HARRIS HA-2720/25

Wide Range Programmable Operational Amplifier

Not Recommended For New Designs See HA-5141 or HA-5151

Features

- WIDE PROGRAMMING RANGE

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

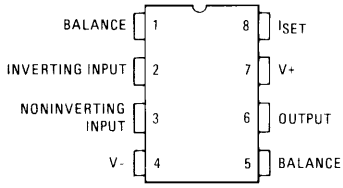
HA-2720/2725 programmable amplifiers are internally compensated monolithic devices offering a wide range of performance, that can be controlled by adjusting the circuits' "set" current (I_{SET}). By means of adjusting an external resistor or current source, power dissipation, slew rate, bandwidth, output current and input noise can be programmed to desired levels. This versatile adjustment capability enables HA-2720/2725 to provide optimum design solutions by delivering the required level of performance with minimum possible power dissipation. HA-2720 and HA-2725 can, therefore, be utilized as the standard amplifier for a variety of designs simply by adjusting their programming current.

A major advantage of HA-2720/2725 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 equipment. A primary application for HA-2720/2725 is in active filters for a wide variety of signals that differ in frequency and amplitude. Also, by modulating the "set" current, HA-2720/2725 can be used for designs such as current controlled oscillators modulators, sample and hold circuits and variable active filters.

HA-2720 is guaranteed over -55°C to +125°C. HA-2725 is specified from 0°C to +75°C. Both parts are available in TO-99 cans or dice form.

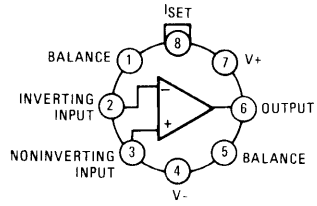
Pinouts

HA7-2720/2725 (CERAMIC MINI-DIP)
TOP VIEW

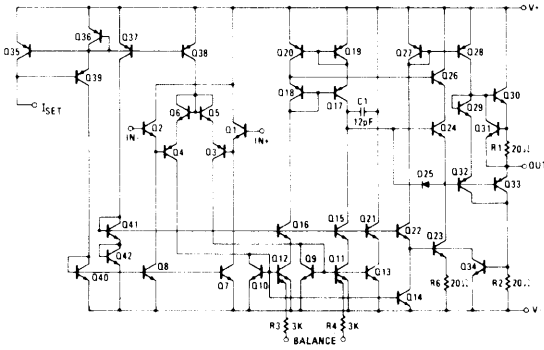


Note: Case tied to V-

HA2-2720/2725 (TO-99 METAL CAN)
TOP VIEW



Schematic



Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 45V
Differential Input Voltage ..... ±30V
Input Voltage (Note 1) ..... ±15V
I_{SET} (Current at I_{SET}) 500µA
V_{SET} (Voltage to GND at I_{SET}) ..... $V+ -2V \leq V_{SET} \leq V+$
Power Dissipation (Note 2) 300mW

Operating Temperature Ranges

HA-2720 ..... $-55^oC \leq T_A \leq +125^oC$
HA-2725 ..... $0^oC \leq T_A \leq +75^oC$
Storage Temperature Range: ..... $-65^oC \leq T_A \leq +150^oC$

Electrical Specifications

V+ = +3V, V- = -3V.

PARAMETER	TEMP.	HA-2720 -55°C to +125°C						HA-2725 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 (Note 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 Specifications (Continued) V+ = +15V, V- = -15V.

PARAMETER	TEMP.	HA-2720 -55°C to +125°C						HA-2725 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

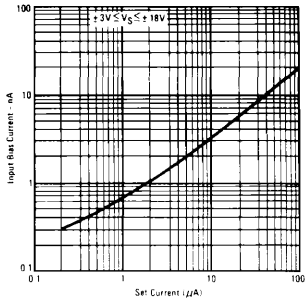
NOTES
1. For supply voltages less than ±15.0V, the absolute maximum input voltage is equal to supply voltage.
2. Derate at 6.8mW/°C for operation ambient temperatures above 75°C

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		

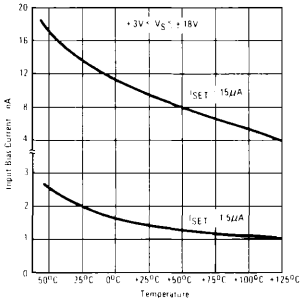
10. This parameter based upon design calculations.

Typical Performance Curves $T_A = +25^oC$, $V_S = \pm15V$ D.C. Unless Otherwise Specified.

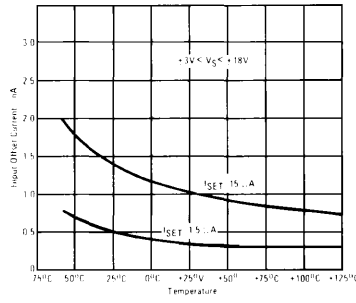
INPUT BIAS CURRENT vs. SET CURRENT



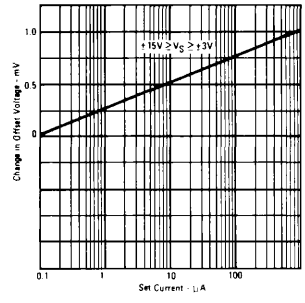
INPUT BIAS CURRENT vs. TEMPERATURE



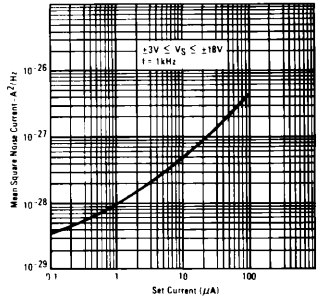
INPUT OFFSET CURRENT vs. TEMPERATURE



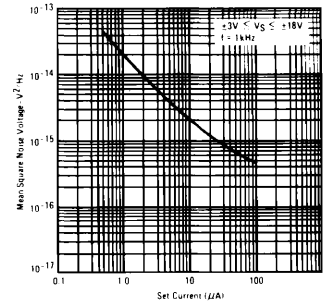
CHANGE IN OFFSET VOLTAGE vs. I_{SET} (UNNULLED)



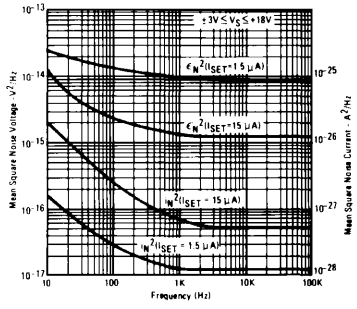
INPUT NOISE CURRENT vs. I_{SET}



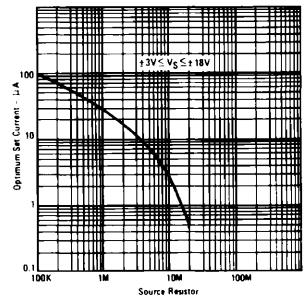
INPUT NOISE VOLTAGE vs. I_{SET}



INPUT NOISE VOLTAGE AND CURRENT vs. FREQUENCY

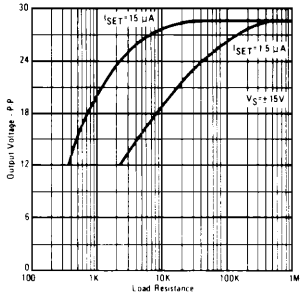


OPTIMUM SET CURRENT FOR MINIMUM NOISE vs. SOURCE RESISTOR

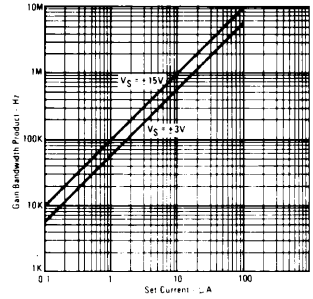


Typical Performance Curves (Continued) $T_A = +25^oC$, $V_S = \pm15V$ D.C. Unless Otherwise Specified.

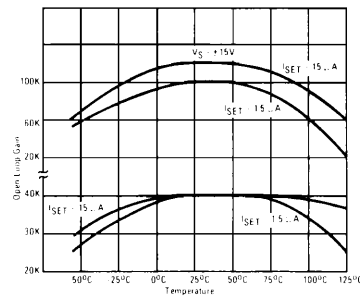
MAXIMUM OUTPUT VOLTAGE SWING vs. LOAD RESISTANCE



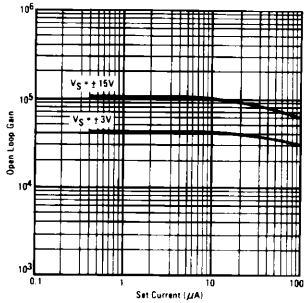
GAIN BANDWIDTH PRODUCT vs. I_{SET}



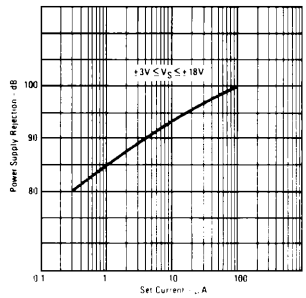
OPEN LOOP VOLTAGE GAIN vs. TEMPERATURE



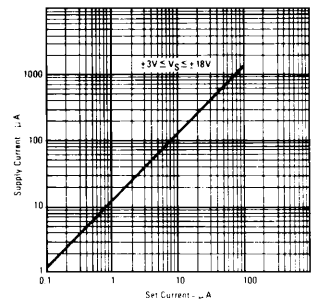
OPEN LOOP VOLTAGE GAIN vs. I_{SET}



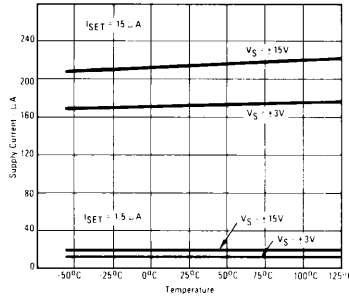
POWER SUPPLY REJECTION vs. I_{SET}



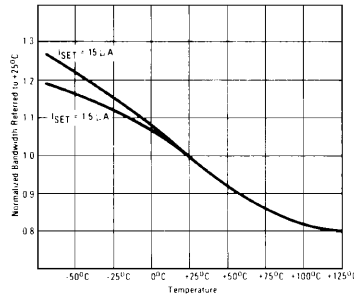
STANDBY SUPPLY CURRENT vs. I_{SET}



SUPPLY CURRENT vs. TEMPERATURE

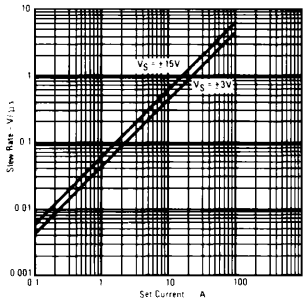


NORMALIZED BANDWIDTH vs. TEMPERATURE

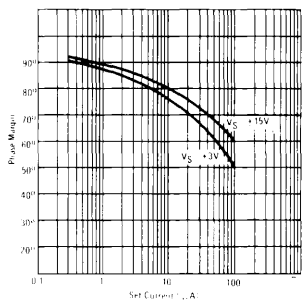


Typical Performance Curves (Continued) $T_A = +25^oC$, $V_S = \pm15V$ D.C. Unless Otherwise Specified.

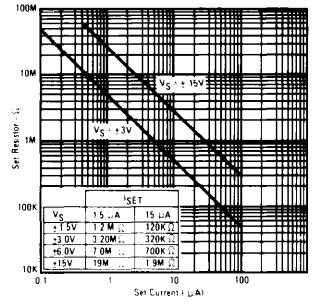
SLEW RATE vs. I_{SET}



PHASE MARGIN vs. SET CURRENT

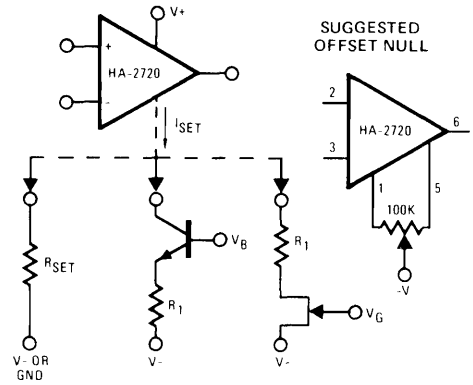


SET CURRENT vs. SET RESISTOR

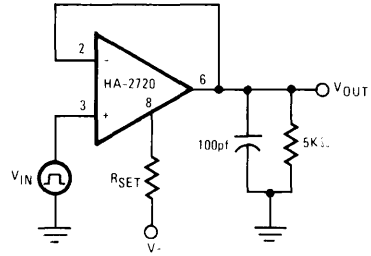


Test Circuits

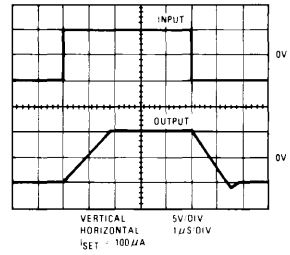
TYPICAL BIASING CIRCUITS



TRANSIENT RESPONSE/SLEW RATE CIRCUIT



SLEWING WAVEFORM



Die Characteristics

Transistor Count 44
Die Dimensions ..... 60 x 44 x 19mils
Substrate Potential ..... Unbiased

Thermal Constants ($^oC/W$)	θ_{ja}	θ_{jc}
HA2-Metal Can (-2,-5)	212	58
HA2-Metal Can (-8)	173	52
HA7-Ceramic DIP (-2,-5)	218	123
HA7-Ceramic DIP (-8)	143	69
HA3-Plastic Mini-DIP (-5)	98	46