SUBSCRIBER LINE INTERFACE CIRCUIT KIT

ADVANCE DATA

MAIN CHARACTERISTICS

- PROGRAMMABLE DC FEEDING RESISTANCE AND LIMITING CURRENT (four values available)
- THREE OPERATING MODES :
- STAND-BY, CONVERSATION, RINGING
  - 1. NORMAL/BOOST BATTERY : DIRECT/REVERSE POLARITY
  - 2. QUICK OFF-HOOK DETECTION IN CVS (1ms) FOR LOW DISTORTION DIAL PULSE DETECTION
  - 3. GROUND KEY DETECTION
- TELETAXE SIGNAL INJECTION WITH INTERNAL FILTER
- HYBRID FUNCTION
- RINGING GENERATION WITH QUASI ZERO OUTPUT IMPEDANCE, ZERO CROSSING INJECTION (no ext. relay needed) AND RING TRIP DETECTION
- AUTOMATIC RINGING STOP WHEN OFF-HOOK IS DETECTED
- SERIAL DIGITAL INTERFACE SLD BUS COMPATIBLE
- LOW NUMBER OF EXTERNAL COMPONENTS
- POSSIBILITY TO WORK ALSO WITH HIGH COMMON MODE CURRENTS
- INTEGRATED THERMAL PROTECTION
- GOOD REJECTION OF THE NOISE ON BATTERY VOLTAGE (20dB at 10Hz ; 40dB at 1kHz)

DESCRIPTION

The SLIC KIT (L3000/L3010) is a set of solid state devices designed to integrate many of the functions needed to interface a telephone line. It consists of 2 integrated devices ; the L3000 line interface circuit and the L3010 control unit

The kit implements the main features of the BORSHT functions :

- Battery feed (balance mode)
- Ringing
- Signalling
- Hybrid

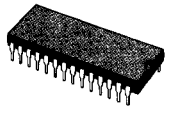
The SLIC KIT injects the ringing signal in balanced mode and requires a positive supply voltage of typically + 72V to be available on the subscriber card.

The L3000/L3010 KIT generates the ringing signal internally, avoiding the requirement for expensive external circuitry. A low level 1Vrms input is required.

This kit is fabricated using a 140V Bipolar technology for L3000 and a 12V Bipolar I2L technology for L3010.

This kit is suitable for all the following applications :

C.O. (Central Office), DLC (Digital Loop Carrier) and high range PABX (Private Automatic Branch Exchange).



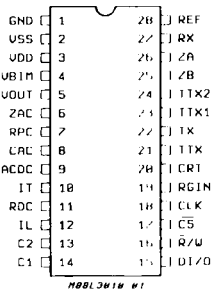
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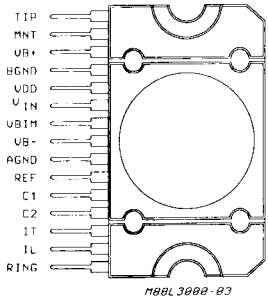


FLEXIWATT15

ORDER CODES :
L3010 (Dip28)
L3000 (Flexiwatt15)

PIN CONNECTION





ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_b-	Negative Battery Voltage	− 80	V
V_b+	Positive Battery Voltage	80	V
$\|V_b- \|+\| V_b+\|$	Total Battery Voltage	140	V
V_{dd}	Positive Supply Voltage	+ 5.5	V
V_{ss}	Negative Supply Voltage	− 5.5	V
$V_{agnd}-V_{bgnd}$	Max Voltage between Analog Ground and Battery Ground	5	V
T_j	Max Junction Temperature	+ 150	°C
T_{stg}	Storage Temperature	− 55 to + 150	°C

THERMAL DATA

L3000 HIGH VOLTAGE

R_{thjc}	Max Resistance Junction to Case	4	°C/W
R_{thja}	Max Resistance Junction to Ambient	50	°C/W

L3010 LOW VOLTAGE

R_{thja}	Max Resistance Junction to Ambient	80	°C/W

OPERATING RANGE

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{oper}	Operating Temperature Range	0		70	°C
V_b-	Negative Battery Voltage	− 70	− 48	− 24	V
V_b+	Positive Battery Voltage	0	+ 72	+ 75	V
$\|V_b- \|+\| V_b+\|$	Total Battery Voltage		120	130	V
V_{dd}	Positive Supply Voltage	+ 4.5		+ 5.5	V
V_{ss}	Negative Supply Voltage	− 5.5		− 4.5	V
I_{max}	Total Line Current (I_L + I_T)			85	mA

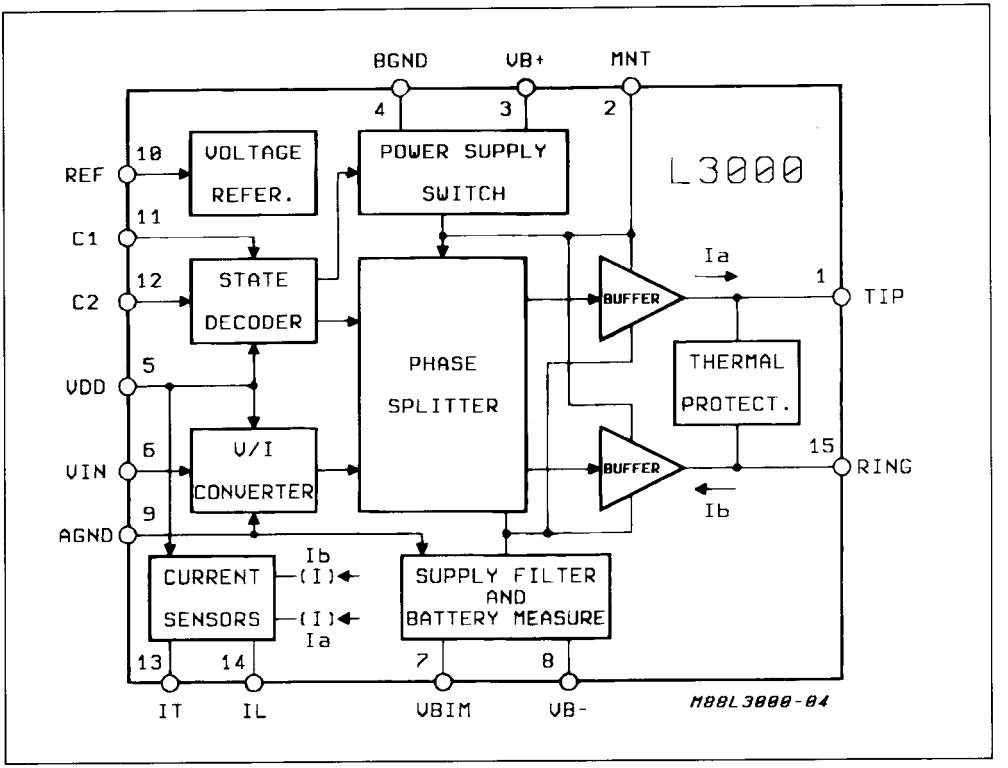
PIN DESCRIPTION (L3000)

N°	Name	Description
1	TIP	A line termination output with current capability up to 100mA (I_a is the current sourced from this pin).
2	MNT	Positive Supply Voltage Monitor
3	V_B+	Positive Battery Supply Voltage
4	BGND	Battery ground relative to the V_B+ and the V_B- supply voltages. It is also the reference ground for TIP and RING signals.
5	V_{DD}	Positive Power Supply + 5V
6	VIN	2 wire unbalanced voltage input.
7	VBIM	Output voltage without current capability, with the following functions : - give an image of the total battery voltage scaled by 40 to the low voltage part. - fliter by an external capacitor the noise on V_B-.
8	V_B-	Negative Battery Supply Voltage
9	AGND	Analog Ground. All input signals and the V_{DD} supply voltage must be referred to this pin.
10	REF	Voltage reference output with very low temperature coefficient. The connected resistor sets internal circuit bias current.
11	C1	Digital signal input (3 levels) that defines device status with pin 12.
12	C2	Digital signal input (3 levels) that defines device status with pin 11.
13	I_T	High precision scaled transversal line current signal. $I_T = \frac{I_a + I_b}{100}$
14	IL	Scaled longitudinal line current signal. $IL = \frac{I_a - I_b}{100}$
15	RING	B line termination output with current capability up to 100mA (I_b is the current sunk into this pin).

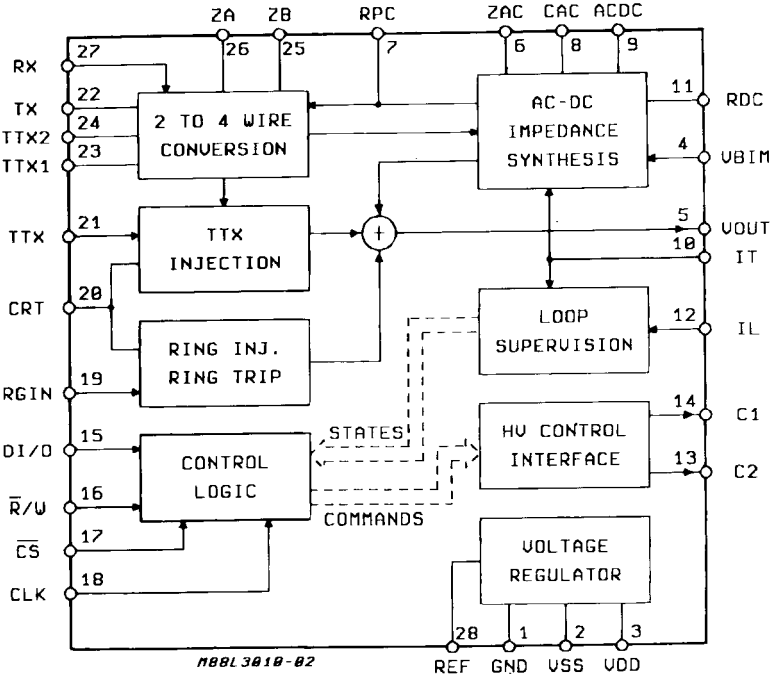
PIN DESCRIPTION (L3010)

N°	Name	Description
1	GND	Analog and Digital Ground
2	VSS	Negative Supply Voltage, – 5V
3	VDD	Positive Supply Voltage, + 5V
4	V_{BIM}	Battery voltage scaled by 40 input ; from L3000, pin 7.
5	VOUT	Two wire unbalanced output carrying out the following signals reduced by 40 : 1) DC voltage to perform the proper DC characteristic. 2) Ringing Signal 3) Voice Signal 4) Teletax Signal
6	ZAC	AC Line Impedance Synthesis
7	RPC	AC Line Impedance Adjustment. Protection Resistances Compensation
8	CAC	AC Feedback Input
9	ACDC	AC - DC Feedback Input
10	IT	Transversal Line Current Input $IT = \frac{I_a + I_b}{100}$
11	RDC	DC Feeding System
12	IL	Longitudinal Line Current Input $IL = \frac{I_a - I_b}{100}$
13	C2	State Control Signal 2
14	C1	State Control Signal 1. Combination of C1 and C2 define operating mode of the high voltage part.
15	DI/O	data Input/output of the Serial Digital Interface
16	$\overline{R}$/W	Read/write Input of the Serial Digital Interface
17	$\overline{CS}$	Chip Select Input
18	CLK	Clock Input of the Serial Digital Interface
19	RGIN	Low Level Ringing Signal Input
20	CRT	Ring Trip Detection and TTX Shoping
21	TTX	Teletaxe Signal Analog Input
22	TX	Transmit Amplifier Output
23	TTX1	Teletaxe Filter
24	TTX2	Teletaxe Filter
25	ZB	Two to four wire conversion Circuit Inputs
26	ZA	Two to four wire conversion Circuit Inputs
27	RX	Receiving Input
28	REF	Bias Setting Pin

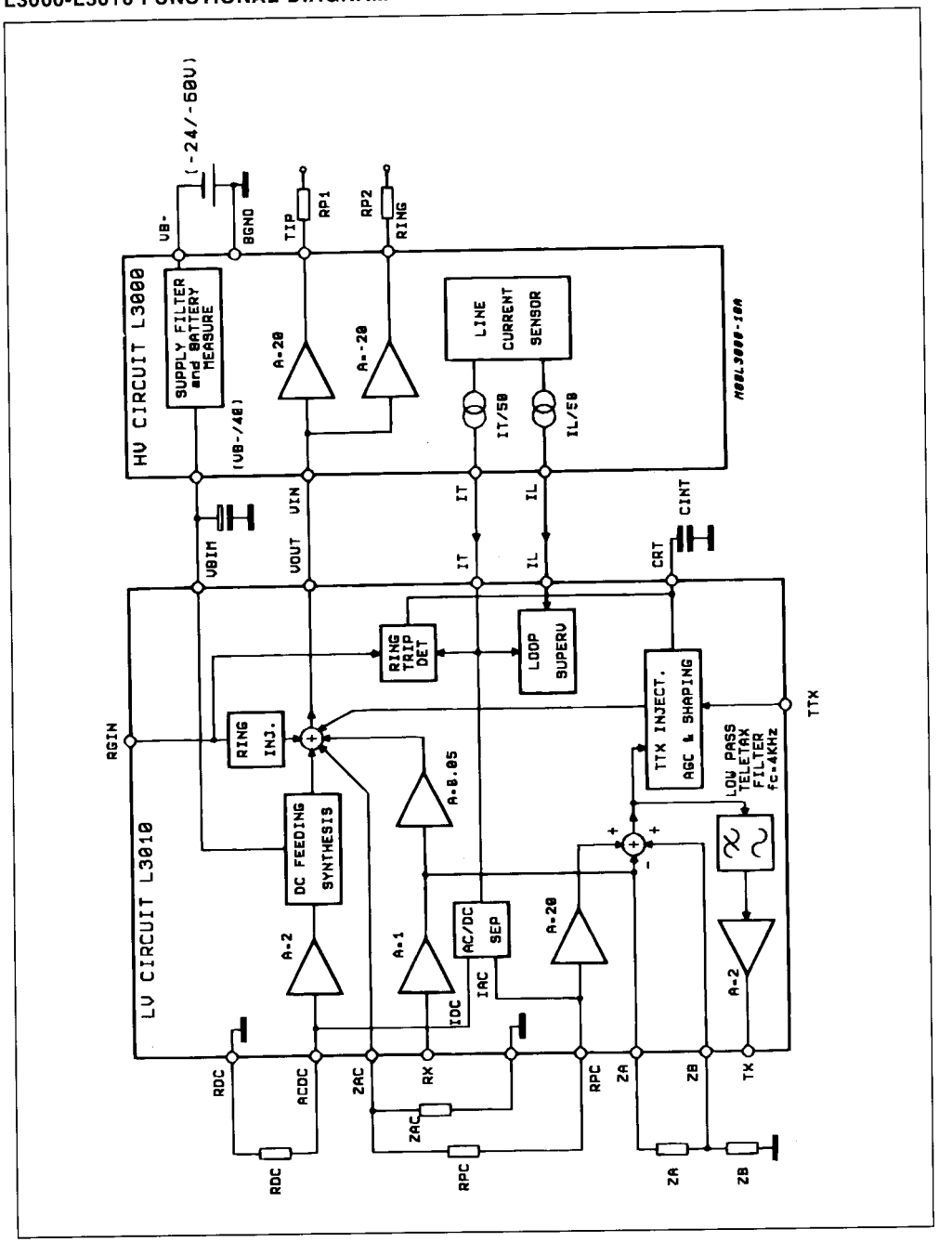
L3000 BLOCK DIAGRAM



L3010 BLOCK DIAGRAM



L3000-L3010 FUNCTIONAL DIAGRAM



FUNCTIONAL DESCRIPTION

L3000 - HIGH VOLTAGE CIRCUIT

The L3000 line interface provides a battery feeding for telephone lines and ringing injection. The IC contains a state decoder that under external control can force the following operational modes : stand-by, conversation and ringing.

In addition Power down mode can be forced connecting the bias current resistor to VDD by an external transistor.

Two pins, I_L and I_T, carry out the information concerning line status which is detected by sensing the line current into the output stage.

The L3000 amplifies both the AC and DC signals entering at pin 6 (VIN).

Separate grounds are provided :

- Analog ground as a reference for analog signals
- Battery ground as a reference for the output stages

The L3000 can work with a (DC + AC) voltage signal up to 5V between the two grounds.

L3010 - LOW VOLTAGE CIRCUIT

The L3010 Low Voltage Control Unit controls the L3000 line interface module, giving the proper informations to set line feed characteristic, to inject the ringing and the teletaxe signals and synthesizes the line and the balance impedances.

An on-chip digital serial interface allows the L3010 to be directly connected to a SLD Bus Interface or to a microprocessor to control all the operations.

L3010 defines working states of line interface and also informs the controller about line status.

WORKING STATES OF THE KIT

In order to carry out the different possible operations, the ST SLIC kit has several different working states. Each state is defined by the voltage respectively applied by pins 14 and 13 of L3010 to the pins 11 and 12 of L3000.

Three different voltage levels (– 5, 0, + 5) are available at each connection, so defining nine possible states as listed in tab. 1.

Table 1.

		Pin 13 of L3010 / Pin 12 of L3000		
		+ 5	0	– 5
Pin 14 of L3010	+ 5	Stand-by	Conversation NB-DP	Conversation NB-RP
	0	Not Used	Conversation BB-DP	Conversation BB-RP
Pin 11 of L3000	– 5	Not Used	Ringing DP	Ringing RP

NB : Normal Battery
BB : Boosted Battery
NP : Normal Polarity
RP : Reverse Polarity

Appropriate combinations of two pins define the three status of the kit, that are :

a) Stand-by (SBY)

b) Conversation (CVS)

c) Ringing (RING)

A fourth status Power down (PD) can be set disconnecting the bias resistor (RH) from pin 10 of L3000 through an external transistor.

The main difference between Stand-by and Power down is that in SBY the power consumption on the voltage battery VB– (– 48V) is reduced but the SLIC can recognize yet the On hook/off hook status. In PD the power consumption on VB- is reduced to zero, but none operation can be performed by the SLIC.

The SBY status should be used when the telephone is in on hook and PD status only in emergency condition when it is mandatory to cut any possible dissipation but no operation are requested.

OPERATING MODES

STAND-BY (SBY) MODE

In this mode the bias currents of both L3000 and L3010 are reduced as only some parts of the two circuits are completely active, control interface and current sensors among them.

The Line Feeding DC Characteristics has two region :

a) Current limiting region with a DC impedance very high (> 20KΩ). The value of the limiting line current is fixed at 10mA.

b) A low resistive region where the equation for the line voltage is equal to

$$V_{LINE} = (|VBAT| - 10) - I_{LINE} * \frac{2}{3} (R_{FS} + 2R_P)$$

The AC characteristic in Stand-by corresponds to a low impedance (2xRP).

In Stand-by mode the Line Voltage Polarity is just in direct condition, that is the TIP wire more positive than the RING one.

The ON/OFF HOOK detection circuit is active and provide at the digital interface the ON-HOOK indication when the Transversal lime current is lower than 6mA and the OFF-HOOK indication when it is higher than 7.5mA.

When the ST SLIC is in Stand-by mode, the power dissipation of L3000 does not exceed 200mW (from – 48V) eventually increased of a certain amount if some current is flowing into the line.

The power dissipation of the L3010 in the same condition is typically 120mW.

CONVERSATION (CVS) MODE

In conversation Mode it is possible to select between two different DC characteristics (Normal and Boost battery) and the polarity of the DC Line Voltage.

As far as the DC characteristic in Normal Battery is concerned three different feeding conditions are present :

a) Current limiting region : the DC impedance of the SLIC is very high (> 20KΩ) and therefore the system works like a current generator. The limiting current value is defined by programmation via the serial digital interface and selected among the four following values : 30/45/60/70mA.

b) A resistive feeding region : the characteristic $V_{LINE} = F(I_{LINE})$ is :

$V_{LINE} = 46V - 2RFS * I_{LINE}$. This part of the DC characteristic does not depend of the Battery Voltage value.

c) A low resistive Feeding region : the Line Voltage is equal to :

$$V_{LINE} = (|VBAT| - 10) - I_{LINE} * \frac{2}{3} (R_{FS} + 2R_P)$$

Switching between the three regions is automatic without discontinuity, and depends on the loop resistance.

Figure 1 : DC Characteristics in Stand-by Mode.

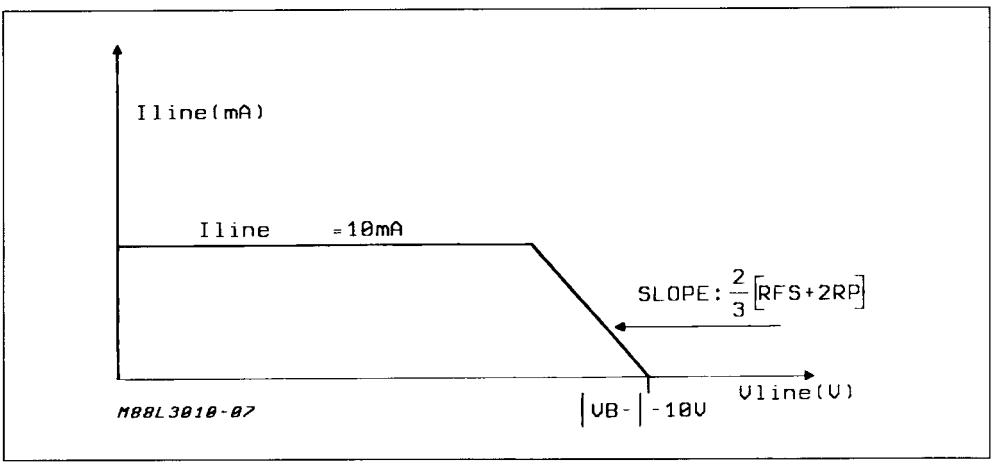


Figure 2 : DC Characteristic in Conversation Mode - R_{FS} = 200Ω ; R_P = 30Ω ; VB– = –48V.

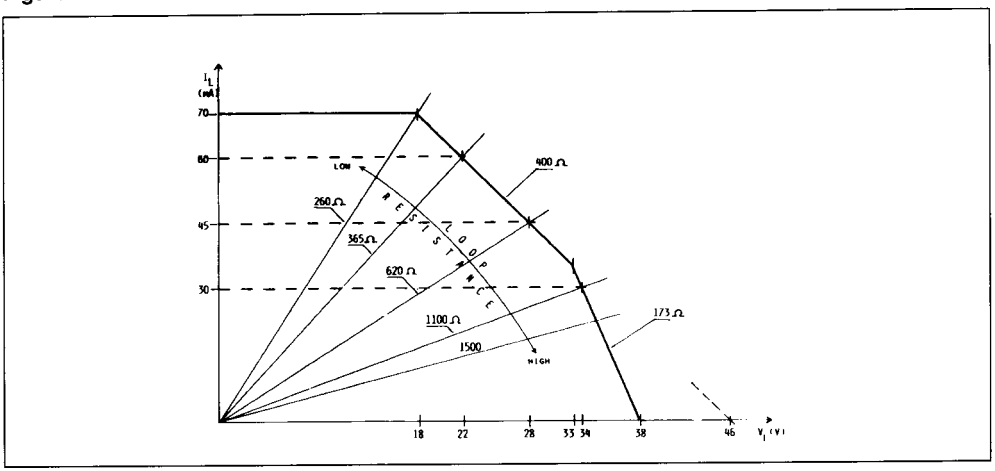
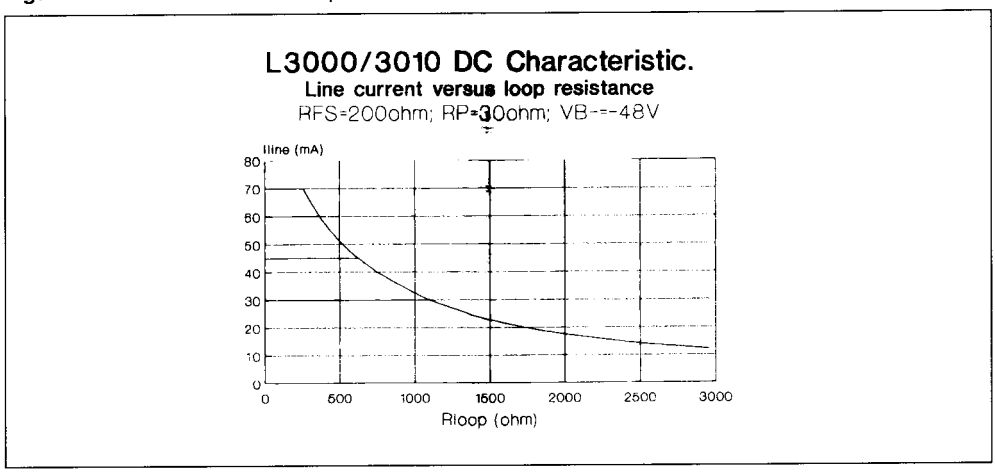


Figure 3 : Line Current versus Loop Resistance - R_{FS} = 200Ω ; R_P = 30Ω ; VB– = –48V.



In Boost Battery the DC characteristic has two Feeding conditions :

a) current limiting region : it has the same characteristics as in Normal Battery

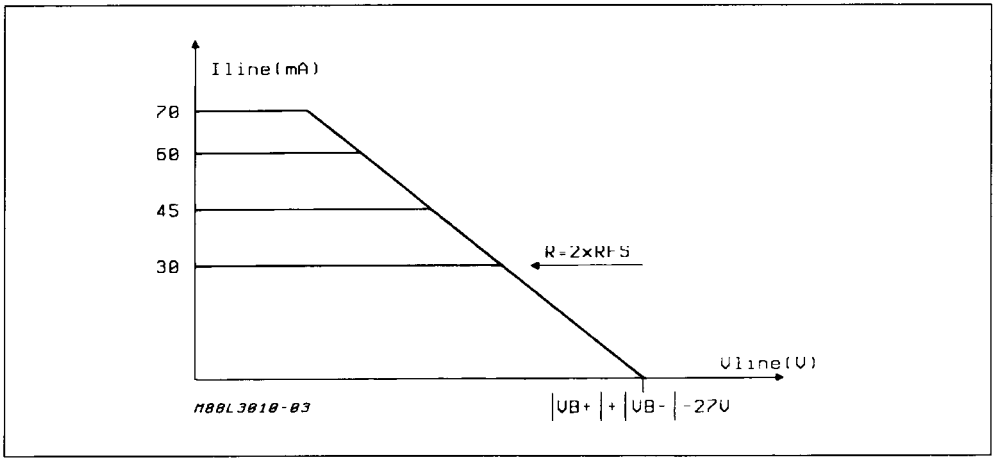
b) resistive Feeding region : the Line Voltage is

$V_{LINE} = (|V_{B-}| + |V_{B+}| - 27V) - I_{LINE} \times 2 \times R_{FS}$

In conversation mode, whatever the condition (normal or boost battery, direct or reverse polarity), it is always possible to inject into the line the 12Khz (or 16Khz) signal with a level of 1Vrms, permanently applied at the L3010's pin 21, as metering pulses, when request by the control processor (through BIT3 set to "1"). A patented automatic control system adjusts the level of the metering signal to contain 2Vrms across the line, regardless of impedance. Moreover the metering signal is ramped at the beginning and at the end of each pulse to prevent undesirable clicking noise : the slope is determined by the value of CINT (see the external component list of L3010).

The metering pulse signals and the AC transmitting and receiving signals can be injected or received from the line also with a DC Line current equal to zero. This allows the ON-HOOK Transmission Function.

Figure 4 : DC Characteristic in Boost Battery Mode.



In conversation mode the AC impedance at the line terminals is synthesized by the external components ZAC and RP, according to the following formula :

$$ZML = \frac{4}{5} Z_{AC} + 2 \times RP$$

Depending on the characteristic of the ZAC network, ZML can be either a pure resistance or a complex impedance. This allows the SLIC to meet different standards as far as the return loss is concerned. The capacitor CCOMP guarantees stability to the system.

The two to four wire conversion is achieved by means of a circuit that can be represented as a Wheatstone bridge the branches of which being :

1) The line impedance (Zline),

2) The SLIC impedance at line terminals (ZML),

3) The balancing network ZA connected between the pin 25 (ZB) and the pin 26 (ZA) of L3010,

4) The network ZB between the pin 25 (ZB) and ground that shall copy the line impedance.

It is important to underline that ZA and ZB are not equal to ZML and to Zline. They both must be multiplied by a factor in the range up to 10, allowing use of smaller capacitors.

In conversation mode, the L3000 dissipates about 500mW for its own operation. The dissipation related to the current supplied to the line shall be added, in order to get the total dissipation. In the same condition the power dissipation of L3010 is typically 200mW.

RINGING MODE

When the ringing function is selected by the control processor a low level signal (1Vrms) with a frequency in the range from 16 to 70Hz, permanently applied to the L3010 (pin RGIN), is amplified and injected in balanced mode into the line through the L3000 with a super imposed DC voltage of 22V.

It is important to underline that the low level ringing signal must be always connected to the pin RGIN also when the SLIC is not in Ringing Mode.

The first and the last ringing cycles are synchronized by the L3010 so that the ringing signal always starts and stops when the line voltage crosses zero.

When this mode is activated, the L3000 operates between the negative and the positive battery voltages, typically - 48V and + 72V, and the impedance to the line is just equal to the two external resistors (typ. = 60 ohm).

There is a sophisticated ring trip detection circuit insensitive to the parasitic noise on the line. The ring trip principle is as follows :

- 1 - During the ringing signal injection at the beginning of each period the voltage across the external capacitor CINT connected between ground and pin 20 (CRT) of L3010 is reset to 0V.
- 2 - The transversal Line Current is sensed, therefore the ring trip detection is not sensitive to the longitudinal current.
- 3 - A fraction of the line current is sent to the ext. capacitor CINT.
- 4 - At the end of each period the voltage across CINT is measured. If it is under a certain value (250mV) the procedure restart as at point - 1 -. If the voltage is higher of 250mV the ringing signal is automatically suspended for three periods and the SLIC is programmed in Conversation Mode.
- 5 - At the end of the third period the On Hook/Off Hook detection circuit checks the line status.
- 6 - If the Off-hook condition is confirmed it sets the BIT 0 (HS Hook Status) of the internal reading register.
- 7 - If the Off-Hook condition is not confirmed the SLIC automatically will come back in Ringing Mode and the ringing signal will be re-injected into the line.

In order to performs the Off-Hook detection in one period the value of the capacitor CINT must be choosen in function of the ringing frequency.

(see external component list table).

DIGITAL CONTROL INTERFACE BETWEEN THE SLIC AND THE BOARD CONTROLLER

The programmable functions of the SLIC are controlled by a microprocessor or a Board Controller through a 4-Wire serial bus SLD compatible.

The four pins have following functions :

CLK : Shift Clock (512kHz max)

$\overline{CS}$: Chip select (active low)

DI/O : Bidirectional pin : data-in (8 bit), data-out (4-bit)

$\overline{R}/W$: $\overline{R}/W = 0$ read operation ; $\overline{R}/W = 1$ writing operation.

The data are shifted into and read by the low voltage L3010- on the falling edge of each CLK pulse, if $\overline{CS} = 0$ and $\overline{R}/W = 1$.

The data are shifted out from L3010 on the rising edge of each CLK pulse, if $\overline{CS} = 0$ and $\overline{R}/W = 0$.

DATA INPUT

One byte can be written into the SLIC to program its functions.

The following table shows the meaning of each bit.

Table 1.

Input Data				
Meaning	**Value**			
BIT 0 = Activation	0 : stand-by			
	1 : power up			
BIT 1 = Battery Polarity	0 : normal Pol. (tip to ground)			
	1 : reverse Pol. (ring to ground)			
BIT 2 = Ringing	0 : ring off			
	1 : ring on			
BIT 3 = Teletaxe	0 : teletaxe off			
	1 : teletaxe on			
BIT 4 = Extra Feeding	0 : normal battery			
	1 : boost battery			
BIT 5	0	0	1	1
BIT 6	0	1	0	1
Line Current Limiting	30mA	45mA	60mA	70mA
BIT 7 = Parity Control	0 : $\sum_{0\text{-}6}$ bit = ODD			
	1 : $\sum_{0\text{-}6}$ bit = EVEN			

Notes : 1. The BIT0 is the first bit to be sent to the L3010 and the BIT7 is the last.
2. In Conversation Mode and in Ringing Mode the BIT0 must be set to "1".
3. BIT7 is the parity control bit. It must be set to 0 if the number of ones into the previous bits from BIT0 to BIT6 is odd.

DATA OUTPUT

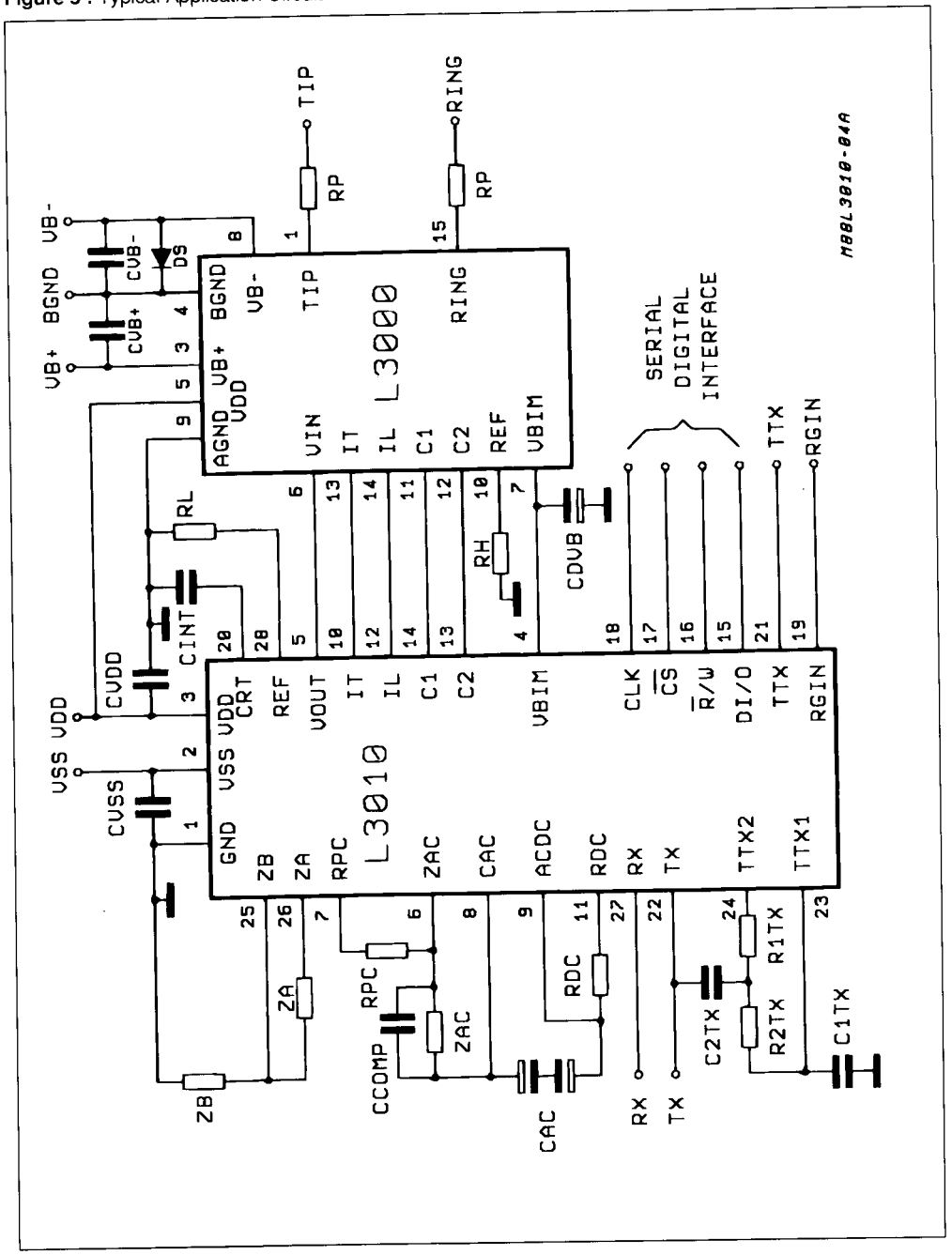
Four bits can be read from the SLIC as shown in the following table 2.

Table 2.

Input Data	
Meaning	**Value**
BIT 0 = Line Supervision (note 1)	0 : on-hook
	1 : off-hook
BIT 1 = Line Current > 60mA (note 2)	0 : off
	1 : on
BIT 2 = Ground Key Detection (note 3-4)	0 : long. Line Curr. < Iline/2.5
	1 : long. Line Curr. > Iline/2
BIT 3 = Previous Word	0 : not accepted
	1 : accepted

Notes : 1. The BIT0 is the first that L3010 send in the output
2. If the line current exceeds 60mA. BIT1 = 1
3. This relation is valid for line current over 5mA
4. The longitudinal current is defined as follows $I_{GDK} = (I_A - I_B)/2$
where I_A is the current sourced from the TIP pin and I_B is the current sunk into the RING pin

Figure 5 : Typical Application Circuit.



EXTERNAL COMPONENTS LIST

To set up the SLIC kit into operation, the following parameters have to be defined :

- The DC feeding resistance RFS, defined as the resistance of each side of the traditional feeding system (most common value for RFS are 200, 400 or 500 ohms).
- The AC input/output SLIC impedance at line terminals, ZML, to which the return loss measurement is refered. It can be real (typically 600 ohms) or complex.
- The equivalent AC impedance of the line Zline used for evaluation of the trans-hybrid loss (2/4 wire conversation). It is usually a complex impedance.
- The frequency of the ringing signal Fr (SLIC can work with this frequency ranging from 16 to 68Hz).
- The metering pulse frequency F_t (two values are possible : 12kHz and 16kHz.
- The value of the two resistors RP in series with the line terminals ; main purpose of the a.m. resistors is to allow primary protection to fire. A minimum value of 30 ohm for each side is suggested.

With these assumptions, the following component list is defined :

EXTERNAL COMPONENT LIST FOR THE L3000

Component		Involved Parameter or Function
Ref	**Value**	
RH	24.9KΩ ± 2%	Bias Resistor
RP	30 to 100Ω	Line Series Resistor
CDVB	47µF – 20WV ± 20%	Battery Voltage Rejection
CVB + (note 1)	0.1µF – 100WV ± 20%	Positive Battery Filter
CVB – (note 1)	0.1µF – 100WV ± 20%	Negative Battery Filter
DS (note 1)	BAT 49	Protective Shottky Diode

EXTERNAL COMPONENT LIST FOR THE L3010

Component		Involved Parameter or Function
Ref	**Value**	
CVSS	0.1µF – 15WV (note 1)	Negative Supply Voltage Filter
CVDD	0.1µF – 15WV (note 1)	Positive Supply Voltage Filter
CAC	47µF – 10WV ± 20%	AC Path Decoupling (not polarised)
ZAC	(ZML – 2xRP) x 1.25	2 Wire AC Impedance
CCOMP	$\frac{1}{6.28 \times 30000 \times ZAC}$	AC Loop Compensation
RPC	RP x 2.5	R_p Insertion Less Compensation
RDC	(RFS – RP) x 1.25	DC Feeding Resistor
RL	24.9KΩ 1%	Bias Resistor
ZB	K Z_{LINE} (note 2)	Line Impedance Balancing Network
ZA	$0.8 \times K \times RPC + (0.8 \times K \times ZAC \,//\, \frac{CCOMP}{0.8 \times K})$	Line Impedance Balancing Network
C1 TX C2 TX R1 TX R2 TX	15nF 1% 15nF 1% 1.3KΩ 1% 2.21KΩ 1%	Teletaxe Filter (12kHz) (note 4)
CINT	(note 5)	Ring Trip Detection Time Constant

Notes :
1. In most applications these components can be shared between all the SLIC's on the Subscriber Card.
2. The structure of this network shall copy the line impedance Z_{LINE}, multiplied by a factor K=1 to . 10.
3. The structure of this network shall copy the SLIC output Impedance ZML multiplied by a factor K = 1 to 10 and compensate the effect of CCOMP on transhybrid rejection.
4. If the Teletex Filter is not used, pin 23 must be connected to the pin 24 and the ext. component can be avoided.
5. CINT value depends on the ringing frequency Fr :

Fr (Hz)	16/19	19/23	23/27	27/34	34/41	41/49	49/61	61/68
CINT (nF)	470	390	330	270	220	180	150	120

ELECTRICAL CHARACTERISTICS

VDD = + 5V ; VSS = – 5V ; VB+ = + 72V ; VB– = – 48V ; Tamb = + 25°C)

STAND-BY

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
VLS	Output Voltage at L3000 Terminals	I line = 0mA	37		39	V
ILCC	Short Circuit Current				12	mA
Iot	Off-hook Detection Threshold		6		7.5	mA
Hys	Off-hook/on-hook Hysteresis		1.5		2.5	mA
Vls	Symmetry to Ground	I line = 0mA			.75	V

DC OPERATION - NORMAL BATTERY

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
VLO	Output Voltage at L3000 Line Terminals	I line = 0mA Data in 1X000XXX	37		39	V
Ilim	Current Program through the Digital Interface	Data in 1X000XXX	I_{LIM} – 10%	I_{LIM}	I_{LIM} + 10%	mA
Iot	Off-hook Detection Threshold		7.5			mA
Hys	Off-hook/on-hook Hysteresis		1.5		2.5	mA
Ilgk	Longitudinal Line Current with GDK Detect	I_{line} > 5mA	$\frac{I_{LINE}}{2.6}$		$\frac{I_{LINE}}{2.2}$	mA

DC OPERATION - BOOST BATTERY

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{LO}	Output Voltage at L3000 Line Terminals	I_{LINE} = 0mA	90		96	V
		I_{LINE} = 20mA RFS = 200Ω	81		89	V

AC OPERATION

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Ztx	Sending Output Impedance on TX	Data in 1X000XXX			15	Ω
THD	Signal Distortion at 2W and 4W Terminals	Vtx = 0dBm @ 1020Hz			0.5	%
Rl	2W Return Loss	f = 300 to 3400Hz	20			dB
Thl	Transhybrid Loss	f = 300 to 3400Hz	24			dB
Gs	Sending Gain	Vso = 0dBm f = 1020Hz	– 0.25		+ 0.25	dB
Gsf	Sending Gain Flatness vs. Frequency	f = 300 to 3400Hz Respect to 1020Hz	– 0.1		+ 0.1	dB
Gsl	Sending Gain Linearity	fr = 1020Hz Vsoref = – 10dBm Vso = + 4/– 40dBm	– 0.1		+ 0.1	dB

ELECTRICAL CHARACTERISTICS (continued)

AC OPERATION (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Gr	Receiving Gain	Vri = 0dBm ; F = 1020Hz	– 0.25		+ 0.25	dB
Grf	Receiving Gain Flatness	f = 300 to 3400Hz Respect to 1020Hz	– 0.1		+ 0.1	dB
Grl	Receiving Gain Linearity	fr = 1020Hz Vriref = – 10dBm Vri = + 4/– 40 dBm	– 0.1		+ 0.1	dB
Np4W	Psophomet. Noise 4W - Tx Terminals			– 75	70	dBmop
NP2W	Psophomet. at Line Terminals			– 75	70	dBmop
SVRR	Supply Voltage Rejection Ratio Relative to VB–	Vn = 0.7Vrms F = 3400Hz F = 1000Hz F = 10Hz			 – 36 – 40 – 20	dB
SVRR	Relative to VDD	F = 3400Hz Vn = 100mVrms			– 20	dB
SVRR	Relative to VSS				– 20	dB
Ltc	Longitudinal to Transversal Conversion	F = 300 to 3400Hz I line = 30mA ZML = 600Ω	49 (*)	60		dB
Tlc	Transversal to Longitudinal Conversion		49 (*)	60		dB
Td	Propagation Time	Both Direction			40	µs
Tdd	Propagation Time Distortion				25	µs
Vttx	Line Voltage of Teletaxe Signal	Z_{LINE} = 200Ω	1.8		2.2	V
THD	Teletaxe Signal Harmonic Dist.				5	%
Zitt	Teletaxe Amplif. Input Impedance		100			KΩ

(*) : up to 52dB using selected L3000.

AC OPERATION BOOST BATTERY

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Gs	Sending Gain	Vso = 0dBm f = 1020HZ	– 0.5		+ 0.5	dB
Gr	Receiving Gain	Vri = 0dBm f = 1020HZ	– 0.5		+ 0.5	dB
Np4W	Psophometric Noise at 4W-Tx Terminals				– 68	dBmp
Np2W	Psophometric Noise at line Terminals			– 73	– 68	dBmp
SVRR	Supply Voltage Rejection Ratio Relative to VB+ (fig. 15)	V = 100mVrsm f = 3400Hz			– 30	dB
SVRR	Relative to Vdd	f = 3400Hz Vs = 100mVrms			– 20	dB
SVRR	Relative to Vss				– 20	dB

ELECTRICAL CHARACTERISTICS (continued)

RINGING PHASE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Vlr	Superimposed DC Voltage	Rloop > 100KΩ	19		30	V
		Rloop = 1KΩ	17		28	V
Vacr	Ringing Signal at Line Terminal	V_{RGIN} = 1Vrms/30Hz Rloop = 1kΩ + 1μF	56	60		Vrms
If	DC Off-hook Del Threshold		1.7		2.3	mA
Ilim	Output Current Capability		85		130	mA
Vrs	Ringing Voltage Symmetry				2	Vrms
THDr	Ringing Signal Distorsion				5	%
Zir	Ringing Amplicat. Input Impedance	Pin RGIN	50			KΩ
Vrr	Residual of Ringing Signal at Tx Output				600	mVrms
Trt	Ring Trip Detection Time	fring = 25Hz (T = 1/fring) CRT = 330nF			80(2T)	ms
Toh	Off-hook Status Delay after the Ringing Stop				120(3T)	μs

SUPPLY CURRENT

Symbol	Parameter		Min.	Typ.	Max.	Unit
I_{DD}	Positive Supply Current	Stand-by		16.3		mA
	CS = 1	Conversation (NB/BB)		26.4		mA
		Ringing		26.4		mA
I_{SS}	Negative Supply Current	Stand-by		9.5		mA
	CS = 1	Conversation (NB/BB)		18		mA
		Ringing		18		mA
I_{BAT-}	Negative Battery Supply Current	Stand-by		2.9	4	mA
	Line Current = ØmA	Conversation NB		9.8	12	mA
		Conversation BB		13	16	mA
		Ringing		26	28.5	mA
I_{BAT+}	Positive Battery Supply Current	Stand-by		10	15	μA
	Line Current = ØmA	Conversation NB		10	15	μA
		Conversation BB		8	10	mA
		Ringing		16	18.5	mA

NB = Normal Battery
BB = Boosted Battery

DIGITAL INTERFACE ELECTRICAL CHARACTERISTICS

(VDD = + 5V, ± 5% ; VSS = – 5V, ± 5% ; Tamb = 0 to + 70°C)

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Vil	Input Voltage at Logical "0"	Pins 15, 16, 17, 18	0		0.8	V
Vih	Input Voltage at Logical "1"		2.0		5	V
Iil	Input Current at Logical "0"	Vil = 0V			200	µA
Iih	Input Current at Logical "1"	Vih = 5V			40	µA
Vol	Output Voltage at Logical "0"	Pin 15 Iout = – 1mA			0.4	V
Voh	Output Voltage at Logical "1"	Pin 15 Iout = 1mA	2.4			V
Ilk	Tristate Leak Current	Pin 15 with NCS = "1"			10	µA

DINAMIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
fclk	CKL Signal Frequency		1		512	Khz
Tr, Tf	CLK Rise and Fall Time				50	ns
Twh, Twl	CLK Impulse Width		800			ns
Tec	"1" RW to CKL Set up Time		100			ns
Tsc	CS to CLK Set up Time		0			ns
Tsk	CS to CLK Set up Time		400			ns
Tsd	Data in Set up Time		0			ns
Thd	Data in Hold Time		300			ns
Tcs	CS to CKL Hold Time		0		400	ns
Tca	RW to CKL Hold Time		200			ns
Tac	RW to CKL Set up Time		100			ns
Tzd	Data out to CS Delay		0		600	ns
Tce	RW to CKL Hold Time		200			ns
Tdz	High Imp. to CS Delay		50		200	ns
Tdd	Data out to CKL Delay		400		800	ns

Figure 6 : Writing Operation Timing (from controller to slic).

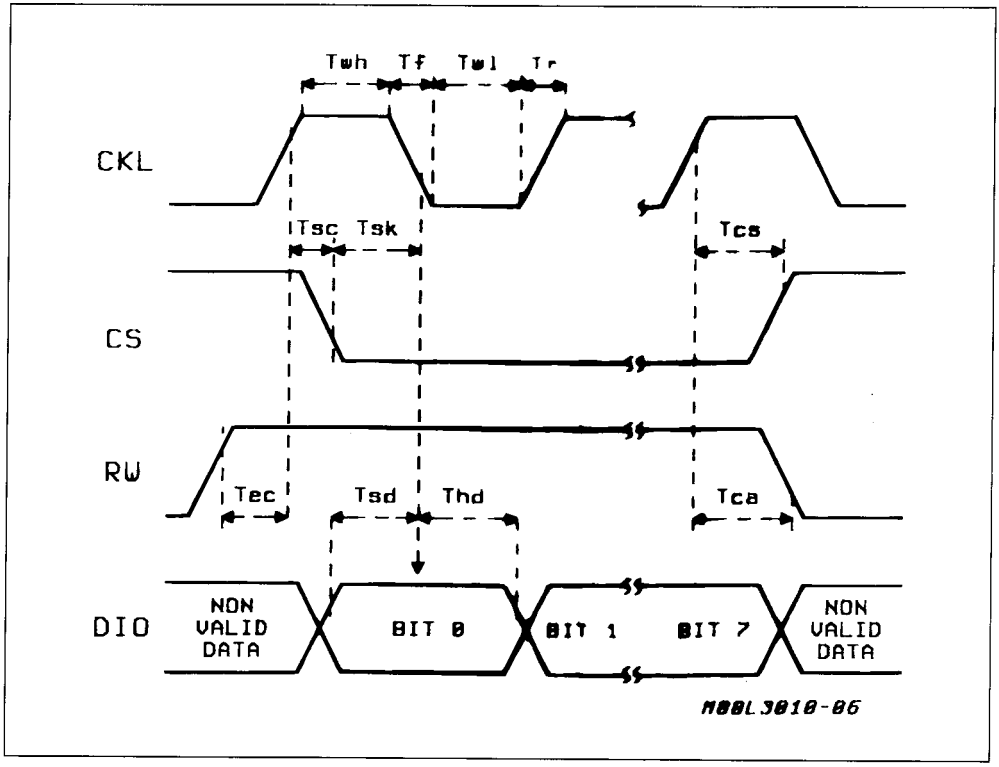


Figure 7 : Reading Operation Timing (from slic to controller).

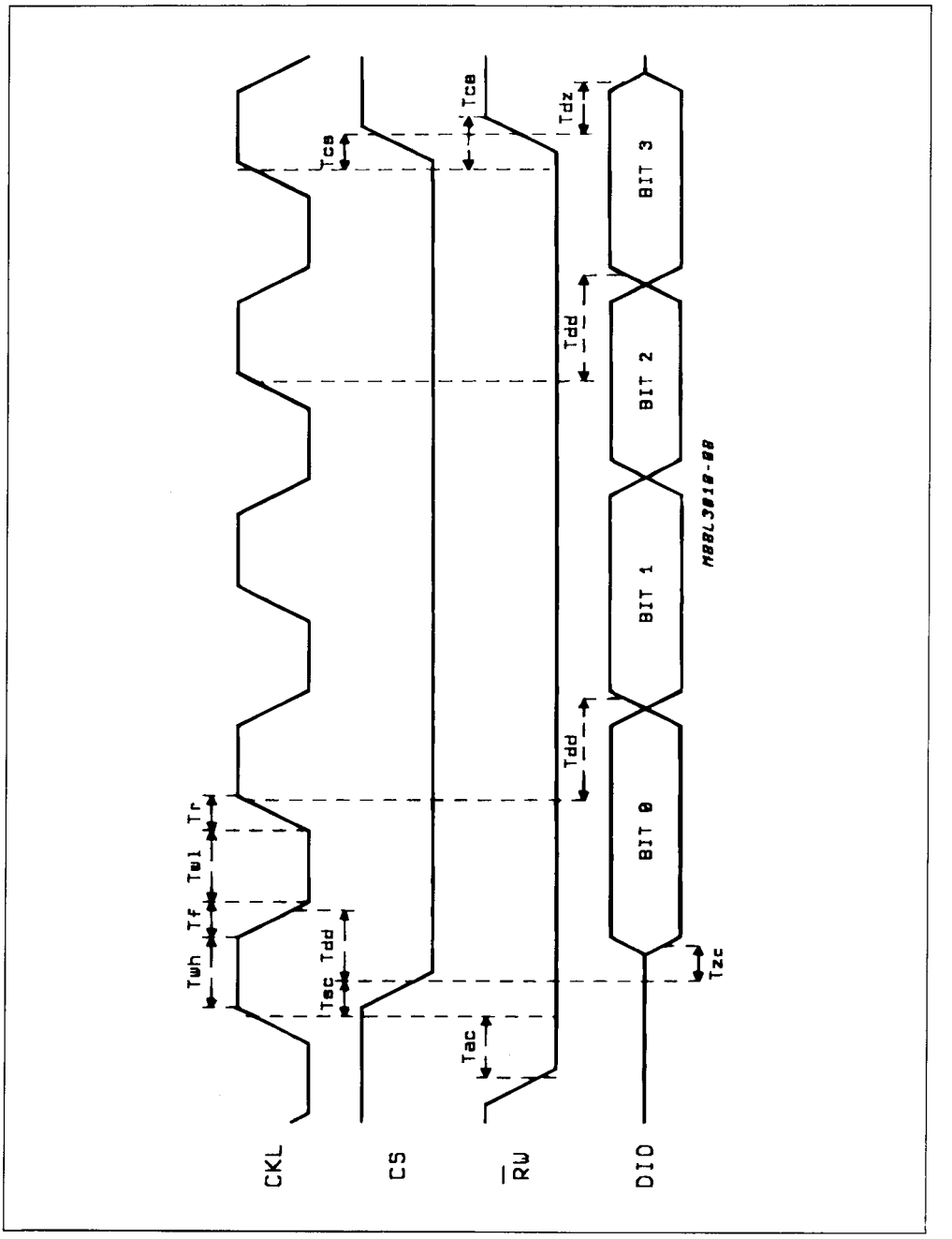
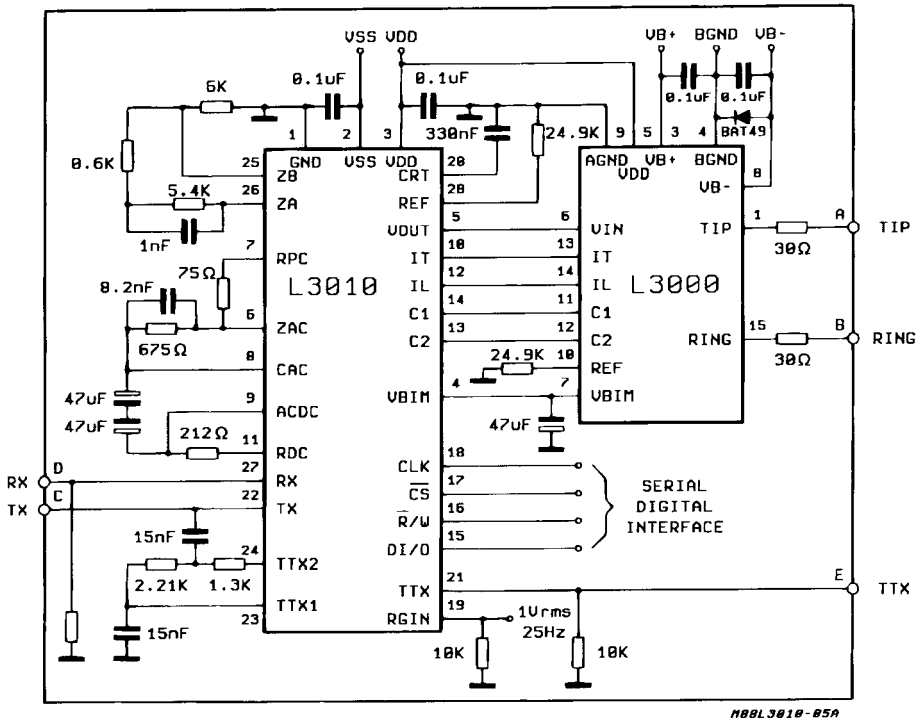


Figure 8 : Slic Test Circuit Schematic.



APPENDIX

SLIC test circuits

Referring to the test circuit reported at the end of each SLIC data sheet here below you can find the proper configuration for each measurement.

In particular : A-B : Line terminals

C : T_X sending output on 4W side

D : R_X receiving input on 4W side

E : T_{TX} teletaxe signal input

R_{GIN} : low level ringing signal input

TEST CIRCUITS

Figure 1 : Symmetry to Ground.

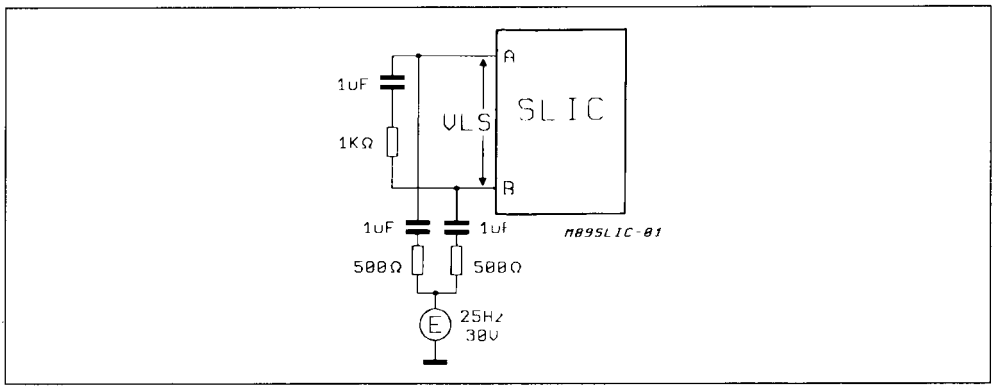
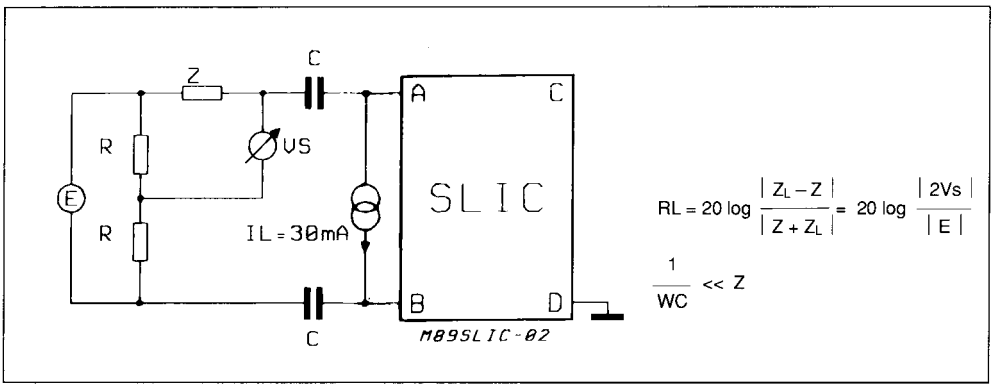


Figure 2 : 2W Return Loss.



TEST CIRCUITS (continued)

Figure 3 : Trans-hybrid Loss.

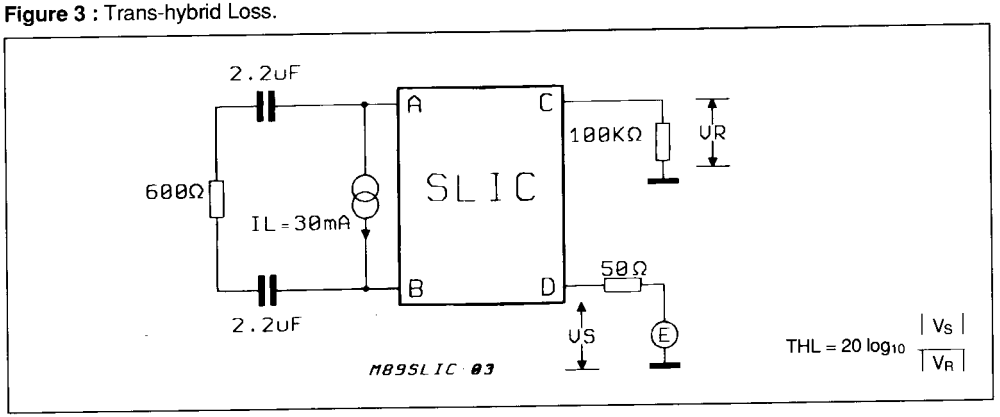


Figure 4 : Sending Gain.

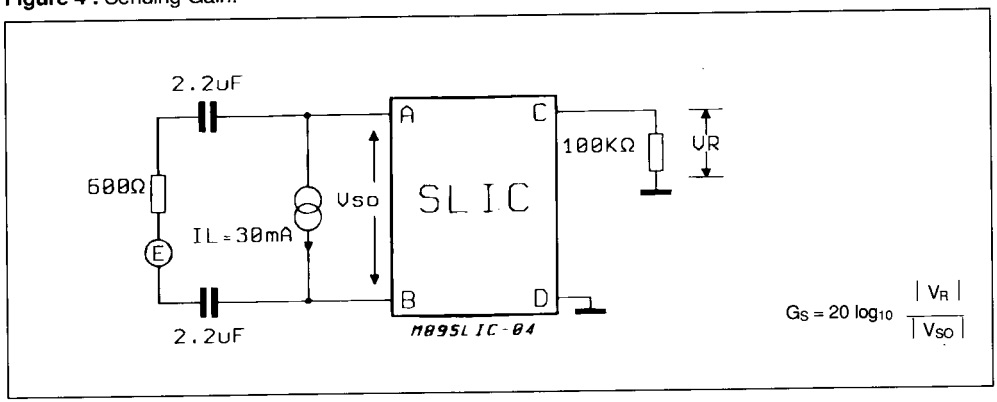
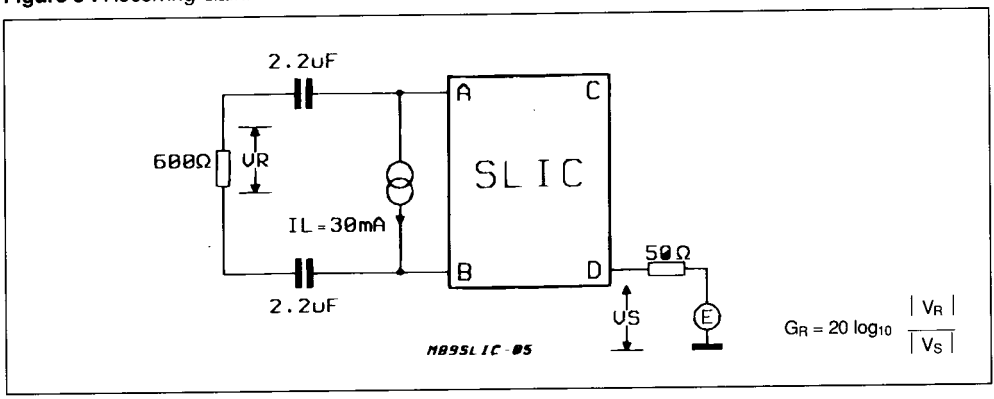


Figure 5 : Receiving Gain.



TEST CIRCUITS (continued)

Figure 6 : SVRR Relative to Battery Voltage VB–.

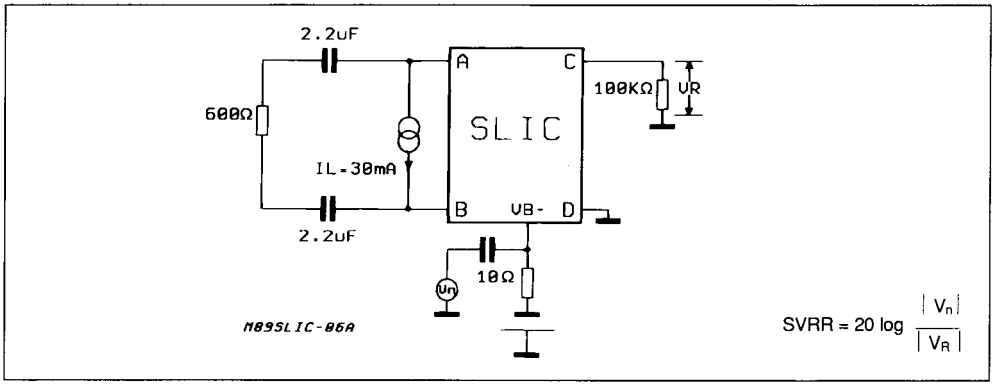


Figure 7 : Longitudinal to Transversal Conversion.

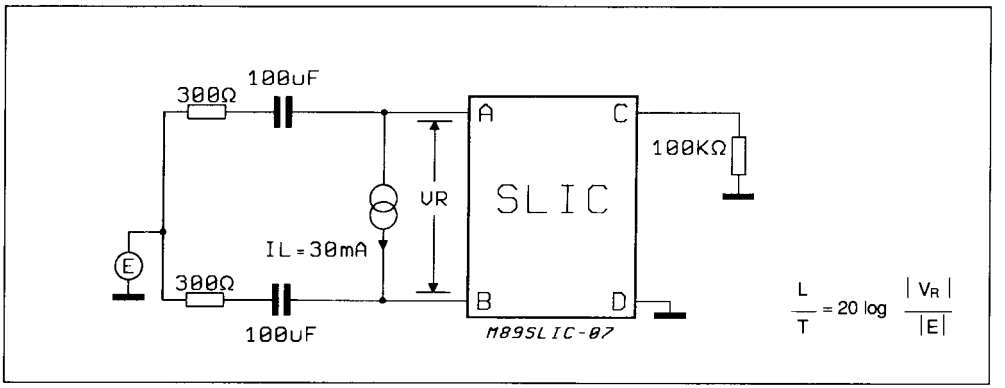
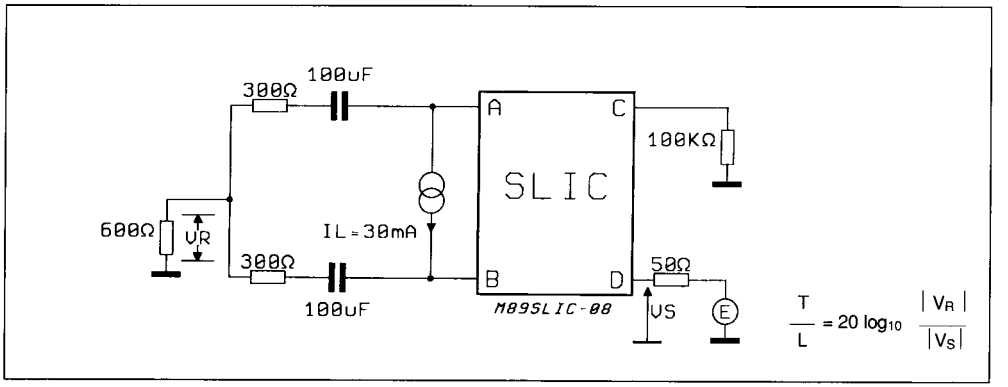


Figure 8 : Transversal to Longitudinal Conversion.



TEST CIRCUITS (continued)

Figure 9 : TTX Level at Line Terminals.

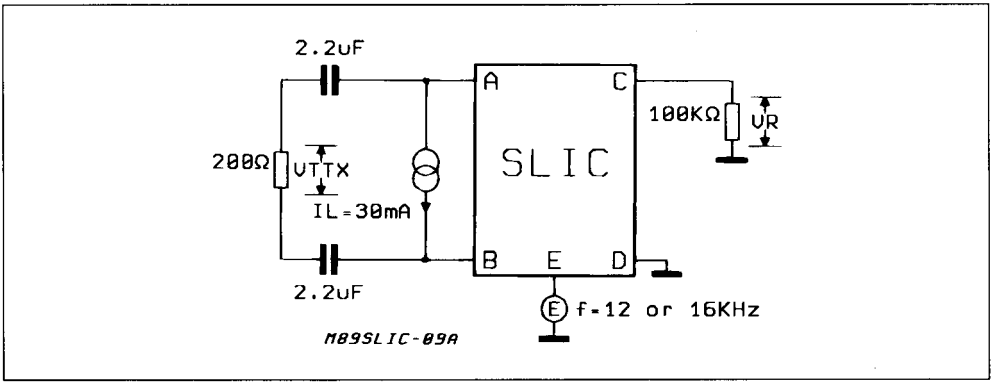
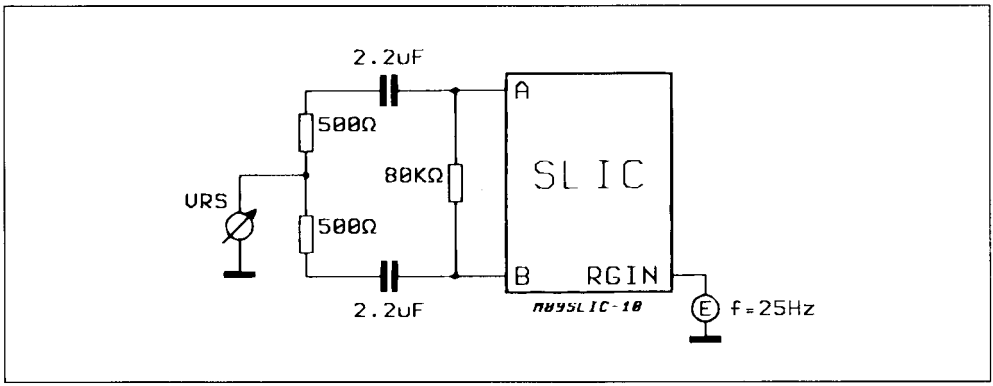


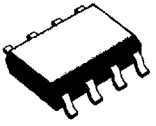
Figure 10 : Ringing Simmetry.

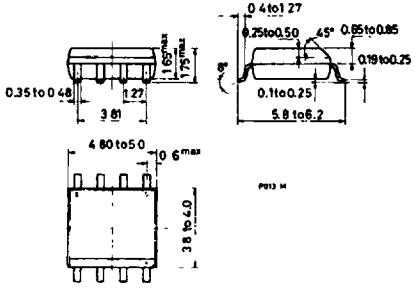


T-90-20

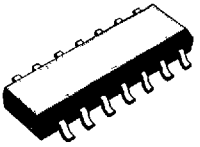
S G S-THOMSON

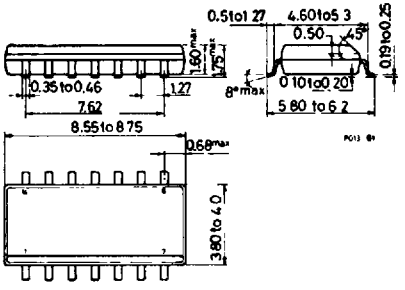
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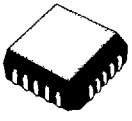


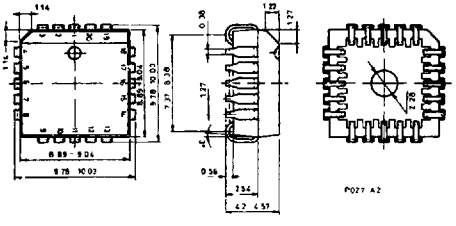
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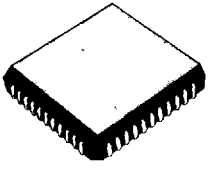


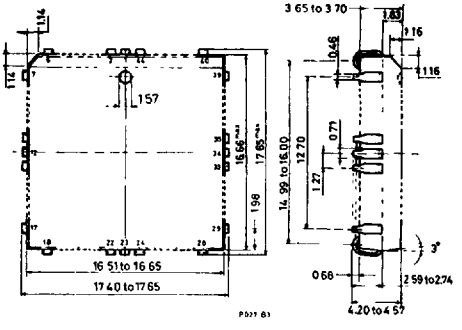
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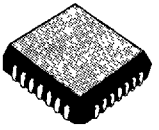


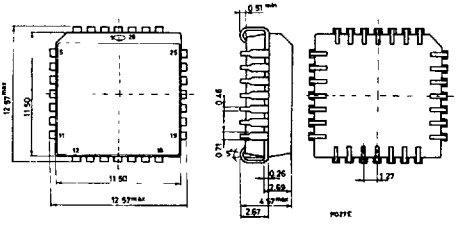
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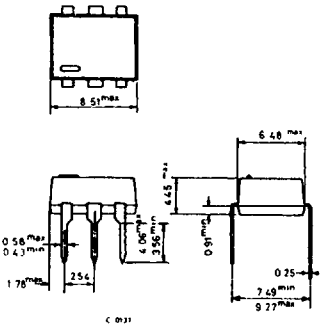
PLCC-28 Plastic Chip Carrier



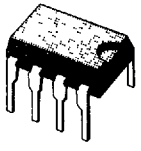


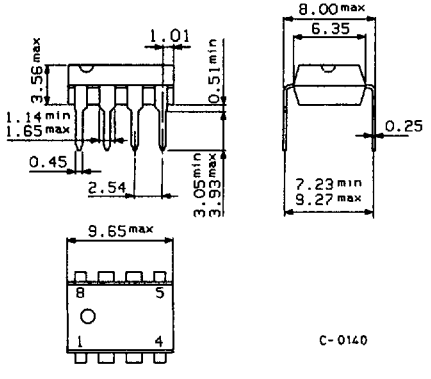
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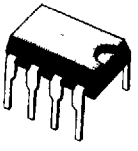


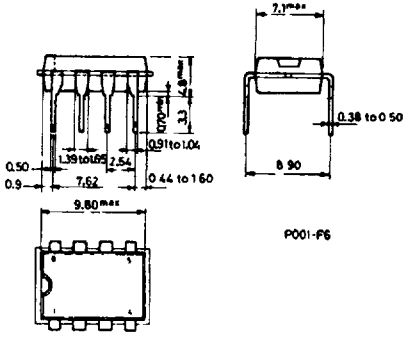
Minidip A Plastic



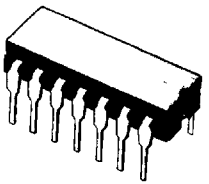


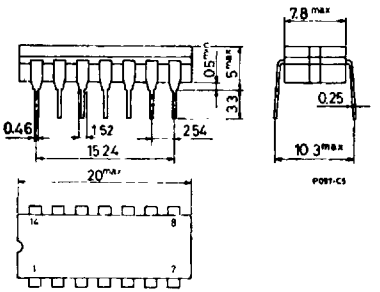
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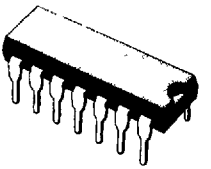


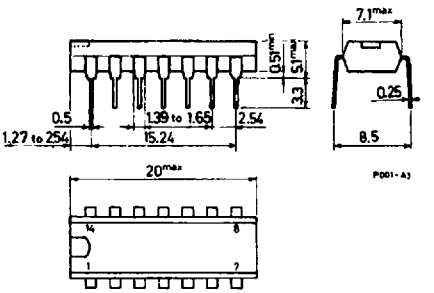
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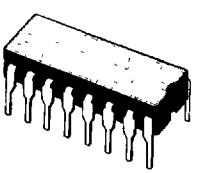


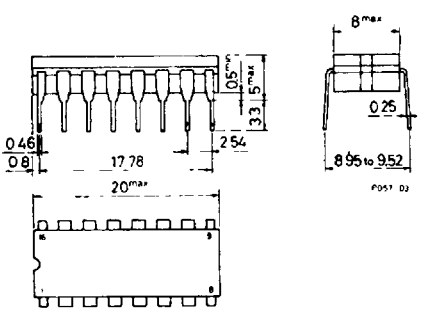
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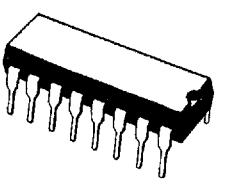


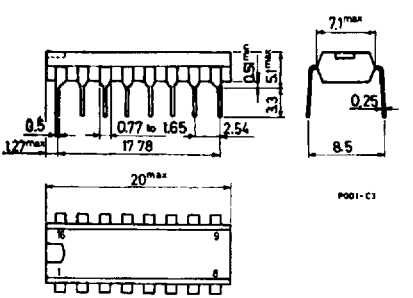
16 lead Ceramic Dip



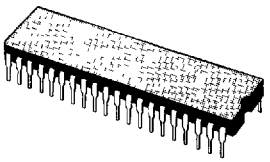


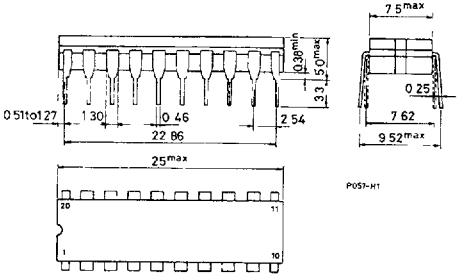
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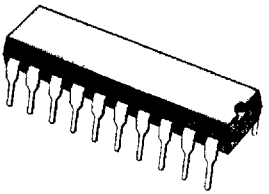


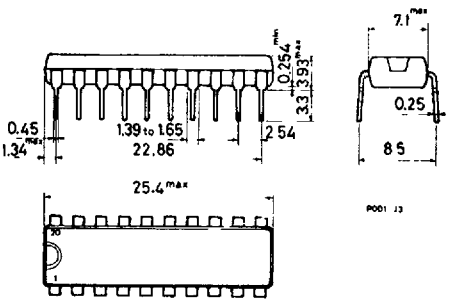
DIP-20 Ceramic



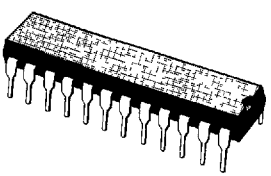


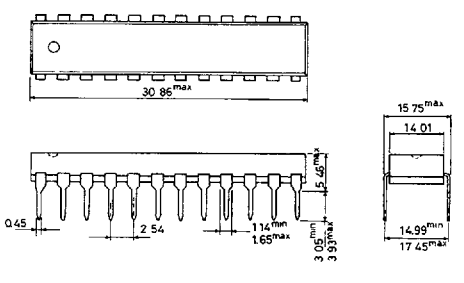
20 lead Plastic Dip (0.25)



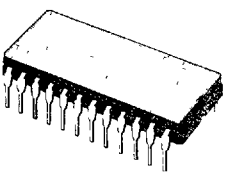


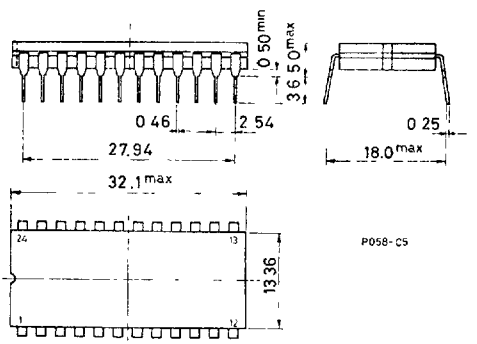
DIP-24 Plastic



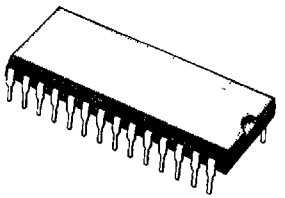


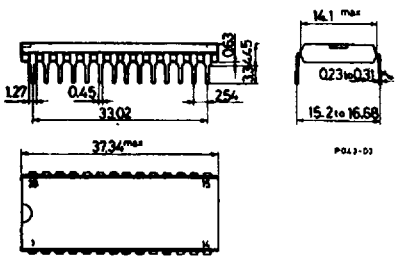
DIP-24 Ceramic (0.25)



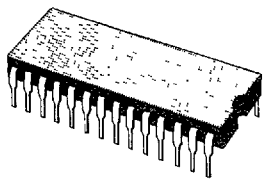


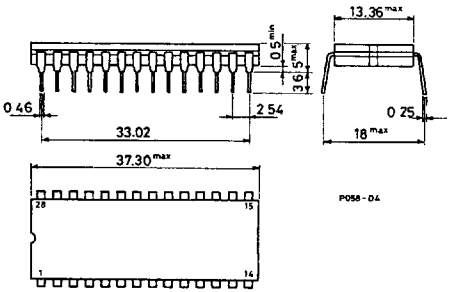
28 lead Plastic Dip



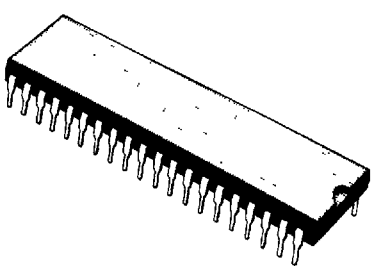


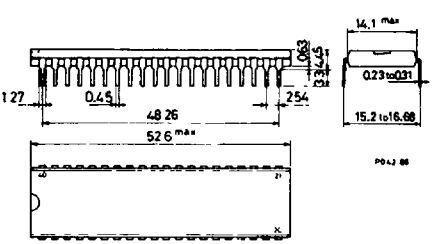
DIP-28 Ceramic (0.25)



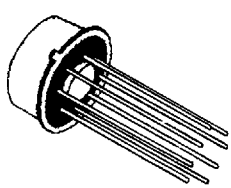


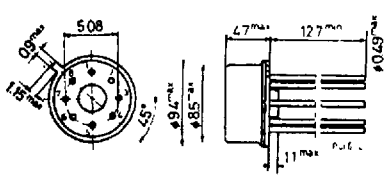
40 lead Plastic Dip





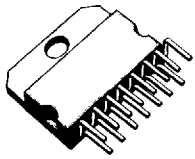
TO-99

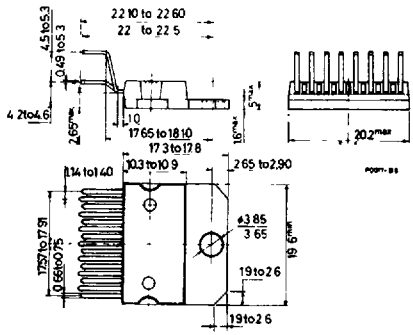




PACKAGES

MULTIWATT-15





FLEXIWATT-15

