

## 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

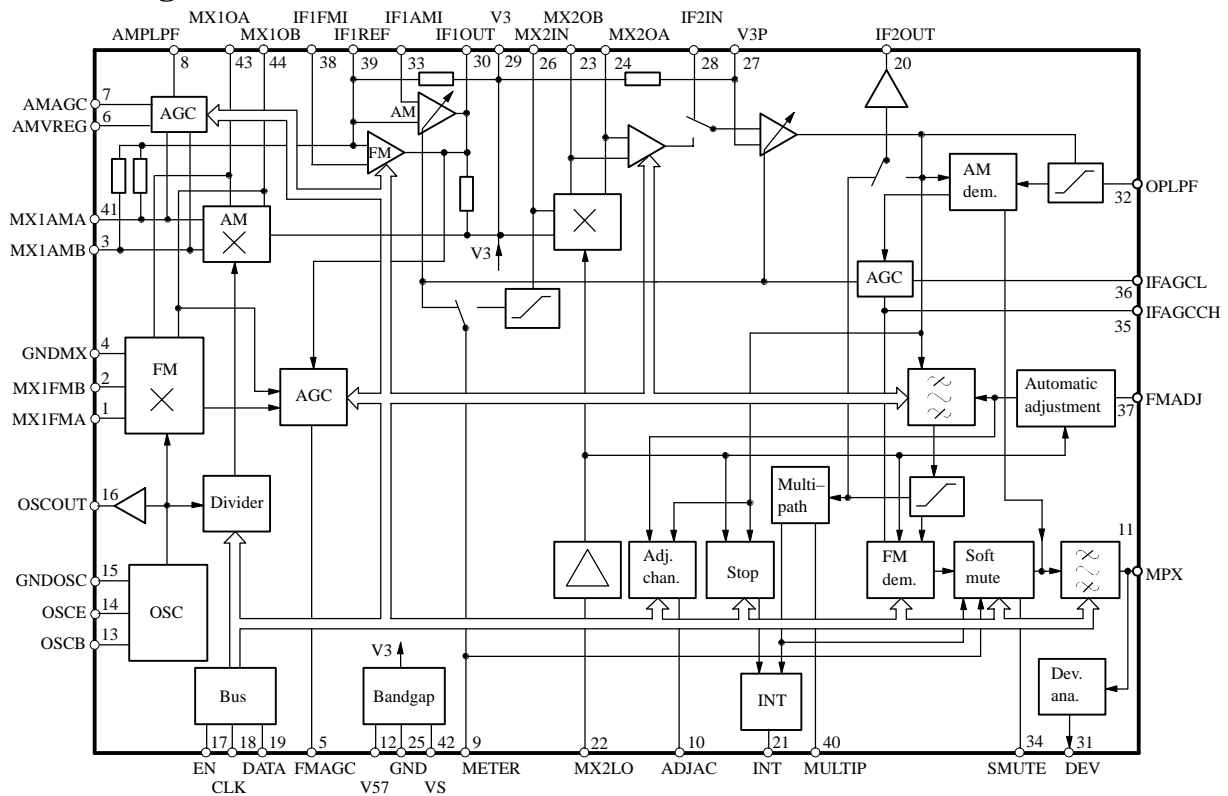


Figure 1. Block diagram

### Ordering Information

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

## Pin Description

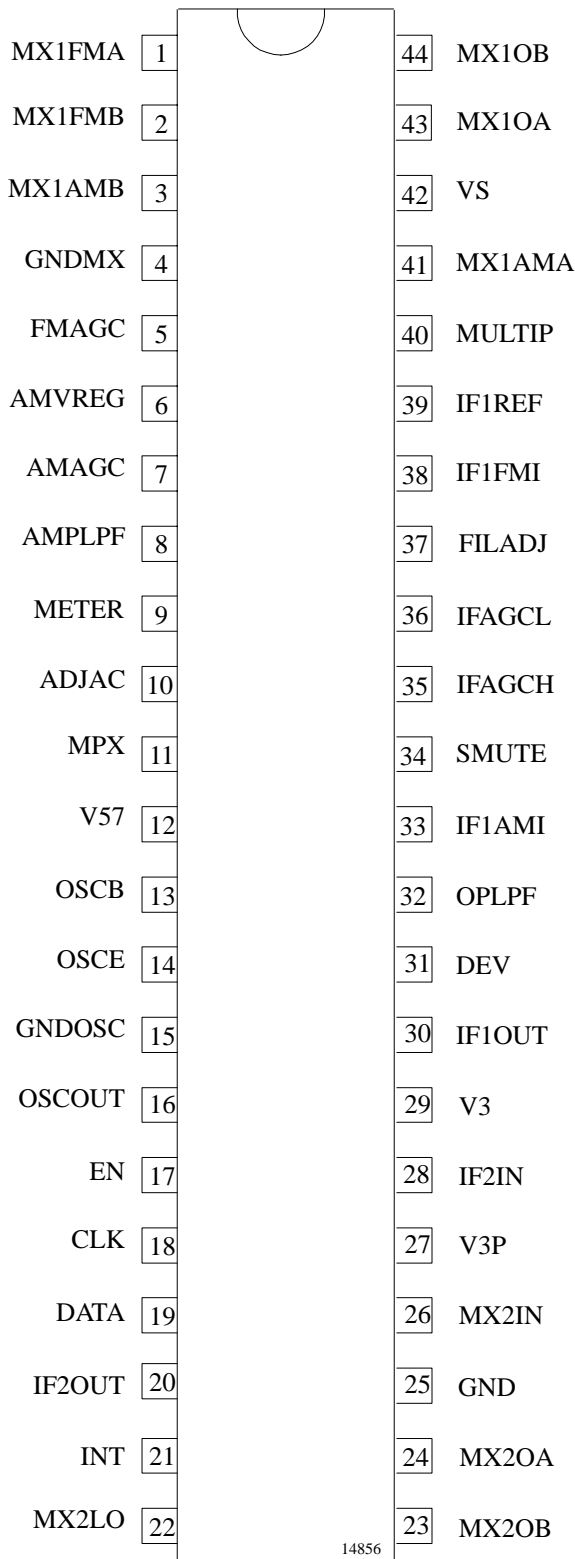


Figure 2. Pinning

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 & MX10OUT 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

## Absolute Maximum Ratings

All voltages are referred to GND (Pin 25)

Parameters	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

Parameters	Symbol	Value	Unit
Junction ambient soldered to PCB	$R_{thJA}$	80	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):  $V_S = 8.5$  V,  $T_{amb} = 25$ °C

For AC parameters:  $f_{iRF} = 100$  MHz,  $R_g = 50$   $\Omega$ ,  $f_{MOD} = 0.4$  kHz,  $\Delta f = \pm 75$  kHz,  $f_{IF} = 450$  kHz, reference point Pin 4

Parameters	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
<b>AM Mixer (10.7 MHz)</b>						
DC supply current				18		mA
Conversion conductance $i_{oif}/v_{iif}$		$S_{m1}$		4.1		mA/v
Maximum IF output	Pins 43 and 44	$v_{oIF}$		8		$v_{DD}$
Third order input intercept point		IP3		133		dB $\mu$ V
Input resistance	Pin 41			2.5		k $\Omega$
<b>AM-1st IF Amplifier (10.7 MHz)</b>						
Input resistance	Pin 33	$R_i$	10			k $\Omega$
1st IF amplifier gain	$R_L = 330$ $\Omega$ Pins 30 to 33	$G$		16		dB
Preamplifier control range				26		dB
<b>Mixer 2 (450 kHz)</b>						
DC supply current				10		mA
Conversion conductance $i_{oif2}/v_{iif1}$		$S_{m2}$		2		mA/v
Maximum IF output	Pins 23 and 24	$v_{oIF}$		8		$v_{DD}$
Output impedance		$R_o$ $C_o$		1 3		M $\Omega$ pF
Third order input intercept point		IP3		133		dB $\mu$ V
Input resistance		$R_i$		330		$\Omega$

## Electrical Characteristics (continued)

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

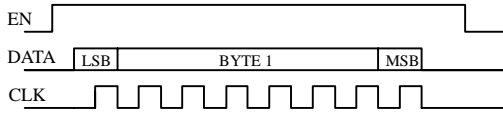
For AC parameters:  $f_{\text{RF}} = 100\text{ MHz}$ ,  $R_g = 50\ \Omega$ ,  $f_{\text{MOD}} = 0.4\text{ kHz}$ ,  $\Delta f = \pm 75\text{ kHz}$ ,  $f_{\text{IF}} = 450\text{ kHz}$ , reference point Pin 4

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>2nd IF Amplifier (450 kHz)</b>						
Input resistance	Pin 28	$R_i$		3		$\text{k}\Omega$
IF preamplifier gain	Pins 28 to 20	G		43		dB
Preamplifier control range				37		dB
<b>Oscillator (Pin 15, GND, connected to external oscillator components)</b>						
Oscillator range	$R_g$ (Pin 13) = $220\ \Omega$ , Q of $\text{Losc} = 70$ , $\text{RL1} = 520\ \Omega$	VLOB VLOE VLObuf	70	160 100 90	220	mV mV mV
Frequency range		$f_{\text{OSC}}$	70		160	MHz
Harmonics	Pin16				-15	dBc
Output resistance	Pin 16	$R_{\text{LO}}$		70		$\Omega$
<b>FM Mixer</b>						
Third order intercept point	Load impedance: $R_{\text{L43,44}} = 200\ \Omega$	IP3		120		$\text{dB}\mu\text{V}$
Conversion transconductance		$g_c$		7		$\text{mA/v}$
Noise figure		$\text{NF}_{\text{dsb}}$		10		dB
Input resistance	Pins 1 to 2	$R_{i1,2}$		1.6		$\text{k}\Omega$
Input capacitance	Pins 1 to 2	$C_{i1,2}$		5		pF
Input 1 resistance to ground	$f = 100\text{ MHz}$ Pin 1	$R_{i1}$		1.2		$\text{k}\Omega$
Input 1 capacitance to ground	$f = 100\text{ MHz}$ Pin 1	$C_{i1}$		9		pF
Input 2 resistance to ground	$f = 100\text{ MHz}$ Pin 2	$R_{i2}$		1.6		$\text{k}\Omega$
Input 2 capacitance to ground	$f = 100\text{ MHz}$ Pin 2	$C_{i2}$		7		pF
Output capacitance to GND	Pins 43, 44	$C_{o43, o44}$		5		pF
<b>1st IF FM Amplifier</b>						
Digitally adjustable gain	3 bit, 10.7 MHz	$G_{\text{min}}$ $G_{\text{max}}$		19 30		dB dB
Input resistance	Pin 38	$R_{i38}$		330		$\Omega$
Output resistance	Pin 30	$R_{o30}$		330		$\Omega$
Temperature coefficient of the gain at $G_{\text{min}}$	$G_{\text{min}}$ , Bit 66 = 0	$\text{TK}_{\text{min}}$		0.044		dB/K
Temperature coefficient of the gain at $G_{\text{max}}$	$G_{\text{max}}$ , Bit 66 = 1	$\text{TK}_{\text{max}}$		0.039		dB/K
<b>FM Demodulator (Pin 11)</b>						
Output voltage	$V_{\text{iPin 23, 24}} = 40\text{ mV}$ $f = 450\text{ kHz}$ Deviation = $\pm 22.5\text{ kHz}$ , $f_{\text{MOD}} = 1\text{ kHz}$	$V_{\text{MPX}}$		140		mV
Total distortion	Bandwidth 2nd IF filter = $120\text{ kHz}$ , deviation = $75\text{ kHz}$			0.3		%

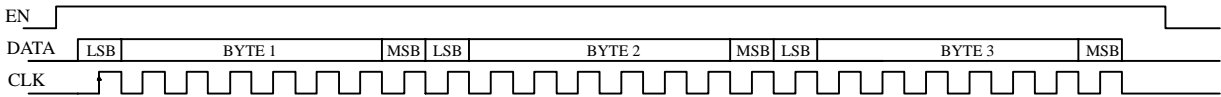
## 3-Wire Bus Description

8-bit command

14857



24-bit command



e.g., R-Divider

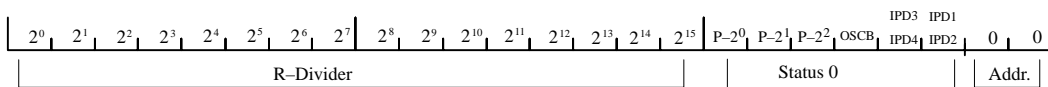


Figure 3. Pulse diagram

## 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																																						
			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

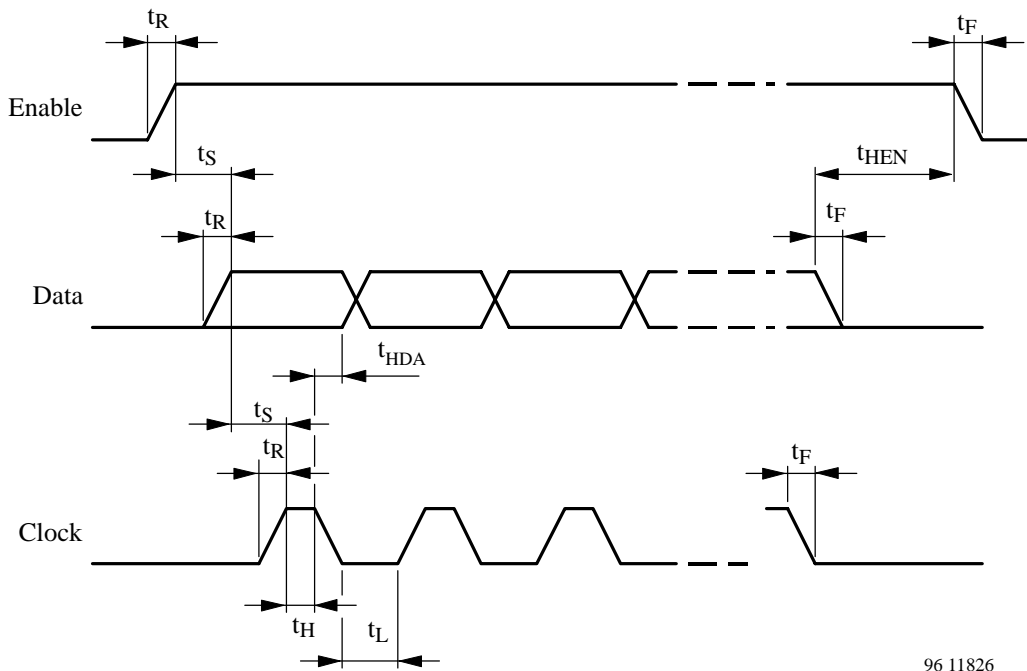


Figure 4. Bus timing

96 11826

## 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 88 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		0	0	0
Divide by 6	1	0		0	0	1
Divide by 7	1	0		0	1	0
Divide by 8	1	0		1	0	0
Divide by 4	1	0		1	0	1

In FM mode and in weather band mode (bit 92), the Bits 81 to 83 set the divide factor at the prescaler

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
Low field strength (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 which 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
$1 \times 3.1969$ ms	0	0	0	0	0	1
.....						
$64 \times 3.1969$ 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
$5 \times$	0	0
$10 \times$	0	1
$20 \times$	1	0
$50 \times$	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 dB $\mu$ V	0	0
97 dB $\mu$ V	1	0
92 dB $\mu$ V	0	1
85 dB $\mu$ V	1	1

### Level Control of the AM AGC threshold

AM AGC Threshold	Bit 63	Bit 62
102 dB $\mu$ V	0	0
105 dB $\mu$ V	1	0
107 dB $\mu$ V	0	1
108 dB $\mu$ V	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	1	0
250 kHz	0	1
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

The Bits 52 and 53 are not used.



**Test Circuit**

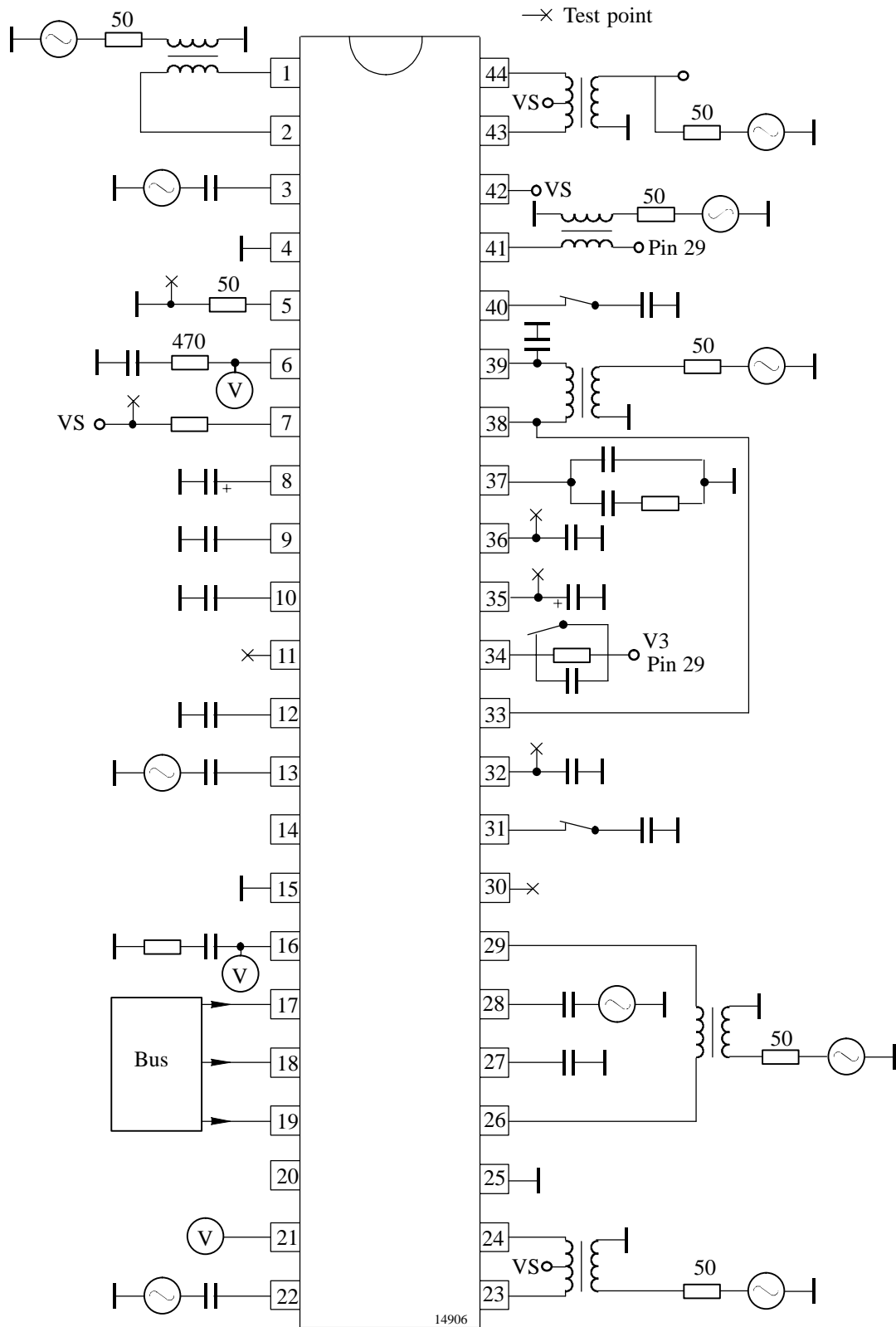


Figure 5. Test circuit

## Application Board Schematic

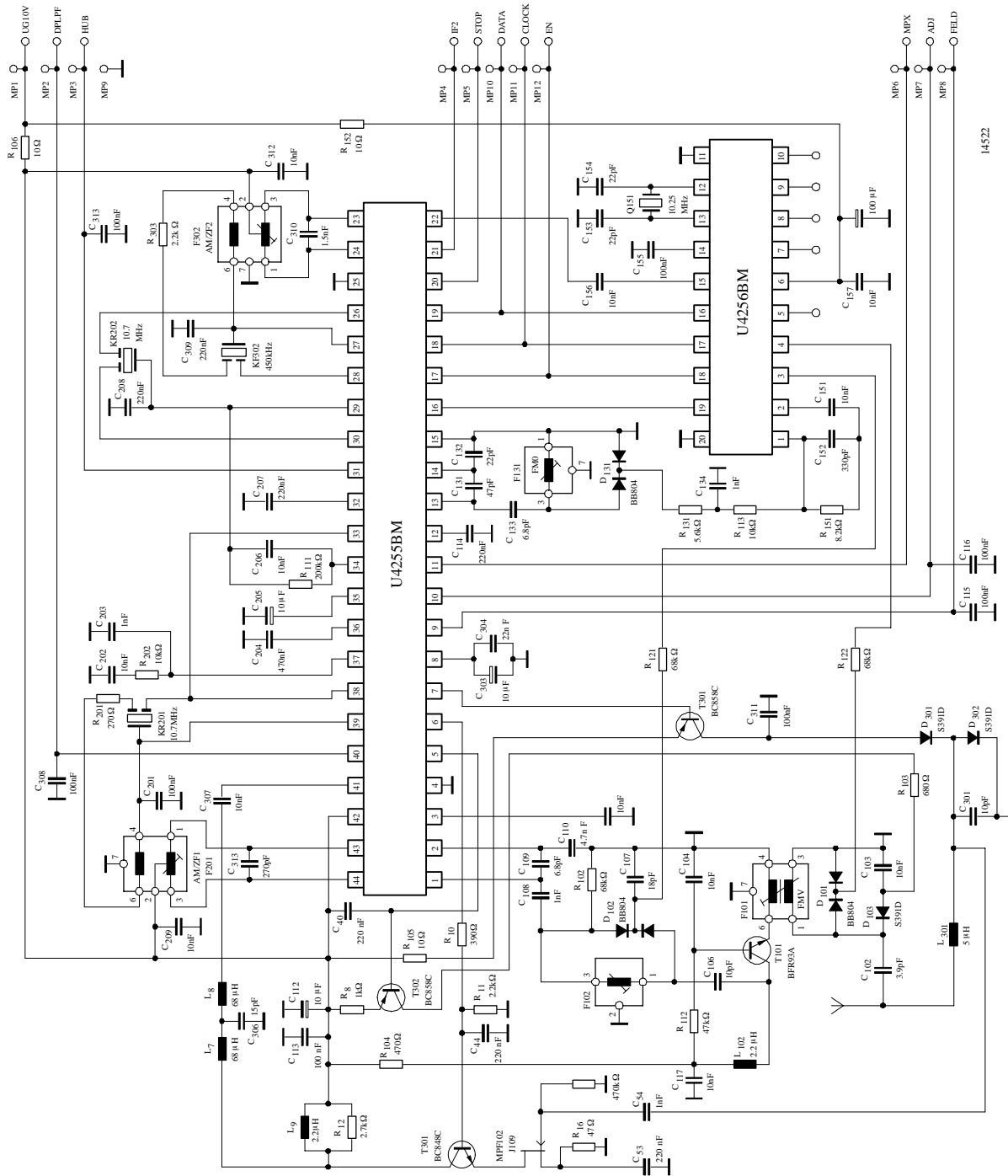
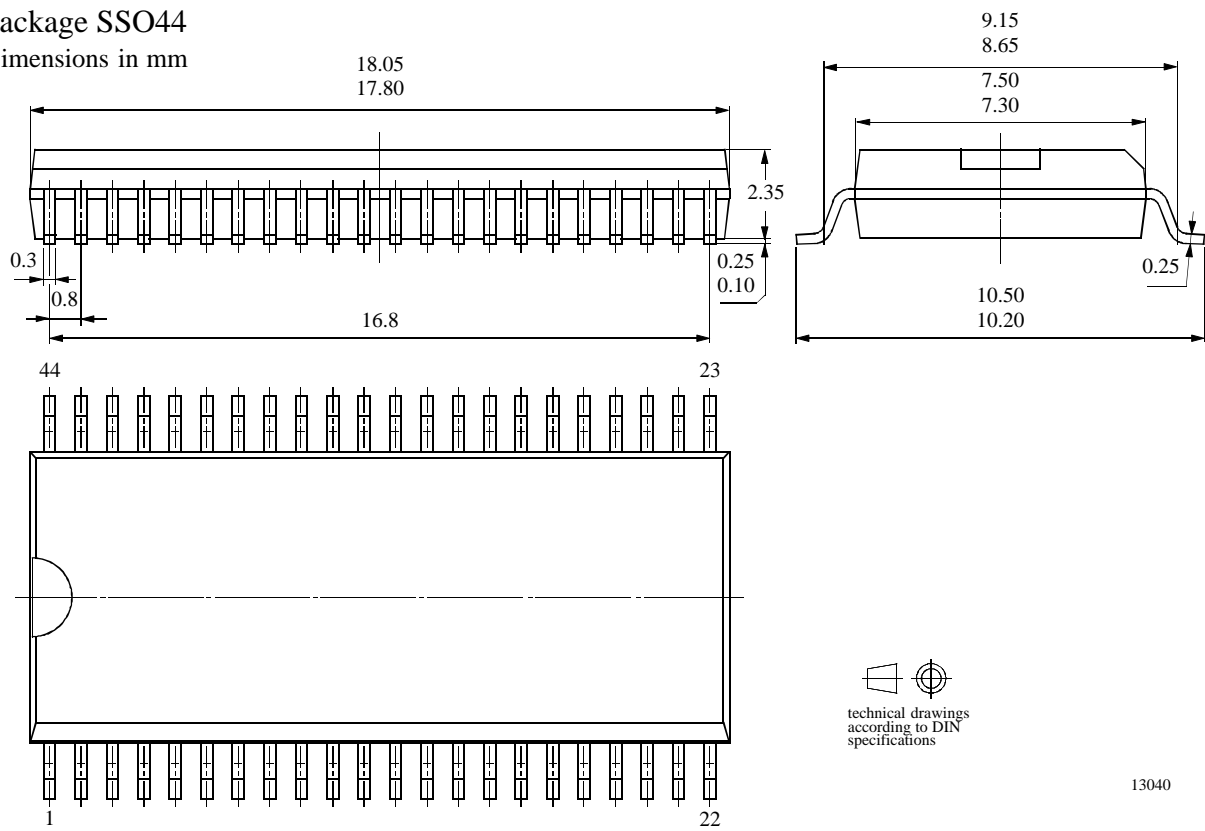



Figure 6. Application board schematic

**Package Information**

Package SSO44

Dimensions in mm



  
technical drawings  
according to DIN  
specifications

13040

## Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC Semiconductor 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.

**TEMIC Semiconductor 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.

**TEMIC Semiconductor GmbH** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

**We reserve the right to make changes to improve technical design and may do so without further notice.**

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**Data sheets can also be retrieved from the Internet: <http://www.temic-semi.com>**

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