# μAF155 • μAF355
## LOW-SUPPLY CURRENT
# μAF156 • μAF356
## WIDEBAND
# MONOLITHIC JFET INPUT OPERATIONAL AMPLIFIERS

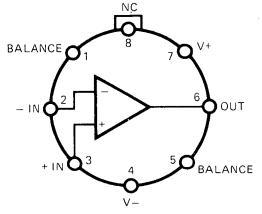
FAIRCHILD LINEAR INTEGRATED CIRCUITS

**GENERAL DESCRIPTION** – These monolithic JFET input operational amplifiers incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors. These amplifiers feature low input bias and offset currents, low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

- LOW INPUT BIAS CURRENT . . . 30 pA
- HIGH INPUT IMPEDANCE . . . $10^{12}\ \Omega$
- LOW INPUT OFFSET VOLTAGE . . . 2 mV
- LOW INPUT OFFSET VOLTAGE TEMPERATURE DRIFT . . . 5 μV/°C
- LOW INPUT NOISE CURRENT . . . 0.01 pA/$\sqrt{\text{Hz}}$
- HIGH COMMON MODE REJECTION RATIO . . . 100 dB
- LARGE DC VOLTAGE GAIN . . . 106 dB

| | μAF155 | μAF156 | Units |
|---|---|---|---|
| • EXTREMELY FAST SETTLING TIME TO 0.01% | 4 | 1.5 | μs |
| • FAST SLEW RATE | 5 | 15 | V/μs |
| • WIDE GAIN BANDWIDTH (μAF157 $AV_{MIN}$ = 5) | 2.5 | 5 | MHz |
| • LOW INPUT NOISE VOLTAGE | 20 | 12 | nV/$\sqrt{\text{Hz}}$ |
| • LOW SUPPLY CURRENT | 2 | 5 | mA |

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

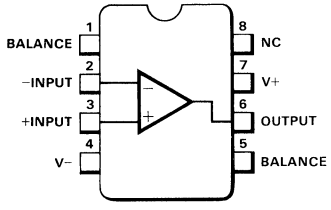



Note: Pin 4 connected to case.

**ORDER INFORMATION**

| TYPE | PART NO. |
|---|---|
| μAF155 | μAF155HM |
| μAF355 | μAF355HC |
| μAF156 | μAF156HM |
| μAF356 | μAF356HC |

**8-PIN MINI DIP**
(TOP VIEW)
PACKAGE CODE T



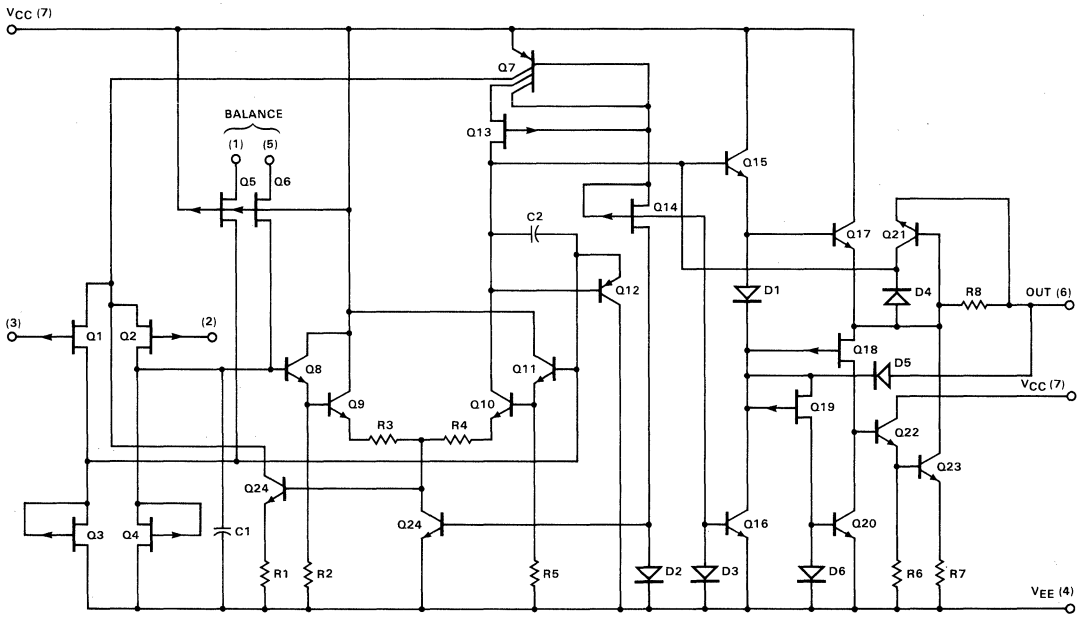

**ORDER INFORMATION**

| TYPE | PART NO. |
|---|---|
| μAF355 | μAF355TC |
| μAF356 | μAF356TC |
| μAF357 | μAF357TC |

**ABSOLUTE MAXIMUM RATINGS**

| | |
|---|---|
| Supply Voltage | |
| μAF155, μAF156 | ±22 V |
| μAF355, μAF356 | ±18 V |
| Power Dissipation (Note 1) | 500 mW |
| Differential Input Voltage | |
| μAF155, μAF156 | ±40 V |
| μA355, μA356 | ±30 V |
| Input Voltage Range (Note 2) | |
| μAF155, μAF156 | ±20 V |
| μAF355, μAF356 | ±16 V |
| Output Short Circuit Duration | Continuous |
| Operating Temperature Range | |
| μAF155, μAF156 | −55°C to +125°C |
| μAF355, μAF356 | 0°C to +70°C |
| Storage Temperature Range | −65°C to +150°C |
| Pin Temperature (Soldering, 10 s) | 300°C |
| Maximum Junction Temperature, $T_{J(MAX)}$ | |
| μAF155, μAF156 | 150°C |
| μAF355, μAF356 | 100°C |

**EQUIVALENT CIRCUIT**



**ELECTRICAL CHARACTERISTICS:** $T_A$ = +25°C unless otherwise noted. (Note 3)

| CHARACTERISTICS | CONDITIONS | μAF155, μAF156 | | | μAF355, μAF356 | | | UNITS |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage ($V_{OS}$) | $R_S$ = 50 Ω | | 3 | 5 | | 3 | 10 | mV |
| Average Input Offset Drift | $R_S$ = 50 Ω | | 5 | | | 5 | | μV/°C |
| Change in Offset Drift with $V_{OS}$ Adj. | $R_S$ = 50 Ω (Note 6) | | 1 | | | 1 | | μV/°C/mV |
| Input Offset Current | $T_J$ = 25°C (Note 4) | | 3 | 20 | | 3 | 50 | pA |
| Input Bias Current | $T_J$ = 25°C (Note 4) | | 30 | 100 | | 30 | 200 | pA |
| Differential Input Resistance and Common Mode Input Resistance | $T_J$ = 25°C | | $10^{12}$ | | | $10^{12}$ | | Ω |
| Large Signal Voltage Gain | $V_S$ = ±15 V, $R_L$ = 2 kΩ<br>$V_O$ = ±10 V | 50 | 200 | | 50 | 200 | | V/mV |
| The following specifications apply for $T_C$ = −55°C to +125°C for μAF155/156<br>$T_C$ = 0°C to 70°C for μAF355/356 | | | | | | | | |
| Input Offset Voltage | $R_S$ = 50 Ω | | | 7 | | | 13 | mV |
| Input Offset Current | | | | 20 | | | 2 | nA |
| Input Bias Current | | | | 50 | | | 8 | nA |
| Large Signal Voltage Gain | | 25 | | | 15 | | | V/mV |
| Output Voltage Swing | $V_S$ = ±15 V, $R_L$ = 10 kΩ | ±12 | ±13 | | ±12 | ±13 | | V |
| Common Mode Voltage Range | $V_S$ = ±15 V | ±11 | +15.1<br>−12 | | ±10 | ±12 | +15.1<br>−12 | V |
| CMRR | | 85 | 100 | | 85 | 100 | | dB |
| PSRR | | 85 | 100 | | 85 | 100 | | dB |

The following specifications apply for $T_C$ = +25°C

| CHARACTERISTICS | μAF155 | | μAF355 | | μAF156 | | μAF356 | | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| | TYP | MAX | TYP | MAX | TYP | MAX | TYP | MAX | |
| Supply Current | 2 | 4 | 2 | 4 | 5 | 7 | 5 | 10 | mA |

| CHARACTERISTICS | CONDITIONS | μAF155 | | | μAF156 | | | UNITS |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Slew Rate | $V_S$ = ±15 V, $A_V$ = +1 | | 5 | | | 15 | | V/μs |
| Gain Bandwidth Product | | | 2.5 | | | 5.0 | | MHz |
| Setting Time to 0.01% (Note 5) | | | 4 | | | 1.5 | | μs |
| Equivalent Input Noise Voltage ($e_n$) | f = 100 Hz | | 25 | | | 15 | | $nV/\sqrt{Hz}$ |
| | f = 1 kHz | | 20 | | | 12 | | $nV/\sqrt{Hz}$ |
| Equivalent Input Noise Current ($i_n$) | f = 100 Hz | | 0.01 | | | 0.01 | | $pA/\sqrt{Hz}$ |
| | f = 1 kHz | | 0.01 | | | 0.01 | | $pA/\sqrt{Hz}$ |
| Input Capacitance ($C_{IN}$) | | | 3 | | | 3 | | pF |

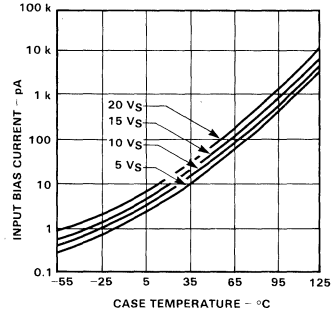
5

NOTES FOR ELECTRICAL CHARACTERISTICS:

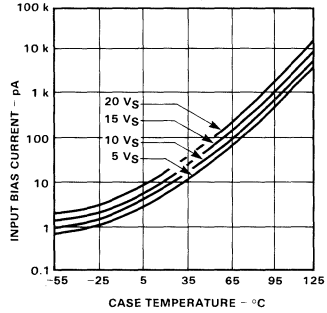
1. For operating at high temperature the package must be derated based on a thermal resistance of 150°C/W junction to ambient or 45°C/W junction to case.
2. Unless otherwise specified the absolute maximum negative input voltage is equal to the negative power supply voltage.
3. These specifications apply for ±15 V ≤ 20 V, unless otherwise stated for the μAF155, μAF156. For the μAF355, μAF356 the temperature specifications are $V_S$ = ±15 V.
4. The input bias currents are junction package currents which approximately double for every 10°C increase in the junction temperature ($T_J$). Due to limited production test time, the input bias currents measured are correlated to junction temperature. In normal operation the junction temperature rises above the ambient temperature as a result of internal power dissipation ($P_D$). $T_J = T_A + \theta_{JA} P_D$ where $\theta_{JA}$ is the thermal resistance from junction to ambient. Use of a heat sink is recommended if input bias current is to be kept to a minimum.
5. Settling time is defined here, for a unity gain inverter connection using 2 kΩ resistors for the μAF155, μAF156. It is the time required for the error voltage (the voltage at the inverting input pin on the amplifier) to settle to within 0.10% of its final value from the time a 10 V step input is applied to the inverter.
6. For voltages across the external resistors used in the offset adjust circuitry of greater than a volt ($R_{EXT}$ = 100 k), the Temperature Coefficient of the adjusted input offset voltage changes only a small amount (1 μV/C typically) for each mV of adjustment from its original unadjusted value. Common mode rejection and open loop voltage gain are also unaffected by offset adjustment.

## DC TYPICAL PERFORMANCE CHARACTERISTICS

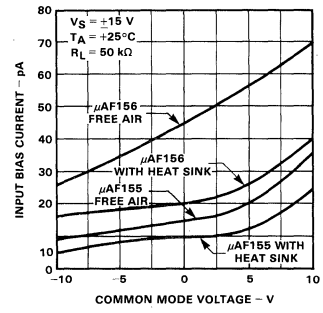
### μAF155 INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE WITH THERMALLOY 3227B HEAT SINK



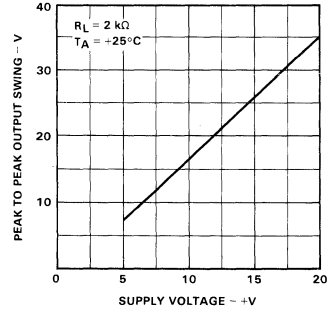

### μAF156 INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE WITH THERMALLOY 3227B HEAT SINK



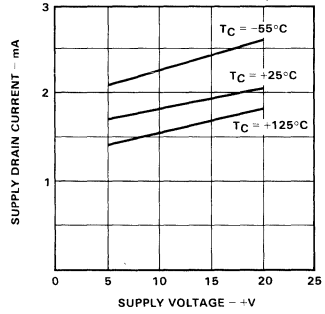

### μAF155, μAF156 INPUT BIAS CURRENT AS A FUNCTION OF COMMON MODE VOLTAGE



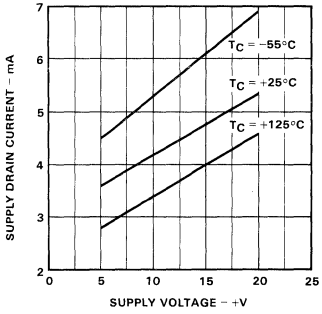

### μAF155, μAF156 MAXIMUM VOLTAGE SWING AS A FUNCTION OF SUPPLY CURRENT



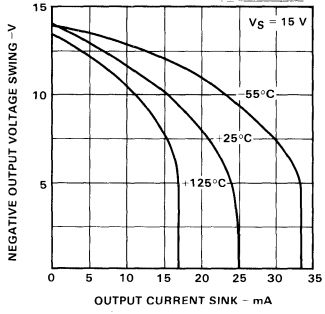

### μAF155 SUPPLY VOLTAGE AS A FUNCTION OF SUPPLY CURRENT



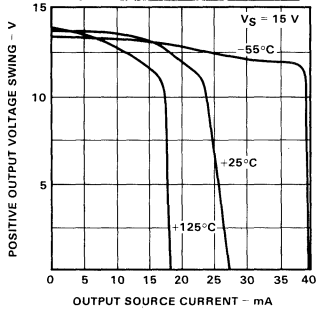

### μAF156 SUPPLY VOLTAGE AS A FUNCTION OF SUPPLY CURRENT




### μAF155, μAF156 NEGATIVE CURRENT LIMIT

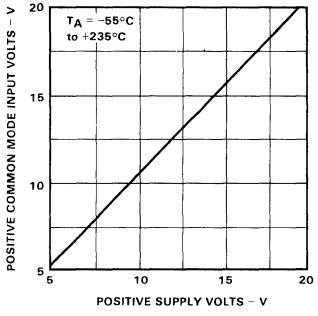



### μAF155, μAF156 POSITIVE CURRENT LIMIT

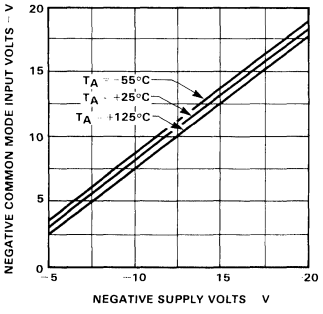


## DC TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

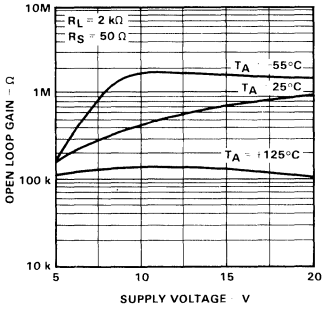
### μAF155, μAF156 POSITIVE COMMON MODE INPUT VOLTAGE AS A FUNCTION OF SUPPLY



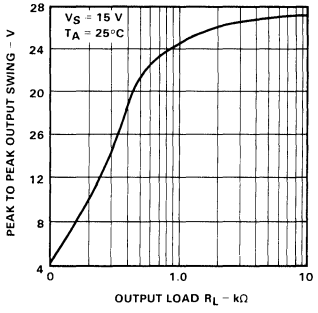

### μAF155, μAF156 NEGATIVE COMMON MODE INPUT VOLTAGE AS A FUNCTION OF SUPPLY



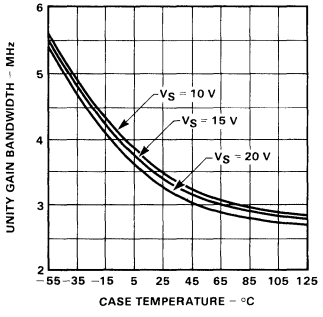

### μAF155, μAF156 LOOP GAIN AS A FUNCTION OF SUPPLY VOLTAGE



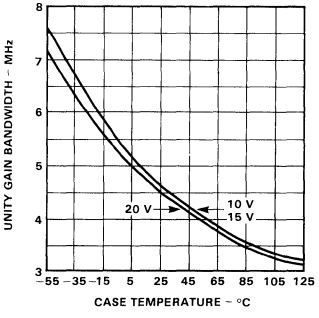

### μAF155, μAF156 VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



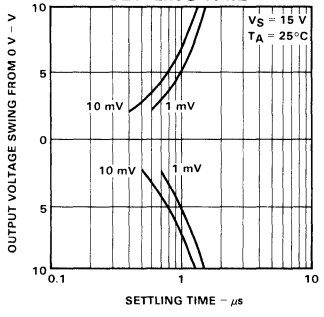

### μAF155 GAIN BANDWIDTH



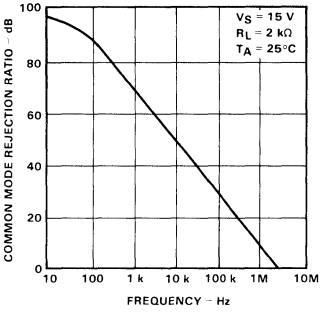

### μAF156 GAIN BANDWIDTH




### μAF156 INVERTER SETTLING TIME



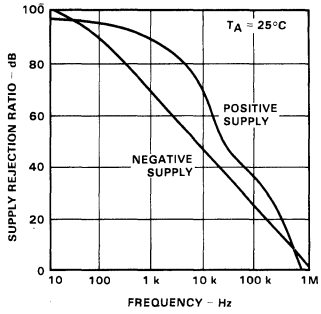

### μAF155, μAF156 COMMON MODE REJECTION RATIO



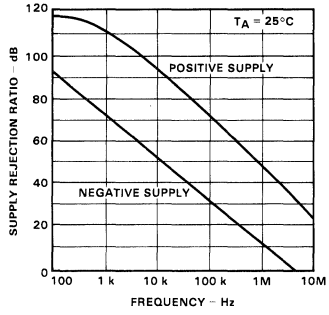

5

## DC TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

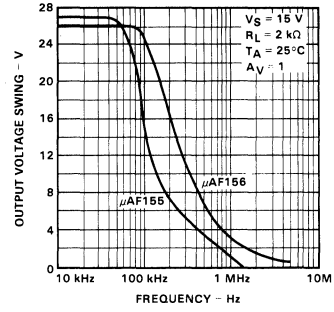
### MAXIMUM UNDISTORTED SWING AS A FUNCTION OF FREQUENCY



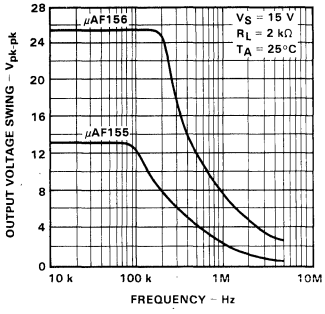

### μAF156 SUPPLY REJECTION AS A FUNCTION OF FREQUENCY



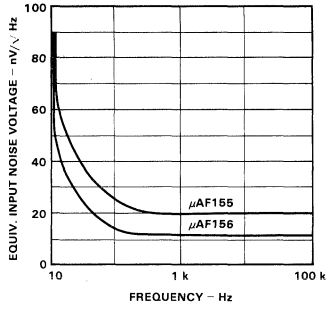

### μAF155 POWER SUPPLY REJECTION



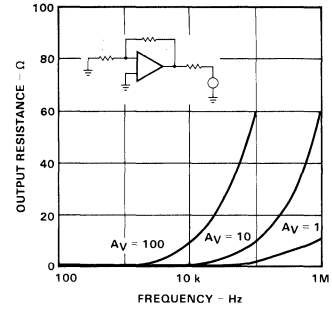

### MAXIMUM OUTPUT SWING AS A FUNCTION OF FREQUENCY



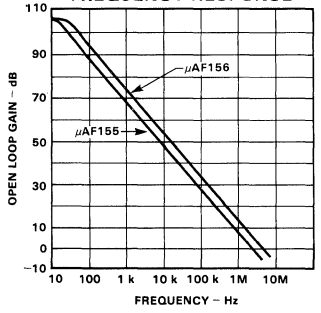

### EQUIVALENT INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



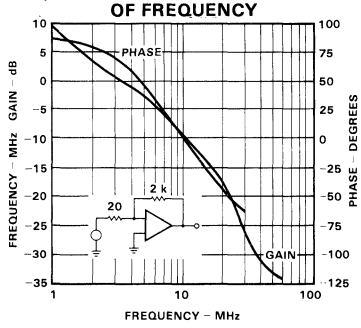

### μAF155, μAF156 OUTPUT RESISTANCE AS A FUNCTION OF FREQUENCY




### OPEN LOOP FREQUENCY RESPONSE




### μAF155 GAIN AS A FUNCTION OF FREQUENCY




### μAF156 GAIN AS A FUNCTION OF FREQUENCY