

ELECTRONIC HOOK SWITCH DEVICE

- TIP AND RING SWITCHES FOR TERMINAL CONNECTED TO A TELEPHONE LINE
- HANDSFREE / ON HOOK DIALING KEY CONTROL
- HANDSET SWITCH CONTROL
- RINGER INTERFACE AND RECTIFIER RINGER BRIDGE
- PULSE DIALING INTERFACE
- AUTOMATIC LINE SEIZURE THROUGH MICROCONTROLLER CONTROL
- LINE INHIBITION THROUGH MICROCONTROLLER CONTROL
- FRENCH DC LINE CURRENT REGULATION :
 - OFF - HOOK MODE (60mA Max.)
 - PULSE DIALING (75mA Max.)
- FRENCH INCOMING CALL CURRENT CONTROL
- IN DC CURRENT REGULATION MODE, VOLTAGE INFORMATION FOR THE SPEECH CIRCUIT FOR Tx AND Rx GAIN CONTROL
- POWER DISSIPATION LIMITATION FOR OVER-VOLTAGE SURGES
- LINE CURRENT PRESENCE INFORMATION
- LOW VOLTAGE SWITCHES REQUESTED FOR EHKS KEY AND HKS SWITCH

DESCRIPTION

The Electronic Hook Switch device integrates the high voltage stage, which is directly connected on a telephone line, of a terminal like, corded telephone set with handsfree or On Hook Dialing, cordless phone, answering machine or fax.

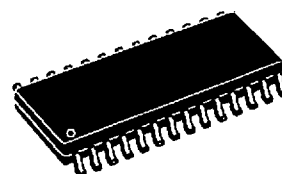
It integrates all the different DC line French regulations.

The high voltage switches, N-channel/D-Mos and P-channel/Drain extension Mos, are integrated in a mixed 250 Volts technology.

The ringer interface allows to use a common ground between speech, dialing and ringing features.

The possible use of low voltage switches, 5 volts, for HKS switch and EHKS key, allows reliable functionality in critical environment condition like humidity atmosphere saturation.

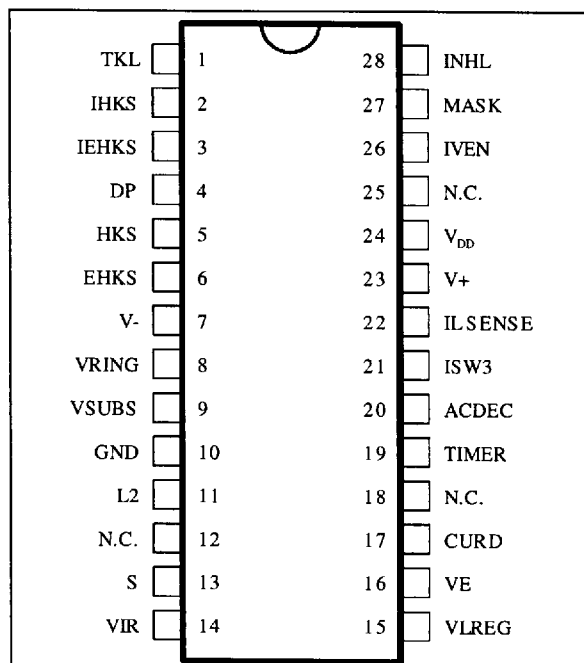
The Electronic Hook Switch device allows to make a high voltage line interface for any terminal connected on a telephone line with few discrete components (Rectifier bridge, R/C ring network and protections) and allows to pass the French requirements by added only two resistors and two capacitors more.



SO28
(Plastic Micropackage)

ORDER CODE : ST3854

PIN CONNECTIONS



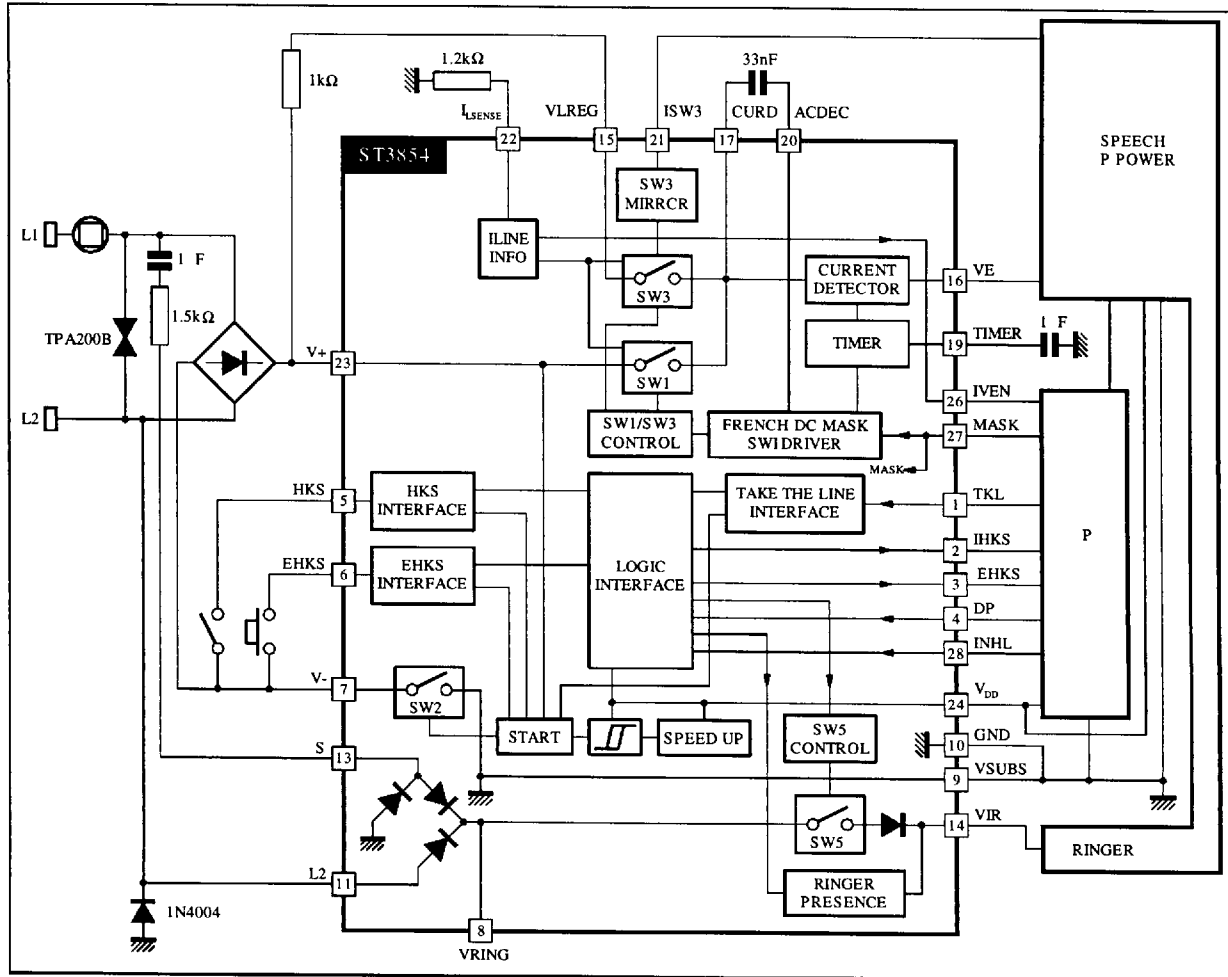
3864-01.EPS

PIN LIST

Pin N°	Symbol	Function
1	TKL	Input logic signal to "take the line" in Electronic hook switch mode or for cordless and answering machine. TKL = "1" ; line closed TKL = "0" ; line released. Note : In inhibit the line feature, this pin should be at level "1".
2	IHKS	Open drain output logic signal following the status of mechanical hook-switch , Pin 5.
3	IEHKS	Open drain output logic signal following the status of EHKS key , Pin 6.
4	DP	Input logic signal for pulse dialing and flash modes. DP = "1" ; line closed. DP = "0" ; line is open and timer and overvoltage protection circuits are resetted.
5	HKS	Mechanical hook switch input
6	EHK	Key input for electronic hook switch feature
7	V-	Connected to the negative polarity of the external rectifier bridge
8	VRING	Ring frequency information for frequency analysis and Inhibit the line feature
9	VSUBS	Substrat
10	GND	Ground, negative common reference point
11	L2	Output connection with the line L2 terminal
12	N.C.	This pin should be left open, (internally connected)
13	S	Output connection to the ring R/C network
14	V _{IR}	Positive ringer supply voltage
15	VLREG	To external 1k resistor for line current regulation purpose (French characteristic.)
16	V _E	Positive power supply for speech circuit
17	CURD	To external AC decoupling capacitor for AC shunt in DC current regulation mode
18	N.C.	
19	TIMER	To external capacitor, for current limiting duration during Off-Hook transient with AC ring signal. (French requirement). This capacitor is also used for AC shunt in DC current regulation mode.
20	ACDEC	To external AC decoupling capacitor for AC shunt in DC current regulation mode
21	ISW3	Current information flowing in SW3 switch to obtain AGC speech linearity during DC current regulation
22	I _L SENSE	Resistor threshold to overvoltage protection circuit
23	V+	Positive path of external rectifier bridge
24	V _{DD}	Internal logic positive supply
25	N.C.	
26	IVEN	Line current presence information output logic
27	MASK	Input logic for DC current regulation control in pulse dialing mode. MASK="1", I _L Max. < 55mA MASK="0", I _L Max. < 75mA
28	INHL	Inhibition of any line connection command through HKS and EHKS pins. Note : In inhibit the line feature, the TKL Pin should also be at level "1".

3854-01.TBL

BLOCK DIAGRAM



3854-02.EPS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{lmax}	Peak voltage between Pins 23 & 7	250	V
V _{emax}	Peak voltage between Pins 16 & 9	20	V
V _{rmax}	Peak voltage between Pins 14 & 9	70	V
V _{DDmax}	Peak voltage between Pins 24 & 9	6	V
I _{smax}	Current in Speech mode	150	mA
P _{max}	Maximum Power	0.7	W
T _{oper}	Operating Temperature	-25, +55	°C
T _{stg}	Storage Temperature	-55, +150	°C
T _j	Junction Temperature	-25, 125	°C

3854-02.TBL

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R _{th(j-a)}	Thermal Resistance Junction-Ambient	Max. 90	°C/W

3854-03.TBL

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $V_{DD} = 3\text{V}$ if not otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
VL1	Minimum Operating Current	Test 1, $I_L = 5\text{mA}$		3	4	V
RSWI1/2	Ron of Switches SW1 & SW2	Test 1, $I_L = 20\text{mA}$		35	45	Ω
RSWI3	Ron of Switch SW3	Test 1, $V_{L1/L2} = 54\text{V}$		220	350	Ω
RSWI5	Ron of Switch SW5	Test 3, $V_S = 10\text{V}$ $V_S = 20\text{V}$ $V_S = 30\text{V}$		560 460 430	700 600 550	Ω Ω Ω
I_{LEAK}	Leakage Current (on-hook)	Test 1, $V_{L1/L2} = 104\text{V}$ $V_{L1/L2} = 250\text{V}$		1 1.5 2	5 10 15	μA μA μA
IBIAS	Current Consumption (off-hook)	Test 1, $I_L = 20\text{mA}$		0.5	0.7	mA
I_{VDD}	Bias Current on V_{DD}	Test 1, $I_L = 20\text{mA}$, $V_{DD} = 3\text{V}$		270	400	μA
V_{DD}	V_{DD} Supply (*)	After speed up mode	2.75		5.5	V
VSUT	V_{DD} Speed-up Threshold	Speed up OFF Speed up ON		2.9 2.6	*	V V
I_{REG}	Line Regulation Current	Test 1, $V_{L1/L2} = 54\text{V}$, $R_L = 300\Omega$		45	55	mA
I_{START}	Start-up Line Current	Test 1, $V_{L1/L2} = 54\text{V}$		110	150	mA
I_{mask}	Line Current in mask mode & in pulse make period	Test 2, $V_{L1/L2} = 54\text{V}$		64	75	mA
I_{opl}	Line Current in mask mode & in pulse break period	Test 2, $V_{L1/L2} = 104\text{V}$		300	350	μA
R_{lsw3}	SW3 Switch Current Ratio	Test 1, $V_{L1/L2} = 54\text{V}$		2000		
I_{TIM}	Timer Pin Bias Current	Test 1, $V_{L1/L2} = 54\text{V}$		10		μA
R_{soff}	R between Pin 5 or Pin 6 and Pin 7 to stay in On-Hook	Test 1, $V_{L1/L2} = 54\text{V}$	100			k Ω
R_{son}	R between Pin 5 or Pin 6 and Pin 7 to maintain Off-Hook	Test 1, $V_{L1/L2} = 54\text{V}$			10	k Ω
I_{sens}	Overvoltage Threshold			0.6		V
ACatt	AC Attenuation, 20 Log V_L/V_E	Test 1, $V_{AC} = 1.4\text{V}_{RMS}$, $f = 1\text{kHz}$, $V_{L1/L2} = 54\text{V}$ $I_L = I_{REG}$ $I_L = 20\text{mA}$		0.5 0.5	1 1	dB dB
ACdist	AC Distortion	Test 1, $V_{AC} = 1.4\text{V}_{RMS}$, $f = 1\text{kHz}$, $V_{L1/L2} = 54\text{V}$ $I_L = I_{REG}$ $I_L = 20\text{mA}$		0.6 0.5	1 1	% %
V_{IH1}	DP, MASK, INHL Input Voltage	Test 1, $V_{DD} = 3\text{V}$, High level = "1"	2.4			V
V_{IH2}	TKL Input Voltage	Test 1, High level = "1" Remote command (master) (**) Remote command (slave), $V_{DD} = 3\text{V}$	4 2.4		V_{DD}	V V
ITKLm ITKLs	TKL Input Current	Remote command (master), $V_{DD} = 5\text{V}$ Remote command (slave), $V_{DD} = 3\text{V}$	200 150	80		μA μA
V_{IL}	TKL, DP, MASK, INHL Input Voltage	Test 1, $V_{DD} = 3\text{V}$, Low level = "0"			0.3	V
V_{OH}	IHKS, IEHKS, IVEN Output voltage	Test 1, $V_{DD} = 3\text{V}$, High level = "1"	2.7			V
V_{OL}	IHKS, IEHKS, IVEN Output voltage	Test 1, $V_{DD} = 3\text{V}$, High level = "0"			0.45	V

* The values of V_{DDmin} and VSUT (Speed up ON) are correlated.

** The command TKL is defined as "Master", if the line is seized through this pin and as "Slave", if the line has been previously seized by EHKS key and use to maintain the line closed.

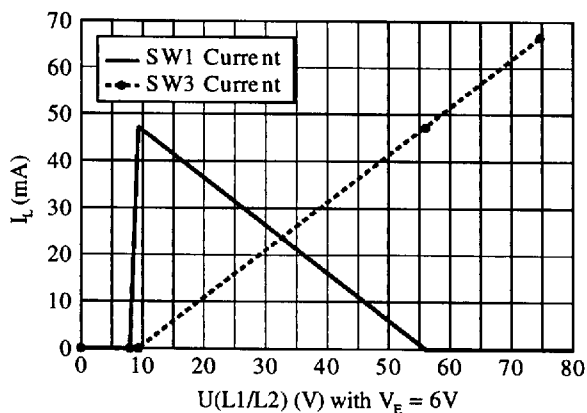
3854-04.TBL

FUNCTIONAL DESCRIPTION

Switches

- SW1, SW2 and SW3 isolate the speech and dialing part in On-Hook mode, these 3 switches are open in On-Hook mode and are closed in Off-Hook mode. These switches are closed if HKS or EHKS input Pin is connected to V-, or if TKL input Pin is at logic level "1".
- In Off-Hook mode, the line current goes in the switch SW1 since the current value reaches the threshold of the current detector connected between CURD Pin and V_E Pin, when this threshold is reached, and the voltage across L1/L2 wires increases the current increases progressively in the switch SW3 and the 1K resistor connected between V+ Pin and VLREG Pin and decreases in the switch SW1. The current threshold is internally fixed at 47mA typical, if necessary, this one can be increased by connecting an external resistor between CURD Pin and V_E Pin.
- SW5 is closed in On-Hook mode to connect the ringer part, in Off-Hook mode this switch is opened and the ringer part is disconnected.

Figure 1 : SW1/SW3 Current Partition



Logic Control

The EHKS device is controlled by a microcontroller through :

- Output Pins IHKS and IEHKS which give the status how the line has been taken.
- Output Pin IVEN which gives the status of the presence of a line current.
- Input Pin TKL to maintain the line closed when it has been previously taken through EHKS key
- Input Pin DP to generate the Pulse dialing and the Flash signalization.

- Input Pin MASK to control the line current during Pulse dialing and Flash signalization
- Input INHL which forbids to close the line through HKS switch and EHKS Key, if INHL and TKL Pins are simultaneously at logic level "1". This feature can be used in an answering machine.
- The V_{DD} supplies all the logic control, a speed up mode charges V_{DD} capacitor to 2.9V, at start up and each time that the V_{DD} supply goes below 2.6V.

Timer

A timer feature allows the line current to go upper 90mA and lower 150mA, at the start up, to realize the incoming call detection requested by French requirements. The time duration (T_{start}) of this upper current limitation is fixed by the capacitor, C_{timer}, connected on TIMER Pin.

$$T_{start} = 0.12 \times 10^6 \times C_{timer}$$

Ringer Interface

Three diodes of the ringer bridge are integrated. In Inhibit the line mode, INHL and TKL Pins simultaneously at logic level "1", the switch SW5 is opened and the presence of a ringing signal can be detected on Pin VRING where the ring frequency is not filtered.

Overvoltage Protection

An overvoltage protection is integrated to open the line when the voltage across the line wires L1 & L2 is too high. The voltage threshold where the line is open is fixed by the external resistor connected on ILSENSE Pin. The overvoltage protection circuit is reseted if the DP pin goes to logic level "0".

Figure 2 : Overvoltage Protection

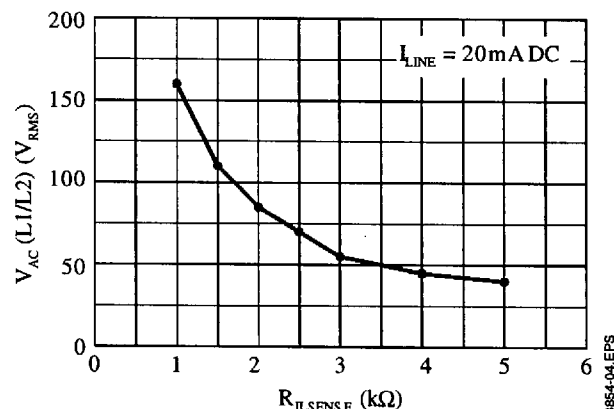


Figure 3 : French DC Mask

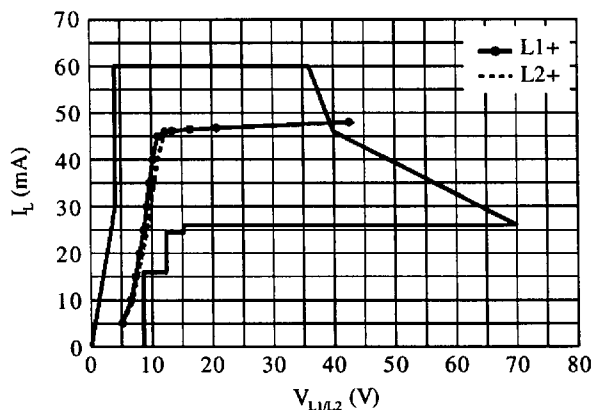


Figure 4 : French Incoming Call (Off-Hook with AC ring signal and DC exchange supply)

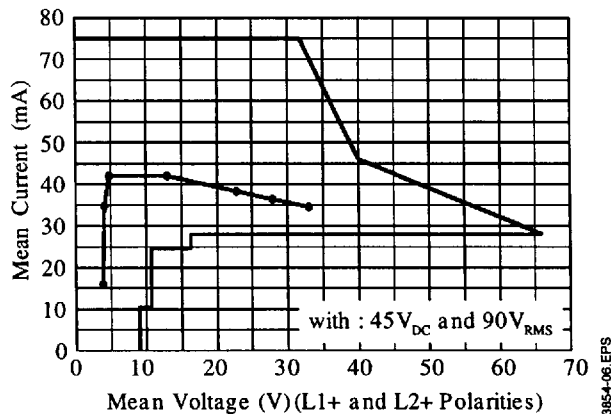


Figure 5 : ISW3 Current Information

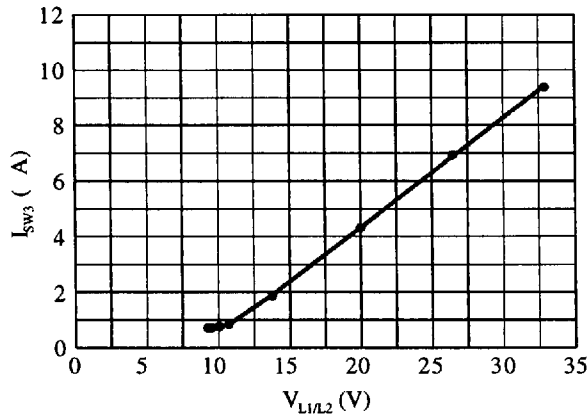


Figure 6 : V_{DD} Current Consumption

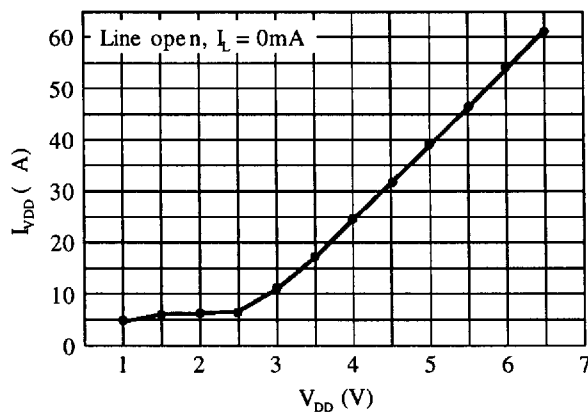


Figure 7 : V_{DD} Current Consumption

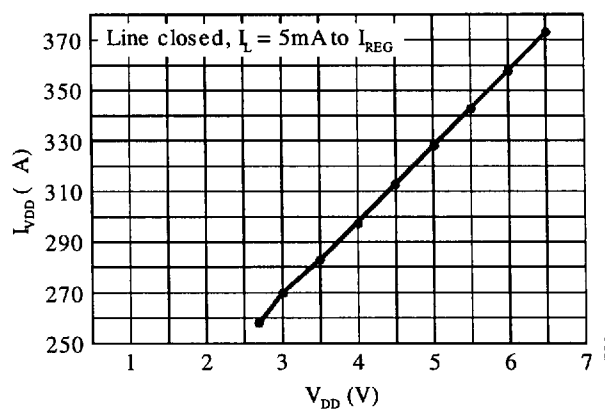
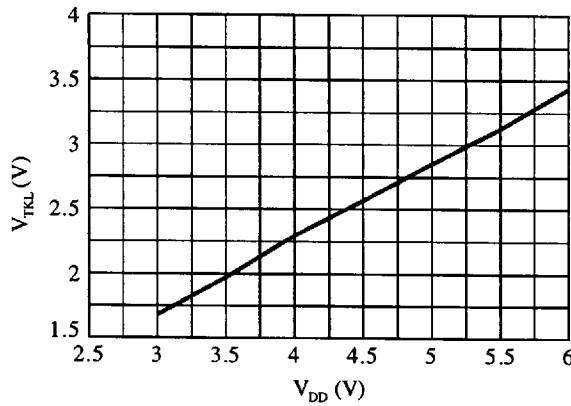
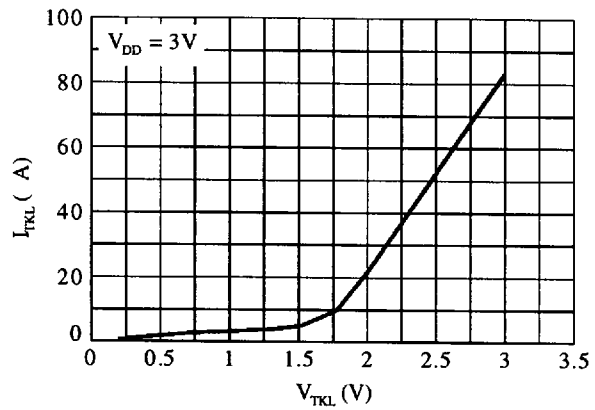


Figure 8 : TKL Pin - V_{TKL} Threshold ON



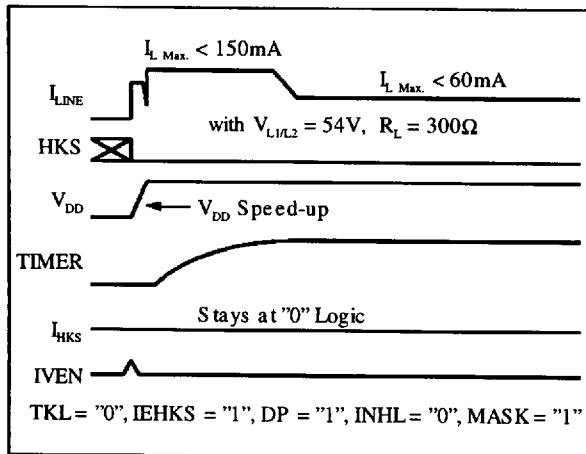
3854-12.EPS

Figure 9 : TKL Pin



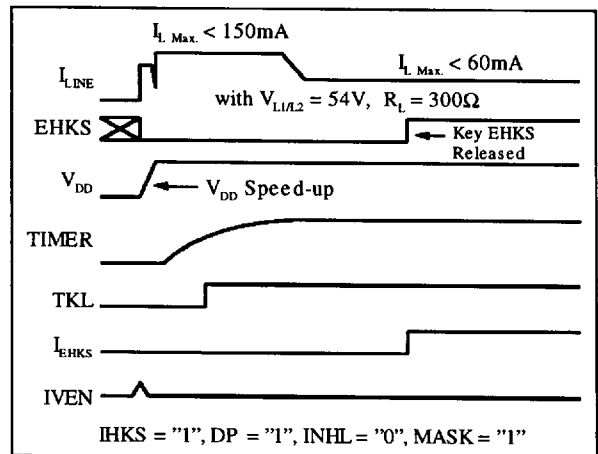
3854-13.EPS

Figure 10 : Off-Hook with mechanical hook switch



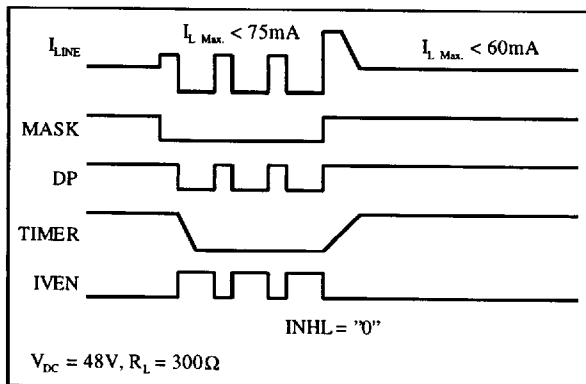
3854-10.EPS

Figure 11 : Off-Hook with EHKS key



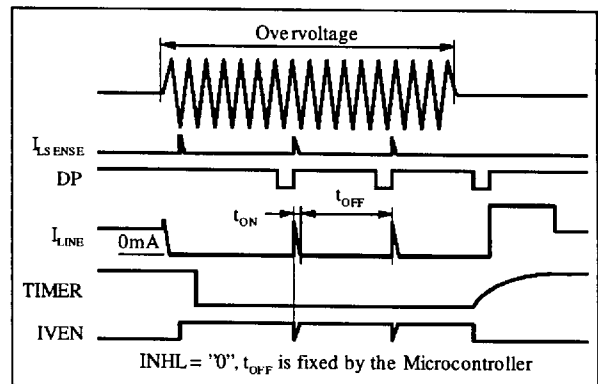
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Figure 12 : Pulse Dialing Mode



3854-14.EPS

Figure 13 : Overvoltage Protection Loop



3854-15.EPS

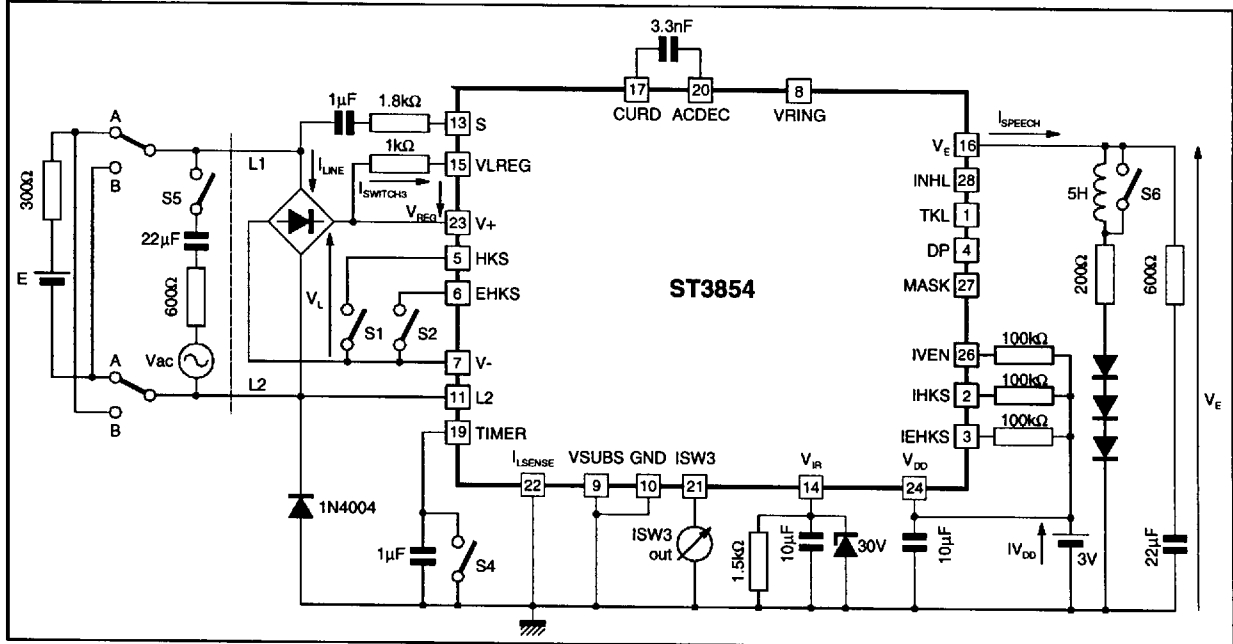
The ratio $\frac{t_{ON}}{t_{ON} + t_{OFF}}$ influences the power dissipated in the ST3854 device.

To limit the power dissipated in the ST3854, t_{OFF} should be higher than 200ms.

Note : If during t_{OFF} , V_{DD} voltage decreases lower than the speed up threshold, the internal latch is reseted, same action than DP pin.

TESTS

Figure 14 : Test 1



$$R_{SW1/2} = \frac{V_L - V_E}{I_{SPEECH}}, \quad R_{SW13} = \frac{V_{15} - V_E}{I_{SW13}}, \quad I_{BIAS} = I_{LINE} - I_{SPEECH}, \quad R_{ISW3} = \frac{I_{SW13}}{I_{SW3OUT}}$$

I_{TIM} is measured in S4 switch.

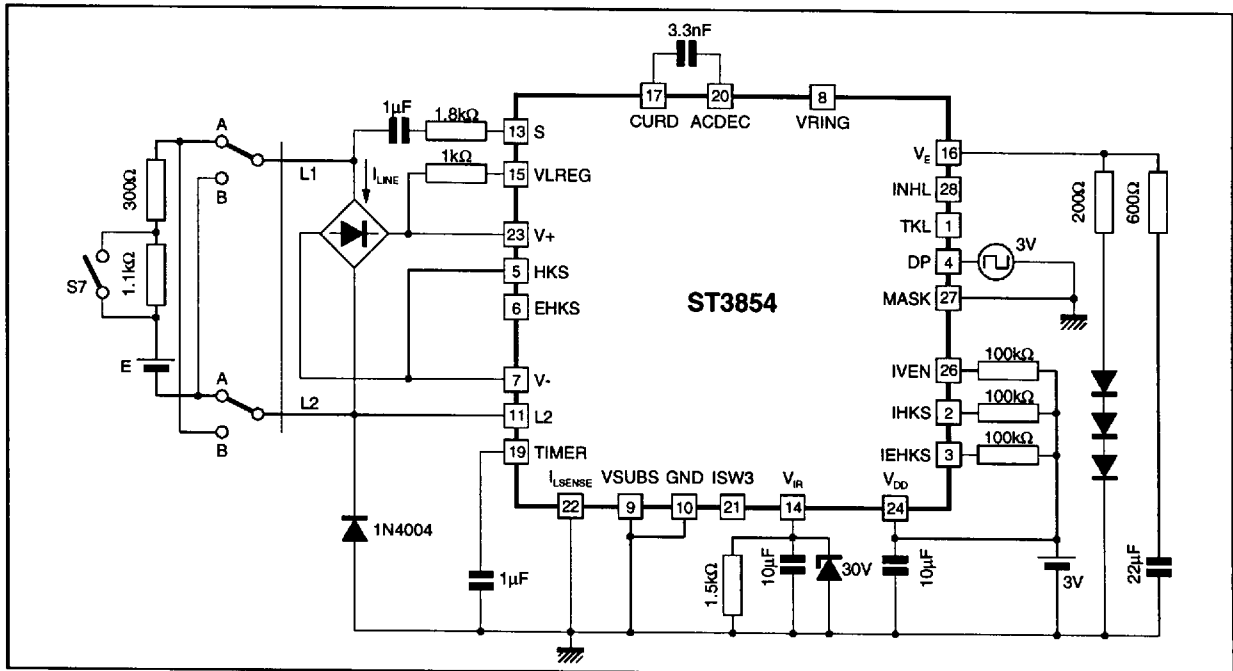
I_{REG} and I_{START} are line values which depend of the switch configuration.

All the parameters are measured in both polarities (S3 in A & B positions)

Parameters	S1	S2	S4	S5	S6
$R_{SW1/2} / I_{BIAS} / I_{VDD}$	Closed	Opened	Closed	Opened	Opened
$V_{E1} / V_{L1} / R_{SW13} / I_{REG} / R_{ISW3} / V_{DD} / V_{SUT}$	Closed	Opened	Opened	Opened	Opened
I_{REG}	Opened	Closed	Opened	Opened	Opened
$I_{LEAK} / R_{SOFF} / R_{SON}$	Opened	Opened	Opened	Opened	Opened
I_{START}	Closed	Opened	Closed	Opened	Closed
I_{TIM}	Closed	Opened	Closed (*)	Opened	Opened
ACatt / ACdist	Closed	Opened	Opened	Closed	Opened

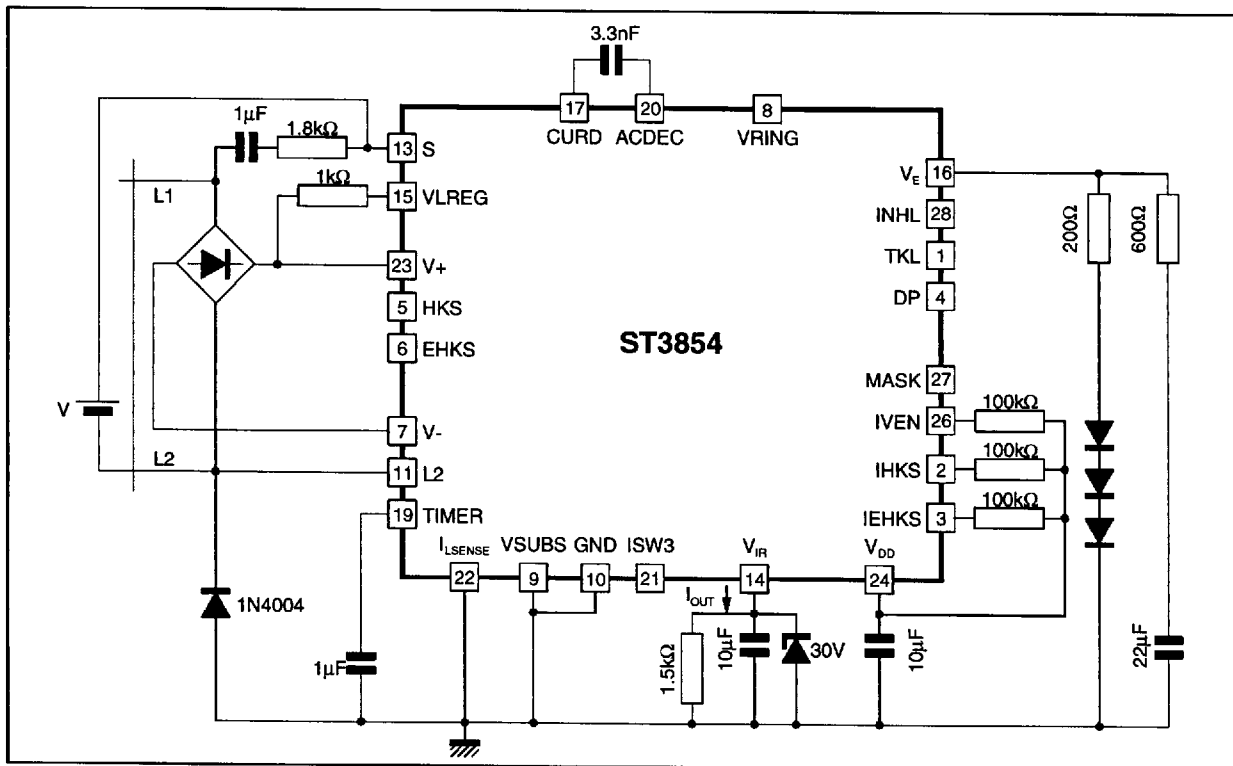
TESTS (continued)

Figure 15 : Test 2



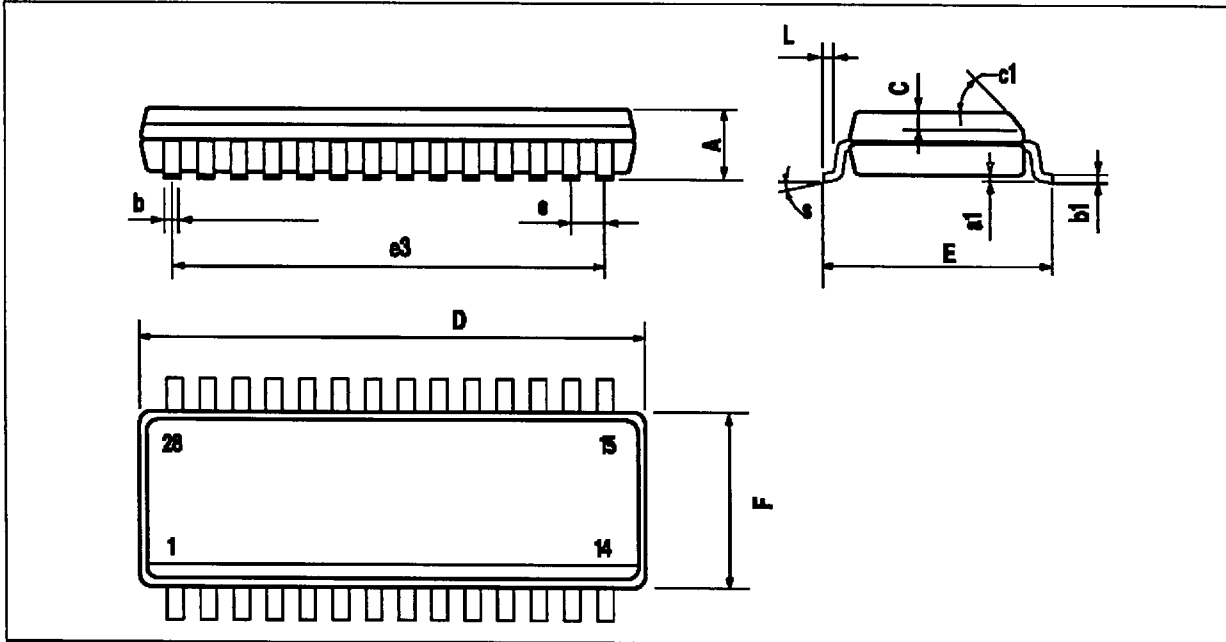
I_{mask} : S7 closed, I_{opl} : S7 opened

Figure 16 : Test 3



$$R_{sw15} = \frac{V - V_{IR}}{I_{OUT}}$$

PACKAGE MECHANICAL DATA
28 PINS - PLASTIC MICROPACKAGE (SO)



PM-S028.EPS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			2.65			0.104
a1	0.1		0.3	0.004		0.012
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1	45° (Typ.)					
D	17.7		18.1	0.697		0.713
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		16.51			0.65	
F	7.4		7.6	0.291		0.299
L	0.4		1.27	0.016		0.050
S	8° (Max.)					

SC028.TBL

ESD - The SGS-THOMSON Internal Quality Standards set a large of 2kV that each pin of the device should withstand in a series of test based on the Human Body Model (MIL STD 883 Method 3015) : with C = 100pF, R = 1500Ω and performing 3 pulses for each pin versus V_{cc} and GND.

Device characterization showed that, in front of the SGS-THOMSON Internal Quality Standards, all pins of ST3854 withstand at least 750V. The above points are not expected to represent a practical limit for the correct device utilization nor for its reliability in the field. Nonetheless they must be mentioned in connection with the applicability of the different SURE 6 requirements to ST3854.

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