| 1 | 0 | | | | | | | Threshold for spike cancelation 270mV |
| 1 | 1 | | | | | | | Threshold for spike cancelation 520mV recommended |

Table 30. Addr 18 S-meter slider

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | S meter slider offset SL=0dB |
| | | | | 0 | 0 | 0 | 1 | S meter offset SL=1dB |
| | | | | 0 | 0 | 1 | 0 | S meter offset SL=2dB |
| | | | | - | - | - | - | - |
| | | | | 1 | 1 | 1 | 1 | S meter offset SL=15dB |
| | | | 0 | | | | | S meter offset -SL |
| | | | 1 | | | | | S meter offset +SL |
| | | 0 | | | | | | S Meter slope 1V/decade |
| | | 1 | | | | | | S meter slope 1.5V/decade |
| | 0 | | | | | | | Overdeviation correction current max=45μA |
| | 1 | | | | | | | Overdeviation correction current max=90μA |
| 0 | | | | | | | | Overdeviation correction "OFF" |
| 1 | | | | | | | | Overdeviation correction "ON" |

Table 31. Addr 19 IF GAIN/XTAL adjust

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-----------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | Xtal amplitude limitation disable |
| | | | | | | | 1 | Xtal amplitude limitation enable |
| | | | | | 0 | 0 | | IF1 gain1 9dB |
| | | | | | 0 | 1 | | IF1 gain1 12dB |
| | | | | | 1 | 0 | | IF1 gain1 15dB |
| | | | | | 1 | 1 | | IF1 gain1 18dB |
| 0 | 0 | 0 | 0 | 0 | | | | C _{Load} 0pF |
| 0 | 0 | 0 | 0 | 1 | | | | C _{Load} 0.75pF |
| 0 | 0 | 0 | 1 | 0 | | | | C _{Load} 1.5pF |
| 0 | 0 | 0 | 1 | 1 | | | | C _{Load} 2.25pF |
| 0 | 0 | 1 | 0 | 0 | | | | C _{Load} 3pF |
| - | - | - | - | - | | | | - |
| 1 | 1 | 1 | 1 | 1 | | | | C _{Load} 23.25pF |

Table 32. Tank adjust

| MSB | | | | LSB | | | | Function |
|-----|----|----|----|-----|----|----|----|----------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | 450kHz 0pF |
| | | | | 0 | 0 | 0 | 1 | 450kHz 1.6pF |
| | | | | 0 | 0 | 1 | 0 | 450kHz 3.2pF |
| | | | | 0 | 0 | 1 | 1 | 450kHz 4.8pF |
| | | | | - | - | - | - | - |
| | | | | 1 | 1 | 1 | 1 | 450kHz 24pF |
| 0 | 0 | 0 | 0 | | | | | 10.7MHz 0pF |
| 0 | 0 | 0 | 1 | | | | | 10.7MHz 0.55pF |
| 0 | 0 | 1 | 0 | | | | | 10.7MHz 1.1pF |
| 0 | 0 | 1 | 1 | | | | | 10.7MHz 1.65pF |
| - | - | - | - | | | | | - |
| 1 | 1 | 1 | 1 | | | | | 10.7MHz 8.25pF |

Table 33. Addr 21 I/Q FM mixer1 adjust

| MSB | | | | LSB | | | | Function |
|-----|----|----|----|-----|----|----|----|----------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | -7 degree |
| | | | | 0 | 0 | 0 | 1 | -6 degree |
| | | | | 0 | 0 | 1 | 0 | -5 degree |
| | | | | - | - | - | - | - |
| | | | | 0 | 1 | 1 | 1 | 0 degree |
| | | | | 1 | 0 | 0 | 0 | +1 degree |
| | | | | 1 | 0 | 0 | 1 | +2 degree |
| | | | | - | - | - | - | - |
| | | | | 1 | 1 | 1 | 1 | +8degree |
| 0 | 0 | | | | | | | Softmute reference offset OFF |
| 0 | 1 | | | | | | | Softmute reference offset -50mV |
| 1 | 0 | | | | | | | Softmute reference offset -100mV |
| 1 | 1 | | | | | | | Softmute reference offset -150mV |

Table 34. Addr 22 AM IF noise blanker

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|-----------------|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| | | | | 0 | 0 | 0 | 0 | Not valid | |
| | | | | 0 | 0 | 0 | 1 | AINBT 12.5mV | |
| | | | | 0 | 0 | 1 | 0 | AINBT 25mV | |
| | | | | - | - | - | - | - | |
| | | | | 1 | 1 | 1 | 1 | AINBT 187.5mV | |
| | | 0 | 0 | | | | | AINBD "ON" | |
| | | 0 | 1 | | | | | AINBD 4.0V | |
| | | 1 | 0 | | | | | AINBD 3.2V | |
| | | 1 | 1 | | | | | AINBD "OFF" | |
| 0 | 0 | | | | | | | AINT 8 μ s | |
| 0 | 1 | | | | | | | AINT 11 μ s | |
| 1 | 0 | | | | | | | AINT 14 μ s | |
| 1 | 1 | | | | | | | AINT 17 μ s | |

Table 35. Addr 23 switch control

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|------------------------------------|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| | | | | | | | 0 | S1 LOW output voltage | |
| | | | | | | | 1 | S1 HIGH output voltage | |
| | | | | | | 0 | | S1 emitter output available | |
| | | | | | | 1 | | S1 open collector output available | |
| | | | | | 0 | | | S2 LOW output voltage | |
| | | | | | 1 | | | S2 HIGH output voltage | |
| | | | | 0 | | | | S2 emitter output available | |
| | | | | 1 | | | | S2 open collector output available | |
| 0 | 0 | 0 | 0 | | | | | SSTOP=IFC (IF counter status) | |
| 0 | 0 | 0 | 1 | | | | | SSTOP= H if IFC=H&FSU>0.89V | |
| 0 | 0 | 1 | 0 | | | | | SSTOP= H if IFC=H&FSU>1.16V | |
| 0 | 0 | 1 | 1 | | | | | SSTOP= H if IFC=H&FSU>1.43V | |
| - | - | - | - | | | | | | |
| 1 | 1 | 1 | 1 | | | | | SSTOP= H if IFC=H&FSU>4.67V | |

Table 36. Addr 24 stereodecoder 1

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|---|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| | | | | | | | 1 | only for testing (has to be set to 1) | |
| | | | | | | 0 | | not valid (only for testing) | |
| | | | | | | 1 | | Audio AM noise blanker fix threshold enable | |
| | | | | | 1 | | | only for testing (has to be set to 1) | |
| | | | | 0 | | | | Audio inverter OFF | |
| | | | | 1 | | | | Audio inverter ON | |
| | | 0 | 0 | | | | | Audio noise blanking time 38µs | |
| | | 0 | 1 | | | | | Audio noise blanking time 25.5µs | |
| | | 1 | 0 | | | | | Audio noise blanking time 32µs | |
| | | 1 | 1 | | | | | Audio noise blanking time 22µs | |
| | 0 | | | | | | | Stereodecoder VCO adjust minus | |
| | 1 | | | | | | | Stereodecoder no VCO adjust recommended | |
| 0 | | | | | | | | Stereodecoder VCO adjust plus | |
| 1 | | | | | | | | Stereodecoder no VCO adjust recommended | |

Table 37. Addr 25 stereodecoder 2

| MSB | | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|----|--|----------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | | |
| | | | | | | | 0 | Stereo decoder mute disable | |
| | | | | | | | 1 | Stereo decoder mute enable | |
| | | | | | | 0 | | Stereo decoder "ON" if muted | |
| | | | | | | 1 | | Stereo decoder "OFF" if muted | |
| | | | | | 0 | | | Forced MONO, must be set in AM | |
| | | | | | 1 | | | MONO/STEREO switch automatically | |
| | | | | 0 | | | | Noise blanker peak charge current low | |
| | | | | 1 | | | | Noise blanker peak charge current high | |
| | | | 0 | | | | | Pilot threshold high | |
| | | | 1 | | | | | Pilot threshold low | |
| | | 0 | | | | | | Deemphasis 50µs | |
| | | 1 | | | | | | Deemphasis 75µs | |
| 0 | 0 | | | | | | | Stereodecoder ingain = 3.75dB | |
| 0 | 1 | | | | | | | Stereodecoder ingain = 2.5dB | |
| 1 | 0 | | | | | | | Stereodecoder ingain = 1.25dB | |
| 1 | 1 | | | | | | | Stereodecoder ingain = 0dB | |

Table 38. Addr 26 stereodecoder 3

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | 0 | 0 | Audio noise blanker low threshold 280mV |
| | | | | | 0 | 0 | 1 | Audio noise blanker low threshold 261mV |
| | | | | | 0 | 1 | 0 | Audio noise blanker low threshold 242mV |
| | | | | | 0 | 1 | 1 | Audio noise blanker low threshold 223mV |
| | | | | | 1 | 0 | 0 | Audio noise blanker low threshold 204mV |
| | | | | | 1 | 0 | 1 | Audio noise blanker low threshold 185mV |
| | | | | | 1 | 1 | 0 | Audio noise blanker low threshold 166mV |
| | | | | | 1 | 1 | 1 | Audio noise blanker low threshold 147mV |
| | | | 0 | 0 | | | | Audio noise blanker noise controlled threshold 1200mV |
| | | | 0 | 1 | | | | Audio noise blanker noise controlled threshold 950mV |
| | | | 1 | 0 | | | | Audio noise blanker noise controlled threshold 700mV |
| | | | 1 | 1 | | | | Audio noise blanker noise controlled threshold 450mV |
| | | 0 | | | | | | Audio noise blanker OFF |
| | | 1 | | | | | | Audio noise blanker ON |
| 0 | 0 | | | | | | | Deviation adjust 2.0V |
| 0 | 1 | | | | | | | Deviation adjust 1.5V |
| 1 | 0 | | | | | | | Deviation adjust 1.0V |
| 1 | 1 | | | | | | | Deviation detector off |

Table 39. Addr 27 stereodecoder 4

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-----------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | | 0 | High Cut OFF |
| | | | | | | | 1 | High Cut ON |
| | | | | | 0 | 0 | | max. High Cut 10dB |
| | | | | | 0 | 1 | | max. High Cut 5.5dB |
| | | | | | 1 | 0 | | max. High Cut 7.5dB |
| | | | | | 1 | 1 | | max. High Cut 8.5dB |
| | | | 0 | 0 | | | | Start level High Cut at 42% REF5V |
| | | | 0 | 1 | | | | Start level High Cut at 50% REF5V |
| | | | 1 | 0 | | | | Start level High Cut at 58% REF5V |
| | | | 1 | 1 | | | | Start level High Cut at 66% REF5V |
| | 0 | 0 | | | | | | Stop level High Cut at 11% VHCH |
| | 0 | 1 | | | | | | Stop level High Cut at 18.3% VHCH |

Table 39. Addr 27 stereodecoder 4 (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | 1 | 0 | | | | | | Stop level High Cut at 25.7% VHCH |
| | 1 | 1 | | | | | | Stop level High Cut at 33% VHCH |
| 0 | | | | | | | | Strong multipath influence on peak discharge OFF |
| 1 | | | | | | | | Strong multipath influence on peak discharge ON (MPF = 0!!) |

Table 40. Addr 28 stereodecoder 5

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | 0 | 0 | Stereoblend control at 29% REF5V |
| | | | | | 0 | 0 | 1 | Stereoblend control at 33% REF5V |
| | | | | | 0 | 1 | 0 | Stereoblend control at 38% REF5V |
| | | | | | 0 | 1 | 1 | Stereoblend control at 42% REF5V |
| | | | | | 1 | 0 | 0 | Stereoblend control at 46% REF5V |
| | | | | | 1 | 0 | 1 | Stereoblend control at 50% REF5V |
| | | | | | 1 | 1 | 0 | Stereoblend control at 54% REF5V |
| | | | | | 1 | 1 | 1 | Stereoblend control at 58% REF5V |
| | | | 0 | 0 | | | | Audio noise blanker field strength adjust 2.0V |
| | | | 0 | 1 | | | | Audio noise blanker field strength adjust 1.6V |
| | | | 1 | 0 | | | | Audio noise blanker field strength adjust 1.4V |
| | | | 1 | 1 | | | | Audio noise blanker field strength adjust OFF |
| | 0 | 0 | | | | | | Quality detector coefficient a=0.6 |
| | 0 | 1 | | | | | | Quality detector coefficient a=0.75 |
| | 1 | 0 | | | | | | Quality detector coefficient a=0.9 |
| | 1 | 1 | | | | | | Quality detector coefficient a=1.05 |
| 0 | | | | | | | | Multipath influence on peak discharge OFF |
| 1 | | | | | | | | Multipath influence on peak discharge ON (-1V/ms) (MPF = 0!!) |

Table 41. Addr 29 stereodecoder 6

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | 0 | 0 | Noise rectifier discharge resistor = infinite |
| | | | | | | 0 | 1 | Noise rectifier discharge resistor =56K |
| | | | | | | 1 | 0 | Noise rectifier discharge resistor =33K |
| | | | | | | 1 | 1 | Noise rectifier discharge resistor =18K |

Table 41. Addr 29 stereodecoder 6 (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | | | Multipath detector band pass gain =6dB |
| | | | | 0 | 1 | | | Multipath detector band pass gain =12dB |
| | | | | 1 | 0 | | | Multipath detector band pass gain =9dB |
| | | | | 1 | 1 | | | Multipath detector band pass gain =10.5dB |
| | | | 0 | | | | | Multipath detector internal influence ON |
| | | | 1 | | | | | Multipath detector internal influence OFF |
| | | 0 | | | | | | Multipath detector charge current =0.8μA |
| | | 1 | | | | | | Multipath detector charge current =0.4μA |
| 0 | 0 | | | | | | | Multipath detector rectifier gain =7.6dB |
| 0 | 1 | | | | | | | Multipath detector rectifier gain =4.6dB |
| 1 | 0 | | | | | | | Multipath detector rectifier gain =0dB |
| 1 | 1 | | | | | | | Multipath detector rectifier gain disabled |

Table 42. Addr 30 stereodecoder 7

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | 0 | 0 | 0 | 0 | Roll-Off compensation not allowed |
| | | | | 0 | 0 | 0 | 1 | Roll-Off compensation 17.1% |
| | | | | 0 | 0 | 1 | 0 | Roll-Off compensation 15.2% |
| | | | | 0 | 0 | 1 | 1 | Roll-Off compensation 13.3% |
| | | | | 0 | 1 | 0 | 0 | Roll-Off compensation 11.4% |
| | | | | 0 | 1 | 0 | 1 | Roll-Off compensation 9.6% |
| | | | | 0 | 1 | 1 | 0 | Roll-Off compensation 7.8% recommended |
| | | | | 0 | 1 | 1 | 1 | Roll-Off compensation 6.0% |
| | | | | 1 | 0 | 0 | 0 | Roll-Off compensation not allowed |
| | | | | 1 | 0 | 0 | 1 | Roll-Off compensation 4.7% |
| | | | | 1 | 0 | 1 | 0 | Roll-Off compensation 2.9% |
| | | | | 1 | 0 | 1 | 1 | Roll-Off compensation 1.3% |
| | | | | 1 | 1 | 0 | 0 | Roll-Off compensation -0.2% |
| | | | | 1 | 1 | 0 | 1 | Roll-Off compensation -1.8% |
| | | | | 1 | 1 | 1 | 0 | Roll-Off compensation -3.4% |
| | | | | 1 | 1 | 1 | 1 | Roll-Off compensation -5% |
| | 0 | 0 | 0 | | | | | Level gain 0dB |
| | 0 | 0 | 1 | | | | | Level gain 0.67dB |

Table 42. Addr 30 stereodecoder 7 (continued)

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | 0 | 1 | 0 | | | | | Level gain 1.34dB |
| | - | - | - | | | | | - |
| | 1 | 1 | 1 | | | | | Level gain 4.7dB |
| 0 | | | | | | | | AM audio filter "OFF" |
| 1 | | | | | | | | AM audio filter "ON" (has to be set if AMNB is used !!) |

Table 43. Addr 31 stereodecoder 8

| MSB | | | | | | | LSB | Function |
|-----|-----|-----|----|----|----|----|-----|--|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | | 0 | 0 | Quality noise gain =6dB |
| | | | | | | 0 | 1 | Quality noise gain =9dB |
| | | | | | | 1 | 0 | Quality noise gain =12dB |
| | | | | | | 1 | 1 | Quality noise gain =15dB |
| | | | | | 0 | | | Enable AFS PIN |
| | | | | | 1 | | | Disable AFS PIN |
| | | | | 0 | | | | AFS influence on stereodecoder mute |
| | | | | 1 | | | | No AFS influence on stereodecoder mute |
| | | | 0 | | | | | PD hold activation if AFS<V _{th1} |
| | | | 1 | | | | | PD hold activation if AFS<V _{th2} |
| | | 0/1 | | | | | | not valid |
| | 0/1 | | | | | | | not valid |
| 0 | | | | | | | | AM audio delay for noise blanking "OFF" |
| 1 | | | | | | | | AM audio delay for noise blanking "ON"(has to be set if AMNB is used !!) |

Table 44. Addr 32 stereodecoder 9

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|-------------------------------|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| | | | | | 0 | | | Deemphasis shift (25/37.5µs) |
| | | | | | 1 | | | Deemphasis no shift (50/75µs) |
| 0 | 0 | 0 | 0 | 0 | | | | AM corner frequency = 3.18kHz |
| 0 | 0 | 0 | 0 | 1 | | | | AM corner frequency = 3.10kHz |
| 0 | 0 | 0 | 1 | 0 | | | | AM corner frequency = 3.02kHz |
| - | - | - | - | - | | | | |
| 1 | 1 | 1 | 0 | 1 | | | | AM corner frequency = 1.12kHz |
| 1 | 1 | 1 | 1 | 1 | | | | AM corner frequency = 1.06kHz |

Table 45. Addr 33 test tuner control 1

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | x | Only for testing (have to be set to 0) |

Table 46. Addr 34 test tuner control 2

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | x | Only for testing (have to be set to 0) |

Table 47. Addr 35 test tuner control 3

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | x | Only for testing (have to be set to 0) |

Table 48. Addr 36 test tuner control 4

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | x | Only for testing (have to be set to 0) |

Table 49. Addr 37 test tuner control 5

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | x | Only for testing (have to be set to 0) |

Table 50. Addr 38 test stereodecoder control

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | 0 | Only for testing (have to be set to 1) |

Table 51. Addr39 test FM demodulator spike blanker and stereo decoder

| MSB | | | | | | | LSB | Function |
|-----|----|----|----|----|----|----|-----|---|
| d7 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | |
| x | x | x | x | x | x | x | 0 | Only for testing (have to be set to 1) |

6 Appendix

Figure 8. Block diagram I/Q mixer

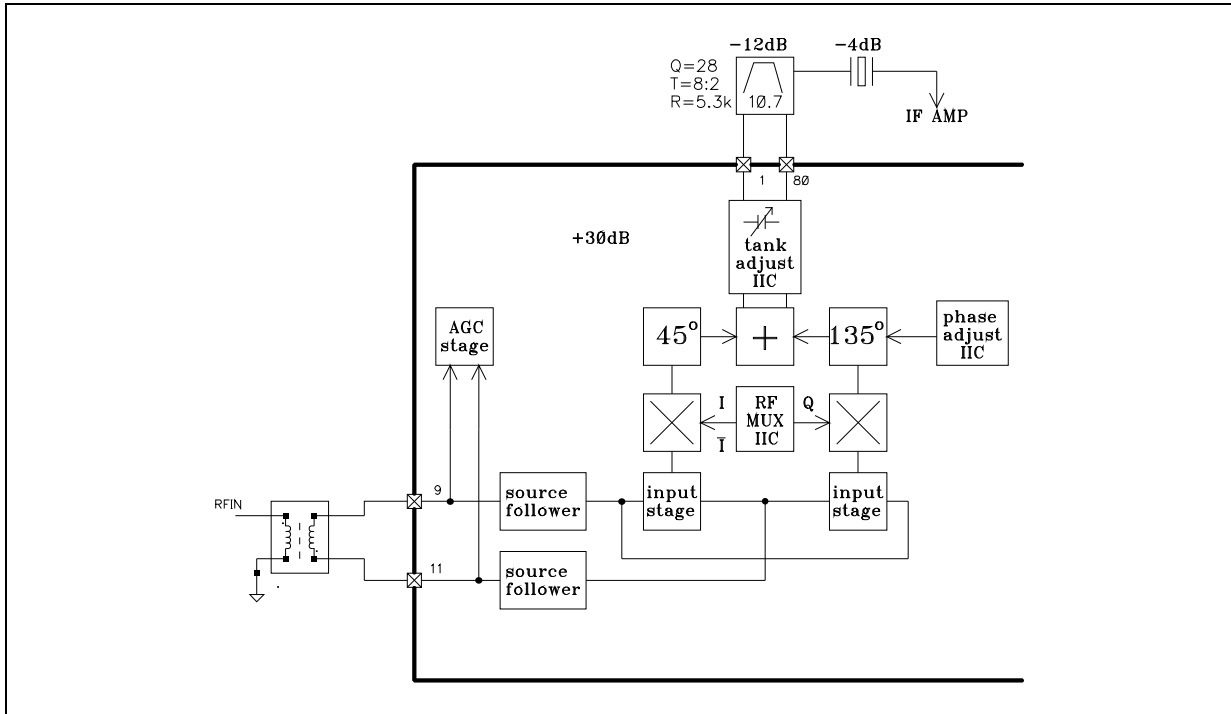


Figure 9. Block diagram VCO

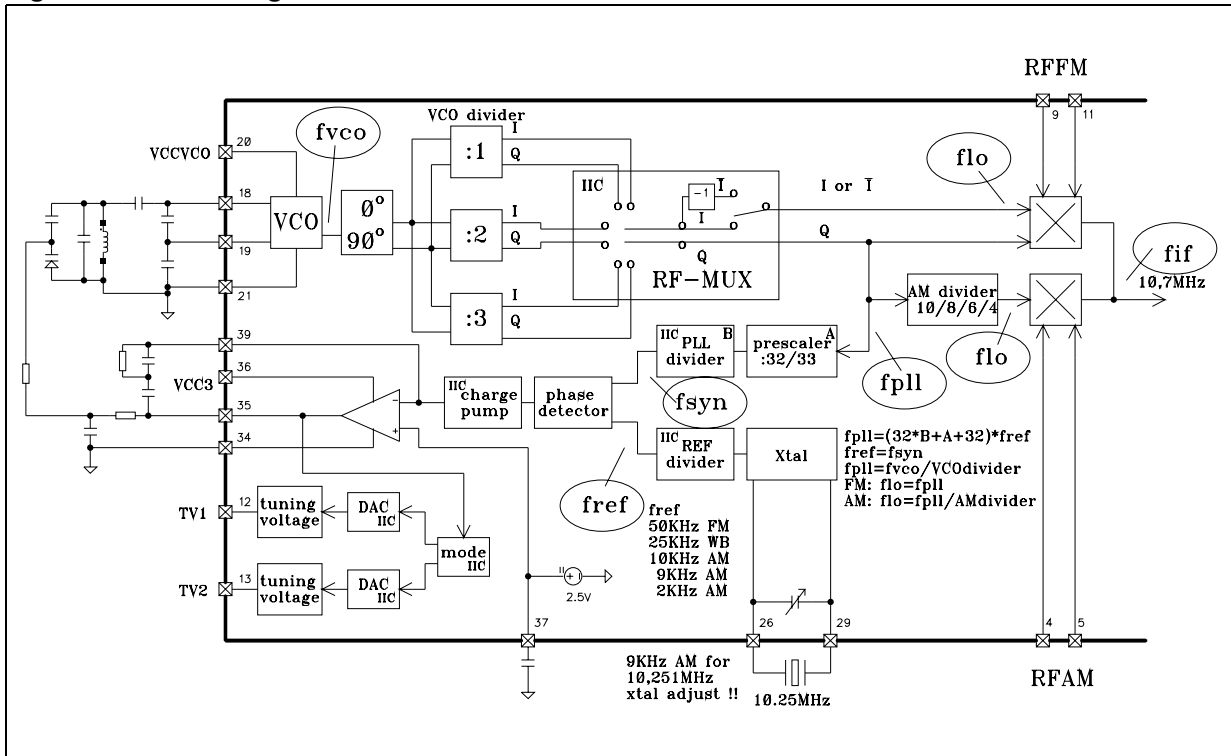


Figure 10. Block diagram keying AGC

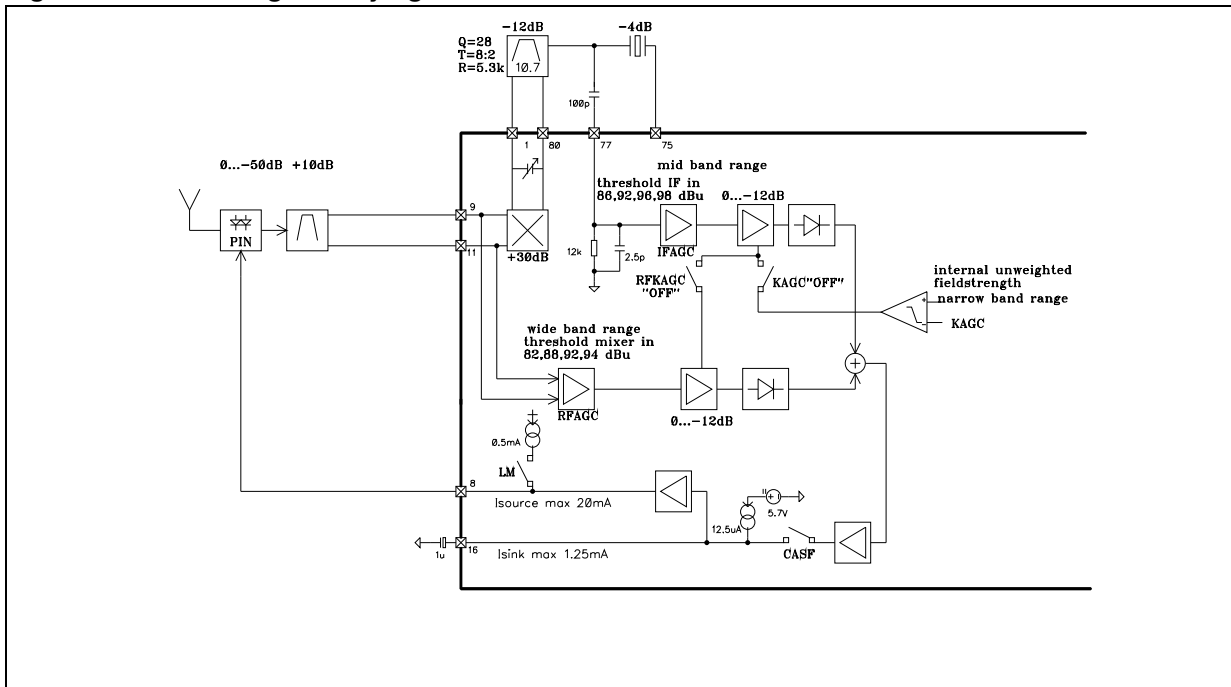
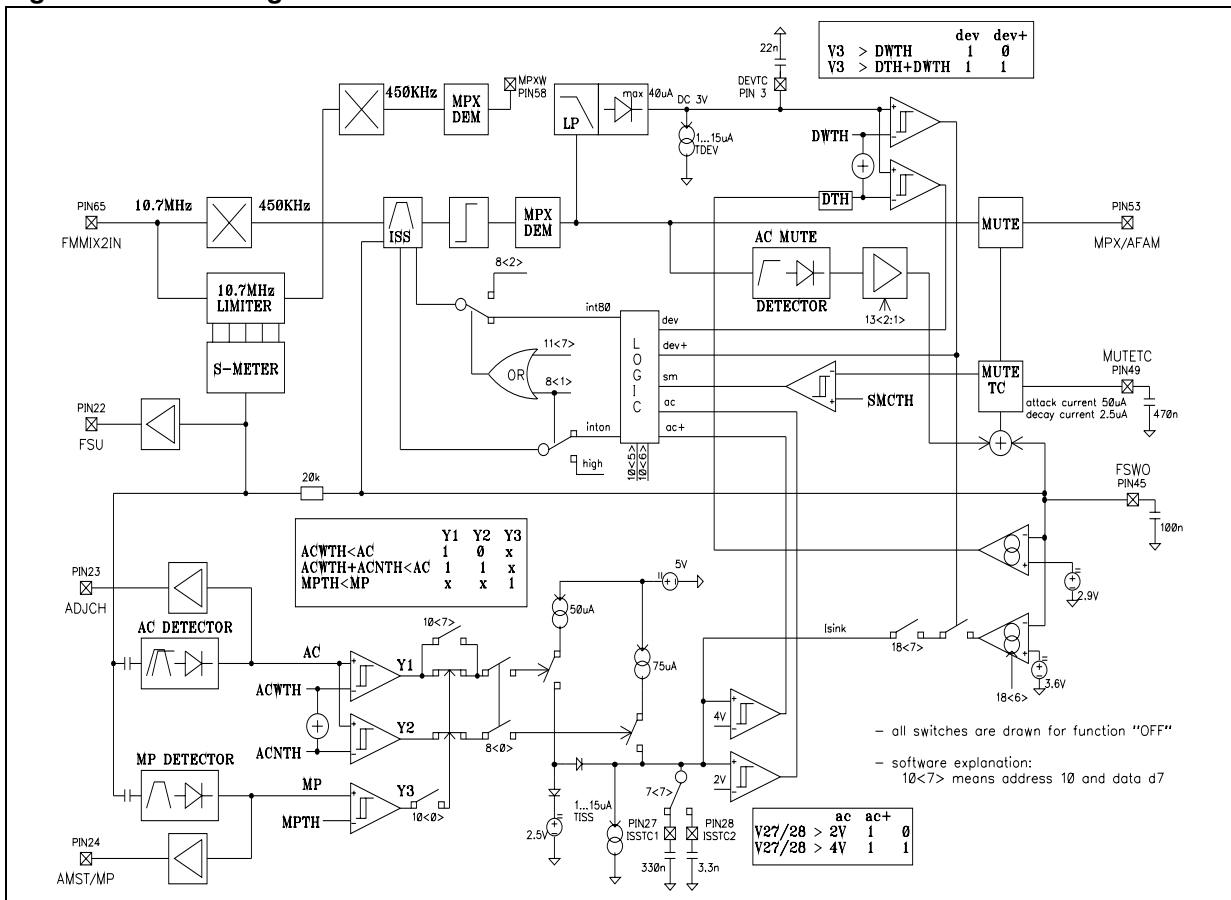


Figure 11. Block diagram ISS function



Block diagram quality detection principle (without overdeviation correction)**Table 52. Block diagram quality detection principle**

| Signal | Low | High |
|--------|--|---|
| ac | No adjacent channel | Adjacent channel present |
| ac+ | No strong adjacent channel | Adjacent channel higher as ac |
| sm | Fieldstrength higher as softmute threshold | Fieldstrength lower as softmute threshold |
| dev | Deviation lower as threshold DWTH | Deviation higher as threshold DWTH |
| dev+ | Deviation lower as threshold DTH*DWTH | Deviation higher as threshold DTH*DWTH |
| inton | ISS filter off by logic (wide) | ISS filter on by logic |
| int80 | ISS filter 120kHz (mid) | ISS filter 80kHz (narrow) |

Table 53. Functional mode quality detection

| Input signals | | | | | Mode1 | | | Mode2 | | |
|---------------|-----|----|-----|------|-------|-------|----------|-------|-------|----------|
| ac | ac+ | sm | dev | dev+ | inton | int80 | Function | inton | int80 | Function |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | wide | 0 | 0 | wide |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | wide | 0 | 0 | wide |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | wide | 0 | 0 | wide |
| 0 | 0 | 1 | 0 | 0 | 1 | 1 | narrow | 1 | 1 | narrow |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | wide | 1 | 0 | mid |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | wide | 0 | 0 | wide |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | narrow | 1 | 0 | mid |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | narrow | 1 | 1 | narrow |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 | mid | 1 | 0 | mid |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | mid | 1 | 1 | narrow |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | narrow | 1 | 1 | narrow |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | narrow | 1 | 1 | narrow |
| 1 | 0 | 1 | 1 | 0 | 1 | 0 | mid | 1 | 0 | mid |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | mid | 1 | 1 | narrow |
| 1 | 0 | 1 | 1 | 1 | 1 | 0 | mid | 1 | 0 | mid |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | mid | 1 | 1 | narrow |

Figure 12. Block diagram AM part

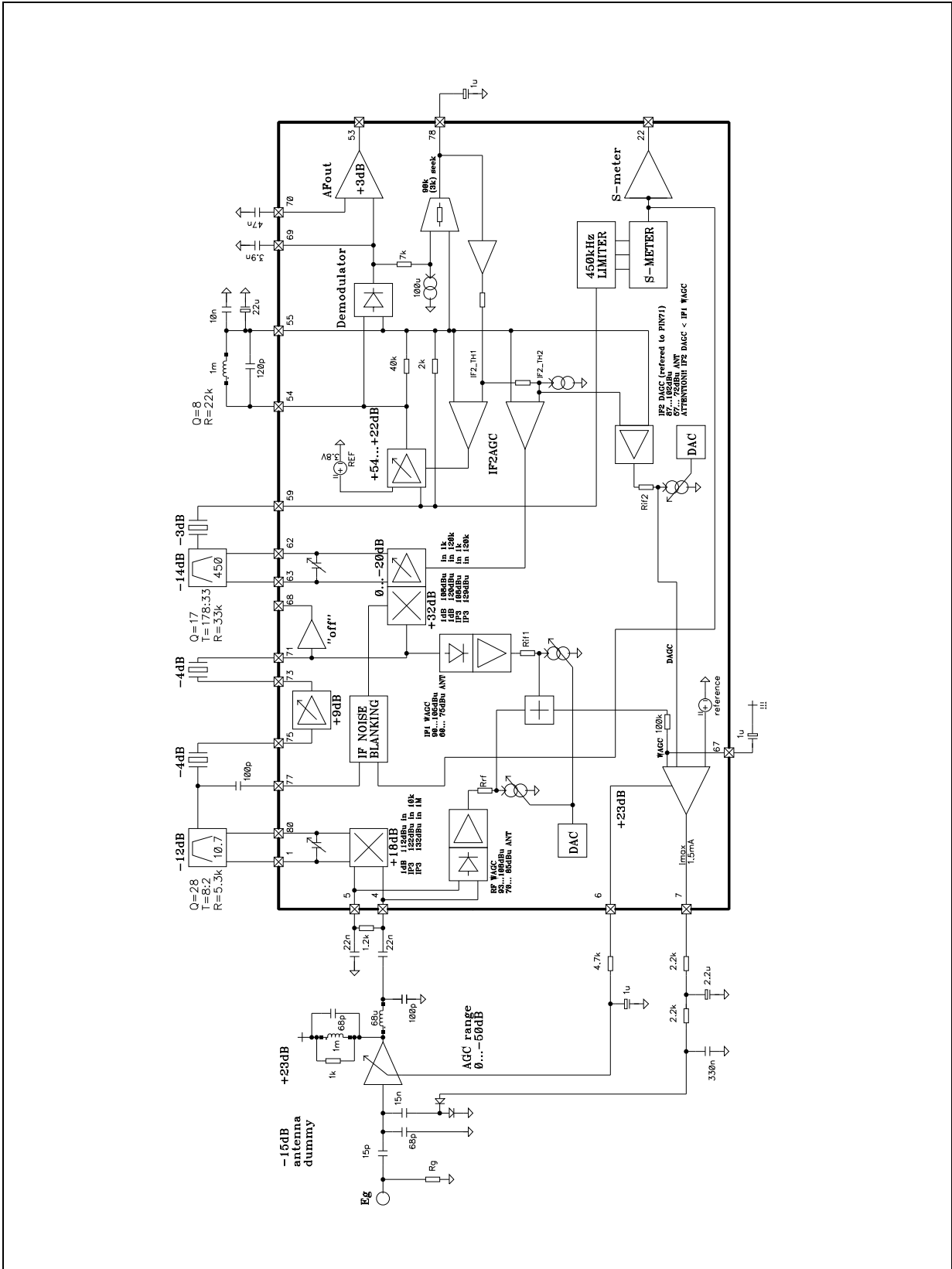


Figure 13. Block diagram AM IF noise blanker

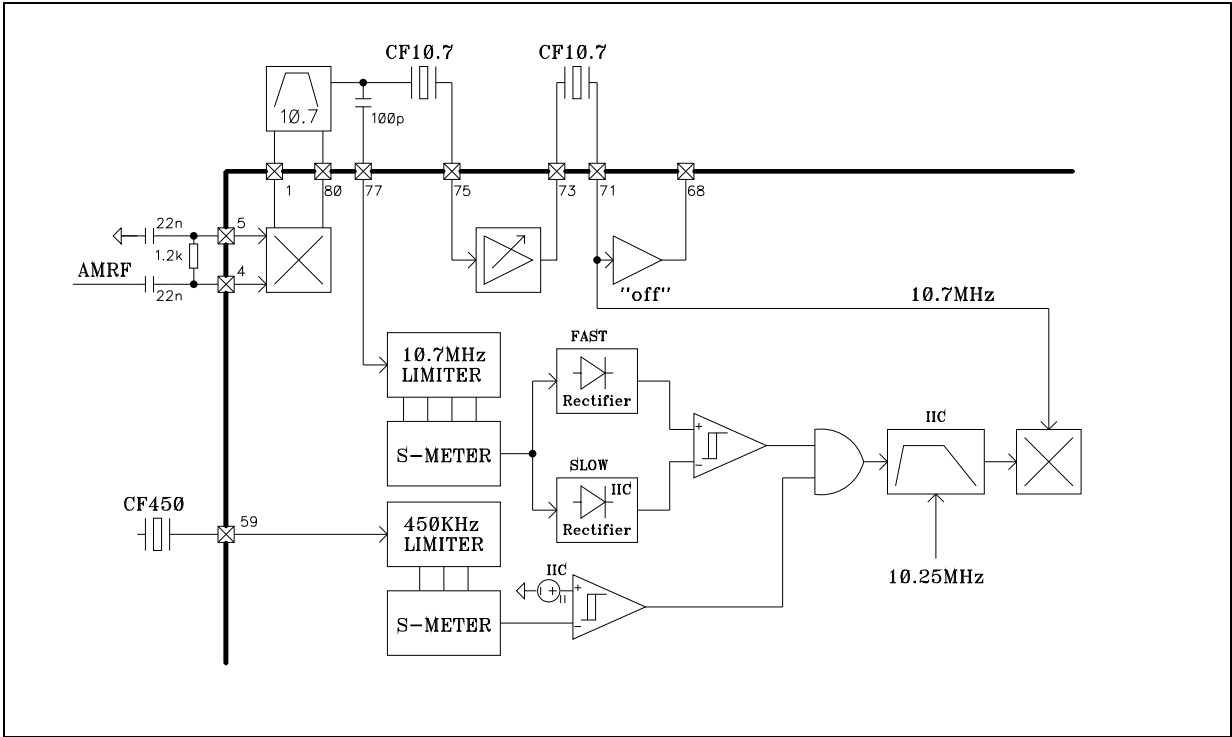


Figure 14. Block diagram stereodecoder

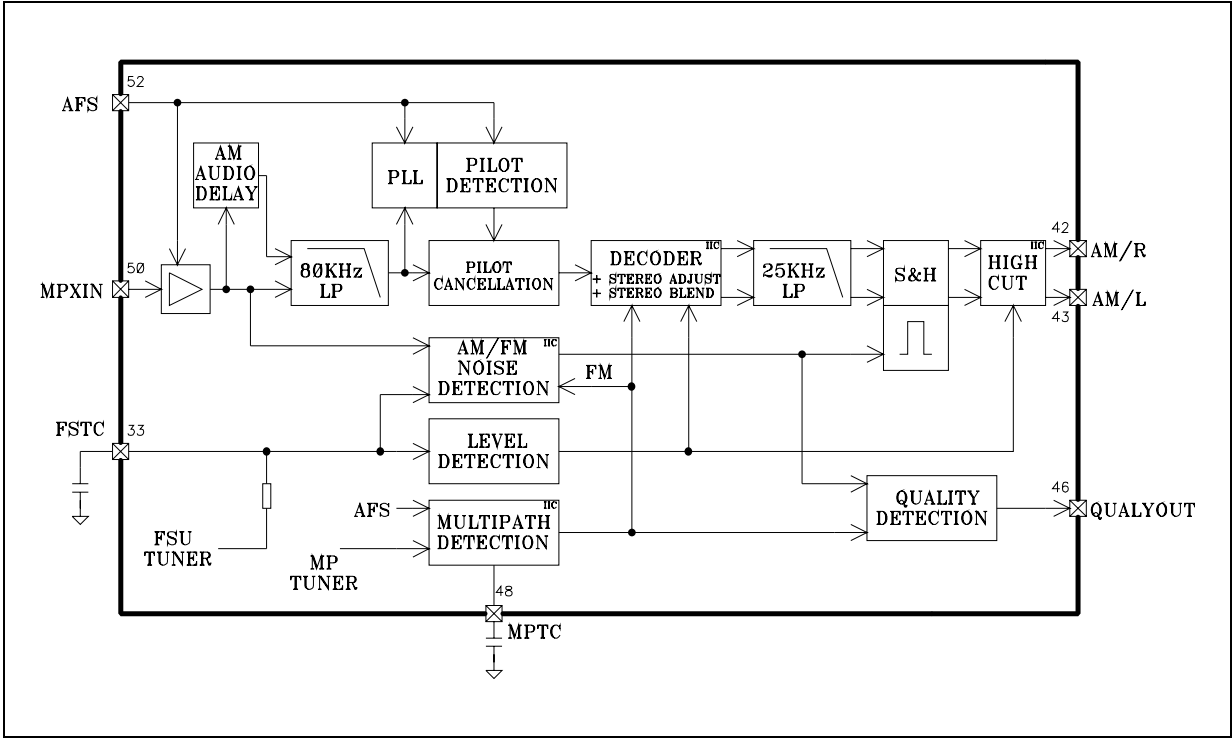


Figure 15. Block diagram audio noise blanker

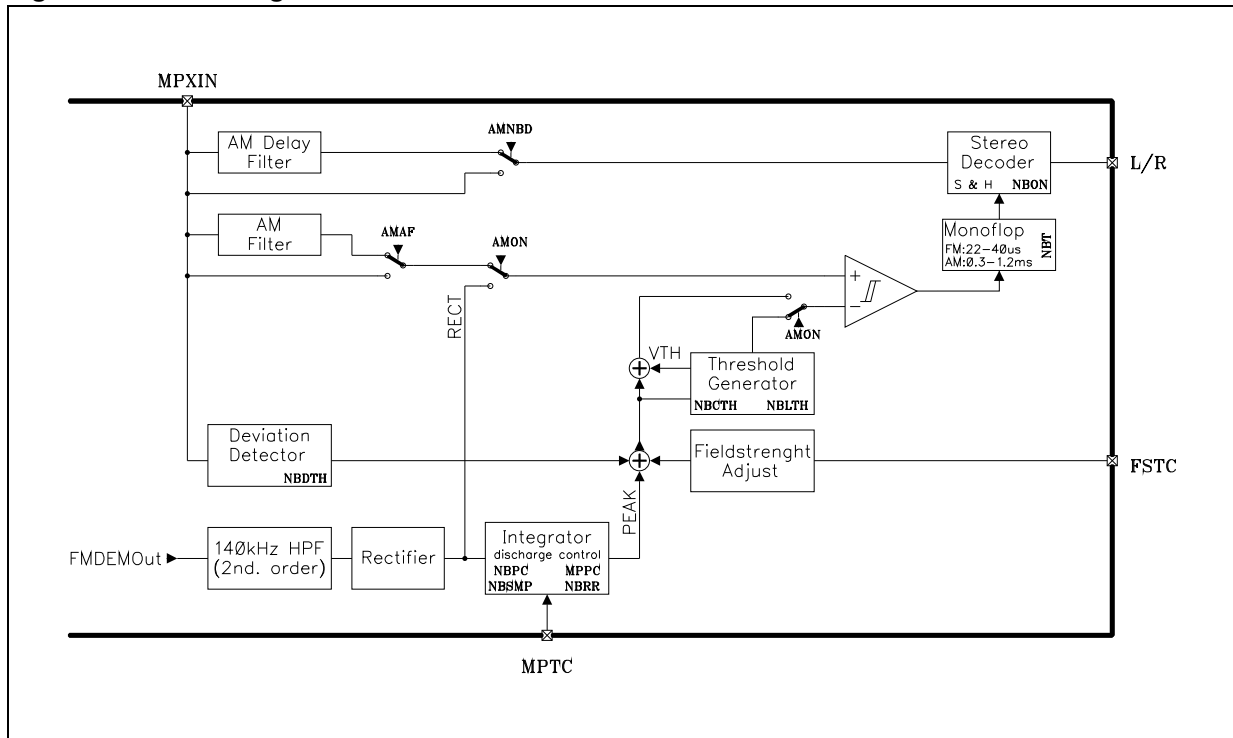


Figure 16. Block diagram multipath detection

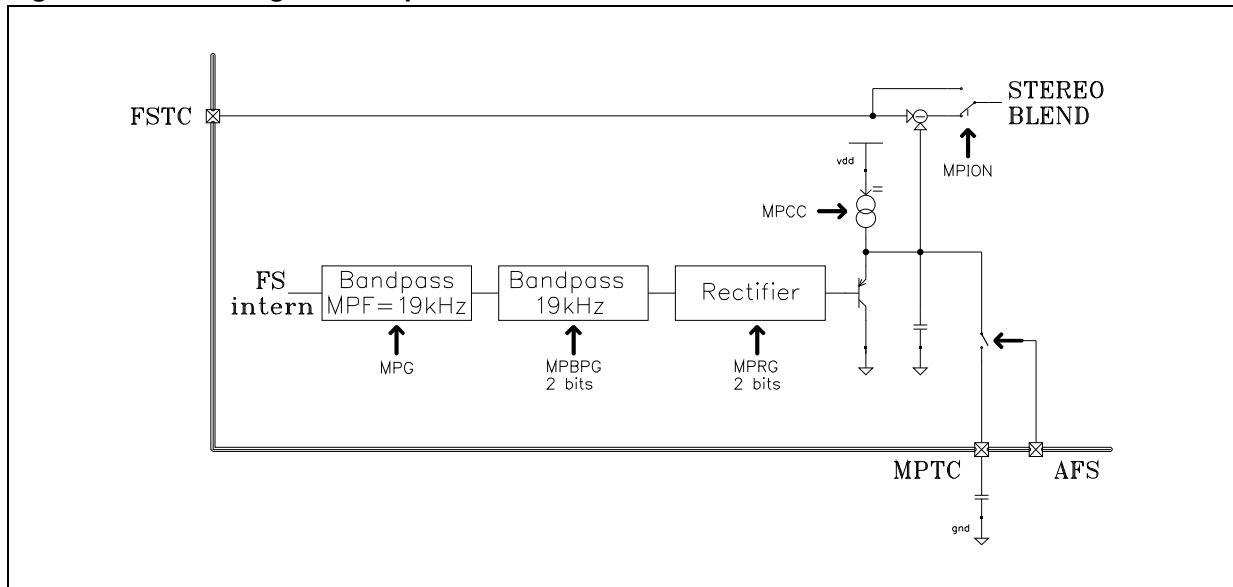
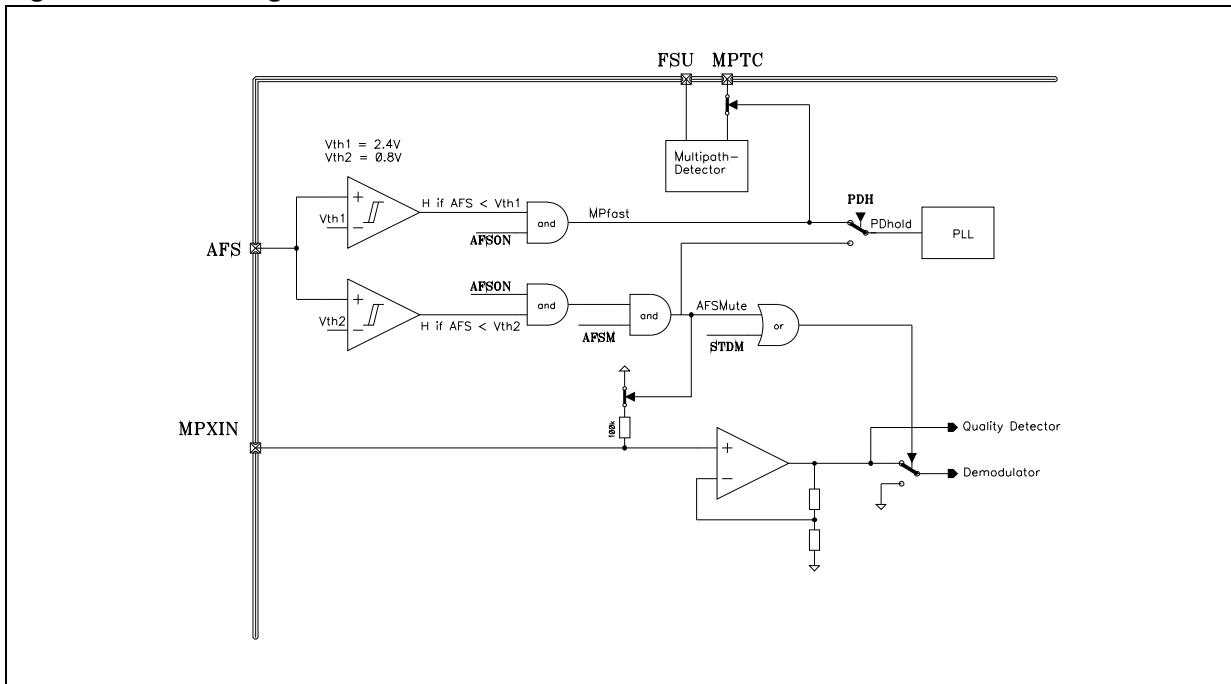


Figure 17. Block diagram AFS function



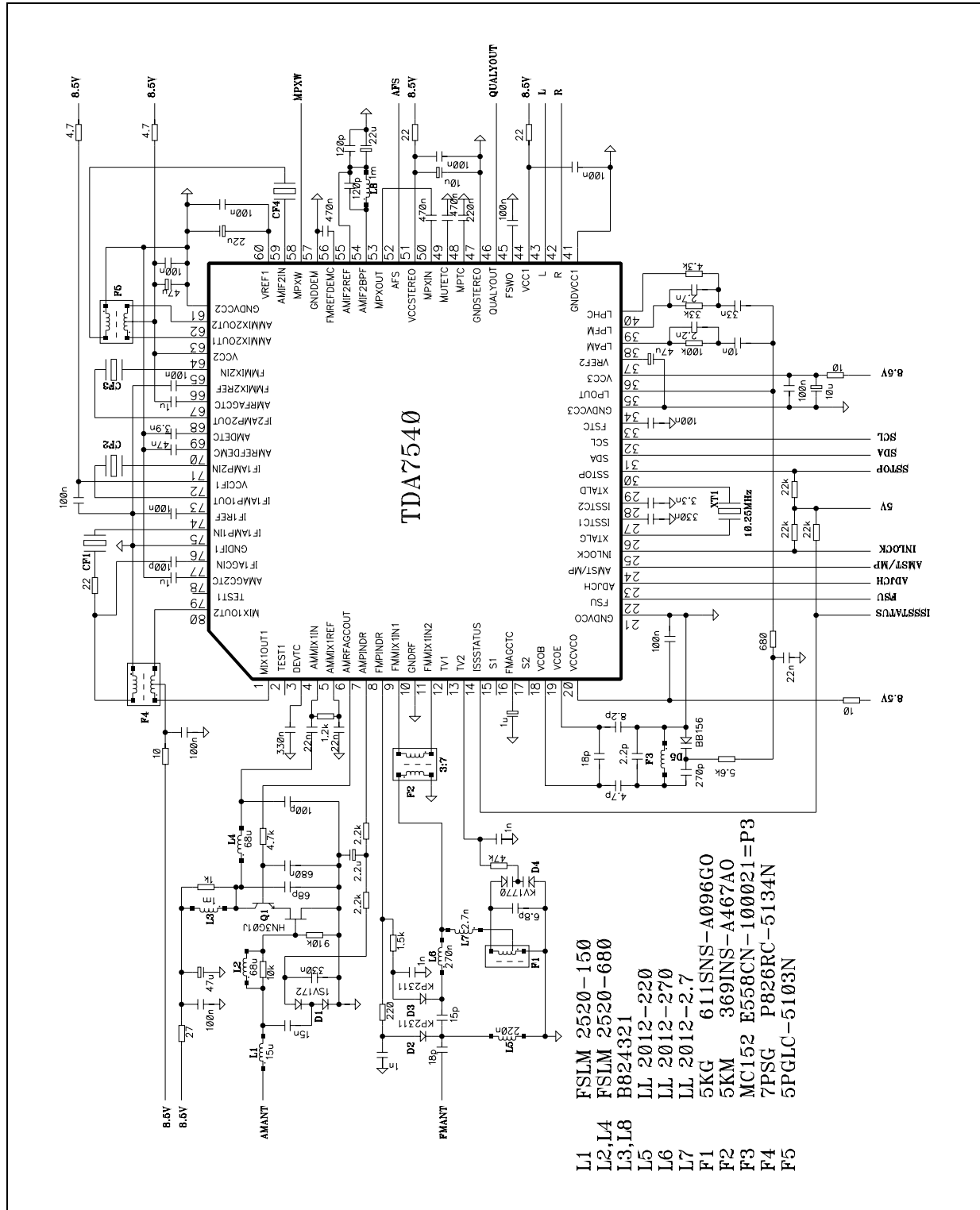
7 Part list

Table 54. Part list (application- and measurement circuit)

| Item | Description |
|---------|-------------------------------|
| F1 | TOKO 5KM 396INS-A543EK |
| F2 | TOKO MC152 E558HNA-100092 |
| F3 | TOKO 7PSG P826RC-5134N |
| F4 | TOKO PGL 5PGLC-5103N |
| L1 | TOKO FSLM 2520-150 15uH |
| L2,L4 | TOKO FSLM 2520-680 68uH |
| L3 | SIEMENS SIMID03 B82432 1mH |
| L5 | TOKO LLQ 2012-220 |
| L6 | TOKO LLQ 2012-680 |
| CF1,CF2 | muRata SFE10.7MS3A10-A 180KHz |
| CF3 | muRata SFE10.7MJA10-A 150KHz |
| CF4 | muRata SFPS 450H |
| D1 | TOSHIBA 1SV172 |
| D2,D3 | TOKO KP2311E |
| D4 | TOKO KV1410 |
| D5 | PHILIPS BB156 |
| Q1 | TOSHIBA HN3G01J |

8 Application circuit

Figure 18. Application circuit



9 Application notes

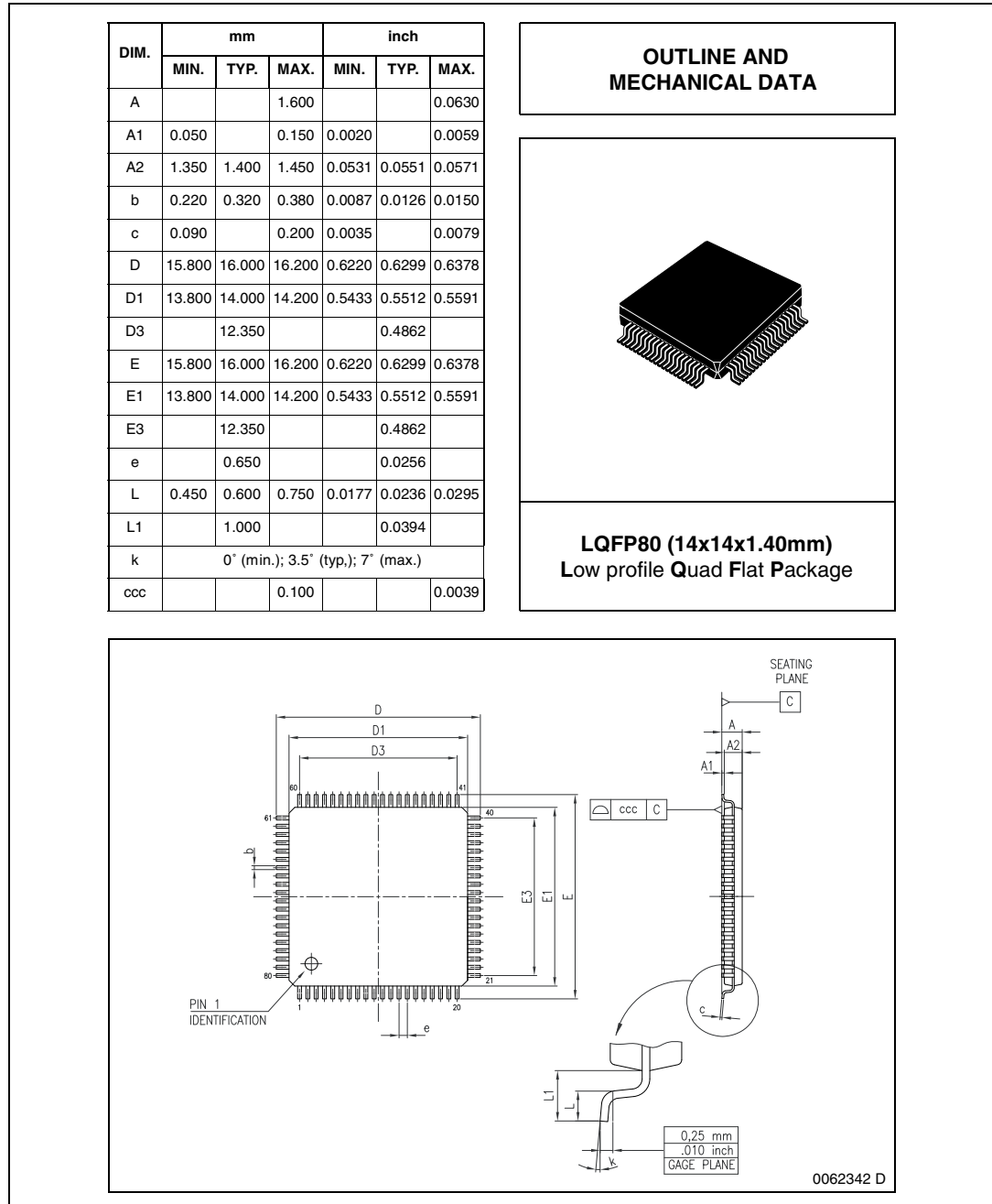
Following items are important to get highest performance of TDA7540N in application:

1. In order to avoid leakage current from PLL loop filter input to ground a guardring is recommended around loop filter PIN's with PLL reference (VREF2) voltage potential.
2. Distance between Xtal and VCO input PIN 18 should be far as possible and Xtal package should get a shield versus ground.
3. Blocking of VCO supply should be near at PIN 20 and PIN 21.
4. Blocking of VCC2 supply should be near at PIN 64 and PIN 61.
5. Wire lenght to FM mixer1-input and -output should be symetrically and short.
6. FM demodulator capacitance at PIN 56 should be sense connected as short as possible versus demodulator ground at PIN 57.
7. Wire lenght from AM mixer tank output to 9KHz ceramic filter input has to be short as possible.
8. To minimize "AM TWEET" the AM demodulator capacitor should be connected versus GNDVCC1 at PIN 41 and FSU output at PIN 22 should be filtered with capacitor of about 2,2nF versus GNDVCC2.

10 Package information

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 19. LQFP80 (14x14x1.40mm) mechanical data and package dimensions



11 Revision history

Table 55. Document revision history

| Date | Revision | Changes |
|-------------|----------|---------------------|
| 12-Nov-2007 | 1 | Initial release. |
| 17-Sep-2013 | 2 | Updated Disclaimer. |

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