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Title: TEMPERATURE EFFECTS ON NOISE SOURCES

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TEMPERATURE EFFECTS ON NOISE SOURCES

T. Dunbrack

In an attempt to better understand the effects that ambient temperature, voltage and current have on noise diodes, the following tests were ran.

Mixer preamps were used with the appropriate coupler and nitrogen cooled load, for the band under test. The IF output was sent to a square law detector, which was used to drive a digital meter an chart recorder.

A sweep generator in the CW mode was used for the local oscillator. The RF port of the mixer was connected to a cold load for better stability. The noise source was connected into the mixer RF port by a coupler.

Attenuation was placed in the noise source output to limit the noise level to about a 10 to 20 percent increase in the system temperature with the source on.

The noise source under test was placed in a temperature controlled oven. All attenuators and couplers were kept outside the oven so only the noise source would feel the effects of the temperature change. A typical setup is shown in Figure (1).

A test was made by having all equipment on and running for at least two hours so everything was stabilized. The measurements were double sideband and no filters were used in the IF. The IF level was adjusted to give one volt output from the square law detector with the noise source off. Then the noise source was turned on and the increase in the square law detector out was noted as a percentage change.

Two separate conditions were used to bias the noise source: A LAMBDA power supply, Model LH 125A FM, was used as a constant voltage source. The constant current source was the same as the Cal circuit designed by Chuck Brockway, that is used in the 5-25 GHz Maser receiver.

The noise source was temperature stabilized at 70° F and the bias voltage or bias current was set for the value specified by the manufacturer.

Four seperate tests were made for each noise source.

1. Hold the voltage constant as the temperature on the noise source is changed by 70° F (40° F -- 110° F)

2. Hold the voltage constant as the temperature on the noise source is changed by 20° F (60° F -- 80° F)

3. Hold the current constant as the temperature on the noise source is changed by 70° F (40° F -- 110° F)

4. Hold the current constant as the temperature on the noise source is changed by 20° F (60° F -- 80° F)

In each test the temperature on the noise source was stabilized at the lower level, then slowly increased to the upper level. The change in total power was plotted across the overall temperature change.

Five noise sources were tested from two manufacturers, MICRONETICS and MICROWAVE SEMICONDUCTOR. Four bands of frequencies were covered, C, X, Ku, & K. The C and X bands were coax mounts while the Ku and K bands were waveguide mounts.

The accompanying chart, Figure (2), shows some of the results. The amount of change for both constant voltage and constant current is displayed as a percent and in db. The db per degree change is shown for th e 20° F change only. The change over this area appears to be linear, but some sources do not have a linear change over the complete 70° F change.

CONCLUSION

1. Each source acts differently.
2. One source did not respond to either voltage or current regulation. (Ku)
3. One source responded better to voltage regulation than to current regulation. (K)
4. Changing the current will produce a level change. It can be either a decrease or an increase in noise output.
5. Increasing the ambient temperature on the noise source will produce a decrease in diode current.
6. There was no evidence of self heating of the diode from the off to the on state. But the response time o f the recorder is too slow to measure anything of short duration. The recorder in use, a MOSLEY 7100 BM, has a 1/2 second for full scale response time.
7. Each noise source should be tested as an individual to determine its best characteristics.

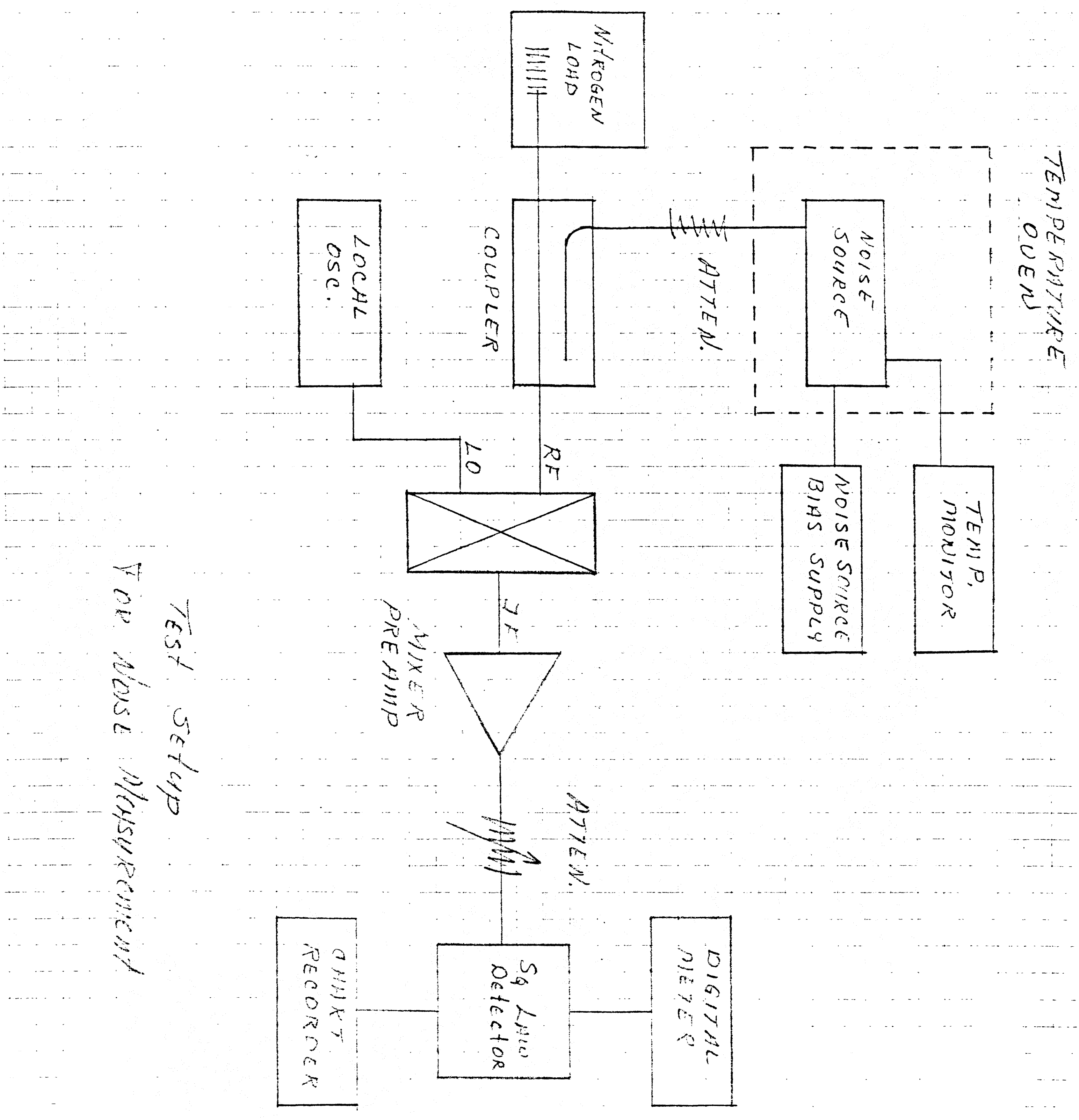
NITROGEN LOAD
COUPLER
LOCAL OSC.
ATTEN.
NOISE SOURCE
TEMPERATURE OVEN
LO
RF
IF
MIXER PREAMP
NOISE SOURCE BIAS SUPPLY
TEMP. MONITOR
ATTEN.
Sq Law Detector
DIGITAL METER
CHART RECORDER
Test Setup For Noise Measurement

FIGURE I

SOURCE			20°F CHANGE 60°F – 80°F CONSTANT Voltage	20°F CHANGE 60°F – 80°F CONSTANT Current	70°F CHANGE 40°F – 110°F CONSTANT Voltage	70°F CHANGE 40°F – 110°F CONSTANT Current
C-BAND	MICRONETICS	% Δ	4.9 %	2.5 %	22 %	9.5 %
	Model 257	db Δ	.208 db	.107 db	.864 db	.394 db
	SERIAL 410	db per °	.01 db	.005 db		
	MICRONETICS	% Δ	7.8 %	.8 %	28.4 %	1.6 %
	Model 257	db Δ	.326 db	.035 db	1.09 db	.069 db
	SERIAL 411	db per °	.016 db	.002 db		
X-BAND	MICRONETICS	% Δ	N. C.	N. C.	.9 %	.9 %
	Model 256	db Δ			.039 db	.039 db
	SERIAL C422	db per °				
Ku-BAND	MICROWAVE Semiconductor	% Δ	1.3 %	1.3 %	4.5 %	4.5 %
	Model 67105	db Δ	.056 db	.056 db	.191 db	.191 db
	SERIAL 113	db per °	.003 db	.003 db		
K-BAND	MICROWAVE Semiconductor	% Δ	1.1 %	1.2 %	2.2 %	10.4 %
	Model 69104	db Δ	.048 db	.052 db	.095 db	.430 db
	SERIAL 926	db per °	.002 db	.003 db		

FIGURE 2