IMISM530 REDUCED EMI CLOCK MODULATOR CHIP

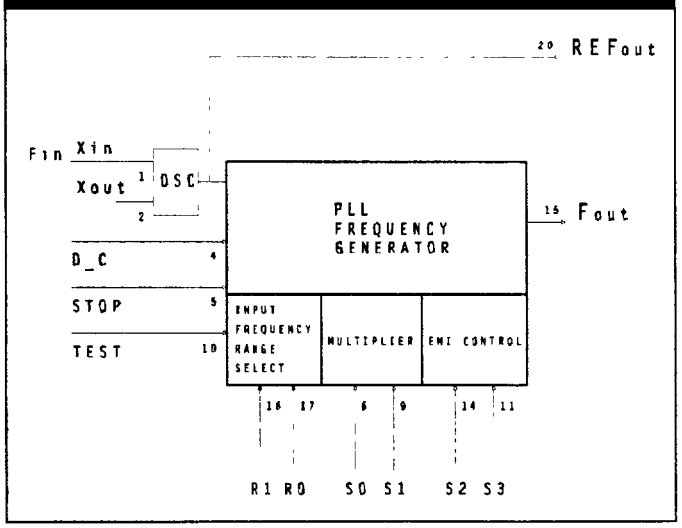
April 21, 1995

CMOS LSI
SPECTRUM SPREAD CLOCK GENERATOR

PRODUCT FEATURES

- Reduces Clock-related EMI up to 20 dB
- Replicates and Modulates Externally Applied Signals
- 3.0V to 5.5V Operating Supply Range
- Wide Range of Selectable Output Frequencies Between 14 and 120 MHz
- Output May be Equal to a Fraction of, or Multiple of, Input Frequency
- Will Accept Input Frequencies Between 14 and 120 MHz
- TTL or CMOS Compatible Outputs with 6 mA Drive Capability
- 20 Pin SSOP or Skinny Dip Packages
- Frequency Spreading with Fin Center Frequency or with Fin Maximum Frequency of Spread
- Compliant with All Major CISC, RISC, and DSP Processors
- Low, Short-term Jitter
- Synchronous Output Enable
- Power-down Mode for Low Power Consumption
- Locks to Externally Applied Signal

BLOCK DIAGRAM



PRODUCT DESCRIPTION

The IMISM530 is a spectrum spread modulator designed for personal computers, laser printers and other digital systems. The IMISM530 uses a patent pending concept to broadband clock frequencies to reduce measured electromagnetic emissions from system clocks and their associated harmonics. The reduction can significantly reduce the cost of complying with regulatory requirements without degrading digital wave forms.

The IMISM530 is extremely flexible in that it can be programmed to broadband frequencies using the input as a center frequency or as the upper frequency limit of the band. It can be used to multiply or divide the input frequency, as well as provide a buffered unmodulated output of the input frequency. The IMISM530 can synchronously stop the modulated output at the low logic level. Power-down mode adds the flexibility to operate the device in a completely static mode to reduce standby currents and simplify system board tests.

APPLICATIONS

The IMISM530 applied to existing clock frequencies will modulate that frequency centering on the input frequency, or up to that frequency and can be used to generate multiples or fractions of that frequency. It can be used with any input frequency between 14 MHz and 120 MHz. See page 3 for 3-volt supply information.

INTERNATIONAL MICROCIRCUITS INC. 525 LOS COCHES ST.
MILPITAS, CA 95035 TEL :408-263-6300 FAX 408-263-6571

PIN DESCRIPTIONS

Xin, Xout - These pins form an on-chip reference oscillator when connected to terminals of an external parallel resonant crystal. OSCin may also serve as an input for an externally generated CMOS level or AC coupled reference signal.

Fout - Modulated output.

S1, S0 - Frequency input multiplier settings. See chart to determine multiplication or division desired. S1 has internal pull-up; S0 has internal pull-down.

LF - This is a phase detector output for the clock signal. It is a single-ended, tri-state output for use as loop error signal. See Figure 1.

REFout - Buffered output of the crystal or frequency in (unmodulated).

S2, S3 - Control pins for setting amount of modulation. See chart for settings. S2 has internal pull-up; S3 has internal pull-down.

R1, R0 - Control pins for frequency input ranges.

- Frequency 14.318 MHz to 30 MHz: R1 = 0, R0 = 1.
- Frequency 30 MHz to 60 MHz: R1 = 1, R0 = 0.
- Frequency 60 MHz to 120 MHz: R1 = 1, R0 = 1.
- Have internal pull-up.

TEST - Internal pull-down to VSS, defaults to 0 state for operating mode. Used by factory for testing. Consult IMI if required.

D_C - Down/center pin, which controls the center frequency of the output modulation. When D_C = 1, the modulation is centered on the Fout. When D_C = 0, the maximum frequency of the modulation is equal to the Fout. The minimum is determined by the modulation range selection pins, S3 and S2. Has internal pull-down.

STOP - When equal to 1, the clock is stopped. TTL input synchronously stops output at low logic level. Has internal pull-down.

OVDD - Oscillator positive power supply.

OVSS - Oscillator circuit ground.

AVDD - Analog circuit positive power supply.

AVSS - Analog circuit ground.

DVDD - Digital positive power supply.

DVSS - Digital circuit ground.

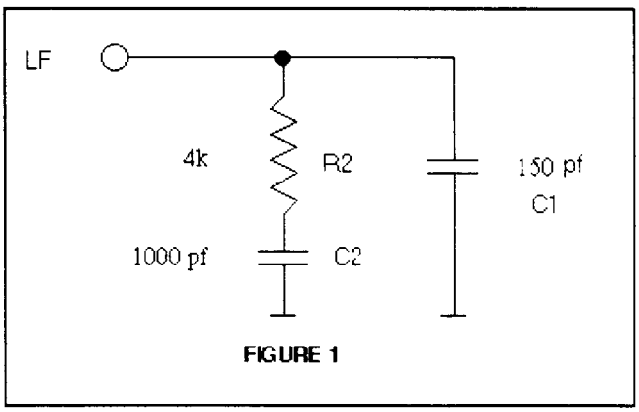


FIGURE 1

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SPECTRUM SPREAD CLOCK MODULATOR FREQUENCY SELECTION TABLE (FREQUENCIES ARE IN MHZ)

*Range Of Fin Frequency		Multiplier Settings		Range of Fout		Required R Settings		Modulation and Power Down Settings	
Min	Max	S1	S0	Min	Max	R1	R0	S3	S2
14	30	0	1	14	30	0	1	See Table 2	
14	30	1	0	28	60	0	1	See Table 2	
14	30	1	1	56	120	0	1	See Table 2	
25	60	0	1	13	30	1	0	See Table 2	
25	60	1	0	25	60	1	0	See Table 2	
25	60	1	1	50	120	1	0	See Table 2	
50	120	0	1	13	30	1	1	See Table 2	
50	120	1	0	25	60	1	1	See Table 2	
50	120	1	1	50	120	1	1	See Table 2	
Reserved		0	0	N/A	N/A	As Set	As Set	1	0
Power Down	Hi-Z	0	0	N/A	N/A	As Set	As Set	1	1
Power Down	0	0	0	N/A	N/A	As Set	As Set	0	0
Power Down	1	0	0	N/A	N/A	As Set	As Set	0	1

Table 1

When Power-down address is selected, the VCO is turned off and the modulation is in the standby mode. The phase detector is in the tri-state mode.

* Note: When operating in 3-volt applications, the input frequency is restricted to no more than 66% of the maximum frequency of the applicable Fin range.

SPECTRUM SPREAD CLOCK MODULATOR MODULATION SELECTION TABLE

EMI Reduction	Modulation Settings		Bandwidth Limit Frequencies as a %Value of Fout			
			Down/Center = 0		Down/Center = 1	
	S3	S2	Low	High	Low	High
Minimum EMI Control	0	0	98 75%	100%	99.375%	100 625%
Suggested Setting	0	1	97.5%	100%	98.75%	101 25%
Alternate Setting	1	0	95.0%	100%	97.5%	102 5%
Maximum EMI Reduction	1	1	90 0%	100%	95%	105%

Table 2

In systems that are not tolerant of clock frequency changes, the S2 and S3 set to 0 is recommended. When down/center is set to 0, the center frequency is offset down to one-half the modulation range.

MAXIMUM RATINGS

Voltage Relative to VSS:	-0.3V to 6V
Voltage Relative to VD:	0.3V
Storage Temperature:	-65°C to +150°C
Operating Temperature:	0°C to +70°C
Recommended Operating Range:	3.0V - 5.5V

This device contains circuitry to protect the inputs against damage due to high static voltages or electric field; however, precautions should be taken to avoid application of any voltage higher than the maximum rated voltages to this circuit. For proper operation, V_{in} and V_{out} should be constrained to the range:

$$V_{SS} < (V_{in} \text{ or } V_{out}) < V_{DD}$$

All inputs are tied high or low internally.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Units
Input Low Voltage	V_{IL}	-	-	0.8	Vdc
Input High Voltage	V_{IH}	2.0	-	-	Vdc
Input Low Current With Pull-up	I_{IL}	-	-	$\frac{10}{100}$	µA
Input High Current With Pull-down	I_{IH}	-	-	$\frac{10}{100}$	µA
Output Low Voltage I_{OL} = 6mA	VOL	-	-	0.4*	Vdc
Output High Voltage I_{OH} = 6mA	VOH	2.5*	-	-	Vdc
Tri-State Leakage Current	Ioz	-	-	10	µA
Static Supply Current	I_{DD}	-	-	250	µA
Dynamic Supply Current	Icc	-	25	30	mA
Short Circuit Current	Isc	25	-	-	mA
					VDD = 5V ±10%, TA = 0°C to 70°C

* At values below 4.5 volts = VDD, these parameter limits will change.

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SWITCHING CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Units
Output Rise and Fall Time Measured at 10% - 90% of V_{DD}	t_{TLH}, t_{THL}	-	-	5	ns
Output Rise and Fall Time Measured at 0.8V - 2.0V	t_{TLH}, t_{THL}	-	-	3	ns
Output Duty Cycles	T_{symF1}	-	-	45/55	%
Peak-to Peak Jitter One Sigma	t_{j1s}	-	-	2	% of F_{out}
				VDD = 5V ±10%, TA = 0°C to 70°C, CL = 15pF	

OSCILLATOR CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
Transconductance	gm	20	80	180	millimhos	-
Output Impedance	Z_o	-	200	800	ohms	-
Input Capacitance	Ci	8	13	18	pf	-
Output Capacitance	Co	3	6	9	pf	-
DC Bias Voltage	V_B	1.5	VDD/2	3.5	Volt	-
Start-up Time	ts	-	-	2	ms	@ VDD = 4.5V
Duty Cycle	T_{symF1}	-	-	45/55	%	-

VCO CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Units	Conditions
VCO Gain	K_o	35	55	65	MHz/volt	ΔF/ΔV Measured with VCO Control at 2V - 3V
Phase Detector Gain	K_d	100	145	200	µA	-

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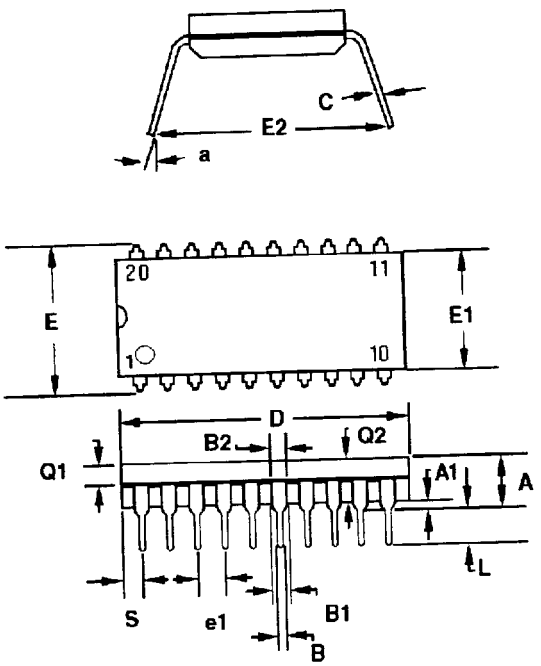
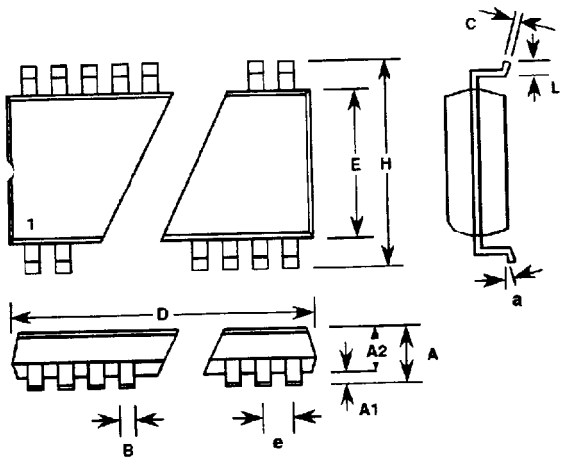
PACKAGE DRAWING AND DIMENSIONS



20 PLASTIC SKINNY DIP
(300 mil narrow body)

20 PIN SKINNY PLASTIC DIP DIMENSIONS						
SYMBOL	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.145	-	0.155	3.68	-	3.93
A1	0.020	-	-	0.51	-	-
B	0.016	0.018	0.020	0.40	0.45	0.50
B1	0.056	0.059	0.062	1.47	1.52	1.57
B2	0.046	0.049	0.052	1.17	1.24	1.32
C	0.008	0.010	0.012	0.20	0.25	0.30
D	1.028	1.030	1.032	26.11	26.16	26.21
E	0.298	-	0.302	7.57	-	7.67
E1	0.248	0.250	0.252	6.30	6.35	6.40
E2	0.335	0.345	0.355	8.51	8.76	9.01
e1	0.100 BSC			2.54 BSC		
L	0.128	0.130	0.132	3.25	3.30	3.35
a	0 °	7 °	15 °	0 °	7 °	15 °
Q1	0.059	0.060	0.061	1.50	1.53	1.55
Q2	0.128	0.130	0.132	3.25	3.30	3.35
S	0.063	0.065	0.067	1.60	1.65	1.70



SSOP PACKAGE

20 PIN SSOP OUTLINE DIMENSIONS						
SYMBOL	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.068	0.073	0.078	1.73	1.86	1.99
A1	0.002	0.005	0.008	0.05	0.13	0.21
A2	0.066	0.068	0.070	1.68	1.73	1.78
B	0.010	0.012	0.015	0.25	0.30	0.38
C	0.005	0.006	0.009	0.13	0.15	0.22
D	0.278	0.284	0.289	7.07	7.20	7.33
E	0.205	0.209	0.212	5.20	5.30	5.38
e	0.0256 BSC			0.65 BSC		
H	0.301	0.307	0.311	7.65	7.80	7.90
a	0 °	4 °	8 °	0 °	4 °	8 °
L	0.022	0.030	0.037	0.55	0.75	0.95

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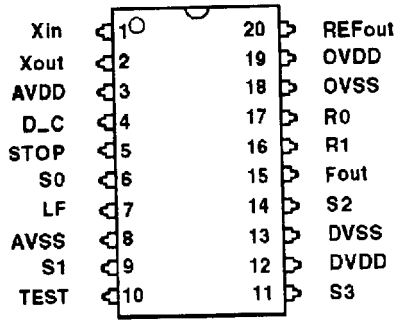
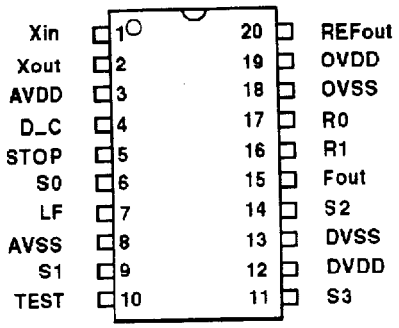
CONNECTION DIAGRAMS

PDIP PACKAGE



SSOP PACKAGE



ORDERING INFORMATION

Part Number	Package Type	Production Flow
IMISM530xPB	Plastic Dip	Commercial, 0°C to +70°C
IMISM530xYB	SSOP	Commercial, 0°C to +70°C

Note: The "x" following the IMI Device Number denotes the device revision. The ordering part number is formed by a combination of device number, device revision, package style, and screening as shown below.

Marking: Example: IMI
SM530xPB
Date Code, Lot #

IMISM530 xPB

- **Flow**
  - B = Commercial, 0°C to +70°C
- **Package**
  - P = Plastic Dip
  - Y = SSOP
- **Revision**
- **IMI Device Number**

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