

FM-Receiving Condition Analyser and Multipath Noise Cancellation

Description

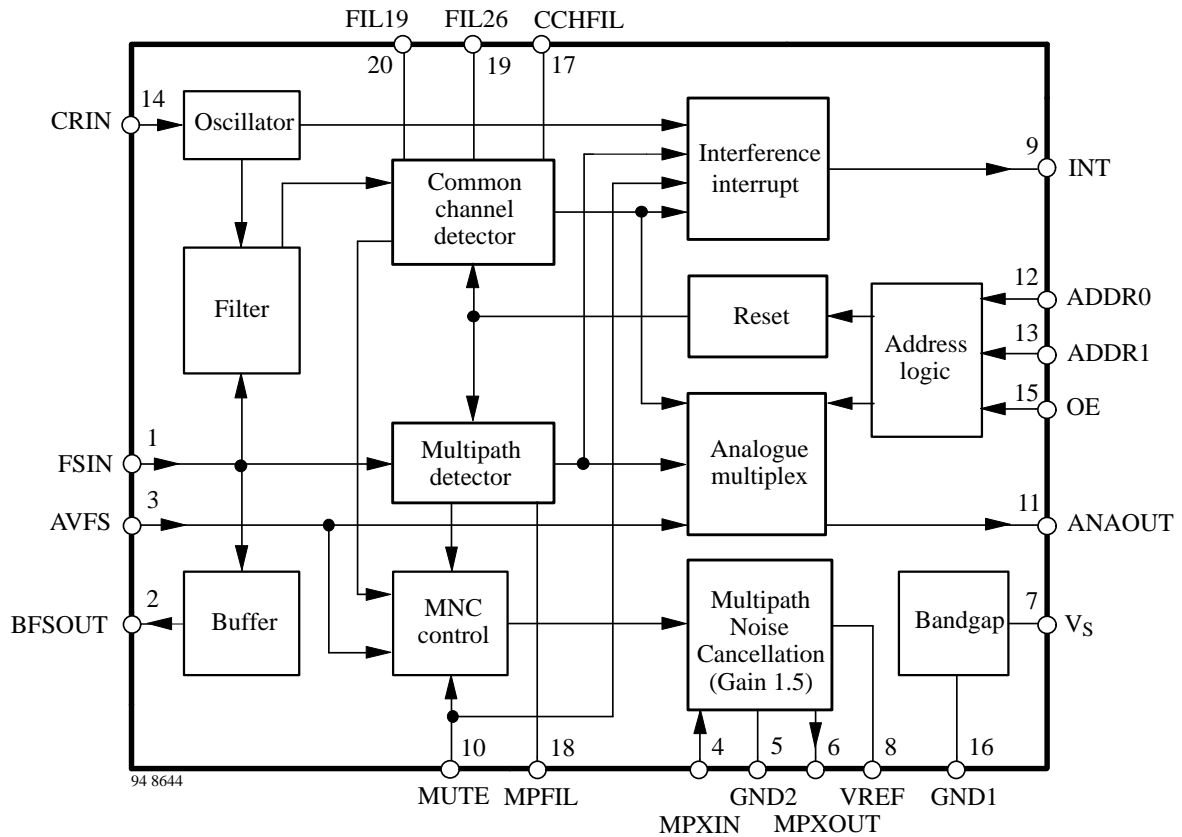
The U4275B is a bipolar integrated receiving conditions analyser as well as multipath noise cancellation circuit.

It is designed for high performance car radio applications.

Features

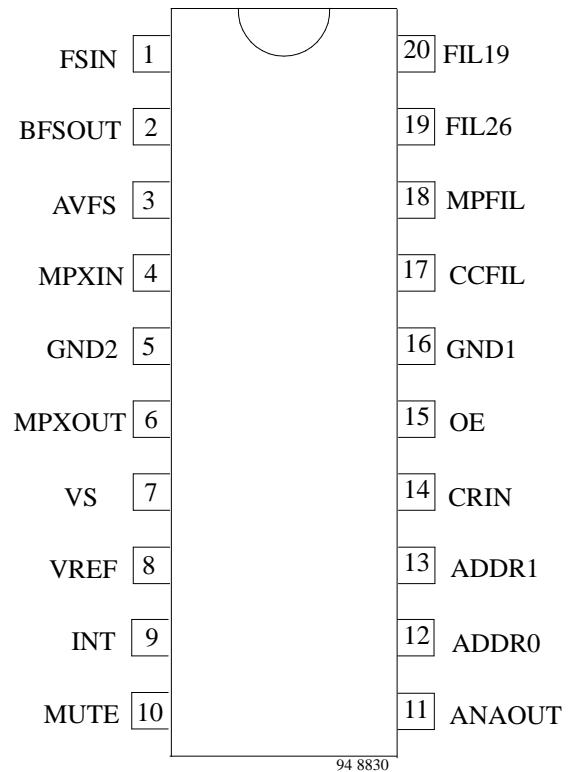
- Preparation of the fieldstrength signal
- Detection of multipath and common channel interferences
- Evaluation of the receiving conditions by microcomputer
- Interrupt output for abruptly occurring interferences
- Suitable for analogue as well as digital processing
- Mute function controllable by microcomputer
- Multipath noise cancellation
- Only a few external components necessary

Block diagram

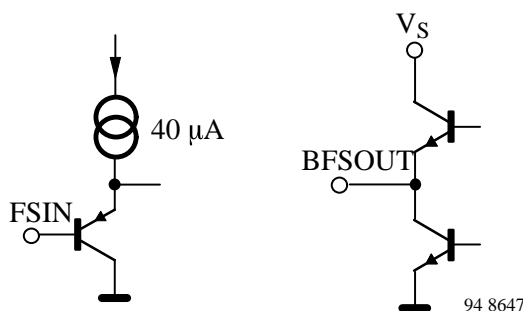


Pin description

Pin	Symbol	Function
1	FSIN	Fieldstrength input
2	BFSOUT	Buffered fieldstrength output
3	AVFS	Average of fieldstrength signal
4	MPXIN	Multiplex input signal
5	GND2	Analogue ground
6	MPXOUT	Multiplex output signal
7	VS	Supply voltage
8	VREF	Reference voltage
9	INT	Interrupt output
10	MUTE	External mute input
11	ANAOUT	Analogue multiplex output
12	ADDR0	Address 0 for analogue multiplexer
13	ADDR1	Address 1 for analogue multiplexer
14	CRIN	Ceramic resonator input (456 kHz)
15	OE	Output enable for ANAOUT
16	GND1	Ground
17	CCFIL	Filter for common channel detection
18	MPFIL	Filter for multipath detection
19	FIL26	Filter for 26 kHz detection
20	FIL19	Filter for 19 kHz-Pilot detection

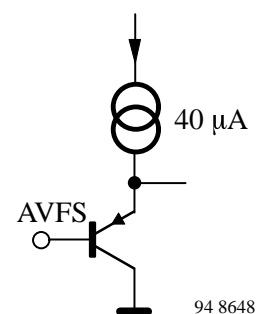


FSIN / BFSOUT



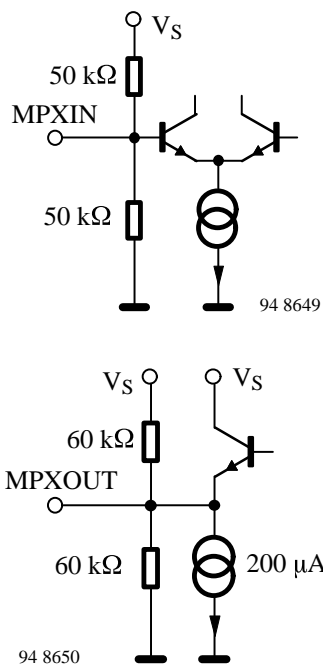
All information about reception conditions is derived from the fieldstrength voltage. The fieldstrength voltage at FSIN is initially buffered so as not to impair the characteristics of the IF IC and is available at BFSOUT.

AVFS



The fieldstrength signal at buffer output BFSOUT is averaged over time and applied to input AVFS via an RC low-pass filter with a large time constant.

MPXIN / MPXOUT

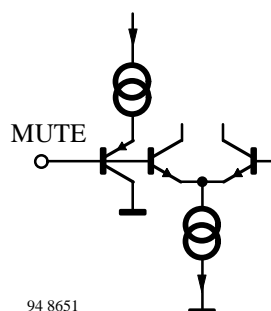


The MPX signal is fed directly from the FM demodulator to input MPXIN and is available amplified by a factor of 1.5 at MPXOUT. The MPX signal is blanked out in the event of multipath interference or when MUTE is activated externally in the circuit part MNC (Multipath Noise Canceller). In all other cases, the MPX signal passes through the IC unchanged.

GND2

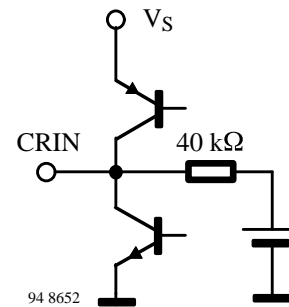
GND2 is the reference potential for the MPX signal. GND2 should be connected directly with the ground terminal of the IF FM demodulator to ensure a high signal-to-noise ratio of the MPX signal.

MUTE



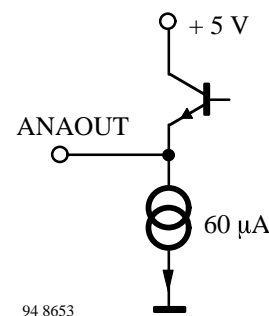
The function unit MNC can be controlled externally via this pin. Blanking occurs when the voltage at the MUTE pin falls below 1 V. A voltage in the range $V_S/2 > 1$ V defines the switching threshold as from which multipath interference is signalled at pin INT.

CRIN



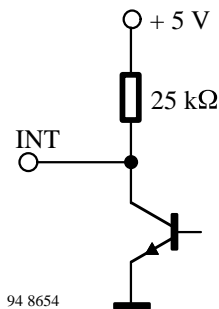
The internal one-pin oscillator is connected to CRIN with a 456 kHz ceramic resonator. The 456 kHz reference frequency is used for calibrating the filters and generating pulses at INT.

ANAOUT



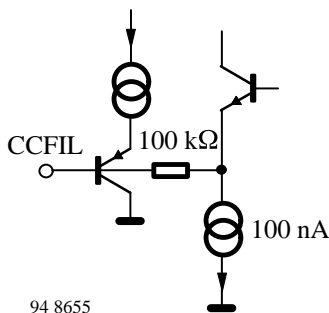
Analyzer output. DC values are available at this pin that characterize the respective reception situation. The output voltage is limited to max. 5 V. ANAOUT is a multiplex output, i.e. the value for the fieldstrength, level of multipath interference or level of common channel interference is applied to this output depending on addressing. ANAOUT can be switched to the high-impedance state by means of OE.

INT



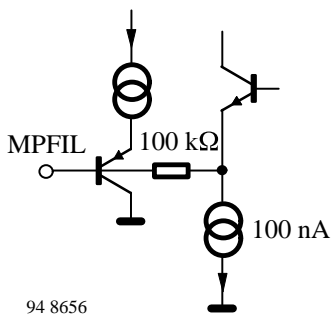
Certain types of abruptly occurring interference with reception require a fast reaction by the receiver. INT signals such events to other circuit parts by means of 40- μ s-wide pulses (low active). The output voltage is limited to 5 V to permit direct activation of a system controller. A monoblock function can thus be activated on simple receivers. On antenna-diversity receivers, INT can activate switchover between antennas.

CCFIL



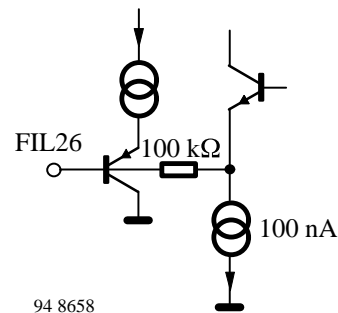
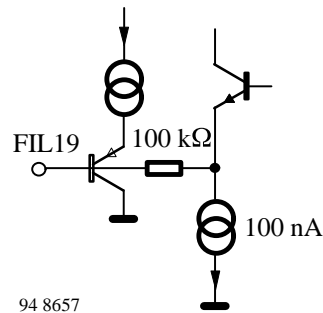
The controller element detects the absolute value of occurring common channel interference. This information is stored in a capacitor which must be connected externally to CGFIL. The capacitor voltage can be selected by the system controller and then available via ANAOUT.

MPFIL



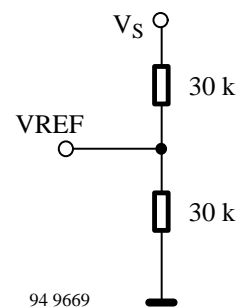
The controller element detects the absolute value of occurring multipath interference. This information is stored in a capacitor which must be connected externally to MPFIL. The capacitor voltage can be interrogated by the system controller via ANAOUT.

FIL19 / FIL26



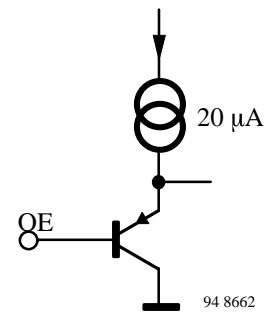
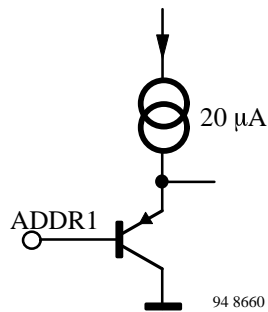
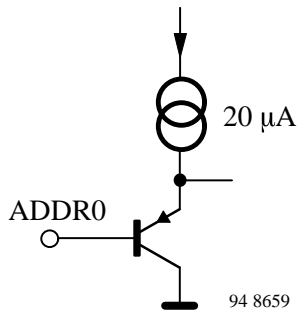
In order to differentiate the various types of interference, the amplitudes of a few spectral components of the fieldstrength signal are determined and filtered in FIL19 and FIL26 for further processing.

VREF



IF Mute is activated, the reference voltage VREF will apply to the output MPXOUT. A capacitor of 100 nF should be connected at VREF for filtering.

ADDR0 / ADDR1 / OE



The desired output variable at ANAOUT is selected via the address lines ADDR0 and ADDR1 and switched to the output via the enable input OE. The following assignment applies:

No	OE	ADDR1	ADDR0	ANAOUT
0	L	L	L	Internal reference voltage Additional reset of the analog voltages for signal level, multipath, common channel
1	L	L	H	Signal level
2	L	H	L	Multipath
3	L	H	H	Common channel
4	H	X	X	High impedance off-state

Functional description

Interference with FM reception can be triggered by various causes, such as multipath reception, adjacent and insufficient field strength. At the same time, multipath reception is responsible for the most frequently occurring types of interference. In order to suppress this interference systematically, it is first necessary to analyze the received signal so that it is possible to derive the type of interference at any time. The circuit U4275B analyzes the FM reception conditions and makes the data available. This data can be requested by a system controller and evaluated (see figure 1). It is thus possible to introduce measures for optimizing reception – possibly tailored to individual types of interference.

Acoustically relevant multipath interference, since it requires a short reaction time, is suppressed directly by the circuit via a Multipath Noise Cancellation (MNC) function.

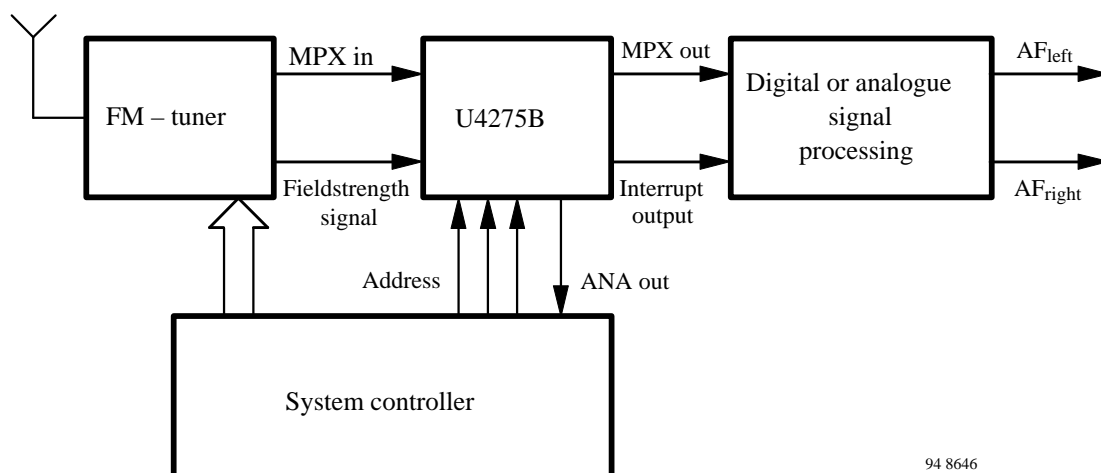
The U4275B can be used both in conventional receivers and in receivers with digital signal processing. Furthermore, it is designed so that it can activate switchover between antennas on antenna-diversity receivers. The integrated circuit can be connected in cascade without much wiring for tuner-diversity receivers.

The field strength voltage of the IF amplifier provides all the information about the reception conditions. The following demands are placed on the field strength output of the IF amplifier:

- (1) A linear characteristic, i.e. the output voltage must be proportional to the logarithm of the IF voltage in the range of RF levels encountered in practice. Deviations from linearity lead to a different evaluation of interference signals of the same intensity of the signal levels are different.
- (2) The “signal level” output has to react to extremely fast dips in the field strength. Total field strength failures lasting 500 ns and occurring a voltage dip to approx. 0 V at the field strength output.

Restrictions

The field strength voltage becomes increasingly noisy in the range of low RF levels (< 30 dB μ V). The noise prevents reliable detection of interference. Therefore, only the average field strength value can be evaluated over a relatively large time constant in this range. The pilot signal component in the receive signal is an important basis for quality assessment. Multipath detection and common channel detection therefore function only in the case of stereo transmitters.



94 8646

Figure 1 Block diagram

Multipath detector

Typical multipath interference is characterized by fast, modulation-dependent field strength dips, as shown in figure 2. The multipath detector detects these field strength dips and evaluates them in accordance with the level of anticipated acoustic interference.

In the case of acoustically relevant interference, it operates the interrupt output INT and the MNC function as a reaction to the interference. If the acoustic effects of interference can be reduced by monobland, only pulses will appear at output INT. In the case of stronger interference, interference suppression takes place by means of the Multipath Noise Cancellation (MNC) function. The multipath interference also generates a voltage proportional to the interference level at MPFIL. The capacitor connected there is responsible for storing the information to give the system controller sufficient time to read out the value at ANAOUT. The capacitor at MPFIL is discharged again slowly with a long time constant. The corresponding addressing at ADDR0, ADDR1 and OE to permit a rapid assessment when the station is changed.

Multipath Noise Cancellation (MNC)

Extremely strong multipath interference remains audible in spite of the monobland function. The remaining interference is reduced still further by the MNC circuit if the output MPXOUT is connected to a reference voltage for a few microseconds while the interference is still occurring.

In order to eliminate the possibility of malfunctions, activation of the MNC depends on the following conditions:

- The average field strength must exceed a certain value so that the noise in the field strength

signal does not cause the MNC to respond at low RF voltages and

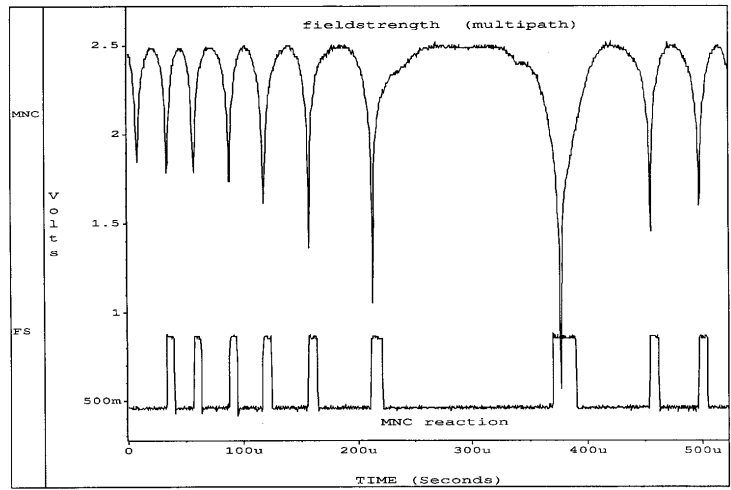
- the field strength dip must not be caused by adjacent-channel interference. Blanking will otherwise make the modulation of the adjacent channel audibly. The information for this purpose is derived from the common channel detector.

The MNC function can also be activated externally via the MUTE pin (low active). The circuit can therefore also be used as a fast high performance mute stage.

Common channel detector

The common channel detector evaluates the spectral composition of the field strength signal to distinguish common channel interference from other types of interference. This is a particularly difficult task, since weak multipath interference results in a spectrum of the field strength signal that is similar to that of common channel interference. The pilot signal portion of the field strength signal serves as a reference variable to permit a clear distinction to be made. A voltage proportional to the interference is generated at the filter input CCFIL in the case of common channel interference. The external capacitor is responsible for storing the information to give the system controller sufficient time to read out the value at ANAOUT. The capacitor is discharged again slowly at CCFIL, with a long time constant. The capacitor can also be discharged rapidly via corresponding addressment when stations are changed.

The common channel detector is blocked for further 20 ms after the detectors are reset to prevent transitory phenomena in the selective filters from causing an indicating error.



94 8663

Figure 2

Absolute maximum ratings

Reference point Pin 1b, unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage Pin 7	V_S	10	V
Supply current Pin 7	I_S	t.b.d.	mA
Ambient temperature range	T_{amb}	- 30 to + 85	°C
Storage temperature range	T_{stg}	t.b.d.	°C
Junction temperature	T_j	t.b.d.	°C
Electrostatic handling (MIL standard 883 C)	$\pm V_{ESD}$	2000	V

Thermal resistance

Parameters	Symbol	Maximum	Unit
Junction ambient	R_{thJA}	t.b.d.	K/W

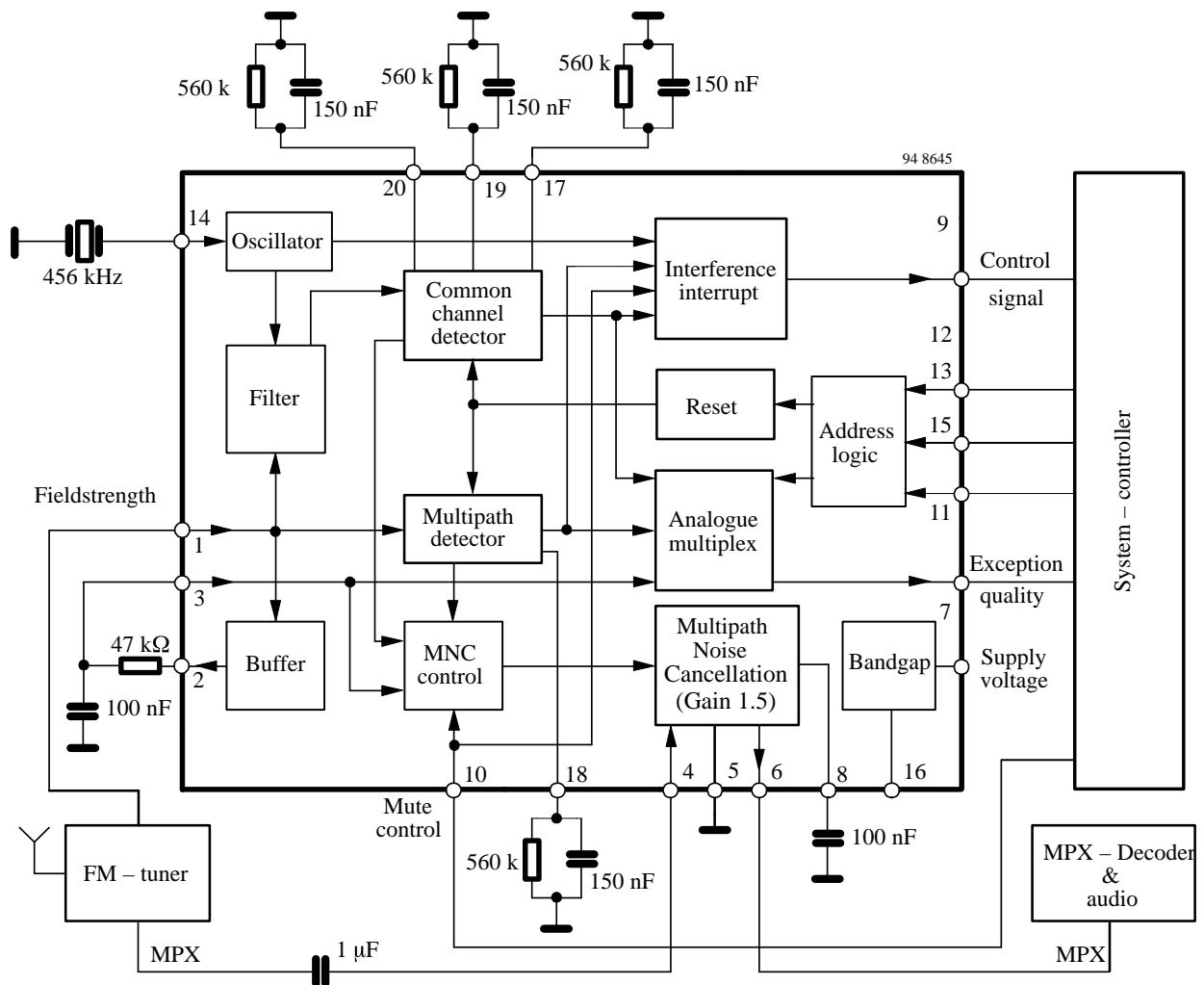
Electrical characteristics

$T_{amb} = 25^\circ\text{C}$, $V_S = 8.5\text{ V}$, unless otherwise specified

Parameters	Test conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Pin 7	V_S	8	8.5	10	V
Supply current	Pin 7	I_S	6	8	10	mA
Fieldstrength						
Input voltage	Pin 1	V_i	0		5.0	V
Output voltage	R_{load} C_{load} Pin 2	V_{out}	50		5000	mV
Bandwidth	Pin 2	BW	100			KHz
Input voltage	Pin 3	V	0		5	V
Multipath Noise Cancellation						
MPX input voltage	Pin 4	V_{MPXIN}			350	V_{RMS}
MPX output voltage	$R_L = 10\text{ k}\Omega$ Pin 6	V_{MPXOUT}			525	V_{RMS}
THD	$R_L = 10\text{ k}\Omega$ Pin 6 $V_{MPXIN} = 350\text{ mV}$			0.06	0.2	%
Bandwidth	$R_L = 10\text{ k}\Omega$ Pin 6		100			kHz
Noise figure						
Mute-depth	$R_L = 10\text{ k}\Omega$ Pin 6		75	82		dB
Gain	$R_L = 10\text{ k}\Omega$ Pin 6	G		3.5		dB
Address logic						
Input voltage low high	Pins 12, 13 and 15	V_{IN}	0 3		1 V_S	V
Input current low high	Pin 12	I_{IN}			1 0.5	μA μA

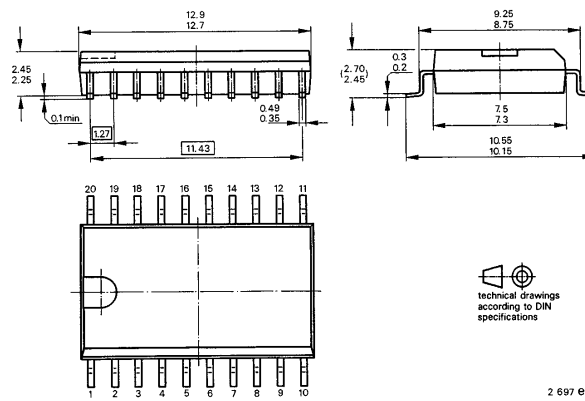
Parameters	Test conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Interrupt output INT						
Output voltage low high	$R_L = \infty$ Pin 9	V_{INT}	0 4.75		0.3 5.25	V V
Reference voltage VREF						
Output voltage	Pin 8	VREF		$V_S/2$		V
Analog multiplex output						
Output voltage	$R_L = 10\text{ k}\Omega$ Pin 11	V_{ANA}	0.200		5.2	V
Oscillator						
Input voltage	Pin 14	V_{OSC}	50			mV _{RMS}
Mute						
Input voltage low high	Pin 10	V_{MUTE}	0 3		1 V_S	V

Application circuit



Extended type number	Package	Remarks
U4275B-AFL	SO 20 plastic	
U4275B-AFLG3	SO 20 plastic	Taping according to IEC-286-3

Dimensions in mm



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

The Montreal Protocol (1987) and its London Amendments (1990) will soon 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.

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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 and
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