AM/FM Receiver IC

Description

The U4255BM is an integrated AM/FM front end circuit in BICMOS technology. It contains a double conversion system for FM and an up/down conversion circuit for AM (IF1 = 10.7 MHz, IF2 = 450 kHz). A complete automatically aligned high performance AM/FM tuner can be built together with the PLL U4256BM. This ICs are designed for high performance car radio applications.

Electrostatic sensitive device.
Observe precautions for handling.

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 preamplifier with AGC and stereo capability
- 3-wire bus controlled
- Stop signal generation for AM and FM
- Automatic alignment possible

Block Diagram

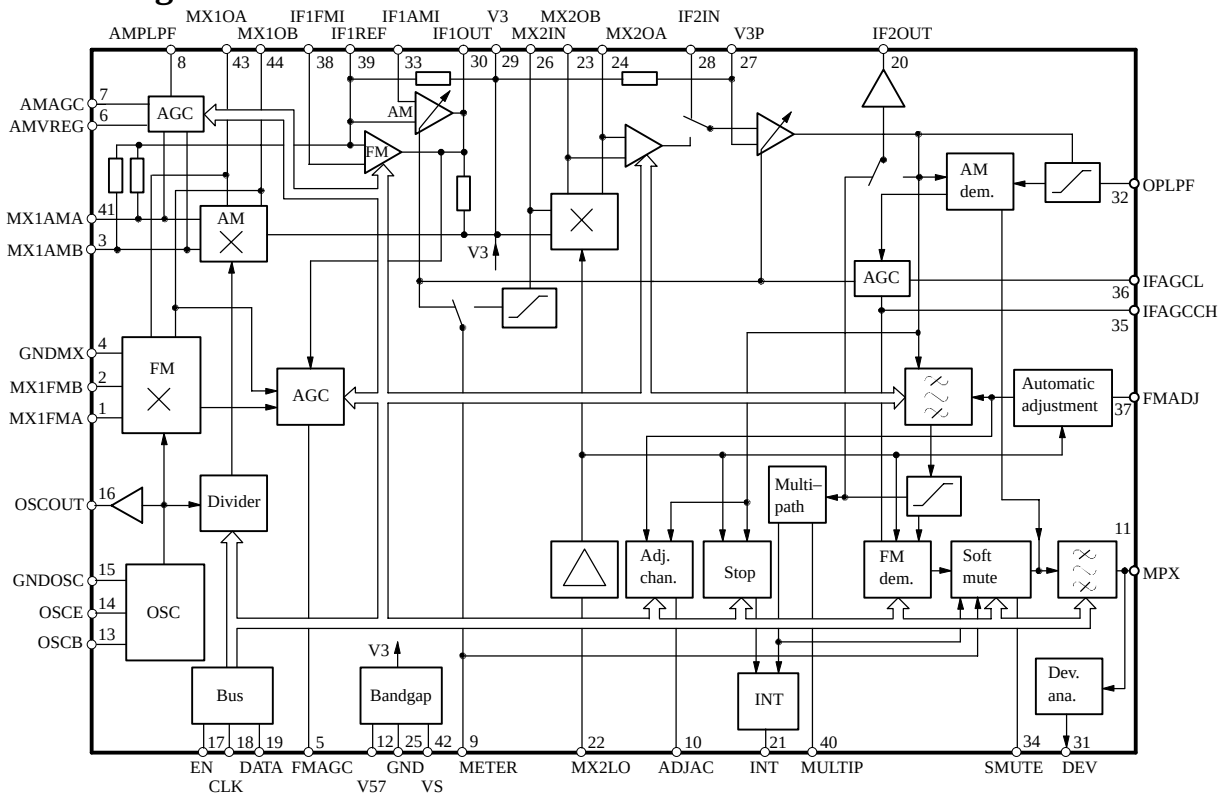


Figure 1. Block diagram

Ordering Information

Extended Type Number	Package	Remarks
U4255BM-AFN	SSO44	Tube
U4255BM-AFNG3	SSO44	Taped and reeled

Pin Description

Pin	Symbol	Function
1	MX1FMA	1st mixer FM input A
2	MX1FMB	1st mixer FM input B
3	MX1AMB	1st mixer AM input B
4	GNDMX	Ground 1st mixer
5	FMAGC	FM preamplifier AGC
6	AMVREG	AM control voltage
7	AMAGC	AM preamplifier AGC
8	AMPLPF	AM AGC LP filter
9	METER	Fieldstrength 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	2nd IF amplifier output
21	INT	Interrupt, stop signal, test out
22	MX2LO	10.25 MHz input for 2nd mixer
23	MX2OB	2nd mixer output B
24	MX2OA	2nd mixer output A
25	GND	Ground
26	MX2IN	2nd mixer input
27	V3P	3 V reference for AMPIN, AMIFAGC, Control, IF2IN
28	IF2IN	2nd IF amplifier input
29	V3	3 V reference for IF1OUT, MX2IN
30	IF1OUT	1st IF amplifier output
31	DEV	Deviation detect output
32	OPLPF	Operating point LPF
33	IF1AMI	1st 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	1st IF FM amplifier input
39	IF1REF	1st IF & MX1OUT reference, MX1AM A, MX1AM B
40	MULTIP	Multipath detection output
41	MX1AMA	1st mixer AM input A
42	VS	Supply voltage
43	MX1OA	1st mixer output A
44	MX1OB	1st mixer output B

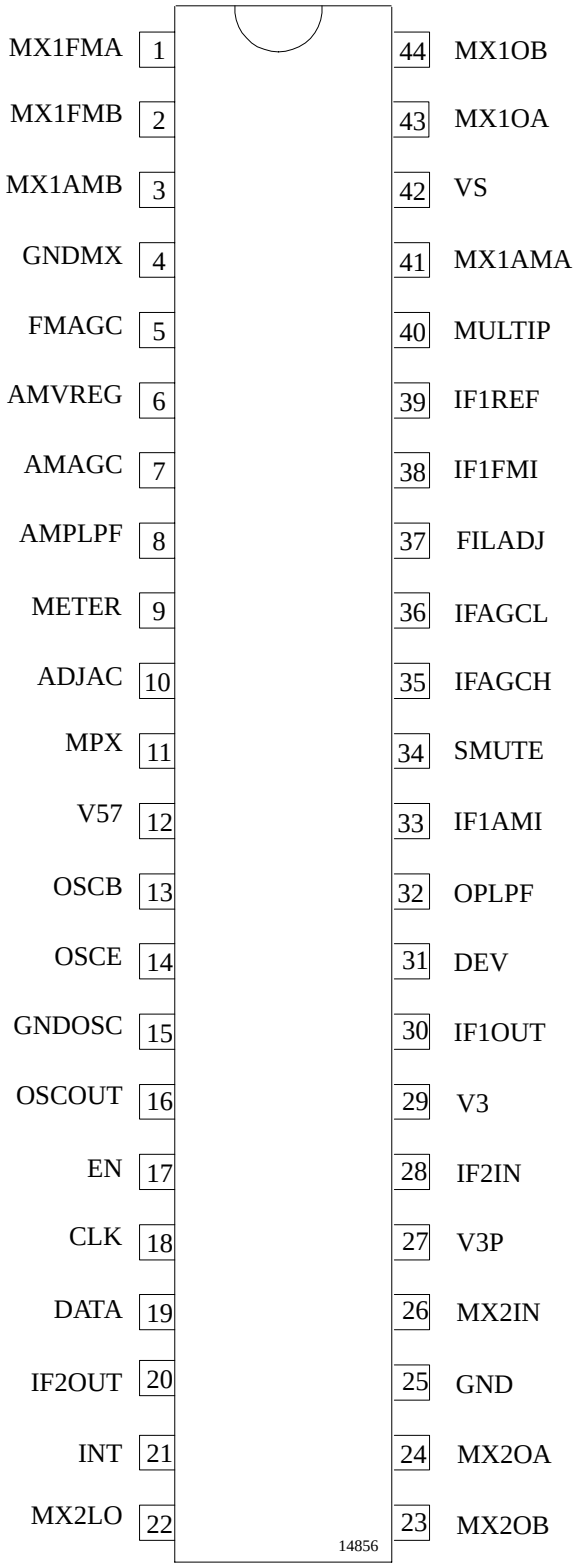


Figure 2. Pinning

Absolute Maximum Ratings

All voltages are referred to GND (Pin 25)

Parameter		Symbol	Value	Unit
Supply voltage	Pin 42	V_S	10	V
Power dissipation		P_{tot}	800	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

Parameter		Symbol	Value	Unit
Junction ambient	soldered to PCB	R_{thJA}	80	K/W

Operating Range

All voltages are referred to GND (Pin 25)

Parameter		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 V, T_{amb} = 25°C. For AC parameters: fi_{RF} = 100 MHz, Rg = 50 Ω , f_{MOD} = 0.4 kHz, Δf = ± 75 kHz, f_{IF} = 450 kHz, reference point Pin 4

Parameter	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Pin 42	V_S		8.5	10	V
Supply current	Pin 42	I_S			70	mA
AM Mixer (10.7 MHz)						
DC supply current				18		mA
Conversion conductance io_{if}/vi_{rf}		S_{m1}		4.1		mA/v
Maximum IF output	Pins 43 and 44	vo_{IF}		8		v_{pp}
Third order input intercept point		IP3		133		dBµV
Input resistance	Pin 41			2.5		kΩ

Electrical Characteristics (continued)

Test conditions (unless otherwise specified): V_S = 8.5 V, T_{amb} = 25°C. For AC parameters: fi_{RF} = 100 MHz, Rg = 50 Ω , f_{MOD} = 0.4 kHz, Δf = ± 75 kHz, f_{IF} = 450 kHz, reference point Pin 4

Parameter	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
AM-1st IF Amplifier (10.7 MHz)						
Input resistance	Pin 33	R_i	10			kΩ
1st IF amplifier gain	RL = 330 Ω Pins 30 to 33	G		16		dB
Preamplifier control range				26		dB
Mixer 2 (450 kHz)						
DC supply current				10		mA
Conversion conductance io_{if2}/vi_{if1}		S_{m2}		2		mA/v
Maximum IF output	Pins 23 and 24	vo_{IF}		8		v_{pp}
Output impedance		R_o C_o		1 3		MΩ pF
Third order input intercept point		IP3		133		dBµV
Input resistance		R_i		330		Ω
2nd IF Amplifier (450 kHz)						
Input resistance	Pin 28	R_i		3		kΩ
IF preamplifier gain	Pins 28 to 20	G		43		dB
Preamplifier control range				37		dB
Oscillator (Pin 15, GND, connected to external oscillator components)						
Oscillator range	Rg (Pin 13) = 220 Ω, Q of Losc = 70, RL1 = 520 Ω	VLOB VLOE VLObuf	 70	160 100 90	 220	mV mV mV
Frequency range		f_{OSC}	70		160	MHz
Harmonics	Pin16				–15	dBc
Output resistance	Pin 16	R_{LO}		70		Ω
FM Mixer						
Third order intercept point	Load impedance: $R_{L43, 44}$ = 200 Ω	IP3		120		dBµV
Conversion transconductance		g_c		7		mA/v
Noise figure		NF_{dsb}		10		dB
Input resistance	Pins 1 to 2	$R_{i\ 1, 2}$		1.6		kΩ
Input capacitance	Pins 1 to 2	$C_{i\ 1, 2}$		5		pF
Input 1 resistance to ground	f = 100 MHz Pin 1	R_{i1}		1.2		kΩ
Input 1 capacitance to ground	f = 100 MHz Pin 1	C_{i1}		9		pF

Electrical Characteristics (continued)

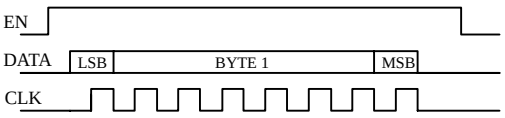
Test conditions (unless otherwise specified): V_S = 8.5 V, T_{amb} = 25°C. For AC parameters: fi_{RF} = 100 MHz, Rg = 50 Ω , f_{MOD} = 0.4 kHz, Δf = ± 75 kHz, f_{IF} = 450 kHz, reference point Pin 4

Parameter	Test Conditions / Pins		Symbol	Min.	Typ.	Max.	Unit
Input 2 resistance to ground	f = 100 MHz	Pin 2	R_{i2}		1.6		kΩ
Input 2 capacitance to ground	f = 100 MHz	Pin 2	C_{i2}		7		pF
Output capacitance to GND	Pins 43, 44		$C_{o\ 43,\ o44}$		5		pF
1st IF FM Amplifier							
Digitally adjustable gain	3 bit, 10.7 MHz		G_{min} G_{max}		19 30		dB dB
Input resistance		Pin 38	R_{i38}		330		Ω
Output resistance		Pin 30	R_{o30}		330		Ω
Temperature coefficient of the gain at G_{min}	G_{min}, Bit 66 = 0		TK_{min}		0.044		dB/K
Temperature coefficient of the gain at G_{max}	G_{max}, Bit 66 = 1		TK_{max}		0.039		dB/K
FM Demodulator (Pin 11)							
Output voltage	$v_{iPin\ 23,\ 24}$ = 40 mV f = 450 kHz Deviation = ± 22.5kHz, f_{MOD} = 1 kHz		v_{MPX}		140		mV
Total distortion	Bandwidth 2nd IF filter = 120 kHz, deviation = 75 kHz				0.3		%

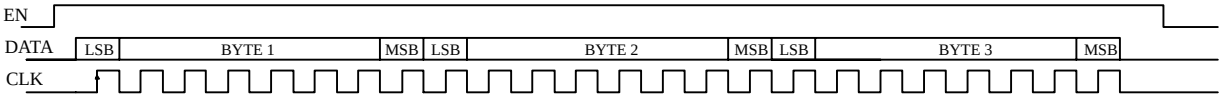
3-Wire Bus Description

8-bit command

14857



24-bit command



e.g., R-Divider

Figure 3. Pulse diagram

Data Transfer

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	BWmpx.	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-fmzf	FM AGC		AM-AGC		FM BW IF2		IF2 center frequency				MP FS	FM ext	Not used		
1	0	1																					x	x
			B72	B71	B70	B69	B68	B67	B66	B65	B64	B63	B62	B61	B60	B59	B58	B57	B56	B55	B54	B53	B52	

A8_100							
MSB BYTE 1 LSB							
ADDR.			Test	MPoff	Mute	NK-Sensor	
1	0	0	0				
			B9	B8	B7	B6	B5

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

Bus Timing

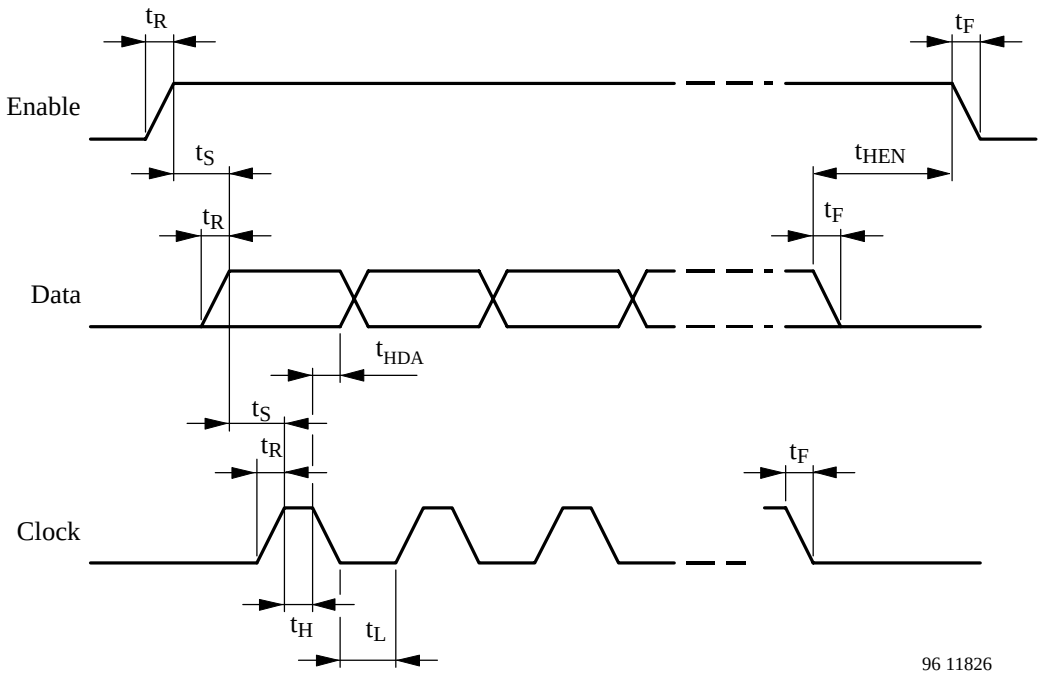


Figure 4. Bus timing

Bus Control

The operating mode is set by the Bits 92 and 93.

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

The Bits 89 to 91 control gain of the FM IF amplifier.

Gain FM-IF	Bit 91	Bit 90	Bit 89
19 dB	0	0	0
21 dB	0	0	1
23 dB	0	1	0
25 dB	0	1	1
27 dB	1	0	0
28 dB	1	0	1
29 dB	1	1	0
30 dB	1	1	1

Bit 88 switches the search mode on/off.

Station Search	Bit 88
Receive	0
Search	1

Bits 85 to 87 select the search-stop deviation from the center frequency.

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

In AM mode (Bits 92 and 93), Bits 81 to 83 set the divide factor of the AM prescaler

Divider AM Mixer 1	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

In FM mode and in weather band mode (bit 92), the Bits 81 to 84 set the sensitivity of the MNC

Sensitivity Multipath	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
	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	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	x	1	1	1	1	1

Bit 80 switches between narrow band field strength information and wide band field strength information.

Field Strength Narrow Band / Wide Band	Bit 80
Field strength at Pin 16 (wide band)	0
Field strength from AGC (narrow band)	1

Bit 79 controls the bandwidth of the lowpass filter of the MPX output.

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

The stop counter calculates an average center frequency during the time wich is set by the Bits 73 to 78.

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

The demodulator gain for the weather band mode is set by the Bits 71 and 72.

Demodulator Gain in Weather Band Mode	Bit 72	Bit 71
5 ×	0	0
10 ×	0	1
20 ×	1	0
50 ×	1	1

For soft mute, the MPX signal level will be reduced depending on the input signal strength. Bits 68 to 70 set the input signal field strength, at which the MPX signal will be reduced by 3 dB (for soft mute). The absolute value depends on the IF-gain Bit 89 – 91.

Start Soft Mute	Bit 70	Bit 69	Bit 68
at low fieldstrength	0	0	0
	0	0	1
	0	1	0
	0	1	1
	1	0	0
	1	0	1
	1	1	0
at high fieldstrength	1	1	1

Bit 67 sets the maximum reduction of the MPX signal level.

Max Value of Soft Mute	Bit 67
30 dB	0
26 dB	1

Temperature coefficient setting of FM IF amplifier.

Temperature Coefficient (TC) of the IF amplifier	Bit 66
TK 1	0
TK 2	1

Level Control of the FM AGC threshold.

FM AGC Threshold	Bit 65	Bit 64
103 dBµV	0	0
97 dBµV	0	1
92 dBµV	1	0
85 dBµV	1	1

Level Control of the AM AGC threshold.

AM AGC Threshold	Bit 63	Bit 62
102 dBµV	0	0
105 dBµV	0	1
107 dBµV	1	0
108 dBµV	1	1

Bits 60 and 61 control the bandwidth of the 2nd mixer output tank, in FM mode.

FM Bandwidth Mixer 2	Bit 61	Bit 60
150 kHz	0	0
200 kHz	0	1
250 kHz	1	0
450 kHz	1	1

Setting of the center frequency of the integrated FM band filter and demodulator.

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

Function of Pin 20 setting is done by Bit 55.

Pin 21: IF out/ Field Strength for Multipath	Bit 55
2nd IF output	0
Multipath field strength	1

Setting Bit 54 = 1 enables the use of an additional external band filter (Pin 23/24 to Pin 28), in FM mode.

2nd IF Filter	Bit 54
Internal filter	0
External and internal filter	1

Setting Bit 53 activates the automatic demodulator fine tuning which is used in weatherband mode. In FM the default setting is B53 = 1.

Demodulator Fine Adjust	Bit 53
Fine tuning ON	0
Fine tuning OFF	1

The bit 52 is not used.

Setting of the center frequency-offset of the integrated FM band filter.

If Bit 4 = 0 the default setting (0 kHz) is used.

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
– 8.75 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
+ 8.75 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

Setting of the bandwidth of the adjacent channel detector filter.

If Bit 4 = 0 the default setting (76 kHz) is used.

IF Correction	Bit 13	Bit 12	Bit 11	Bit 10
3 kHz	0	0	0	0
46 kHz	0	0	0	1
17.5 kHz	0	0	1	0
60 kHz	0	0	1	1
31 kHz	0	1	0	0
76 kHz (default)	0	1	0	1
54 kHz	0	1	1	0
90 kHz	0	1	1	1
61 kHz	1	0	0	0
106 kHz	1	0	0	1
76 kHz	1	0	1	0
120 kHz	1	0	1	1
90 kHz	1	1	0	0
136 kHz	1	1	0	1
105 kHz	1	1	1	0
151 kHz	1	1	1	1

Setting Bit 9 activates test mode.

Mode	Bit 9
Normal operation	0
Testmode	1

Bit 8 = 0 activates the multipath noise canceller.

Multipath Noise Canceller	Bit 8
Active	0
Not active	1

Bit 7 = 1 mutes the MPX output.

Mute of MPX Output	Bit 7
MPX out, Pin 11	0
Mute MPX	1

Bits 6 and 5 set the center frequency of the adjacent channel sensor.

Center Frequency Adjacent Channel Sensor	Bit 6	Bit 5
450 kHz	0	0
300 kHz	0	1
700 kHz	1	0
Filter off	1	1

Bit 4 = 1 activates bit 10 to bit 17.
If Bit 4 = 0 then the default seting is used.

Activate Bit 10 to Bit 17	Bit 4
Disable Bits 10 to 17	0
Enable Bits 10 to 17	1

Bits 0 to 3 set the band width of the integrated band filter.

IF Band Width	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

Test Circuit

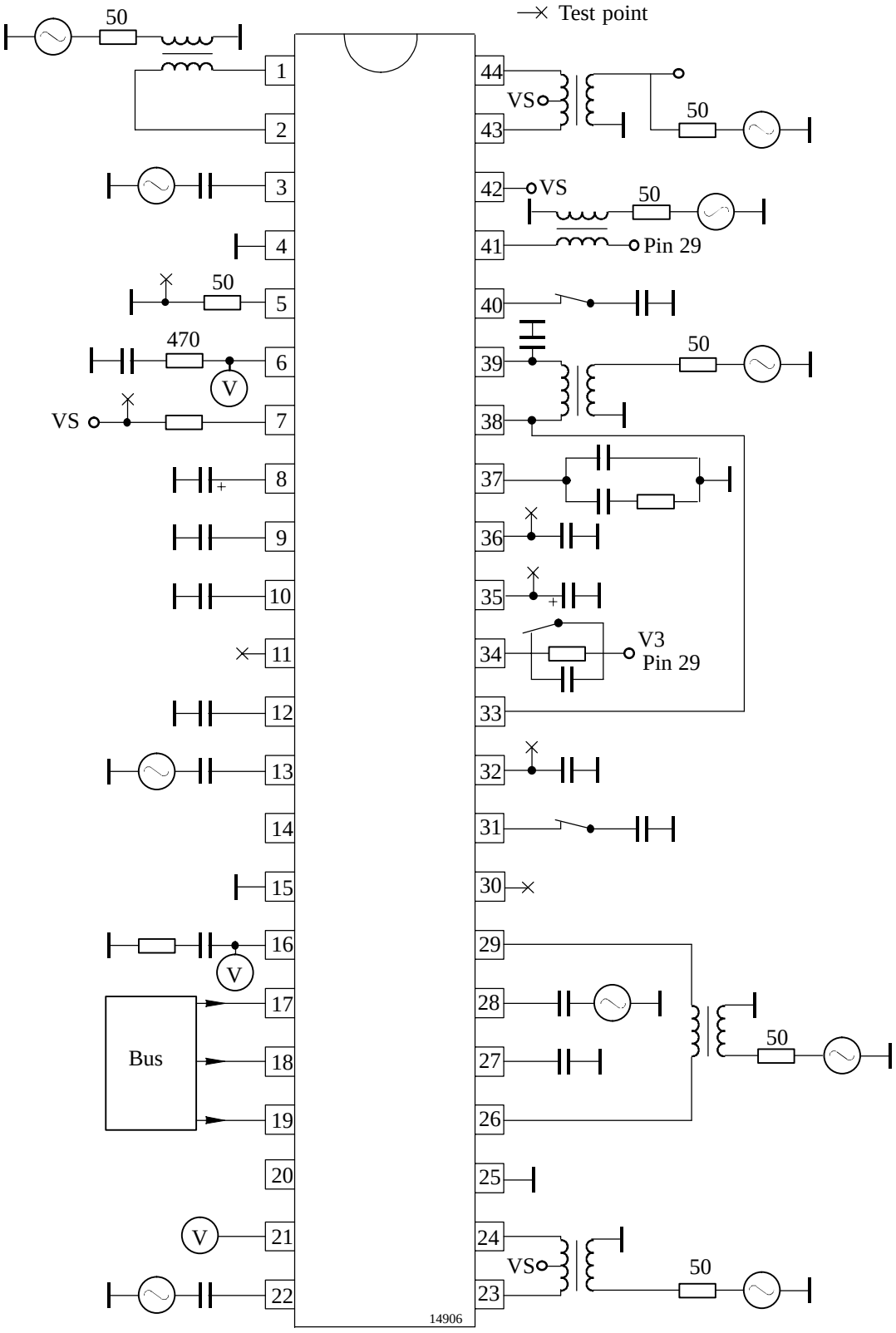


Figure 5. Test circuit

Application Board Schematic

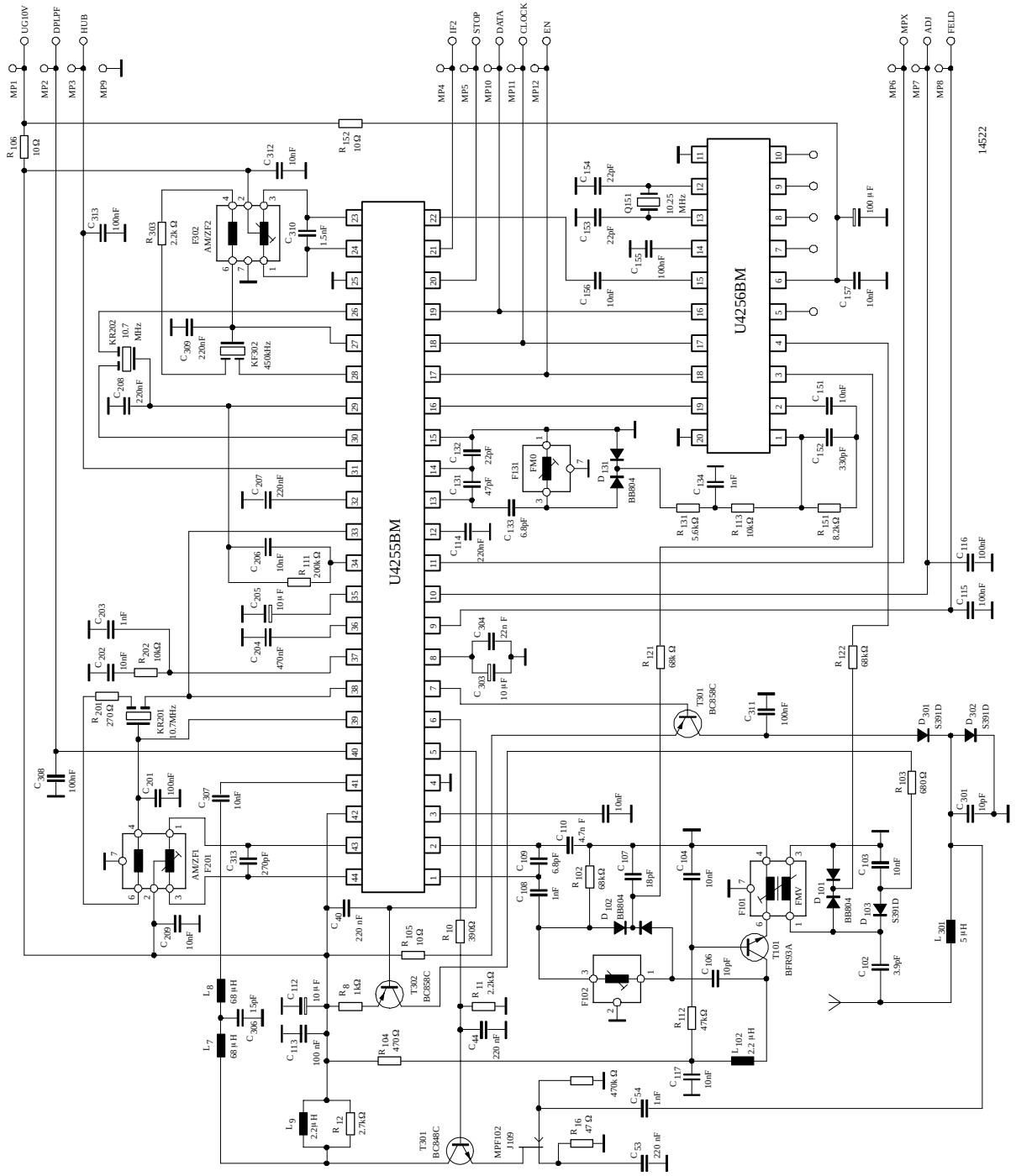
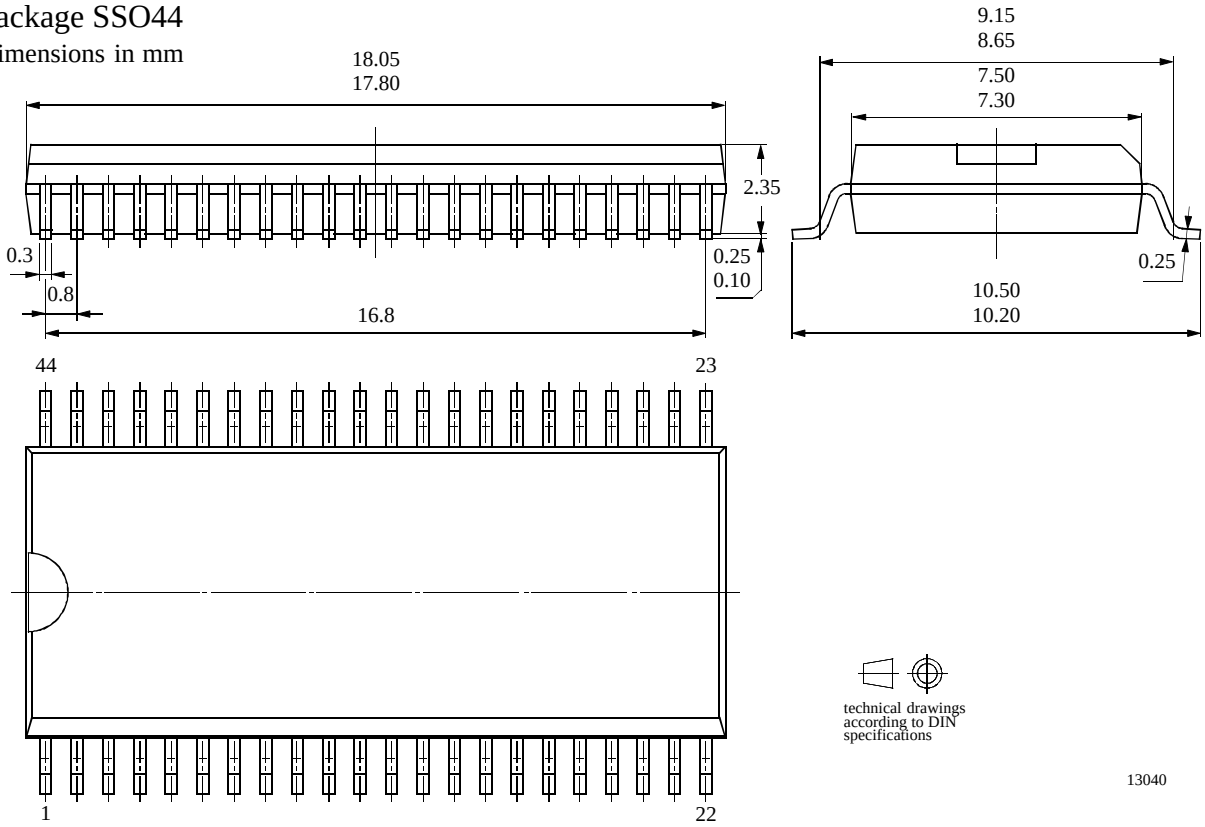


Figure 6. Application board schematic

Package Information

Package SSO44
Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Atmel Germany GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Atmel Germany GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Data sheets can also be retrieved from the Internet: http://www.atmel–wm.com

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