

---

## Features

- FM Double-conversion System
- Integrated Second IF Filter with Software-controlled Bandwidth
- Completely Integrated FM Demodulator
- Soft Mute and Multipath Noise Cancellation
- Receiving Condition Analyzer
- AM Up/Down-conversion System
- AM Preamp with AGC and Stereo Capability
- 3-wire Bus Controlled
- Search Stop Signal Generation for AM and FM
- Automatic Alignment Possible
- Lead-free Package



Electrostatic sensitive device.  
Observe precautions for handling.



## Description

The ATR4255 is a highly integrated AM/FM front-end circuit manufactured using Atmel's advanced BICMOS technology. It represents a complete, automatically adjustable AM/FM front end, containing a double-conversion system for FM and an up/down-conversion receiver for AM with  $IF1 = 10.7$  MHz and  $IF2 = 450$  kHz. The front end is suitable for digital or analog AF-signal processing. Together with the PLL U4256BM, an automatically aligned high-performance AM/FM tuner can be built. These ICs are dedicated for highly sophisticated car radio applications.



---

**AM/FM  
Receiver IC**

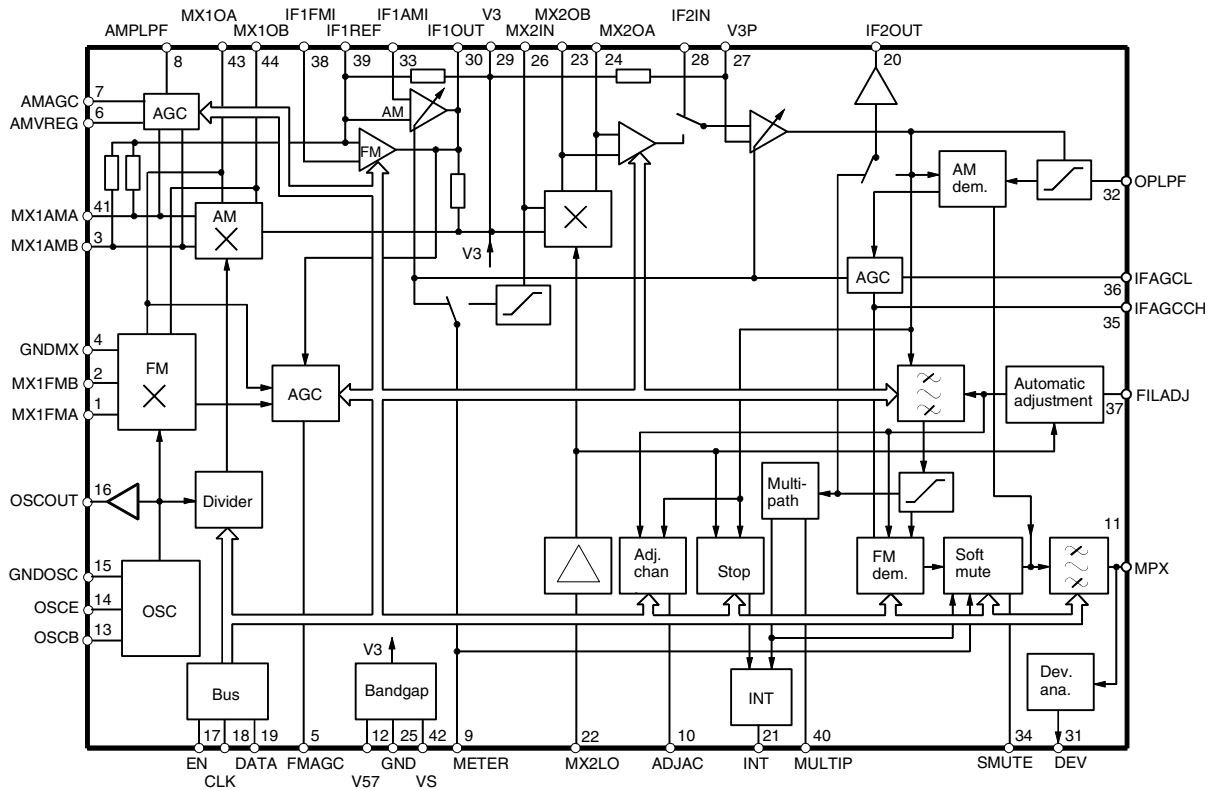
---

**ATR4255**

Rev. 4837A-AUDR-10/04

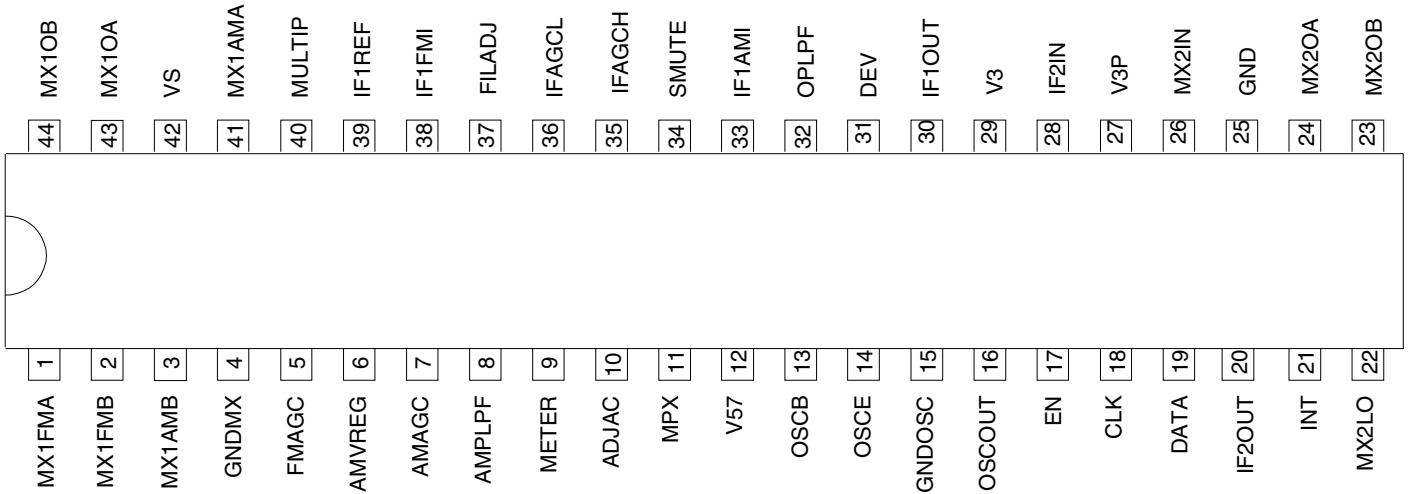


Figure 1. Block Diagram



## Pin Configuration

Figure 2. Pinning SSO44



## Pin Description

| Pin | Symbol | Function  |
|-----|--------|---|
| 1   | MX1FMA | 1 <sup>st</sup> mixer FM input A                          |
| 2   | MX1FMB | 1 <sup>st</sup> mixer FM input B                          |
| 3   | MX1AMB | 1 <sup>st</sup> mixer AM input B                          |
| 4   | GNDMX  | Ground 1 <sup>st</sup> mixer, preamplifier AGC            |
| 5   | FMAGC  | FM preamplifier AGC                                       |
| 6   | AMVREG | AM control voltage  |
| 7   | AMAGC  | AM preamplifier AGC                                       |
| 8   | AMPLPF | AM AGC LP filter  |
| 9   | METER  | Field strength output                                     |
| 10  | ADJAC  | Adjacent channel detection output                         |
| 11  | MPX    | Multiplex signal  |
| 12  | V57    | 5.7 V reference voltage                                   |
| 13  | OSCB   | Oscillator basis  |
| 14  | OSCE   | Oscillator emitter  |
| 15  | GNDOSC | Oscillator ground   |
| 16  | OSCOUT | Oscillator output   |
| 17  | EN     | 3-wire bus enable   |
| 18  | CLK    | 3-wire bus clock  |
| 19  | DATA   | 3-wire bus data   |
| 20  | IF2OUT | 2 <sup>nd</sup> IF amplifier output                       |
| 21  | INT    | Interrupt, stop signal                                    |
| 22  | MX2LO  | 10.25 MHz input for 2 <sup>nd</sup> mixer                 |
| 23  | MX2OB  | 2 <sup>nd</sup> mixer output B                            |
| 24  | MX2OA  | 2 <sup>nd</sup> mixer output A                            |
| 25  | GND    | Ground  |
| 26  | MX2IN  | 2 <sup>nd</sup> mixer input                               |
| 27  | V3P    | 3 V reference for AMPIN, AMIFAGC, Control, IF2IN          |
| 28  | IF2IN  | 2 <sup>nd</sup> IF amplifier input                        |
| 29  | V3     | 3 V reference for IF1OUT, MX2IN                           |
| 30  | IF1OUT | 1 <sup>st</sup> IF amplifier output                       |
| 31  | DEV    | Deviation detect output, test output                      |
| 32  | OPLPF  | Operating point LPF                                       |
| 33  | IF1AMI | 1 <sup>st</sup> IF AM amplifier input                     |
| 34  | SMUTE  | Soft MUTE control input                                   |
| 35  | IFAGCH | IF AGC LP filter high time                                |
| 36  | IFAGCL | IF AGC LP filter low time constant                        |
| 37  | FILADJ | Filter adjust   |
| 38  | IF1FMI | 1 <sup>st</sup> IF FM amplifier input                     |
| 39  | IF1REF | 1 <sup>st</sup> IF and MX1OUT reference, MX1AM A, MX1AM B |
| 40  | MULTIP | Multipath detection output                                |
| 41  | MX1AMA | 1 <sup>st</sup> mixer AM input A                          |
| 42  | VS     | Supply voltage  |
| 43  | MX1OA  | 1 <sup>st</sup> mixer output A                            |
| 44  | MX1OB  | 1 <sup>st</sup> mixer output B                            |

## Functional Description

The ATR4255 implements an AM up/down-conversion reception path from the RF input signal to the AM-demodulated audio frequency output signal, and for FM reception a double-conversion reception path from the RF input signal to the FM-demodulated multiplex signal (MPX). A VCO and an LO prescaler for AM are integrated to generate the LO frequency for the 1<sup>st</sup> mixer. Automatic gain control (AGC) circuits are implemented to control the preamplifier and IF stages in the AM and FM reception path.

For improved FM performance, an integrated IF filter with adjustable bandwidth, a soft-mute feature and an automatic multipath noise cancellation (MNC) circuit are fully integrated. A powerful set of sensors is provided for receiving condition analysis and stop signal generation.

Several register bits (bit 0 to bit 93) are used to control circuit operation and to adapt certain circuit parameters to the specific application. The control bits are organized in two 8-bit and three 24-bit registers that can be programmed by the 3-wire bus protocol. The bus protocol and the bit-to-register mapping is described in the section “3-wire Bus Description” on page 17. The meaning of the control bits is mentioned in the following sections.

## Reception Mode

The IC can be operated in four different modes. Mode AM, FM, WB, Standby are selected by means of bit 92 and bit 93 according to Table 1.

In AM mode the AM mixer, the AM RF-AGC and the 1<sup>st</sup> IF AM amplifier at pin 33 are activated. The input of the 2<sup>nd</sup> IF amplifier is connected to pin 28 and the output of the 2<sup>nd</sup> IF amplifier is fed to the AM demodulator. The output of the AM demodulator is available at MPX output pin 11.

In FM mode the FM mixer, the FM RF-AGC and the 1<sup>st</sup> IF FM amplifier at pin 38 are activated. The bandwidth of the output tank at pin 23, pin 24 is increased and the input of the 2<sup>nd</sup> IF amplifier can be switched between pin 23, pin 24 and pin 28. The output of the 2<sup>nd</sup> IF amplifier is fed to the integrated bandfilter and FM demodulator. The output of the FM demodulator is available at MPX output pin 11.

WB mode is similar to FM mode but the input of the 2<sup>nd</sup> IF amplifier is fixed to pin 28, the range of the bandwidth control of the integrated band filter is shifted to lower bandwidth and the gain of the FM demodulator is increased.

In standby mode the mixers, IF amplifiers and AGC circuits are deactivated to reduce current consumption.

**Table 1.** Operating Mode

| AM/FM/Weather Channel | Bit 93 | Bit 92 |
|-----------------------|--------|--------|
| Standby               | 0      | 0      |
| FM                    | 0      | 1      |
| AM                    | 1      | 0      |
| Weather band          | 1      | 1      |

## Test Mode

A special test mode is implemented for final production test only. This mode is activated by setting bit 9 = 1. **This mode is not intended to be used in customer application.** For normal operation, bit 9 has to be set to 0. Bit 18 to bit 30 are deactivated in normal operation mode.

**Table 2.** Test Mode

| Mode             | Bit 9 |
|------------------|-------|
| Normal operation | 0     |
| Testmode         | 1     |

## VCO

An oscillator circuit is implemented to build a VCO as proposed in the application schematic. The VCO frequency is used to generate the LO frequency of the 1<sup>st</sup> mixer stages. The control voltage of the VCO is usually generated by the PLL circuit U4256BM. The VCO signal is provided at the buffered output pin 16 to be fed to the PLL circuit.

## FM RF-AGC

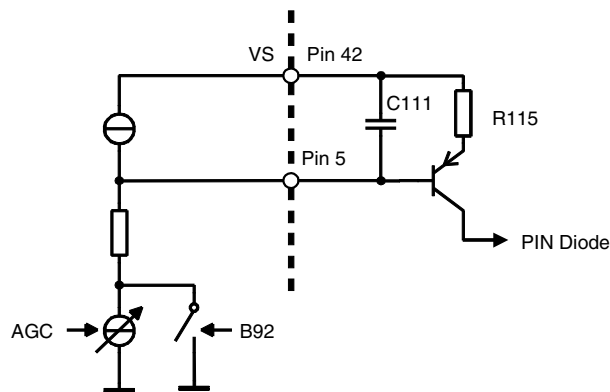
The FM RF-AGC circuit includes a wideband level detector at the input pin 1 of the FM mixer and an in-band level detector at the output of the FM IF amplifier (pin 30). The outputs of these level detectors are used to control the current into the pin diode (see Figure 3) in order to limit the signal level at the FM mixer input and the following stages. The maximum pin diode current is determined by R115 and the time constant of the AGC control loop can be adjusted by changing the value of C111.

The AGC threshold level at the input of the FM mixer can be adjusted by bit 64 and bit 65 according to Table 3. The in-band AGC threshold referred to the FM mixer input (pin 1, pin 2) depends on the gain of the FM IF amplifier and can be adjusted by bit 89 to bit 91.

**Table 3.** FM-AGC Threshold

| FM-AGC Threshold | Bit 65 | Bit 64 |
|------------------|--------|--------|
| 104 dB $\mu$ V   | 0      | 0      |
| 101 dB $\mu$ V   | 0      | 1      |
| 98 dB $\mu$ V    | 1      | 0      |
| 92 dB $\mu$ V    | 1      | 1      |

**Figure 3.** FM RF-AGC Bit 92



## AM RF-AGC

The AM RF-AGC controls the current into the AM pin diodes (pin 7) and the source drain voltage of the MOSFET in the AM preamplifier stage (pin 6) to limit the level at the AM mixer input (pin 3, pin 41). This threshold level can be set by bit 62 and bit 63. If the level at the AM mixer input exceeds the selected threshold, the current into the AM pin diodes is increased. If this step is not sufficient, the source drain voltage of the MOSFET is decreased. The time constant of the AGC control loop can be adjusted by changing the value of the capacitor at pin 8.

**Table 4.** AM-AGC Threshold

| AM-AGC Threshold | Bit 63 | Bit 62 |
|------------------|--------|--------|
| 99 dB $\mu$ V    | 0      | 0      |
| 102 dB $\mu$ V   | 0      | 1      |
| 104 dB $\mu$ V   | 1      | 0      |
| 105 dB $\mu$ V   | 1      | 1      |

## FM 1<sup>st</sup> Mixer

In the 1<sup>st</sup> FM mixer stage, the FM reception frequency is down converted to the 1<sup>st</sup> IF frequency. The VCO frequency is used as LO frequency for the mixer.

## AM 1<sup>st</sup> Mixer

The AM 1<sup>st</sup> mixer is used for up-conversion of the AM reception frequency to the 1<sup>st</sup> IF frequency. Therefore, an AM prescaler is implemented to generate the necessary LO frequency from the VCO frequency. The divide factor of the AM prescaler can be selected according to Table 5.

**Table 5.** Divide Factor of the AM Prescaler

| Divider AM Prescaler | Bit 93 | Bit 92 | Bit 84 | Bit 83 | Bit 82 | Bit 81 |
|----------------------|--------|--------|--------|--------|--------|--------|
| Divide by 10         | 1      | 0      | x      | 0      | 0      | 0      |
| Divide by 6          | 1      | 0      | x      | 0      | 0      | 1      |
| Divide by 7          | 1      | 0      | x      | 0      | 1      | 0      |
| Divide by 8          | 1      | 0      | x      | 1      | 0      | 0      |
| Divide by 4          | 1      | 0      | x      | 1      | 0      | 1      |

## FM 1<sup>st</sup> IF Amplifier

A programmable gain amplifier is used in FM and WB mode between pin 38 and pin 30 to compensate the loss in the external ceramic band filters. The gain of this amplifier is adjusted by bit 89 to bit 91. The input and the output resistance is 330  $\Omega$  and fits to external ceramic filters.

Two different temperature coefficients of the FM IF amplifier can be selected by bit 66.

**Table 6.** Gain of the FM IF Amplifier

| Gain FM IF | Bit 91 | Bit 90 | Bit 89 |
|------------|--------|--------|--------|
| 20 dB      | 0      | 0      | 0      |
| 22 dB      | 0      | 0      | 1      |
| 24 dB      | 0      | 1      | 0      |
| 26 dB      | 0      | 1      | 1      |
| 28 dB      | 1      | 0      | 0      |
| 29 dB      | 1      | 0      | 1      |
| 30 dB      | 1      | 1      | 0      |
| 31 dB      | 1      | 1      | 1      |

**Table 7.** Temperature Coefficient Setting of FM IF Amplifier

| Temperature Coefficient (TC) of the IF Amplifier | Bit 66 |
|--|--------|
| TK <sub>min</sub>                                | 0      |
| TK <sub>max</sub>                                | 1      |

## AM 1<sup>st</sup> IF Amplifier

In AM mode, the gain of the 1<sup>st</sup> IF amplifier is controlled by the IF-AGC to extend the control range of the IF-AGC.

## 2<sup>nd</sup> Mixer

The 2<sup>nd</sup> mixer is used in AM, FM and WB mode. The mixer input has 330 Ω input resistance and can be connected directly to an external ceramic filter.

In FM mode, the high output resistance of the second mixer is reduced to increase the bandwidth of the tank at the mixer output. The output resistance can be selected by bit 60 and bit 61.

**Table 8.** 2<sup>nd</sup> Mixer Output Resistance in FM Mode

| Bit 61 | Bit 60 | Output Resistance (Bit 54 = 0) | Output Resistance (Bit 54 = 1) |
|--------|--------|--------------------------------|--------------------------------|
| 0      | 0      | 3.3 kΩ                         | ~100 kΩ                        |
| 0      | 1      | 0.63 kΩ                        | 0.78 kΩ                        |
| 1      | 0      | 0.47 kΩ                        | 0.55 kΩ                        |
| 1      | 1      | 0.29 kΩ                        | 0.32 kΩ                        |

The LO frequency of the 2<sup>nd</sup> mixer (10.25 MHz) has to be applied at pin 22. This signal is usually generated by the PLL circuit U4256BM.

**Table 9.** FM Bandwidth Mixer 2

| Bit 61 | Bit 60 | FM BW Mixer 2 |
|--------|--------|---------------|
| 0      | 0      | 150 kHz       |
| 0      | 1      | 200 kHz       |
| 1      | 0      | 250 kHz       |
| 1      | 1      | 450 kHz       |

Note: The bandwidth is also depending from the values of the application circuit.

## 2<sup>nd</sup> IF Amplifier

In AM and WB mode, the input of the second IF amplifier is pin 28, which is externally connected to the 2<sup>nd</sup> mixer tank through the AM ceramic filter to achieve channel selectivity. During normal FM operation (bit 54 = 0), the input of the second IF amplifier is connected to the 2<sup>nd</sup> mixer output (pin 23, pin 24) and the integrated FM band filter is used for channel selectivity only. It is possible to use an additional external filter between the 2<sup>nd</sup> mixer tank and pin 28 in FM mode by setting bit 54 to 1.

**Table 10.** 2<sup>nd</sup> IF Filter in FM Mode

| 2 <sup>nd</sup> IF Filter    | Bit 54 |
|------------------------------|--------|
| Internal filter              | 0      |
| External and internal filter | 1      |

## IF-AGC

The IF-AGC controls the level of the 2<sup>nd</sup> IF signal that is passed to the AM demodulator input or the integrated FM bandfilter and to the 2<sup>nd</sup> IF output pin 20.

Two different time constants of the IF-AGC can be selected by the capacitors at pin 35 (IFAGCH) and pin 36 (IFAGCL). The short time constant (IFAGCL) is used in FM mode and in AM search mode. The long time constant (IFAGCH) is used for AM reception.

**Table 11.** IF-AGC Time Constant

| Mode         | Bit 92 | Bit 88 | IF AGC Time Constant |
|--------------|--------|--------|----------------------|
| FM/WB        | 1      | X      | IFAGCL (fast)        |
| AM reception | 0      | 0      | IFAGCH (slow)        |
| AM search    | 0      | 1      | IFAGCL (fast)        |

In FM/WB mode, the output signal of the FM demodulator is applied to pin 35 via a series resistor of about 95 k $\Omega$ . This low-pass filtered output signal of the FM demodulator is used for the FM demodulator fine adjustment, for muting and as a reference for the deviation sensor.

## 2<sup>nd</sup> IF Output

The 2<sup>nd</sup> IF after the gain-controlled 2<sup>nd</sup> IF amplifier is available at pin 20 (bit 55 = 0). In AM mode, this signal may be used for an external AM stereo decoder. Alternatively, a signal corresponding to the logarithmic field strength after the integrated FM band filter, which is used for multipath detection, can be switched to pin 20 by setting bit 55 = 1.

**Table 12.** Pin 20 Output Setting

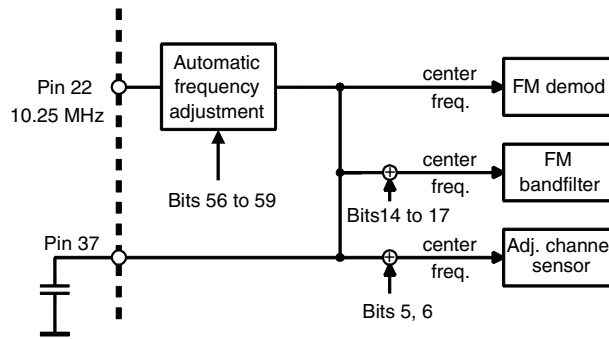
| Pin 20                    | Bit 55 |
|---------------------------|--------|
| 2 <sup>nd</sup> IF output | 0      |
| Multipath field strength  | 1      |

## Automatic IF Center Frequency Adjustment

Integrated active filters are used in the FM band filter, FM demodulator and adjacent channel sensor. The center frequency of these filters is automatically adjusted to the second IF frequency of 450 kHz. The frequency of 10.25 MHz at pin 22 is used as a reference for this alignment.



**Figure 4.** Automatic IF Center Frequency Adjustment



For fine tuning, the center frequency of all these integrated active filters (band filter, demodulator and adjacent channel sensor) can be shifted in steps of 6.25 kHz by means of bit 56 to bit 59. Additionally, the center frequency of the band filter can be adjusted separately by means of bit 14 to bit 17 if bit 4 is set to 1. If bit 4 is set to 0, the default setting is used.

**Table 13.** 2<sup>nd</sup> IF Center Frequency

| IF Center  | Bit 59 | Bit 58 | Bit 57 | Bit 56 |
|------------|--------|--------|--------|--------|
| 450.00 kHz | 0      | 0      | 0      | 0      |
| 456.25 kHz | 0      | 0      | 0      | 1      |
| 461.50 kHz | 0      | 0      | 1      | 0      |
| 468.75 kHz | 0      | 0      | 1      | 1      |
| 475.00 kHz | 0      | 1      | 0      | 0      |
| 481.25 kHz | 0      | 1      | 0      | 1      |
| 487.50 kHz | 0      | 1      | 1      | 0      |
| 493.75 kHz | 0      | 1      | 1      | 1      |
| 450.00 kHz | 1      | 0      | 0      | 0      |
| 443.75 kHz | 1      | 0      | 0      | 1      |
| 437.50 kHz | 1      | 0      | 1      | 0      |
| 431.25 kHz | 1      | 0      | 1      | 1      |
| 425.00 kHz | 1      | 1      | 0      | 0      |
| 418.75 kHz | 1      | 1      | 0      | 1      |
| 412.50 kHz | 1      | 1      | 1      | 0      |
| 406.25 kHz | 1      | 1      | 1      | 1      |

**Table 14.** FM Band Filter Center Frequency Correction

| IF Correction    | Bit 17 | Bit 16 | Bit 15 | Bit 14 |
|------------------|--------|--------|--------|--------|
| -0 kHz           | 0      | 0      | 0      | 0      |
| -6.25 kHz        | 0      | 0      | 0      | 1      |
| -12.50 kHz       | 0      | 0      | 1      | 0      |
| -18.75 kHz       | 0      | 0      | 1      | 1      |
| -25.00 kHz       | 0      | 1      | 0      | 0      |
| -31.25 kHz       | 0      | 1      | 0      | 1      |
| -37.50 kHz       | 0      | 1      | 1      | 0      |
| -43.75 kHz       | 0      | 1      | 1      | 1      |
| +0 kHz (default) | 1      | 0      | 0      | 0      |
| +6.25 kHz        | 1      | 0      | 0      | 1      |
| +12.50 kHz       | 1      | 0      | 1      | 0      |
| +18.75 kHz       | 1      | 0      | 1      | 1      |
| +25.00 kHz       | 1      | 1      | 0      | 0      |
| +31.25 kHz       | 1      | 1      | 0      | 1      |
| +37.50 kHz       | 1      | 1      | 1      | 0      |
| +43.75 kHz       | 1      | 1      | 1      | 1      |

### Integrated FM Band Filter

For FM reception a band filter with variable bandwidth is integrated in front of the demodulator to provide channel selectivity on the 2<sup>nd</sup> IF. The bandwidth of this filter can be adjusted by bit 0 to 3 (see Table 15) to be suitable for the present receiving condition. In WB mode, the bandwidth of the integrated filter is shifted to lower bandwidth values, while the necessary channel selectivity is achieved by an external ceramic filter.

The center frequency of the integrated FM band filter can be adjusted by means of bit 14 to 17 (bit 4 set to 1). The field strength after the integrated FM band filter that is available at pin 20 (bit 55 = 1) can be used for this purpose.

**Table 15.** Bandwidth of the Integrated FM Band Filter

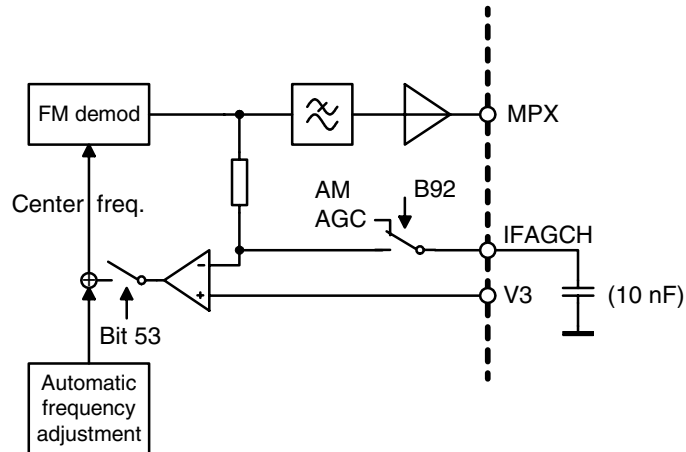
| IF Bandwidth | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|--------------|-------|-------|-------|-------|
| 200 kHz      | 0     | 0     | 0     | 0     |
| 190 kHz      | 0     | 0     | 0     | 1     |
| 180 kHz      | 0     | 0     | 1     | 0     |
| 170 kHz      | 0     | 0     | 1     | 1     |
| 160 kHz      | 0     | 1     | 0     | 0     |
| 150 kHz      | 0     | 1     | 0     | 1     |
| 140 kHz      | 0     | 1     | 1     | 0     |
| 130 kHz      | 0     | 1     | 1     | 1     |
| 120 kHz      | 1     | 0     | 0     | 0     |
| 110 kHz      | 1     | 0     | 0     | 1     |
| 100 kHz      | 1     | 0     | 1     | 0     |
| 90 kHz       | 1     | 0     | 1     | 1     |
| 80 kHz       | 1     | 1     | 0     | 0     |
| 70 kHz       | 1     | 1     | 0     | 1     |
| 60 kHz       | 1     | 1     | 1     | 0     |
| 50 kHz       | 1     | 1     | 1     | 1     |

**FM Demodulator**

For weather band reception, the gain of the FM demodulator is increased and can be adjusted by means of bit 71, bit 72 in order to increase the output voltage to compensate the low frequency deviation in weather band.

An integrated demodulator fine adjustment allows automatic fine tuning of the demodulator center frequency to the average frequency of the received signal. This feature is implemented for use in weather band mode and can be activated by setting bit 53 to 0.

**Figure 5.** FM Demodulator Automatic Fine Tuning



The center frequency of the FM demodulator can be adjusted by means of bit 56 to 59. At the center frequency, the DC voltage at the MPX output pin 11 is equal to the MPX offset voltage that can be measured at pin 11 while MPX mute is active (bit 7 = 1). This adjustment will affect the center frequency of all integrated filters as mentioned before.

**Table 16.** Demodulator Gain in Weather Band Mode

| Demodulator Gain in Weather Band Mode Relative to FM Mode | Bit 72 | Bit 71 |
|---|--------|--------|
| 12 dB   | 0      | 0      |
| 15 dB   | 0      | 1      |
| 18 dB   | 1      | 0      |
| 21 dB   | 1      | 1      |

**Table 17.** Demodulator Fine Adjustment

| Demodulator Fine Adjustment | Bit 53 |
|-----------------------------|--------|
| Fine tuning ON              | 0      |
| Fine tuning OFF             | 1      |

## Soft Mute

The soft mute functionality is implemented to reduce the output level of the FM demodulator at low input signal levels to limit the noise at MPX output in this case. If the input level falls below an adjustable threshold, continuously the output of the FM demodulator is continuously muted with decreasing input level until a maximum mute value is reached. The threshold for the start of soft mute and the maximum mute can be adjusted. The signal level for 3 dB mute can be set by means of bit 68 to bit 70 and the maximum value for soft mute can be selected by bit 67. The steepness and the time constant of the soft mute can be adjusted by the resistor and capacitor between pin 34 and pin 29.

The field strength signal available at pin 9 is used for soft mute. Therefore, the soft mute threshold referred to the input of the FM mixer depends on the gain from FM mixer input to the field strength sensor.

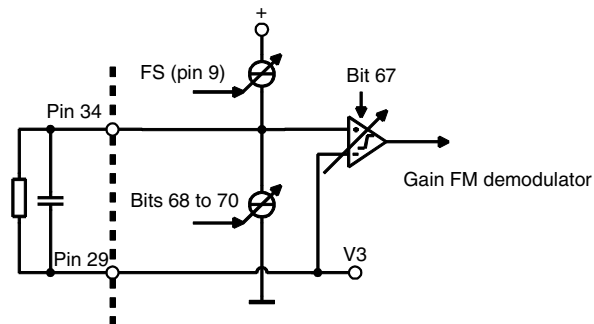
**Table 18.** Soft Mute Threshold

| Relative Soft Mute Threshold | Bit 70 | Bit 69 | Bit 68 |
|------------------------------|--------|--------|--------|
| Soft mute OFF                | 0      | 0      | 0      |
| -18 dB                       | 0      | 0      | 1      |
| -15 dB                       | 0      | 1      | 0      |
| -12 dB                       | 0      | 1      | 1      |
| -9 dB                        | 1      | 0      | 0      |
| -6 dB                        | 1      | 0      | 1      |
| -3 dB                        | 1      | 1      | 0      |
| 0 dB                         | 1      | 1      | 1      |

**Table 19.** Maximum Soft Mute

| Maximum Value of Soft Mute | Bit 67 |
|----------------------------|--------|
| 28 dB                      | 0      |
| 24 dB                      | 1      |

**Figure 6.** Soft Mute



**MPX Output**

The output of the AM demodulator (AM mode) or the output of the FM demodulator (FM/WB mode) are available at the MPX output (pin 11).

The MPX output signal can be muted by setting bit 7 to bit 1.

The bandwidth of the lowpass filter at the MPX output can be set by means of bit 79 to 90 kHz or 180 kHz.

**Table 20.** MPX Output Mute

| MPX Output                       | Bit 7 |
|----------------------------------|-------|
| MPX out, pin 11 normal operation | 0     |
| Mute ON                          | 1     |

**Table 21.** MPX Output Bandwidth

| Bandwidth MPX Lowpass Filter | Bit 79 |
|------------------------------|--------|
| 90 kHz                       | 0      |
| 180 kHz                      | 1      |

**Receiving Condition Analyzer**

The ATR4255 implements several sensors that provide information about the receiving condition of the selected station.

**Field Strength Sensor**

The field strength sensor provides a DC voltage at pin 9 which represents the logarithmic field strength of the signal in the reception band.

The field strength information can be retrieved either from a level detector at the input of the 2<sup>nd</sup> mixer (pin 26) or from the IF-AGC depending on the setting of bit 80. The bandwidth of the field strength detection in the AGC is smaller than by using the level detector because of additional selectivity between the 2<sup>nd</sup> mixer and the 2<sup>nd</sup> IF amplifier particularly in AM and WB, but the field strength detection in the AGC is limited to the IF AGC range. Usually the field strength from the level detector is used in FM mode and the AGC field strength is used in AM mode.

**Table 22.** Field Strength Selection

| Field Strength Narrow Band/Wide Band    | Bit 80 |
|---|--------|
| Fieldstrength at pin 26 (wide band)     | 0      |
| Fieldstrength from IF-AGC (narrow band) | 1      |

**Search Stop Detector**

A search stop detector is available in AM and FM/WB mode. A STOP condition is signaled if the frequency of the ZF signal is within a window around the center frequency of 450 kHz. The width of this search stop window can be set by bit 85 to bit 87 in the range of 0.5 kHz to 80 kHz. The frequency of the ZF signal is measured by counting the number of periods of the ZF signal during a measurement time which is determined by bit 73 to bit 78. The inverted STOP signal is available at pin 21 according to Table 25 on page 14. The frequency of 10.25 MHz at pin 22 is used as time reference.

**Table 23.** Search Stop Detector Measurement Time

| Time Window for Stop Signal | Bit 78 | Bit 77 | Bit 76 | Bit 75 | Bit 74 | Bit 73 |
|-----------------------------|--------|--------|--------|--------|--------|--------|
| 1 × 3.1969 ms               | 0      | 0      | 0      | 0      | 0      | 1      |
| .....                       |        |        |        |        |        |        |
| 63 × 3.1969 ms              | 1      | 1      | 1      | 1      | 1      | 1      |

**Table 24.** Search Stop Window

| Search Stop Window | Bit 87 | Bit 86 | Bit 85 |
|--------------------|--------|--------|--------|
| ±0.5 kHz           | 0      | 0      | 0      |
| ±1.1 kHz           | 0      | 0      | 1      |
| ±2.3 kHz           | 0      | 1      | 0      |
| ±4.8 kHz           | 0      | 1      | 1      |
| ±10 kHz            | 1      | 0      | 0      |
| ±20 kHz            | 1      | 0      | 1      |
| ±40 kHz            | 1      | 1      | 0      |
| ±80 kHz            | 1      | 1      | 1      |

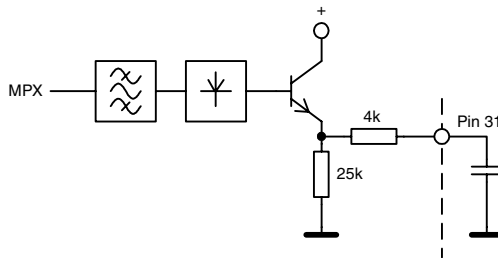
**Table 25.** Signals Available at Digital Output Pin 21

| Bit 88 | Bit 92    | INT (Pin 21)             |
|--------|-----------|--------------------------|
| 0      | 0 (AM)    | 1                        |
| 0      | 1 (FM/WB) | NOT MPINT                |
| 1      | 0 (AM)    | NOT STOP                 |
| 1      | 1 (FM/WB) | NOT (STOP AND NOT MPINT) |

## Deviation Sensor

The deviation sensor is active in AM and FM/WB mode and measures the modulation of the signal. It is implemented as a peak detector of the lowpass-filtered MPX signal (see Figure 7). The output voltage at pin 31 is proportional to the frequency deviation in FM/WB or the modulation depth in AM respectively.

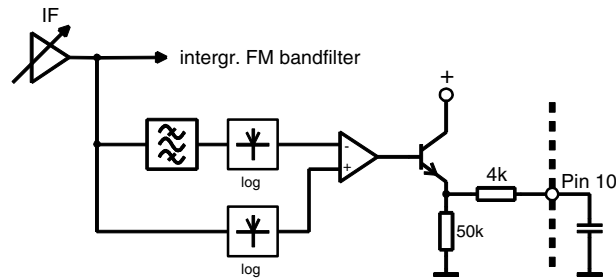
**Figure 7.** Deviation Sensor



## Adjacent Channel Sensor

The adjacent channel sensor is active in FM mode only and measures the field strength outside the reception band. By setting the center frequency of the band filter of the adjacent channel sensor below or above the 2<sup>nd</sup> IF frequency (bit 5, bit 6), it can be determined whether the disturbance signal is located above or below the reception frequency (see Table 28 on page 16). The bandwidth of the band filter used in the adjacent channel sensor can be changed by means of bit 10 to 13. If bit 4 = 0 the default bandwidth setting is used. The output of the adjacent channel sensor is independent of the bandwidth setting of the integrated FM band filter.

**Figure 8.** Adjacent Channel Sensor



**Table 26.** Bandwidth of the Adjacent Channel Detector Filter

| BW Adjustment    | Bit 13 | Bit 12 | Bit 11 | Bit 10 |
|------------------|--------|--------|--------|--------|
| 3 kHz            | 0      | 0      | 0      | 0      |
| 16 kHz           | 0      | 0      | 1      | 0      |
| 32 kHz           | 0      | 1      | 0      | 0      |
| 50 kHz           | 0      | 1      | 1      | 0      |
| 65 kHz           | 1      | 0      | 0      | 0      |
| 80 kHz           | 1      | 0      | 1      | 0      |
| 95 kHz           | 1      | 1      | 0      | 0      |
| 110 kHz          | 1      | 1      | 1      | 0      |
| 50 kHz           | 0      | 0      | 0      | 1      |
| 65 kHz           | 0      | 0      | 1      | 1      |
| 80 kHz (default) | 0      | 1      | 0      | 1      |
| 95 kHz           | 0      | 1      | 1      | 1      |
| 110 kHz          | 1      | 0      | 0      | 1      |
| 130 kHz          | 1      | 0      | 1      | 1      |
| 145 kHz          | 1      | 1      | 0      | 1      |
| 160 kHz          | 1      | 1      | 1      | 1      |

**Table 27.** Center Frequency Adjacent Channel Sensor

| Center Frequency | Bit 6 | Bit 5 |
|------------------|-------|-------|
| 450 kHz          | 0     | 0     |
| 300 kHz          | 0     | 1     |
| 700 kHz          | 1     | 0     |
| Filter OFF       | 1     | 1     |

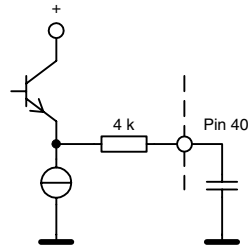
**Table 28.** Output Voltage of Adjacent Channel Sensor for Different Receiving Conditions and Center Frequencies

| Adjacent Channel Disturbance | 300 kHz | 450 kHz | 600 kHz |
|------------------------------|---------|---------|---------|
| no                           | high    | low     | high    |
| below                        | high    | high    | low     |
| above                        | low     | high    | high    |

## Multipath Sensor

The multipath sensor is active in FM mode only and measures the disturbance due to multipath reception. The multipath sensor detects drops in the field strength after the integrated band filter by calculating the difference between an averaged maximum field strength and the current field strength. The maximum depth of these drops is represented by the voltage of the peak detector at pin 40 (MULTIP). The level of this voltage represents the degree of disturbance in the received signal.

**Figure 9.** Multipath Sensor



A Multipath Noise Canceller (MNC) is implemented to reduce disturbance of the received signal in multipath reception conditions. If the difference between the momentary and the averaged field strength falls below a threshold adjustable by bit 81 to bit 84 (see Table 30 on page 17), the MPX signal may be muted and this situation (MPINT) can be signaled at pin 21 (INT) according to Table 25 on page 14. Muting of the MPX signal during multipath disturbances can be activated by setting bit 8.

**Table 29.** Multipath Noise Canceller

| Multipath Noise Canceller | Bit 8 |
|---------------------------|-------|
| Active                    | 0     |
| Not active                | 1     |



**Table 30.** Sensitivity of the MNC

| Sensitivity MNC (Threshold) | Bit 93 | Bit 92 | Bit 84 | Bit 83 | Bit 82 | Bit 81 |
|-----------------------------|--------|--------|--------|--------|--------|--------|
| Off                         | x      | 1      | 0      | 0      | 0      | 0      |
| Low                         | x      | 1      | 0      | 0      | 0      | 1      |
|                             | x      | 1      | 0      | 0      | 1      | 0      |
| (-18 dB)                    | x      | 1      | 0      | 0      | 1      | 1      |
|                             | x      | 1      | 0      | 1      | 0      | 0      |
|                             | x      | 1      | 0      | 1      | 0      | 1      |
|                             | x      | 1      | 0      | 1      | 1      | 0      |
| Normal (-12 dB)             | x      | 1      | 0      | 1      | 1      | 1      |
|                             | x      | 1      | 1      | 0      | 0      | 0      |
|                             | x      | 1      | 1      | 0      | 0      | 1      |
|                             | x      | 1      | 1      | 0      | 1      | 0      |
|                             | x      | 1      | 1      | 0      | 1      | 1      |
|                             | x      | 1      | 1      | 1      | 0      | 0      |
|                             | x      | 1      | 1      | 1      | 0      | 1      |
|                             | x      | 1      | 1      | 1      | 1      | 0      |
| High (-9 dB)                | x      | 1      | 1      | 1      | 1      | 1      |

### 3-wire Bus Description

The register settings of ATR4255 are programmed by a 3-wire bus protocol. The bus protocol consists of separate commands. A defined number of bits is transmitted sequentially during each command.

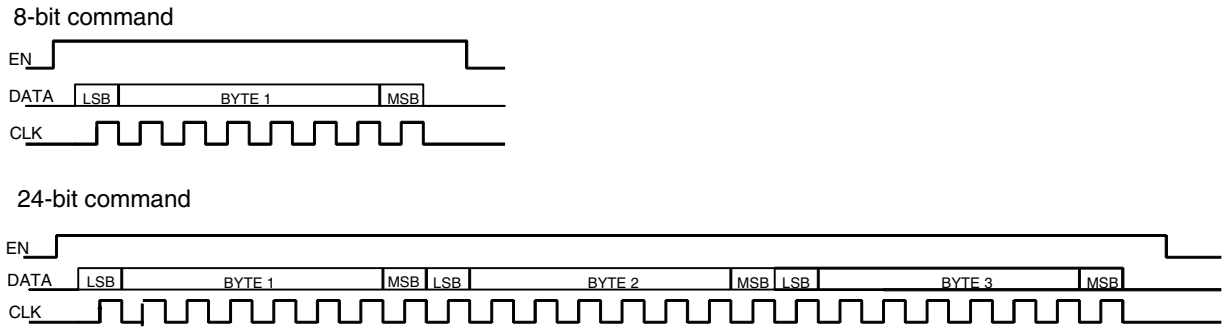
One command is used to program all bits of one register. The different registers available (see Table 31 on page 19) are addressed by the length of the command (number of transmitted bits) and by three address bits that are unique for each register of a given length. 8-bit registers are programmed by 8-bit commands and 24-bit registers are programmed by 24-bit commands.

Each bus command starts with a rising edge on the enable line (EN) and ends with a falling edge on EN. EN has to be kept HIGH during the bus command.

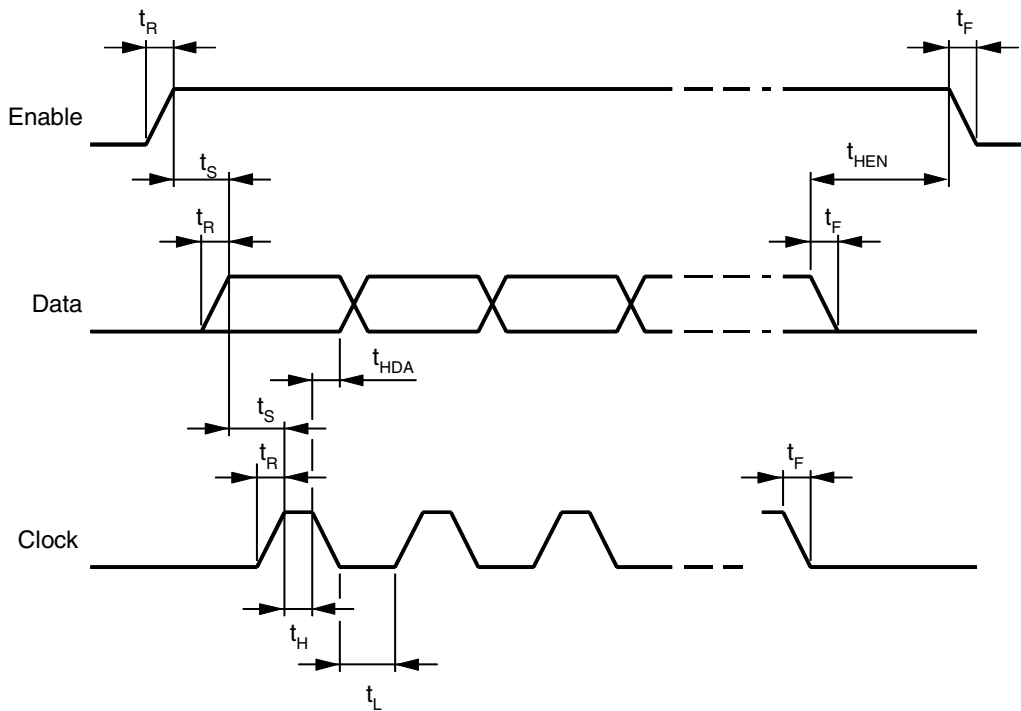
The sequence of transmitted bits during one command starts with the LSB of the first byte and ends with the MSB of the last byte of the register addressed. The DATA is evaluated at the rising edges of CLK. The number of LOW to HIGH transitions on CLK during the HIGH period of EN is used to determine the length of the command.

The bus protocol and the register addressing of ATR4255 are compatible to the addressing used in U4256BM. That means ATR4255 and U4256BM can be operated on the same 3-wire bus as shown in the application circuit.

**Figure 10. Pulse Diagram**



**Figure 11. Bus Timing**



Data Transfer

Table 31. Control Registers

| A24_100 |   |   |          |     |                      |     |     |        |                 |     |     |                                   |     |        |                |        |                         |     |     |     |     |     |     |  |        |  |  |  |  |     |
|---------|---|---|----------|-----|----------------------|-----|-----|--------|-----------------|-----|-----|-----------------------------------|-----|--------|----------------|--------|-------------------------|-----|-----|-----|-----|-----|-----|--|--------|--|--|--|--|-----|
| MSB     |   |   | BYTE 3   |     |                      |     |     | LSB    |                 |     | MSB |                                   |     | BYTE 2 |                |        |                         |     | LSB |     |     | MSB |     |  | BYTE 1 |  |  |  |  | LSB |
| ADDR.   |   |   | AM/FM/WB |     | Gain FM IF amplifier |     |     | Search | Width of window |     |     | OSC divider/multipath sensitivity |     |        | Field strength | BWM PX | Time window stop signal |     |     |     |     |     |     |  |        |  |  |  |  |     |
| 1       | 0 | 0 | AM       | FM  |                      |     |     |        |                 |     |     |                                   |     |        |                |        |                         |     |     |     |     |     |     |  |        |  |  |  |  |     |
|         |   |   | B93      | B92 | B91                  | B90 | B89 | B88    | B87             | B86 | B85 | B84                               | B83 | B82    | B81            | B80    | B79                     | B78 | B77 | B76 | B75 | B74 | B73 |  |        |  |  |  |  |     |

| A24_101 |   |   |               |     |             |     |     |       |          |        |     |        |     |                             |     |                      |     |     |       |        |           |          |     |  |        |  |  |  |  |     |
|---------|---|---|---------------|-----|-------------|-----|-----|-------|----------|--------|-----|--------|-----|-----------------------------|-----|----------------------|-----|-----|-------|--------|-----------|----------|-----|--|--------|--|--|--|--|-----|
| MSB     |   |   | BYTE 3        |     |             |     |     | LSB   |          |        | MSB |        |     | BYTE 2                      |     |                      |     |     | LSB   |        |           | MSB      |     |  | BYTE 1 |  |  |  |  | LSB |
| ADDR.   |   |   | WB-Demod-Gain |     | Start Smute |     |     | Smute | Tk-FM IF | FM-AGC |     | AM-AGC |     | FM BW 2 <sup>nd</sup> mixer |     | IF2 center frequency |     |     | MP FS | FM ext | Dem. Adj. | Not used |     |  |        |  |  |  |  |     |
| 1       | 0 | 1 |               |     |             |     |     |       |          |        |     |        |     |                             |     |                      |     |     |       |        |           |          | x   |  |        |  |  |  |  |     |
|         |   |   | B72           | B71 | B70         | B69 | B68 | B67   | B66      | B65    | B64 | B63    | B62 | B61                         | B60 | B59                  | B58 | B57 | B56   | B55    | B54       | B53      | B52 |  |        |  |  |  |  |     |

| A24_111 |   |   |                        |     |     |     |     |     |     |     |     |     |     |        |     |                                |     |     |                               |     |     |     |     |   |        |   |  |  |  |     |
|---------|---|---|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|-----|--------------------------------|-----|-----|-------------------------------|-----|-----|-----|-----|---|--------|---|--|--|--|-----|
| MSB     |   |   | BYTE 3                 |     |     |     |     | LSB |     |     | MSB |     |     | BYTE 2 |     |                                |     |     | LSB                           |     |     | MSB |     |   | BYTE 1 |   |  |  |  | LSB |
| ADDR.   |   |   | used in test mode only |     |     |     |     |     |     |     |     |     |     |        |     | center frequency of bandfilter |     |     | bandwidth adj. channel sensor |     |     |     |     |   |        |   |  |  |  |     |
| 1       | 1 | 1 |                        |     |     |     |     |     |     |     |     |     |     |        |     |                                |     |     | 1                             | 0   | 0   | 0   | 0   | 1 | 0      | 1 |  |  |  |     |
|         |   |   | B30                    | B29 | B28 | B27 | B26 | B25 | B24 | B23 | B22 | B21 | B20 | B19    | B18 | B17                            | B16 | B15 | B14                           | B13 | B12 | B11 | B10 |   |        |   |  |  |  |     |

| A8_100 |   |   |        |       |      |                     |     |
|--------|---|---|--------|-------|------|---------------------|-----|
| MSB    |   |   | BYTE 1 |       |      |                     | LSB |
| ADDR.  |   |   | Test   | MPoff | Mute | Adj. channel sensor |     |
| 1      | 0 | 0 | 0      |       |      |                     |     |
|        |   |   | B9     | B8    | B7   | B6                  | B5  |

| A8_101 |   |   |          |    |            |     |    |
|--------|---|---|----------|----|------------|-----|----|
| MSB    |   |   | BYTE 1   |    |            | LSB |    |
| ADDR.  |   |   | Optimize |    | Band width |     |    |
| 1      | 0 | 1 |          |    |            |     |    |
|        |   |   | B4       | B3 | B2         | B1  | B0 |

## Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

All voltages refer to GND (pin 25).

| Parameters                | Symbol    | Value       | Unit |
|---------------------------|-----------|-------------|------|
| Supply voltage, pin 42    | $V_S$     | 10          | V    |
| Power dissipation         | $P_{tot}$ | 1000        | mW   |
| Junction temperature      | $T_j$     | 150         | °C   |
| Ambient temperature range | $T_{amb}$ | -40 to +85  | °C   |
| Storage temperature range | $T_{stg}$ | -50 to +150 | °C   |

## Thermal Resistance

| Parameters                        | Symbol     | Value | Unit |
|-----------------------------------|------------|-------|------|
| Junction ambient, soldered to PCB | $R_{thJA}$ | 60    | K/W  |

## Operating Range

All voltages are referred to GND (pin 25).

| Parameters                   | Symbol    | Min. | Typ. | Max. | Unit |
|------------------------------|-----------|------|------|------|------|
| Supply voltage range, pin 42 | $V_S$     | 7.5  | 8.5  | 10   | V    |
| Ambient temperature          | $T_{amb}$ | -40  |      | +85  | °C   |

## Electrical Characteristics

Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ .

| No.      | Parameters                  | Test Conditions                          | Pin | Symbol     | Min. | Typ. | Max. | Unit     | Type* |
|----------|-----------------------------|--|-----|------------|------|------|------|----------|-------|
| <b>1</b> | <b>Power Supply</b>         |  |     |            |      |      |      |          |       |
| 1.1      | Supply voltage              |  | 42  | $V_S$      | 7.5  | 8.5  | 10   | V        | C     |
| 1.2      | Supply current              | Standby mode<br>(bit 92 = 0, bit 93 = 0) | 42  | $I_{Stby}$ |      | 20   | 25   | mA       | A     |
| 1.3      | Supply current              | Other operation<br>modes                 | 42  | $I_S$      |      | 50   | 60   | mA       | A     |
| <b>2</b> | <b>VCO</b>                  |  |     |            |      |      |      |          |       |
| 2.1      | Frequency range             |  |     | $f_{VCO}$  | 70   |      | 160  | MHz      | D     |
| 2.2      | DC bias voltage             |  | 13  |            | 2.8  | 3.0  | 3.2  | V        | A     |
| 2.3      | Buffer output voltage       | $f_{osc} = 120\text{ MHz}$               | 16  |            | 130  | 150  | 250  | mVrms    | A     |
| 2.4      | Buffer output<br>resistance |  | 16  |            |      | 70   |      | $\Omega$ | D     |
| 2.5      | Buffer output DC<br>voltage |  | 16  |            | 2.8  | 3.0  | 3.2  | V        | A     |

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

**Electrical Characteristics (Continued)**

 Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ .

| No.      | Parameters   | Test Conditions                              | Pin           | Symbol        | Min.        | Typ.        | Max. | Unit            | Type* |
|----------|--|--|---------------|---------------|-------------|-------------|------|-----------------|-------|
| <b>3</b> | <b>FM RF-AGC</b>                                   |  |               |               |             |             |      |                 |       |
| 3.1      | Saturation voltage                                 | No input signal                              | 5             |               | 8.3         |             |      | V               | A     |
| 3.2      | Saturation voltage                                 | No input signal                              | 5             |               | $V_S - 0.2$ |             |      | V               | B     |
| 3.3      | Threshold level                                    | In-band signal                               | 30            |               |             | 110         |      | dB $\mu$ V      | D     |
| 3.4      | Maximum threshold level                            | Out-of-band signal (110 MHz), bit 64, 65 = 0 | 1             |               | 100         | 102         | 104  | dB $\mu$ V      | A     |
| <b>4</b> | <b>AM RF-AGC, AM Mode (Bit 92 = 0, Bit 93 = 1)</b> |  |               |               |             |             |      |                 |       |
| 4.1      | Saturation voltage                                 | No input signal                              | 7             |               | 8.3         |             |      | V               | A     |
| 4.2      | Saturation voltage                                 | No input signal                              | 7             |               | $V_S - 0.2$ |             |      | V               | B     |
| 4.3      | Output voltage for minimum gain                    | Bit 92 = 1                                   | 7             |               | 6.5         | 6.8         | 7.1  | V               | A     |
| 4.4      | Output voltage for minimum gain                    | Bit 92 = 1                                   | 7             |               |             | $V_S - 1.7$ |      | V               | B     |
| 4.5      | Maximum control voltage                            | $V(\text{pin } 8) = 3\text{ V}$              | 6             |               | 6.5         | 7.0         | 7.5  | V               | A     |
| 4.6      | Maximum control voltage                            | $V(\text{pin } 8) = 3\text{ V}$              | 6             |               |             | $V_S - 1.5$ |      | V               | B     |
| 4.7      | Minimum control voltage                            | $V(\text{pin } 8) = 6\text{ V}$              | 6             |               |             | 0.2         | 0.7  | V               | A     |
| 4.8      | Minimum threshold level                            | Bits 62, 63 = 0                              | 41            |               | 97          | 99          | 101  | dB $\mu$ V      | A     |
| <b>5</b> | <b>AM Mixer, AM Mode (Bit 92 = 0, Bit 93 = 1)</b>  |  |               |               |             |             |      |                 |       |
| 5.1      | Supply current                                     | Sum of current in pins 43, 44                | 43, 44        |               | 14          | 16          | 20   | mA              | A     |
| 5.2      | Conversion conductance                             |  | 3, 41, 43, 44 |               |             | 4.1         |      | mS              | D     |
| 5.3      | 3 <sup>rd</sup> -order input intercept point       | Pin 3 AC-grounded                            | 41            | $IP3_{AMmix}$ |             | 132         |      | dB $\mu$ V      | C     |
| 5.4      | Noise figure (SSB)                                 | Generator resistance 2.5 k $\Omega$ (pin 41) | 43, 44        | $NF_{AMmix}$  |             | 14          |      | dB              | C     |
| 5.5      | Input bias DC voltage                              |  | 3, 41         |               | 2.4         | 2.6         | 2.9  | V               | A     |
| 5.6      | Input resistance                                   | Single-ended, pin 39 AC-grounded             | 3, 41         |               |             | 2.5         |      | k $\Omega$      | D     |
| 5.7      | Input capacitance                                  |  | 3, 41         |               |             |             | 3    | pF              | D     |
| 5.8      | Maximum output voltage                             | Differential                                 | 43, 44        |               | 12          |             |      | V <sub>pp</sub> | D     |
| 5.9      | Output resistance                                  |  | 43, 44        |               | 100         |             |      | k $\Omega$      | D     |
| <b>6</b> | <b>FM Mixer (FM Mode (Bit 92 = 1, Bit 93 = 0)</b>  |  |               |               |             |             |      |                 |       |
| 6.1      | Supply current                                     | Sum of current in pins 43, 44                | 43, 44        |               | 15          | 17.5        | 20   | mA              | A     |
| 6.2      | Conversion conductance                             |  | 1, 2, 43, 44  |               |             | 7           |      | mS              | D     |

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$ .

| No.      | Parameters  | Test Conditions                               | Pin           | Symbol               | Min. | Typ.  | Max. | Unit            | Type* |
|----------|---|---|---------------|----------------------|------|-------|------|-----------------|-------|
| 6.3      | 3 <sup>rd</sup> -order intercept point                                  |   | 1, 2          | $IP3_{\text{FMmix}}$ |      | 120   |      | dB $\mu$ V      | C     |
| 6.4      | Noise figure (DSB)  | Generator resistance<br>200 $\Omega$          | 43, 44        | $NF_{\text{FMmix}}$  |      | 10    |      | dB              | C     |
| 6.5      | Input resistance  |   | 1, 2          |                      |      | 1.6   |      | k $\Omega$      | D     |
| 6.6      | Input capacitance   | Pin 2 AC-grounded                             | 1             |                      |      | 5     |      | pF              | D     |
| 6.7      | Maximum differential output voltage                                     | $V_S = 8.5\text{ V}$                          | 43, 44        |                      | 12   |       |      | V <sub>pp</sub> | D     |
| 6.8      | Output resistance   |   | 43, 44        |                      | 100  |       |      | k $\Omega$      | D     |
| <b>7</b> | <b>1<sup>st</sup> IF FM Amplifier, FM Mode (Bit 92 = 1, Bit 93 = 0)</b> |   |               |                      |      |       |      |                 |       |
| 7.1      | Minimum voltage gain  | Bits 89, 90, 91 = 0                           | 38, 30        |                      | 19   | 21    | 23   | dB              | A     |
| 7.2      | Temperature coefficient of gain   | Bit 66 = 0                                    |               | $TK_{\text{min}}$    |      | 0.039 |      | dB/K            | D     |
| 7.3      | Temperature coefficient of gain   | Bit 66 = 1                                    |               | $TK_{\text{max}}$    |      | 0.044 |      | dB/K            | D     |
| 7.4      | Input resistance  | Pin 39 AC-grounded                            | 38            |                      | 270  | 330   | 400  | $\Omega$        | D     |
| 7.5      | Input capacitance   | Pin 39 AC-grounded                            | 38            |                      |      | 5     |      | pF              | D     |
| 7.6      | Output resistance   |   | 30            |                      | 270  | 330   | 400  | $\Omega$        | D     |
| <b>8</b> | <b>1<sup>st</sup> IF AM Amplifier, AM Mode (Bit 92 = 0, Bit 93 = 1)</b> |   |               |                      |      |       |      |                 |       |
| 8.1      | Maximum voltage gain  | 330 $\Omega$ load at pin 30                   | 30, 33        |                      |      | 16    |      | dB              | D     |
| 8.2      | Gain control range  |   |               |                      |      | 26    |      | dB              | D     |
| 8.3      | Noise figure  | Generator resistance<br>2.5 k $\Omega$        |               | $NF_{\text{IFAM}}$   |      | 20    |      | dB              | C     |
| 8.4      | Input resistance  |   | 33            |                      | 10   |       |      | k $\Omega$      | D     |
| 8.5      | Input capacitance   | Pin 39 AC-grounded                            | 33            |                      |      | 1     |      | pF              | D     |
| 8.6      | Output resistance   |   | 30            |                      | 270  | 330   | 400  | $\Omega$        | D     |
| <b>9</b> | <b>2<sup>nd</sup> Mixer</b>   |   |               |                      |      |       |      |                 |       |
| 9.1      | FM supply current   | Bit 92 = 1, bit 93 = 0                        | 23, 24        |                      | 10   | 14    | 16   | mA              | A     |
| 9.2      | AM/WB supply current  | Bit 92 = 0, bit 93 = 1                        | 23, 24        |                      | 8    | 10    | 12   | mA              | D     |
| 9.3      | Conversion conductance  |   | 26, 23,<br>24 |                      |      | 2     |      | mS              | D     |
| 9.4      | Noise figure (SSB)  | Generator resistance<br>330 $\Omega$ (pin 26) | 23, 24        | $NF_{\text{Mix2}}$   |      | 23    |      | dB              | C     |
| 9.5      | 3 <sup>rd</sup> -order input intercept point                            |   | 26            | $IP3_{\text{Mix2}}$  |      | 132   |      | dB $\mu$ V      | C     |
| 9.6      | AM/WB output resistance   | Bit 92 = 0, bit 93 = 1                        | 23, 24        |                      | 100  |       |      | k $\Omega$      | D     |
| 9.7      | Maximum differential output voltage AM/WB                               | $V_S = 8.5\text{ V}$                          | 23, 24        |                      | 12   |       |      | V <sub>pp</sub> | D     |

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ .

| No.       | Parameters   | Test Conditions  | Pin          | Symbol              | Min. | Typ. | Max. | Unit              | Type* |
|-----------|--|--|--------------|---------------------|------|------|------|-------------------|-------|
| 9.8       | Maximum differential output voltage FM   |  | 23, 24       |                     | 1    |      |      | V <sub>pp</sub>   | D     |
| 9.9       | Input resistance   |  | 26           |                     | 270  | 330  | 400  | $\Omega$          | D     |
| 9.10      | LO input voltage   |  | 22           |                     | 80   |      | 500  | mV <sub>pp</sub>  | D     |
| 9.11      | LO input resistance  |  | 22           |                     |      | 1    |      | k $\Omega$        | D     |
| 9.12      | LO input bias voltage  |  | 22           |                     | 2.8  | 3.0  | 3.2  | V                 | A     |
| <b>10</b> | <b>2<sup>nd</sup> IF Amplifier (Bit 55 = 0)</b>  |  |              |                     |      |      |      |                   |       |
| 10.1      | Input resistance   | Pin 27 AC-grounded   | 28           |                     |      | 3    |      | k $\Omega$        | D     |
| 10.2      | Maximum voltage gain   | AM/WB mode (Bit 93 = 1)  | 28, 20       |                     | 44   | 47   | 50   | dB                | A     |
| 10.3      | Gain control range   | AM/WB mode (Bit 93 = 1)  |              |                     |      | 44   |      | dB                | D     |
| 10.4      | Maximum voltage gain   | FM mode (bit 92 = 1, bit 93 = 0, bit 54 = 0)   | 23, 24<br>20 |                     |      | 37   |      | dB                | D     |
| 10.5      | DC output voltage  |  | 20           |                     | 3.1  | 3.4  | 3.7  | V                 | A     |
| 10.6      | AC output voltage  | Unmodulated signal, 82 dB $\mu$ V at pin 1 (IF AGC active)   | 20           |                     | 145  | 175  | 200  | mV <sub>rms</sub> | A     |
| 10.7      | Output impedance   | Small signal   | 20           |                     |      | 70   |      | $\Omega$          | D     |
| <b>11</b> | <b>FM Demodulator Integrated Bandfilter, FM Mode (Bit 92 = 1, Bit 93 = 0), BW Setting 2<sup>nd</sup> IF Filter = 120 kHz</b> |  |              |                     |      |      |      |                   |       |
| 11.1      | AC output voltage  | Deviation = $\pm 75\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$   | 11           |                     | 420  | 480  | 540  | mV <sub>rms</sub> | A     |
| 11.2      | Stereo roll-off  | Deviation = $\pm 75\text{ kHz}$ , $f_{mod} = 38\text{ kHz}$ (reference: 1 kHz)                           | 11           |                     | -2.3 | -2.0 | -1.7 | dB                | A     |
| 11.3      | Total harmonic distortion  | Deviation = $\pm 75\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$   | 11           | THD <sub>FM</sub>   |      | 0.4  | 0.7  | %                 | A     |
| 11.4      | Maximum signal-to-noise ratio  | Dev. = $\pm 22.5\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$ , 50 $\mu$ s de-emphase, signal input at 450 kHz | 11           | (S/N) <sub>FM</sub> | 62   | 65   |      | dB                | A     |
| <b>12</b> | <b>Soft Mute, FM Mode (Bit 92 = 1, Bit 93 = 0, Bit 80 = 0)</b>   |  |              |                     |      |      |      |                   |       |
| 12.1      | Mute gain  | Bit 67 = 0, V (pin 34) = 2 V   | 11           |                     | -31  | -28  | -26  | dB                | A     |
| 12.2      | Mute gain  | Bit 67 = 1, V (pin 34) = 2 V   | 11           |                     | -26  | -24  | -22  | dB                | A     |
| 12.3      | Soft mute threshold  | Bits 89 to 91 = 0, Bits 68 to 70 = 1   | 1            |                     | 50   | 53   | 56   | dB $\mu$ V        | B     |
| <b>13</b> | <b>AM Demodulator, AM Mode (Bit 92 = 0, Bit 93 = 1)</b>  |  |              |                     |      |      |      |                   |       |
| 13.1      | AC output voltage  | Modulation depth = 80%, $f_{mod} = 1\text{ kHz}$   | 11           |                     | 350  | 400  | 450  | mV <sub>rms</sub> | A     |
| 13.2      | Total harmonic distortion  | Modulation depth = 80%, $f_{mod} = 1\text{ kHz}$ , V(pin 35) = const.                                    | 11           | THD <sub>AM</sub>   |      | 0.6  | 2    | %                 | A     |

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ .

| No.       | Parameters   | Test Conditions   | Pin | Symbol       | Min. | Typ. | Max. | Unit       | Type* |
|-----------|--|---|-----|--------------|------|------|------|------------|-------|
| 13.3      | Maximum signal-to-noise ratio  | Modulation depth = 80%, $f_{mod} = 1\text{ kHz}$ , 74 dB $\mu\text{V}$ at pin 41    | 11  | $(S/N)_{AM}$ | 52   | 54   |      | dB         | A     |
| <b>14</b> | <b>MPX Output</b>  |   |     |              |      |      |      |            |       |
| 14.1      | DC output voltage  | Bit 7 = 1   | 11  |              | 2.15 | 2.25 | 2.4  | V          | A     |
| 14.2      | Mute gain  | Bit 7 = 1, FM dev. = $\pm 75\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$                 | 11  |              |      | -70  | -50  | dB         | A     |
| 14.3      | Output resistance  | Small signal  | 11  |              |      | 60   |      | $\Omega$   | D     |
| <b>15</b> | <b>Search Stop Detector, INT Output</b>  |   |     |              |      |      |      |            |       |
| 15.1      | LOW saturation voltage   |   | 21  |              |      | 0    | 0.5  | V          | A     |
| 15.2      | LOW output resistance  |   | 21  |              |      | 0.3  |      | k $\Omega$ | D     |
| 15.3      | HIGH saturation voltage  |   | 21  |              | 4.5  | 4.75 | 5.0  | V          | A     |
| 15.4      | HIGH output resistance   |   | 21  |              |      | 1    |      | k $\Omega$ | D     |
| <b>16</b> | <b>Deviation Sensor, FM Mode (Bit 92 = 1, Bit 93 = 0)</b>  |   |     |              |      |      |      |            |       |
| 16.1      | Offset voltage   | FM dev. = $\pm 0\text{ kHz}$  | 31  |              |      | 20   | 150  | mV         | A     |
| 16.2      | Output voltage   | FM dev. = $\pm 75\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$                            | 31  |              | 1.7  | 2.0  | 2.5  | V          | A     |
| <b>17</b> | <b>Field Strength Sensor, FM Mode (Bit 92 = 1, Bit 93 = 0, Bit 89-91 = 0, Bit 80 = 0)</b>        |   |     |              |      |      |      |            |       |
| 17.1      | Offset voltage   | No signal   | 9   |              | 0.4  | 0.75 | 1.1  | V          | A     |
| 17.2      | Output voltage   | Unmodulated signal 84 dB $\mu\text{V}$ at pin 1                                     | 9   |              | 2.7  | 3.0  | 3.3  | V          | A     |
|           | <b>Field Strength Sensor, AM Mode (Bit 92 = 0, Bit 93 = 1, Bit 80 = 1)</b>                       |   |     |              |      |      |      |            |       |
| 17.3      | Output voltage LOW field strength  | 63 dB $\mu\text{V}$ at pin 28   | 9   |              | 0.7  | 0.9  | 1.1  | V          | A     |
| 17.4      | Output voltage HIGH field strength   | 94 dB $\mu\text{V}$ at pin 28   | 9   |              | 2.3  | 2.5  | 2.7  | V          | A     |
| <b>18</b> | <b>Multipath Sensor, FM Mode (Bit 92 = 1, Bit 93 = 0)</b>  |   |     |              |      |      |      |            |       |
| 18.1      | Offset voltage   | Unmodulated signal, 60 dB $\mu\text{V}$ at pin 1                                    | 40  |              |      | 20   | 200  | mV         | A     |
| 18.2      | Output voltage   | AM modulation depth = 60%, $f_{mod} = 20\text{ kHz}$ , 60 dB $\mu\text{V}$ at pin 1 | 40  |              | 1.4  | 1.8  | 2.2  | V          | A     |
| <b>19</b> | <b>Adjacent Channel Sensor, FM Mode (Bit 92 = 1, Bit 93 = 0), Bit 4 = 0 (Default BW Setting)</b> |   |     |              |      |      |      |            |       |
| 19.1      | Offset voltage   | Unmodulated signal  | 10  |              |      | 100  | 300  | mV         | A     |
| 19.2      | Output voltage   | FM dev. = $\pm 50\text{ kHz}$ , $f_{mod} = 1\text{ kHz}$                            | 10  |              |      | 0.6  | 1.0  | V          | A     |

\*) Type means: A =100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter



### Electrical Characteristics (Continued)

Test conditions (unless otherwise specified):  $V_S = 8.5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ .

| No.       | Parameters                                     | Test Conditions  | Pin           | Symbol         | Min.       | Typ. | Max. | Unit          | Type* |
|-----------|--|--|---------------|----------------|------------|------|------|---------------|-------|
| 19.3      | Output voltage                                 | Desired<br>FM dev. = $\pm 75\text{ kHz}$ ,<br>$f_{mod} = 1\text{ kHz}$<br>undesired:<br>unmodulated<br>RF level<br>undesired/desired:<br>+30 dB frequency<br>offset = -150 kHz | 10            |                | 1.0        | 1.2  | 1.6  | V             | A     |
| <b>20</b> | <b>3-wire Bus</b>                              |  |               |                |            |      |      |               |       |
| 20.1      | Input voltage LOW                              |  | 17, 18,<br>19 |                |            |      | 0.8  | V             | D     |
| 20.2      | Input voltage HIGH                             |  | 17, 18,<br>19 |                | 2.7        |      |      | V             | D     |
| 20.3      | Leakage current                                | $V = 0\text{ V}, 5\text{ V}$   | 17, 18,<br>19 |                |            |      | 10   | $\mu\text{A}$ | D     |
| 20.4      | Clock frequency                                |  | 18            |                |            |      | 1.0  | MHz           | D     |
| 20.5      | Period of CLK<br>HIGH<br>LOW                   |  |               | $t_H$<br>$t_L$ | 250<br>250 |      |      | ns<br>ns      | D     |
| 20.6      | Rise time<br>EN, DATA, CLK                     |  |               | $t_r$          |            |      | 400  | ns            | D     |
| 20.7      | Fall time<br>EN, DATA, CLK                     |  |               | $t_f$          |            |      | 100  | ns            | D     |
| 20.8      | Set-up time                                    |  |               | $t_s$          | 100        |      |      | ns            | D     |
| 20.9      | Hold time EN                                   |  |               | $t_{HEN}$      | 250        |      |      | ns            | D     |
| 20.10     | Hold time DATA                                 |  |               | $t_{HDA}$      | 0          |      |      | ns            | D     |
| <b>21</b> | <b>Internally Generated Reference Voltages</b> |  |               |                |            |      |      |               |       |
| 21.1      | Output voltage                                 |  | 12            |                | 5.5        | 5.7  | 6.0  | V             | A     |
| 21.2      | Output voltage                                 |  | 29            |                |            | 3.0  |      | V             | D     |
| 21.3      | Output voltage                                 |  | 27            |                |            | 3.0  |      | V             | D     |
| 21.4      | Output voltage                                 |  | 39            |                |            | 3.0  |      | V             | D     |

\*) Type means: A =100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

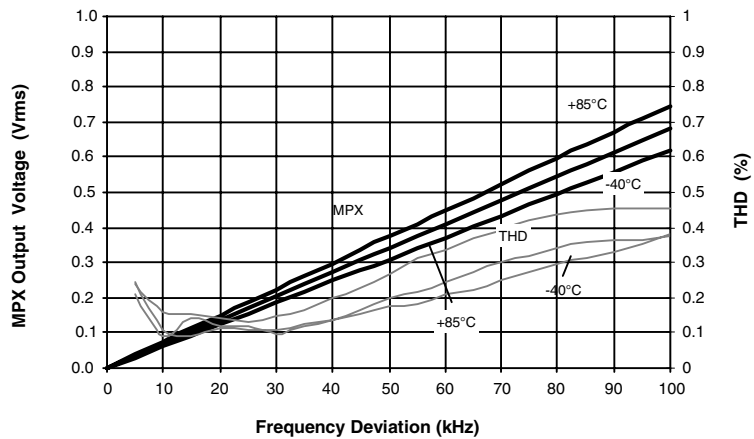


## Diagrams

The following data was measured with the application board (see Figure 20).

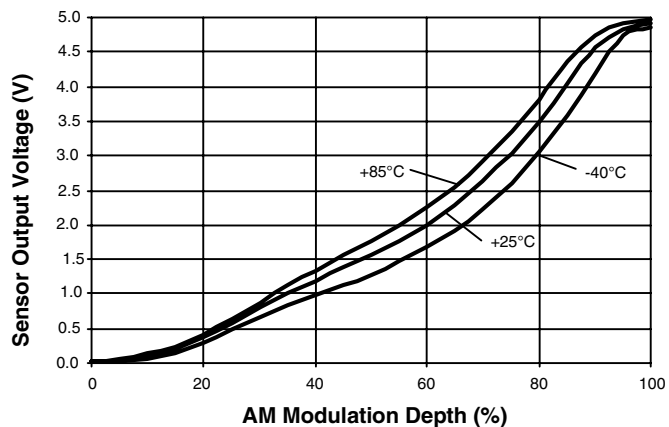
In the measurement setup, a 50-Ω generator is terminated by 50 Ω and connected to the antenna input by a 50-Ω series resistor to achieve 75-Ω termination at the antenna input. The generator level specified is the output voltage of this 50-Ω generator at 50 Ω load. If the application board is replaced by a 75-Ω resistor, the voltage at this resistor is 6 dB below the specified voltage level of the 50 Ω generator.

**Figure 12.** FM Demodulator



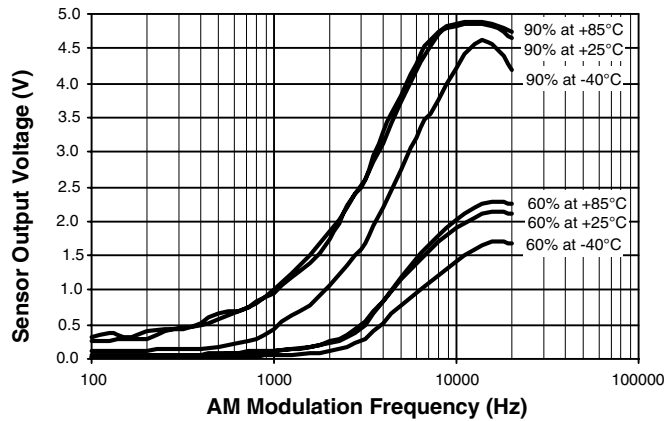
Note: Integrated bandfilter BW setting: 120 kHz, bits 0 to 2 = 0, bit 3 = 1; 1 kHz modulation frequency; 50 μs de-emphasis (THD).

**Figure 13.** Multipath Sensor



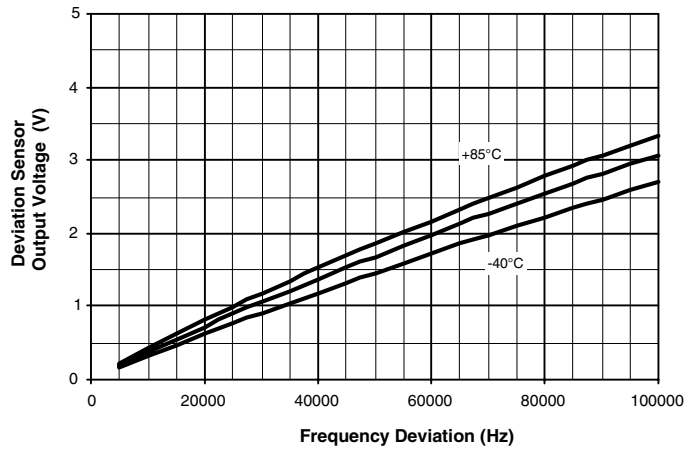
Note: AM modulation frequency 20 kHz; generator level 40 dBμV.

Figure 14. Multipath Sensor Frequency Response



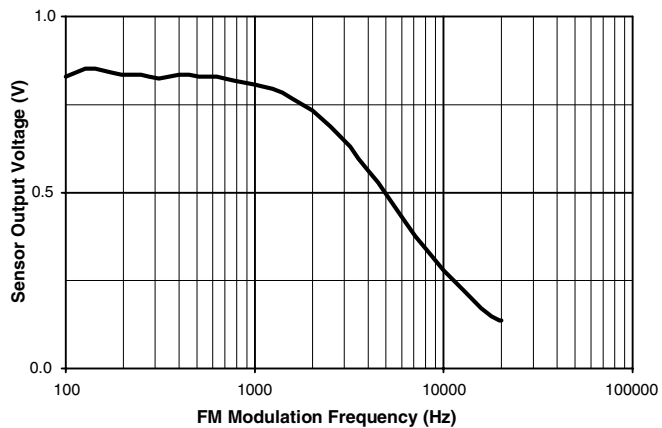
Note: Generator level 40 dB $\mu$ V.

Figure 15. Deviation Sensor



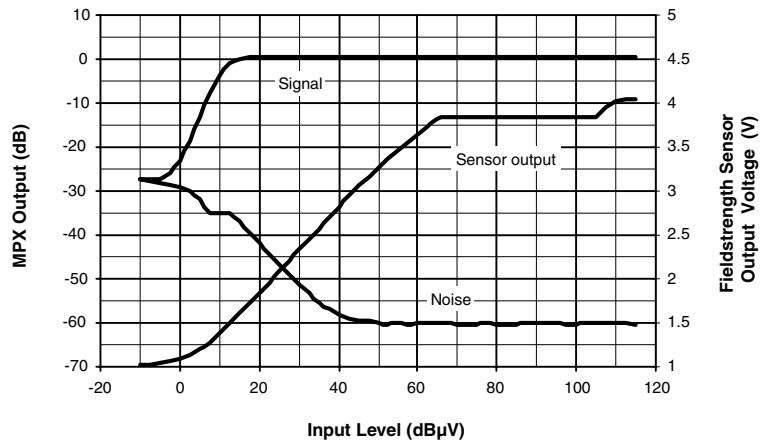
Note: FM modulation frequency: 1 kHz; BW setting 2<sup>nd</sup> IF filter = 120 kHz.

Figure 16. Deviation Sensor Frequency Response



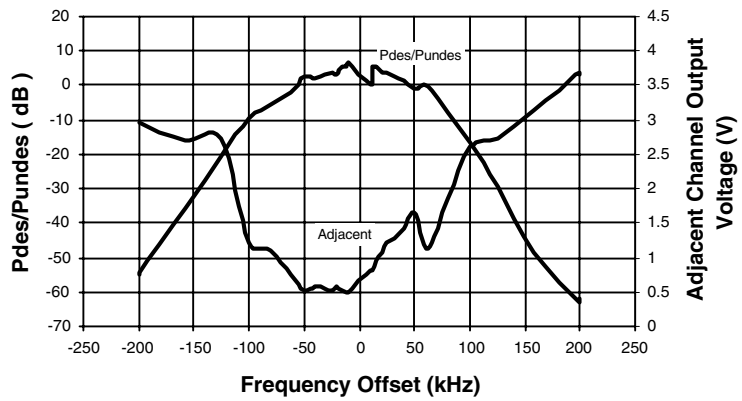
Note: FM frequency deviation: 22.5 kHz.

**Figure 17. FM Input Level Sweep**



Note: Soft mute threshold bits 68 and 69 = 0, bit 70 = 1; soft mute gain bit 67 = 1, gain FM IF amplifier bit 89 = 1, bits 90 and 91 = 0.

**Figure 18. Selectivity**



Note: Integrated bandfilter BW setting: 120 kHz  
 Desired signal level adjusted to 40 dB S/N without undesired signal,  
 undesired signal level adjusted to 26 dB S/N.

Figure 19. Test Circuit

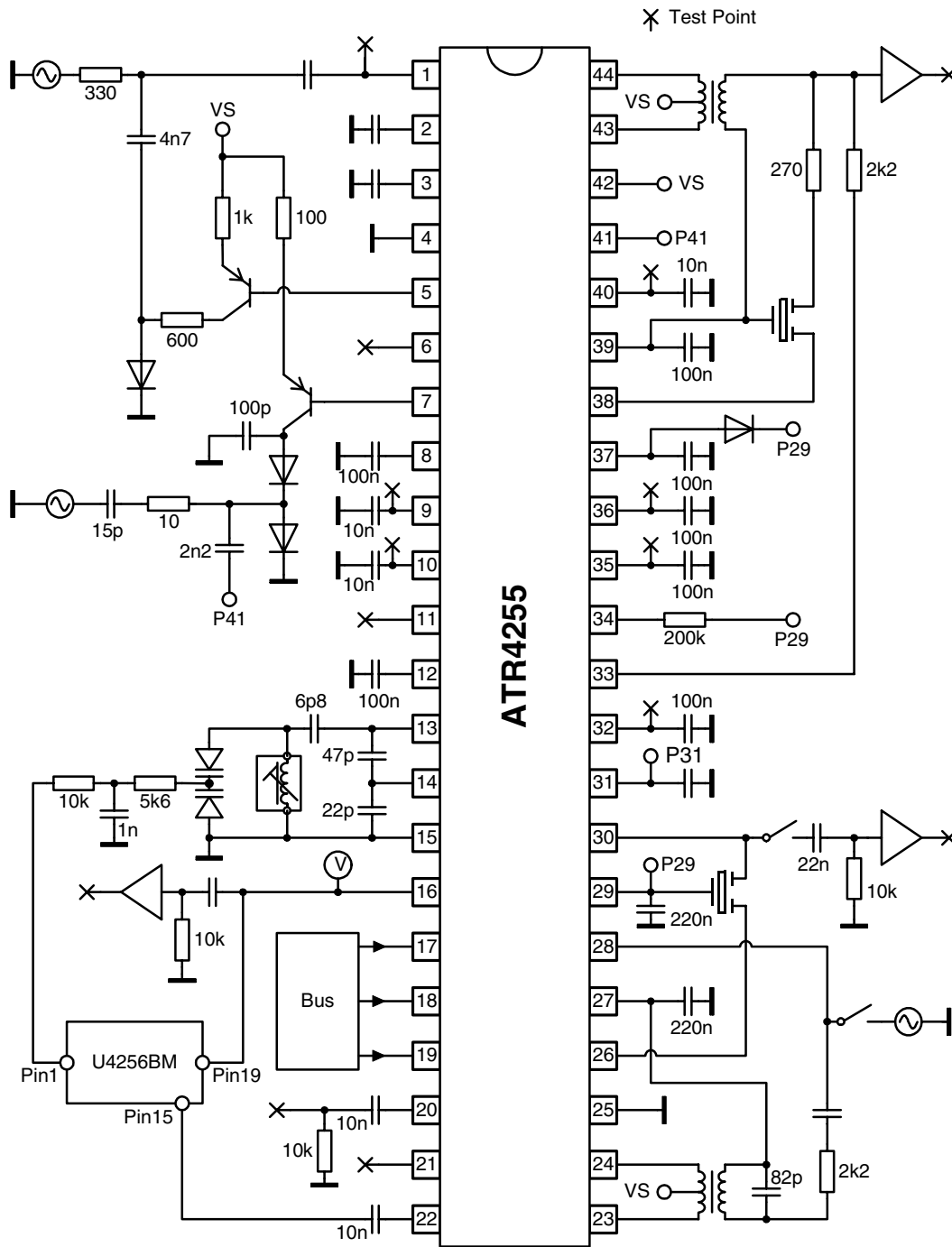
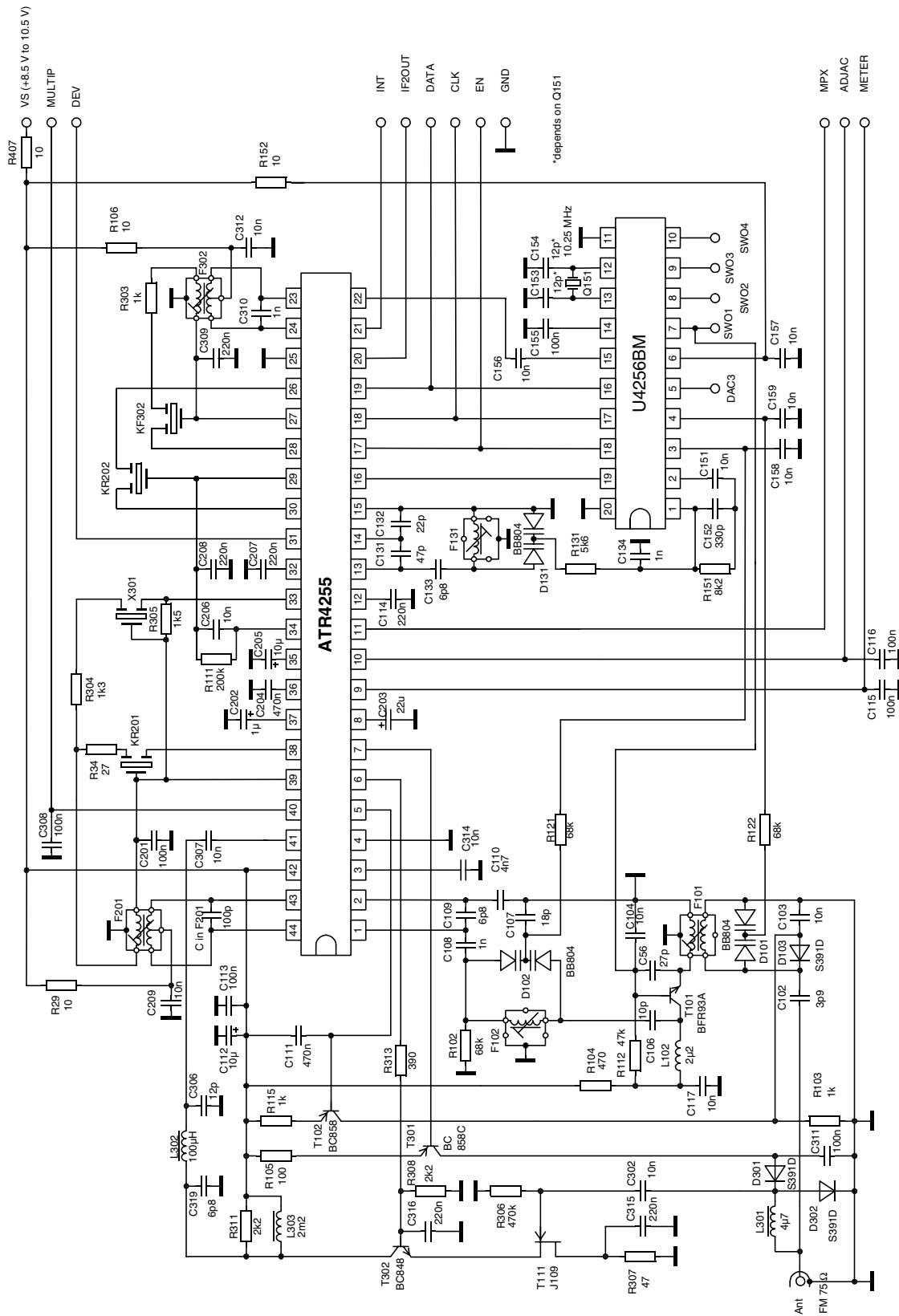


Figure 20. Application Circuit



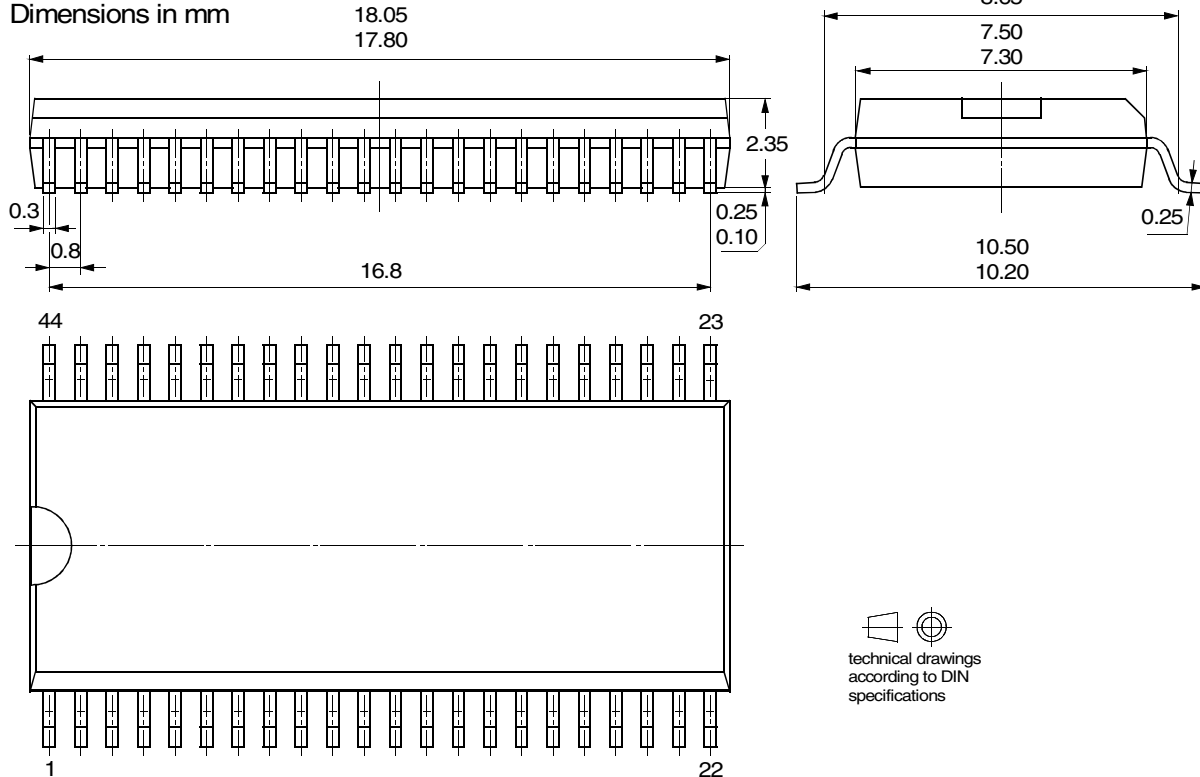
### Ordering Information

| Extended Type Number | Package | Remarks                     |
|----------------------|---------|-----------------------------|
| ATR4255-ILSH         | SSO44   | Tube, lead-free             |
| ATR4255-ILQH         | SSO44   | Taped and reeled, lead-free |

### Package Information

#### Package SSO44

Dimensions in mm



technical drawings according to DIN specifications



## Atmel Corporation

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 487-2600

## Regional Headquarters

### Europe

Atmel Sarl  
Route des Arsenaux 41  
Case Postale 80  
CH-1705 Fribourg  
Switzerland  
Tel: (41) 26-426-5555  
Fax: (41) 26-426-5500

### Asia

Room 1219  
Chinachem Golden Plaza  
77 Mody Road Tsimshatsui  
East Kowloon  
Hong Kong  
Tel: (852) 2721-9778  
Fax: (852) 2722-1369

### Japan

9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
Japan  
Tel: (81) 3-3523-3551  
Fax: (81) 3-3523-7581

## Atmel Operations

### Memory

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

### Microcontrollers

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

La Chantrerie  
BP 70602  
44306 Nantes Cedex 3, France  
Tel: (33) 2-40-18-18-18  
Fax: (33) 2-40-18-19-60

### ASIC/ASSP/Smart Cards

Zone Industrielle  
13106 Rousset Cedex, France  
Tel: (33) 4-42-53-60-00  
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park  
Maxwell Building  
East Kilbride G75 0QR, Scotland  
Tel: (44) 1355-803-000  
Fax: (44) 1355-242-743

### RF/Automotive

Theresienstrasse 2  
Postfach 3535  
74025 Heilbronn, Germany  
Tel: (49) 71-31-67-0  
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

### Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine  
BP 123  
38521 Saint-Egreve Cedex, France  
Tel: (33) 4-76-58-30-00  
Fax: (33) 4-76-58-34-80

---

### Literature Requests

[www.atmel.com/literature](http://www.atmel.com/literature)

**Disclaimer:** The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© Atmel Corporation 2004. All rights reserved. Atmel®, logo and combinations thereof are registered trademarks, and Everywhere You Are<sup>SM</sup> are the trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.



Printed on recycled paper.

4837A-AUDR-10/04