HARRIS

HA-2730/35

Not Recommended For New Designs See HA-5142

Wide Range Dual Programmable Operational Amplifier

FEATURES

- WIDE PROGRAMMING RANGE

SET CURRENT	0.1 TO 100μA
SLEW RATE	0.06 TO 6V/μs
BANDWIDTH	5kHz TO 10MHz
BIAS CURRENT	0.4 TO 50nA
SUPPLY CURRENT	1μA TO 1.5mA

- WIDE POWER SUPPLY RANGE ±1.2 TO ±18V
- CONSTANT AC PERFORMANCE OVER SUPPLY RANGE

APPLICATIONS

- ACTIVE FILTERS
- CURRENT CONTROLLED OSCILLATORS
- VARIABLE ACTIVE FILTERS
- MODULATORS
- BATTERY-POWERED EQUIPMENT

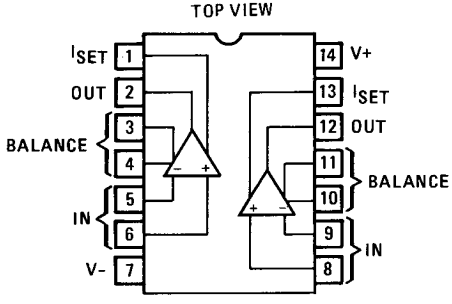
DESCRIPTION

HA-2730/2735 Dual Programmable Amplifiers are internally compensated monolithic devices offering a wide range of performance, that can be controlled by adjusting the circuits' "set" current (I_{SET}). By means of adjusting an external resistor or current source, power dissipation, slew rate, bandwidth, output current and input noise can be programmed to desired levels. Each amplifier on the chip can be adjusted independently. This versatile adjustment capability enables HA-2730/2735 to provide optimum design solutions by delivering the required level of performance with minimum possible power dissipation. HA-2730/2735 can, therefore, be utilized as the standard amplifier for a variety of designs simply by adjusting their programming current.

A major advantage of HA-2730/2735 is that operating characteristics remain virtually constant over a wide supply range (±1.2V to ±15V), allowing the amplifiers to offer maximum performance in almost any system including battery-operated equipement. A primary application for HA-2730/2735 is in active filters for a wide variety of signals that differ in frequency and amplitude. Also, by modulating the "set" current, HA-2730/2735 can be used for designs such as current controlled oscillators, modulators, sample and hold circuits and variable active filters.

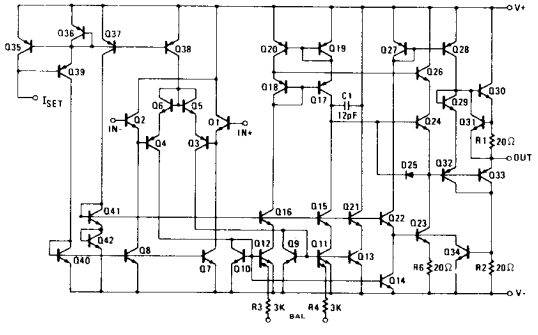
HA-2730 is guaranteed over -55°C to +125°C. HA-2735 is specified from 0°C to +75°C. Both parts are available in 14 lead D.I.P. package or dice form.

PINOUT



NOTE: Bottom of package is connected to V-.

SCHEMATIC



(ONE HALF ONLY)
HA-2730/35

SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Voltage Between V+ and V- Terminals	45.0V	Power Dissipation (Note 2)	500mW
Differential Input Voltage	±30.0V	Operating Temperature Range:	
Input Voltage (Note 1)	±15.0V	HA-2730	$-55^{o}C \leq T_A \leq +125^{o}C$
I_{SET} (Current at I_{SET})	500μA	HA-2735	$0^{o}C \leq T_A \leq +75^{o}C$
V_{SET} (Voltage to Gnd. at I_{SET})	$V+ - 2.0V \leq V_{SET} \leq V+$	Storage Temperature Range	$-65^{o}C \leq T_A \leq +150^{o}C$

ELECTRICAL CHARACTERISTICS (Each Side) V+ = +3.0V, V- = -3.0V

		HA-2730 -55°C to +125°C						HA-2735 0°C to +75°C						
		I_{SET} = 1.5μA			I_{SET} = 15μA			I_{SET} = 1.5μA			I_{SET} = 15μA			
PARAMETER	TEMP.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS
INPUT CHARACTERISTICS														
Offset Voltage	25°C		2.0	3.0		2.0	3.0		2.0	5.0		2.0	5.0	mV
	Full			5.0			5.0			7.0			7.0	mV
Offset Current	25°C		0.5	3.0		1.0	10		0.5	5.0		1.0	10	nA
	Full			7.5			20			7.5			20	nA
Bias Current	25°C		2.0	5.0		8.0	20		2.0	10		8.0	30	nA
	Full			10			40			10			40	nA
Input Resistance (Note 10)	25°C		50			5			50			5		MΩ
Input Capacitance	25°C		3.0			3.0			3.0			3.0		pF
TRANSFER CHARACTERISTICS														
Large Signal Voltage Gain (Notes 3 & 9)	25°C	15K	40K		15K	40K		15K	40K		15K	40K		V/V
	Full	10K			10K			10K			10K			V/V
Common Mode Rejection Ratio (Note 4)	Full	80			80			74			74			dB
OUTPUT CHARACTERISTICS														
Output Voltage Swing (Note 3)	25°C	±2.0	±2.2		±2.0	±2.2		±2.0	±2.2		±2.0	±2.2		V
	Full	±2.0			±2.0			±2.0			±2.0			V
Output Current (Note 5)	25°C		±0.2			±2.0			±0.2			±2.0		mA
Output Resistance	25°C		2K			500			2K			500		Ω
Output Short-Circuit Current	25°C		2.8			14			2.8			14		mA
TRANSIENT RESPONSE														
Rise Time (Note 6)	25°C		2.5			0.25			2.5			0.25		μs
Overshoot (Note 6)	25°C		5			10			5			10		%
Slew Rate (Note 7)	25°C		0.07			0.70			0.07			0.70		V/μs
POWER SUPPLY CHARACTERISTICS														
Supply Current	25°C		15			170			15			170		μA
	Full			25			250			25			250	μA
Power Supply Rejection Ratio (Note 8)	Full	80			80			76			76			dB

ELECTRICAL CHARACTERISTICS (Each Side) V+ = +15.0V, V- = -15.0V

PARAMETER	TEMP.	HA-2730 -55°C to +125°C						HA-2735 0°C to +75°C						UNITS
		I_{SET} = 1.5μA			I_{SET} = 15μA			I_{SET} = 1.5μA			I_{SET} = 15μA			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
INPUT CHARACTERISTICS														
Offset Voltage	25°C		2.0	3.0		2.0	3.0		2.0	5.0		2.0	5.0	mV
	Full			5.0			5.0			7.0			7.0	mV
Offset Current	25°C		0.5	3.0		1.0	10		0.5	5.0		1.0	10	nA
	Full			7.5			20			7.5			20	nA
Bias Current	25°C		2.0	5.0		8.0	20		2.0	10		8.0	30	nA
	Full			10			40			10			40	nA
Input Resistance (Note 10)	25°C		50			5			50			5		MΩ
Input Capacitance	25°C		3.0			3.0			3.0			3.0		pF
TRANSFER CHARACTERISTICS														
Large Signal Voltage Gain (Notes 3 & 9)	25°C	30K	100K		30K	120K		25K	40K		25K	120K		V/V
	Full	20K			20K			20K			20K			V/V
Common Mode Rejection Ratio (Note 4)	25°C		90			90			90			90		dB
	Full	80			80			74			74			dB
OUTPUT CHARACTERISTICS														
Output Voltage Swing (Note 3)	25°C	± 12	±13.5		± 12	±13.5		± 12	±13.5		± 12	±13.5		V
	Full	± 10			± 10			± 10			± 10			V
Output Current (Note 5)	25°C		± 0.5			± 5.0			± 0.5			± 5.0		mA
Output Resistance	25°C		2K			500			2K			500		Ω
Output Short-Circuit Current	25°C		3.7			19			3.7			19		mA
TRANSIENT RESPONSE														
Rise Time (Note 6)	25°C		2.0			0.2			2.0			0.2		μs
Overshoot (Note 6)	25°C		5			15			5			15		%
Slew Rate (Note 7)	25°C		0.1			0.8			0.1			0.8		V/μs
POWER SUPPLY CHARACTERISTICS														
Supply Current	25°C		20			210			20			210		μA
	Full			50			450			50			450	μA
Power Supply Rejection Ratio (Note 8)	Full	80			80			76			76			dB

NOTES:
1. For supply voltages less than ±15.0V, the absolute maximum input voltage is equal to supply voltage.
2. Derate at 4.7mW/°C at ambient temperatures above 68°C.

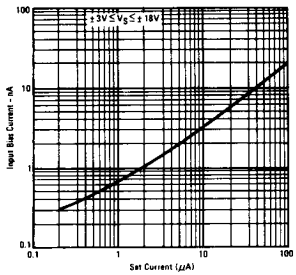
	V_{SUPPLY} = ±3.0V	V_{SUPPLY} = ±15.0V	I_{SET} = 1.5μA	I_{SET} = 15μA
3.	T = +25°C and Full	T = +25°C	R_L = 75KΩ	R_L = 5KΩ
	—	T = Full	R_L = 75KΩ	R_L = 75KΩ
4.	V_{CM} = ±1.5V	V_{CM} = ±5.0V		
5.	V_O = ±2.0V	V_O = ±10.0V		
6.	← A_V = +1, V_{IN} = 400mV, R_L = 5K, C_L = 100pF →			
7.	V_O = ±2.0V	V_O = ±10.0V	R_L = 20K	R_L = 5K
8.	ΔV = ±1.5V	ΔV = ±5.0V		
9.	V_O = ±1.0V	V_O = ±10.0V		

10. This parameter value based upon design calculations.

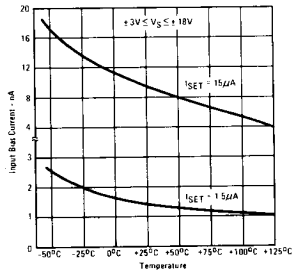
PERFORMANCE CURVES

UNLESS OTHERWISE NOTED: $T_A = 25^oC$, $V_S = \pm 15VDC$

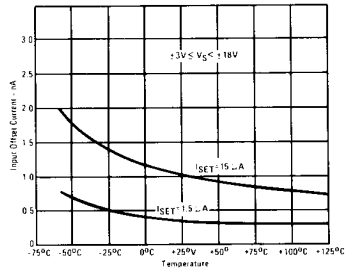
INPUT BIAS CURRENT
vs. SET CURRENT



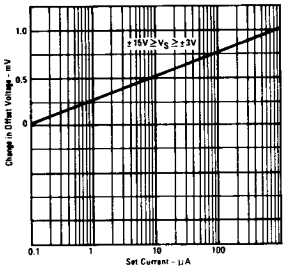
INPUT BIAS CURRENT
vs. TEMPERATURE



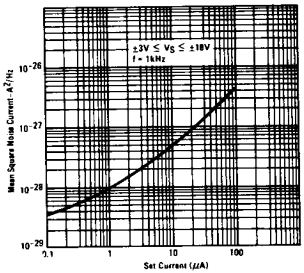
INPUT OFFSET CURRENT
vs. TEMPERATURE



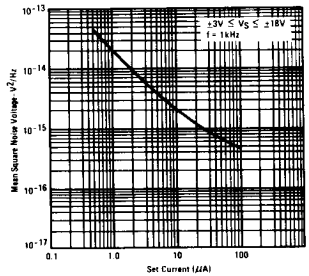
CHANGE IN OFFSET VOLTAGE
vs. I_{SET} (UNNULLED)



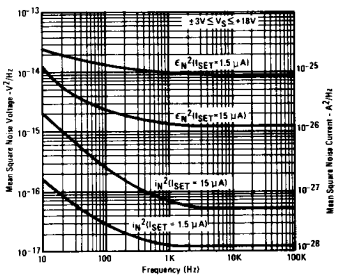
INPUT NOISE CURRENT
vs. I_{SET}



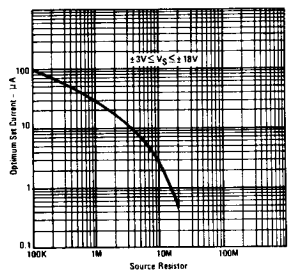
INPUT NOISE VOLTAGE
vs. I_{SET}



INPUT NOISE VOLTAGE AND CURRENT
vs. FREQUENCY



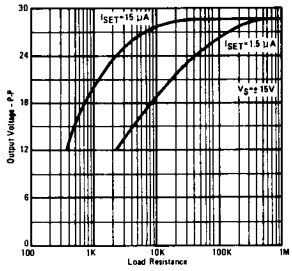
OPTIMUM SET CURRENT FOR MINIMUM
NOISE vs. SOURCE RESISTOR



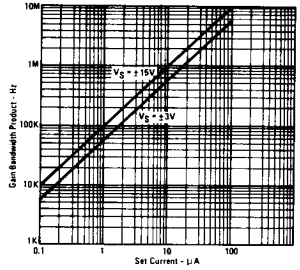
PERFORMANCE CURVES

UNLESS OTHERWISE NOTED: $T_A = 25^oC$, $V_S = \pm 15VDC$

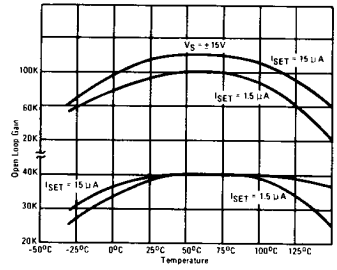
MAXIMUM OUTPUT VOLTAGE SWING vs. LOAD RESISTANCE



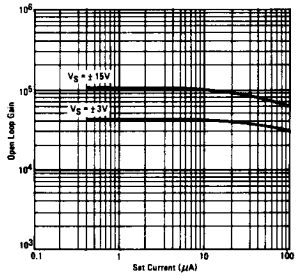
GAIN BANDWIDTH PRODUCT vs. I_{SET}



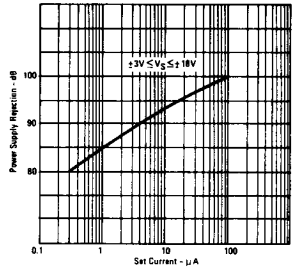
OPEN LOOP VOLTAGE GAIN vs. TEMPERATURE



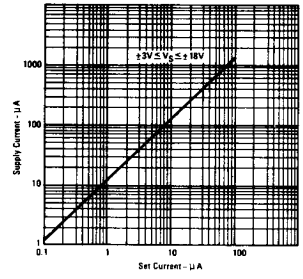
OPEN LOOP VOLTAGE GAIN vs. I_{SET}



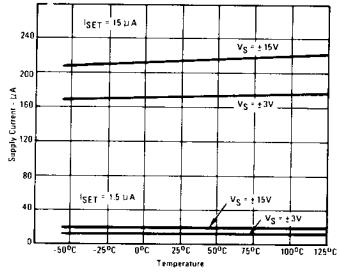
POWER SUPPLY REJECTION vs. I_{SET}



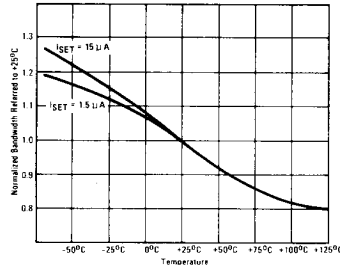
STANDBY SUPPLY CURRENT vs. I_{SET}



SUPPLY CURRENT vs. TEMPERATURE

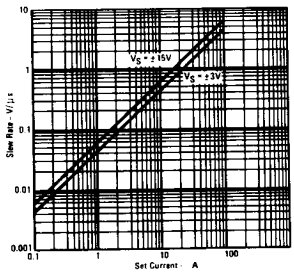


NORMALIZED BANDWIDTH vs. TEMPERATURE

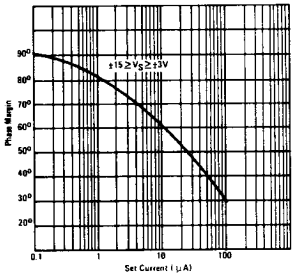


PERFORMANCE CURVES

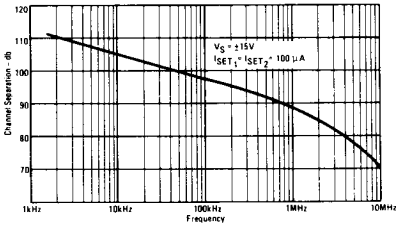
SLEW RATE vs. I_{SET}



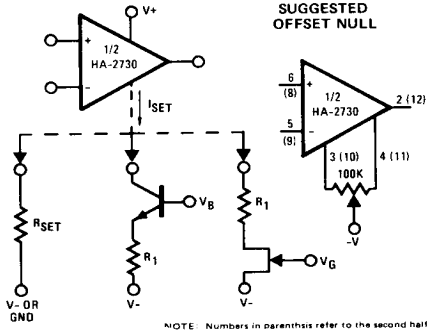
PHASE MARGIN vs. SET CURRENT



CHANNEL SEPARATION vs. FREQUENCY

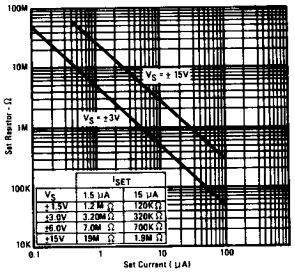


TYPICAL BIASING CIRCUITS

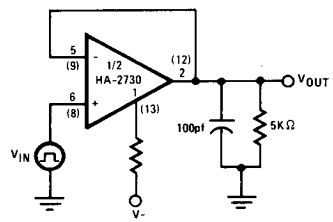


NOTE: Numbers in parenthsis refer to the second half

SET CURRENT VS. SET RESISTOR



TRANSIENT RESPONSE/SLEW RATE CIRCUIT



NOTE: Numbers in parenthsis refer to the second half.

SLEWING WAVEFORM