TEXAS INSTRUMENTS

SEMICONDUTTORI ITALIA S.P.A.

TMS 3617A- NS

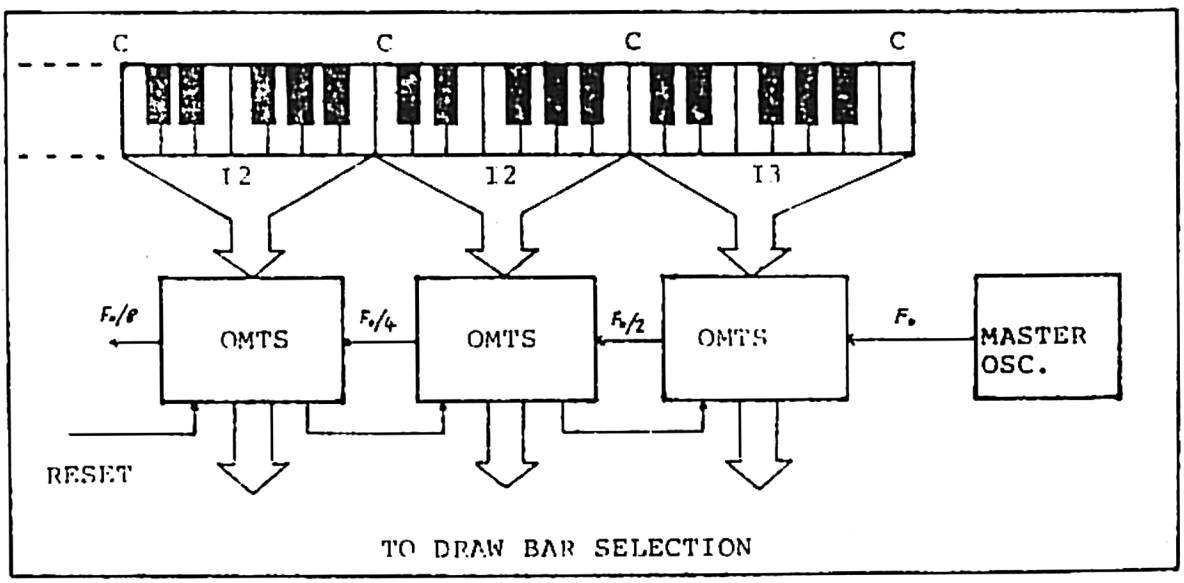
OCTAVE MULTIPLE TONE SYNTHESIZER - OMTS™

(6 FOOTAGES)

TMS3617 A NS;

The TMS3617ANS is a device of the OCTAVE MULTIPLE TONE SYNTHESIZER family, producing 6 footage current outputs, for application in electronic musical instruments.

With this simple high integration component, used repetitively for each octave, the architecture of an electronic organ becomes:



The TMS 3617ANS makes possible the introduction of substantial advantages in the electronic organ:

- achievement of modularity by matching the device count to the number of octaves in the keyboard
- major simplification of the architecture
- enhanced analog characteristics
- significant improvement of the reliability

KEY FEATURES

- Low cost P MOS technology
- 13 key input (octave organization)
- Internal tone generation
- Mask programmable TOS duty cycle

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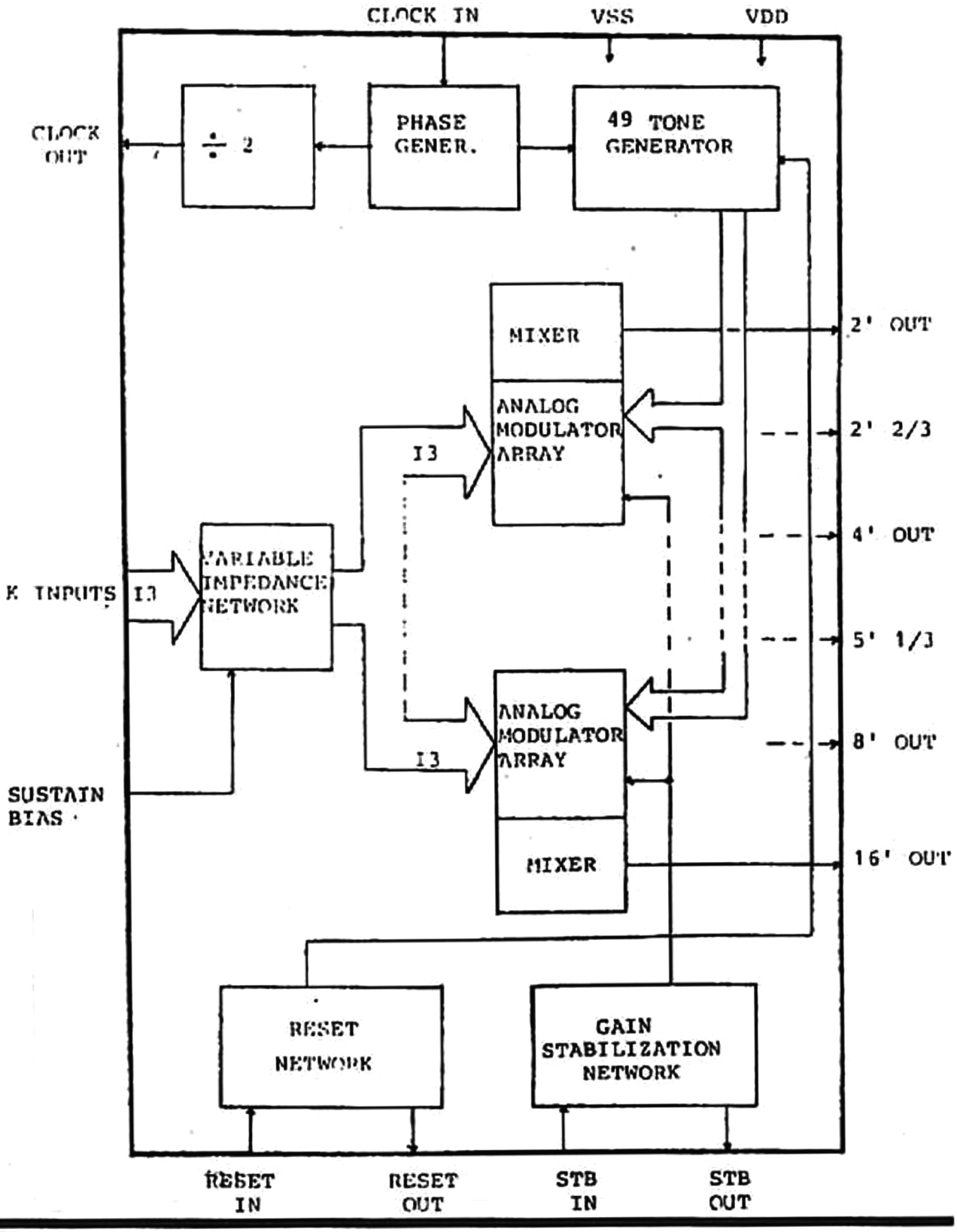
- 6 footages (16', 8', 5'$^{1}/_{3}$, 4', 2'$^{2}/_{3}$, 2') current outputs
- Sustain of the output signals is possible by simply connecting a capacitor (1 /uF) to each key input
- Sustain decay time adjustable from a few ms to a very long time (key memorization) through a dedicated analog input TMS3617ANS RI11X-17 or digital input TMS3617ANS RI-11X-171
- Possibility of controlling the amplitude swing of the footage outputs, to minimize the spread among different devices, by connecting a simple external network to the appropriate terminals
- Asynchronous reset to synchronize devices of different octaves
- Single power supply (15V or 12V typical)
- Clock output for lower octave devices.


CLOCK IN
VSS
VDD
CLOCK OUT
÷ 2
PHASE GENER.
49 TONE GENERATOR
MIXER
2' OUT
ANALOG MODULATOR ARRAY
2' 2/3
I3
4' OUT
K INPUTS
I3
VARIABLE IMPEDANCE NETWORK
5' 1/3
ANALOG MODULATOR ARRAY
8' OUT
I3
SUSTAIN BIAS
MIXER
16' OUT
RESET NETWORK
GAIN STABILIZATION NETWORK
RESET IN
RESET OUT
STB IN
STB OUT

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CIRCUIT DESCRIPTION

There is a tone generation network that produces 49 acoustic frequencies for the various footages.

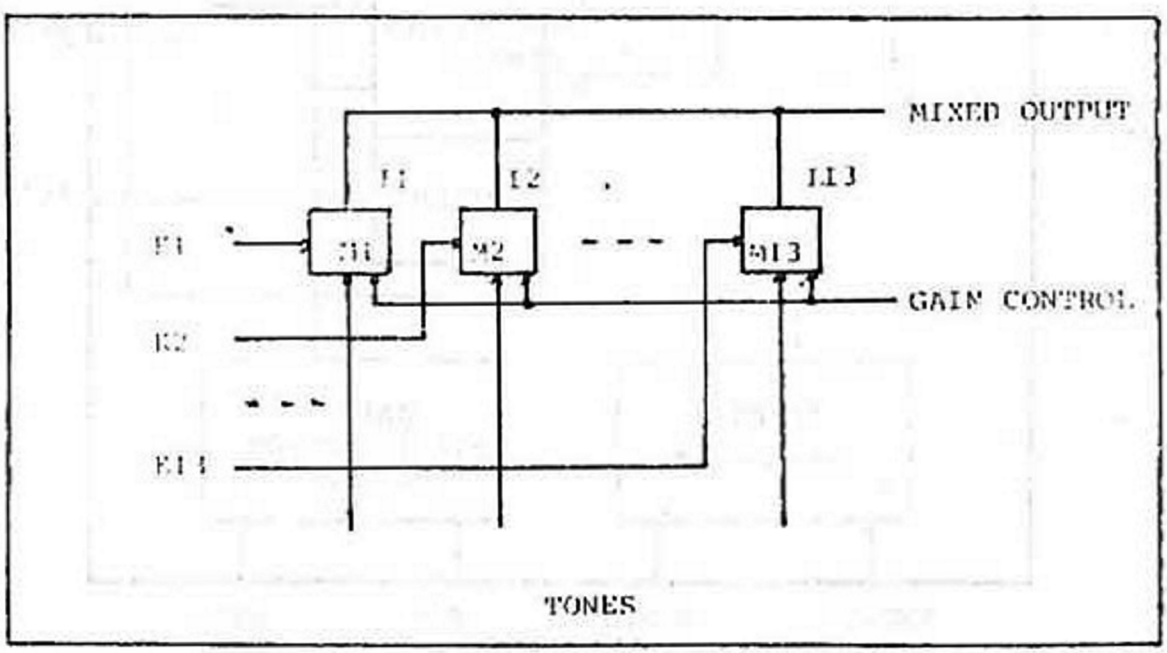
The actual frequency of the tones depends on the input clock.

A clock output (half of the frequency of the clock input) is provided to be used as clock input to the next lower octave device.

The pull-up impedance of the K inputs is programmable from a low value to an open circuit value by applying to the Sustain Bias input a variable voltage for the TMS3617ANS RI11X-17 (analog control) or a variable duty cycle square wave for the TMS3617ANS RI11X-171 (digital control).

The K inputs go in parallel to the Analog Modulator Array blocks of the 6 footages.

Each of these blocks contains 13 identical current output analog modulators as shown in fig.



Each modulator produces an acoustic carrier (Tone), amplitude modulated from 0% to 100% by the corresponding k input voltage, around a constant d.c. level (offset current) equal to one half the maximum swing of each modulator output.

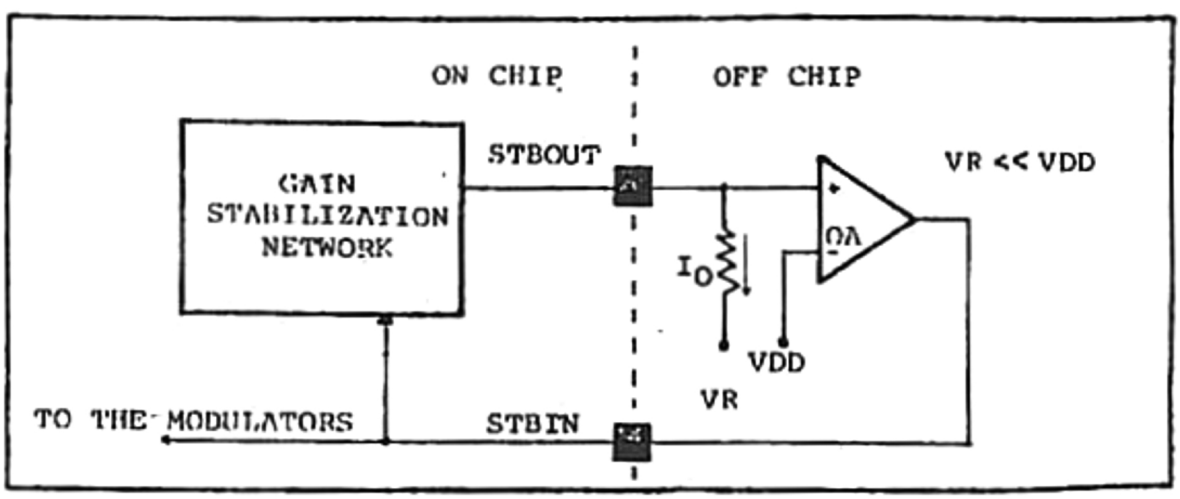
These outputs are then summed together, instant by instant, to provide a single composite output current given by:

$$I_{out} = \sum_{k=1}^{13} (I_o + C\ Vk\ Fk)$$

Where:

- I_o is the modulator output current (100 uA typical) with the k input at Vss.
- C is a constant
- Vk are the voltages on the k inputs, with respect of Vss.
- Fk are functions whose value are +1 or -1 according to the internal tone waveforms ("1", "0" logic).

The mean value of each modulator's output is equal to I_o while the signal component C Vk Fk is equal to $\pm I_o$ if Vk is equal to V_{DD}. In order to make this I_o value independent from temperature and constant, among different devices serving different octaves, each modulator has a gain control (STBIN) coming from the GAIN STABILIZATION NETWORK. This network provides automatic gain control (A.G.C.) when used in conjunction with an external amplifier that senses the current on the output STBOUT (this current is equal to I_o) and automatically adjusts the STBIN voltage to maintain this current constant, as shown in Fig



If the gain stabilization is not needed, the STBOUT may be left open and the STBIN must be connected at V_{SS}.

A reset network is provided to synchronize many devices together and to allow the frequency counters (tos) enter their proper counting sequence. On the reset input RESIN there is a schmitt trigger to allow slow changing edges of the reset signal.

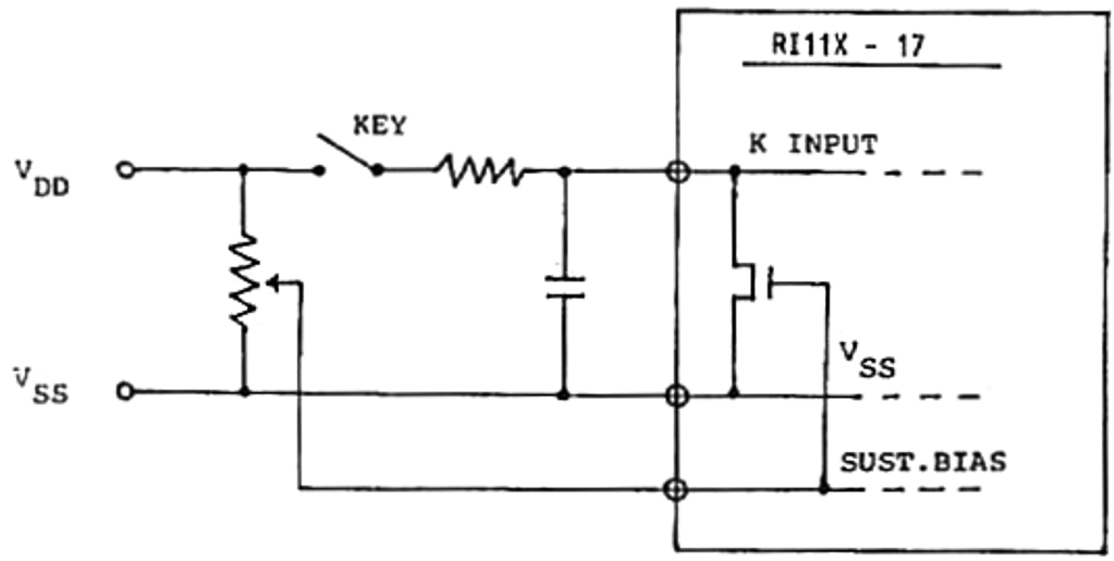
The output of this schmitt trigger is available on RESOUT.

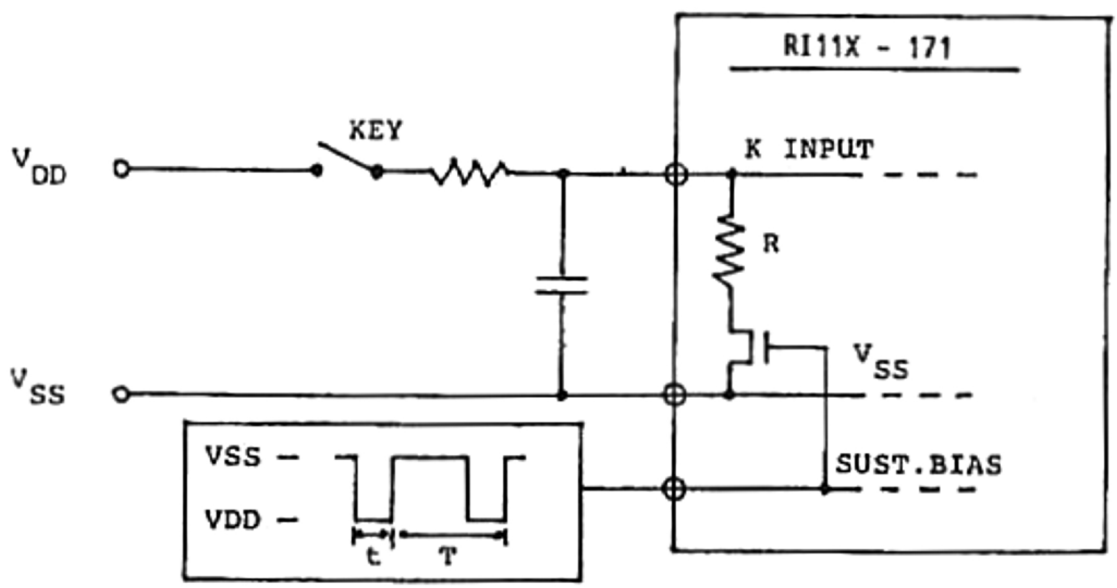
WARNING

In order to avoid that a mishandling of the PC Board might cause reliability problems associated with the internal circuitry, we suggest to connect the PIN4 and PIN24 with an external resistor of .5 MΩ to V_{SS} on the same PC Board.

APPLICATION INFORMATION

KEY CONTACTS & SUSTAIN





The K input equivalent impedance is given by :

$$Req = R \frac{t}{T}$$

DIVISIONAL FACTORS

The output frequencies are related to the input clock frequency through the following divisional factors:

INPUT	OUT 2'	OUT 2' 2/3	OUT 4'	OUT 5'1/3	OUT 8'	OUT 16'
K 1	478 *	638	956	1276	1912	3824
K 2	451 *	602	902	1204	1804	3608
K 3	426 *	568	852	1136	1704	3408
K 4	402 *	536	804	1072	1608	3216
K 5	379 *	506	758	1012	1516	3032
K 6	358 *	478	716	956	1432	2864
K 7	338 *	451 *	676	902	1352	2704
K 8	319 *	426 *	638	852	1276	2552
K 9	301 *	402 *	602	804	1204	2408
K 10	284 *	379 *	568	758	1136	2272
K 11	268 *	358 *	536	716	1072	2144
K 12	253 *	338 *	506	676	1012	2024
K 13	239 *	319 *	478	638	956	1912

* TOS FREQUENCIES WITH PROGRAMMABLE DUTY CYCLE

PRODUCT RANGE

DEVICE	TOS DUTY-CYCLE	SUSTAIN BIAS
RI114-17	50%	ANALOG
RI114-171	50%	DIGITAL
RI115-17	30%	ANALOG
RI115-171	30%	DIGITAL

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PIN ASSIGNMENT

PIN NBR	FUNCTION
1	5'1/3 OUT
2	4' OUT
3	16' OUT
4	SUSTAIN BIAS
5	VSS
6	K 8
7	K 9
8	K 10
9	K 11
10	K 12
11	K 13
12	RESET OUT
13	CLOCK IN
14	VDD
15	CLOCK OUT
16	RESET IN
17	K 1
18	K 2
19	K 3
20	K 4
21	K 5
22	K 6
23	K 7
24	STBIN
25	STBOUT
26	8' OUT
27	2' OUT
28	2'2/3 OUT

ABSOLUTE MAXIMUM RATINGS

Supply voltage VDD	VSS + .3V to VSS -20V
Input voltage range	VSS + .3V to VSS -20V
Storage temperature	-55°C to +150°C
Total power dissipation at (or below) 25°C Free-Air temperature	1 W
Operating Free-Air temperature range	0°C to 50°C

ELECTRICAL CHARACTERISTICS

At 25°C Free-Air temperature VSS = 0V, VDD = -15V (Unless Otherwise Specified)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
STBTN Input Current (See Fig. A)	VIN=VDD		30		uA
K Input Impedance RI11X-17 Only (See Fig. B1)	VK=VDD, PIN 4 at VDD	30	45	60	KΩ
	VK=VDD, PIN 4 at VSS	30	1000		MΩ
K Input Impedance RI11X-171 Only (see Fig. B2)	VK=VDD, PIN 4 at VDD	5	10	15	KΩ
	VK=VDD, PIN 4 at VSS	30	1000		MΩ
Input leakage current (any input except K inputs, Pin 24 and Pin 4)	VIN=VDD All other Pins at VSS			1	uA
Clock input frequency		20		2200*	KHz
Clock input rise/fall				150	ns
Clock input high		-1		VSS	V
Clock input low		VDD		-7	V
Sust.Bias Input Current	VIN = VDD		2.5	5	uA

* 4.4 MHz available upon request

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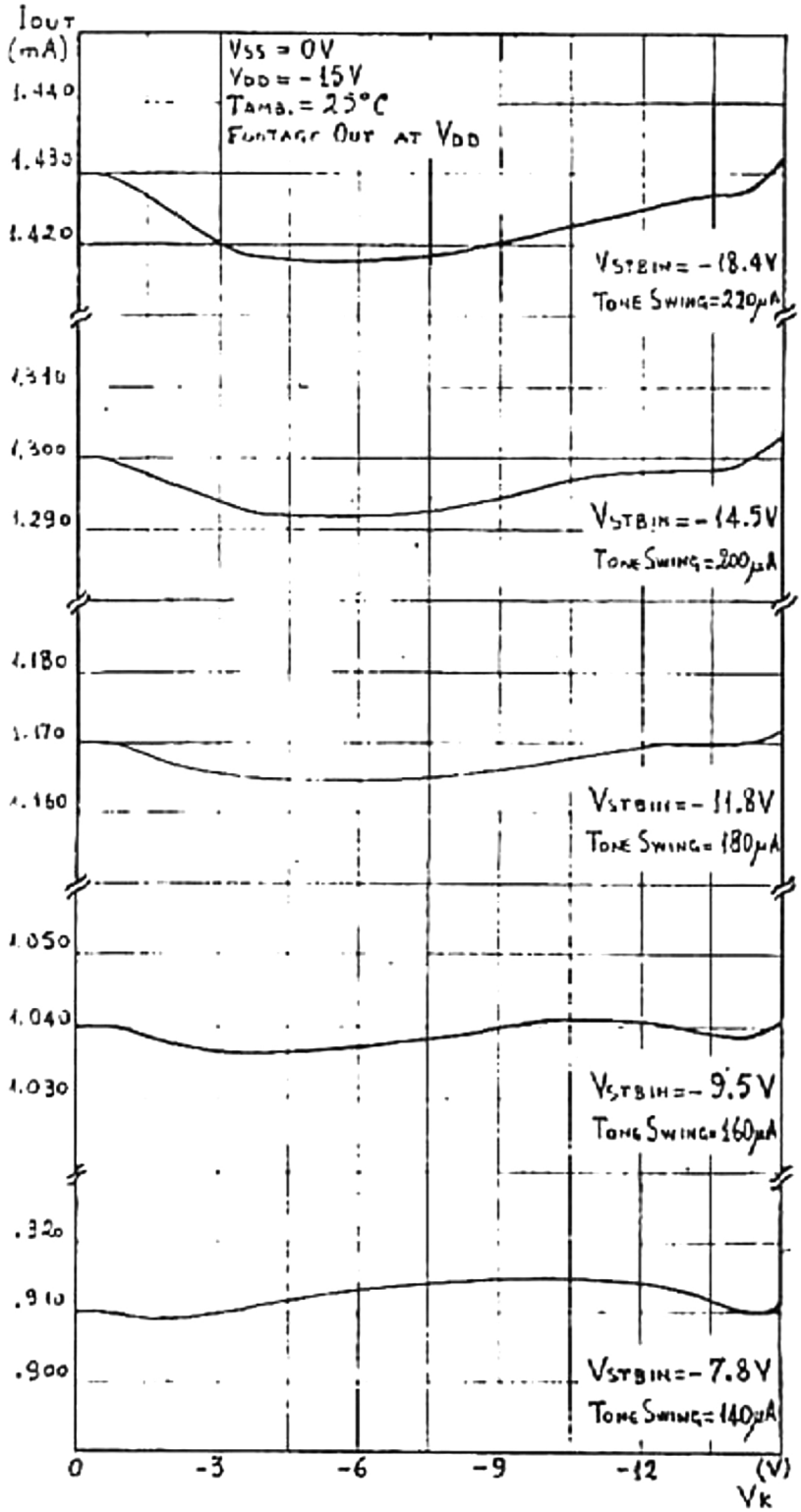
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Clock input low level pulse width		200			ns
Clock input high level pulse width		200			ns
Reset in low level				-8.5	V
Reset in high level		-2.5			V
K input level for 0% modulation index		VDD	VDD	VDD	V
K input level for 100% modulation index			-1.8		V
Clock Out low level	R load 1 M			-8	V
Clock Out high level		-1			V
Clock Out rise/fall	C load 30 pF			150	ns
Reset Out low level	R load 1 M			-9.5	V
Reset Out high level		-1			V
STB Out/Footage Out bias voltage (see fig. C)		VDD-2	VDD	VDD+2	V
STB Out Current (See fig. D)	STB Out at VDD STB in voltage=VDD		100		uA
Power Supply VDD		-11		-16	V
Power Consumption	All outputs open Reset In = Low Sustain Bias=VSS			50	mA
Clock Input Capacitance	VIN = VSS F = 1MH2		10		pF

NOTE: unused K inputs must be tied at VSS.

FOOTAGE OUTPUTS
TYPICAL CHARACTERISTICS



D.C. OUTPUT CURRENTS
V_S
SINGLE K-INPUT VOLTAGE

FIG. E

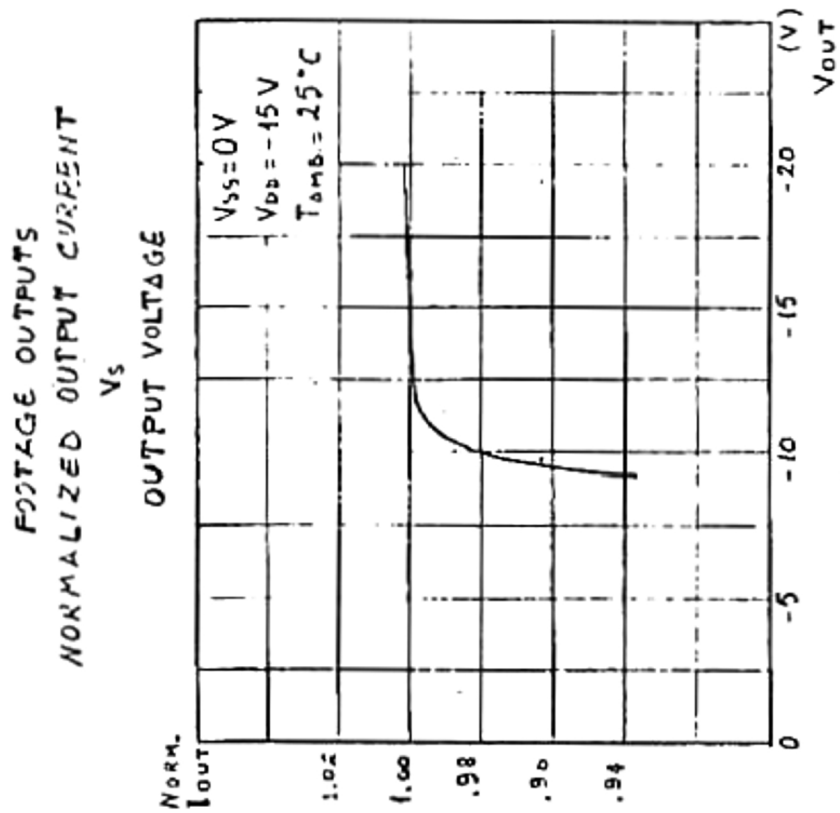

FOOTAGE OUTPUTS
NORMALIZED OUTPUT CURRENT
Vs
OUTPUT VOLTAGE
NORM. IOUT
1.02
1.00
.98
.96
.94
VSS=0V
VDD=-15V
TAMB=25°C
0
-5
-10
-15
-20
(V)
VOUT

FIG. C

TEXAS INSTRUMENTS

TYPICAL CHARACTERISTICS

K-INPUTS CURRENT
V_S
K-INPUTS VOLTAGE
RI11X-17 ONLY

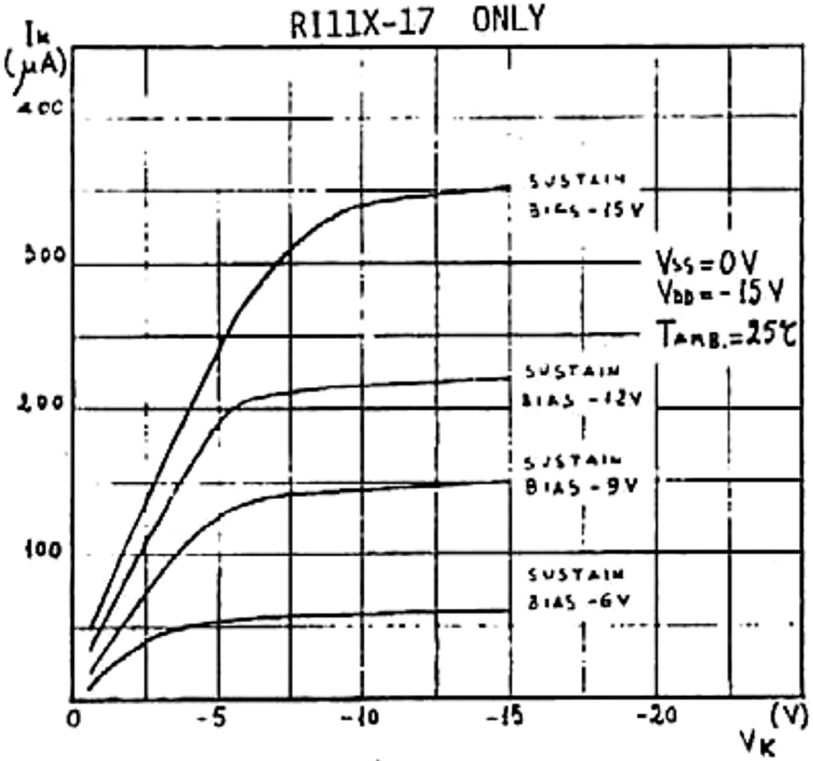


FIG. B 1

K-INPUTS CURRENT
V_S
K-INPUTS VOLTAGE
RI11X-171 ONLY

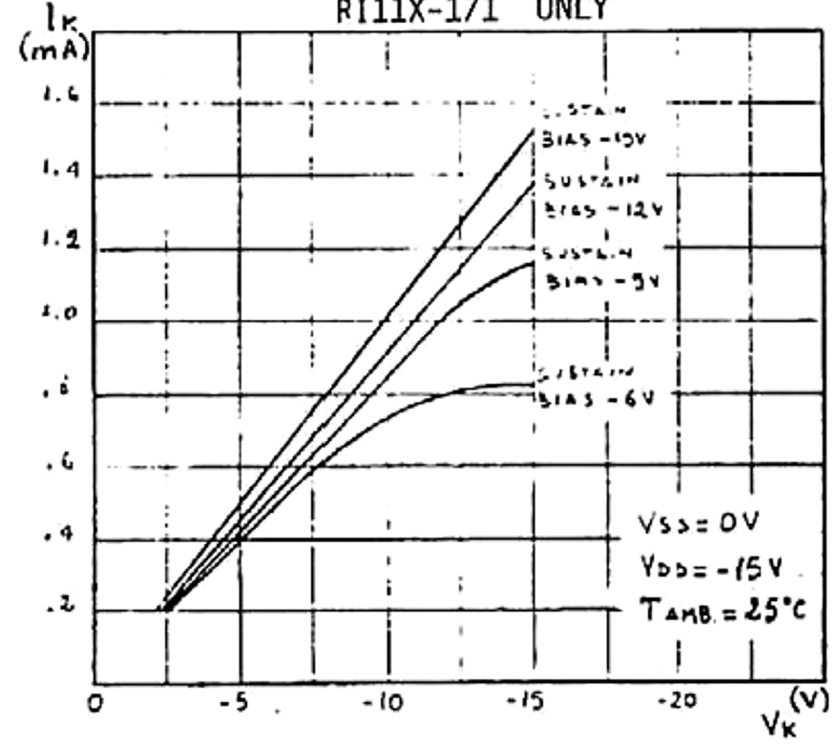


FIG. B 2

TEXAS INSTRUMENTS

TYPICAL CHARACTERISTICS

STBIN CURRENT
Vs
STBIN VOLTAGE

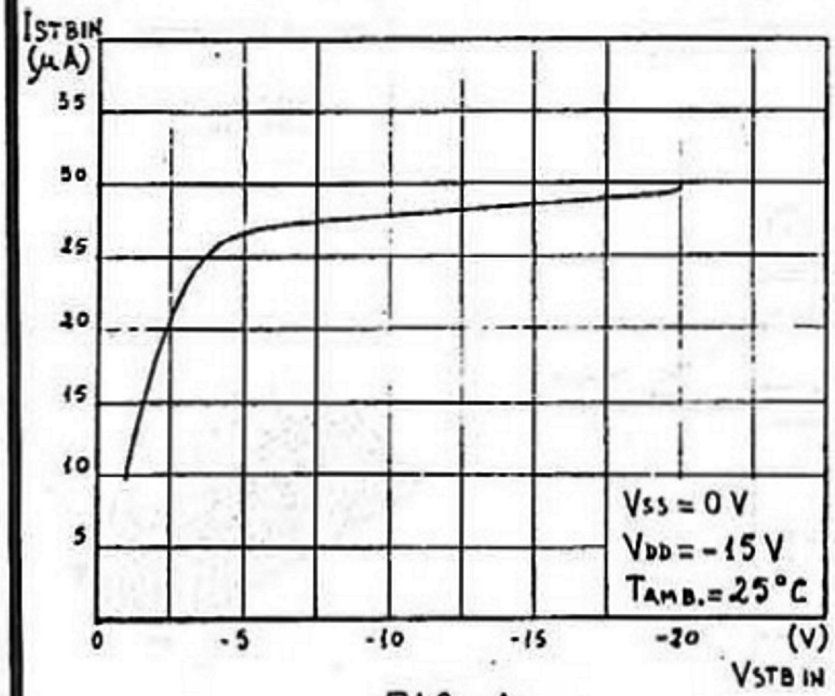


FIG. A

STB OUT CURRENT Vs STBIN VOLTAGE

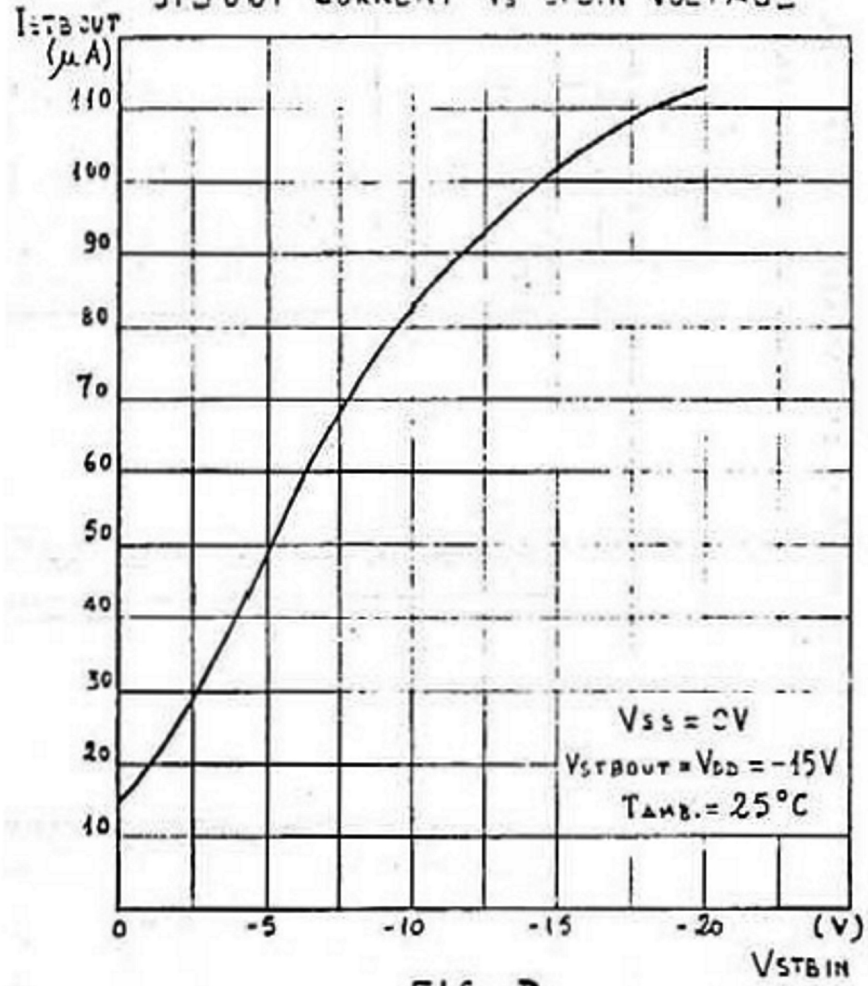
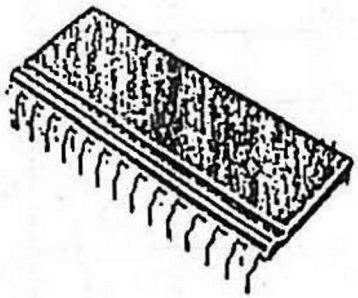
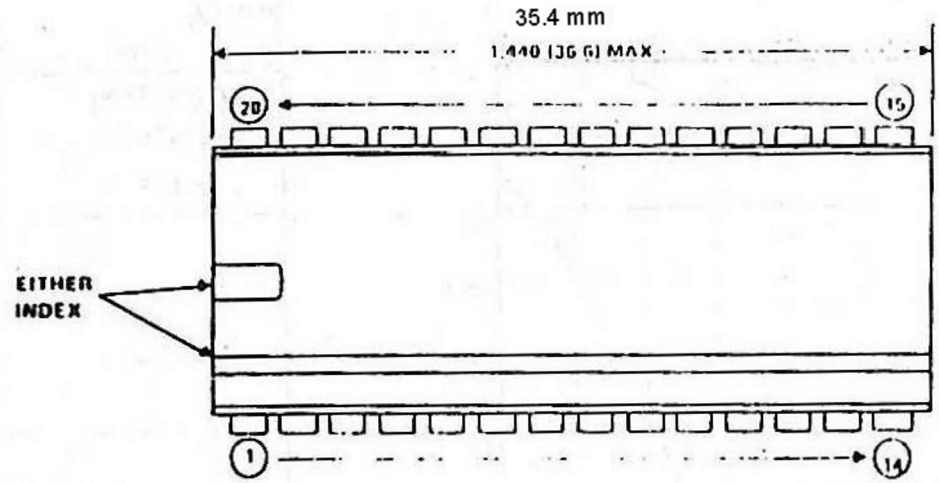
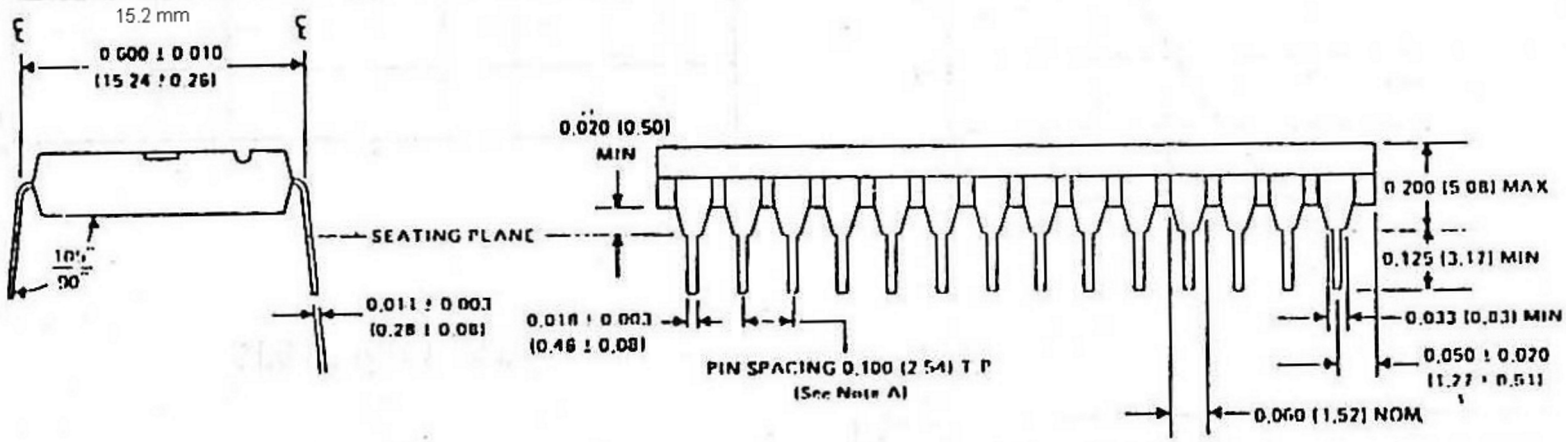


FIG. D

28-PIN 600-MIL PLASTIC PACKAGE (100-MIL PIN SPACING)







NOTES: a. Each pin centerline is located within 0.010 inch (0.26 millimeters) of its true longitudinal position.
b. All linear dimensions are shown in inches (and parenthetically in millimeters for reference only). Inch dimensions govern.