Knowles®

TB7

EFFECTS OF SOURCE IMPEDANCE UPON RECEIVER RESPONSE

The impedance of the signal source with respect to that of the receiver can affect the shape of its response curve. Since the impedance of the receiver (primarily an inductive device) will vary with the frequency, then response curves, to have any meaning, must state the impedance of the signal source used in the test. One of three source impedance conditions can be used in the specification of Knowles receivers:

1. Constant Current. In this test the source impedance is high relative to the load impedance. This type of source impedance condition is comparable to an application where the receiver is AC coupled to the collector circuit of a common-emitter output transistor. A typical collector source impedance would be greater than 50K Ohms. The high impedance condition is generally satisfied if the source impedance is at least 20 times the magnitude of the receiver impedance throughout the frequency range of interest.

2. Constant Voltage. In this test source impedance is low relative to load impedance. This type of source impedance condition is comparable to an application where the receiver is AC coupled to the emitter circuit of an emitter-follower output transistor. A typical emitter source impedance can be 100 Ohms or less. If additional feedback is provided, the output impedance can be closer to 1 Ohm. The low impedance condition is generally satisfied if the source impedance is at most 1/10 the magnitude of the receiver impedance throughout the frequency range of interest.

3. Maximum Available Power (MAP). In this test the source impedance equals the nominal value of the load impedance at 1kHz. This type of source impedance condition is comparable to an application where the receiver is in the emitter circuit of an emitter-follower output transistor and the emitter source impedance is closer to 1kOhm due to the high impedance of a preceding stage of amplification.

Figure 1 illustrates the influence of source impedance on the response curve obtained when the same receiver is tested under the three conditions described above. The input for the Constant Current test was 0.78mA RMS, for the Constant Voltage test 0.80 Volts RMS, and for the MAP test 1.42 Volts RMS with a 1kOhm source resistor.

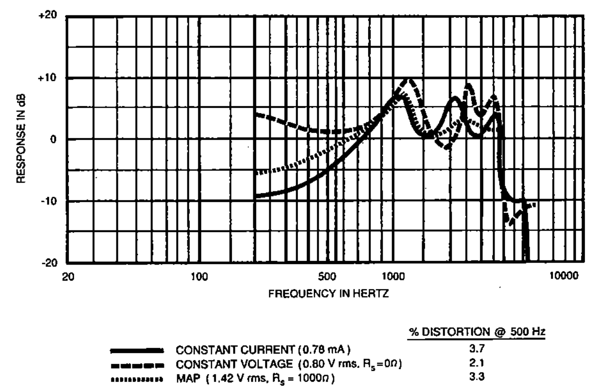

Fig.1 Receiver tested under three conditions of Source Impedance.

Figure 2 shows the impedance curve and phase angle table for the same receiver and acoustic load. The receiver impedance and the source impedance can be used to explain the differences in the three response curves. At any given frequency, the relative response is dependent on the magnitude of the current flowing through the receiver. Table 1 compares the results of a theoretical study to the measured response of the receiver at three frequencies.

KNOWLES ELECTRONICS, INC.
1151 Maplewood Drive,
Itasca, Illinois 60143, U.S.A.
Phone: (708) 250-5100
Fax: (708) 250-0575
Telex: 433-0330

KNOWLES ELECTRONICS CO.
73 Victoria Road, Burgess Hill,
West Sussex. RH15 9LP, England.
Phone: (0444) 235432
Fax: (0444) 248724
Telex: 87460.

TECHNICAL BULLETIN

Knowles®

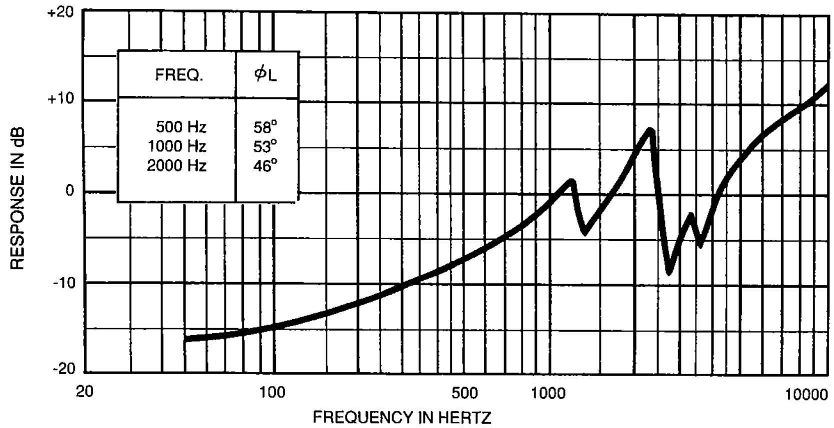

Fig. 2 Impedance Curve for the Receiver of fig. 1.

TABLE 1

Test	Frequency Hz	Receiver X_L Ohms	Receiver R_L Ohms	Source R_s Ohms	Total Z_T Ohms	$\frac{E_s}{Z_T} = \lvert I \rvert$ mA	$\lvert I \rvert$ re Constant Current Drive	Measured SPL re Constant Current Response
Constant Voltage	500	372	233	0	438	1.83	+7.4dB	+7.7dB
	1000	825	620	0	1030	0.78	0	0
	2000	1300	1230	0	1780	0.45	-4.7	-4.5
Maximum Available Power	500	372	233	1000	1285	1.10	+3.0	+3.1
	1000	825	620	1000	1790	.79	+0.1	0
	2000	1300	1230	1000	2580	.55	-3.0	-3.0

Where, $Z_T = \sqrt{(R_s+R_L)^2+X_L^2}$

$X_L = \lvert Z_L \rvert \sin \phi_L$, and

$R_L = \lvert Z_L \rvert \cos \phi_L$.

In summation then, if the drive current is the same for the three test conditions at 1kHz, the sound output level of a receiver driven from a low impedance source will be higher at low frequencies than the same receiver driven under either MAP or Constant Current conditions. And at high frequencies near 5kHz, the low source impedance drive will result in a lower output level. At intermediate frequencies, a source impedance change will alter the resonant frequencies. Because the source impedance effectively acts as a load to any distortion generated within the receiver, the distortion measured at 500 Hz is also generally reduced as the source impedance is lowered even though the driving current is increased.