

AM/FM Receiver / Digital Tuning and FM-Stereo Decoder

Description

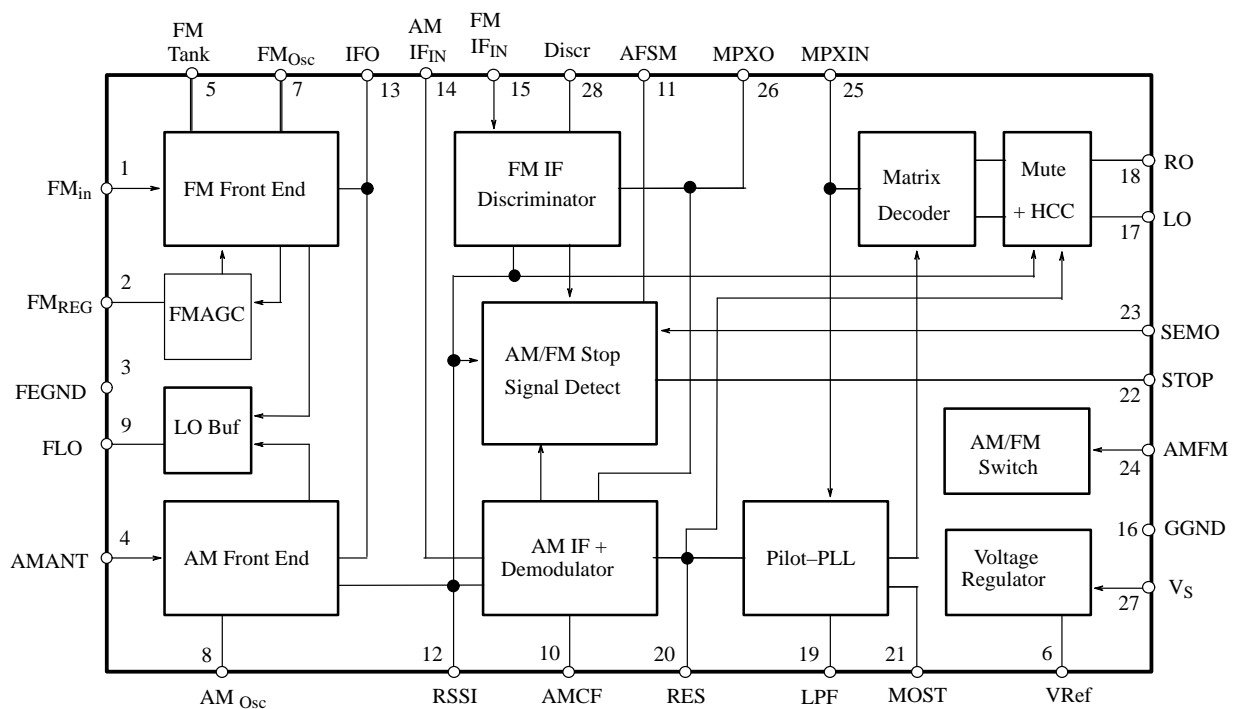
The U2514B is an integrated bipolar radio suitable for digital tuning systems. It contains a FM front-end with preamplifier and FM-stereo-decoder as well as a complete AM receiver and demodulator. Stop-signal

generation is implemented for FM and AM mode. This circuit is designed for use in small radios, power packs and cost effective car radios.

Features

- Integrated stop signal generation with true AM/ FM discriminators
- LO-buffer
- Different stop signal sensitivities
- FM wideband AGC
- Automatic stereo-mono-blend
- High cut
- Mute function
- Pilot canceller
- Supply voltage range 2.7 V to 13.5 V
- Package: SO28

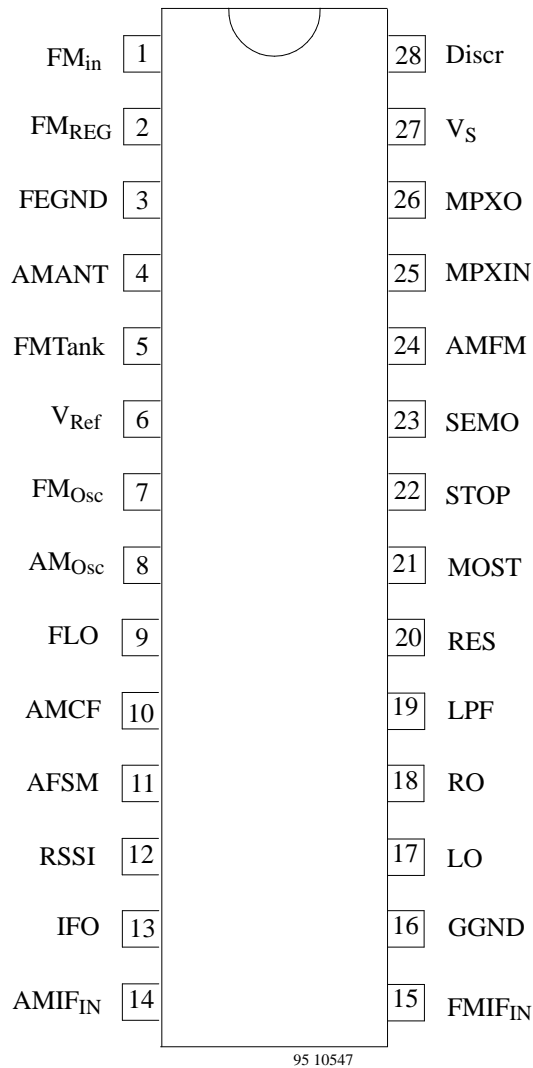
Block Diagram



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Figure 1.

Pin Description



Pin	Symbol	Function
1	FM _{in}	FM antenna input
2	FM _{REG}	Wideband AGC input
3	FEGND	AM/ FM frontend ground
4	AMANT	AM antenna input
5	FMTank	FM tank
6	V _{Ref}	Reference voltage 2.4 V
7	FM _{Osc}	FM oscillator tank
8	AM _{Osc}	AM oscillator tank
9	FLO	Local oscillator output
10	AMC	AM stop signal center frequency
11	AFSM	AF smooth
12	RSSI	Fieldstrength voltage
13	IFO	IF output of both AM and FM tuner
14	AMIF _{IN}	AM IF amplifier input
15	FMIF _{IN}	FM amplifier input
16	GGND	General ground
17	LO	Output left channel
18	RO	Output right channel
19	LPF	Low pass filter for MPX-PLL
20	RES	Resonator 456 kHz
21	MOST	Mono stereo switch
22	STOP	Stop signal output (active low)
23	SEMO	Search mode switch (active low)
24	AMFM	AM/ FM switch
25	MPXIN	MPX input into stereo decoder
26	MPXO	AF and MPX output of both AM and FM IF
27	V _S	Supply voltage
28	Discr	FM discriminator tank

Pin1 FM_{in}

The FM-Input leads to an input transistor in base grounded circuit, which offers low noise and excellent large signal behaviour by itself. The recommended generator impedance is about 100 Ω. This impedance is loaded by the input impedance of the IC (26Ω). In case of large input signals greater than 66dBμV within the bandwidth of the FM tank, the input AC current is bypassed by the additional wide band AGC transistor. The DC current through the amplifying transistor is then reduced. Ground of the input signal should be directly connected to Pin 2 and Pin 3.

Pin2 FM_{REG}

This pin has two different functions. First, it shortens the base of the input transistor to FEGND via an external capacitor (e.g. 100pF with good performance at 100MHz). The further function is smoothing of the AGC signal via an additional external capacitor. The voltage at this pin is reduced if regulation takes place. Thus, externally increasing this voltage to max V_{ref}(2.4V) may completely avoid AGC or reducing this voltage by a resistor to ground may reduce the AGC threshold if required.

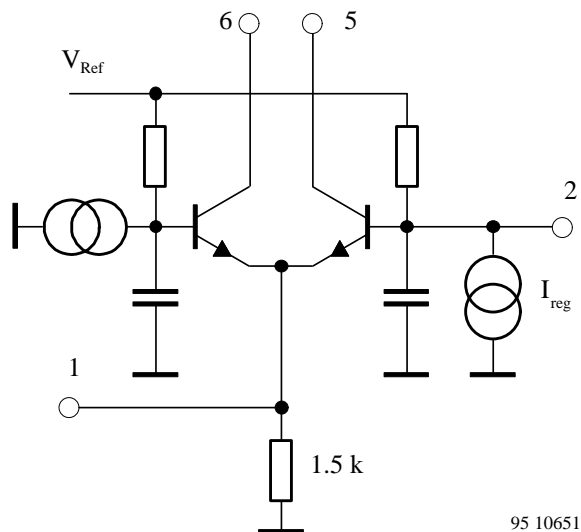


Figure 2.

Pin3 FEGND

This pin should directly be connected to the ground of the FM input circuit and via the RF capacitor to pin2.

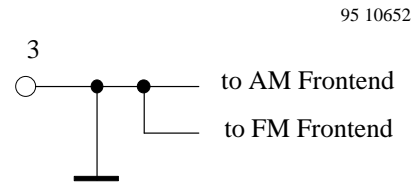


Figure 3.

Pin4 AMANT

The AM antenna coil should be connected to V_{ref} (pin6) and with a tap to pin 4. The tap should offer a generator impedance of 25k to the IC. The input impedance of the circuit is high compared to this value. AC ground for the AM antenna is V_{ref} (pin6).

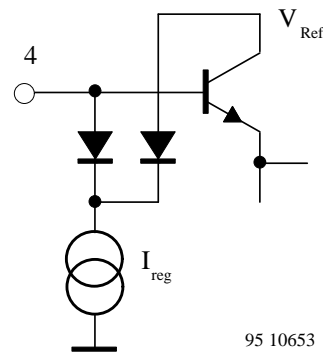


Figure 4.

U2514B

Pin 5 FMTank

At this pin, the collector of the FM input transistor is available. It should be loaded with a tank of maximum impedance to Vref (Pin6). At the same time, this is the input of the FM mixer.

The FM mixer is a double balanced mixer operating at a current of 0.5mA with additional linearizing resistors in the emitter path. Thus, low noise and a good large signal behaviour is achieved.

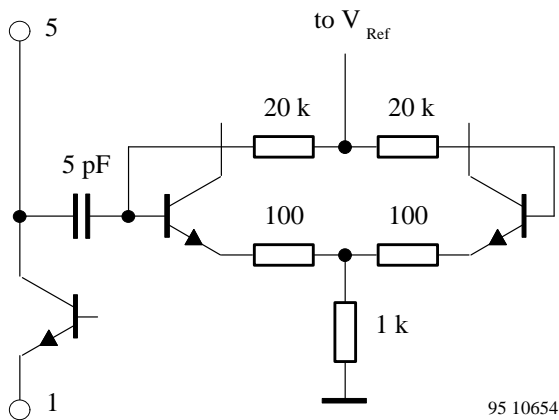


Figure 5.

Pin6 VRef

The internal voltage regulator offers a stable 2.4V reference voltage to all function blocks of the IC. This voltage may also be externally loaded, e.g. to feed the microprocessor. The voltage has an excellent pssr. An external capacitor of 0.1F to ground is necessary for stability and noise suppression.

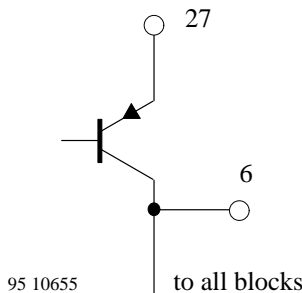


Figure 6.

Pin7 FM_{Osc}

The internal one pin oscillator generates the local oscillator signal. The external tank circuit determines the oscillation frequency

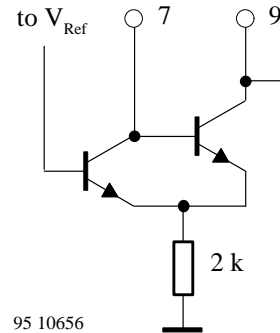


Figure 7.

Pin8 AM_{Osc}

The AM oscillator should be loaded by an external tank. If reduction of oscillator voltage is necessary, this may be achieved by a parallel resistor.

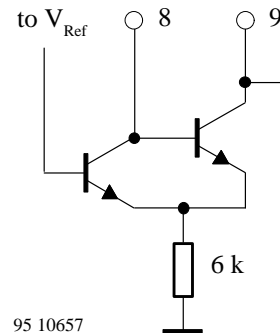


Figure 8.

Pin9 FLO

At this pin the current for driving the PLL circuit is available. The voltage may be achieved by an external resistor to Vref (pin6). Maximum dc resistance is 470. We recommend the use of our PLL family U428xBM. These PLL circuits offer high S/N values at low current consumption. Due to the excellent input sensitivity of these circuits, an additional LO driver is not necessary.

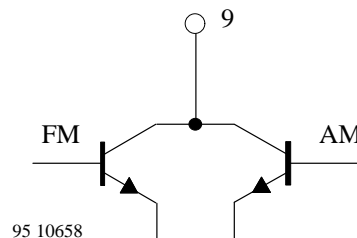


Figure 9.

Pin10 AMCF

The U2514B uses the resonator of the stereo decoder PLL circuit as stop signal detector for AM signals. For this purpose, the parallel resonance frequency of the resonator, which is unloaded about 458kHz, is reduced by an internal load capacitor down to 455kHz. Thus, the AM IF must be 455kHz. The internal loading capacitor is defined by the current through Pin10 to ground. An external resistor allows the alignment of the stop signal center frequency. The width of the stop window is 1kHz. In case of FM stereo operation, this pin is internally pulled to ground.

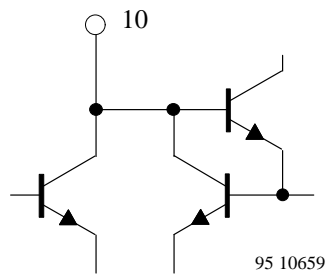


Figure 10.

Pin12 RSSI

In FM-mode this pin is driven by a current corresponding to the level of the FM-IF signal. The required external load consists of a resistor (100k to 150k) in parallel with an external capacitor (e.g. 0.22F, in order to suppress AF influence on the RSSI signal). The voltage at this pin then controls in case of search mode the stop signal, in case of reception mode the high cut and Mono-Stereo blend function. Thus, these functions can be affected by the designer by choosing different values of the load resistor.

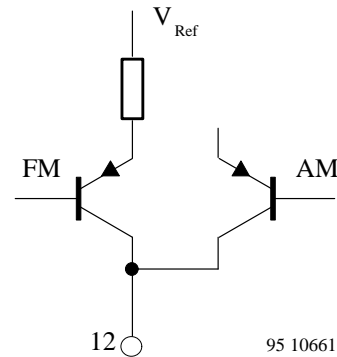


Figure 12.

Pin11 AFSM

The AF-smooth-pin allows the external smoothing of the FM-AF via a capacitor (0.1F). This is necessary as the deviation of the FM signal (75kHz) is greater than the stop signal window (25kHz). In order to get a modulation-independent stop signal, a smooth of the AF is required. In the AM-search-mode the external capacitor smoothes the discriminated AM-IF-signal.

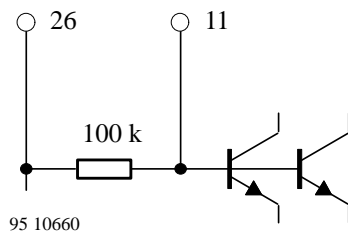


Figure 11.

Pin13 IFO

The IF output of both the FM and the AM tuner should be loaded into external IF tank circuits. Q of IF coils must not be lower than 50.

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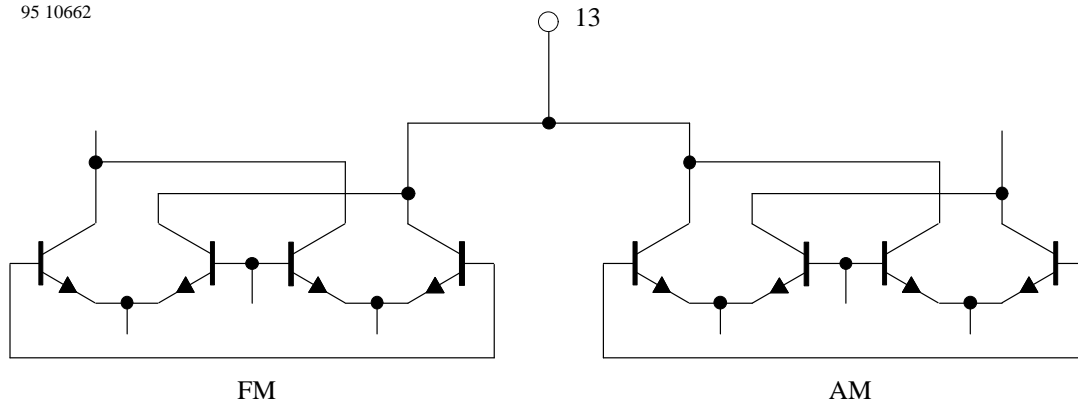
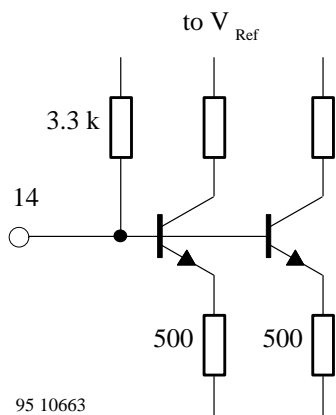


Figure 13.

Pin14 AMIF_{IN}

The input impedance of the AM IF amplifier is 3.3k according to the required impedance of most ceramic filters. The input refers to V_{ref}.

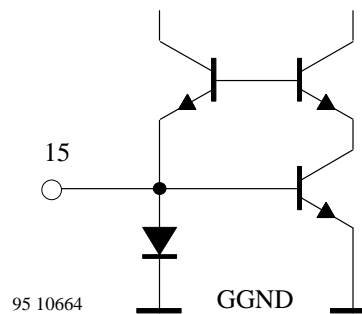


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Figure 14.

Pin15 FMIF_{IN}

Input impedance of the FM IF amplifier is 330 according to the required impedance of most FM ceramic filters. The input refers to GGND.

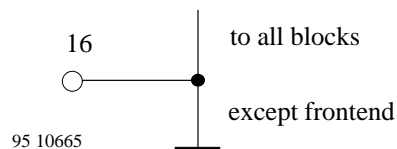


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Figure 15.

Pin16 GGND

The general ground pin is the reference point for all blocks except the AM and FM tuner blocks.



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Figure 16.

Pin17 LO

The open collector output of this pin requires an external resistor of about 4.7k to ground. The deemphasis may be achieved by an additional parallel capacitor

Pin18 RO

The open collector output of this pin requires an external resistor of about 4.7k to ground. The deemphasis may be achieved by an additional parallel capacitor

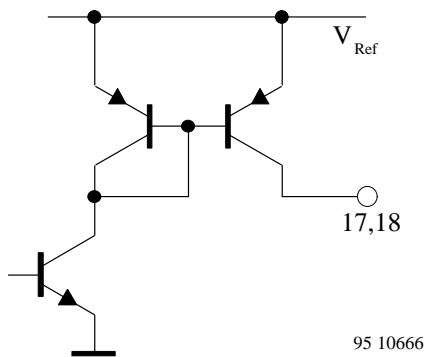


Figure 17.

Pin20 RES

A two pin ceramic resonator of 456kHz parallel resonance frequency at 30pF chip internal load capacitance is necessary for the pilot regeneration. A close connection to the IC is recommended to avoid spurious radiation. In the AM search mode, this resonator is used for stop signal generation. The parallel resonance frequency is then reduced down to 455kHz.

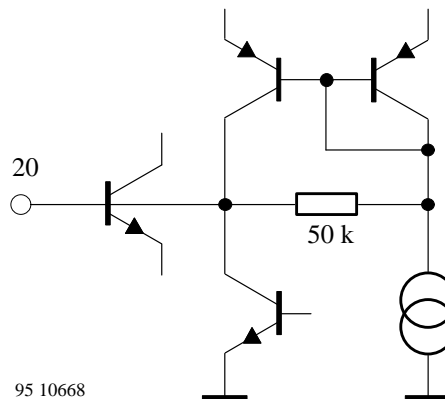


Figure 19.

Pin19 LPF

The stereo-decoder uses the PLL-principle for pilot regeneration. Therefore, a loop filter is necessary to stabilize the PLL. A RC network to ground is to be connected.

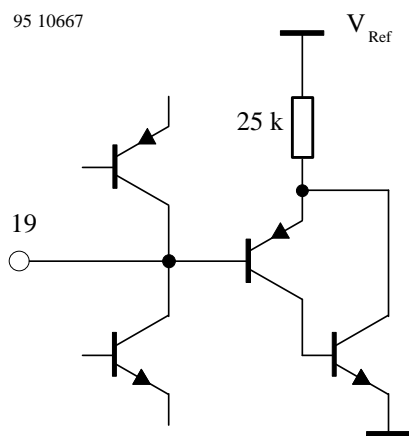


Figure 18.

Pin21 MOST

The Mono-Stereo switch can either be driven by the internal, RSSI dependent Mono-Stereo-blend function or by an externally forced Mono. In this case, this pin should be connected to ground. In search mode, an external connection to ground of this pin enables a reduced stop signal sensitivity.

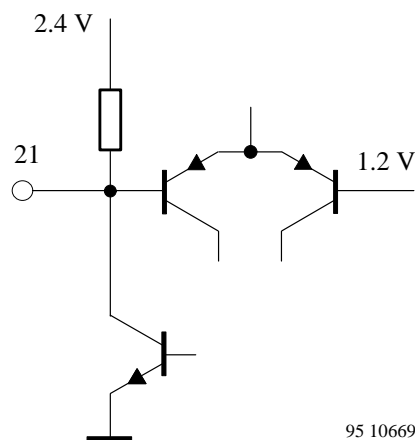


Figure 20.

Pin22 STOP

The stop signal output (active low) is generated in search mode by the following two conditions: voltage at the RSSI-pin above 1.2V and voltage at the AFSM-pin between 1.1V and 1.3V.

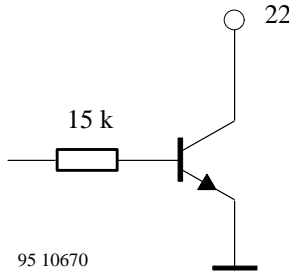


Figure 21.

Pin23 SEMO

The Search Mode pin is the most important pin compared to an analog tuned radio. If the voltage at pin23 drops below 1.6V, the mute function is activated. No AF signal will any longer pass to the Lout and Rout pins. If the voltage at Pin23 drops below 0.8V, the whole circuit additionally turns into the search mode. In this mode, the stop signal output is active and generates the stop signal depending on the above mentioned conditions.

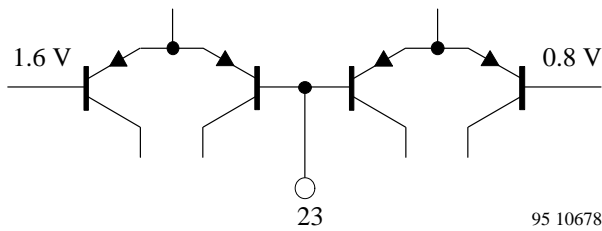


Figure 22.

Pin24 AMFM

If the voltage at this pin drops below 1.1V, the receiver is in AM mode, if the voltage rises above 1.3V, the FM mode is chosen. The use of the mute function via pin23 in case of a band switch is recommended. This can easily be performed by the microprocessor.

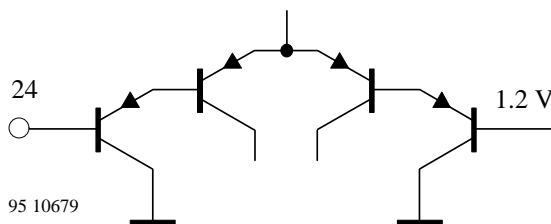


Figure 23.

Pin25 MPXIN

Via Pin25, the MPX signal is fed to the stereo decoder. The input resistance of the IC is about 60k. We recommend an alignment of the channel separation by an RC network between Pin26 and Pin25 due to tolerances in group delay of the IF filter.

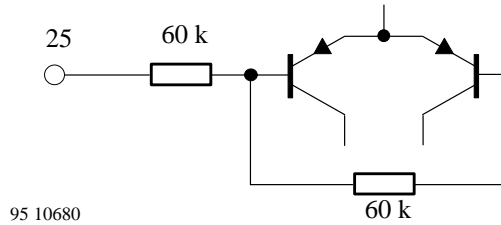


Figure 24.

Pin26 MPXO

In order to drive both the compensation network to pin25 and an optional RDS detector, the MPX output pin has a low output impedance. The DC level is 1.2V in FM mode (depending on the discriminator coil alignment) and 0.7 to 1.5V in AM mode (depending on the signal level).

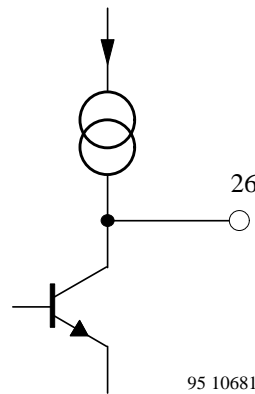


Figure 25.

Pin27 V_S

The voltage supply pin is connected to the internal reference voltage regulator and to some other blocks who need a higher supply voltage and tolerate some ripple on it. As the AC current through the FM discriminator is fed through that pin, a good AC connection to GGND is necessary close to the ground connection of the discriminator.

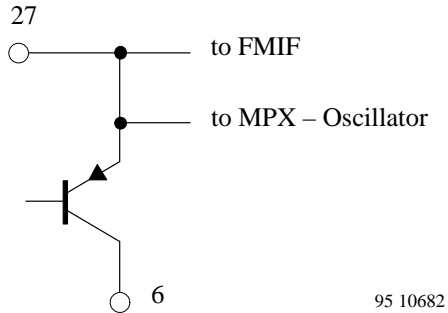


Figure 26.

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Pin28 Discr

The discriminator output pin allows the connection of both a ceramic resonator or a standard LC discriminator. The LC discriminator requires alignment but also allows minimization of THD and adjustment of center frequency versus temperature (which is necessary for a good stop signal versus temperature)

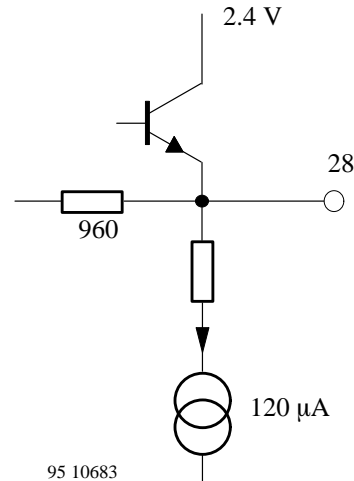


Figure 27.

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Absolute Maximum Values

Reference point pin 16 and 3, unless otherwise specified

Parameters	Symbol	Value	Unit
Supply voltage Pin 27	V_S	13.5	V
Supply current Pin 27	I_S	tbd	mA
Power dissipation $V_S = 13.5$ V Pin 27/16	P	750	mW
Junction temperature	T_j	+ 125	°C
Storage temperature	T_{stg}	- 25 to + 125	°C

Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range Pin 27	V_S	2.7 to 13.5	V
Ambient temperature	T_{amb}	- 25 to + 85	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient when soldered to PCB	R_{thJA}	tbd	K/W

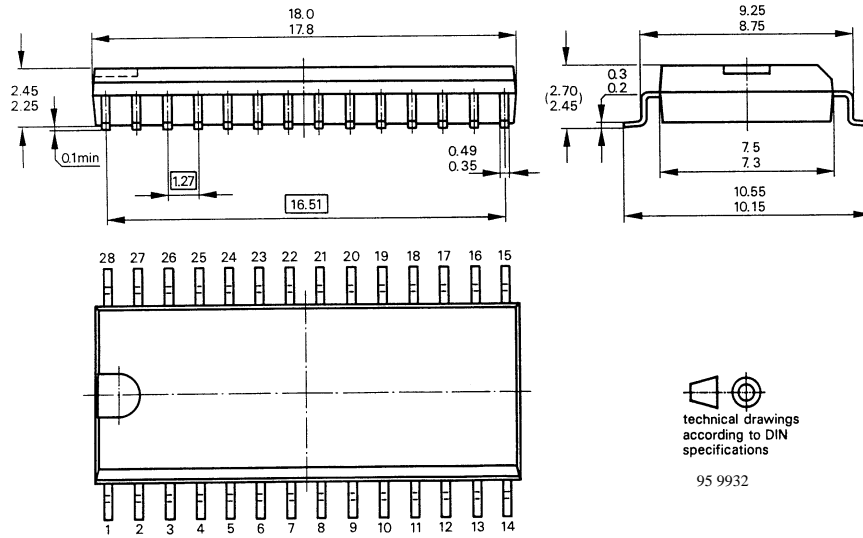
Electrical Characteristics

$V_S = +5V$, $T_{amb} = +25^\circ C$; reference point pins 3 or 16, unless otherwise specified

Parameters / Test Condition	Type	Symbol	Min.	Typ.	Max.	Unit
DC supply (pin 27)						
Supply voltage (pin 27)		V_S	2.7		13.5	V
Supply current (pin 27)		I_S		tbd		mA
Reference voltage (pin 6)		V_{ref}	2.3	2.4	2.5	V
External capacitor (pin 6)			tbd	0,1	tbd	μF
External current to ground (pin 6)					5	mA
Voltage for AM mode (pin 24)			0		1.1	V
FM mode (pin 24), pin 24 open						
Voltage for externally forced mono			0		1.1	V
Voltage for mute function (pin 23)		SEMO		1.6		V
Voltage for search mode (pin 23)		SEMO		0.8		V
FM frontend; Z_{Tank} (pin 5) = 2 kΩ, f = 100 MHz						
Noise figure preamplifier				2		dB
DC current preamplifier (pin 5)			0.7	1	1.3	mA
Input IP3 preamplifier (pin 1/pin 5)				0		dBm
AGC threshold (pin 1)				60		dB μV
Dynamic range of AGC				20		dB
Mixer IP3				tbd		
LO tank impedance (pin 5)		FMOSC	500		4k	Ω
LO output rms voltage (pin 9) @ 470 Ω		FLO		50		mV
Tuner gain see application circuit				40		dB
FM IF						
Input impedance (pin 15)		FMIF _{in}		330		Ω
3 dB corner frequencies			6		12	MHz
Limiting threshold				tbd		
RSSI voltage (pin 12)				500		mV/20dB
FM Discriminator						
Recovered AM/FM output voltage M = 30%, deviation/ 22.5 kHz				70		mV _{rms}
Output impedance (pin 28)		Discr		tbd		
Stop window				20		kHz
AM frontend: (pin 4/14) f = 1 MHz						
Input generator impedance				25		k Ω
LO output rms voltage		FLO		50		mV
Noise figure (DSB)				2		dB
Stop window				1		kHz
Stop generator						
Output current STOP signal Active low			100			μA

Dimensions in mm

Package: SO 28



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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).

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

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