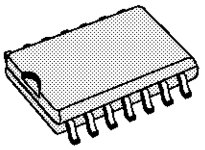
SGS-THOMSON MICROELECTRONICS

TEA5750

ACTIVE SIDEBAND OPTIMIZATION (ASOplus™)

ADVANCE DATA

- VHS, S-VHS, VIDEO 8, HI-8 VCR APPLICATIONS
- PICTURE SHARPNESS IMPROVEMENT
- S/N RATIO IMPROVEMENT WHEN PLAYING BACK AGED TAPES
- REDUCTION OF THE DISTURBING TEARING EFFECTS
- SMALL DETAILS ENHANCEMENT
- ADJUSTMENT FREE
- 5V POWER SUPPLY



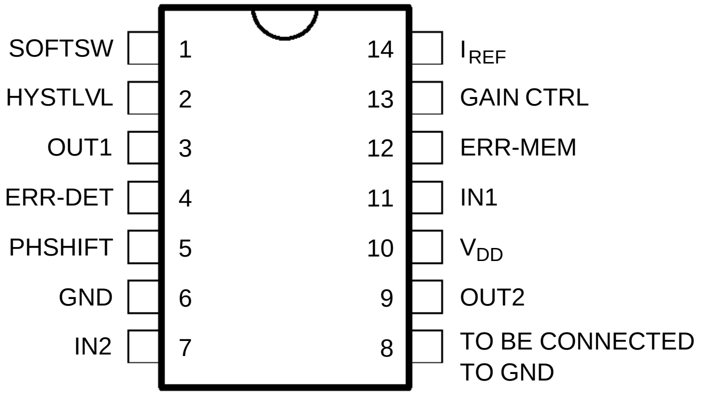
SO14
(Plastic Package)

ORDER CODE : TEA5750

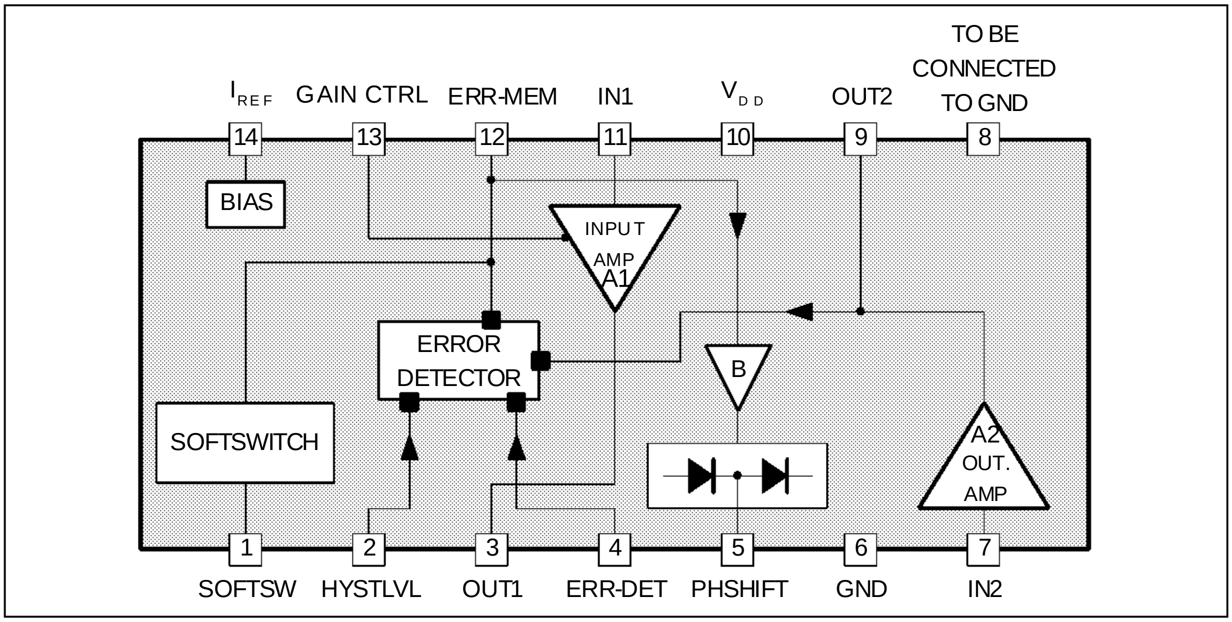
DESCRIPTION

The TEA5750 IC improves the picture sharpness by active correction of the phase of the FM playback signal. It also allows the optimization of the S/N ratio by autoadaptative bandwidth adjustment. For further information please refer to the Application Note AN551.

PIN CONNECTIONS



BLOCK DIAGRAM



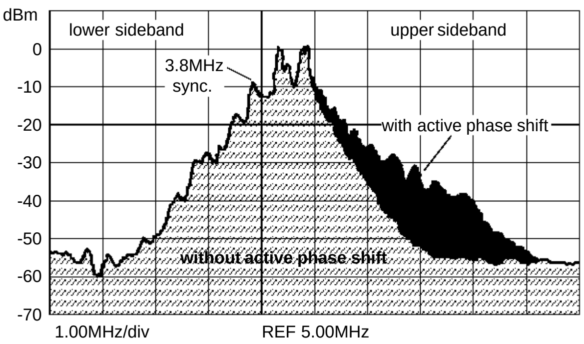
5750-02.EPS

FUNCTIONAL DESCRIPTION

Located between the head amplifier and the FM demodulator, the TEA5750, which replaces the commonly used FM equalizer, features the two main following functions :

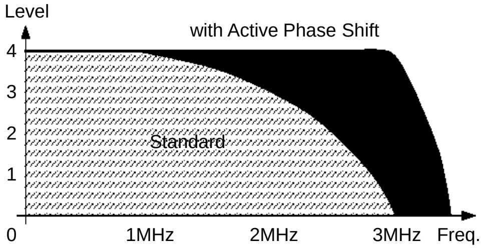
– Dynamic compensation of the phase errors induced in the FM playback signal (errors coming from the limited bandwidth of the front end part of the playback channel : tape, heads rotary transformer, head amplifiers). This compensation improves the fall and rise times of the demodulated signal, and therefore improves the picture sharpness. In the particular case of VHS, TEA5750 leads to flat frequency response of the demodulated signal in excess of 3MHz (Figure 1)

Figure 1a : Spectrum of the Playback FM Carrier (VHS case)



5750-03.EPS

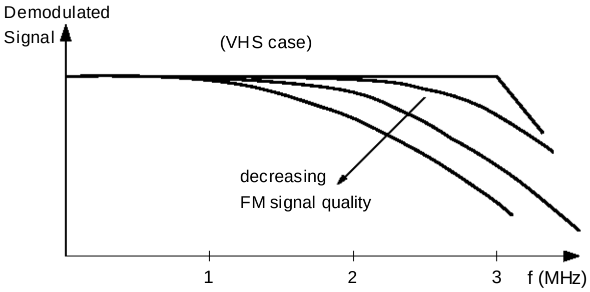
Figure 1b : Frequency Response of the Demodulated Video Signal (VHS case)



5750-04.EPS

– Monitoring of the overall quality of the FM playback signal. In doing so, the TEA5750 automatically and continuously adapts the frequency response of the FM playback signal delivered to the FM demodulator in such a way that the S/N ratio is improved. This function is particularly active in case of aged tapes (Figure 2).

Figure 2 : Demodulated Signal Bandwidth Adjustment versus Input Signal Quality



5750-05.EPS

Important remark : Unlike FM equalizer solution, the active side band optimization (ASO) performed by the TEA5750 does not trade off picture sharpness against noise sensitivity.

ACTIVE PHASE SHIFTING

(phase errors compensation)

The amplitude of the signal delivered by the heads changes with the frequency (amplitude decreases when frequency increases).

In combination with an external LC filter the TEA5750 transforms this natural amplitude modulation into phase shifting which compensates the delays (or phase errors) induced during the fast frequency deviations.

Phase Shift Generation

The core of the phase shifting function is given in Figure 3. Under normal conditions, the V_{PS} voltage at the phase shift input reaches the threshold of the level controlled diodes. Then for each half cycle, as long as the diodes conduct, a magnetic flux is stored in the inductance L. At the phase shift input pin, the next zero crossing time is delayed respect to the input signal V_{IN} for a duration θ which is proportional to the energy W_L stored in the inductance L.

The energy W_L increases versus input amplitude and period, consequently θ increases when the input frequency decreases.

Black to White Transients (fast increases of the FM carrier frequency) (Figure 4a)

In this case, the input FM signal changes from large amplitude and long period to small amplitude and short period. Consequently the delay produced by the phase shifting circuit changes from large values to small values. At the instance of a black to white transient, the phase shifting induces a long period t_0 followed by a short periof t_1. This results in a faster frequency shift and in shorter rise times at the output of the FM demodulator.

White to Black Transients (fast decreases of the FM carrier frequency) (Figure 4b)

In this opposite case, the input FM signal changes from small amplitudes and short periods to large amplitudes and long periods. The corresponding delays will encrease. So during white to black transient, the period t_1 will be increased respect to the input period t_H. This results in a faster frequency change and shorter fall times at the output of the FM demodulator.

Figure 3 : Phase Shift Function Core

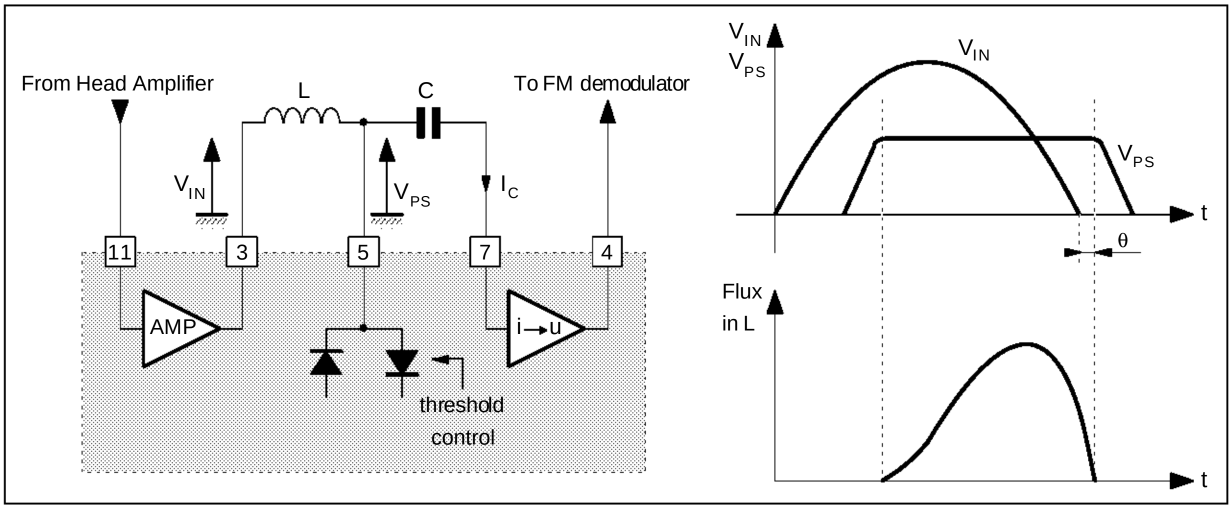


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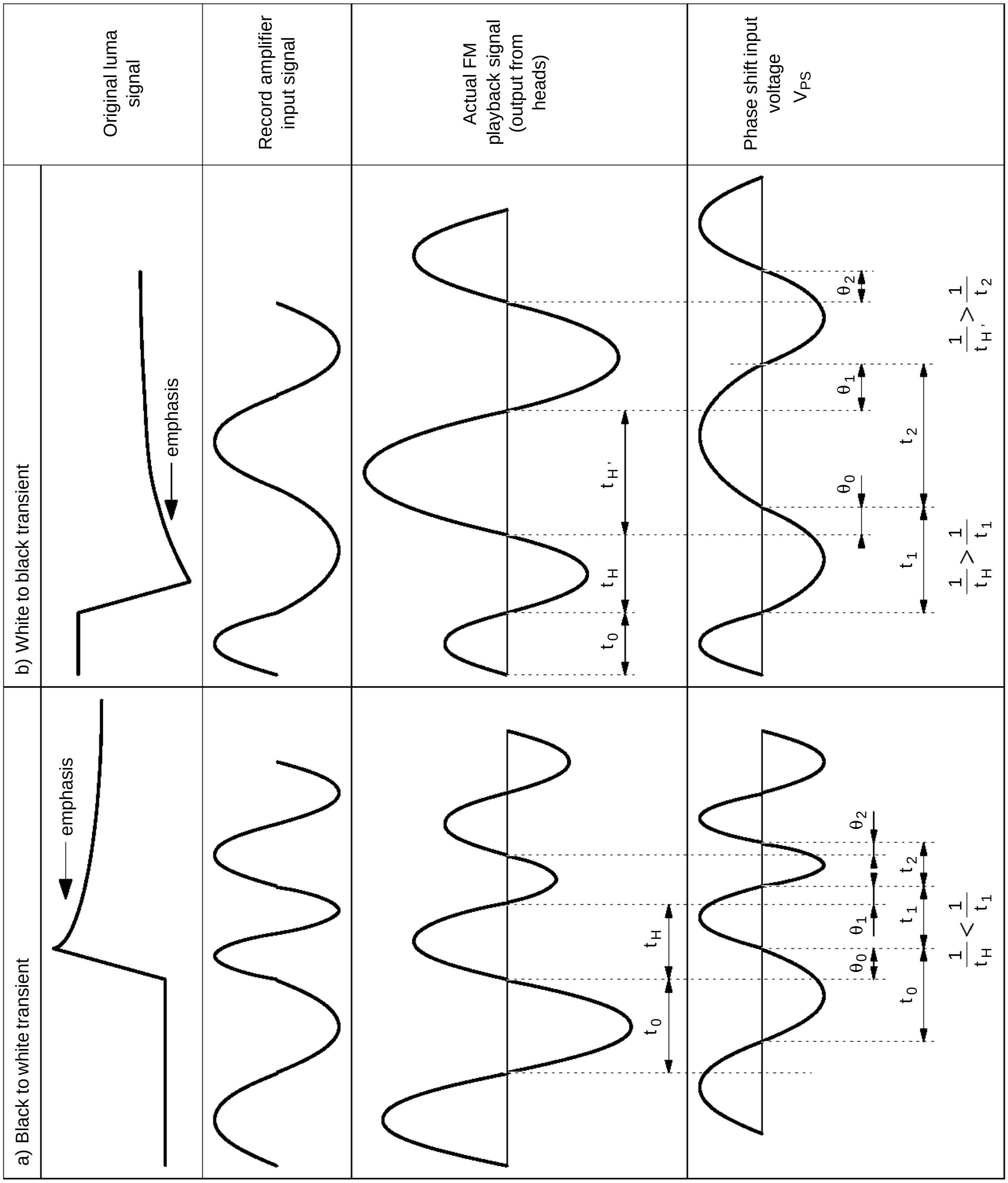
Figure 4 : Phase Shift Effect on the FM Playback Signal



5750-07.EPS

PLAYBACK SIGNAL QUALITY MONITORING
(see Figure 5)

The TEA5750 monitors the average quality of the playback signal by counting the occurrence rate of missing zero crossing. This phenomena can be noticed in the following cases :

– weak and noisy playback signal
– poor quality tape

At each missing zero crossing in the FM signal, the error memory function of the TEA5750 charges the C_{MEM} capacitor with a fixed amount of charges (typ. 40µA x 800µs). Then the resulting voltage V_{MEM} at Pin 12 proportionnaly encreases with the error rate. Three operating cases can be distinguished (see Figure 6).

– $V_{MEN} < 0.8V$: Low error rate, the FM playback signal is good quality. No correction is implemented.
– $0.8V \le V_{MEN} \le 1.2V$: The FM playback signal is poor quality and the softswitch is gradually turned on, modifying then the correcting filter characteristics. The demodulated signal bandwidth is reduced in its upper part (≥ 2.5MHz).
– $1.2V < V_{MEM}$: The FM signal is very poor quality. The softswitch keeps conducting but additionnally the active phase shifting is reduced by encreasing the clamping threshold of the diodes. This induces a further video bandwidth reduction.

Figure 5 : Average Quality Monitoring of the Playback Signal

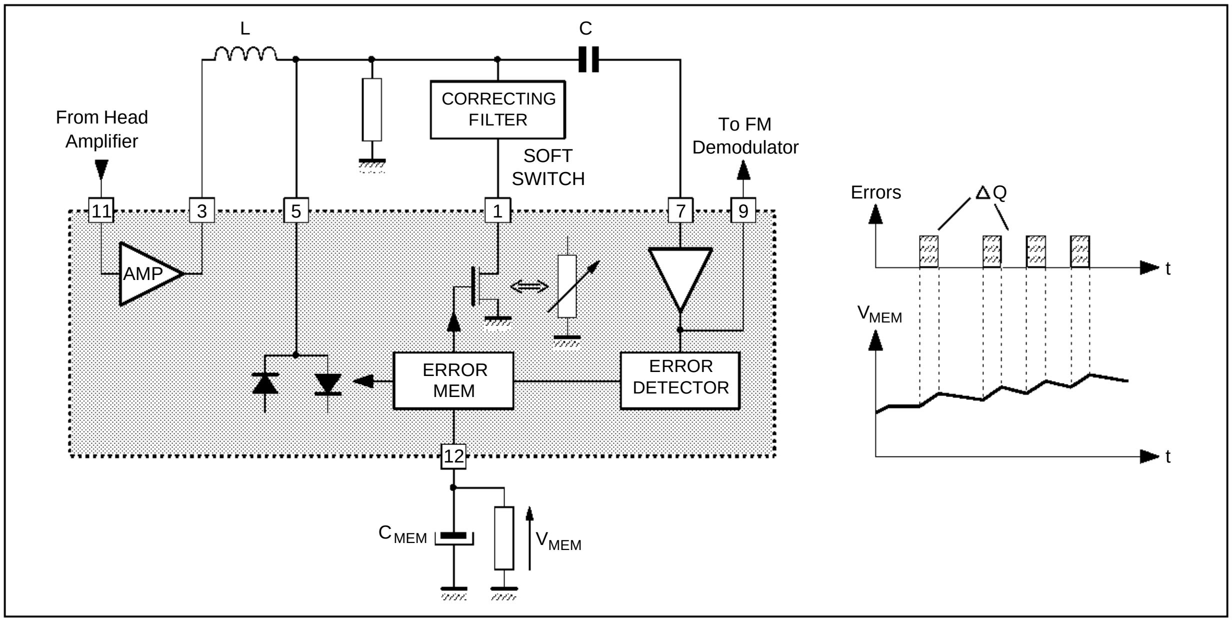
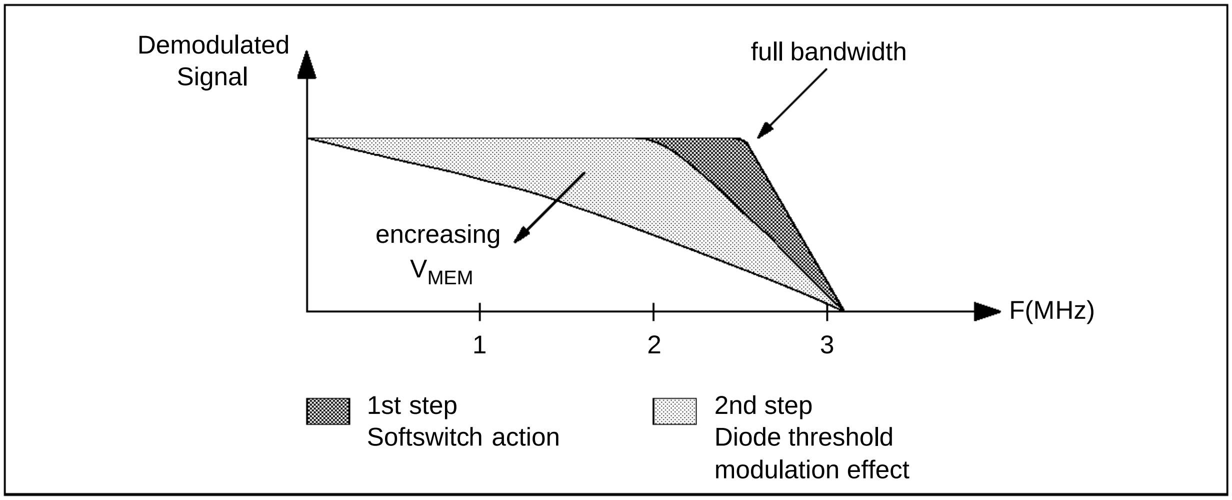


Figure 6 : Video Bandwidth Correction versus FM Signal Quality



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DD}	Power Supply Voltage	6	V
T_{oper}	Operating Temperature	0, +70	^oC
T_j	Junction Temperature	+150	^oC

5750-01.TBL

THERMAL DATA

Symbol	Parameter		Value	Unit
$R_{th\ (j-a)}$	Junction-ambient Thermal Resistance	Max.	160	$^oC/W$

5750-02.TBL

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Power Supply Voltage	4.5	5	5.5	V
R_1	Biasing Resistor	1kΩ at 1%			
R_7	Hysteresis Adjustment			10	kΩ
V_4	Error Detector Adjustment	1.2			V

5750-03.TBL

ELECTRICAL OPERATING CHARACTERISTICS

5V ± 10% and $0^oC < T_{amb} < 70^oC$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{DD}	Supply Current			24		mA
V_{REF}	Reference Voltage		1.16	1.23	1.28	V

INPUT AMPLIFIER

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{IN1}	Input Impedance			28	50	Ω
R_{OUT1}	Output Impedance			17	30	Ω
C_{IN1}	Input Capacitor			3	5	pF
G1	Current to Voltage Gain	Adjusted by external resistor at Pin 13 R_2 = 1kΩ R_2 = 2kΩ R_2 = 3kΩ		 2.1 3.8 5.2		 V/mA V/mA V/mA
dG1	Gain Dispersion	R_2 = 1kΩ or R_2 = 2kΩ or R_2 = 3kΩ	0		1	dB
BW1	Bandwidth (-3dB)	0dB at f = 4.3MHz, $R_{Load} = \infty$	12	15		MHz
AC1	Max. Output Voltage Swing		3			V_{PP}
I_{IN1PP}	Input Current Capability	Linearity < 1%	1			mA_{PP}
I_{OUT1PP}	Output Current Capability	Linearity < 1%	1.5			mA_{PP}

OUTPUT AMPLIFIER

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{IN2}	Input Impedance			13	25	Ω
R_{OUT2}	Output Impedance			30	60	Ω
C_{IN2}	Input Capacitor			3	5	pF
G2	Open Loop Current to Voltage Gain		700	1000	1300	V/mA
BW2	Bandwidth (-3dB)		12	15		MHz
I_{IN2PP}	Input Current Capability	Linearity < 1%	1.5			mA_{PP}
I_{OUT2PP}	Output Current Capability	Linearity < 1%	1			mA_{PP}

ERROR MEMORY

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{TH}	Threshold Voltage		0.95	1	1.05	V
I_{Leak}	Leakage Current at Pin 12				200	nA
ΔQ	Injected Charge Unit per detected error from Pin 12			32		nC

5750-04.TBL

ELECTRICAL OPERATING CHARACTERISTICS

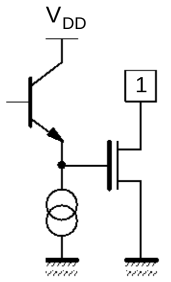
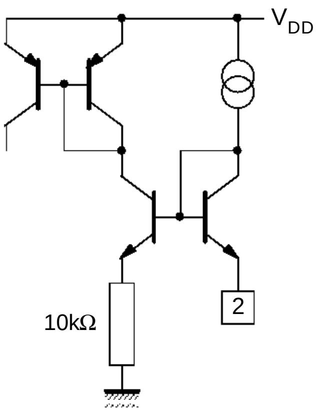
5V ± 10% and $0^{o}C < T_{amb} < 70^{o}C$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
PHASE SHIFTER						
$I_{PHSHIFT}$	Current Capability		1			mA_{PP}
$C_{IPHSHIFT}$	Capacitance at Pin 5			3	5	pF
V_{CLAMP1} V_{CLAMP2} V_{CLAMP3}	Peak-to-peak Clamp Level at Pin 5	$V_{12} < V_{TH}$, $I_5 = 1mA_{PP}$ $V_{12} = 1.5V$, $I_5 = 500\mu A_{PP}$ $V_{12} = 2.5V$, $I_5 = 500\mu A_{PP}$		0.34 0.9 2.0		V V V
ERROR DETECTOR						
ΔV	Hysteresis Voltage	$R_2 = 1k\Omega$		20		mV_{PP}
I_{Leak1}	Leakage Current at Pin 4				200	nA
V_{E3}	3T Detection Threshold Voltage at Pin 4	(see Note 1)			2.7	V
V_{E4}	4T Detection Threshold Voltage at Pin 4	(see Note 2)			3.7	V
SOFTSWITCH						
V_{SF1}	Voltage at Pin 12	To get input impedance at Pin 1 lower than 100Ω		1.6		V
V_{SF2}	Voltage at Pin 12	To get input impedance at Pin 1 higher than $1k\Omega$		0.8		V

5750-05.TBL

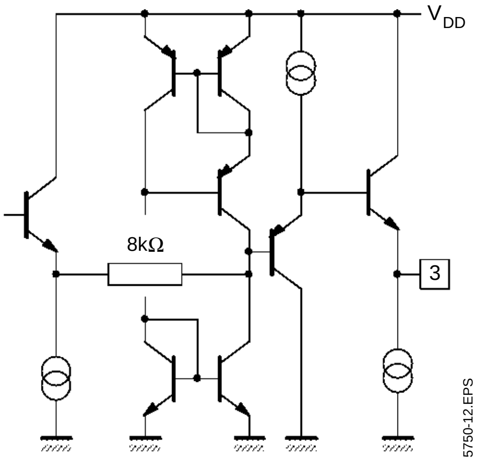
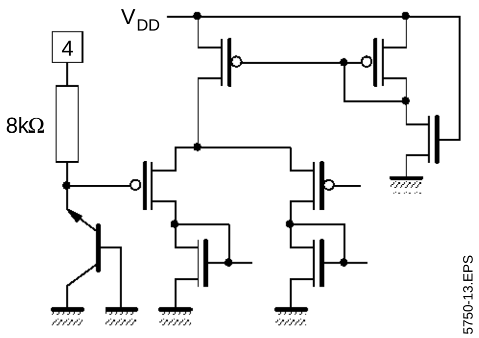
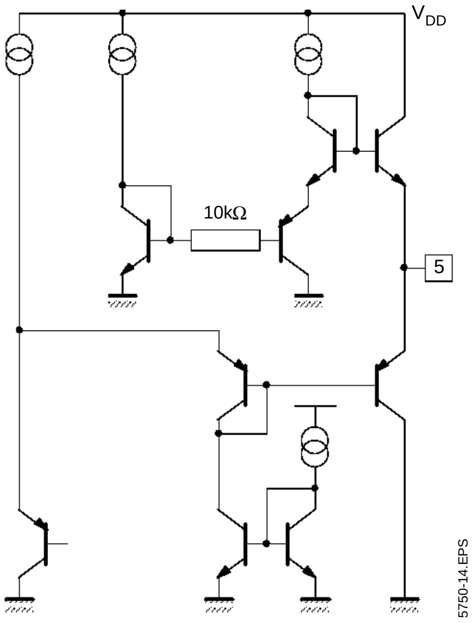
Notes :
1. V_{E3}: Voltage to be applied at Pin 4 to detect 3T long duration without zero crossing. 3T : Three times the average duration between zero crossings of the FM signal (ex: 3 x 116ns in case of VHS).
2. Same as note 1, but in case of four times the average duration between zero crossings of the FM signal.

INPUT/OUTPUT EQUIVALENT INTERNAL CIRCUITS

Pin N°	Name	Equivalent Circuit	Description
1	SOFTSW	 5750-10.EPS	Low-pass filter switch, $R_{DS\ ON}$ value versus V_{12} (see Figure 7)
2	HYSTLVL	 5750-11.EPS	Error detection hysteresis level adjustment $R_{EXT\ (max.)} = 10k\Omega$

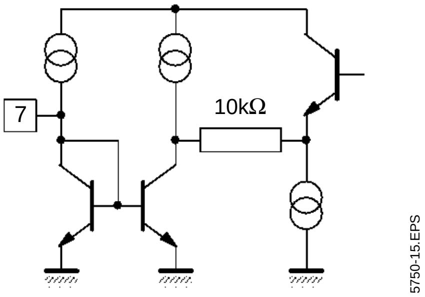
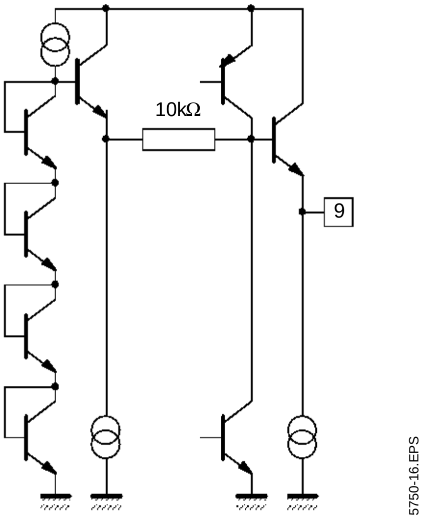
5750-06.TBL

INPUT/OUTPUT EQUIVALENT INTERNAL CIRCUITS (continued)

Pin N°	Name	Equivalent Circuit	Description
3	OUT1		Input amplifier output $V_{3(DC)}$ = 2.25V, $V_{3\ P\text{-}P\ (AC)\ (max.)}$ = 3V
4	• ERR-DET		Voltage Reference for error detection threshold $2V \le V_4$ typ. $\le 4V$
5	PHSHIFT		Phase shifter (see Figure 7)
6	GND		Ground

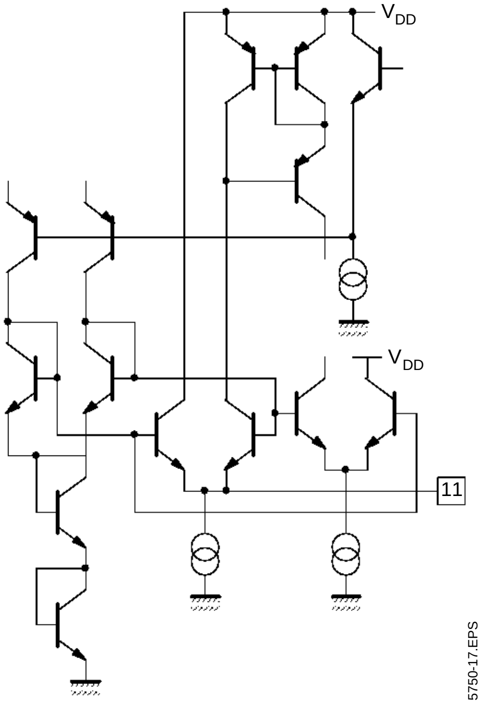
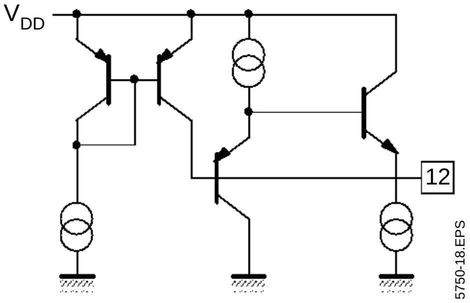
5750-07.TBL

INPUT/OUTPUT EQUIVALENT INTERNAL CIRCUITS (continued)

Pin N^o	Name	Equivalent Circuit	Description
7	IN2		Output amplifier input
8			To be connected to ground
9	OUT2		Output amplifier output $V_{9(DC)} = 2V_{BE}$, $V_{9\ P\text{-}P\ (AC)\ (max.)} = 0.75V$
10	V_{DD}		Power Supply

5750-08.TBL

INPUT/OUTPUT EQUIVALENT INTERNAL CIRCUITS (continued)

Pin N°	Name	Equivalent Circuit	Description
11	IN1		Input amplifier input $V_{11(DC)} = 2V_{BE}$
12	ERR-MEM		Error rate store

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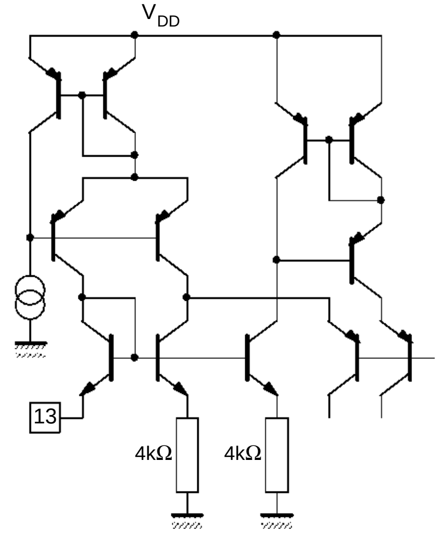
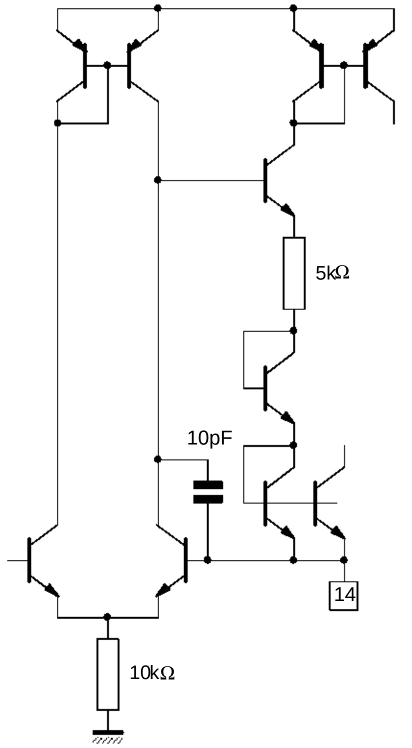
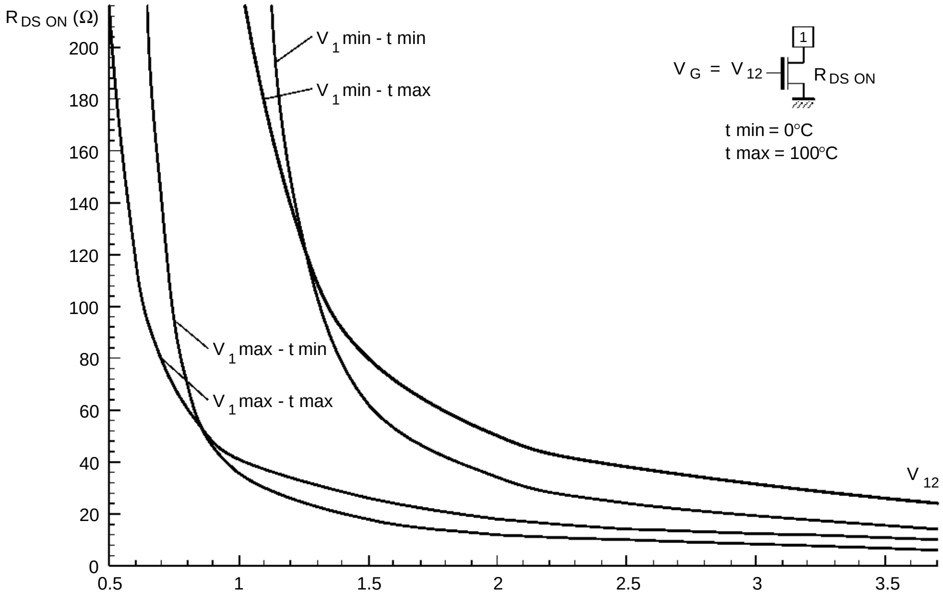
INPUT/OUTPUT EQUIVALENT INTERNAL CIRCUITS (continued)

Pin N°	Name	Equivalent Circuit	Description
13	CTRLGAIN		Input amplifier gain control 1kΩ ≤ $R_{13\,EXT}$ ≤ 3kΩ
14	I_{REF}		Current reference $R_{14\ EXT}$ = 1.1kΩ, V_{DC} = 1.23V

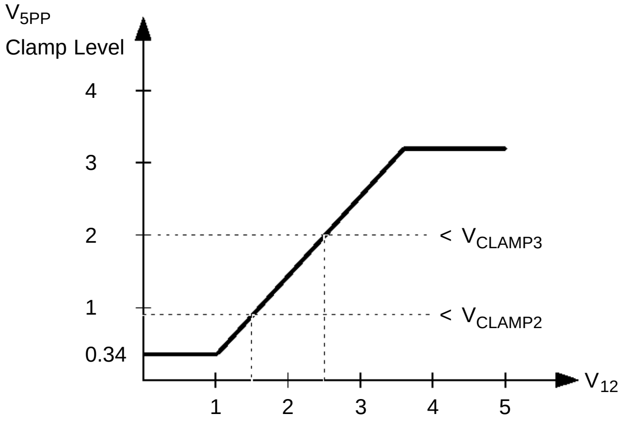
5750-10.TBL

Figure 7 : $R_{DS\ ON}$ versus $V_{ERR\text{-}MEM}$ on Pin 12



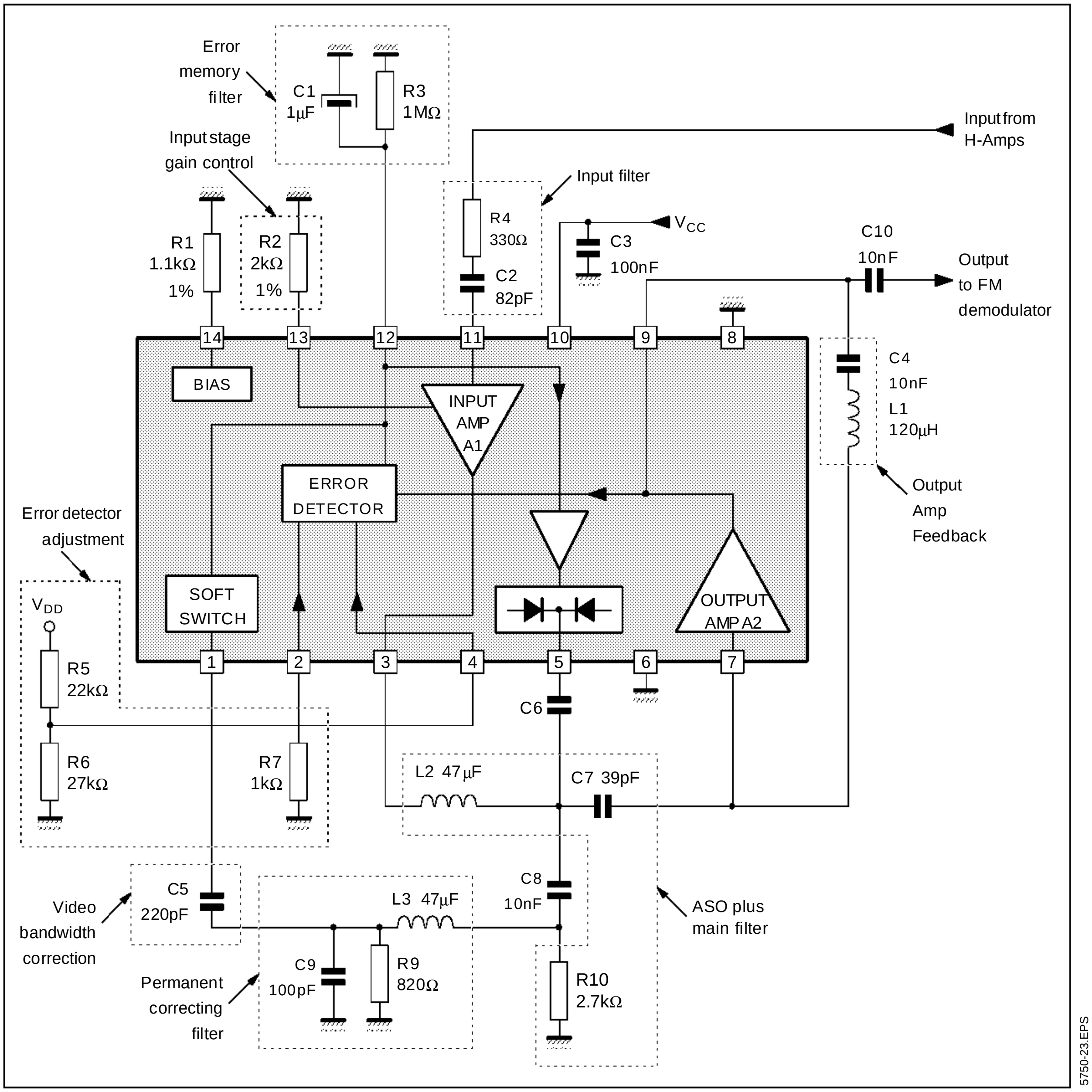
5750-21.EPS

Figure 8 : Clamp Voltage versus $V_{ERR\text{-}MEM}$ on Pin 12



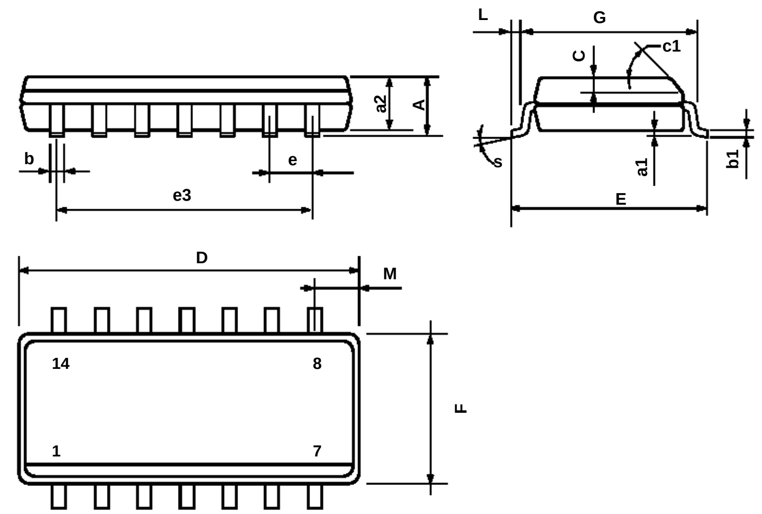
5750-22.EPS

TYPICAL APPLICATION DIAGRAM



PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE



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Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

SO14.TBL

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