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APPLICATION NOTE

L 3845 FOR PABX AND MODEM LINE INTERFACE APPLICATIONS

by D. Salomoni

1 INTRODUCTION

The L3845 is used for MODEM and PABX Line Interface applications. The circuit provides DC loop termination for analog trunk lines. The V/I characteristic is equivalent to a fixed voltage drop (zener characteristic) in series with an external resistance that determines the slope of the DC characteristic. An external low voltage electrolytic capacitor causes the circuit to exibit high impedance to all AC signal in the voice band frequency range (>20 Kohm). The OFF-HOOK status is detected when the Line Current is higher than 8 mA. In this condition a constant current generator is activated to supply an external device (typically an optocoupler) without affecting the DC/AC characteristics of the circuit. An additional function is provided in order to reduce the DC fixed voltage drop and the AC impedance (PULSE MODE) This function can be used to respect some European Countries specifications during Pulse Dialling Operation.

2 GENERAL APPLICATION DESCRIPTION

Figure 1 shows the block diagram of L 3845. Figure 2 and figure 3 give two typical circuits for analog or digital applications. It is worth to note that the TRUNK TERMINATION CIRCUIT, together with the LS 5018 transient suppressor provides a compact and low cost module fully pro-tected against lighting or overvoltage frequently present of telephone lines. When it is not necessary to make the protection against high energy pulses the LS 5018 can be replaced with two zeners of 16 V connected in series back to back. With the use of this circuit it is possible to terminate an analog trunk so that the DC current component is flowing in the TRUNK TERMINATION CIRCUIT. The AC signal through a low voltage capacitor it is provided to a low cost audio transformer and to the internal circuits. In figure 2 is indicated as example a simple hybrid circuit to made the 2 wire / 4 wire convertion. In figure 3 is indicated an application circuit with the SGS-THOMSON TS 5070 second generation COMBO that provide a programmable 2 wire / 4 wire convertion in addition to CODEC FILTER and other functions. In some European Countries it is requested that when the system is in PULSE DIALLING OPERATION the DC voltage at the Line Terminals during the MAKE pulses must be lower than the DC Line voltage in OFF-HOOK condition. By connecting the PULSE input (pin 3) to the reference ground V- (pin 2) the device reduces the DC charcteristic of about 1.5 V and the same time the AC impedance will decrease from 20 Kohm to a value equal to the external resistor (56 ohm typical). The PULSE function will be auto-matically set by the device if one capacitor is connected between pin 3 and pin 2 as will be explain in deep in the paragraf 3.2.d.

Figure 1: L3845 Trunk Interface

Figure 2

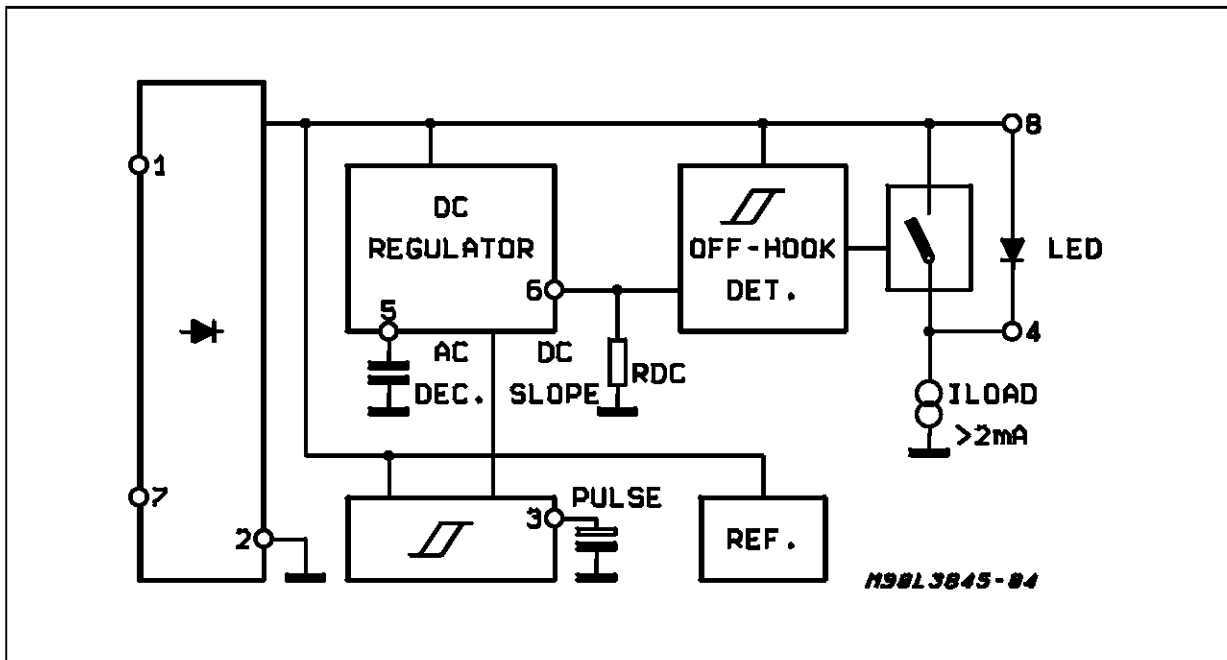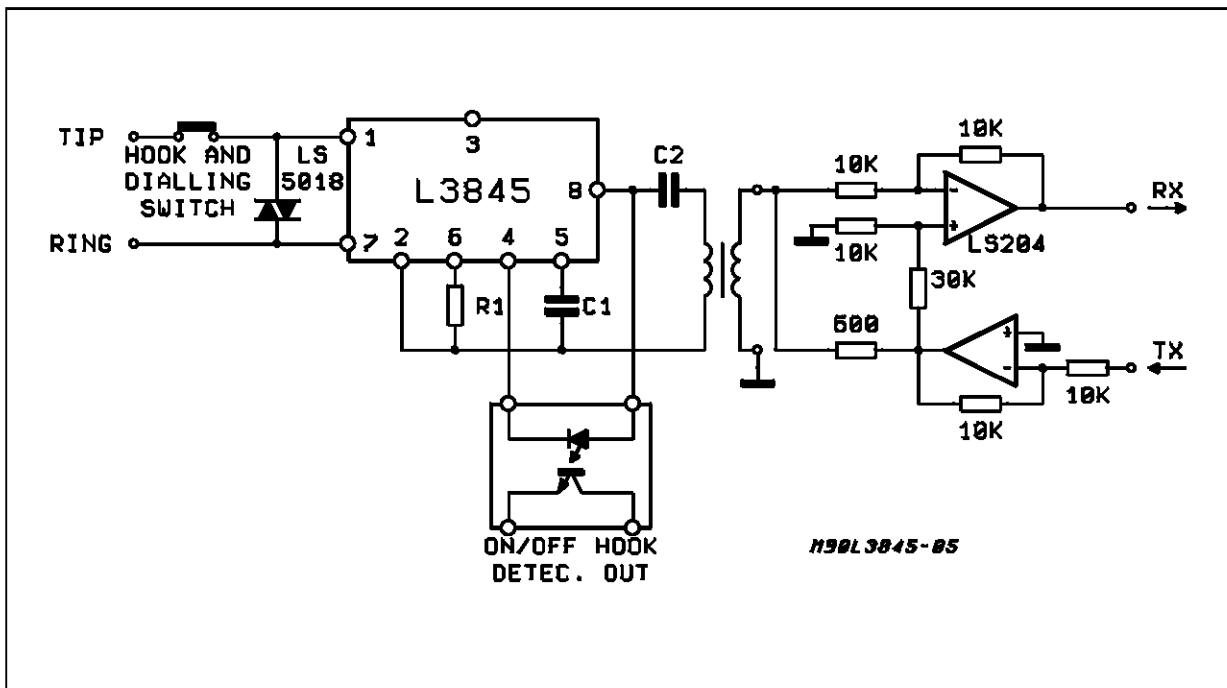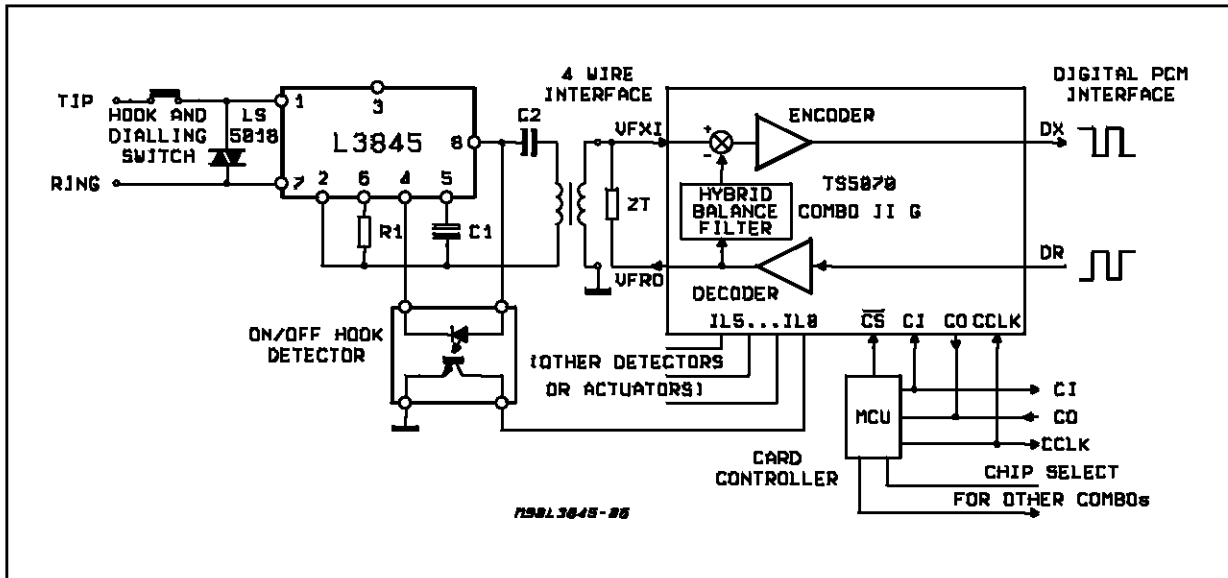**SGS-THOMSON**
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Figure 3

3 GENERAL CHARACTERISTIC DESCRIPTION

In this chapter are described the characteristics of L 3845.

3.1 DC CHARACTERISTICS

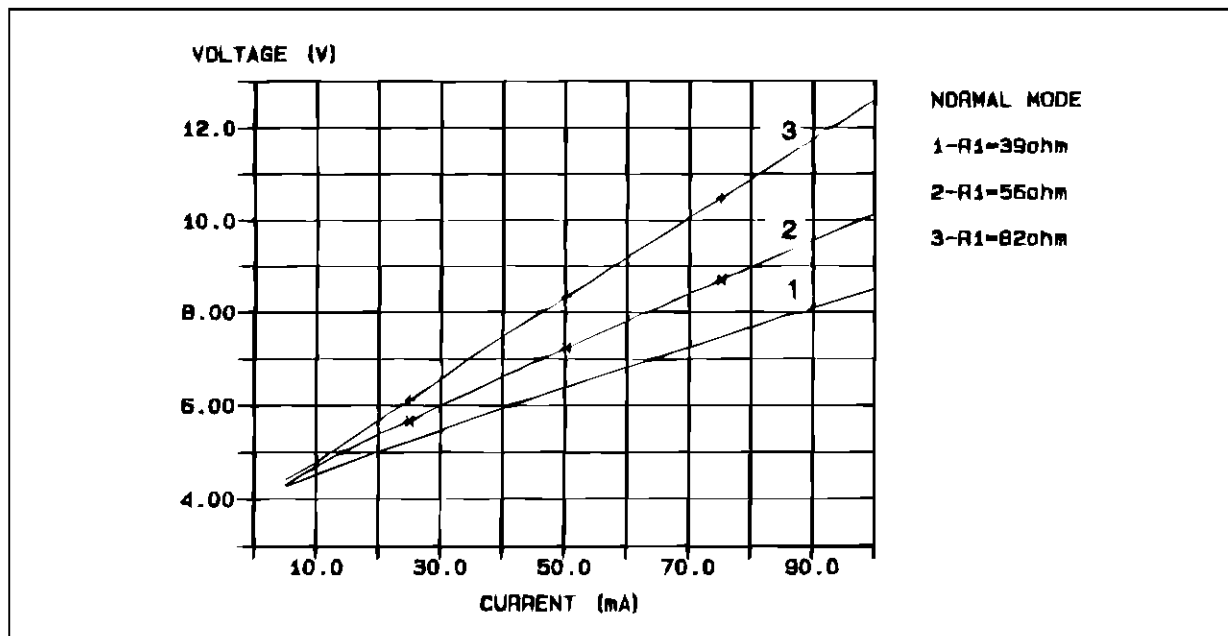The DC characteristic are divided in three parts:

- DC characteristic in NORMAL MODE
- DC characteristic in PULSE MODE
- OFF-HOOK DETECTION.

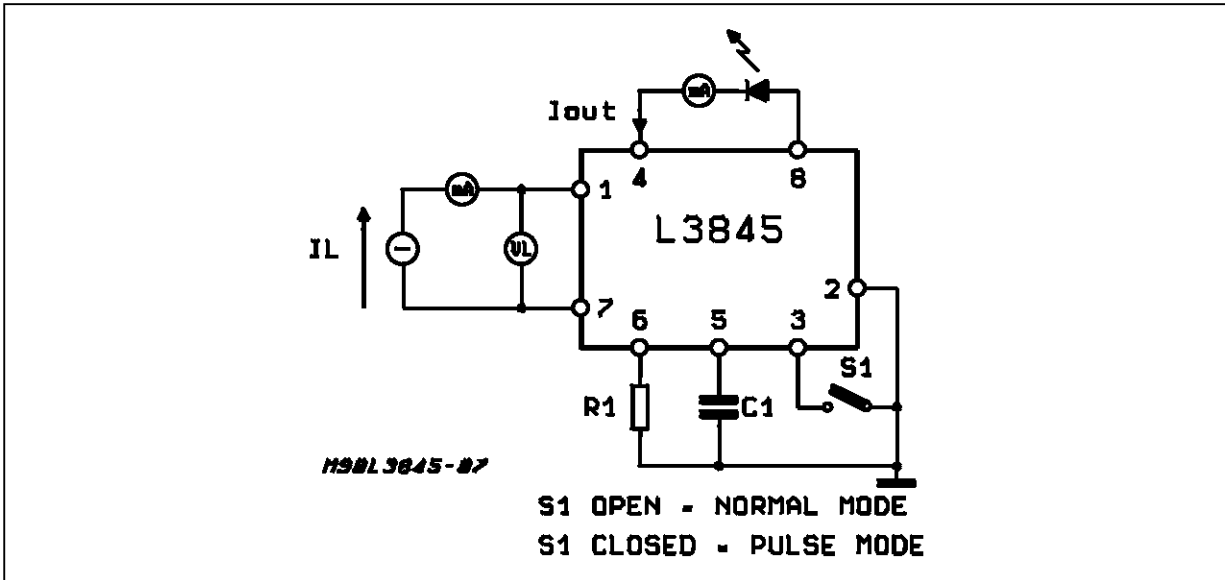**Figure 4:** DC Characteristics

3.1.a DC CHARACTERISTIC IN NORMAL MODE

The NORMAL MODE is set when pin 3 is left open. In this mode the AC impedance is high (typical 20 Kohm).

Figure 4 shows the typical DC characteristic for different R1 values. With a good approximation, the characteristic is linear for values of IL greater that 6 mA. The slope (ΔV_L / ΔI_L) of this characteristic is programmable and it is equivalent to the external resistor value. The test circuit is shown in figure 5.

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Figure 5

3.1.b DC CHARACTERISTIC IN PULSE MODE

This mode is set by connecting the PULSE input (pin 3) to V- (pin 2). In this mode the DC Line Voltage is reduced of about 1.5 V and the slope of the DC characteristic (/\VL / /\IL) is the same of the slope of the DC characteristic in NORMAL MODE, and equal to the external resistor R1 value. The test circuit is shown in figure 5 with S1 closed. Figure 6 shows the typical characteristic for different R1 resistor values.

Figure 6: DC Characteristics

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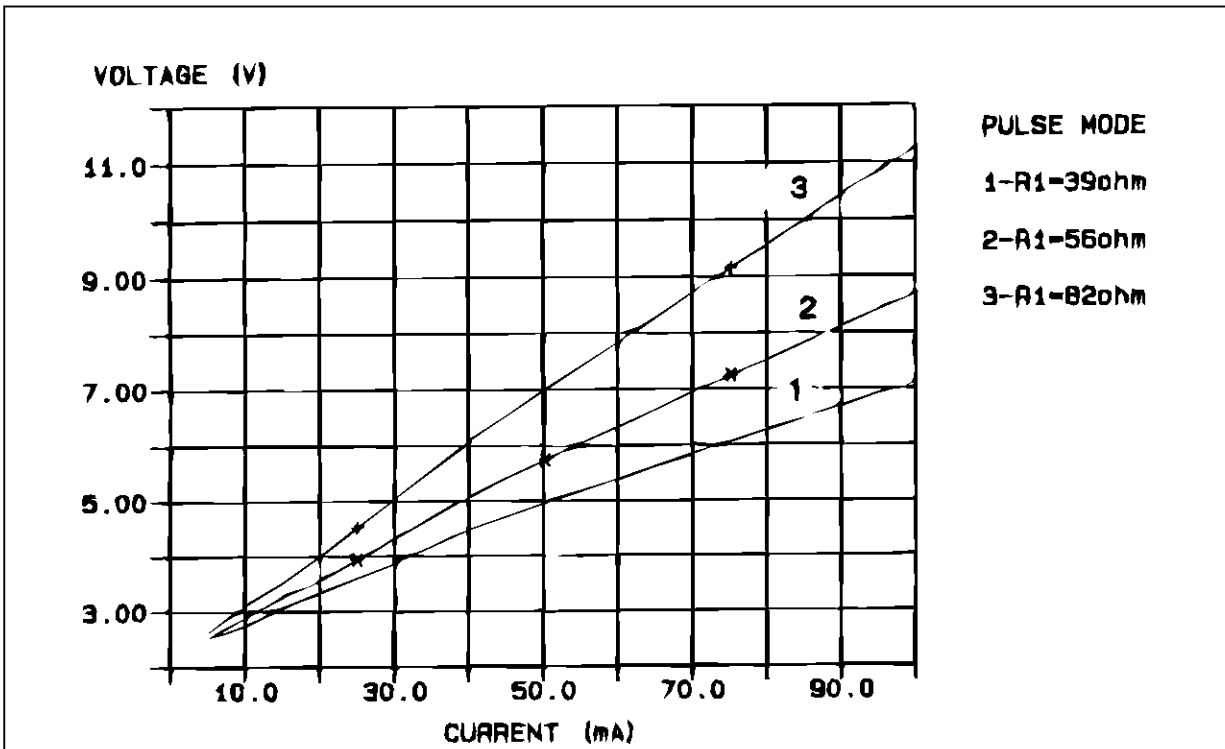
3.1.c OFF-HOOK DETECTION CIRCUIT

The L 3845 has a circuit to detect the OFF-HOOK condition. When the Line Current is over than 8 mA the constant current generator at pin HDO (pin 4) is activated. Figure 7 shows the Output Drive Current at the output HDO (pin 4) versus the Line Current IL. This circuit has the same characteristic both in NORMAL and in PULSE MODE. The test circuit is shown in figure 5.

Figure 7: DC Characteristics

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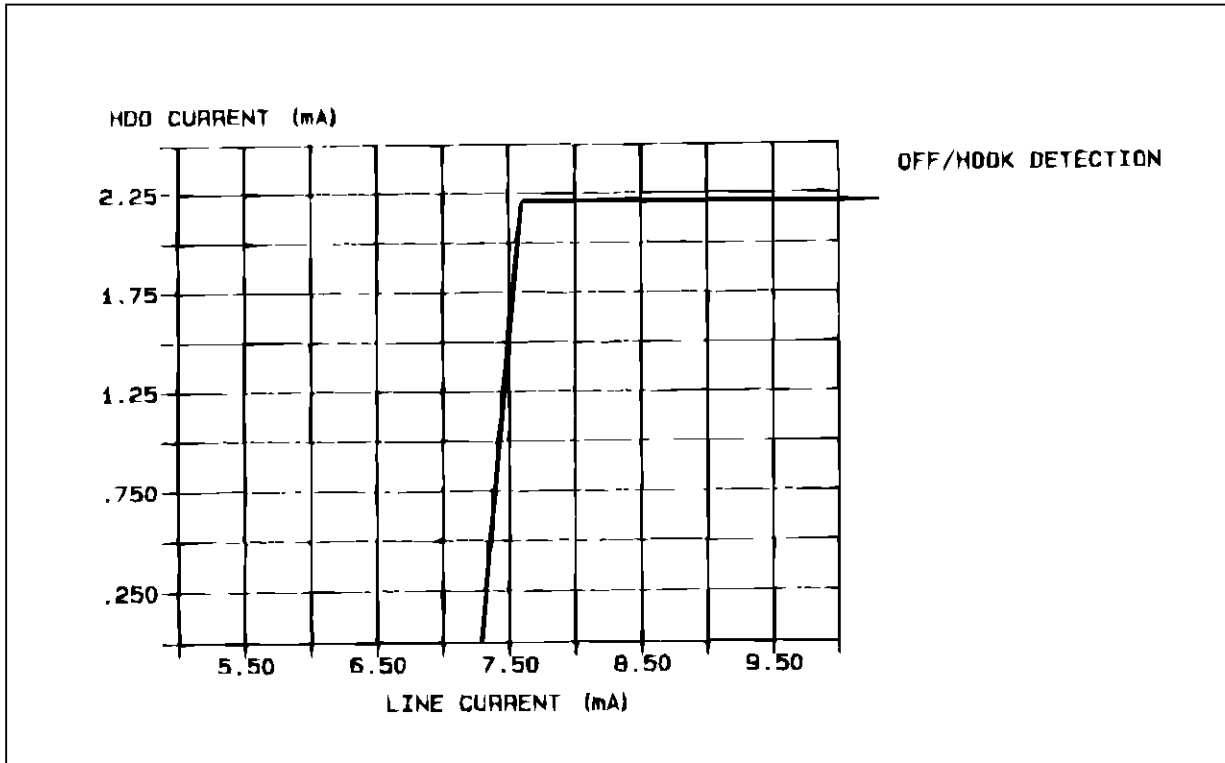
3.2 AC CHARACTERISTICS

The AC characteristics are divided in four parts:

- AC IMPEDANCE
- RETURN LOSS
- DISTORTION
- AUTOMATIC PULSE MODE

3.2.a AC IMPEDANCE

Figure 8 shows the AC IMPEDANCE of the device L 3845 for different Line Current values. Figure 9 shows the AC IMPEDANE for different C1 capacitor values and figure 10 shows the AC IMPEDANCE for different R1 resistor values. The test circuit is shown in figure 11.
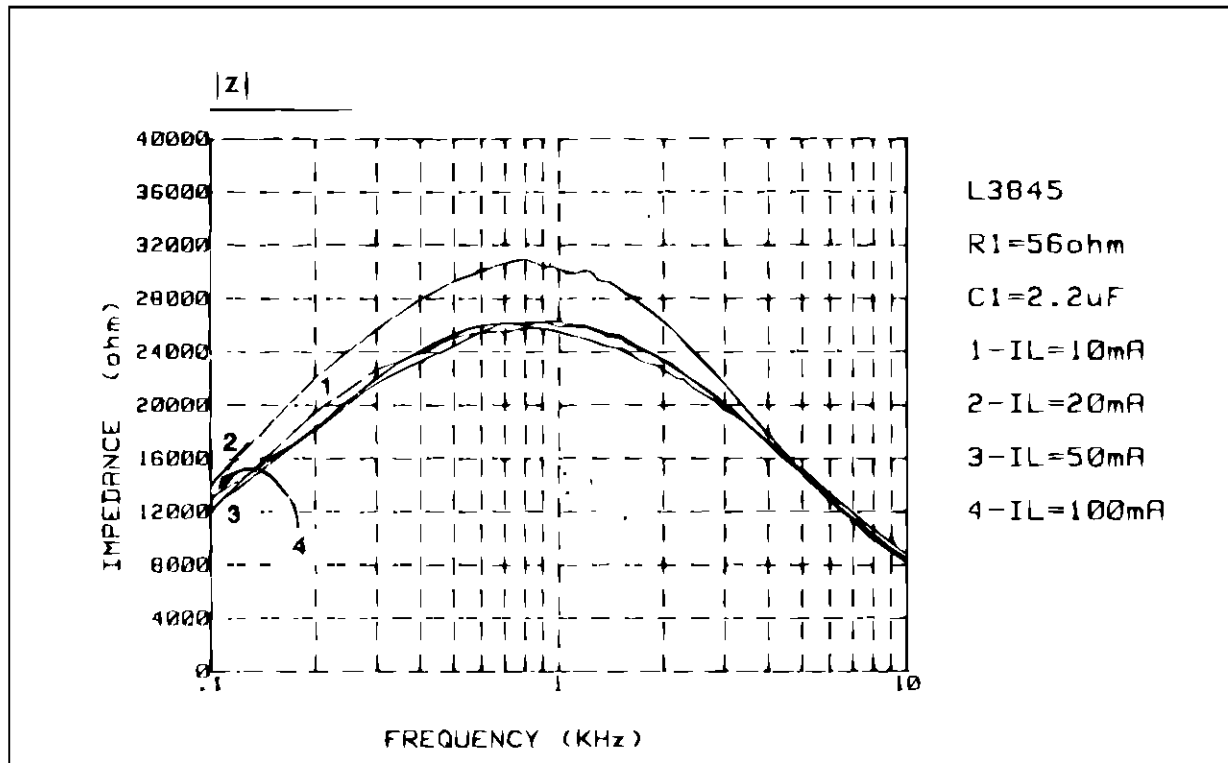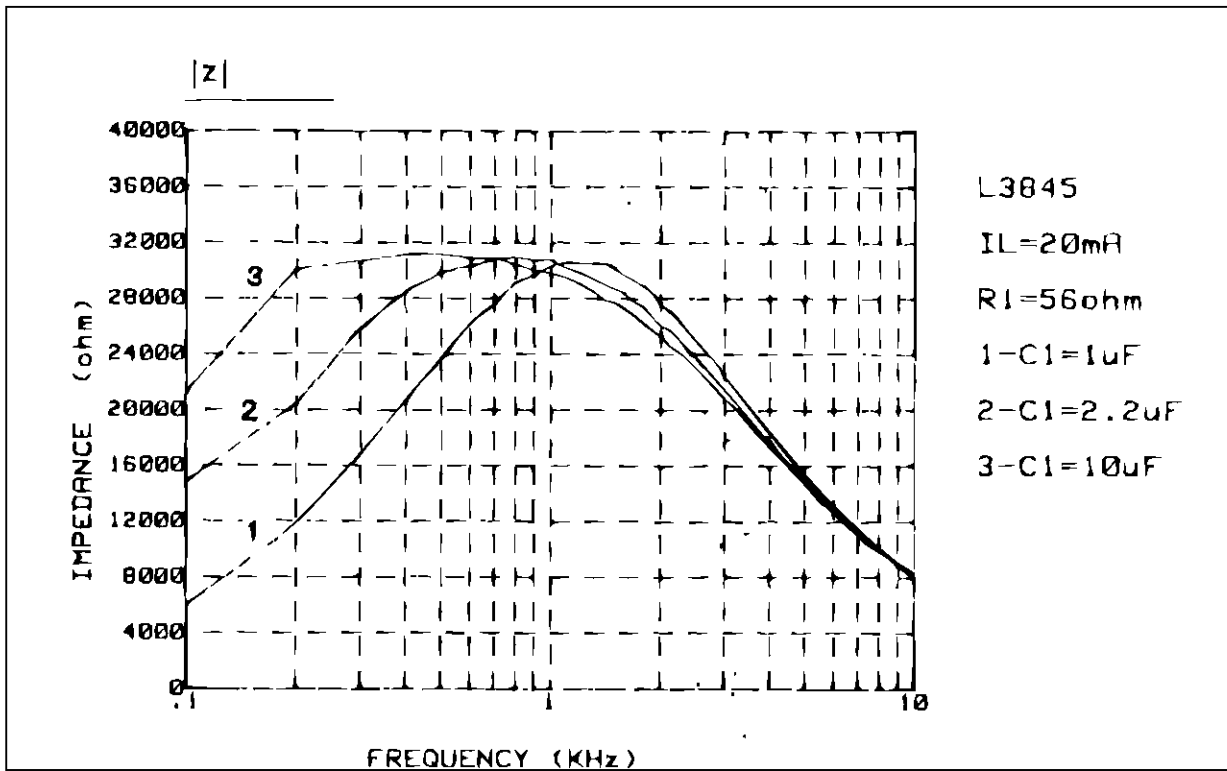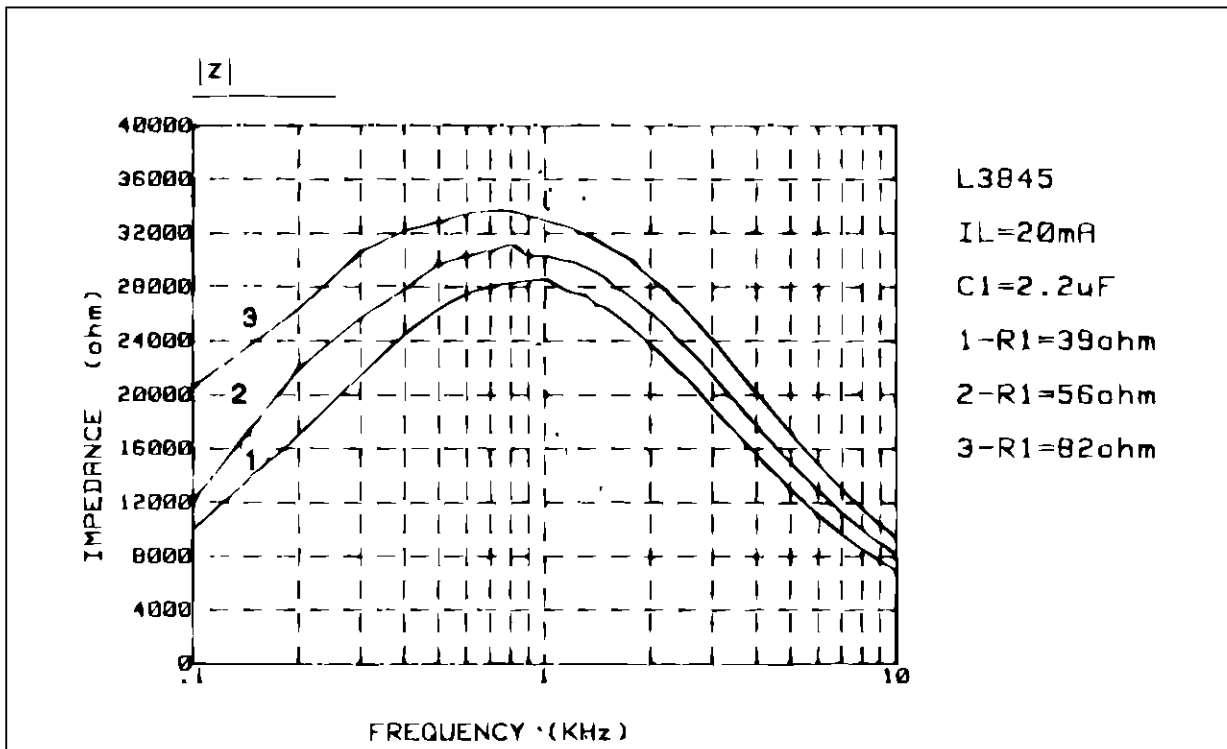
Figure 8: Impedance

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Figure 9: Impedance

Figure 10: Impedance

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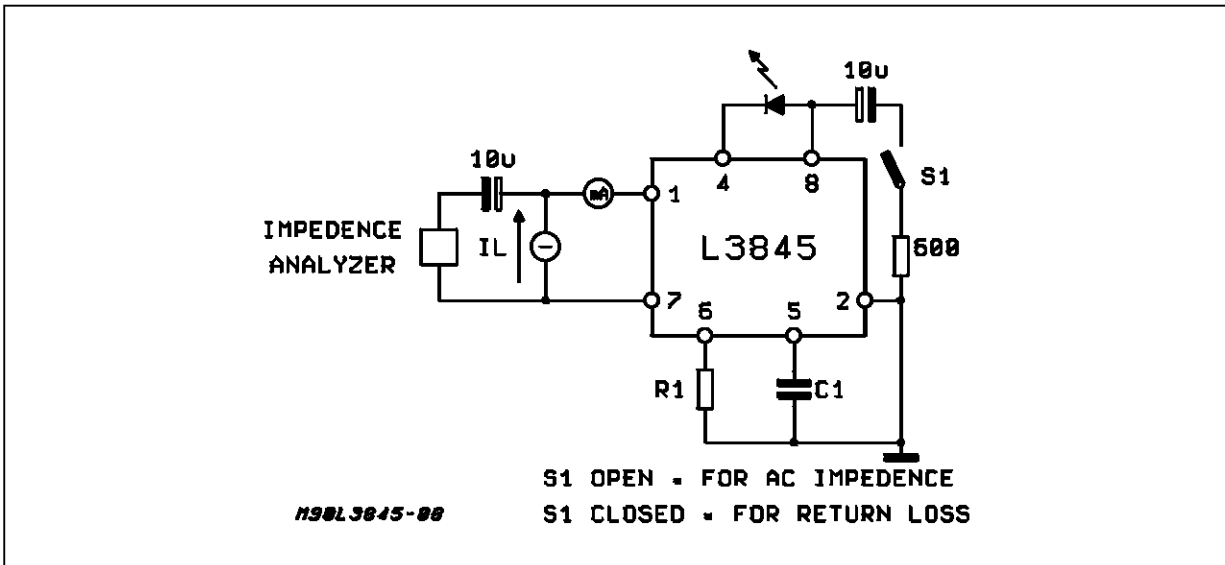
Figure 11

3.2.b RETURN LOSS

Figure12 shows the RETURN LOSS referred to 600 ohm impedance for different C1 capacitor values. Figure 13 shows the RETURN LOSS referred to 600 ohm impedance for different R1 resistor values. The test circuit is shown in figure 11 with S1 closed. The definition of the RETURN LOSS is:

$$RL = 20 \log \frac{|\,Zout + 600\,|}{|\,Zout - 600\,|}$$

Figure 12: Return Loss
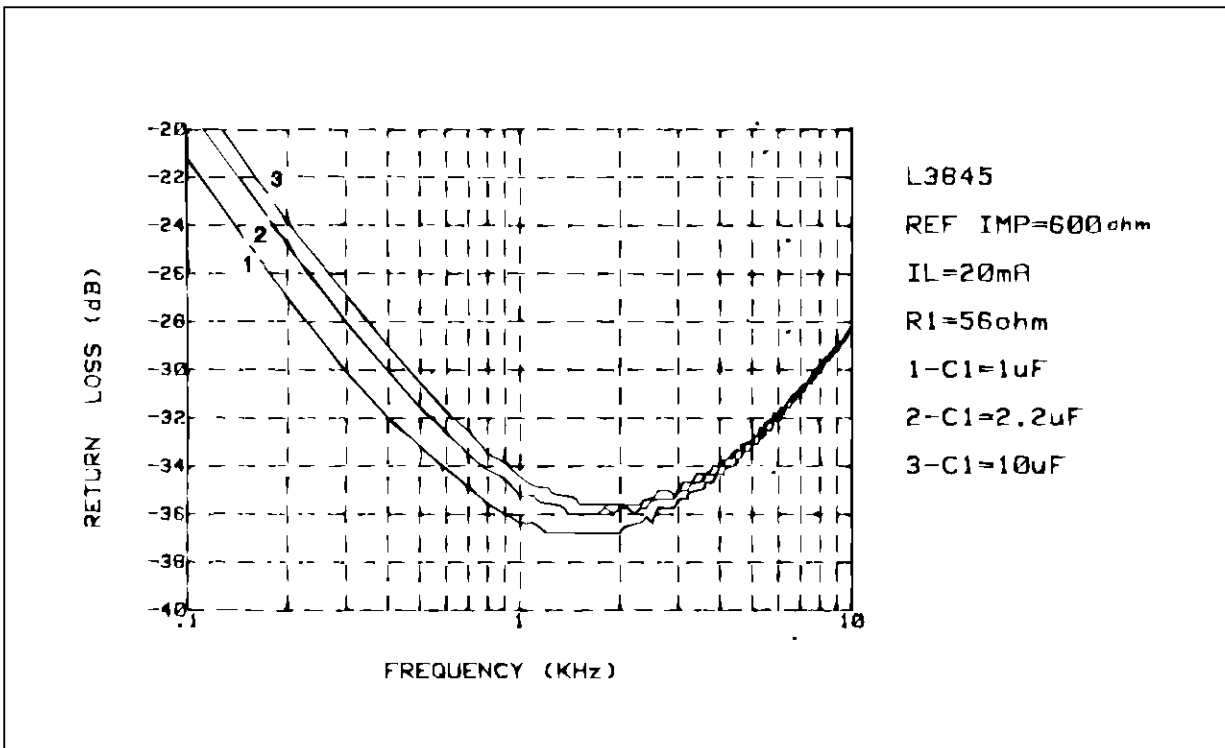
Figure 13: Return Loss
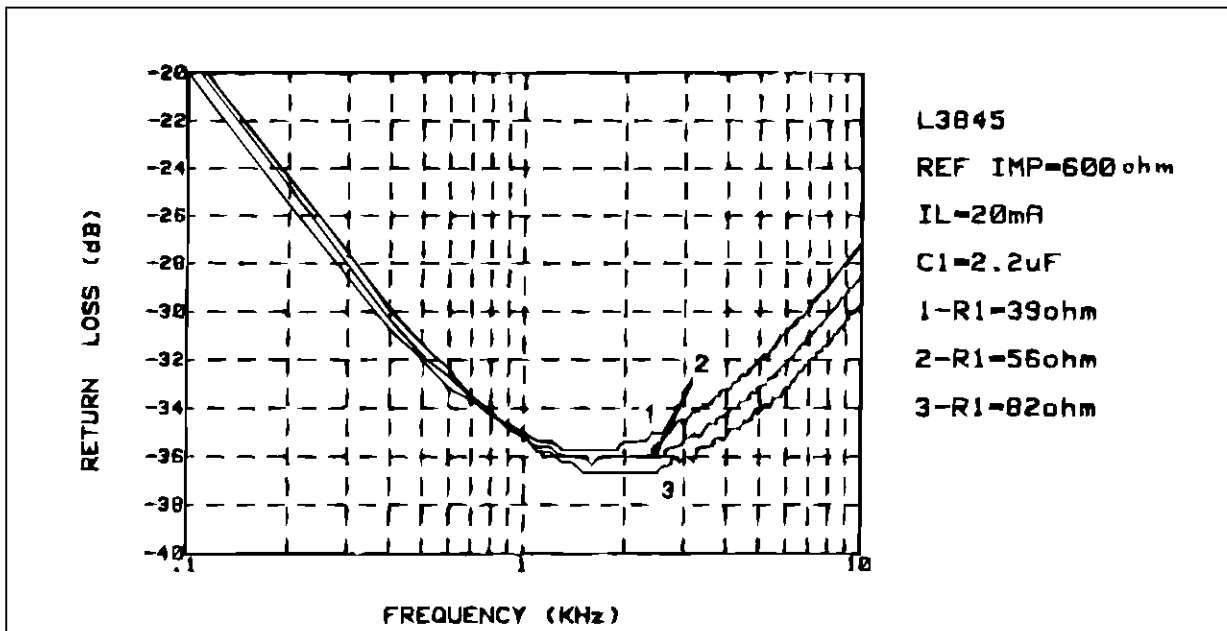
3.2.c DISTORTION

The measurements had been performed using the test circuit of figure 14. Figure 15 shows the maximum amplitude of the input signal between the pins 1-7 in order to measure a Total Harmonic Distortion less than 2%. It is possible to improve this performance connecting a resistor R2 in parallel to capacitor C1. A typical value for R2 is 300 Kohm. By this way, it is possible to increase the DC characteristic and therefore to improve the

signal swing. The resistor R2 will influence also the slope of the DC characteristic, that will become:

$$\frac{/\backslash V_L}{/\backslash I_L} = R_1 \left(1 + \frac{150\ Kohm}{R_2} \right)$$

and the value of the AC impedance in the low frequency range.

Figure 14

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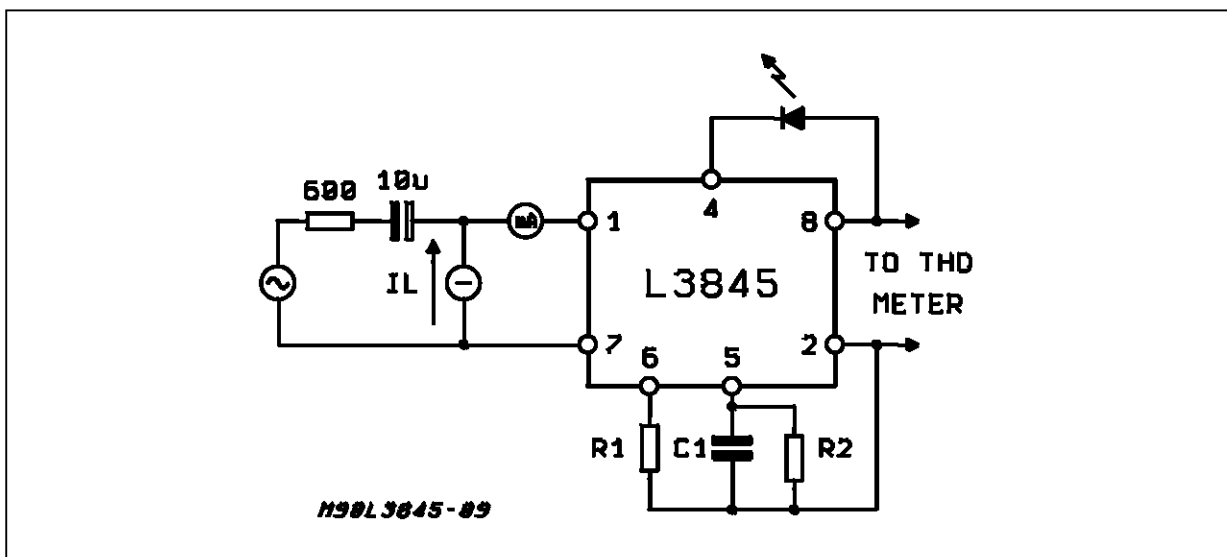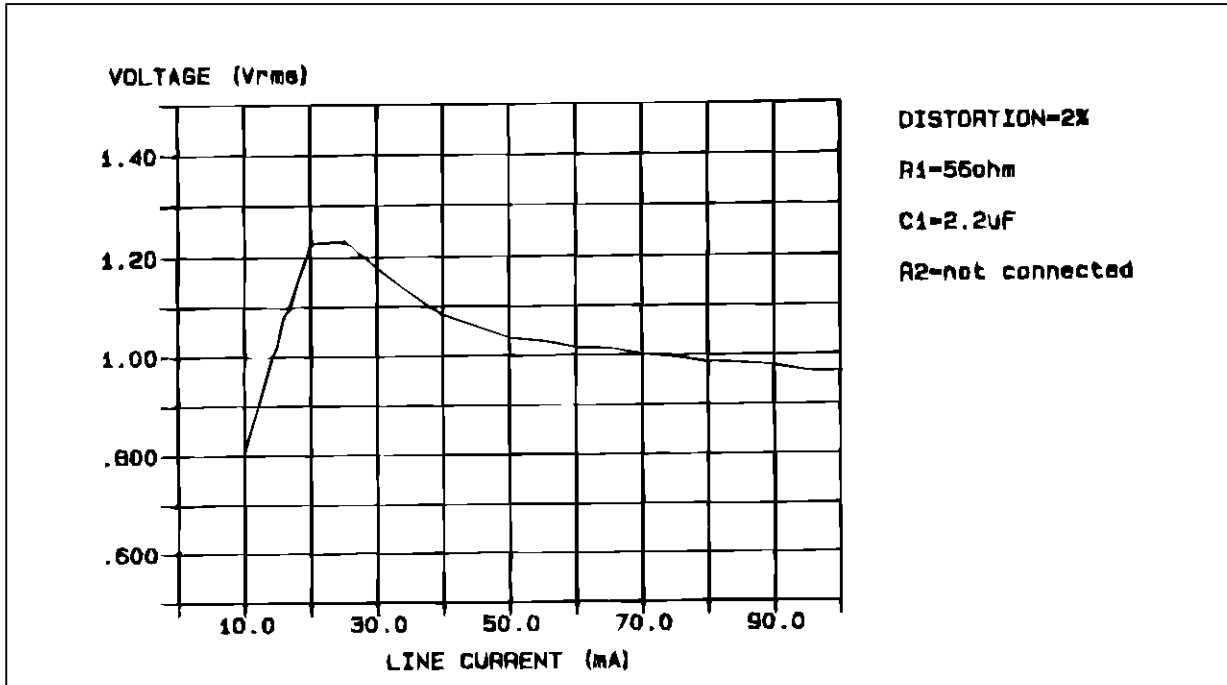
Figure 15: Max. Line Voltage

Figure 16 shows the MAX. Line Voltage versus Line Current for a THD = 2% and with R2 = 300 Kohm and different R1 resistor values. Figure 17 shows the DC characteristic with R2 = 300 Kohm and for different R1 values. Figure 18 shows the AC impedance with R2 = 300 Kohm and for different R1 values. When the signal is applied between the pins 8-2 and the THD is measured at pins 1-7 the results are exactly the same.
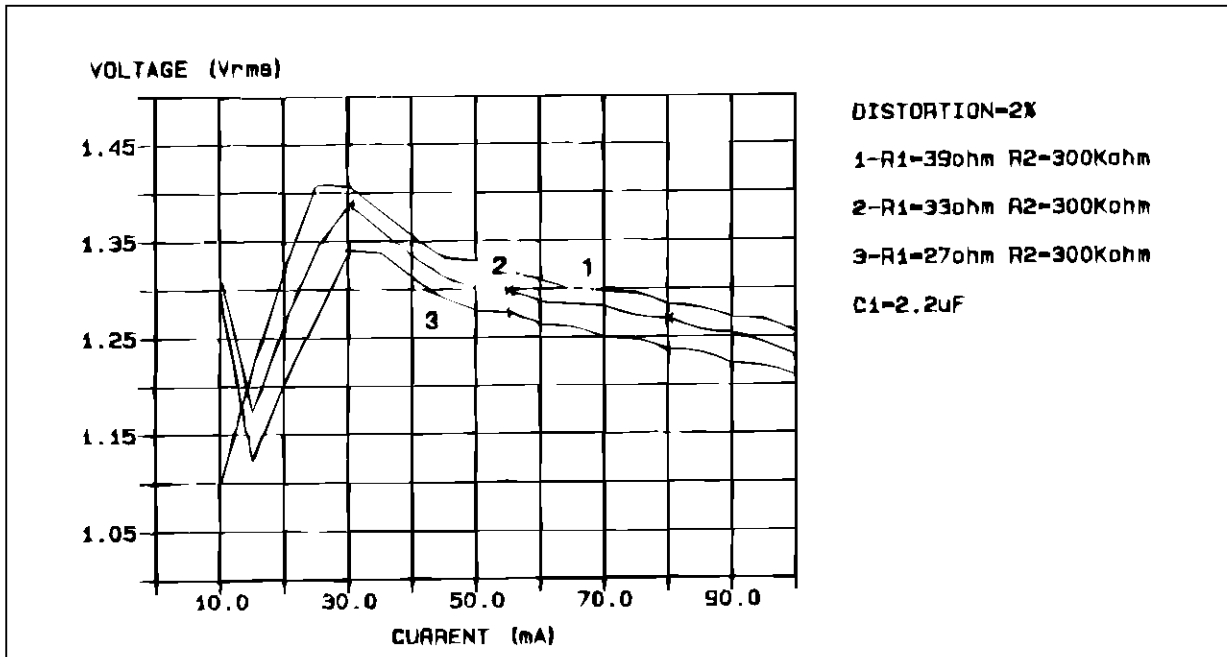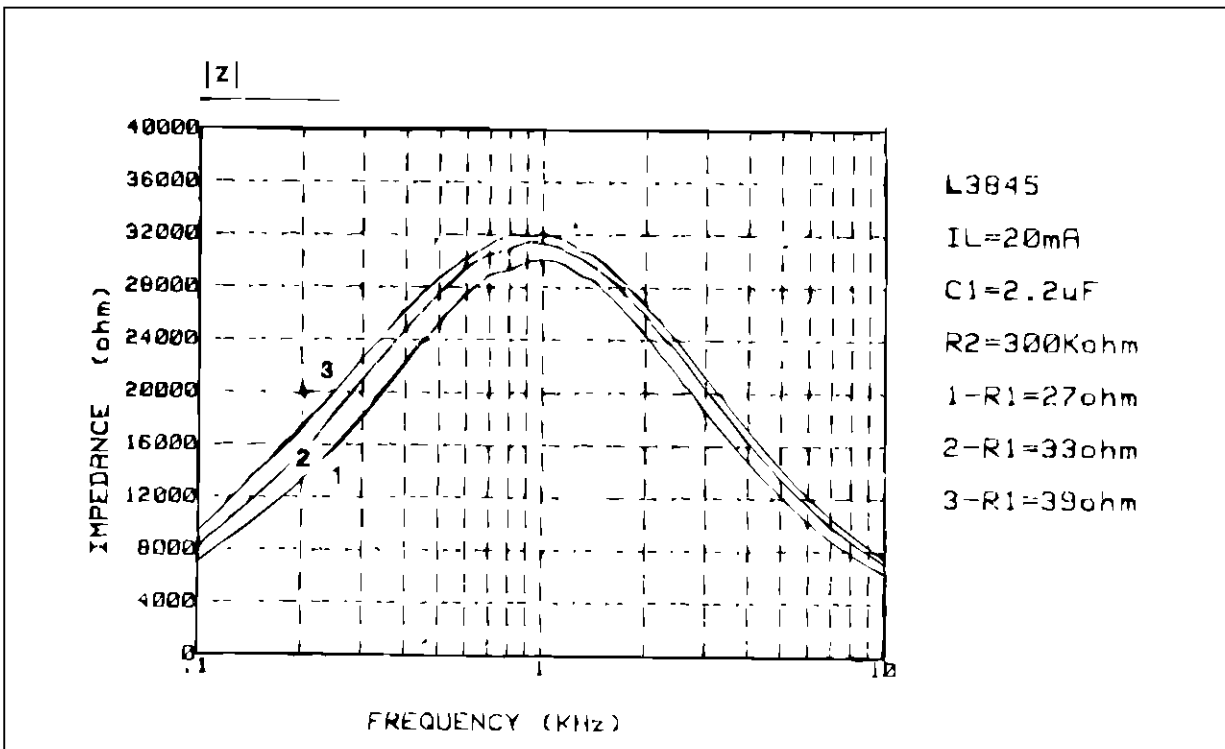
Figure 16: Max. Line Voltage

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Figure 17: DC Characteristics
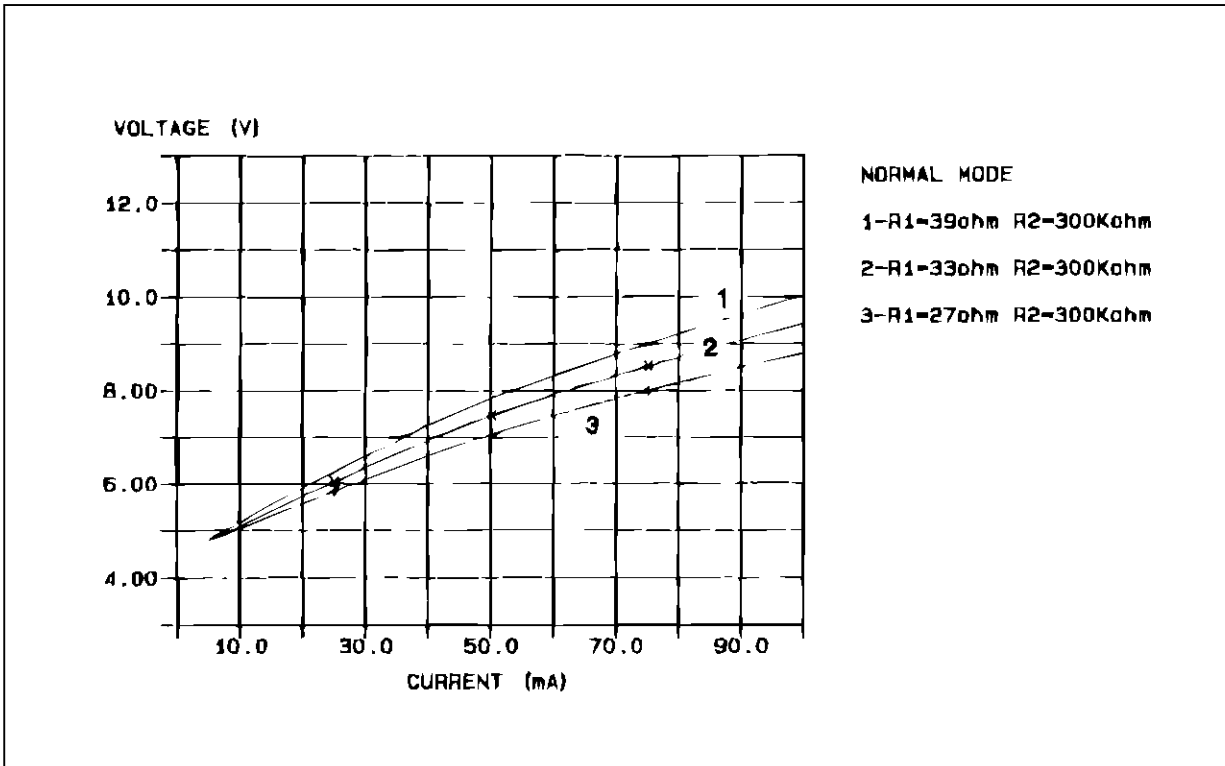
Figure 18: Impedance

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3.2.d AUTOMATIC PULSE MODE

The PULSE MODE is set by connecting the input PULSE (pin 3) to the reference ground V- (pin 2). To set L3845 in NORMAL MODE the PULSE input (pin 3) must be open. The device is able to set automatically the PULSE MODE, without any external operation, by connecting a capacitor C2 between pin 3 and pin 2, the suggested value for C2 is 1 μF. In this case when the device recognise an ON-HOOK condition (I_L < 8 mA) automatically it goes in PULSE MODE. The delay time t1 to go from NORMAL MODE to PULSE MODE is about 0.8 mSec with C2 = 1 μF. When the Line Current returns higher than 8 mA the device will stay in PULSE MODE for a time t2 fixed by external C2 capacitor. This time is long enough in order to keep in PULSE MODE the device during PULSE DIALLING at 10 Hz. The delay time t2 is determinate by the relationship:

$$t_2 = \frac{C_2 * (V_T - V_{BE})}{I_T}$$

Where VT is a voltage threshold of an internal comparator (VT = 1.4 V) and IT = 10 μA is the value of the internal current generator that charge the external capacitor C2 connected between pin 3 and reference ground V- (pin 2). For: C2 = 1 μF, t2 will be = 80ms. Figure 19 shows the waveforms at pins 8 and 3 for the function "AUTOMATIC PULSE MODE". Figure 20 shows the waveform between pins 1 and 7. Figure 21 shows the test circuit. From figure 20 you can see that the DC voltage at pin 1 during the MAKE pulses is 1.5V lower than the voltage in NORMAL MODE. In conclusion, how you can see, the device performs automatically the pulse function without any external device.
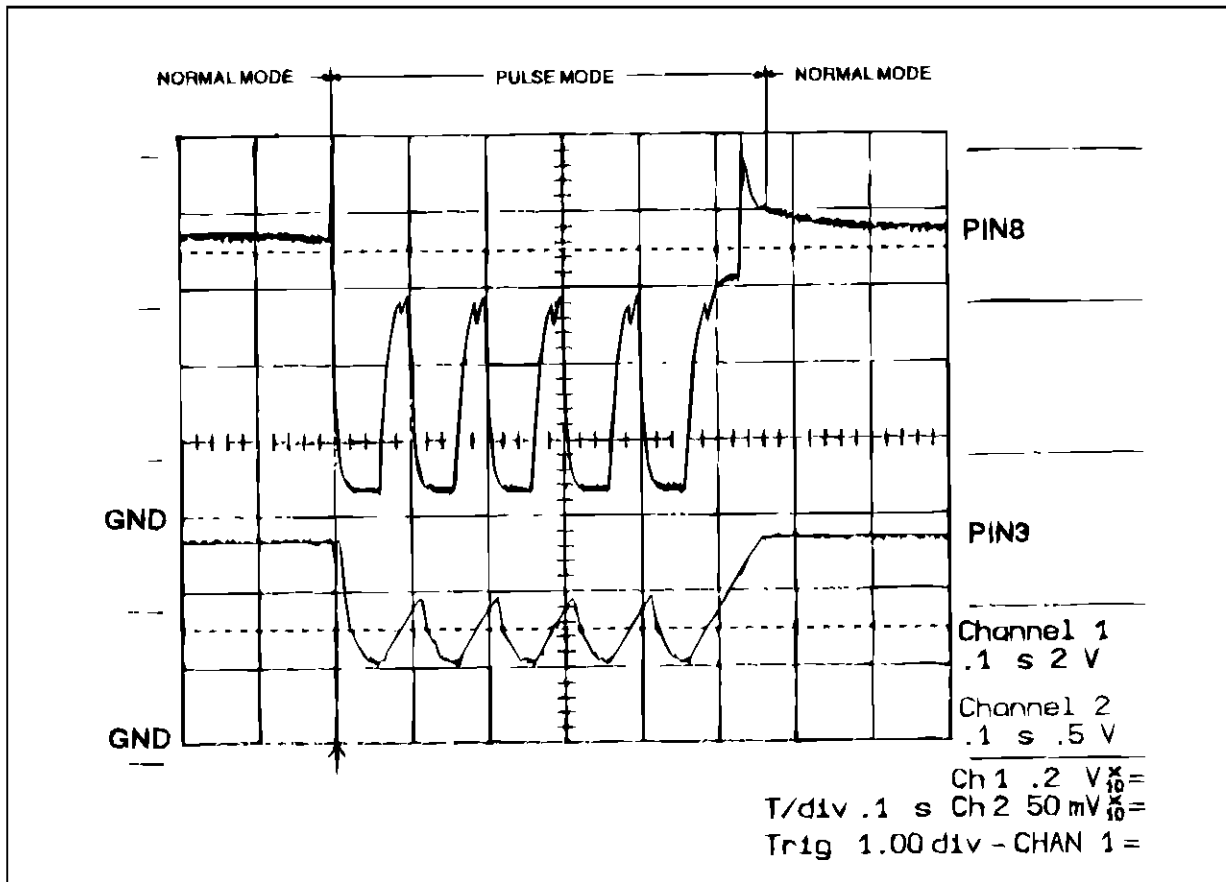
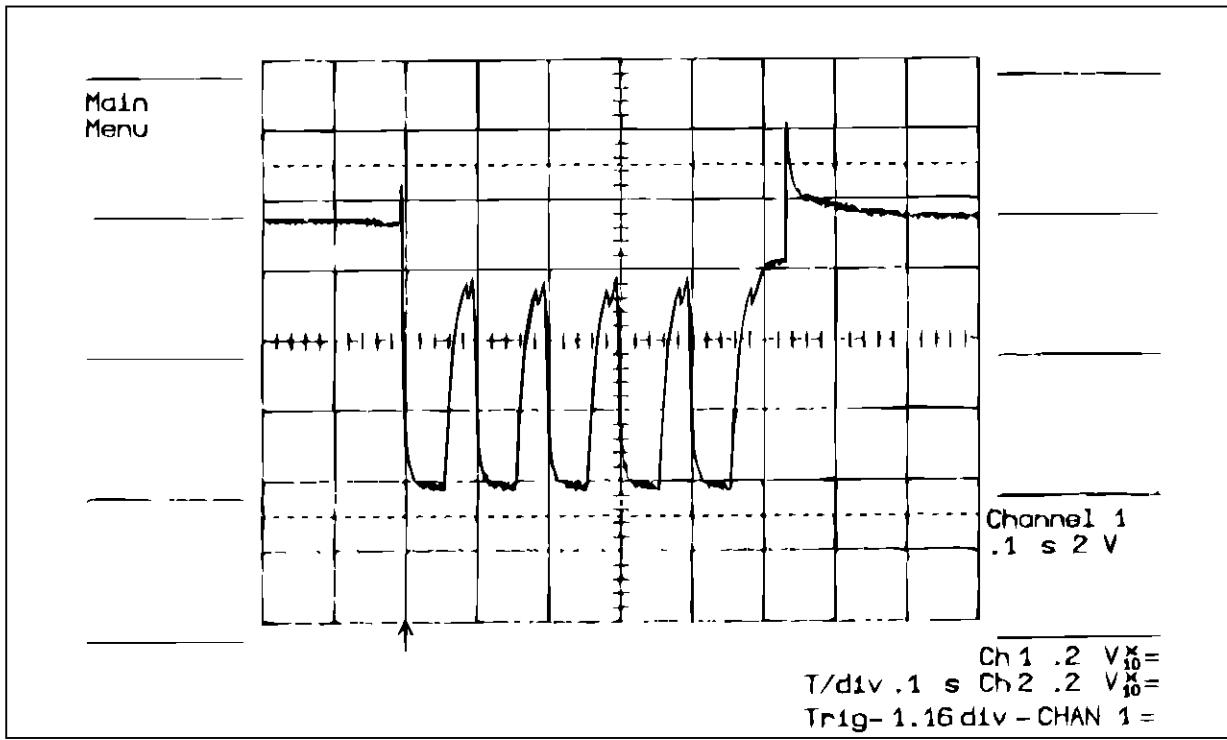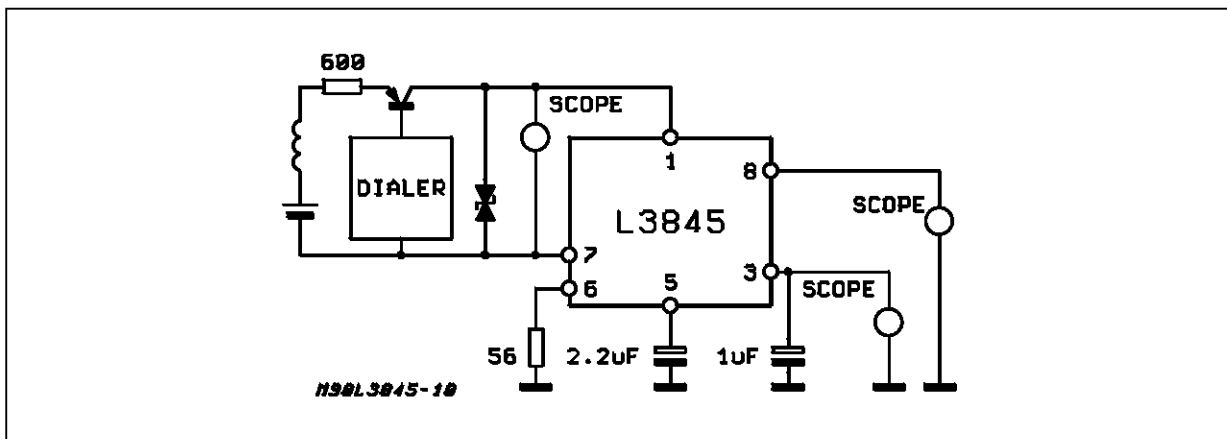**Figure 19:** Automatic Pulse Mode

Figure 20: Automatic Pulse Mode

Figure 21

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