

# SIEMENS

## PLL Stereo Decoder

### Preliminary Data

TCA 4511-2

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. [DataSheet4U.com](http://www.DataSheet4U.com)

### 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 $V_{18} \times I_{LP} \leq 300 \text{ mW}$	$I_{LP}$	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

**Characteristics** $V_S = 12\text{ V}; T_A = 25\text{ }^\circ\text{C}$ 

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 $V_{18} \times I_{LP} \leq 300\text{ mW}$	$I_{LP}$	10		25	mA
Lamp current short circuit $V_{18} \times I_{LP} \leq 300\text{ mW}$	$I_{LP}$			50	mA

**Input Amplifier**

Op amp input signal	$V_{16}$			1.6	$V_{pp}$
Op amp output signal <sup>1)</sup>	$V_{14}$		$V_{16}$		$V_{pp}$
Input resistance	$R_I$	90	125		$k\Omega$
Degeneration resistance	$R_F$		10		$k\Omega$
Reference voltage	$V_{13}$		1.75		V

**Stereo Matrix**

Output voltage (stereo) <sup>1, 6)</sup> for modulated output	$V_{QAF}$	0.9	1.2	1.6	$V_{pp}$
Output voltage (mono) <sup>2, 6)</sup> L or R modulated	$V_{QAF}$	0.45	0.6	0.8	$V_{pp}$
Output resistance	$R_O$		1.5	2	$k\Omega$
Cross-talk attenuation <sup>1)</sup> $f_{AF} = 1\text{ kHz}$	$a_{CR}$	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 <sup>3)</sup>	$a_{hum}$	40	45		dB
Noise voltage <sup>4)</sup>	$V_{Qn}$		30	80	$\mu\text{V}$
Total harmonic distortion <sup>1, 6)</sup> $f_{AF} = 1\text{ kHz}$	$THD$			0.5	%
Channel balance <sup>2)</sup>	$B$			0.5	dB
Switching noise mono/stereo S1 closed/open	$\Delta V_9, \Delta V_{10}$			60	mV

1) For notes refer to page 390

**Characteristics** (cont'd) $V_S = 12\text{ V}; T_A = 25\text{ }^\circ\text{C}$ 

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
<b>Oscillator</b>					
Output resistance for $f_{osc}$ measurement	$R_{O8}$		200		$k\Omega$
Oscillator basic frequency	$f_{osc}$		19		kHz
Capture and hold range <sup>1)</sup>	$f_{CH}$	$\pm 0.4$	$\pm 1$	$\pm 2.0$	kHz
Balancing resistance $f_{osc} = 19\text{ kHz}$	$R_{osc}$	13		18	$k\Omega$
Oscillator in operation S1 closed	$V_{18}$	1.0			V
Switch off of the oscillator <sup>8)</sup> S1 open	$V_{18}$			0.4	V
Function of the oscillator $I_{18} = 10\text{ mA}$	$V_{18}$	0.9			V

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1) For notes refer to page 390

**Characteristics** (cont'd) $V_S = 12\text{ V}$ ;  $T_A = 25\text{ }^\circ\text{C}$ 

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	

**Phase Comparisons**

Input voltage <sup>1)</sup>	$V_5$	0.5	0.7	0.9	$V_{pp}$
Input resistance	$R_5$		3.3		$k\Omega$
Input voltage	$V_5$			1.6	$V_{pp}$

**Stereo Switch**

Threshold stereo ON <sup>5)</sup> $f = 19\text{ kHz}$	$V_{IPT}$		30	55	$mV_{pp}$
Threshold stereo OFF <sup>5)</sup> $f = 19\text{ kHz}$	$V_{IPT}$	12	15		$mV_{pp}$
Hysteresis	$H_y$	3	6	9	dB

**Mono/Stereo Blending**

Mono $V_H = V_8 = 0.5\text{ V}^7)$	$a_{CR}$	3	6	9	dB
Stereo $V_H = V_8 = 0.9\text{ V}^7)$	$a_{CR}$	34			dB

1)  $V_{1pp} = 1.2\text{ V MPX}$ ;  $V_H = 1\text{ V}$ ; S1 closed;  $f_{AF} = 1\text{ kHz}$ 2)  $V_{1pp} = 1.2\text{ V MPX}$ ; S1 open;  $f_{AF} = 1\text{ kHz}$ 3)  $V_S = 12\text{ V} + V_n$ ;  $V_n\text{ rms} = 200\text{ mV}$ ; 200 Hz

4) CCIR DIN 45 405; unweighted; S1 open

5) S1 closed

6) After TP with  $f_{co} = 6.5\text{ kHz}$ ; reduction 36 dB/octave7)  $V_{16pp} = 0.75\text{ V MPX}$ ; S1 closed;  $f_{AF} = 1\text{ kHz}$ 8) The oscillator is switched off, if pin 18 is connected with a voltage  $\leq 0.4\text{ V}$  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:

$$\begin{aligned}(L + R) + a(L - R) &= L(1 + a) + R(1 - a) \\ (L + R) - a(L - R) &= L(1 - a) + R(1 + a)\end{aligned}$$

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

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.

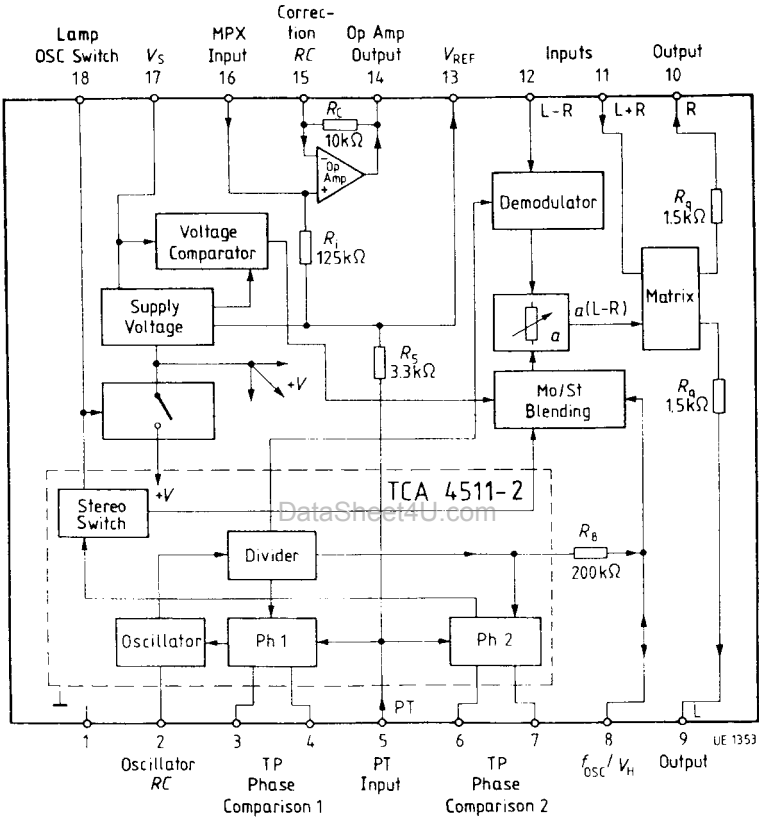
If switch S1 is open, the IC switches the oscillator off, whereby the stereo switch and the mono/stereo blending suppress the  $L - R$  signal. The supply current is thus reduced. Also, since the oscillator does not resonate when switch S1 is open, AM receiver signals can be forwarded without interference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

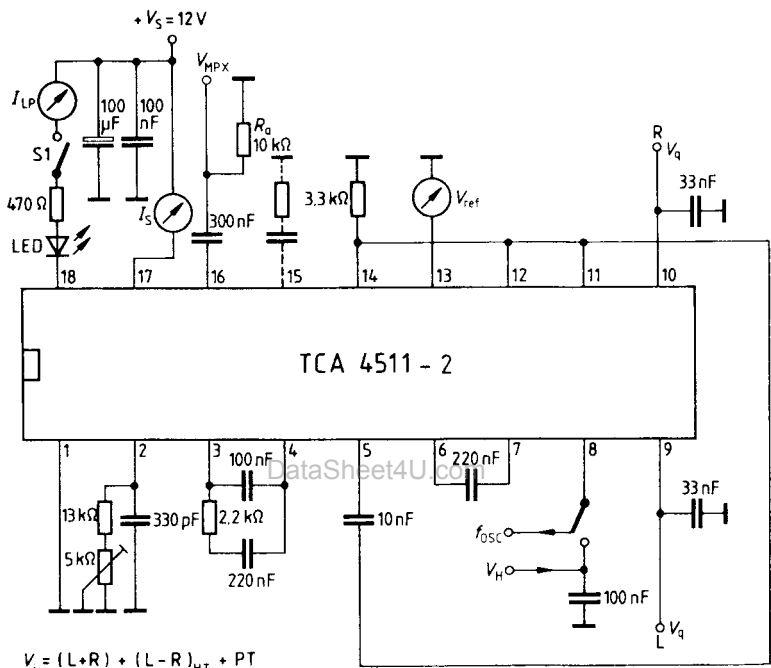


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DataSheet

TCA 4511-2

**Test Circuit**  
**Switching Operation**



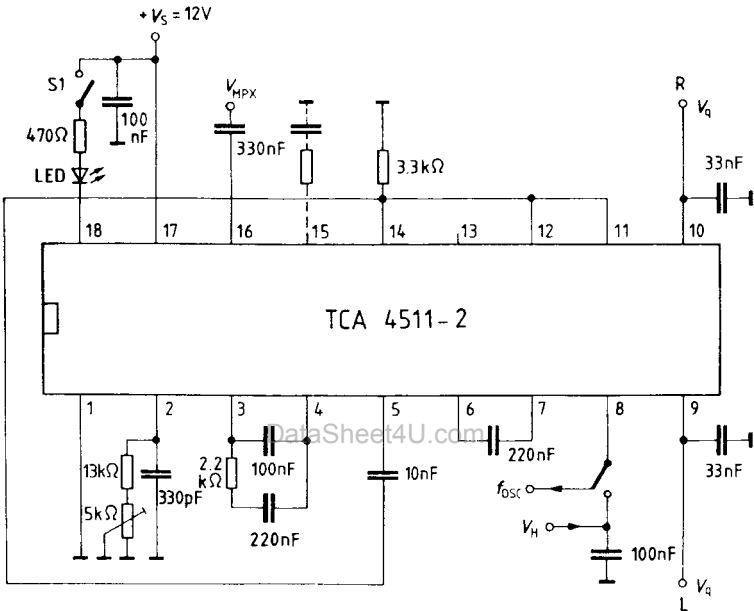
$V_i = (L+R) + (L-R)_{HT} + PT$   
 $L = 100\% ; R = 0\% \text{ or}$   
 $R = 100\% ; L = 0\%$   
 $S1 \text{ open} = AM$   
 $S1 \text{ closed} = FM$

UE 1354



### Application Circuit

#### Switching Operation



S1 open = AM  
S1 closed = FM

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