μAF111 • μAF311

FET INPUT VOLTAGE COMPARATORS

FAIRCHILD LINEAR INTEGRATED CIRCUITS

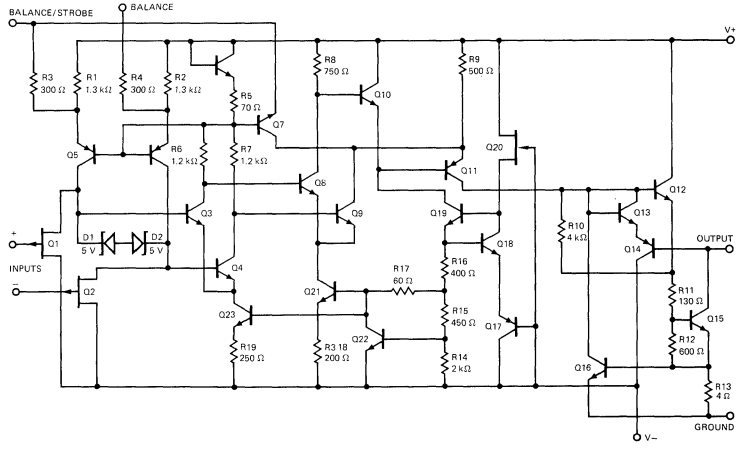
GENERAL DESCRIPTION – The μAF111 and μAF311 are monolithic, FET input Voltage Comparators, constructed using the Fairchild Planar* epitaxial process. The μAF111 series operates from the single 5 V integraetd circuit logic supply to the standard ±15 V operational amplifier supplies. The μAF111 series is intended for a wide range of applications including driving lamps or relays and switching voltages up to 50 V at currents as high as 50 mA. The output stage is compatible with RTL, DTL, TTL and MOS logic. The input stage current can be raised to increase input slew rate.

- **EXTREMELY LOW INPUT BIAS CURRENT** . . . 50 pA MAX (μAF111), 150 pA MAX (μAF311)
- **EXTREMELY LOW INPUT OFFSET CURRENT** . . . 25 pA MAX (μAF111), 75 pA MAX (μAF311)
- **DIFFERENTIAL INPUT VOLTAGE** . . . ±30 V
- **POWER SUPPLY VOLTAGE SINGLE 5.0 V SUPPLY TO ±15 V**
- **OFFSET VOLTAGE NULL CAPABILITY**
- **STROBE CAPABILITY**

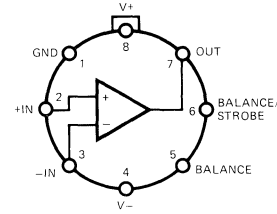
ABSOLUTE MAXIMUM RATINGS

Voltage Between V+ and V− Terminals	36 V
Output to V− (μAF111)	50 V
(μAF311)	40 V
Ground to V−	30 V
Differential Input Voltage	±30 V
Input Voltage (Note 1)	±15 V
Internal Power Dissipation (Note 2)	
Metal Can	500 mW
DIP	670 mW
Output Short Circuit Duration	10 s
Storage Temperature Range (Metal Can)	
Metal Can	−65°C to +150°C
Hermetic DIP	−55°C to +125°C
Operating Temperature Range	
Military (μAF111)	−55°C to +125°C
Commercial (μAF311)	0°C to +70°C
Pin Temperature	
Metal Can, Hermetic DIP (Soldering, 60 s)	300°C

EQUIVALENT CIRCUIT



CONNECTION DIAGRAMS
8-PIN METAL CAN
(TOP VIEW)
PACKAGE OUTLINE 5S
PACKAGE CODE H

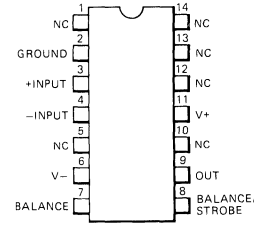


ORDER INFORMATION

TYPE	PART NO.
μAF111	μAF111HM
μAF311	μAF311HC

NOTE: Pin 4 connected to case.

CONNECTION DIAGRAM
14-PIN DIP
(TOP VIEW)
PACKAGE OUTLINE 6A
PACKAGE CODE D



ORDER INFORMATION

TYPE	PART NO.
μAF111	μAF111DM
μAF311	μAF311DC

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μAF111

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = -55°C$ to $+125°C$ unless otherwise specified, Note 3.

CHARACTERISTICS	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage (Note 4)	$T_A = 25°C$, $R_S \leq 50$ kΩ		0.7	4.0	mV
Input Offset Current (Note 4)	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		5.0	25	pA
Input Bias Current	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		20	50	pA
Voltage Gain	$T_A = 25°C$		200		V/mV
Response Time (Note 5)	$T_A = 25°C$		200		ns
Saturation Voltage	$V_{IN} \leq -5$ mV, $I_{OUT} = 50$ mA $T_A = 25°C$		0.75	1.5	V
Strobe On Current	$T_A = 25°C$		3.0		mA
Output Leakage Current	$V_{IN} \geq 5$ mV, $V_{OUT} = 35$ V $T_A = 25°C$		0.2	10	nA
Input Offset Voltage (Note 4)	$R_S \leq 50$ kΩ			6.0	mV
Input Offset Current (Note 4)	$V_S = \pm 15$ V, $V_{CM} = 0$ (Note 6)		2.0	3.0	nA
Input Bias Current	$V_S = \pm 15$ V, $V_{CM} = 0$ (Note 6)		5.0	7.0	nA
Input Voltage Range			+14 −13.5		V V
Saturation Voltage	$V^+ \geq 4.5$ V, $V^- = 0$ $V_{IN} \leq -6$ mV, $I_{SINK} \leq 8$ mA		0.23	0.4	V
Output Leakage Current	$V_{IN} \geq 5$ mV, $V_{OUT} = 35$ V		0.1	0.5	μA
Positive Supply Current	$T_A = 25°C$		5.1	6.0	mA
Negative Supply Current	$T_A = 25°C$		4.1	5.0	mA

μAF311

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 0°C$ to $+70°C$ unless otherwise specified, Note 3.

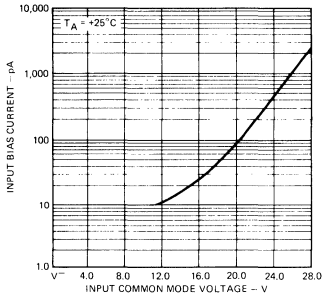
CHARACTERISTICS	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage (Note 4)	$T_A = 25°C$, $R_S \leq 50$ kΩ		2.0	10	mV
Input Offset Current (Note 4)	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		5.0	75	pA
Input Bias Current	$T_A = 25°C$, $V_{CM} = 0$ (Note 6)		25	150	pA
Voltage Gain	$T_A = 25°C$		200		V/mV
Response Time (Note 5)	$T_A = 25°C$		200		ns
Saturation Voltage	$V_{IN} \leq -10$ mV, $I_{OUT} = 50$ mA $T_A = 25°C$		0.75	1.5	V
Strobe On Current	$T_A = 25°C$		3.0		mA
Output Leakage Current	$V_{IN} \geq 10$ mV, $V_{OUT} = 35$ V $T_A = 25°C$		0.2	10	nA
Input Offset Voltage (Note 4)	$R_S \leq 50$ kΩ			15	mV
Input Offset Current (Note 4)	$V_S = \pm 15$V, $V_{CM} = 0$ (Note 6)		1.0		nA
Input Bias Current	$V_S = \pm 15$ V, $V_{CM} = 0$ (Note 6)		3.0		nA
Input Voltage Range			+14 −13.5		V V
Saturation Voltage	$V^+ \geq 4.5$ V, $V^- = 0$ $V_{IN} \leq -10$ mV, $I_{SINK} \leq 8$ mA		0.23	0.4	V
Positive Supply Current	$T_A = 25°C$		5.1	7.5	mA
Negative Supply Current	$T_A = 25°C$		4.1	5.0	mA

NOTES:

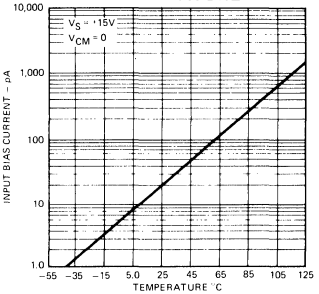
1. This rating applies for ±15 V supplies. The positive input voltage limit is 30 V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30 V below the positive supply, whichever is less.
2. Rating applies to ambient temperatures up to 70°C. Above 70°C ambient derate linearly at 6.3 mW/°C for metal can; 8.3 mW/°C for DIP.
3. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5 V supply up to ±15 V supplies.
4. The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
5. ,The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive.
6. For input voltages greater than 15 V above the negative supply the bias and offset currents will increase – see typical performance curves.

TYPICAL PERFORMANCE CURVES

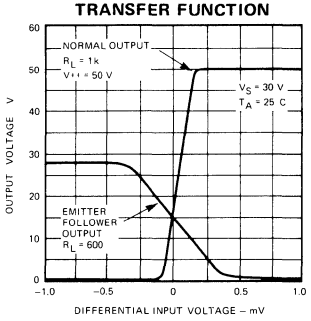
INPUT BIAS CURRENT AS A FUNCTION OF COMMON MODE VOLTAGE



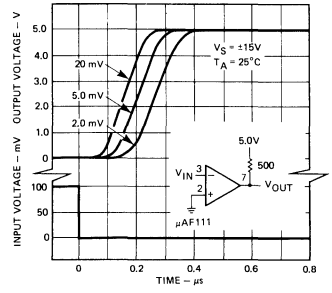
INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE



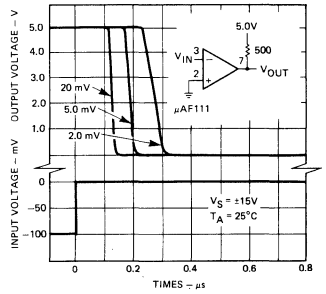
TRANSFER FUNCTION



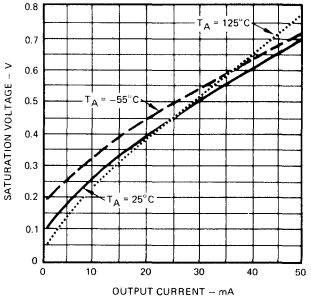
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



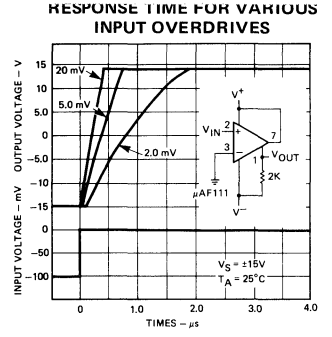
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



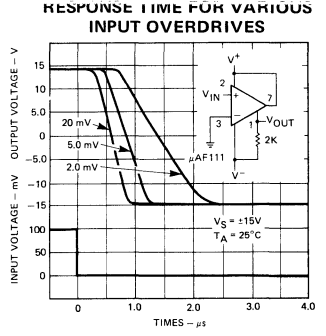
OUTPUT SATURATION VOLTAGE



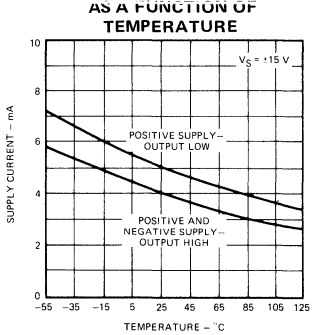
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



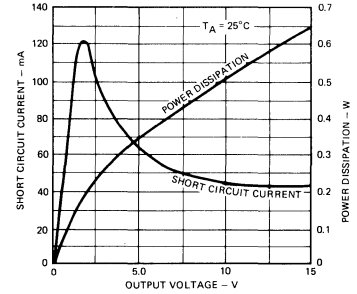
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



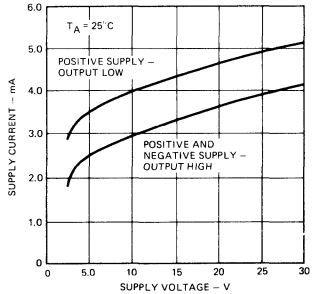
SUPPLY CURRENT AS A FUNCTION OF TEMPERATURE



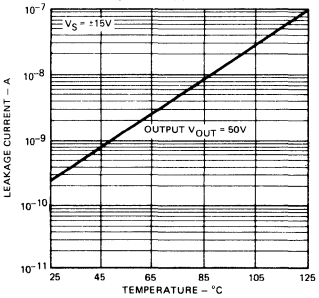
OUTPUT LIMITING CHARACTERISTICS



SUPPLY CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



OUTPUT LEAKAGE CURRENT AS A FUNCTION OF TEMPERATURE



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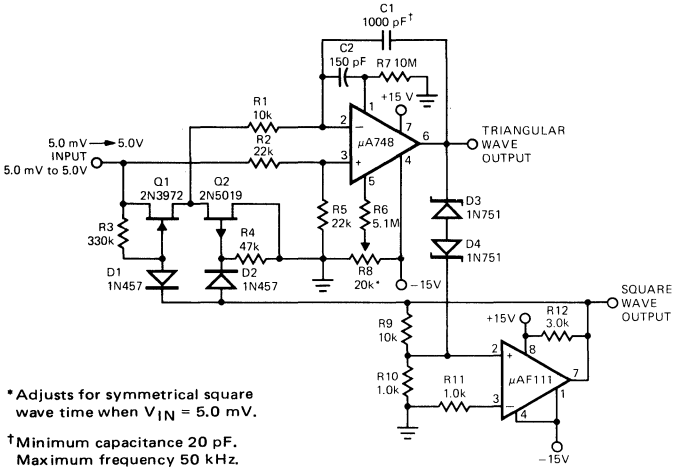
TYPICAL APPLICATIONS

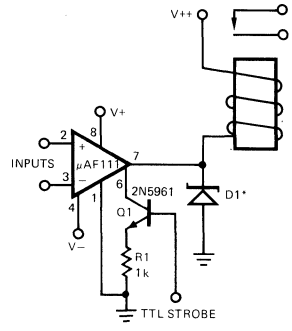
10 Hz TO 10 kHz VOLTAGE CONTROLLED OSCILLATOR



*Adjusts for symmetrical square wave time when V_{IN} = 5.0 mV.

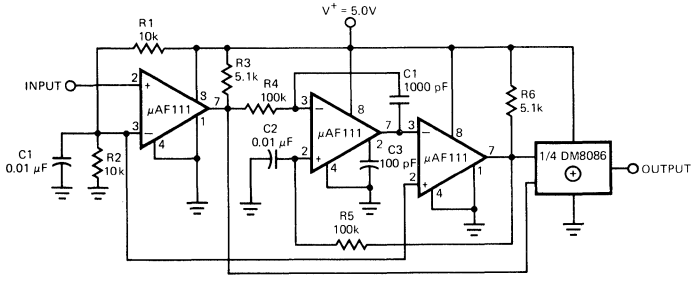
†Minimum capacitance 20 pF. Maximum frequency 50 kHz.

RELAY DRIVER WITH STROBE



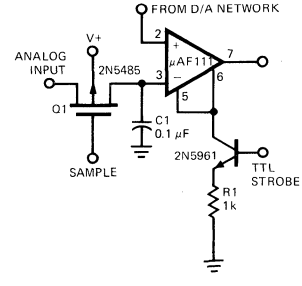
*Absorbs inductive kickback of relay and protects IC from severe voltage transients on V^{++} line.

FREQUENCY DOUBLER



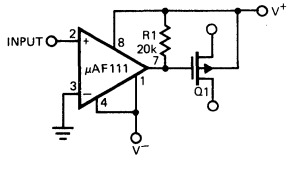
Frequency range:
Input — 5.0 kHz to 50 kHz
Output — 10 kHz to 100 kHz

STROBING OFF BOTH INPUT* AND OUTPUT STAGES

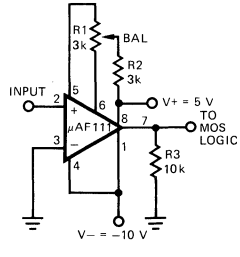


*Typical input current is 50 pA with inputs strobed off.

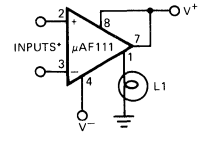
ZERO CROSSING DETECTOR DRIVING MOS SWITCH



ZERO CROSSING DETECTOR DRIVING MOS LOGIC



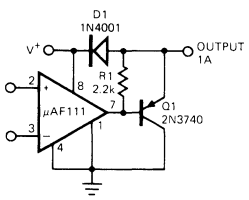
DRIVING GROUND-REFERRED LOAD



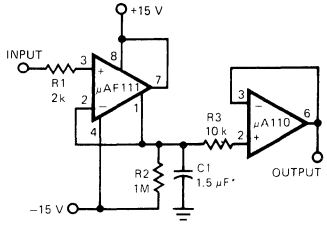
*Input polarity is reversed when using pin 1 as output.

TYPICAL APPLICATIONS (Cont'd)

COMPARATOR AND SOLENOID DRIVER

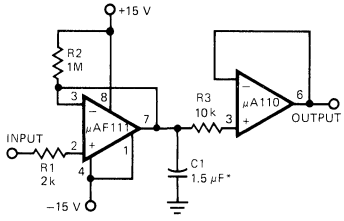


POSITIVE PEAK DETECTOR



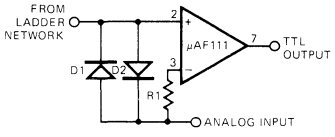
*Solid tantalum

NEGATIVE PEAK DETECTOR

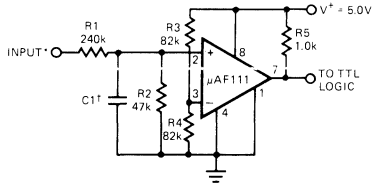


*Solid tantalum

USING CLAMP DIODES TO IMPROVE RESPONSE



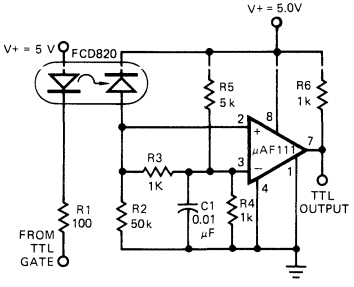
TTL INTERFACE WITH HIGH LEVEL LOGIC



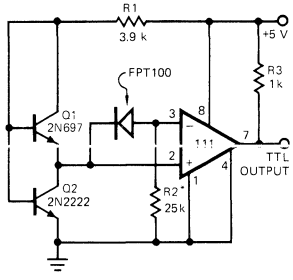
*Values shown are for a 0 to 30 V logic swing and a 15 V threshold.

†May be added to control speed and reduce susceptibility to noise spikes.

DIGITAL TRANSMISSION ISOLATOR



PRECISION PHOTODIODE COMPARATOR



*R2 sets the comparison level. At comparison, the photodiode has less than 5.0 mV across it, decreasing leakages by an order of magnitude.

DEFINITIONS:

AVERAGE TEMPERATURE COEFFICIENT OF INPUT OFFSET CURRENT – The change in input offset current over the operating temperature range divided by the operating temperature range.

AVERAGE TEMPERATURE COEFFICIENT OF INPUT OFFSET VOLTAGE – The change in input offset voltage over the operating temperature range divided by the operating temperature range.

DIFFERENTIAL INPUT VOLTAGE RANGE – The range of voltage applied between the input terminals for which operation within specifications is assured.

INPUT BIAS CURRENT – The average of the two input currents with no signal applied.

INPUT COMMON MODE VOLTAGE RANGE – The range of common mode input voltage over the device will operate within specifications.

INPUT OFFSET CURRENT – The difference between the two input currents with the output at the logic threshold voltage.

INPUT OFFSET VOLTAGE – The voltage which must be applied to the input terminals to give the logic threshold voltage at the output.

INPUT VOLTAGE RANGE – The range of voltage on either input terminal over which the device will operate as specified.

NEGATIVE OUTPUT VOLTAGE LEVEL – The dc output voltage in the negative direction with the input voltage equal to, or greater than, a minimum specified value.

RESPONSE TIME – The interval between the application of an input step function and the time when the output voltage crosses the logic threshold level.

STROBE CURRENT – The maximum current taken by the strobe terminal during activation.

VOLTAGE GAIN – The ratio of the change in output voltage to the change in voltage between the input terminals producing it with the dc output in the vicinity of the logic threshold.