SIEMENS

PLL Stereo Decoder

TCA 4511-2

Preliminary Data

Bipolar IC

Features

- Good channel separation
- No need for coils
- Automatically adjustable bandwidth
- Good suppression of ARI subcarrier and pilot tone harmonics

Type	Ordering Code	Package
TCA 4511-2	Q67000-A8011	P-DIP-18

The TCA 4511 decodes the transmitter side stereo information in both L and R channels. Stereo transmission is shown by means of an indicator lamp. A continual blending of mono and stereo signals is possible. The switching frequencies are controlled by a phase-locked loop. The stereo decoder operates in time multiplex mode (switching) or in frequency multiplex (matrix) mode.

Absolute Maximum Ratings

Parameter	Symbol	Limit Values	Unit
Supply voltage	V_S	18	V
Lamp voltage	V_{LP}	18	V
Current for stereo indicator lamp $V_{18} \times I_{LP} \leq 300$ mW	I_{LP}	50	mA
Minimum voltage at all pins	V	0	V
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	– 40 to 125	°C
Thermal resistance system-air junction-case	 $R_{th\,SA}$ $R_{th\,JC}$	 78 45	 K/W K/W

Operating Range

Supply voltage	V_S	8 to 18	V
Ambient temperature	T_A	– 25 to 85	°C

Characteristicsz

V_S = 12 V; T_A = 25 °C

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Total current (FM operation) S1 closed	I_S		14	20	mA
Total current (AM operation) S1 open	I_S		10	15	mA
Lamp current adjustment range $V_{18} \times I_{LP} \leq 300$ mW	I_{LP}	10		25	mA
Lamp current short circuit $V_{18} \times I_{LP} \leq 300$ mW	I_{LP}			50	mA
Input Amplifier					
Op amp input signal	V_{16}			1.6	Vpp
Op amp output signal[1)]	V_{14}		V_{16}		Vpp
Input resistance	R_I	90	125		kΩ
Degeneration resistance	R_F		10		kΩ
Reference voltage	V_{13}		1.75		V
Stereo Matrix					
Output voltage (stereo)[1, 6)] for modulated output	$V_{Q\,AF}$	0.9	1.2	1.6	Vpp
Output voltage (mono)[2, 6)] L or R modulated	$V_{Q\,AF}$	0.45	0.6	0.8	Vpp
Output resistance	R_Q		1.5	2	kΩ
Cross-talk attenuation[1)] f_{AF} = 1 kHz	a_{CR}	34	40		dB
Reduction 19 kHz / test circuit 1	a_{19}	30	32		dB
Reduction 38 kHz / test circuit 1	a_{38}	30	40		dB
Reduction 57 kHz / test circuit 1	a_{57}	30	45		dB
Reduction 76 kHz / test circuit 1	a_{76}	30	40		dB
Hum suppression[3)]	a_{hum}	40	45		dB
Noise voltage[4)]	V_{Qn}		30	80	µV
Total harmonic distortion[1, 6)] f_{AF} = 1 kHz	THD			0.5	%
Channel balance[2)]	B			0.5	dB
Switching noise mono/stereo S1 closed/open	ΔV_9, ΔV_{10}			60	mV

1) For notes refer to page 390

Characteristics (cont'd)
V_S = 12 V; T_A = 25 °C

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Oscillator					
Output resistance for f_{OSC} measurement	R_{Q8}		200		kΩ
Oscillator basic frequency	f_{OSC}		19		kHz
Capture and hold range[1])	$f_{C/H}$	± 0.4	± 1	± 2.0	kHz
Balancing resistance f_{OSC} = 19 kHz	R_{OSC}	13		18	kΩ
Oscillator in operation S1 closed	V_{18}	1.0			V
Switch off of the oscillator[8]) S1 open	V_{18}			0.4	V
Function of the oscillator I_{18} = 10 mA	V_{18}	0.9			V

1) For notes refer to page 390

Characteristics (cont 'd)
V_S = 12 V; T_A = 25 °C

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Phase Comparisons					
Input voltage[1])	V_5	0.5	0.7	0.9	Vpp
Input resistance	R_5		3.3		kΩ
Input voltage	V_5			1.6	Vpp
Stereo Switch					
Threshold stereo ON[5]) f = 19 kHz	V_{IPT}		30	55	mVpp
Threshold stereo OFF[5]) f = 19 kHz	V_{IPT}	12	15		mVpp
Hysteresis	H_y	3	6	9	dB
Mono/Stereo Blending					
Mono $V_H = V_8$ = 0.5 V[7])	a_{CR}	3	6	9	dB
Stereo $V_H = V_8$ = 0.9 V[7])	a_{CR}	34			dB

[1]) V_I pp = 1.2 V MPX; V_H 1 V; S1 closed; f_{AF} = 1 kHz
[2]) V_I pp = 1.2 V MPX; S1 open; f_{AF} = 1 kHz
[3]) V_S = 12 V + V_n; V_n rms = 200 mV; 200 Hz
[4]) CCIR DIN 45 405; unweighted; S1 open
[5]) S1 closed
[6]) After TP with f_{co} = 6.5 kHz; reduction 36 dB/octave
[7]) V_{16} pp = 0.75 V MPX; S1 closed; f_{AF} = 1 kHz
[8]) The oscillator is switched off, if pin 18 is connected with a voltage ≤ 0.4 V or S1 is open.

Circuit Description

The MPX input signal is corrected in amplitude and phase by an operational amplifier. For this purpose an RC circuit is connected at pin 15.

Subsequently, the (L + R) and (L - R) signals are processed in separate stages. The (L – R) signal is demodulated and can be reduced by the factor a through mono/stereo blending. In the final matrix circuit the aggregate signal (L + R) is added to the demodulated signal a (L – R) according to the following formulae:

$$(L + R) + a\,(L - R) = L\,(1 + a) + R\,(1 - a)$$
$$(L + R) - a\,(L - R) = L\,(1 - a) + R\,(1 + a)$$

$$\begin{array}{ccccc} 0 & \leq & a & \leq & 1 \\ \text{Mono} & & \text{Blending} & & \text{Stereo} \end{array}$$

The generated output signals are then forwarded to two external RC low-passes for deemphasis.

The required frequency to demodulate the L – R signal is obtained by a phase-locked loop (PLL) from the divider. By means of a pilot tone applied to pin 5, the oscillator is synchronized by phase comparison 1. An additional phase comparison 2 provides mono or stereo information. Based on this information, the indicator lamp is activated and lights up when a sufficiently strong signal is present at the input. Moreover, the (L – R) reduction is eliminated.

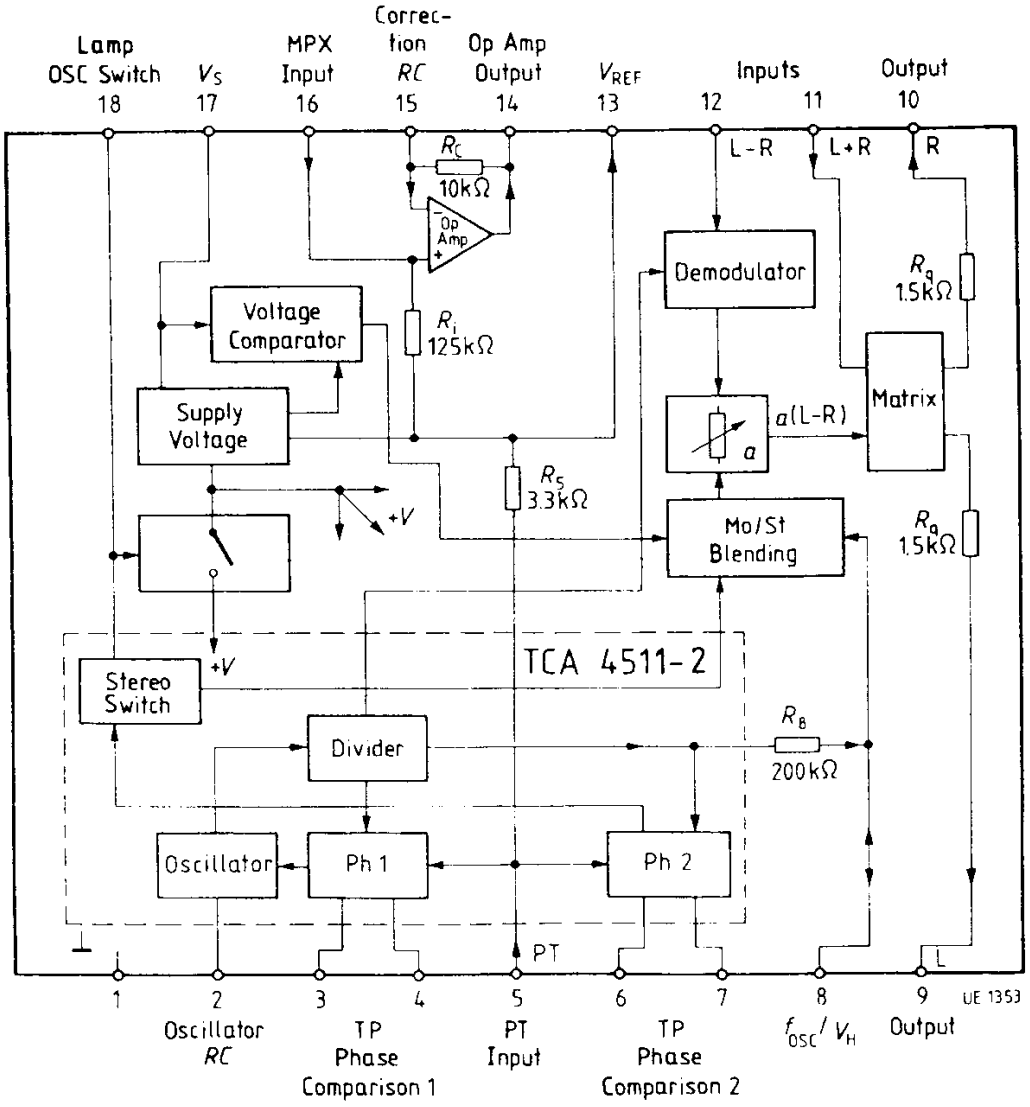
If switch S1 is open, the IC switches the oscillator off, whereby the stereo switch and the mono/stereo blending suppress the L – R signal. The supply current is thus reduced. Also, since the oscillator does not resonate when switch S1 is open, AM receiver signals can be forwarded without interference via the IC.

If pin 8 is not connected, the oscillator frequency can be measured. For normal operating functions, the blending voltage V_H is applied to pin 8 or pin 8 must be blocked by a capacitor. Otherwise, cross-talk is affected by the oscillator frequency.

Pin Functions

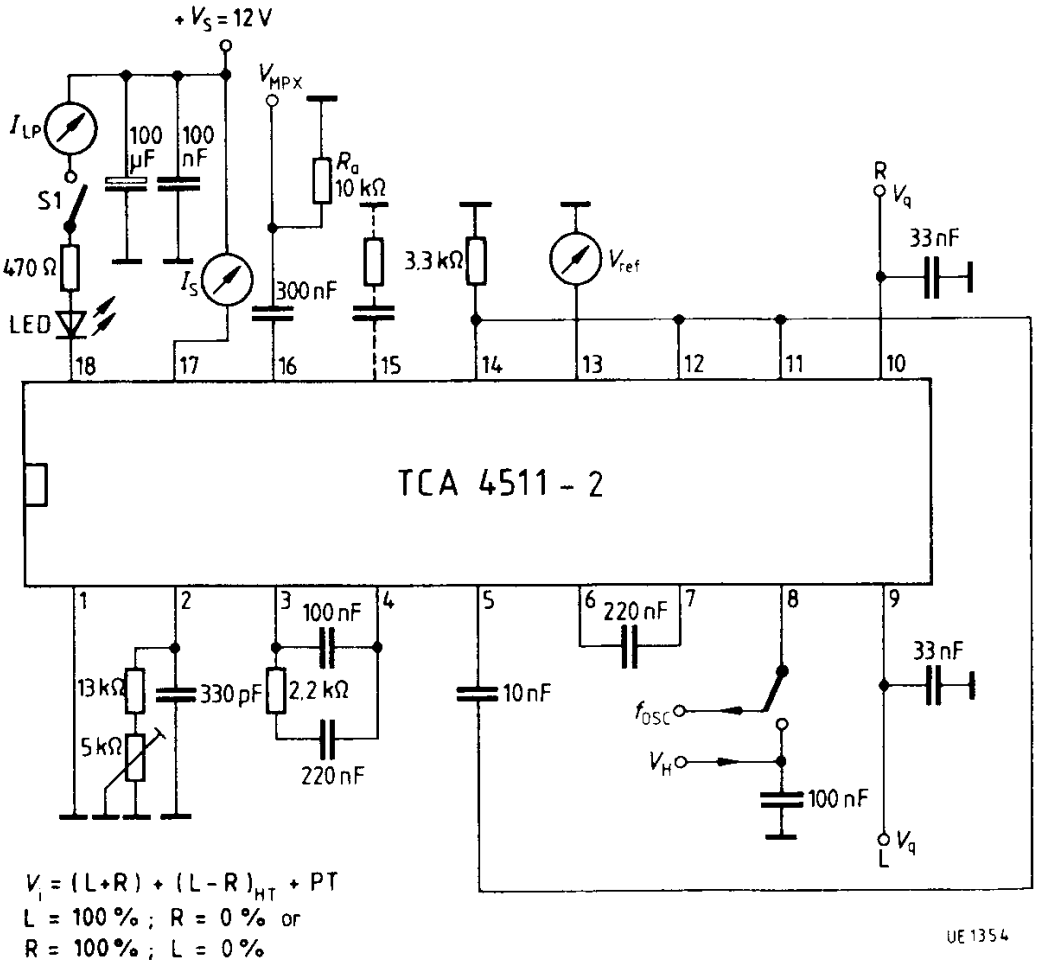
Pin No.	Function
1	GND
2	Oscillator *RC*
3	TP phase comparison 1
4	TP phase comparison 1
5	Pilot tone (PT) input
6	TP phase comparison 2
7	TP phase comparison 2
8	f_{OSC} output/St-Mo blending V_H
9	Output L
10	Output R
11	(L + R) input
12	(L – R) input
13	Reference voltage
14	Output op amp
15	– input op amp
16	+ input op amp
17	Supply voltage
18	Lamp connection/oscillator switch

Block Diagram



Test Circuit

Switching Operation



$V_I = (L+R) + (L-R)_{HT} + PT$

L = 100 % ; R = 0 % or

R = 100 % ; L = 0 %

S1 open = AM

S1 closed = FM

Application Circuit

Switching Operation