FAIRCHILD
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μA714 Precision Operational Amplifier

Linear Division Operational Amplifiers

Description

The μA714 is a monolithic instrumentation operational amplifier constructed using the Fairchild Planar Epitaxial process. It is intended for precise, low level signal amplification applications where low noise, low drift and accurate closed loop gain are required. The offset null capability, low power consumption, very high voltage gain as well as wide power supply voltage range provide superior performance for a wide range of instrumentation applications.

- **Low Offset Voltage — 75 μV**
- **Low Offset Voltage Drift — 1.0 μV/°C Typically**
- **Low Bias Current — ±2.6 nA**
- **Low Input Noise Current — 0.12 pA/ $\sqrt{Hz}$ at 1.0 kHz Typically**
- **High Open Loop Gain — 500 K Typically**
- **Low Input Offset Current — 2.8 nA**
- **High Common Mode Rejection — 110 dB**
- **Wide Power Supply Range — ±3.0 To ±22 V**
- **Plug-In Replacement For Op-07**

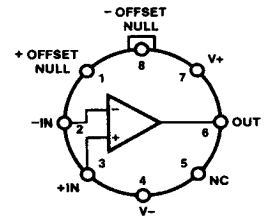
Absolute Maximum Ratings

Storage Temperature Range	
Metal Can	−65°C to +175°C
Molded DIP and SO-8	−65°C to +150°C
Operating Temperature Range	
Extended (μA714M)	−55°C to +125°C
Commercial (μA714C, μA714EC, μA714LC)	0°C to +70°C
Lead Temperature	
Metal Can (soldering, 60 s)	300°C
Molded DIP and SO-8 (soldering, 10 s)	265°C
Internal Power Dissapation[1, 2]	
8L-Metal Can	1.00 W
8L-Molded DIP	0.93 W
SO-8	0.81 W
Supply Voltage	
μA714, μA714C, μA714E	±22 V
μA714L	±18 V
Differential Input Voltage	±30 V
Input Voltage[3]	
μA714, μA714C, μA714E	±22 V
μA714L	±18 V

Notes

1. $T_{J\ Max}$ = 150°C for the Molded DIP and SO-8, and 175°C for the Metal Can.
2. Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 8L-Metal Can at 6.7 mW/°C, the 8L-Molded DIP at 7.5 mW/°C, and the SO-8 at 6.5 mW/°C.
3. For supply voltage less than ±22 V, the absolute maximum input voltage is equal to the supply voltage.

Connection Diagram 8-Lead Metal Package (Top View)



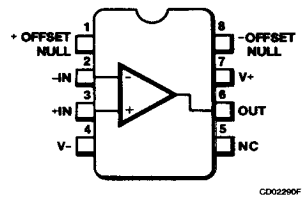
CD00781F

Lead 4 connected to case.

Order Information

Device Code	Package Code	Package Description
μA714HM	5W	Metal
μA714HC	5W	Metal
μA714EHC	5W	Metal
μA714LHC	5W	Metal

Connection Diagram 8-Lead DIP and SO-8 Package (Top View)

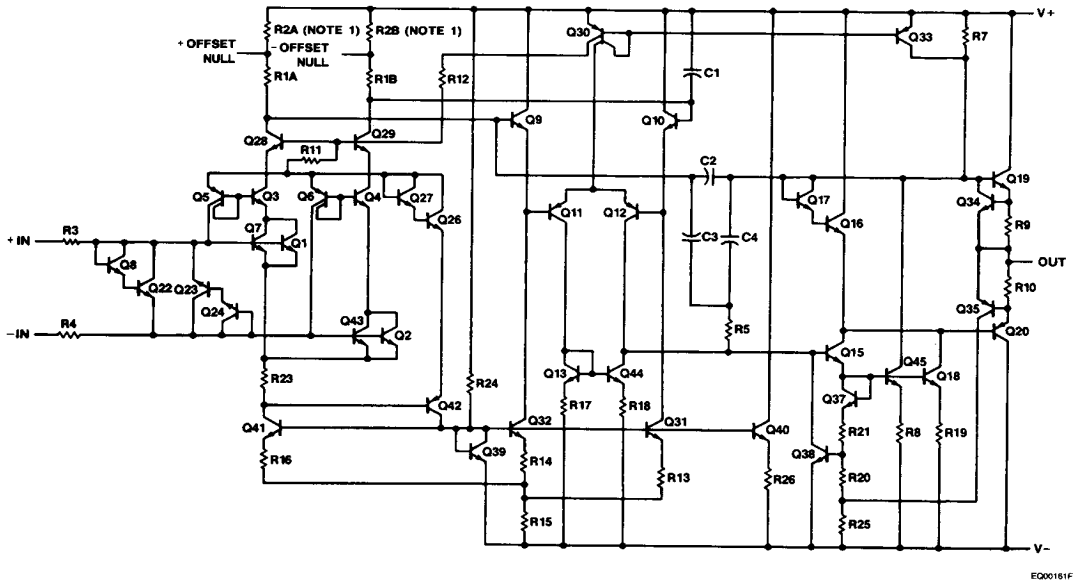


CD02290F

Order Information

Device Code	Package Code	Package Description
μA714SC	KC	Molded Surface Mount
μA714TC	9T	Molded DIP
μA714LSC	KC	Molded Surface Mount
μA714LTC	9T	Molded DIP

Equivalent Circuit



Note

1. R2A and R2B are electronically adjusted on chip at the factory for minimum offset voltage

μA714
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		30	75	μV
S	Long Term Input Offset Voltage Stability	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.2		μV/mo
$V_{IO\ adj}$	Input Offset Voltage Adjustment Range	$R_O = 20$ kΩ		±4.0		mV
I_{IO}	Input Offset Current	$V_{CM} = 0$ V		0.4	2.8	nA
I_{IB}	Input Bias Current	$V_{CM} = 0$ V		1.0	3.0	nA
Z_I	Input Impedance		20	60		MΩ
P_c	Power Consumption	$V_O = 0$ V		75	120	mW
		$V_{CC} = \pm 3.0$ V, $V_O = 0$ V		4.0	6.0	
CMR	Common Mode Rejection	$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	110	126		dB
V_{IR}	Input Voltage Range		±13.0	±14.0		V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	100	110		dB
A_{VS}	Large Signal Voltage Gain	$R_L \geq 2.0$ kΩ, $V_O = \pm 10$ V	200	500		V/mV
		$R_L \geq 500\ \Omega$, $V_O = \pm 0.5$ V, $V_{CC} = \pm 3.0$ V	150	500		
V_{OP}	Output Voltage Swing	$R_L = 10$ kΩ	±12.5	±13.0		V
		$R_L = 2.0$ kΩ	±12.0	±12.8		
		$R_L = 1.0$ kΩ	±10.5	±12.0		
BW	Bandwidth	$A_V = 1.0$		0.6		MHz
SR	Slew Rate	$R_L = 2.0$ kΩ, $A_V = 1.0$		0.17		V/μs
e_n	Input Noise Voltage	0.1 Hz to 1.0 kHz		0.35	0.6	μVp—p
	Input Noise Voltage Density	$f_o = 10$ Hz		10.3	18.0	nV/√Hz
		$f_o = 100$ Hz		10.0	13.0	
		$f_o = 1000$ Hz		9.6	11.0	
i_n	Input Noise Current	0.1 Hz to 1.0 kHz		14		pA p—p
	Input Noise Current Density	$f_o = 10$ Hz		0.32	0.80	pA/√Hz
		$f_o = 100$ Hz		0.14	0.23	
		$f_o = 1000$ Hz		0.12	0.17	

μA714 (Cont.)
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic		Condition	Min	Typ	Max	Unit
The following specifications apply for $V_{CC} = \pm 15$ V, $-55°C \leq T_A \leq +125°C$							
V_{IO}	Input Offset Voltage		$R_S = 50\ \Omega$, $V_{CM} = 0$ V		60	200	μV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity[1]	Without External Trim	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.3	1.3	μV/°C
		With External Trim	$R_O = 20$ kΩ, $R_S = 50\ \Omega$		0.3	1.3	
I_{IO}	Input Offset Current		$V_{CM} = 0$ V		1.2	5.6	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		8.0	50	pA/°C
I_{IB}	Input Bias Current		$V_{CM} = 0$ V		2.0	6.0	nA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		13	50	pA/°C
CMR	Common Mode Rejection		$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	106	123		dB
V_{IR}	Input Voltage Range			±13.0	±13.5		V
PSRR	Power Supply Rejection Ratio		$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	94	106		dB
A_{VS}	Large Signal Voltage Gain		$R_L \geq 2.0$ kΩ, $V_O = \pm 10$ V	150	400		V/mV
V_{OP}	Output Voltage Swing		$R_L = 2.0$ kΩ	±12.0	±12.6		V

μA714E
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		30	75	μV
S	Long Term Input Offset Voltage Stability	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.3		μV/mo
$V_{IO\ adj}$	Input Offset Voltage Adjustment Range	$R_O = 20$ kΩ		±4.0		mV
I_{IO}	Input Offset Current	$V_{CM} = 0$ V		0.5	3.8	nA
I_{IB}	Input Bias Current	$V_{CM} = 0$ V		1.2	4.0	nA
Z_I	Input Impedance		15	50		MΩ
P_c	Power Consumption	$V_O = 0$ V		75	120	mW
		$V_{CC} = \pm 3.0$ V, $V_O = 0$ V		4.0	6.0	
CMR	Common Mode Rejection	$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	106	123		dB

μA714E (Cont.)
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IR}	Input Voltage Range		±13.0	±14.0		V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	94	107		dB
A_{VS}	Large Signal Voltage Gain	$R_L \geq 2.0$ kΩ, $V_O = \pm 10$ V	200	500		V/mV
		$R_L \geq 500\ \Omega$, $V_O = \pm 0.5$ V, $V_{CC} = \pm 3.0$ V	150	500		
V_{OP}	Output Voltage Swing	$R_L = 10$ kΩ	±12.5	±13.0		V
		$R_L = 2.0$ kΩ	±12.0	±12.8		
		$R_L = 1.0$ kΩ	±10.5	±12.0		
BW	Bandwidth	$A_V = 1.0$		0.6		MHz
SR	Slew Rate	$R_L = 2.0$ kΩ, $A_V = 1.0$		0.17		V/μs
e_n	Input Noise Voltage[1]	0.1 Hz to 1.0 kHz		0.35	0.6	μV p—p
	Input Noise Voltage Density[1]	$f_o = 10$ Hz		10.3	18.0	nV/√Hz
		$f_o = 100$ Hz		10.0	13.0	
		$f_o = 1000$ Hz		9.6	11.0	
i_n	Input Noise Current[1]	0.1 Hz to 1.0 kHz		14	30	pA p—p
	Input Noise Current Density[1]	$f_o = 10$ Hz		0.32	0.80	pA/√Hz
		$f_o = 100$ Hz		0.14	0.23	
		$f_o = 1000$ Hz		0.12	0.17	

The following specifications apply for $V_{CC} = \pm 15$ V, $0°C \leq T_A \leq 70°C$

V_{IO}	Input Offset Voltage		$R_S = 50\ \Omega$, $V_{CM} = 0$ V		45	130	μV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity[1]	Without External Trim	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.3	1.3	μV/°C
		With External Trim	$R_O = 20$ kΩ, $R_S = 50\ \Omega$		0.3	1.3	
I_{IO}	Input Offset Current		$V_{CM} = 0$ V		0.9	5.3	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		8.0	35	pA/°C
I_{IB}	Input Bias Current		$V_{CM} = 0$ V		1.5	5.5	nA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		13	35	pA/°C
CMR	Common Mode Rejection		$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	103	123		dB

μA714E (Cont.)
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IR}	Input Voltage Range		± 13.0	± 13.5		V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 3.0$ V to ± 18 V, $R_S = 50\ \Omega$	90	104		dB
A_{VS}	Large Signal Voltage Gain	$R_L \geqslant 2.0\ k\Omega$, $V_O = \pm 10$ V	180	450		V/mV
V_{OP}	Output Voltage Swing	$R_L = 2.0\ k\Omega$	± 12.0	± 12.6		V

μA714C
Electrical Characteristics $T_A = 25°C$, $V_{CC} = 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		60	150	μV
S	Long Term Input Offset Voltage Stability	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.4	2.0	μV/mo
$V_{IO\ adj}$	Input Offset Voltage Adjustment Range	$R_O = 20\ k\Omega$		± 4.0		mV
I_{IO}	Input Offset Current	$V_{CM} = 0$ V		0.8	6.0	nA
I_{IB}	Input Bias Current	$V_{CM} = 0$ V		1.8	7.0	nA
Z_I	Input Impedance		8.0	33		MΩ
P_c	Power Consumption	$V_O = 0$ V		80	150	mW
		$V_{CC} = \pm 3.0$ V, $V_O = 0$ V		4.0	8.0	
CMR	Common Mode Rejection	$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	100	120		dB
V_{IR}	Input Voltage Range		± 13.0	± 14.0		V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 3.0$ V to ± 18 V, $R_S = 50\ \Omega$	90	104		dB
A_{VS}	Large Signal Voltage Gain	$R_L \geqslant 2.0\ k\Omega$, $V_O = \pm 10$ V	120	400		V/mV
		$R_L \geqslant 500\ \Omega$, $V_O = \pm 0.5$ V, $V_{CC} = \pm 3.0$ V	100	400		
V_{OP}	Output Voltage Swing	$R_L = 10\ k\Omega$	± 12.0	± 13.0		V
		$R_L = 2.0\ k\Omega$	± 11.5	± 12.8		
		$R_L = 1.0\ k\Omega$		± 12.0		
BW	Bandwidth	$A_V = 1.0$		0.6		MHz
SR	Slew Rate	$R_L = 2.0\ k\Omega$, $A_V = 1.0$		0.17		V/μs

μA714C (Cont.)
Electrical Characteristics $T_A = 25°C$, $V_{CC} = 15$ V

Symbol	Characteristic		Condition	Min	Typ	Max	Unit
e_n	Input Noise Voltage[1]		0.1 Hz to 1.0 kHz		0.38	0.65	μVp — p
	Input Noise Voltage Density[1]		$f_o = 10$ Hz		10.5	20.0	nV/√Hz
			$f_o = 100$ Hz		10.2	13.5	
			$f_o = 1000$ Hz		9.8	11.5	
i_n	Input Noise Current[1]		0.1 Hz to 1.0 kHz		0.15	35	μVp — p
	Input Noise Current Density[1]		$f_o = 10$ Hz		0.35	0.90	pA/√Hz
			$f_o = 100$ Hz		0.15	0.27	
			$f_o = 1000$ Hz		0.13	0.18	
The following specifications apply for $V_{CC} = \pm 15$ V, $0°C \leq T_A \leq 70°C$							
V_{IO}	Input Offset Voltage		$R_S = 50\ \Omega$, $V_{CM} = 0$ V		85	250	μV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity[1]	Without External Trim	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.5	1.8	μV/°C
		With External Trim	$R_O = 20\ k\Omega$, $R_S = 50\ \Omega$		0.4	1.6	
I_{IO}	Input Offset Current		$V_{CM} = 0$ V		1.6	8.0	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		12	50	pA/°C
I_{IB}	Input Bias Current		$V_{CM} = 0$ V		2.2	9.0	nA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		18	50	pA/°C
CMR	Common Mode Rejection		$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	97	120		dB
V_{IR}	Input Voltage Range			±13.0	±13.5		V
PSRR	Power Supply Rejection Ratio		$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	86	100		dB
A_{VS}	Large Signal Voltage Gain		$R_L \geq 2.0\ k\Omega$, $V_O = \pm 10$ V	100	400		V/mV
V_{OP}	Output Voltage Swing		$R_L = 2.0\ k\Omega$	±11.0	±12.6		V

μA714L
Electrical Characteristics $T_A = 25°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		100	250	μV
S	Long Term Input Offset Voltage Stability	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		0.5	3.0	μV/mo
$V_{IO\ adj}$	Input Offset Voltage Adjustment Range	$R_O = 20$ kΩ		±4.0		mV
I_{IO}	Input Offset Current	$V_{CM} = 0$ V		5.0	20	nA
I_{IB}	Input Bias Current	$V_{CM} = 0$ V		6.0	30	nA
Z_I	Input Impedance		8.0	33		MΩ
P_c	Power Consumption	$V_O = 0$ V		100	180	mW
		$V_{CC} = \pm 3.0$ V, $V_O = 0$ V		5.0	12	
CMR	Common Mode Rejection	$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	100	120		dB
V_{IR}	Input Voltage Range		±13.0	±14.0		V
PSRR	Power Supply Rejection Ratio	$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	90	104		dB
A_{VS}	Large Signal Voltage Gain	$R_L \geq 2.0$ kΩ, $V_O = \pm 10$ V	100	300		V/mV
		$R_L \geq 500\ \Omega$, $V_O = \pm 0.5$ V, $V_{CC} = \pm 3.0$ V	50	150		
V_{OP}	Output Voltage Swing	$R_L = 10$ kΩ	±12.0	±13.0		V
		$R_L = 2.0$ kΩ	±11.0	±12.8		
		$R_L = 1.0$ kΩ		±12.0		
BW	Bandwidth	$A_V = 1.0$		0.6		MHz
SR	Slew Rate	$R_L = 2.0$ kΩ, $A_V = 1.0$		0.17		V/μs
e_n	Input Noise Voltage[1]	0.1 Hz to 1.0 kHz		0.5		μV p—p
	Input Noise Voltage Density[1]	$f_o = 10$ Hz		10.5		nV/√Hz
		$f_o = 100$ Hz		10.2		
		$f_o = 1000$ Hz		9.8		
i_n	Input Noise Current[1]	0.1 Hz to 1.0 kHz		0.15		pA p—p
	Input Noise Current Density[1]	$f_o = 10$ Hz		0.35		pA/√Hz
		$f_o = 100$ Hz		0.15		
		$f_o = 1000$ Hz		0.13		

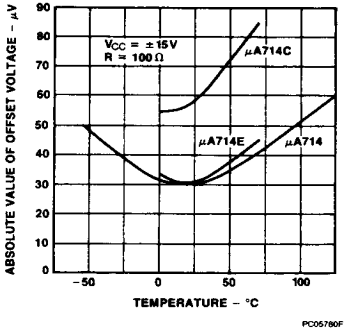
μA714L (Cont.)
Electrical Characteristics $0°C \leq T_A \leq +70°C$, $V_{CC} = \pm 15$ V

Symbol	Characteristic		Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage		$R_S = \Omega$, $V_{CM} = 0$ V			400	μV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity[1]	Without External Trim	$R_S = 50\ \Omega$, $V_{CM} = 0$ V		1.0	3.0	μV/°C
		With External Trim	$R_O = 20\ k\Omega$, $R_S = 50\ \Omega$		1.3		
I_{IO}	Input Offset Current		$V_{CM} = 0$ V		8.0	40	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		20	100	pA/°C
I_{IB}	Input Bias Current		$V_{CM} = 0$ V		15	60	nA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Sensitivity[1]		$V_{CM} = 0$ V		35	150	pA/°C
CMR	Common Mode Rejection		$V_{CM} = \pm 13$ V, $R_S = 50\ \Omega$	94	120		dB
V_{IR}	Input Voltage Range			±13.0	±13.5		V
PSRR	Power Supply Rejection Ratio		$V_{CC} = \pm 3.0$ V to ±18 V, $R_S = 50\ \Omega$	83	100		dB
A_{VS}	Large Signal Voltage Gain		$R_L \geq 2.0\ k\Omega$, $V_O = \pm 10$ V	80	400		V/mV
V_{OP}	Output Voltage Swing		$R_L = 2.0\ k\Omega$	±10.0	±12.6		V

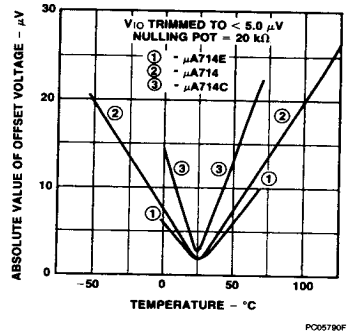
Note
1. Parameter is not 100% tested; 90% of the units meet this specification.

Typical Performance Curves

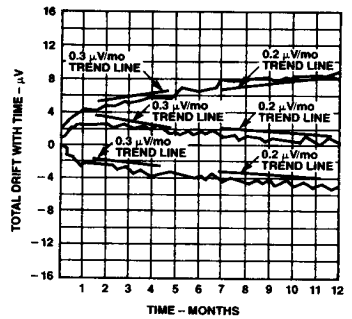
Untrimmed Offset Voltage vs Temperature



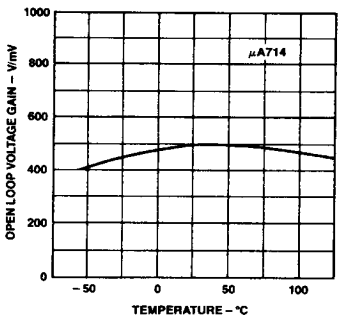
Trimmed Offset Voltage vs Temperature



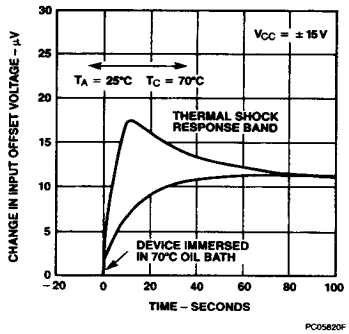
Offset Voltage Stability vs Time



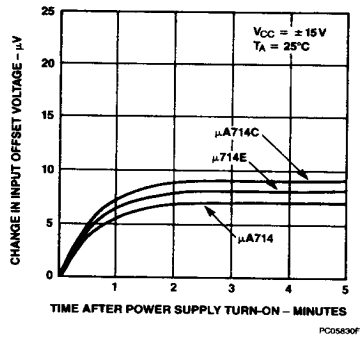
Voltage Gain vs Temperature



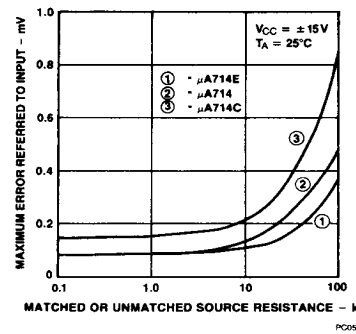
Offset Voltage Change Due to Thermal Shock



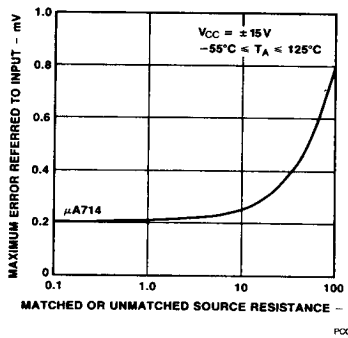
Warm-Up Drift



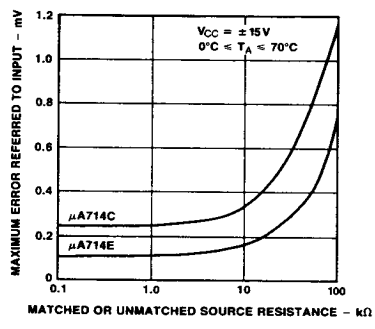
Maximum Error vs Source Resistance



Maximum Error vs Source Resistance

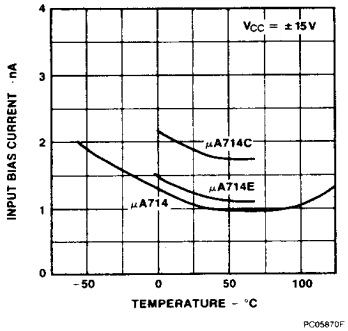


Maximum Error vs Source Resistance

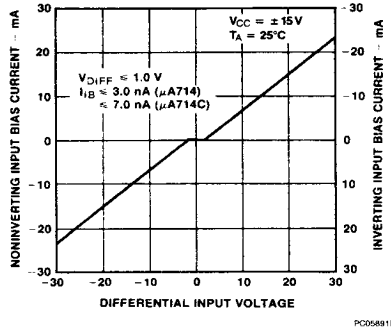


Typical Performance Curves (Cont.)

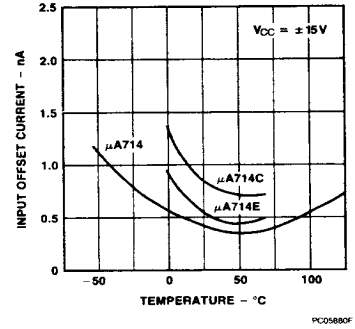
Input Bias Current vs Temperature



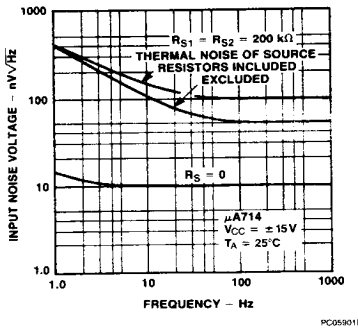
Input Bias Current vs Differential Input Voltage



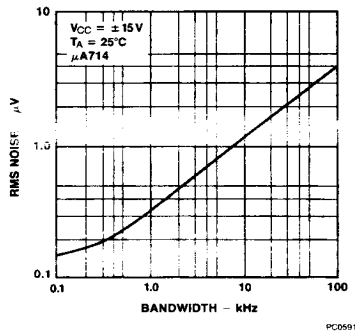
Input Offset Current vs Temperature



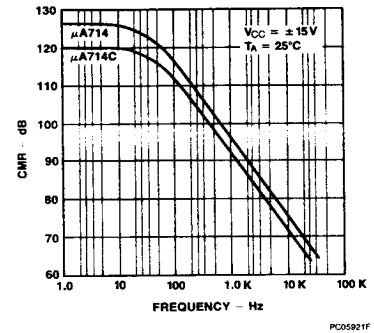
Input Noise Voltage vs Frequency



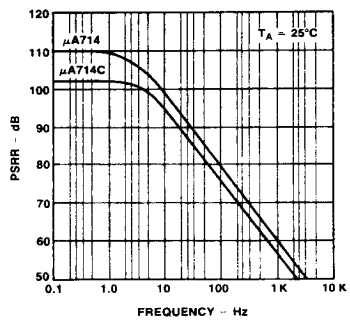
Input Wideband Noise vs Bandwidth (0.1 Hz to Frequency Indicated)



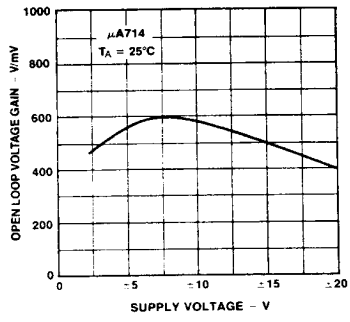
CMR vs Frequency



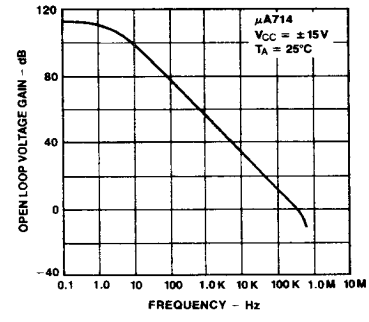
PSRR vs Frequency



Voltage Gain vs Supply Voltage

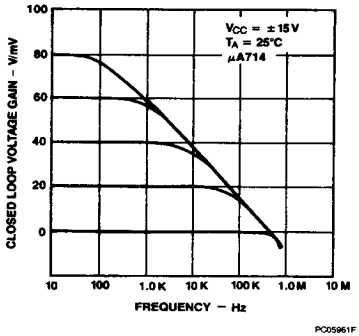


Open Loop Frequency Response



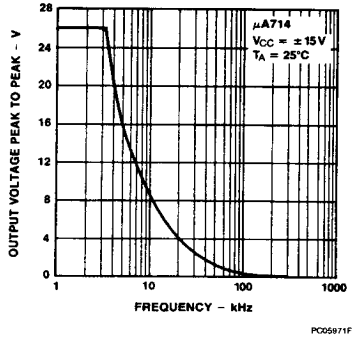
Typical Performance Curves (Cont.)

Frequency Response For Various Closed Loop Gains



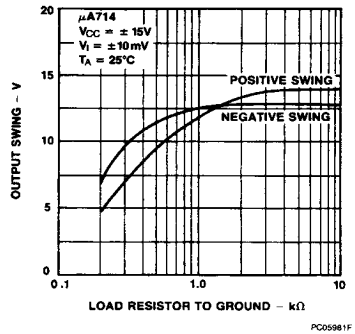
PC05961F

Maximum Undistorted Output vs Frequency



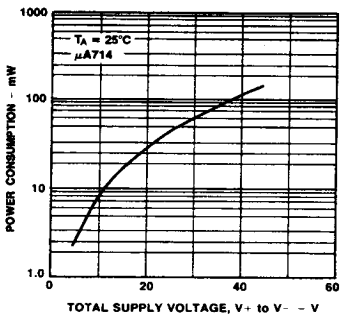
PC05971F

Output Voltage vs Load Resistance



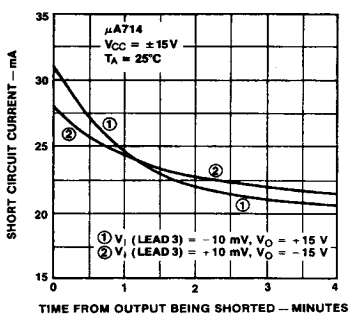
PC05981F

Power Consumption vs Supply Voltage



PC05991F

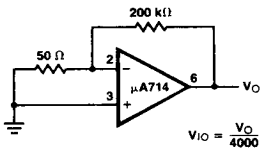
Short Circuit Current vs Time



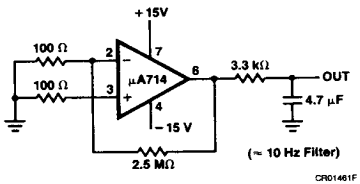
PC06001F

Test Circuits

Offset Voltage Test Circuit

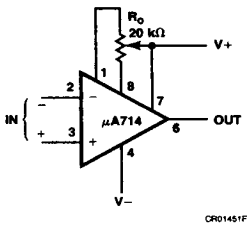


Low Frequency Noise Test Circuit



Input Referred Noise = $\frac{V_O}{25{,}000}$

Optional Offset Nulling Circuit



7