A/D-D/A CONVERTERS
SAMPLE/HOLDS
MULTIPLIERS/DIVIDERS
NON-LINEAR FUNCTIONS
AMPLIFIERS
ACTIVE FILTERS
POWER SUPPLIES

BURR-BROWN

1975 CATALOG

Welcome to the product world of Burr-Brown.

And, welcome inside our 1975 General Catalog. We have tried to organize the information to provide as complete a picture as possible, and still make it easy for you to find what you're looking for.

This catalog is divided into six product lines which include Data Conversion Products, Operational Amplifiers, Instrumentation Amplifiers, Analog Circuit Functions, Active Filters, and Power Supplies. Within the space available, each product has been described in as much detail as possible. When you need more detailed information on a specific product, just ask for a Product Data Sheet. See page 84 for details.

Following the product information you will find package information and a Model Number Index for all devices listed in the catalog. If you know a model number and want to see all the specifications, you'll find the page number listed next to the model number in the Model Number Index on page 81. If you want to locate a particular type of product, refer to the Table of Contents below.

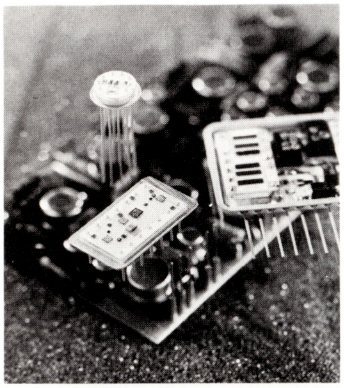
Thank you for considering Burr-Brown. We hope we can be of service to you.

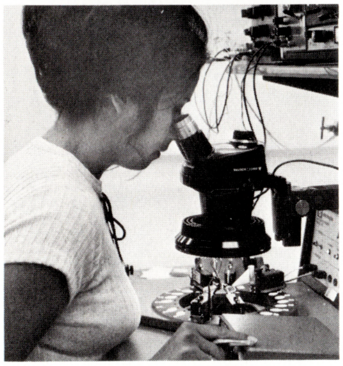
CONTENTS

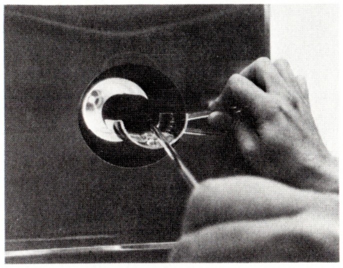
Printed in U.S.A. LI-214 January, 1975

For almost twenty years, Burr-Brown has been manufacturing a broad line of high quality electronic products designed for optimum performance and ease of use. We are constantly developing new manufacturing methods to keep abreast and ahead of the state-of-the-art, and to build better products at less cost. We like the business we're in, and continually strive to provide products of outstanding value to circuit and system designers throughout the world.

International Airport Industrial Park • TUCSON, ARIZONA 85734 • Telephone (602) 294-1431 • TWX: 910-952-1111 • Cable:BBRCORP







PRODUCTS...

Whether your needs include Data Conversion Products, Amplifiers, Analog Circuit Functions, Active Filters, or Power Supplies, we have them in depth. Many are available in hybrid and monolithic integrated circuits, most are available for off-the-shelf delivery, and all are very attractively priced.

FACILITIES...

We're no longer just module makers. Our in-house manufacturing and processing capabilities include: Complete monolithic IC facilities, from circuit design through wafer processing and automated final test; a complete thin-film facility engaged in volume production of passivated silicon chip resistor arrays; complete thick-film processing and hybrid assembly capability; computerized laser trimming and circuit adjustment and; broad packaging capabilities including DIP's, TO cans, as well as transfer molded, epoxy cast, conformal coated, and other non-hermetic types.

ENGINEERING...

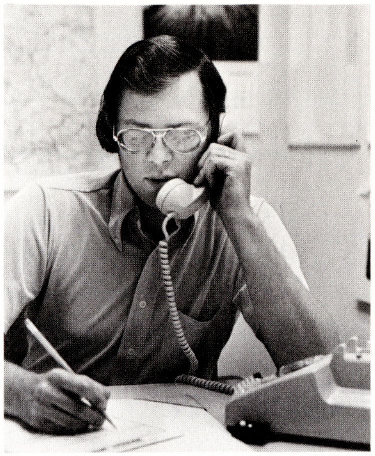
At Burr-Brown, the engineer is given the respect, design freedom, and technology he needs to achieve just the right balance of performance, quality, and cost, without compromising reliability. If he needs to use thin or thick film technology, it's available to him right here. If his designs involve monolithic processing, or he needs the latest test equipment, an automated laser, or a diffusion furnace, we have that, too.

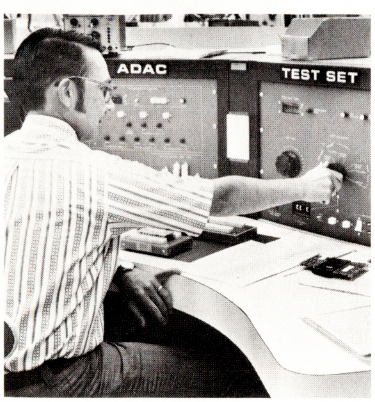
PRODUCTION...

Each month, thousands of Burr-Brown units are produced, and undergo a rigorous series of quality checks and tests before being shipped across the country and around the world. We set our own high standards of quality. And, we set them to equal or exceed those expected by our customers.

MARKETS...

There are very few industries or geographic locations that have not benefited from the use of Burr-Brown products. Computerized Process Control Systems, Medical and Analytical Instrumentation, Communications Systems, Navigation and Guidance, Aircraft, and Business Machines, ... you name it. From the depths of the earth to the outer reaches of space, Burr-Brown products are there.





BURR-BROWN IS SERVICE . . .

Even before the sale of our first product in 1956, we were offering technical assistance to the electronics industry. Today, Burr-Brown markets hundreds of standard electronic products, and provides a vast number of individual custom designs in a year's time. In order to make it easy for the customers to use our products we maintain an in-depth customer service program.

APPLICATIONS ENGINEERING STAFF . . .

Our Tucson based applications engineering staff is as near to you as the telephone. Highly skilled and well tutored in the use of our products, they will discuss with you the selection of a suitable unit for your application, discuss the parameter tradeoffs, and even suggest a block-diagram design approach to your system. They may be able to provide lower cost alternative methods of performing the same functions. Whether the application is analog or digital, they are there to help. Detailed applications assistance is also available from our field sales offices in the Chicago, Los Angeles, and San Francisco areas, the United Kingdom, France, and Japan.

In addition to our field sales offices, we have 23 United States sales representative offices, and over 30 exclusive engineering representatives in as many countries around the globe serving over 5,000 customers.

BURR-BROWN IS THE FUTURE . . .

Every day there is a growing need to develop new machines, new devices, and new processes to explore, to search, and to conserve what we have. The role that electronics is playing in these efforts is becoming increasingly more important, and Burr-Brown is helping. We are pledged to expand our technical horizons through research and development at an ever accelerating rate. We will continue our efforts to develop new methods for manufacturing better products at lower costs. We will continue to grow and expand. And, we will maintain our flexibility and reputation for high quality products and service. Just as Burr-Brown has paced the development of modern electronics, we will be in the forefront of future developments.

DATA CONVERSION PRODUCTS

Analog-to-Digital Converters

Digital-to-Analog Converters

Sample/Holds

Multiplexers

Voltage-to-Frequency Converters

Digitally-Programmed Voltage Sources

Comparators

Peak Detectors

BURR-BROWN

HOW CONVERSION PRODUCTS ARE CLASSIFIED

In general, products in this category are electronic devices which manipulate or operate on information which is in either digital or analog form. The output of these devices contains time-correlated information which may be in either analog or digital form.

Each product type performs a specific basic function. They are classified by key performance categories as follows:

A/D CONVERTERS provide coded digital output signals that represent the amplitude of analog input signals. Two conversion techniques are utilized by the A/D converters included in this catalog: successive approximation A/D conversion is used where moderate to high speed conversion rates are required; delta sigma modulation integration technique is used for high resolution and high accuracy where fast conversion speed is not required.

A/D converters are organized by the following categories:

(1) High performance, general purpose, covering the span of low drift (±7 ppm/°C) to fast conversion speed (800 nanoseconds per bit) for 8, 10, and 12 bit resolutions.

(2) High resolution, high accuracy A/D converters offer resolutions up to 16 bits with initial accuracies of 0.005%.

(3) High speed A/D converters in modular packages offer 8, 10, and 12 bit resolutions and conversion speeds up to 110 nanoseconds per bit.

D/A CONVERTERS accept weighted digital signals and convert them into an equivalent analog current or voltage as an output.

The switched current ladder network method of D/A conversion is used to provide the widest range of speed and accuracy requirements.

D/A converters are organized by the following categories:

(1) High performance, general purpose, 8, 10, and 12 bit resolutions.

(2) High speed (fast settling) generally for use in CRT displays and construction of high speed A/D converters.

(3) High resolution, covering the span of 14 or 16 bit resolutions.

(4) Economy, general purpose.

(5) High reliability, specifically designed for operation in rugged or exposed environments.

(6) Digitally programmable voltage source designed for computerized instrument tests and process control applications.

V/F CONVERTERS provide a digital pulse train as an output whose repetition rate (frequency) is directly proportional to the amplitude of the analog input signal.

These devices offer a low cost method of A/D conversion and/or transmission of analog signals over long distances while preserving signal accuracy as well as many other applications.

The units in this catalog are designed for general purpose use in industrial, laboratory and similar applications.

SAMPLE/HOLD amplifiers provide a simple method of storing an analog signal for a finite time period.

All Burr-Brown sample/hold amplifiers are designed to operate from standard ±15 volt power supplies, and are complete (except the Hybrid IC Model SHC23, which requires an external capacitor).

These devices offer a wide spectrum of performance ranging from 1 microsecond acquisition speed for 0.01% accuracy to very low droop rates of 250 microvolts per second. Accuracies ranging from ±0.02% to ±0.005% will satisfy a majority of data acquisition and control applications.

ANALOG MULTIPLEXERS

Single-ended 8 to 16 channel and 8 channel differential analog multiplexers with internal channel address decoders offer a compact and economical method of multiplexing data signal inputs or outputs for data acquisition or control applications.

The IC Models MPC8D (differential) and MPC16S (single-ended) offer compact and low cost C-MOS analog FET multiplexing in 28 pin DIP packages for applications requiring 20 kHz to 200 kHz channel sampling rates. The modular MPM8S offers very low crosstalk and low channel ON resistance for applications where a large number of signals are multiplexed.

COMPARATORS

Designed for control applications, Burr-Brown's IC comparators are ideal for driving relays, lamps, and loads.

These devices are categorized as:

(1) General purpose with variable hysteresis.

(2) Variable window with presettable upper and lower limits.

PEAK DETECTORS

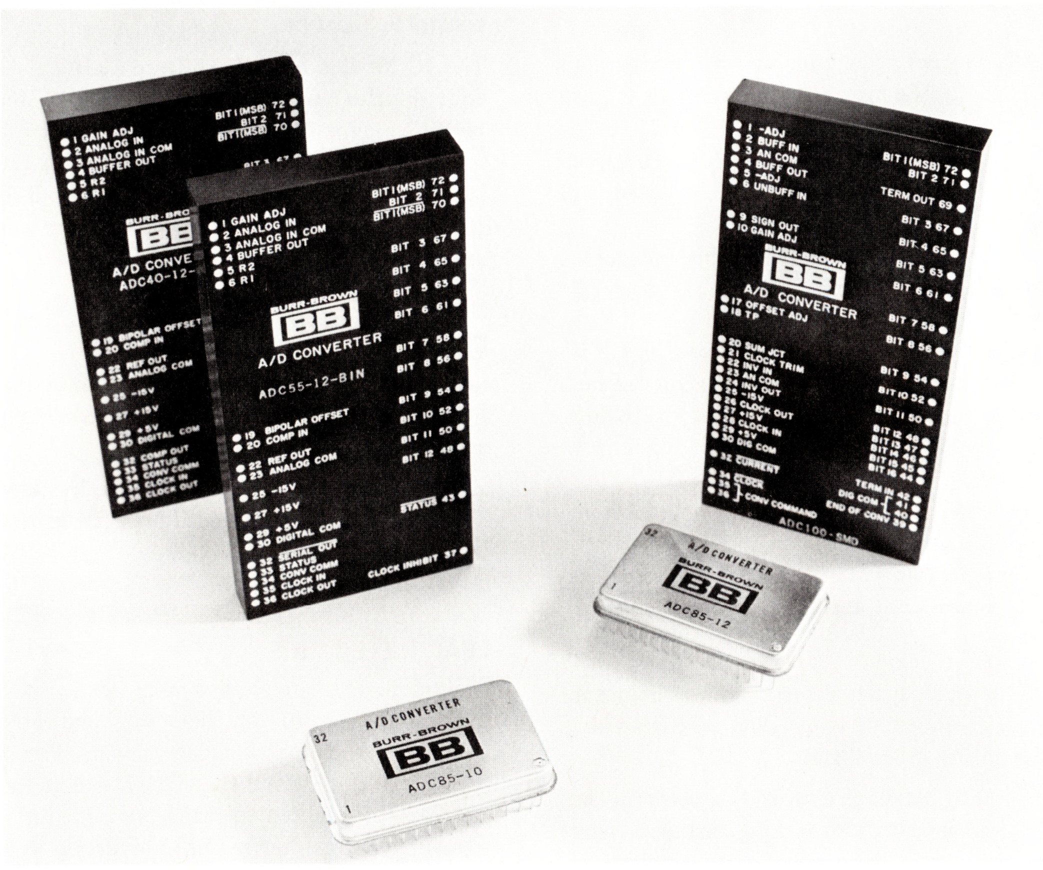
Peak detectors are very similar to sample/holds. These devices are capable of detecting and holding the peak amplitude of a varying analog signal. The operating mode (PEAK DETECT, HOLD, RESET) is externally controlled, and may be adapted to many test, measurement, and control applications that require low droop in HOLD and fast response to changes in input signals while in the PEAK DETECT mode.

Analog-to-Digital CONVERTER HIGHLIGHTS

Burr-Brown's A/D converter line offers a wide spectrum of performance with resolutions up to 16 binary bits, 8 bit conversion speeds as fast as 880 nsec, and guaranteed gain drifts as low as ±7 ppm/°C. Designed to maximize cost/performance parameters, these A/D converters can provide solutions to some of your toughest data conversion problems.

All A/D converters are complete with internal references and user connectable input buffer amplifier. All digital inputs and outputs are DTL/TTL compatible, and all units operate from ±15 VDC and +5 VDC power.

Should you need further information of any of the A/D converters, or for that matter, any of the products presented in this catalog, please ask your local Burr-Brown Representative or contact us in Tucson. Most products are fully described in separate Product Data Sheets which contain detailed specifications, operating instructions, performance curves, and applications hints.



HIGH PERFORMANCE, GENERAL PURPOSE

NEW! FAST 10 AND 12-BIT HYBRID IC
MODEL ADC85 -25° to +85°C
MODEL ADC85C 0° to +70°C

Designed to save space, weight and money, these A/D converters offer premium performance in a 32 pin hermetically sealed DIP compatible metal package. Conversion speeds up to 6 microseconds for 10 bit resolution and 10 microseconds for 12 bit resolution make the ADC85 ideal for applications that require system throughput sampling rates up to 150 kHz.

The ADC85 is complete with internal reference and user connectable buffer amplifier and may be user programmed to accept bipolar analog input signals of ±2.5, ±5, or ±10 volts or unipolar signals of 0 to +5 or 0 to +10 volts. In addition, these units can be "short cycled" to achieve faster conversion speeds for resolutions less than 10 bits. Data is available in parallel and serial form with corresponding clock and status signals.

MODEL ADC40 - LOW DRIFT ±7 ppm/°C
MODEL ADC50 - GENERAL PURPOSE

The ADC40 and 50 family of 8, 10, and 12 bit A/D converters offer state-of-the-art design and the optimum in modular packaging. Requiring only input signal and power, these self-contained units are designed for applications that require low drift and conversion speeds up to 2.5 microseconds per bit. Throughput rates of 50 kHz for 8 bit resolutions and 33 kHz for 10 and 12 bit resolutions are easily achieved with the ADC40/50 series A/D converters.

These converters are available with binary or BCD output codes and user programmable (unipolar and bipolar) input voltage ranges. These units are available in 2" x 4" x 0.4" modular packages.

MODEL ADC55 - FAST 10 AND 12-BIT

The ADC55 10 and 12 bit A/D converters are designed for use in applications where conversion speeds of from 0.8 to 1 μsec/bit are required. Offered in 2" x 4" x 0.4" modules, the ADC55 employs state-of-the-art IC components and hybrid circuit techniques to assure high reliability.

The successive approximation technique employed in the ADC55 is combined with a proprietary speed improvement circuit that provides settling to ±0.01% accuracies at conversion speeds in excess of 1 microsecond per bit.

This self-contained A/D converter has internal reference and user selectable input buffer amplifier and input signal ranges of ±2.5, ±5, ±10, 0 to +5 and 0 to +10 volts.

HIGH SPEED-NEW!

MODEL ADC60 - UP TO 1 MHz SAMPLING RATE

The Model ADC60 is a very high speed successive approximation A/D converter that is designed for applications requiring systems throughput rates from 300 kHz to 1 MHz. The fast conversion speed is accomplished with proprietary fast settling circuits which preserve linearity and drift while permitting conversion speeds up to 110 nanoseconds per bit.

Available in 8, 10, and 12 bit resolutions the ADC60 contains internal components that are provided for pin programmable analog input signal ranges of ±2.5, ±5, ±10, 0 to +5 and 0 to +10 volts.

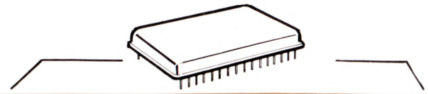
Data is available in both serial and parallel binary digital form with corresponding timing signals. The ADC60 is housed in a 2" x 4" x 0.75" module.

HIGH RESOLUTION, INTEGRATING

MODEL ADC100 - 16-BIT RESOLUTION

The ADC100 is excellent for applications which require good accuracy and high resolution, but where speed is not too important. The ADC100 is an integrating A/D converter that utilizes the delta sigma modulation principle. The digital equivalent of analog signals is developed by counting a number of pulses whose average repetition rate is proportional to the amplitude of the input signal over a fixed integration period. The internal clock is externally adjustable to provide integration periods which are integral multiples of 50 or 60 Hz periods for maximum power line noise rejection. The closed conversion loop assures linear performance of ±0.005% ±1 count that is independent of clock frequency deviations over the specified temperature range of 0 to +70°C. Conversion speeds range from 12 milliseconds for 12 bit binary to 30 milliseconds for 4 digit plus sign BCD codes.

The ADC100 is housed in a 2" x 4" x 0.4" module and four basic models are offered: Unipolar 4 digit BCD, 4 digit plus sign BCD, unipolar and bipolar 16 bit binary. The binary units are pin programmable for 12, 14, or 16 bit resolution.



Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	UNITS	NEW! ADC60 HIGH SPEED			NEW! ADC85C FAST		ADC85	
RESOLUTION	Bits Digits	8	10	12	10	12	10	12
INPUT								
ANALOG INPUT								
Voltage Range - Binary Codes	Volts	±2.5,±5, ±10, 0 to +5, 0 to +10						
- Decimal Codes	Volts	—			—			
Impedance	Ω	200Ω/V of FSR			10^8			
DIGITAL INPUTS(1)								
Convert Command (positive pulse)								
Minimum Pulse Width	nsec	30			50			
Loading	TTL Loads(2)	2			1			
TRANSFER CHARACTERISTICS								
ACCURACY								
Gain Error (Adjustable to zero)	% of FSR(3)	±0.1			±0.1			
Offset Error (Adjustable to zero)								
Unipolar	% of FSR	0.1			±0.05			
Bipolar	% of FSR	0.1			±0.1			
Linearity Error, max	% of FSR	±0.2	±0.05	±0.025	±0.05	±0.012	±0.05	±0.012
Quantizing Error		±1/2 LSB						
ACCURACY DRIFT								
Specification Temperature Range	°C	0 to +70			0 to +70		-25 to +85	
Gain, max	ppm/°C				±40	±25	±20	±15
Offset (Unipolar)	ppm of FSR/°C	±20(4)	±20(4)	±15(4)	±3			
Linearity, max	ppm of FSR/°C				±3	±3	±3	±2
Monotonicity Temperature Range		GUARANTEED (0 to +70°C min)					(-25°C to +85°C min)	
CONVERSION SPEED, max	μsec msec	0.88	1.88	3.50	6	10	6	10
OUTPUT								
DIGITAL OUTPUTS(5)								
Data (Parallel and Serial Format) Codes		BIN(7)			CBI(9)			
Status(6)		End of convert and its complement Logic "1" during conversion.						
POWER REQUIREMENTS								
Rated Voltages	Volts	±15 and +5						
Range, max	Volts	±14.5 to ±15.5 and +4.75 to +5.25						
Supply Drain +15V	mA	+110			+40			
-15V	mA	-48			-30			
+5V	mA	+270			+120			
PACKAGE DRAWING (See pages 69, 70, 72)		23 B 2"x 4"x 0.75"			25 1.12" x 1.75" x 0.2" METAL			
PRICE (1 - 9)		$330.00	$350.00	$400.00	$160.00	$195.00	$185.00	$225.00

(1) DTL/TTL compatible, "0" = 0.8V max, "1" = 2.0V min.
(2) 1 TTL Load = 40 μA @ Logic "1" and -1.6mA @ Logic "0".
(3) FSR means Full Scale Range.
(4) Total Accuracy Drift in ppm of FSR/°C.
(5) DTL/TTL compatible Logic @ max = 0.4V, Logic 1 min = 2.4V.
(6) Status indicates that a conversion is in progress and the output data is not valid.

Prices and specifications are subject to change without notice.

ORDERING INFORMATION

ADC60

ADCXX – XX

A/D Converter Family

Resolution Number of Bits (8, 10, 12* Bits)

ADC85

ADC85 X – XX

A/D Converter Family

Blank = -25 to +85°C Model
C = 0 to +70°C Model

Resolution Number of Bits (10 or 12 Bits)

ADC40 LOW DRIFT				ADC50 GENERAL PURPOSE				ADC55 FAST		ADC100 INTEGRATING, HIGH RESOLUTION			
8	10	12	3	8	10	12	3	10	12	16	16	4	4+
±2.5, ±5, ±10, 0 to +5, 0 to +10								±2.5,±5,±10, 0 to +5,0 to +10		±10	+10	—	—
0 to +10								—		—	—	+10	±10
10^8								10^8		2×10^8			
100								100		3000			
4								1		2			
±0.1								±0.1		±0.05			
±0.05								±0.05		±0.02		±0.02	
±0.1								±0.1		±0.05		±0.05	
±0.2	±0.05	±0.012	±0.05	±0.2	±0.05	±0.012	±0.05	±0.05	±0.012	±0.005			
±1/2 LSB								±1/2 LSB		±1 count			
0 to +70								0 to +70					
±10	±10	±7	±10	±15	±15	±12	±15	±30	±20	±10 (4)	±10 (4)	±10 (4)	±5 (4)
±2				±3				±3					
±5	±5	±3	±5	±5	±5	±3	±5	±3					
GUARANTEED (0 to +70°C min)													
20	30	30	30	20	30	30	30	8	12	50 to 200 (10)		30	30
BIN (7)			BCD (8)	BIN (7)			BCD (8)	BIN (7)		BOB	USB	BCD (8)	SMD (11)
End of convert and its complement Logic "1" during conversion										Logic "0" during conversion			
±15 and +5								±15 and +5					
±14.5 to ±15.5 and +4.75 to +5.25								±14.5 to ±15.5 and +4.75 to +5.25					
+30								+55		+25			
−40								−60		−15	−15	−20	−20
+300								+300		+300			
(23) A 2" x 4" x 0.4"				(23) A 2" x 4" x 0.4"				(23) A 2" x 4" x 0.4"		(23) C and D 2" x 4" x 0.4"			
$195.00	$225.00	$290.00	$275.00	$175.00	$195.00	$245.00	$230.00	$210.00	$225.00	$250.00	$250.00	$225.00	$250.00

(7) Unipolar or bipolar codes user selectable.
Unipolar and bipolar codes derived from BIN code are BTC, BOB and USB.
BTC = Binary Two's Complement
BOB = Bipolar Offset Binary
USB = Unipolar Straight Binary

(8) BCD - Unipolar Binary Coded Decimal

(9) CBI = Complementary Binary. Unipolar and bipolar codes derived from this code are CSB, COB and CTC - user selectable.
COB = Complementary Offset Binary
CTC = Complementary Two's Complement
CSB = Complementary Straight Binary

(10) 50 msec for 14 bits, 200 msec for 16 bits.

(11) SMD = Sign Magnitude Decimal Code.

ADC40, ADC50, ADC55

ADCXX – XX – XXX

- A/D Converter Family
- Resolution Number of Bits (10, 12 for ADC55) (8, 10, 12 for all other Models)
- Output Code (BIN, BCD, ADC40, and ADC50 only)

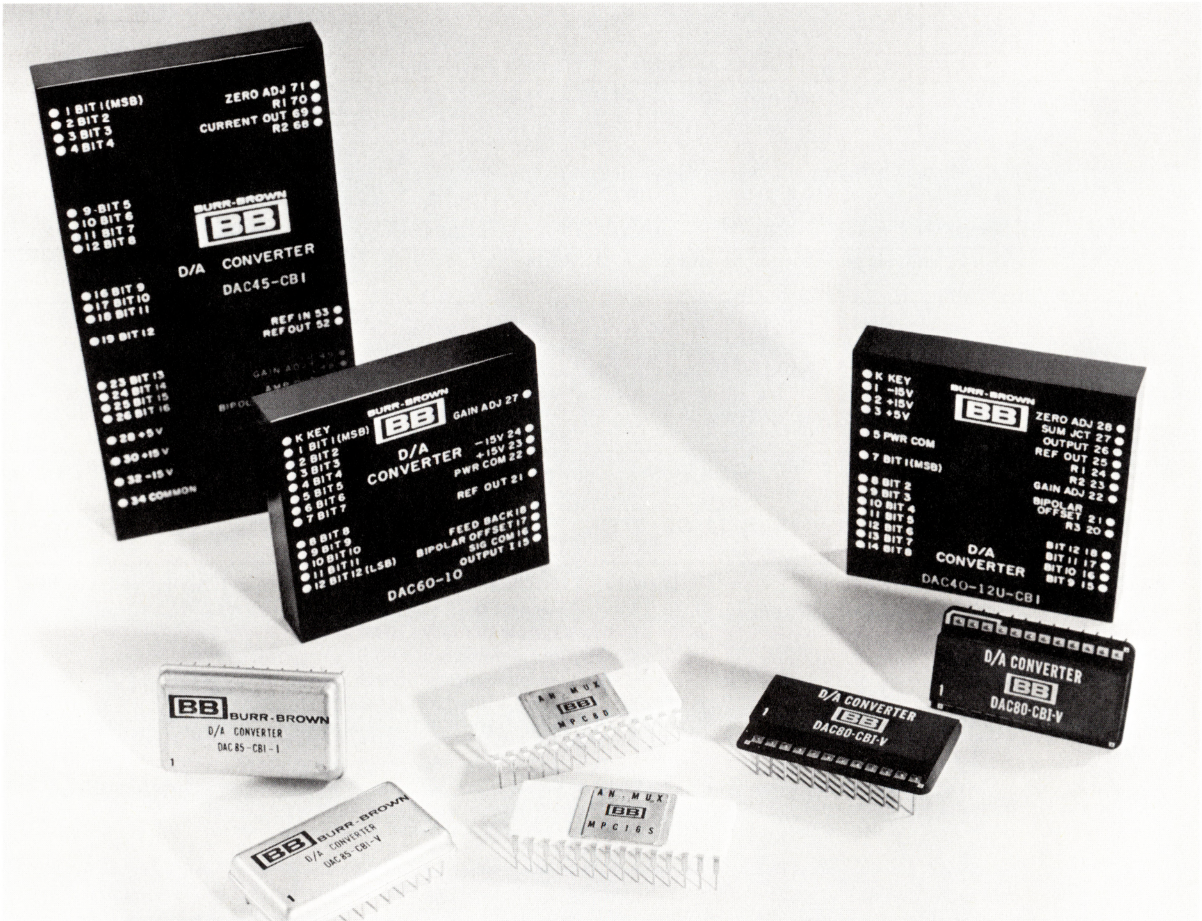
ADC100

ADC100 – XXX

- A/D Converter Family
- Output Code (BCD, SMD, USB, BOB)

Digital-to-Analog CONVERTER HIGHLIGHTS

Our D/A converters have established a reputation for high quality cost conscious approaches to digital-to-analog conversion. These units accept 8 to 16 bit binary or 4 digit BCD codes. These D/A converters offer a wide choice of accuracies (±0.2% to ±0.003%) drift (±7 ppm/^{o}C to ±40 ppm/^{o}C gain drift), settling speeds (25 nanoseconds to 50 microseconds), and size (2" x 4" x 0.4" to 24 pin DIP), allowing you to choose the right product for your specific application. All are DTL/TTL compatible and operate from ±15 volt and +5 volt DC power supplies. We have two of the smallest complete quality performance hybrid D/A converters on the market today in our DAC80 and DAC85.



GENERAL PURPOSE, HYBRID IC

NEW! MODEL DAC80 - 12-BIT LOW COST

Designed for many general purpose applications where low cost, small size and 8 to 12 bit accuracy are requirements, the DAC80 offers maximum nonlinearity error of ±0.012% over a 0°C to 70°C temperature range, and maximum initial nonlinearity error of ±0.012% at 25°C. It is guaranteed monotonic over 0°C to 70°C, and settles to ±0.01% of full scale range in just 3 microseconds. The DAC80 is complete with internal reference and amplifier for bipolar voltage output ranges of ±2.5 to ±10 volts or 0 to +5 and 0 to +10 volts unipolar ranges—all selectable by you. Or, if you need a fast settling current output, the DAC80 is also available with 2 current ranges of ±1 mA or 0 to -2 mA, and it settles to ±0.01% in only 300 nanoseconds.

The DAC80 is packaged in a 1.35" x 0.50" x 0.20" 24 pin DIP compatible ceramic package.

MODEL DAC85 - 12-BIT LOW DRIFT

The DAC85 12 bit D/A converter offers quality performance usually found in larger, higher cost modular units. Housed in a 24 pin dual-in-line metal case, this D/A converter is complete with internal reference and output amplifier and is engineered to preserve the performance, while providing sealed protection from rugged environments.

Highly stable laser trimmed thin-film resistors and our 4550 quad current switches provide low nonlinearities of ±0.012% over 0 to 70°C (DAC85C) or ±0.012% over -25°C to +85°C (DAC85 and DAC85LD) operating temperature ranges. Current output models settle to ±0.01% in 300 nanoseconds while voltage output models settle to ±0.01% in 3 microseconds, permitting throughput rates as high as 3 MHz for full scale range changes. All models are guaranteed monotonic over the specified temperature ranges.

A full MIL temperature range (-55°C to +125°C) Model DAC85ET is also available for wide temperature operation.

The small size of the DAC85 makes it an ideal choice as the heart of your A/D converter design or for applications where space or weight is at a premium, such as CRT displays, aircraft instrumentation, and portable instruments. The wide choice of performance models allows you to choose the right unit for your application and budget.

GENERAL PURPOSE, HIGH PERFORMANCE

MODEL DAC40 - LOW DRIFT

The DAC40 series features 8, 10, and 12 bit resolution, binary or BCD codes and guaranteed monotonicity. In addition, these fully specified units feature settling times as low as 3 μsec and a guaranteed maximum gain drift as low as ±7 ppm/°C. An internal thin-film resistor voltage scaling network permits the user to select +5, +10, ±2.5, ±5, and ±10V output voltage ranges.

Models are available with or without a TTL compatible buffer storage register.

MODEL DAC45 - 16-BIT RESOLUTION

The DAC45 accepts up to 16 bit binary or 4 digit BCD DTL/TTL compatible input codes at transfer rates as high as 30 kHz, and translates these digital words into one of seven user selectable voltage ranges as an output. The low drift and ultra-linearity of the DAC45 provide equivalent voltage or current output signals that are accurate to ±0.003% of full scale input range at ambient temperature.

The DAC45 is one of the most accurate self-contained 2" x 4" x 0.4"modular D/A converters available today. All units are burned-in for 48 hours assuring you of a high quality, highly reliable product for your high accuracy requirements. All models contain internal reference and output amplifier. The DAC45 voltage output settles to ±0.003% in 50 μsec.

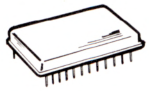
MODEL DAC20 - FAST SETTLING

This family of D/A converters packs a lot of performance into a relatively small 3" x 2.1" x 0.4" package. The series has units for 8, 10, and 12 bit conversion, binary or BCD codes, and all models provide accuracy of ±1/2 LSB. Guaranteed drifts are as low as 20 ppm/°C and conversion speeds are as fast as 1.5 μsec. And, all units are guaranteed monotonic over the 0°C to +70°C temperature range. Each unit is self-contained and can be ordered with or without an input buffer storage register.

MODEL DAC60 - ULTRA HIGH SPEED

The DAC60 is a high speed D/A converter designed for high speed applications. It is available in 10 and 12 bit resolution, provides 1/2 LSB maximum differential nonlinearity error, and is guaranteed monotonic. Typical settling time to 0.05% for a one LSB step is 25 nanoseconds. The maximum settling time for the major carry or for a full scale transition is only 40 nanoseconds to 0.05%.

The DAC60 is pin programmable to obtain unipolar or bipolar output signals. The current output may be fed directly into the summing junction of an external high speed operational amplifier, or an external summing resistor.



Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	UNITS	NEW! DAC80 LOW COST		DAC85C ECONOMY		DAC85 GENERAL PURPOSE	
RESOLUTION							
Binary	Bits	12		12		12	
Decimal	Digits		3		3		3
INPUT							
INPUT CODES(1) (2)							
Binary		CBI		CBI		CBI	
Decimal			CCD		CCD		CCD
INPUT STORAGE REGISTER		NO		NO		NO	
TRANSFER CHARACTERISTICS							
ACCURACY							
Linearity Error, max @ 25°C							
Binary Models	% of FSR	±0.012		±0.012		±0.012	
Decimal Models	% of FSR		±0.05		±0.05		±0.05
Gain Error (Adj. to zero)	% of FSR	±0.1		±0.1		±0.1	
Unipolar Offset Error (Adj. to zero)	% of FSR	±0.05		±0.05		±0.05	
ACCURACY DRIFT							
Gain Drift, max	ppm/°C	±30		±20		±20	
Offset Drift, max - Unipolar	ppm of FSR/°C	±1		±1		±1	
Combined Gain & Offset Drift, max	ppm of FSR/°C	—		—		—	
Linearity Error Over Temperature	% of FSR	±0.012†		±0.012†	±0.05†	±0.012†	±0.05†
Specified Operating Temperature	°C	0 to +70		0 to +70		−25 to +85*	
CONVERSION SPEED							
Settling Time to ±1/2 LSB(Unipolar)	μsec	3 (V_{out}), 0.3 (I_{out})		3(V_{out}), 0.3(I_{out})		3 (V_{out}), 0.3 (I_{out})	
Slew Rate	V/μsec	20		20		20	
OUTPUT							
VOLTAGE RANGE							
Unipolar	Volts	0 to +5, 0 to +10					
Bipolar	Volts	±2.5, ±5, ±10					
Current, min	mA	±5					
Impedance	Ω	0.05					
CURRENT RANGE							
Unipolar	mA	0 to −2					
Bipolar	mA	±1					
Compliance (Unipolar/Bipolar)	Volts	±2.5					
Impedance (Unipolar/Bipolar)	Ω	15k / 4.4k					
POWER SUPPLY							
Voltages (rated)	Volts	±15, +5 (9)					
Range	Volts	±14 to ±16 and +4.75 to +5.25		±14.5 to ±15.5 and +4.75 to +5.25			
Sensitivity	% of FSR/%	±0.002(6), ±0.02(7)					
PACKAGE DRAWING (See pages 69-75)		(27) 0.8"x 1.4"x 0.20" CERAMIC		(26) 0.8"x 1.4"x 0.20" METAL			
PRICE (1 - 9)(8)		$49.00	$47.00	$69.00	$69.00	$89.00	$89.00

(1) All input codes are DTL/TTL compatible.

Prices and specifications are subject to change without notice.

(2) Input codes are designated:

- CBI - Complementary Binary
- BIN - Straight Binary
- BOB - Bipolar Offset Binary
- BTC - Bipolar Two's Complement
- CCD - Complementary BCD
- BCD - Binary Coded Decimal

†Maximum; monotonicity guaranteed over operating temperature range.

*Also available for −55°C to +125°C operating temperature range (CBI only).

ORDERING INFORMATION

DAC20, DAC40

DACXX – XX X – XXX

- D/A Converter Family
- Resolution Number of Bits (8, 10, 12)
- Input: Buffered (B) or Unbuffered (U)
- Input Code: DAC20: USB, BOB, BTC, BCD DAC40: CBI, CCD (BIN, BTC, BCD available with register option only)

DAC45

DAC45 – XXX – XXX

- D/A Converter Family
- Input Code: Modular Units: CCD,CBI
- Package Options PC or/16A Codes: USB, CSB, BOB, COB, BTC, CTC, BCD, CCD

NEW! DAC85LD LOW DRIFT	DAC20 FAST SETTLING			DAC40 LOW DRIFT			DAC45 HIGH RESOLUTION		DAC60 ULTRA HIGH SPEED	
12	8	10 3	12	8	10 3	12	16	4	10	12
CBI —	BIN, BOB, BTC BCD			CBI,BIN,BOB,BTC CCD,BCD			CBI,BIN(5) BOB,(5)BTC(5)	CCD,BCD(5)	CBI —	
NO	Optional (3)			Optional(4)			Optional(5)		NO	
±0.012 ±0.1 ±0.05	±0.2 ±0.1 ±0.05	±0.05 ±0.05 ±0.05 ±0.05	±0.012 ±0.05 ±0.025	±0.2	±0.05 ±0.024 ±0.1 ±0.05	±0.012	±0.003 ±0.003 ±0.025 ±0.025		±0.012 ±0.05 ±0.001	±0.012
±10 ±1 ±0.012† -25 to +85	— — ±40 ±0.2	— — ±20 ±0.05 0 to +70	— — ±15 ±0.012	±10 ±1 — ±0.2†	±10 ±1 — ±0.05† 0 to +70	±7 ±1 — ±0.012†	±7 ±1 — ±0.006 0 to +70	±0.006	— — ±30 ±0.05 0 to +70	— — ±30 ±0.024
3(V_{out}), 0.3(I_{out}) 20	1	1 70	1.5	3	3 20	3	50 1	50	0.04 1000	0.15
0 to +5, 0 to +10 ±2.5, ±5, ±10 ±5 0.05	0 to −10 ±10.25 ±20 0.1			0 to +5, 0 to +10 ±2.5, ±5, ±10 ±5 0.05			0 to +5, 0 to +10 ±2.5, ±5, ±10 ±8 0.05		N/A	
0 to −2 ±1 ±2.5 15k/4.4k	N/A			N/A			0 to −2 ±1 ±0.5 15k/4.4k		0 to −5 ±2.5 3.2/0.0 650/516	
±15, +5 ±0.002(6), ±0.02(7)	±15, +5 ±14 to ±16 and +4.75 to +5.25 ±0.007			±15, +5 ±14.5 to ±15.5 and +4.75 to +5.25 ±0.002			±15, +5 ±0.001		±15 ±14.5 to ±15.5 ±0.002	
(26) 0.8″ x 1.4″ x 0.20″ METAL	(24) 2″ x 3″ x 0.4″			(29) A & (23) E 2″ x 2″ x 0.4″ (4)			(23) F 2″ x 4″ x 0.4″		(29) B 2″ x 2″ x 0.4″	
$150.00	$120.00	$160.00	$195.00	$135.00	$145.00	$165.00	$340.00	$330.00	$110.00	$150.00

(3) Extra cost option, same package as unbuffered models.

(4) Extra cost option. All unbuffered models have complementary codes. Buffered models have uninverted codes, and are in 2″ x 4″ x 0.4″ package.

(5) Extra cost option. Basic module has complementary codes. Optional model is on P.C. Card - all codes are available.

(6) For −15V and +5V supplies.

(7) For +15V Supply.

(8) Prices shown for basic models only.

(9) The +5V supply can be eliminated by connecting the +5V pin to the ±15V supply.

DAC80, DAC85

DACXX XX − XXX − X

D/A Converter Family:
DAC80
DAC85

Model (DAC85 only)
C = 0 to +70°C
Blank = −25°C to +85°C
LD = −25°C to +85°C Low Drift
ET = −55°C to +125°C

Input Code:
CBI = Complementary 12 Bit Binary
CCD = Complementary 3 Digit BCD (Not available for LD or ET Models)

Output:
I = Current
V = Voltage

DAC60

DAC60 − XX

D/A Converter Family

Resolution Number of Bits (10, 12)

SAMPLE/HOLDS

Burr-Brown manufactures a sample/hold for almost any application. Whether your design requires high speed, high accuracy, or 8 to 13 bit system compatibility, we have it. The performances are excellent, the prices reasonable, and they all have that little extra called "Burr-Brown Quality".

NEW! MODEL SHC85- FAST 0.01% HYBRID IC

The SHC85 acquires up to ±10 volt signals in 5.5 μsec and is accurate to ±0.01% of full scale. The SHC85 is complete with holding capacitor and is packaged in a compact 14 pin DIP package, and has compensating circuitry to minimize charge offset and dielectric absorption. External capacitance may be added to extend the SHC85 performance for lower droop with correspondingly longer acquisition time.

Two models are available – the Model SHC85 is specified for 0°C to +70°C operating temperature range and the SHC85ET is specified for -55°C to +125°C operating temperature range.

MODEL SHC23- HYBRID IC USER SELECTABLE ACQUISITION TIME AND DROOP

If you need a small package and a low cost method of storing an analog voltage, Burr-Brown's SHC23 sample/hold amplifier may be the solution to your problems. Upon command, this unit will acquire and hold an analog signal with very low droop errors. These TTL compatible units need only the addition of an external storage capacitor to provide a complete sample/hold unit. The selection of this capacitor allows you to tailor the specifications of the SHC23 to suit your requirements. For instance, a small storage capacitor will provide an acquisition time as low as 25 μseconds while a much larger storage capacitor will allow the output to be held longer than 15 minutes with less than 1% error.

It's hermetically sealed in a TO-8 case, provides ±0.01% accuracy, and for those extreme environmental conditions, the SHC23ET operates over a temperature range of -55°C to +125°C. Burr-Brown guarantees the total unadjustable error (dynamic nonlinearity) of these sample/hold amplifiers to be less than ±0.01%. This makes the SHC23 the best price/performance bargain in its class.

MODEL SHM41- 13 BIT-COMPATIBLE

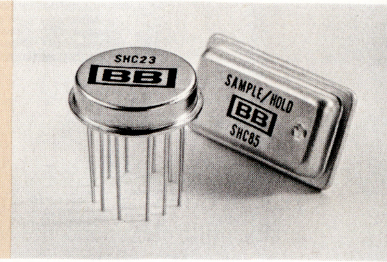
The SHM41 acquires ±10 volt signals, settles to 0.005% of final value in 4 μsec, and maintains that value for a minimum of 1 millisecond. Designed for use with 12 and 13 bit A/D converters, the SHM41 also accepts ±10 volt data, a DTL/TTL or C/MOS compatible control signal, and requires ±15 VDC power.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	UNITS
INPUT	
ANALOG INPUT	
Voltage Range	Volts
Impedance	Ω
Bias Current, max	nA
DIGITAL INPUT (Mode Control)(1)	
Sample Mode (Logic 1) Current	μA
Hold Mode (Logic 0) Current	μA
INPUT POWER	
Voltages	Volts
Current	mA
TRANSFER CHARACTERISTICS	
ACCURACY	
Dynamic Nonlinearity(2), max	% of 20V
for Sample Period	μsec
Hold Period	μsec
Gain Range	V/V
Gain Error, max	% of 20V
Voltage Offset, (Adj. to zero)	mV
Droop Rate, max	μV/ms
ACCURACY DRIFT	
Gain Drift	ppm of 20V
Droop over specification temp.	mV/ms
Specification Temperature Range	°C
DYNAMIC CHARACTERISTICS	
Bandwidth (Full Power)	kHz
Output Slew Rate	V/μsec
Acquisition Time (to ±0.01%)	
10 Volt Step, max	μs
20 Volt Step, max	μs
Aperture Time	ns
Feedthrough in HOLD Mode	% of Step change on input
OUTPUT	
Voltage Range	Volts
Current Range	mA
Impedance	Ω
PACKAGE DRAWING (See pages 68-75)	
PRICE (1 - 9)	

(1) Mode Control Command is DTL/TTL Compatible.
(2) Includes all unadjustable errors for specified sample and hold period.

Prices and specifications are subject to change without notice.



MODEL SHM60-HIGH SPEED AND SELECTABLE 1 to 1000 GAINS

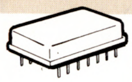
Designed for use with fast A/D and D/A converters and analog multiplexers, the SHM60 high speed sample/hold acquires analog signals of up to ±10 volt amplitude and settles to 0.01% in less than 1.5 microsecond for 20 volt input step. Both analog input terminals are available for user selection of gains from unity to 1000. Aperture time is a mere 12 nanoseconds, and feedthrough is just 0.005%.

Internal compensation of charge storage effects and dielectric absorption are provided to assure accurate and fast operation. The SHM60 dynamic nonlinearity of 0.01% is specified for hold periods of up to 15 microseconds to simplify the user's task of computing system throughput error for specific operating conditions.

MODEL 4034/25-LOW DROOP

This sample/hold is designed for applications where accuracies of up to ±0.01% must be maintained for long hold periods. The 4034/25 will hold ±10 volt signals for up to 5 milliseconds to an accuracy of ±0.01% max. The low droop rate of only 0.25 μV/msec maximum makes the 4034/25 excellent for simultaneous sample/hold and low speed applications.

No external components are required for this module, although an external balance potentiometer may be used for a fine balance adjustment of the unit. Just apply ±15 VDC power, and the module is ready to operate.

NEW! SHC85 FAST	SHC23(3) LOW COST	SHC23ET (3) WIDE TEMPERATURE	4034/25 LOW DROOP	SHM41 HIGH ACCURACY	SHM60(4) HIGH SPEED
					
±10	±10	±10	±10	±10	±10
10^8	10^8	10^8	5 x 10^7	10^8	10^{11}
50, typ	30	30	600	30	0.04
.05	5	5	200	1	100
-50	-100	-100	-60	-50	-0.05
±15	±15	±15	±15	±15	±15
±13	±15	±15	±40	±15	+25/-15
±0.01	±0.01	±0.01	±0.01	±0.005	±0.01
5	70	70	10	5.5	1
1000	1000	1000	5000	1000	15
+1.0	+1.0	+1.0	+1.0	+1.0	±1 to ±1000
±0.01	±0.01	±0.01	±0.01	±0.02	±0.01
±2	±2	±2	±1	±1	±3
500	20	20	0.25	20	5000
±2	±3	±3	±2.5	±1	±2
doubles every 10°C	0.1	2	3	doubles every 10°C	doubles every 10°C
0 to +70(6)	0 to +70	-55 to +125	0 to +60	0 to +70	0 to +70
200	20	20	2	100	400
20	1	1	0.1	10	25
4.5	60	60	500	4	1.0
5.5	70	70	1000	5	1.5
30	50	50	100	40	12
±0.005	note 5	note 5	±0.01	±0.002	±0.005 max
±10	±10	±10	±10	±10	±10
±10	±5	±5	±5	±10	±20
0.1	1.0	1.0	0.05	0.1	1.0
(28) 14 Pin DIP	(31) TO-8	(31) TO-8	(30) 1.8″ x 2.4″ x 0.6″	(29) C 2″ x 2″ x 0.4″	(29) D 2″ x 2″ x 0.4″
$65.00	$49.00	$80.00	$119.00	$135.00	$99.00

(3) Specification shown for 0.01 μF holding capacitor.
(4) Specification shown for unity gain.
(5) Not specified. This parameter is a function of the holding capacitor and the circuit layout.
(6) Model SHC85ET (-55°C to +125°C) is also available.

NEW! MODELS MPC-8D, MPC-16S, 8-CHANNEL DUAL and 16-CHANNEL SINGLE-ENDED CMOS-FET

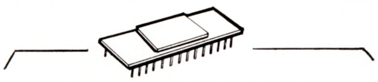
The MPC-16S is a single-ended monolithic 16 channel analog multiplexer and the MPC-8D is a monolithic dual 8 channel analog multiplexer constructed with voltage protected CMOS devices. Transfer accuracies of better than 0.01% can be achieved at sampling rates up to 200 kHz from signal sources of up to ±10 volts amplitude.

These DTL/TTL/CMOS compatible devices feature self-contained binary channel address decoding. An ENABLE line is also made available which allows the user to individually enable a 16 channel group (MPC-16S) or an 8 channel group (MPC-8D) facilitating channel expansion in either single-node or multi-tiered matrix configurations.

Digital and analog inputs are failure protected from either over-voltages that exceed the power supplies or from the loss of power. The break-before-make switches also serve to protect the signal sources from shorting during switching.

High quality processing is employed to produce CMOS-FET analog channel switches which have low leakage current, high OFF resistance, low feedthrough capacitance, and fast settling time.

These devices are housed in compact 28 pin dual-in-line packages that measure just 0.6" wide, and are specified for operation over a 0°C to +75°C temperature range. Power consumption is only 15 mW when operating at 100 kHz and just 7.5 mW on standby.



MODEL MPM-8S 8-CHANNEL MOS-FET

The MPM-8S is a single-ended, 8 channel analog multiplexer. Transfer accuracies of 0.01% can be achieved at sampling rates well over 150 kHz from signal sources of ±10 volts. This DTL/TTL compatible module features self-contained binary channel address decoding. An INHIBIT SIGNAL INPUT allows the user to turn OFF all channels and facilities expansion of the multiplexer to as many as 256 channels in a multi-tier matrix structure.

State-of-the-art zener protected MOS-FET switches with low ON resistance are used in the MPM-8S to achieve a low 200 Ω ON resistance, maximum leakage current of just 0.2 nA, an OFF resistance of 10^{11}Ω, a low feedthrough capacitance, and a 7 μsec settling time. The unit is housed in a 2" x 2" x 0.4" module with 0.020"diameter pins and DIP compatible spacing.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	MPC-8D 8-CHANNEL DIFFERENTIAL	MPC-16S 16-CHANNEL SINGLE-ENDED	MPM-8S 8-CHANNEL SINGLE-ENDED	UNITS
INPUT				
Analog Inputs				
Number of Input Channels				
Single-ended	N/A	16	8	Channels
Differential	8	N/A	N/A	Channels
Voltage Range	±15	±15	±10	Volts
Maximum Safe Overvoltage	±V Supply ±20	±V Supply ±20	±15	Volts
Reference Voltage Range	+4 to +20	+4 to +20	N/A	Volts
ON Characteristics				
ON Resistance (R_{on})	1.3	1.3	0.2	k Ω
Ron Drift vs. Temperature	0.25	0.25	1	%/°C
Ron Mismatch				
Channel-to-Channel	50	50	20	Ω
Differential	50	N/A	N/A	Ω
Input Leakage Current	1	1	0.2	nA
OFF Characteristics				
Off Resistance-to-Ground	10^{11}	10^{11}	10^{11}	Ω
Leakage Current	0.2	0.2	0.05	nA
Digital Inputs				
Channel Select				
No. of bits	3(1)	4(1)	3(2)	
Code	one of 8	one of 16	one of 8	
Group Enable Bit	Logic "0" disables channels, Logic "1" enables channel select		Logic "0" enables channel select, Logic "1" disables all channels	
Power Supply Requirements				
Supply Voltages (rated)	±15	±15	±15, +5	Volts
Supply Range ±15V	-5 to +20	+5 to +20	+14 to +18	Volts
-15V	-5 to -20	-5 to -20	-14 to -25	Volts
+ 5 V	N/A	N/A	+4.75 to +5.25	Volts
Power Consumption	7.5	7.5	800	mW
DYNAMIC CHARACTERISTICS				
Gain Error (20 MΩ load), max	0.01	0.01	0.01	% of FSR
Crosstalk	0.005	0.005	0.005	% of OFF Channel Sig.
Settling Time to 0.01%	4	4	7	μsec
Common-Mode Rejection, min	120 dB	N/A	N/A	
Switching Time				
Turn ON	0.5	0.5	0.2	μsec
Turn OFF	0.3	0.3	0.7	μsec
OUTPUT				
Voltage Range, min	±15	±15	±10	Volts
Capacitance-to-Ground	50	50	40	pF
Operating Temperature Range	0 to +75	0 to +75	0 to +70	°C
PACKAGE DRAWING (See pages 75,76)	32 B 28 pin DIP	32 A 28 pin DIP	29 E 2" x 2" x 0.4"	
PRICE (1 - 9)	$45.00	$42.00	$99.00	

(1) TTL/CMOS compatible: $-V_{supply} \leq V_L < 0.8V$ @ 1 nA, $+4.0V \leq V_H \leq +V_{supply}$ @ 1 nA.

(2) DTL/TTL compatible: $0V \leq V_L \leq 0.8V$ @ -1.3 mA, $2.0V \leq V_H \leq +5.5V$ @ 500 μA.

VOLTAGE-to-FREQUENCY CONVERTERS

NEW! MODELS VFC12 AND VFC15

- **LOW COST – $35.00 in 100's**
- **ONE SIGNAL LINE TRANSMISSION**
- **COMPACT –**
  1.5" x 1.5" x 0.4"
- **ACCURATE –**
  0.01% linearity gives you 12 bit accuracy
- **STABLE –**
  20 ppm/°C gain drift gives you better than 0.4 LSB stability over temperature for 12 bit applications.
- **VERSATILE –**
  Many simple-to-implement scaling options
  Unipolar or bipolar operation–VFC15
- **CONVENIENTLY SCALED – 1 kHz per volt**

Voltage-to-frequency conversion is a simple and low cost method of converting analog signals into an equivalent digital form. The output is a DTL/TTL compatible digital pulse train whose repetition rate is proportional to the amplitude of the analog input signal; these pulses have constant width and constant amplitude.

The VFC12 accepts 0 to 10 volt analog signals while Model VFC15 accepts 0 to 20 volt analog signals. The VFC12 operates over DC to 10 kHz frequency range and the VFC15 operates over a DC to 20 kHz frequency range.

The low 0.01% maximum nonlinearity error of these V/F converters makes them excellent for use in applications where digital resolutions of 12 or 13 bits are desired. These units are completely self-contained and require only ±15 VDC power and input signal. The gain and offset are adjustable with external potentiometers. A number of optional configurations to scale the input or output for best compatibility with your system are easily realized with simple external circuitry. These VFC's can be used to increase noise immunity on long single-line signal transmission, for 12 bit accuracy A/D conversion, in digital panel meter front ends, and they are ideal for feed rate generator and control applications.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	VFC12	VFC15	UNITS
FREQUENCY RANGE	10	20	kHz
INPUT			
ANALOG INPUT			
Voltage Range	0 to +10	0 to +20	V
Overrange, min	100	10	% of FSR[1]
Impedance	33	33	k Ω
Maximum Safe Input Voltage	22	22	V
INPUT POWER			
Rated Voltages[2]	±15 ±10%		VDC
Supply Drain			
Typical	±16		mA
Maximum	±20		mA
TRANSFER CHARACTERISTICS			
TRANSFER EQUATION	$f_{out} = 10^4 \frac{V_{in}}{10}$		Hz
ACCURACY			
Full Scale Error[3]	Adjustable		
Offset Error[4]			
Typical	±0.002	±0.001	% of FSR
Maximum	±0.01	±0.005	% of FSR
Linearity Error, max			
V_{in} = + 1 mV to + 10 V	±0.01	–	% of FSR
V_{in} = + 1 mV to + 20 V	–	±0.01	% of FSR
Power Supply Sensitivity	±0.005		% of FSR/%
STABILITY (0°C to +70°C)			
Full Scale Drift			
Voltage Input			
Typical	±20		ppm of FSR/°C
Maximum	±50		ppm of FSR/°C
Current Input	N/A	±35	ppm of FSR/°C
Stability vs. Time			
Full Scale Drift			
Per Day	±100		ppm of FSR
Per Month	±200		ppm of FSR
Input Offset Drift			
Per Day	±10		ppm of FSR
Per Month	±20		ppm of FSR
Offset Drift			
Typical	±2		ppm of FSR/°C
Maximum	±5		ppm of FSR/°C
RESPONSE			
Settling Time for 10 V Input Step, max	2 output pulses of new frequency plus 20 μsec		
Overload Recovery Time	1 to 2 pulses of new frequency		
TEMPERATURE RANGE			
Specification	0 to + 70		°C
Operating (derated specifications)	-25 to +85		°C
Storage	-55 to +125		°C
OUTPUT			
Waveform	Train of TTL/DTL compatible pulses		
Pulse Characteristics			
Logic 1 (High)	4.7 ±0.5		V
Logic 0 (Low)	0.2 ±0.1		V
Pulse Width	30		μsec
Fan Out	10 TTL Loads		
Impedance	3		k Ω
Capacitive Load, max	1000		pF
PACKAGE DRAWING (See page 77)	33 A 1.5" x 1.5" x 0.4"	33 B	
PRICE (1 - 9)	$57.00	$59.00	

(1) FSR = Full Scale Range and is 10V for VFC12 and 20V for VFC15.
(2) A regulated supply with 1% or less ripple is recommended.
(3) Adjusted at factory for 9.900V = 10 kHz.
(4) May be externally adjusted to zero.

DIGITALLY PROGRAMMED VOLTAGE SOURCES

MODELS 4800 AND 4801

- **0.01% ACCURACY**
- **±60 V, 200 mA OUTPUT**
- **FULL DIGITAL PROGRAMMING OF**
  - **Voltage Magnitude**
  - **Voltage Range**
  - **Voltage Polarity**
  - **Current Limit**
- **INPUT STORAGE REGISTERS**
- **VOLTAGE OR CURRENT PROGRAMMING**

The 4800 and 4801 are the first digitally programmed voltage sources (DPVS) developed specifically for design-in applications in automated and computer-controlled test equipment. They are packaged in a compact module suitable for mounting on a printed circuit board, and are essentially self-contained digitally programmable power supplies (DPPS). By eliminating the size and weight of the AC/DC power supply and the expensive hardware of an instrument-type DPPS, and through extensive use of our own low cost, high precision components, we have provided maximum performance and applications versatility at minimum cost. Because the required DC power is normally available in the user's system (or can be provided at small cost) and because instrument hardware is usually unnecessary, the tradeoffs are extremely favorable.

Both binary (4800) and BCD (4801) programming are provided, thus minimizing the need for expensive code-conversion circuitry. The 4800 and 4801 contain a high-stability D/A converter, power output circuitry, sensing amplifier, and all the digital controls and interfaces necessary to allow easy computer control. Each unit has selectable ±10V and ±60V output ranges. Alternatively, they may be used as digitally programmed current sources.

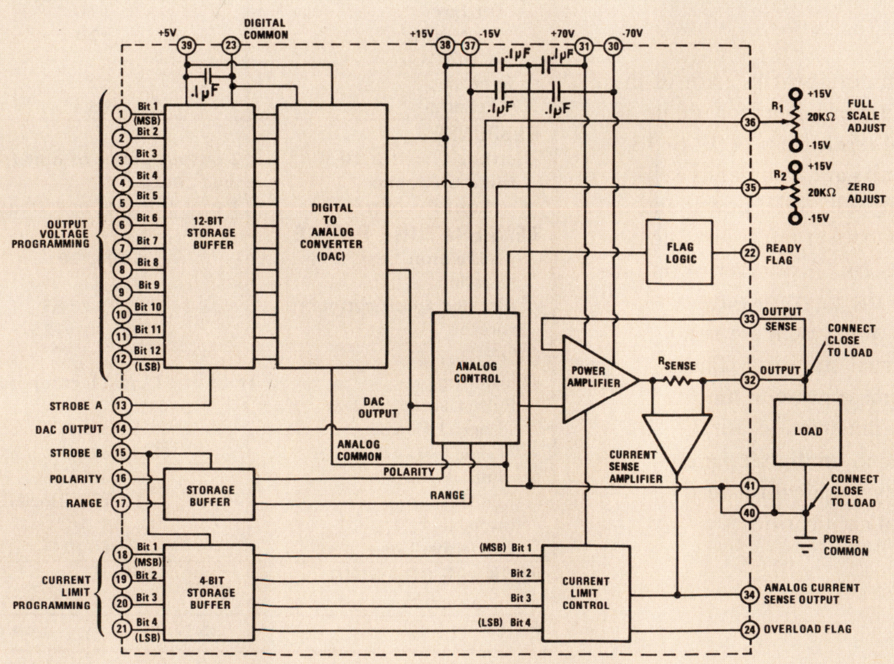
When operated in the voltage programming mode, a current sense output is available. Also, the internal current limiting level is digitally programmable.

Settling time of the 4800 or 4801, after a programmed change in the digital input word is 100 μsec (worst case). The maximum trimmed output error is ±0.012%. Package size is 4.4" x 3.4" x 0.8". See (34) on page 77.

PRICE in 1 - 9 quantities:

Model 4800 (Binary Coding)	$650.00
Model 4801 (BCD Coding)	$650.00

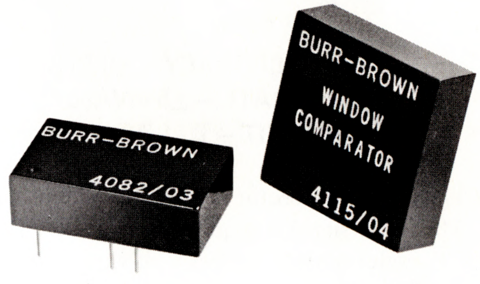
For additional details request data sheet PDS-306.



4800/4801
BLOCK DIAGRAM

COMPARATORS

In their simplest form, comparators are used to provide a two-state logic output that indicates whether an analog voltage is greater than or less than another analog voltage. Parameters that vary considerably with circuit complexity are sensitivity, hysteresis, stability of trip point with variations in temperature and power supply voltages, input voltage range, and switching speed. Burr-Brown comparators are fully specified and can be used in your circuit with a minimum of design time.



MODEL 4082 - FAST SETTLING

The 4082/03 combines a low cost differential input comparator with an open collector transistor output stage capable of sinking 100 mA. With transient protection of 400 mA, this unit is an excellent choice to drive lamps, relays, and other devices with high transient requirements. In addition, the open collector output will accept up to +40 VDC making this device compatible with MOS circuitry and high noise immunity logic as well as DTL and TTL devices.

MODEL 4115- WINDOW-DUAL LIMIT

Model 4115/04 is a hybrid IC window comparator in a double width DIP. The unit has three inputs; one for a voltage that sets the upper limits, another for a voltage that sets the lower limits, and the third for a signal input. There are three mutually exclusive outputs; HIGH, GO, and LOW. When an output is ON it will sink up to 200 mA of current. This input diode protected device is designed to work with input voltages of up to ±10 V, and will not be harmed by voltages to ±15 V.

The unit's three open collector outputs indicate that the input signal voltage is above, below or in the window. They will drive a variety of loads including lamps, relays, MOS circuitry and high noise immunity logic as well as DTL and TTL devices.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

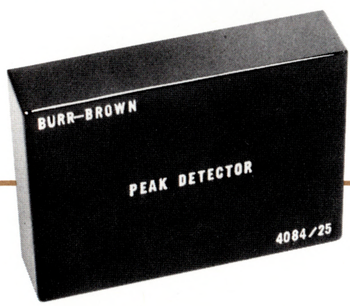
MODEL	4082/03 FAST SETTLING	4115/04 WINDOW (DUAL LIMIT)	UNITS
INPUT			
Voltage Range (All Inputs)	±10	±10	Volts
Maximum Safe Input	±15	±15	Volts
Impedance, min	300	6	k Ω
TRANSFER CHARACTERISTICS			
Accuracy			
Sensitivity, min	±0.1	±0.2	mV
Voltage Offset, max (Referred to input)	±10	±2	mV
vs Power Supply	±50	±50	μV/V
vs Temperature, max (-25°C to +85°C)	±150	±30	μV/°C
SWITCHING SPEED			
20 mV Step Input	7	N/A	μsec
For 30 mV Overdrive	N/A	300	μsec
OUTPUT			
Load Voltage Supply	0 to +30	0 to +30	Volts
Load Current			
Steady State	100	200	mA
Transient (1 second max)	400	400	mA
Impedance to common (All outputs)			
OFF State	1	1	M Ω
ON State	3	3	Ω
POWER SUPPLY REQUIREMENTS			
Rated Supply Voltages	±15	±15	VDC
Supply Range	-14 to +16	-12 to +18	VDC
Supply Drain, max	±12	±15	mA
TEMPERATURE RANGE			
Rated Specifications	-25 to +85	-25 to +85	°C
Operating	-40 to +85	-40 to +85	°C
PACKAGE DRAWING (See pages 77, 78)	35 0.76"x 0.46"x 0.25"	36 0.76"x 0.76"x 0.25"	
PRICE (1 - 9)	$36.00	$49.00	

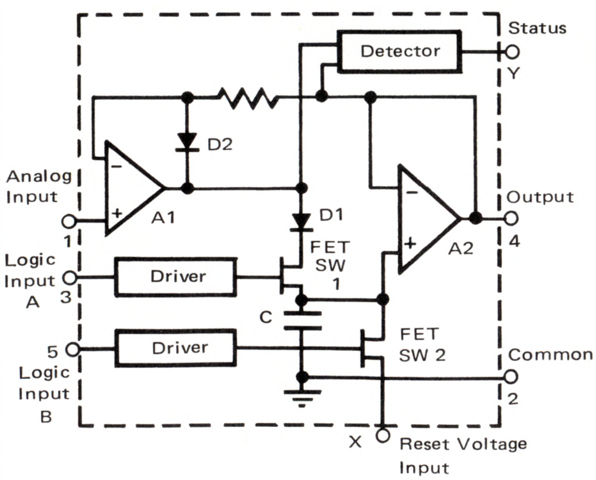
MODEL 4084/25

- **HIGH GAIN ACCURACY – ±0.01%**
- **LOW DROOP RATE – ±5 mV/sec**
- **STATUS OUTPUT – DTL/TTL Compatible**

The 4084/25 peak detector is a special type of sample/hold. The input signal is acquired and tracked (PEAK DETECT mode) until it reaches a maximum value then the unit automatically holds this value while signaling that a peak has been reached (STATUS output). The 4084/25 can then be placed in the HOLD mode to ignore further peaks or RESET to a reference level ready to detect the next peak. The extremely low output droop (voltage decay with time) of this unit allows it to be used with a variety of instruments to record or display its output (A/D converters, digital voltmeters, analog meters, etc.).

The 4084/25 will detect peaks in the range of -10 volts to +10 volts. The RESET mode charges the internal holding capacitor to any reference level between +10 volts and -10 volts. The peak detector will then detect any peak more positive than the reference level. For instance, with a voltage reference input of 0 volts, the unit will detect peak voltages between 0 and +10 V and,with a -10 V voltage reference input, the 4084/25 will detect peaks between -10 V and +10 V.



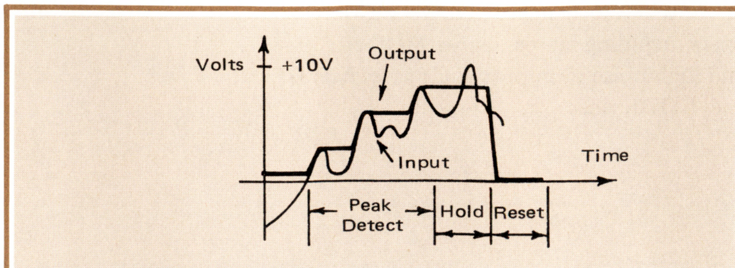


BLOCK DIAGRAM

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	4084/25
ANALOG INPUTS	
Input Signal Level	
Operating (absolute max)	±10 V (±15V)
Input Bias Current	600 nA
Input Impedance	50 M Ω
Reset Input Voltage (Current)	±10 V (3 mA)
DIGITAL INPUTS	
Logic Level "1" Voltage	+2.4V $<V_H<$ +15 V
Logic Level "0" Voltage	0V $<V_L<$ +0.8V
Rise Time	1 μsec
Input Impedance, Each Logic Input	10 kΩ‖50 pF
	LOGIC INPUT A / LOGIC INPUT B
PEAK DETECT Mode	"0" / "0"
RESET Mode	"1" / "1"
HOLD Mode	"1" / "0"
OFFSET Adjust Mode	"0" / "1"
ACCURACY	
Voltage Gain	1.0 V/V
Gain Accuracy at DC (Over Temp. Range)	±0.01% Full Scale
Dynamic Accuracy DC to 100 Hz	±0.02% Full Scale
Input Voltage Offset , max	±1 mV
vs. Temperature ,max	±50 μV/°C
Input-to-Output Feedthrough	±0.5 mV
STABILITY	
Droop (in the Hold Mode)	
From 0°C to +25°C , max	±5 mV/sec
At +60°C ,max	±60 mV/sec
Power Supply Sensitivity	±1 mV/%
SWITCHING PERFORMANCE	
Acquisition Time in PEAK DETECT MODE (for +10 V Input Step and Output Settling to within 1 mV of Input)	200 μsec
Output Slew Rate in PEAK DETECT	1 V/μsec
Reset Time in RESET to within ±0.01%	100 μsec
PEAK DETECT to HOLD mode offset	-5 mV
ANALOG OUTPUT	
Rated Output	
Voltage	±10V
Current	±5 mA
Output Impedance	0.05 Ω
Capacitive Load	1000 pF
Noise DC to 10 kHz	0.1 mV rms
DIGITAL OUTPUT STATUS	
(DTL/TTL Compatible)	
$E_{in} < E_o$	0 V
$E_{in} \geqslant E_o$	+5 V
Delay Time Plus Rise Time	(1)
TEMPERATURE RANGE	
Specification	0°C to +60°C
Operating	0°C to +85°C
Storage	-55°C to +85°C
POWER REQUIREMENTS	
Rates Supply Voltage	±15 V
Voltage Range	±14 to ±16 VDC
Supply Drain Quiescent (Rated Output)	±25 mA (±40 mA)
PACKAGE DRAWING (See page 78)	37 2.4"x 1.8"x 0.6"
PRICE (1 - 9)	$145.00

(1) Depending upon the rate-of-change of the input signal, the delay plus rise time of the STATUS output can vary from as small as 5 μsec to over 100 msec.

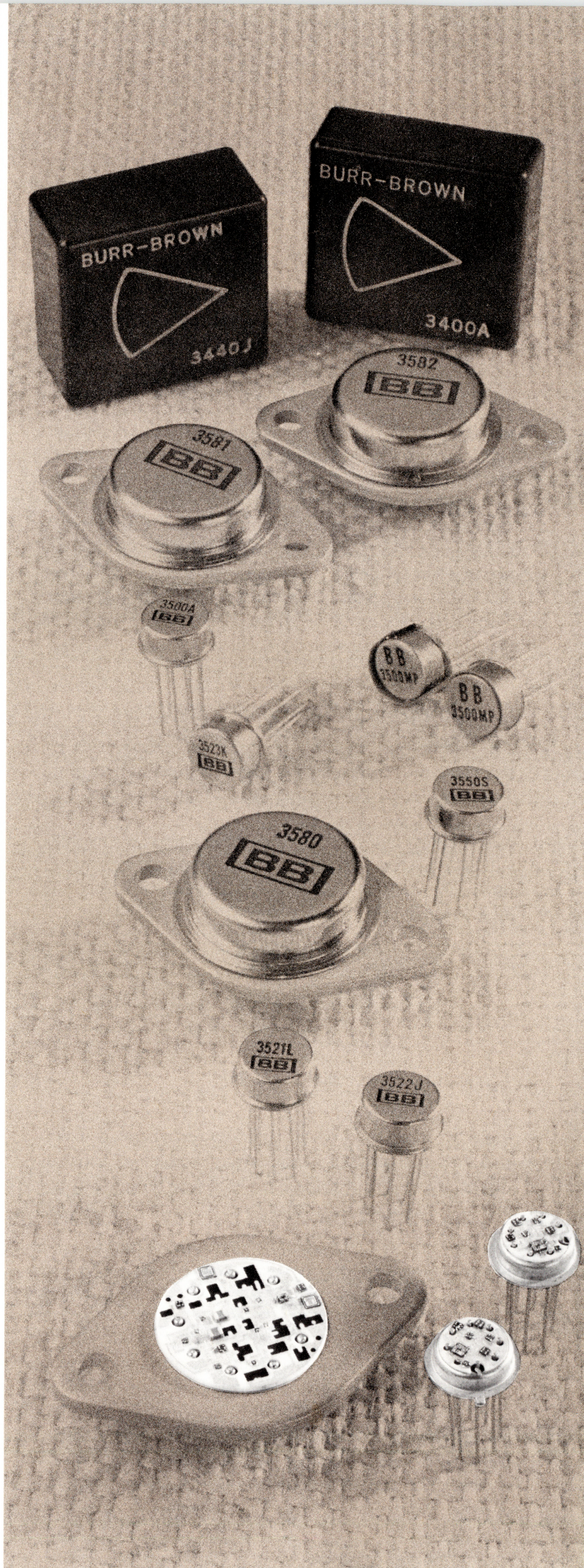


TYPICAL OPERATION OF PEAK DETECTOR

OPERATIONAL AMPLIFIERS

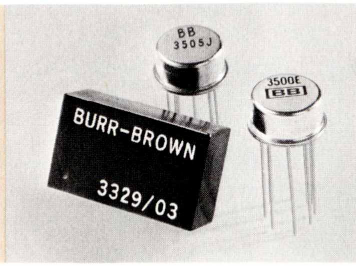
General Purpose
Low Drift
Low Bias Current
Wideband and Fast Settling
High Voltage and High Current
Iso-Op-Amps

BURR-BROWN



OP AMP HIGHLIGHTS

All Burr-Brown op amps are listed in six applications groups which correspond to the user's general design requirements. These groups include General Purpose, Low Drift, Low Bias Current, Wideband, High Voltage and High Current (including power boosters), and an unusual new product– the Iso-Op-Amp™. Features of some of the key products in each group are described on these two pages.



GENERAL PURPOSE

LOW DRIFT, LOW NOISE IC; 3500 SERIES (pg. 26)

The 3500 series is designed for low input currents while maintaining slew rates and bandwidths adequate for most applications. The low input bias current is achieved by a unique current canceling circuit which insures low bias currents over the full temperature and common-mode voltage ranges, and gives the amplifier both high differential and common-mode input impedance. The 3500 family also has exceptionally good noise characteristics. These internally compensated amplifiers have many guaranteed specifications and offer a wide range of offset voltage and bias current performance from which to choose.

LOW COST, 20 mA; 3268/3269 SERIES (pg. 27)

The 3268/3269 series is a modular, bipolar input device featuring low cost and moderately high output current. This series is particularly useful in applications requiring somewhat faster slew rate than is available in IC or low cost modular devices. The open loop gain is high, and the amplifier has very stable frequency response and transient response, even for large values of feedback resistance and capacitive loading.

LOW DRIFT

1 μV/°C DRIFT IC; 3500E (pg. 28)

The 3500E, based on the proven Burr-Brown 3500 series design, is a low 1 μV/°C drift unit with excellent open loop gain, bias current, and common-mode rejection specifications. The initial offset voltage is 500 μV max and it has the same excellent noise performance of the 3500 family.

MATCHED OFFSET VOLTAGE AND DRIFT IC; 3500MP (pg. 28)

Close process control and careful grading by Burr-Brown make possible a new dimension in IC op amps – drift matched pairs. Offset voltage and drift are matched to within 200 μV max and 1 μV/°C max respectively. This performance allows you to build multi-stage op amp circuits with excellent accuracy. They are especially suited for high input impedance instrumentation amplifier type circuits.

LOW DRIFT FET IC; 3521L (pg. 28)

Now, there is an amplifier with both 1 μV/°C max drift <u>and</u> low bias current (10 pA max). By using our own thin-film components and advanced laser trimming techniques, Burr-Brown has broken the performance barrier on low drift IC FET's. Low offset voltage, low drift and low bias current – all in the same family of amplifiers.

0.1 μV/°C CHOPPER; 3291/14 (pg. 29)

For most inverting applications where ultra low drift vs. temperature and time is a requirement, the 3291/14 will be the best choice. The low voltage and bias current drifts of this op amp are combined with extremely high open loop gain to provide excellent overall closed loop accuracy. A low-profile package, a low price, and frequency response more than adequate for most applications make it a "best buy".

DIFFERENTIAL INPUT CHOPPER; 3354/25 (pg. 29)

Until the introduction of the model 3354, high performance chopper stabilized operational amplifiers were always single-ended. Now, the same ultra low drift (0.1 μV/°C) and other truly premium performance specifications can be obtained for noninverting, differential input, and other applications in which the amplifier must function with both differential and common-mode signals.

WIDEBAND and FAST SETTLING

FAST SLEWING IC; 3505J and 3507J (pg. 32)

Burr-Brown models 3505J and 3507J differential input op amps are intended for use in circuits requiring fast transient response – pulse amplifiers, D/A converters, comparators, fast followers, etc. The 3505J offers a settling time of 300 nanoseconds to 0.1% of final value, a typical slew rate of 30 V/μs, and a unity gain bandwidth of 6 MHz. It has a very stable 6 dB/octave gain rolloff at high frequencies which makes the amplifier stable at all gains without external compensation. The 3507J has a typical slew rate of 120 V/μs, and a gain bandwidth product of 20 MHz at a gain of 10. External compensation allows the designer to select the frequency response appropriate to his own circuit for optimum performance.

WIDEBAND IC; 3506J AND 3508J (pg. 32)

Designed specifically for circuits requiring extended bandwidths and high gains, the models 3506J and 3508J differential input IC op amps are ideally suited for RF signal amplifiers, fast recovery voltage references, high speed integrators, high frequency active filters and photo-diode applications. The 3506J is internally compensated for stability at all gains, and presents a small signal unity gain bandwidth of 12 MHz, and a typical slew rate of 7 V/μs. The 3508J has an exceptionally high gain bandwidth product of 100 MHz at a gain of 100, and a typical slew rate of 35 V/μs. The 3508J is also externally compensated to allow the designer to select frequency response parameters to fit his individual circuit requirements.

NEW!

600 ns (0.01%) SETTLING TIME IC; 3550 (pg. 33)

The 3550 provides 0.6 μs max (0.01%) settling time, 20 MHz unity gain frequency, and 1.5 MHz min full power frequency. Its 6 dB/octave rolloff without external components gives excellent frequency stability (even with heavy capacitative loads) and settling performance previously obtainable only with larger modules. The 3550 is specifically designed for requirements where fast settling, high accuracy, and high input impedance are important. It is ideal for such applications such as D/A and A/D conversion, sample/hold, and multiplexer buffering.

LOW BIAS CURRENT

1 pA BIAS CURRENT IC; 3522 (pg. 30)

The 3522 family offers excellent input characteristics at moderate cost through the use of monolithic chips, thin-film technology, and laser trimming. Unlike other FET op amps of comparable cost, the 3522 series has low bias current (1 pA max, 3522L), low input current noise (0.3 pA p-p), and moderate voltage drift. In addition, the 3522 family is internally compensated and provides excellent frequency stability at all gains.

NEW! 0.1 pA BIAS CURRENT IC; 3523 (pg. 30)

Guaranteed specifications of 0.1 pA max, bias current, ±0.5 mV max offset voltage, and ±25 μV/^{o}C max voltage drift makes the 3523L the best performing ultra low bias current IC FET you can find. It can solve your toughest current-to-voltage converter and high input impedance buffer circuit problems.

0.01 pA BIAS CURRENT VARACTOR; 3430 (pg. 30)

The 3430 inverting amplifier minimizes input bias current (0.01 pA, max) and input noise current through use of a varactor diode bridge technique. This model is designed for use with current signal sources where the signal is applied directly to the inverting input terminal and a single feedback resistor determines the input-current to output-voltage gain factor. Because of the extremely small input bias and noise currents of this amplifier, its effective resolution extends well below the picoamp range. Typical signal sources requiring such resolution include photomultiplier tubes, radiation detectors and flame detectors.

HIGH VOLTAGE & HIGH CURRENT

NEW! HIGH VOLTAGE & CURRENT; 3580, 81, & 82 (pg. 35)

The 3580 series is the first family of IC op amps to provide output voltage swings as high as 290 V p-p! Also, they have self-contained thermal sensing and shutoff which automatically prevents damage to the amplifier from overheating.

The FET input stage minimizes the offset voltages caused by bias currents flowing in the large feedback resistances normally used with high voltage circuits. The 3580 family is enclosed in a hermetic TO-3 package which can dissipate over three watts without a heat sink and up to 4.5 watts with a suitable heat sink.

POWER BOOSTER; 3329/03 (pg. 35)

The 3329/03 provides a ±100 mA output current in a compact, dual-in-line type package without the need for an external heat sink. The unit is short circuit protected over the full temperature range, and output current is limited to ±150 mA by internal circuitry.

ISO-OP-AMP™ (pg. 36)

The Iso-Op-Amp is a brand new product from Burr-Brown. As the name implies, it is a true uncommitted differential input operational amplifier that offers input/output isolation. The various models are rated at ±500 to ±2000 volts of continuous isolation voltage (factory tested at 2000 to 5000 volts) and have either bipolar transistor or FET input stages. Also, one model provides isolated ±15 VDC at the input for powering circuitry such as bridges and other op amps.

NEW! LOW DRIFT; 3450 (pg. 36)

The 3450 has a low drift (less than ±1 μV/^{o}C) bipolar input stage which is optimized for use with low-level signals from low impedance signal sources such as strain gages and thermocouples. Input voltage drift is less than ±1μV/^{o}C and gain linearity is ±0.01%. Isolation mode rejection is 160 dB at ±500 VDC.

NEW! LOW BIAS CURRENT; 3451 (pg. 36)

The 3451 has a low bias current (–25 pA, max) FET input stage which is suitable for use with low-level current sources or high impedance voltage sources. Input impedance is 10^{11} Ω and isolation mode rejection is 160 dB at ±500 VDC.

NEW! 1200 VOLT ISOLATION; 3452 (pg. 36)

The 3452 provides input/output isolation for continuous service of ±2000 VDC minimum (tested at ±5000 volts). Isolation mode rejection is 160 dB at ±2000 VDC. And the 3452 has the unique feature of having isolated ±15 VDC available at the input.

OPERATIONAL AMPLIFIER COMPARISON GUIDE

MODEL NUMBER	PAGE	DESCRIPTION	OPEN LOOP GAIN	RATED OUTPUT		FREQUENCY RESPONSE		
						UNITY GAIN	FULL POWER	SLEW RATE
			dB	V	mA	MHz	kHz	V/µs
3051	26	External Frequency Compensated IC, Mil Temp	93	±10	±5	1.0	20	1.2
3052	27	*	*	*	*	1.0	20	1.2
3053	27	*	*	*	*	0.9	15	0.9
3055	27	External Frequency Compensated IC	*	*	±10	1.0	20	1.2
3056	27	*	*	*	*	0.9	15	0.9
3057	27	*	90	*	*	0.7	10	0.6
3069/49	35	500 mA Power Booster	Approx. 0	±10	±500	—	50	—
3268/14	27	20 mA Output	114	±10	±20	1	100	6
3269/14	27	*	*	*	*	*	*	6
3271/25	29	±60 V to ±120 V Chopper Stabilized	140	±50 to ±110	±20	1	30	20
3291/14	29	Low Cost Chopper Stabilized	*	±10	±5	4	100	6
3292/14	29	*	*	*	*	*	*	6
3293/14	29	*	*	*	*	*	*	6
3329/03	35	100 mA Power Booster	Approx. 0	±10	±100	—	1000	—
3341/15C	33	100 mA Output, 1000 V/µs	100	±10	±100	50	10 MHz	1000
3342/15C	33	*	*	*	*	*	*	*
3354/25	29	Differential Input Chopper Stabilized	140	±10	±5	6	100	6
3355/25	29	*	*	*	*	*	*	*
3356/25	29	*	*	*	*	*	*	*
3400A	33	100 MHz, Differential Input	90	±10	±20	100	10 MHz	1000
B	33	*	*	*	*	*	*	*
3401A	33	1 µs Settling, Buffer	100	±10	±20	8	500	65
B	33	*	*	*	*	*	*	*
3430J	30	Ultra Low Bias Current Varactor, Inverting	100	±10	±5	0.002	0.007	0.4 V/ms
K	30	*	*	*	*	*	*	*
3431J	30	Ultra Low Bias Current Varactor, Noninverting	100	±10	±5	0.002	0.007	0.4 V/ms
K	30	*	*	*	*	*	*	*
3440J	29	Ultra Low Drift	110	±10	±10	1	10	0.6
K	29	*	*	*	*	*	*	*
L	29	*	*	*	*	*	*	*
3450	36	Iso-Op-Amp *TM*	94	±10	±5	—	1 (3)	—
3451	36	*	88	*	*	—	1 (3)	—
3452	36	*	94	*	*	—	1 (3)	—
3460	34	±11 V to ±150 V Supply	106	±1 to ±140	±10	1	—	10
3480J	35	Low Drift Chopper Amp.	140	±10	±10	100Hz(3)	2 - 50 Hz(3)	100V/sec
K	35	*	*	*	*	*	*	*
3500A	26	Low Drift Bipolar IC	93	±10	±10	1.5	10	0.6
B	26	*	*	*	*	*	15	1
C	26	*	*	*	*	*	15	1
R	26	Low Drift Bipolar IC, Mil Temp	*	*	*	*	10	0.6
S	26	*	*	*	*	*	15	1
T	26	*	*	*	*	*	15	1
3500E	28	1 µV/°C IC	100	±10	±10	1.5	12	0.8
3500MP	28	Matched Pair, IC	100	±10	±10	1.5	12	0.8
3501A	26	Low Bias Current, Bipolar IC	93	±10	±5	0.5	1.6	0.1
B	26	*	*	*	*	*	*	*
C	26	*	*	*	*	*	*	*
R	26	Low Bias Current, Bipolar IC, Mil Temp	*	*	*	*	*	*
S	26	*	*	*	*	*	*	*
3540J	31	Lowest Cost FET IC	86	±10	±5	1	100	6
3505J	32	Fast Slew IC, Internal Compensation	94	±10	±10	6	300	20
3506J	32	Wideband IC, *	106	±10	±10	12	50	4
3507J	32	Fast Slew IC, External Compensation	90	±10	±10	20	1200	80
3508J	32	Wideband IC, *	106	±10	±10	100(5)	320	20
3521H	31	Low Drift FET IC	94	±10	±10	1.0	10	0.6
J	31	*	*	*	*	*	*	*
K	31	*	*	*	*	*	*	*
L	31	*	*	*	*	*	*	*
R	31	Low Drift FET IC, Mil Temp	*	*	*	*	*	*
3522J	30	Low Bias FET IC	94	±10	±10	1	10	0.6
K	30	*	*	*	*	*	*	*
L	30	*	*	*	*	*	*	*
S	30	Low Bias FET IC, Mil Temp	*	*	*	*	*	*
3523J	30	Ultra Low Bias FET IC	94	±10	±10	1	10	0.6
K	30	*	*	*	*	*	*	*
L	30	*	*	*	*	*	*	*
3542J	31	Low Cost FET IC	88	±10	±10	1	8	0.5
S	31	*	*	*	*	*	*	*
3550J	33	Fast Settling IC	100	±10	±10	10	1000	65
K	33	*	*	*	*	20	1500	100
S	33	Fast Settling IC, Mil Temp	*	*	*	10	1000	65
3551J	33	Wide Gain-Bandwidth IC	100	±10	±10	50(5)	3800	250
S	33	Wide Gain-Bandwidth IC, Mil Temp	*	*	*	*	*	*
3580J	35	High Voltage IC	106	±13 to ±30(6)	±60	3	100	15
3581J	35	*	112	±27 to ±70(6)	±20	*	60	20
3582J	35	*	118	±65 to ±145(6)	±15	*	30	20

*Specification same as above model. (1) Adjusts to zero. (2) Available in either package (3) −3 dB Points (4) Specifications for match.
Prices and specifications are subject to change without notice.

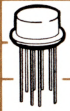
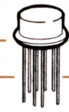
OFFSET VOLTAGE		BIAS CURRENT		INPUT IMPEDANCE		COMMON-MODE REJECTION	PACKAGE	PRICES (Small qty.)
@25°C	TEMP DRIFT	@25°C	TEMP DRIFT	DIFFERENTIAL	COMMON-MODE			
mV	μV/°C	nA	nA/°C	Ω	Ω	dB		
±3	±5	400	±0.6	0.3 M	200 M	90	TO-99	$ 24.00
±4	±10	500	±0.8	*	*	*	*	19.00
±6	±30	600	±1.0	*	*	80	*	11.00
±3	±5	400	±0.6	*	*	90	*	19.00
±4	±10	500	±0.8	*	*	*	*	13.00
±6	±30	600	±1.0	*	*	*	*	7.50
—	—	—	—	—	15 k	—	2″ x 2″ x 0.7″	83.00
(1)	±5	50	±0.6	1 M	500 M	86	1.5″ x 1.5″ x 0.4″	39.00
*	±20	*	*	*	*	*	*	28.00
±50 μV	±1	±0.08	±0.002	500 k	—	Inverting	1.8″ x 2.4″ x 0.6″	175.00
±20 μV	±0.1	±0.05	±0.0005	500 k	—	Inverting	1.5″ x 1.5″ x 0.4″	77.00
±50 μV	±0.3	±0.05	±0.001	*	—	*	*	56.00
±100 μV	±1	±0.1	±0.002	*	—	*	*	49.00
—	—	—	—	—	10 k	—	DIL Type	25.00
±1	±25	-0.1	doubles/+10°C	10^{11} ∥ 3 pF	—	Inverting	1.2″ x 1.8″ x 0.6″	79.00
*	±50	*	*	*	—	*	*	68.00
±30 μV	±0.1	±0.02	doubles/+10°C	1 M	10^{13}	140 @ DC	1.8″ x 2.4″ x 0.6″	145.00
±50 μV	±0.25	±0.05	*	*	*	*	*	110.00
±100 μV	±1	±0.05	*	*	*	*	*	100.00
footnote (1)	±100	-0.1	doubles/+10°C	10^{11} ∥ 6 pF	10^{11} ∥ 12 pF	60 (+8, -10V)	1.1″ x 1.1″ x 0.4″	65.00
*	±50	*	*	*	*	*	*	79.00
footnote (1)	±50	-0.02	doubles/+10°C	10^{11} ∥ 2 pF	10^{11} ∥ 2 pF	92 (±10V)	1.1″ x 1.1″ x 0.4″	46.00
*	±20	*	*	*	*	*	*	57.00
footnote (1)	±30	±0.01pA	doubles/+10°C	3 x 10^{11} ∥ 30 pF	—	—	1.7″ x 3.1″ x 0.7″	59.00
*	±10	*	*	*	—	—	*	85.00
footnote (1)	±30	±0.01pA	doubles/+10°C	3 x 10^{11} ∥ 30 pF	10^{14} ∥ 2 pF	100 (±25V)	1.7″ x 3.1″ x 0.7″	59.00
*	±10	*	*	*	*	*	*	85.00
±250μV	±1.5	25	±0.25	0.4 M	500 M	100	1.1″x 1.1″ x 0.5″	43.00
±100μV	±0.5	*	±0.15	*	*	*	*	58.00
±100μV	±0.25	*	±0.15	*	*	*	*	74.00
±0.55	1	±50	±0.5	10^{7} ∥ 6 pF	5 x 10^{9} ∥ 6 pF	100 (±10V)	2.3″ x 3.5″x 0.7″	180.00
±20	50	-25 pA	doubles/+10°C	10^{11} ∥ 10 pF	10^{11} ∥ 10 pF	80 (±10V)	*	105.00
±0.3	5	-20 pA	*	10^{11} ∥ 10 pF	10^{11} ∥ 10 pF	90 (±10V)	*	135.00
±1	±50	-0.025	doubles/+10°C	10^{11}	10^{11}	90	1.8″ x 2.4″x 0.6″	89.00
±25 μV	±0.3	±0.3	±0.01	80 k ∥ 0.1 μF	10^{9} ∥ 0.2 μF	110	1.5″x 1.5″ x 0.4″	49.00
*	±0.1	*	*	*	*	*	*	64.00
±5	±20	±30	±1	10 M ∥ 3 pF	5 x 10^{9} ∥ 3 pF	100	TO-99/Mini Dip(2)	7.50
±2	±5	±20	±0.5	*	*	*	*	12.00
±1	±3	±15	±0.3	*	*	*	*	15.00
±5	±20	±30	±1.5	*	*	*	TO-99	15.00
±2	±10	±20	±1	*	*	*	*	24.00
±1	±5	±15	±0.5	*	*	*	*	36.00
±0.5	±1	±50	±0.5	10 M ∥ 3 pF	5 x 10^{9} ∥ 3 pF	100	TO-99	25.00
±0.2[4]	±1[4]	±50	±0.5	10 M ∥ 3 pF	5 x 10^{9} ∥ 3 pF	100	TO-99	25.00
±5	±20	±15	±0.2	50 M ∥ 3 pF	10^{10} ∥ 3 pF	100	TO-99	4.50
±2	±10	±7	±0.15	*	*	*	*	8.85
±2	±5	±3	±0.1	*	*	*	*	12.00
±5	±20	±15	±0.2	*	*	*	*	15.00
±2	±10	±7	±0.15	*	*	*	*	20.00
±50	±75	-25 pA	doubles/+10°C	10^{10}	10^{11}	90	TO-99	6.45
±8	±20	250	±0.5	50 M ∥ 3 pF	500 M ∥ 5 pF	90	TO-99	11.00
±5	*	±25	*	300 M ∥ 3 pF	10^{9} ∥ 3 pF	100	TO-99	9.00
±10	±30	250	*	100 M ∥ 3 pF	10^{9} ∥ 5 pF	90	TO-99	11.00
±5	*	±25	*	300 M ∥ 3 pF	10^{9} ∥ 3 pF	100	TO-99	9.00
±0.5	±10	-20 pA	doubles/+10°C	10^{11}	10^{12}	90	TO-99	17.80
±0.25	±5	*	*	*	*	*	*	22.00
*	±2	-15 pA	*	*	*	*	*	34.00
*	±1	-10 pA	*	*	*	*	*	44.00
*	±5	-20 pA	*	*	*	*	*	50.00
±1	±50	-10 pA	doubles/+10°C	10^{11}	10^{12}	90	TO-99	12.50
±0.5	±25	-5 pA	*	*	*	*	*	15.00
*	*	-1 pA	*	*	*	*	*	22.00
*	*	-5 pA	*	*	*	*	*	26.00
±1	±50	-0.5 pA	doubles/+10°C	10^{12}	10^{13}	80	TO-99	25.00
±0.5	±25	-0.25pA	*	*	*	*	*	28.00
±0.5	±25	-0.1 pA	*	*	*	*	*	32.00
±20	±50	-25 pA	doubles/+10°C	10^{11}	10^{11}	80	TO-99	6.45
*	*	*	*	*	*	*	*	11.50
±1	±50	-100pA	doubles/+10°C	10^{11} ∥ 3 pF	10^{11} ∥ 3 pF	70	TO-99	22.50
*	*	*	*	*	*	*	*	27.00
*	*	*	*	*	*	*	*	39.00
±1	±50	-100pA	doubles/+10°C	10^{11} ∥ 3 pF	10^{11} ∥ 3 pF	70	TO-99	22.50
*	*	*	*	*	*	*	*	39.00
±10	±30	-50 pA	doubles/+10°C	10^{11} ∥ 10 pF	10^{11}	86	TO-3	40.00
±3	±25	-20 pA	*	*	*	110	*	65.00
*	*	*	*	*	*	*	*	79.00

(5) Gain-bandwidth product (6) Depends on power supply voltage $V_{out} = \pm(|V_{cc}| - 5)$VDC.

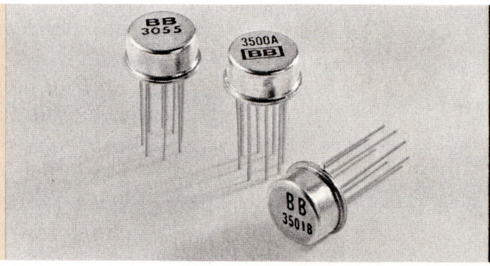
GENERAL PURPOSE AMPLIFIERS

General Purpose op amps give moderately good performance over a wide range of parameters at moderate cost. If more performance in a particular area is required, consult the appropriate special application group listing on the following pages.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	 LOW DRIFT, LOW NOISE 3500			 LOW BIAS CURRENT 3501		
Industrial Temperature Range Military Temperature Range	A R	B S	C T	A R	B S	C
OPEN LOOP GAIN DC, no load min		93 dB			93 dB	
RATED OUTPUT, min		±10 V @ 10 mA			±10 V @ 5 mA	
OUTPUT IMPEDANCE, DC		2 kΩ			2 kΩ	
FREQUENCY RESPONSE						
Small Signal Bandwidth (unity gain)		1.5 MHz			0.5 MHz	
Full Power Bandwidth, min	10 kHz	15 kHz	15 kHz		1.6 kHz	
Slew Rate, min	0.6 V/µs	1 V/µs	1 V/µs		0.1 V/µs	
INPUT OFFSET VOLTAGE						
Initial @ 25°C, max	±5 mV	±2 mV	±1 mV	±5 mV	±2 mV	±2 mV
Drift vs. Temp. , max	±20 µV/°C (A) ±20 µV/°C (R)	±5 µV/°C (B) ±10 µV/°C (S)	±3 µV/°C (C) ±5 µV/°C (T)	±20 µV/°C (A) ±20 µV/°C (R)	±10 µV/°C (B) ±10 µV/°C (S)	±5 µV/°C (C) —
Drift vs. Supply Voltage		±40 µV/V			±40 µV/V	
Drift vs. Time		±2 µV/day			±2 µV/day	
INPUT BIAS CURRENT						
Initial @ 25°C, max	±30 nA	±20 nA	±15 nA	±15 nA	±7 nA	±3 nA
Drift vs. Temp., max	±1 nA/°C (A) ±1.5 nA/°C (R)	±0.5 nA/°C (B) ±1 nA/°C (S)	±0.3 nA/°C (C) ±0.5 nA/°C (T)	±0.2 nA/°C (A) ±0.2 nA/°C (R)	±0.15 nA/°C (B) ±0.15 nA/°C (S)	±0.1 nA/°C (C) —
Drift vs. Supply Voltage		±0.2 nA/V			±30 pA/V	
INPUT OFFSET CURRENT						
Initial @ 25°C	±15 nA	±10 nA	±7 nA	±5 nA	±3 nA	±2 nA
Drift vs. Temp.	±0.5 nA/°C (A) ±0.7 nA/°C (R)	±0.2 nA/°C (B) ±0.5 nA/°C (S)	±0.1 nA/°C (C) ±0.2 nA/°C (T)	±0.1 nA/°C (A) ±0.1 nA/°C (R)	±0.05 nA/°C (B) ±0.05 nA/°C (S)	±0.03nA/°C (C) —
Drift vs. Supply Voltage		±0.1 nA/V			±10 pA/V	
INPUT IMPEDANCE						
Differential		10 MΩ || 3 pF			50 MΩ || 3 pF	
Common-Mode		5 x 10^9 Ω || 3 pF			10^{10} Ω || 3 pF	
INPUT NOISE						
Voltage, 0.01 Hz to 10 Hz, p-p		0.8 µV			0.8 µV	
10 Hz to 10 kHz, rms		1.2 µV			1.2 µV	
Current, 0.01 Hz to 10 Hz, p-p		30 pA			30 pA	
10 Hz to 10 kHz, rms		50 pA			50 pA	
INPUT SIGNAL RANGE						
Common-Mode Voltage Range		± (|Supply| -4) V			± (|Supply| -4) V	
Common-Mode Rejection		100 dB			100 dB	
Maximum Safe Input Voltage		± Supply			± Supply	
POWER SUPPLY						
Rated Voltage, Quiescent Current, max		±15 V @ ±3 mA			±15 V @ ±1.5 mA	
Voltage Range, Derated Performance		±3 V to ±20 V			±3 V to ±20 V	
TEMPERATURE RANGE						
Industrial Spec. (A, B, C)		-25°C to +85°C			-25°C to +85°C	
Military Spec, (R, S, T)		-55°C to +125°C			-55°C to +125°C	
PACKAGE DRAWING (See page 63)		1 A or 3 TO-99 or Mini-DIP(1)			1 A TO-99	
PRICE (1 - 24)						
Industrial	$7.50	$12.00	$15.00	$4.50	$8.85	$12.00
Military	$15.00	$24.00	$36.00	$15.00	$20.00	—

(1) The Mini-Dip Package is available for Model 3500 A/B/C.
If this option is desired, suffix the letter N to the model number (e.g., 3500 CN).



Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	EXTERNAL FREQUENCY COMPENSATION			20 mA OUTPUT	
	3055/3051	**3056/3052**	**3057/3053**	**3268/14**	**3269/14**
OPEN LOOP GAIN DC, no load min	93 dB	93 dB	90/93 dB	114 dB	
RATED OUTPUT, min	±10 V @ ±5/10 mA			±10 V @ 20 mA	
OUTPUT IMPEDANCE, DC	4 kΩ			1 kΩ	
FREQUENCY RESPONSE					
Small Signal Bandwidth (unity gain)	1.0 MHz	0.9/1.0 MHz	0.7/0.9 MHz	1 MHz	
Full Power Bandwidth, min	20 kHz	15/20 kHz	10/15 kHz	100 kHz	
Slew Rate, min	1.2 V/μs	0.9/1.2 V/μs	0.6/0.9 V/μs	6 V/μs	
INPUT OFFSET VOLTAGE					
Initial @ 25°C, max	±3 mV	±4 mV	±6 mV	Adjust to Zero	
Drift vs. Temp., max	±5 μV/°C	±10 μV/°C	±30 μV/°C	±5 μV/°C	±20 μV/°C
Drift vs. Supply Voltage	±50 μV/V			±50 μV/V	
Drift vs. Time	±10 μV/day			±40 μV/day	
INPUT BIAS CURRENT					
Initial @ 25°C, max	400 nA	500 nA	600 nA	50 nA	
Drift vs. Temp., max	±0.6 nA/°C	±0.8 nA/°C	±1.0 nA/°C	±0.6 nA/°C	
Drift vs. Supply Voltage	±10 nA/V			±1.5 nA/V	
INPUT OFFSET CURRENT					
Initial @ 25°C	±30 nA	±40 nA	±60 nA	±3 nA	
Drift vs. Temp.	±0.2 nA/°C	±0.3 nA/°C	±0.4 nA/°C	±0.6 nA/°C	
INPUT IMPEDANCE					
Differential	0.3 MΩ			1 MΩ	
Common-Mode	200 MΩ			500 MΩ	
INPUT NOISE					
Voltage, 0.01 Hz to 10 Hz, p-p	3 μV (2)			2 μV	
10 Hz to 10 kHz, rms	0.8 μV (2)			3 μV	
Current, 0.01 Hz to 10 Hz, p-p	0.15 nA (2)			30 pA	
10 Hz to 10 kHz, rms	0.03 nA (2)			3 pA	
INPUT SIGNAL RANGE					
Common-Mode Voltage Range	± (|Supply| -4) V			± (|Supply| -5) V	
Common-Mode Rejection	90 dB	90 dB	90/80 dB	86 dB	
Maximum Safe Input Voltage	±Supply			± Supply	
POWER SUPPLY					
Rated Voltage, Quiescent Current	±15 V @ 6 mA			±15 V @ ±5 mA	
Voltage Range, Derated Performance	±12 V to ±18 V			±12 V to ±18 V	
TEMPERATURE RANGE	-25°C to +85°C/-55°C to +125°C			-25°C to +85°C	
PACKAGE DRAWING (See page 63-64)	1 C TO-99			5 A 1.5" x 1.5" x 0.4"	
PRICE (1 - 9)	$19.00/$24.00	$13.00/$19.00	$7.50/$11.00	$39.00	$28.00

(2) All 3050 Series Models available with these noise specifications as guaranteed max. Contact factory for details.

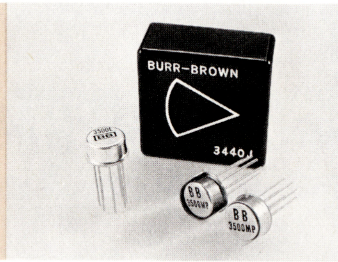
LOW DRIFT AMPLIFIERS

Low Drift designs are optimized to reduce variations of input offset voltage as a function of temperature and to minimize the initial input offset voltage at room temperature. This group is subdivided into Integrated Circuits, Chopper Stabilized Amplifiers, and other modular units. The IC's now contain FET and bipolar inputs both with maximum voltage drifts as low as 1 µV/°C. The chopper stabilized amplifiers provide drift as low as 0.1 µV/°C, and are now available in inverting, noninverting, and fully differential designs. They represent the best in long term stability but the overload recovery time may be excessive in some applications.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

	BIPOLAR INPUT		FET INPUT				
MODEL	**3500E**	**3500MP(1)**	**3521**				
Industrial Temperature Range Military Temperature Range			**H**	**J**	**K**	**L**	**R**
OPEN LOOP GAIN DC, rated load	100 dB no load		94 dB, min				
RATED OUTPUT, min	±10 V @ 10 mA		±10 V @ 10 mA				
OUTPUT IMPEDANCE	1 kΩ		100 Ω				
FREQUENCY RESPONSE							
Small Signal Bandwidth (unity gain)	1.5 MHz		1.0 MHz				
Full Power Bandwidth, min	12 kHz		10 kHz				
Slew Rate, min	0.8 V/µs		0.6 V/µs				
INPUT OFFSET VOLTAGE							
Initial @ 25°C, max	±500 µV	200 µV(1)	±500 µV	±250 µV	±250 µV	±250 µV	±250 µV
Drift vs. Temp., max	±1 µV/°C	1µV/°C(1)	±10µV/°C	±5µV/°C	±2µV/°C	±1µV/°C	±5µV/°C
Drift vs. Supply Voltage	±40 µV/V		±25 µV/V				
Drift vs. Time	±2µV/month		5 µV/month				
INPUT BIAS CURRENT							
Initial @ 25°C, max	±50 nA		-20 pA	-20 pA	-15 pA	-10 pA	-20 pA
Drift vs. Temp., max	±0.5 nA/°C		doubles/+10°C, typ				
Drift vs. Supply Voltage	±0.2 nA/V		0.1 pA/V				
INPUT OFFSET CURRENT							
Initial @ 25°C	±30 nA,max	±25 nA	±2 pA				
Drift vs. Temp.	±0.3 nA/°C		doubles/+10°C, typ				
Drift vs. Supply Voltage	±0.2 nA/V		—				
INPUT IMPEDANCE							
Differential	10 MΩ ∥ 3 pF		10^{11} Ω				
Common-Mode	5 x 10^9 Ω ∥ 3 pF		10^{12} Ω				
INPUT NOISE							
Voltage, 0.01 Hz to 10 Hz, p-p	0.8 µV		4 µV				
10 Hz to 10 kHz, rms	1.2 µV		2 µV				
Current, 0.01 Hz to 10 Hz, p-p	30 pA		0.3 pA				
10 Hz to 10 kHz, rms	50 pA		0.6 pA				
INPUT SIGNAL RANGE							
Common-Mode Voltage Range	± (|Supply|−4) V_{min}		± (|Supply|−5) V				
Common-Mode Rejection	100 dB		90 dB				
Maximum Safe Input Voltage	±Supply		±Supply				
POWER SUPPLY							
Rated Voltage, Quiescent Current	±15V @ ±3 mA		±15V @ ±4 mA				
Voltage Range, Derated Performance	±3V to ±20V		±5V to ±20V				
TEMPERATURE RANGE							
Industrial Range (H, J, K, L)	−25°C to +85°C		0°C to +70°C				
Military Range (R)	—		−55°C to +125°C				
PACKAGE DRAWING (See pages 63-65)	(1) A TO-99		(1) A TO-99				
PRICE (1 - 9)		—	—	—	—	—	—
(1 - 24)	$25.00/ea.	$25.00/pr.	$17.80	$22.00	$34.00	$44.00	$50.00

(1) The 3500MP is a matched pair of operational amplifiers. Specifications marked "(1)" apply to the match between the two units. Other specifications apply to individual units in the pair.



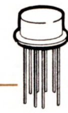
CHOPPER STABILIZED

LOW COST INVERTING			NONINVERTING		DIFFERENTIAL INPUT			HIGH VOLTAGE	BIPOLAR INPUT		
3291/14	3292/14	3293/14	3480(2)		3354/25	3355/25	3356/25	3271/25	3440		
			J	K					J	K	L
140 dB, min			140 dB, min		140 dB, min			140 dB, min	110 dB, min		
±10V @ 5 mA			±10V @ 5 mA		±10V @ 5 mA			±50V to ±110V @ 20mA	±10V @ 10 mA		
1.5 kΩ @ 25 Hz			2 kΩ @ DC		2 kΩ @ 25 Hz			25 kΩ @ 25 Hz	3 kΩ		
4 MHz			100 Hz (-3dB)(3)		6 MHz			1 MHz	1 MHz		
100 kHz			2 to 50Hz (-3dB)(3)		100 kHz			30 kHz	10 kHz		
6V/μs			100 V/sec(3)		6 V/μs			20 V/μs	0.6V/μs		
±20μV	±50μV	±100 μV	±25μV		±30μV	±50μV	±100μV	±50μV	250μV	100μV	100μV
±0.1μV/°C	±0.3μV/°C	±1.0μV/°C	±0.3μV/°C	±0.1μV/°C	±0.1μV/°C	±0.25μV/°C	±1μV/°C	±1μV/°C	±1.5μV/°C	±0.5μV/°C	±0.25μV/°C
±5μV/V			±1μV/V		±10μV/V			±1μV/V	±50μV/V		
±1μV/mo			±1μV/mo		±1μV/mo			±1μV/mo	±3μV/day		
±50 pA	±50 pA	±100 pA	±300 pA		±20 pA	±50 pA	±50 pA	±80 pA	25 nA		
±0.5 pA/°C	±1.0pA/°C	±2 pA/°C	±10 pA/°C		doubles/+10°C typ			±2 pA/°C	±0.25nA/°C	±0.15nA/°C	±0.15nA/°C
±10 pA/V			±20pA/V		±1 pA/V			±10pA/V	±0.5nA/V		
—			—		—			—	±2 nA		
—			—		—			—	±0.02nA/°C		
—			—		—			—	—		
500 kΩ			80 kΩ ∥ 0.01 μF		1 MΩ			500 kΩ	0.4MΩ		
N/A			10^9 Ω ∥ 0.02 μF		10^{13} Ω			N/A	500 MΩ		
2 μV			1 μV		8 μV			20 μV	1 μV		
3 μV			—		2 μV			5 μV	2 μV (10 Hz to 1 kHz)		
10 pA			10 pA		30 pA			200 pA	80 pA		
80 pA			—		400 pA			50 pA	10 pA (10 Hz to 1 kHz)		
Inverting			±1 V		±10 V			Inverting	± (|Supply|-5) V		
N/A			110 dB		140 dB @ DC, 100 dB @ 100 Hz			N/A	100 dB		
±15 V			±20 V		±15 V			±Supply	±Supply		
±15V @ ±10 mA			±15V @ ±6mA		±15V @ ±10mA			±120V @ ±20mA	±15V @ ±5mA		
±12V to ±18V			±10V to ±18V		±12V to ±18V			±60V to ±120V	±12V to ±18V		
-25°C to +85°C			0°C to +70°C		-25°C to +85°C			-25°C to +85°C	0°C to +70°C		
5 B 1.5" x 1.5" x 0.4"			5 C 1.5" x 1.5" x 0.4"		7 B 1.2" x 1.8" x 0.6"			7 C 1.8" x 2.4" x 0.6"	4 D 1.1" x 1.1" x 0.5"		
$77.00	$56.00	$49.00	$49.00	$64.00	$145.00	$110.00	$100.00	$175.00	$43.00	$58.00	$74.00
—	—	—	—	—	—	—	—	—	—	—	—

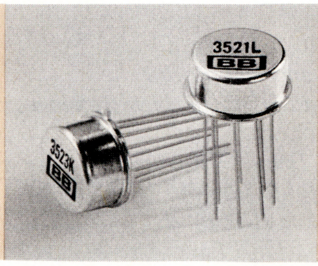
(2) Chopper amplifier without high frequency channel.
(3) Determined by external capacitor.

LOW BIAS CURRENT AMPLIFIERS

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	INVERTING VARACTOR 3430		NONINVERTING VARACTOR 3431		NEW!  ULTRA LOW BIAS CURRENT FET 3523			 LOW BIAS CURRENT FET 3522			
Industrial Temp. Range / Military Temp. Range	J	K	J	K	J	K	L	J	K	L	S
OPEN LOOP GAIN											
DC, rated load min	100 dB		100 dB		94 dB			94 dB			
RATED OUTPUT, min	±10 V @ 5 mA		±10 V @ 5 mA		10 V @ 10 mA			±10 V @ 10 mA			
OUTPUT IMPEDANCE	2 kΩ @ DC		2 kΩ @ DC		100 Ω			100 Ω			
FREQUENCY RESPONSE											
Small Signal Bandwidth (unity gain)	2 kHz		2 kHz		1 MHz			1 MHz			
Full Power Bandwidth, min	7 Hz		7 Hz		10 kHz			10 kHz			
Slew Rate, min	0.4 V/ms		0.4 V/ms		0.6V/μs			0.6V/μs			
INPUT OFFSET VOLTAGE											
Initial @ 25°C, max	Adjusts to zero		Adjusts to zero		±1mV	±500μV	±500μV	±1mV	±500μV	±500μV	±500μV
Drift vs. Temp.,max(μV/°C)	±30	±10	±30	±10	±50	±25	±25	±50	±25	±25	±25
Drift vs. Supply Voltage	±500 μV/V		±500 μV/V		±25 μV/V			±25 μV/V			
Drift vs. Time	±100 μV/mo		±100 μV/mo		±5 μV/mo			±5 μV/mo			
INPUT BIAS CURRENT											
Initial @ 25°C, max	±0.01 pA		±0.01 pA		-0.5pA	-0.25pA	-0.1pA	-10pA	-5pA	-1 pA	-5 pA
Drift vs. Temp.	doubles/+10°C		doubles/+10°C		doubles/+10°C			doubles/+10°C			
Drift vs. Supply Voltage	±0.01 pA/V		±0.01 pA/V		±0.01 pA/V			±0.1 pA/V			
INPUT OFFSET CURRENT											
Initial @ 25°C	—		—		±0.2pA	±0.1pA	±0.05pA	±2pA	±1pA	±0.5pA	±1pA
Drift vs. Temp.	—		—		doubles/+10°C			doubles/+10°C			
INPUT IMPEDANCE											
Differential	3 x 10^{11} Ω ‖ 30pF(1)		3 x 10^{11} Ω ‖ 30pF(2)		10^{12} Ω			10^{11} Ω			
Common-Mode			10^{14} Ω ‖ 2 pF(1)		10^{13} Ω			10^{12} Ω			
INPUT NOISE											
Voltage, 0.01 Hz to 10Hz,p-p	10 μV(3)		10 μV(3)		5 μV			4 μV			
10 Hz to 10 kHz, rms	5 μV(4)		10 μV(4)		2 μV			2 μV			
Current, 0.01 Hz to 10 Hz,p-p	0.001 pA(3)		0.001 pA(3)		0.003 pA			0.3 pA			
10 Hz to 10 kHz, rms	0.002 pA(4)		0.002 pA(4)		0.01 pA			0.6 pA			
INPUT SIGNAL RANGE											
Common-Mode Voltage Range	—		±200 V		± (|Supply| -5) V			± (|Supply| -5) V			
Common-Mode Rejection	—		100 dB (±25 V)		80 dB			90 dB			
Maximum Safe Input Voltage	±300 V		±300 V		± Supply			± Supply			
POWER SUPPLY											
Rated Voltage, Quiescent Current	+15 V @ +12, -6mA		±15 V @ +12, -6 mA		±15 V @ ±4 mA			±15 V @ ±4 mA			
Voltage Range, Derated Performance	±12 to ±18 V		±12 V to ±18 V		±5 V to ±20 V			±5 V to ±20 V			
TEMPERATURE RANGE											
Industrial Range (J,K,L)	0°C to +70°C		0°C to +70°C		0°C to +70°C			0°C to +70°C			
Military Range (R, S, T)	—		—		—			-55°C to +125°C			
PACKAGE DRAWING (See pages 63-65)	9 3.1" x 1.7" x 0.7"		9 3.1" x 1.7" x 0.7"		1 A TO-99			1 A TO-99			
PRICE (1 - 9)	$59.00	$85.00	$59.00	$85.00	—	—	—	—	—	—	—
(1 - 24)	—	—	—	—	$25.00	$28.00	$32.00	$12.50	$15.00	$22.00	$26.00

(1) Input to common. (2) Between input and feedback point. (3) 0.01 Hz to 1 Hz. (4) 1 Hz to 100 Hz.



These amplifiers are designed to have high input impedance (approximately $10^{11}\,\Omega$) and very low bias currents (0.01 to 25 pA). They are especially useful for impedance buffering of high impedance current sources. This group includes varactor, IC, and modular devices. The varactors feature ultra low bias currents and low input noise, but are limited in frequency response. The IC devices have good all-around performance and are low cost.

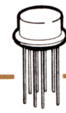
LOWEST COST FET NEW!	LOW COST FET		LOW VOLTAGE DRIFT FET				
3540J	3542		3521				
	J	S	H	J	K	L	R
86 dB	88 dB				94 dB		
±10V(±13V typ)@ 5 mA	±10 V @ 10 mA				±10 V @ 10 mA		
—	75 Ω				100 Ω		
1 MHz	1 MHz				1 MHz		
100 kHz, typ	8 kHz typ				10 kHz		
6 V/μs, typ	0.5V/μs typ				0.6 V/μs		
±50 mV	±20 mV		±500μV	±250μV	±250μV	±250μV	±250μV
±75	±50		±10	±5	±2	±1	±5
±200 μV/V	±50 μV/V				±25μV/V		
—	±100 μV/mo				5 μV/mo		
-50 pA	-25 pA		-20pA	-20pA	-15 pA	-10 pA	-20pA
doubles/+10°C	doubles/+10°C				doubles / +10°C		
—	1 pA/V				0.1pA/V		
±0.5 pA	±2 pA				±2 pA		
doubles/+10°C	doubles/+10°C				doubles/+10°C		
10^{10} Ω ‖ 2 pF	10^{11} Ω				10^{11} Ω		
10^{11} Ω ‖ 2 pF	10^{11} Ω				10^{12} Ω		
13 μV	2 μV				4 μV		
3 μV	3 μV(5)				2 μV		
0.1 pA	0.3 pA				0.3 pA		
0.15 pA	0.6 pA(5)				0.6 pA		
± (|Supply| -5) V	± (|Supply| -5) V				± (|Supply| -5) V		
70 dB, min (90 dB, typ)	80 dB				90 dB		
±Supply	±Supply				±Supply		
±15V @ ±6mA	±15V @ ±4mA				±15V @ ±4mA		
±5V to ±18V	±5V to ±20V				±5V to ±20V		
0°C to +70°C	0°C to +70°C				0°C to +70°C		
-55°C to +125°C	-55°C to +125°C				-55°C to +125°C		
1 A TO-99	1 A TO-99				1 A TO-99		
$6.45 (1-24) $4.45 (100's)	$7.00	$11.50	$17.80	$22.00	$34.00	$44.00	$50.00

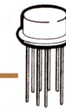
(5) 10 Hz to 1 kHz.

WIDEBAND AND FAST SETTLING AMPLIFIERS

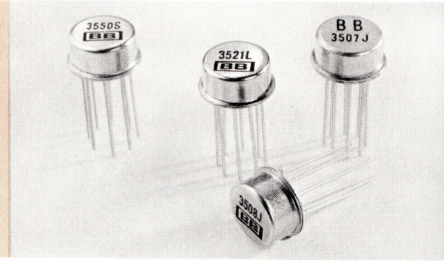
The op amps in this group have their designs optimized for wideband, fast slewing, and fast settling applications. Wideband and fast slewing op amps are ideally suited for video and pulse applications where high frequency response is necessary to follow the input waveform exactly. The fast settling op amps meet the requirements of A/D and D/A converters, and multiplexers; all of which require that the amplifier output settle rapidly and precisely to a final value in response to a step input.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.





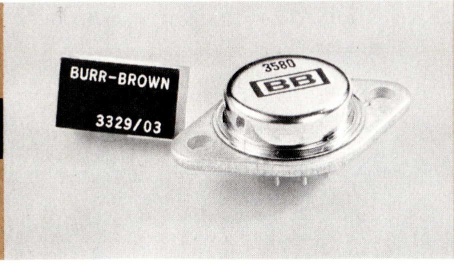
	FAST SLEWING		WIDEBAND	
	INTERNALLY COMPENSATED	EXTERNALLY COMPENSATED	INTERNALLY COMPENSATED	EXTERNALLY COMPENSATED
MODEL	**3505J**	**3507J**	**3506J**	**3508J**
OPEN LOOP GAIN, DC no load	94 dB	90 dB	106 dB	106 dB
RATED OUTPUT, min	±10V @ 10 mA	±10V @ 10 mA	±10V @ 10 mA	±10V @ 10 mA
FREQUENCY RESPONSE				
Small Signal Bandwidth (unity gain)	6 MHz	—	12 MHz	—
Gain - Bandwidth Product	12 MHz (A_{CL} = 10)	20MHz (A_{CL} = 10)	—	100MHz (A_{CL} = 100)
Full Power Bandwidth, min	0.3 MHz	1.2 MHz	0.05 MHz	0.32 MHz
Slew Rate, min	20 V/μs	80 V/μs	4 V/μs	20 V/μs
Settling Time (0.1%)	300 ns	200 ns	1.5 μs	—
INPUT OFFSET VOLTAGE				
Initial @ 25°C, max	±8 mV	±10 mV	±5 mV	±5 mV
Drift vs. Temp.	±20 μV/°C	±30 μV/°C	±20 μV/°C	±30 μV/°C
Drift vs. Supply Voltage	±30 μV/V	±30 μV/V	±30 μV/V	±30 μV/V
INPUT BIAS CURRENT				
Initial @ 25°C, max	+250 nA	+250 nA	±25 nA	±25 nA
Drift vs. Temp., max	±0.5 nA/°C	±0.5 nA/°C	±0.5 nA/°C	±0.5 nA/°C
INPUT OFFSET CURRENT				
Initial @ 25°C, max	±50 nA	±50 nA	±25 nA	±25 nA
Drift vs. Temp.	±0.1 nA/°C	±0.1 nA/°C	±0.2 nA/°C	±0.2 nA/°C
INPUT IMPEDANCE				
Differential	50 MΩ ‖ 3 pF	100 MΩ ‖ 3 pF	300 MΩ ‖ 3 pF	300 MΩ ‖ 3 pF
Common-Mode	500 MΩ ‖ 5 pF	1000 MΩ ‖ 5pF	1000 MΩ ‖ 3pF	1000 MΩ ‖ 3 pF
INPUT SIGNAL RANGE				
Common-Mode Voltage Range	± (|Supply| -3)V	± (|Supply| -3) V	± (|Supply| -2) V	± (|Supply| -2) V
Common-Mode Rejection	90 dB	90 dB	100 dB	100 dB
Maximum Safe Input Voltage	±Supply	±Supply	±Supply	±Supply
POWER SUPPLY				
Rated Voltage, Quiescent Current	±15 V @ ±4 mA	±15 V @ ±4 mA	±15 V @ ±3 mA	±15 V @ ±3 mA
Voltage Range, Derated Performance	±8 V to ±20 V	±8 V to ±20 V	±8 V to ±22 V	±8 V to ±22 V
TEMPERATURE RANGE	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C
PACKAGE DRAWING (See page 63)	1 B TO-99	1 B TO-99	1 B TO-99	1 B TO-99
PRICE (1 - 24)	$11.00	$11.00	$9.00	$9.00



Specifications typical at 25°C and rated supply voltage unless otherwise noted.

	±100 mA OUTPUT 1000 V/μsec		0.6 μsec max SETTLING			50 MHz GAIN-BANDWIDTH		100 MHz BW DIFFERENTIAL		1 μsec SETTLING BUFFER	
MODEL	3341/15C	3342/15C	NEW! 3550			NEW! 3551		3400		3401	
			J	S	K	J	S	A	B	A	B
OPEN LOOP GAIN											
DC, no load min	100 dB		100 dB typ			100 dB typ		90 dB		100 dB	
RATED OUTPUT, min	±10 V @ 100 mA		±10 V @ ±10 mA			±10 V @ 10 mA		±10 V @ 20 mA		±10 V @ 20 mA	
OUTPUT IMPEDANCE	25 Ω @ 10 MHz		100 Ω @ 1 MHz			100 Ω @ 1 MHz		25 Ω @ 10 MHz		25 Ω @ 1 MHz	
FREQUENCY RESPONSE											
Small Signal Bandwidth (unity gain)	50 MHz, min		10 MHz		20MHz	50 MHz(1)		100 MHz		8 MHz	
Full Power Bandwidth, min	10 MHz		1 MHz		1.5MHz	3.8MHz typ., C_f = 0		10 MHz		0.5 MHz	
Slew Rate, min	1000 V/μs		65V/μs		100V/μs	250V/μs typ., C_f = 0		1000 V/μs		65 V/μs	
Settling Time (0.1%)	400 ns		400 ns			400 ns, C_f = 10		400 ns		600 ns	
(0.01%)	550 nsec		1.0μs, max		0.6 μs, max	600 ns, C_f = 10		2 μs		1 μs, max	
INPUT OFFSET VOLTAGE											
Initial @ 25°C, max	±1 mV		±1 mV			±1 mV		Adjusts to Zero		Adjusts to Zero	
Drift vs. Temp., max	±25μV/°C	±50μV/°C	±50μV/°C			±50μV/°C		±100μV/°C	±50μV/°C	±50μV/°C	±20μV/°C
Drift vs. Supply Voltage	±500 μV/V		±500 μV/V			±500 μV/V		±300 μV/V		±30 μV/V	
INPUT BIAS CURRENT											
Initial @ 25°C, max	−100 pA		−100 pA			−100 pA		−100 pA		−20 pA	
Drift vs. Temp.	doubles/+10°C		doubles/+10°C			doubles/+10°C		doubles/+10°C		doubles/+10°C	
INPUT IMPEDANCE											
Differential	10^{11} Ω ∥ 3 pF		10^{11} Ω ∥ 3 pF			10^{11} Ω ∥ 3 pF		10^{11} Ω ∥ 6 pF		10^{11} Ω ∥ 2 pF	
Common-Mode	—		10^{11} Ω ∥ 3 pF			10^{11} Ω ∥ 3 pF		10^{11} Ω ∥ 12 pF		10^{11} Ω ∥ 2 pF	
INPUT NOISE											
10 Hz to 10 kHz, rms	10 μV		4 μV			4 μV		5 μV		5 μV	
INPUT SIGNAL RANGE											
Common-Mode Voltage Range	Inverting only		± (∣Supply∣ −5) V			± (∣Supply∣ −5) V		± (∣Supply∣ −5) V		± (∣Supply∣ −5) V	
Common-Mode Rejection	—		70 dB @ +5, −10V			70 dB (+5, −10V)		60 dB (+8, −10 V)		92 dB (±10 V)	
Max Safe Input Voltage	±Supply		±Supply			±Supply		±Supply		±Supply	
POWER SUPPLY											
Rated Voltage, Quiescent Current	±15V @ ±30 mA		±15V @ ±11 mA			±15 V @ ±11 mA		±15 V @ ±25 mA		±15 V @ ±15 mA	
Voltage Range, Derated Performance	±12 V to ±18 V		±5 V to ±20 V			±5 V to ±20 V		±12 V to ±18 V		±12 V to ±18 V	
TEMPERATURE RANGE											
Industrial	−25°C to +85°C		0°C to +70°C		0°C to +70°C	0°C to +70°C	−55°C to +125°C	−25°C to +85°C		−25°C to +85°C	
Military				−55°C to +125°C							
PACKAGE DRAWING (See pages 63, 65)	8 1.8″ x 1.2″ x 0.6″		1 B TO-99			1 B TO-99		4 A 1.1″ x 1.1″ x 0.4″		4 A 1.1″ x 1.1″ x 0.4″	
PRICE (1 - 9)	$79.00	$68.00	—	—	—	—	—	$65.00	$79.00	$46.00	$57.00
(1 - 24)	—	—	$22.50	$39.00	$27.00	$22.50	$39.00	—	—	—	—

(1) Gain-Bandwidth product for Gain = 10 V/V to 1000 V/V.



HIGH VOLTAGE AND HIGH CURRENT AMPLIFIERS

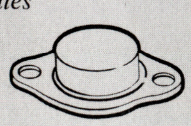
Specifications typical at 25°C and rated supply voltage unless otherwise noted.

	WIDE SUPPLY RANGE	CHOPPER STABILIZED	WIDEBAND	
MODEL	**3460**	**3271/25**	**3341/15C**	**3342/15C**
OPEN LOOP GAIN DC, no load min	106 dB	140 dB	100 dB	
RATED OUTPUT, min			±10 V @ 100 mA	
Minimum Supply Voltage	±1 V @ 10 mA	±50 V @ 20 mA	—	
Maximum Supply Voltage	±140 V @ 10 mA	±110 V @ 20 mA	—	
Typical Supply Voltage	—	—	±15 V	
OUTPUT IMPEDANCE	10 kΩ @ DC	25 kΩ @ DC	25 Ω @ 10 MHz	
FREQUENCY RESPONSE				
Small Signal Bandwidth (unity gain)	1 MHz	1 MHz	50 MHz, min	
Full Power Bandwidth, min	—	30 kHz	10 MHz	
Slew Rate, min	10 V/µs	20 V/µs	1000 V/µs	
Settling Time (0.1%)	—	—	400 ns	
INPUT OFFSET VOLTAGE				
Initial @ 25°C, max	±1 mV	±50 µV	±1 mV	
Drift vs. Temp., max	±50 µV/°C	±1 µV/°C	±25 µV/°C	±50 µV/°C
INPUT BIAS CURRENT				
Initial @ 25°C, max	-25 pA	±80 pA	-100 pA	
Drift vs. Temp.	doubles/+10°C	±2 pA/°C, max	doubles / +10°C	
INPUT IMPEDANCE				
Differential	10^{11} Ω	500 kΩ	10^{11} Ω ‖ 3 pF	
Common-Mode	10^{11} Ω	N/A	—	
INPUT NOISE				
Voltage, 0.01 Hz to 10 Hz, p-p	5 µV	20 µV	—	
10 Hz, to 10 kHz, rms	8 µV	5 µV	10 µV	
Current, 0.01 Hz to 10 Hz, p-p	1 pA	200 pA	—	
10 Hz to 10 kHz, rms	2 pA	50 pA	—	
INPUT SIGNAL RANGE				
Common-Mode Voltage Range	± (|Supply|-10) V	Inverting Only	Inverting only	
Common-Mode Rejection	90 dB	—	—	
Maximum Safe Input Voltage	±Supply	±Supply	±Supply	
POWER SUPPLY				
Rated Voltage, Quiescent Current, max	±120 V @ ±10 mA	±120 V @ ±20 mA	±15 V @ ±30 mA	
Voltage Range, Derated Performance	±11 V to ±150 V	±60 V to ±120 V	±12 V to ±18 V	
TEMPERATURE RANGE	-25°C to +85°C	-25°C to +85°C	-25°C to +85°C	
PACKAGE DRAWING (See page 64-65)	7 A 2.4" x 1.8" x 0.6"	7 C 2.4" x 1.8" x 0.6"	8 1.8" x 1.2" x 0.6"	
PRICE (1 - 9)	$89.00	$175.00	$79.00	$68.00
(1 - 24)	—	—	—	—

coming soon!

HIGH CURRENT IC, MODELS 3571 and 3572

- *2 Amp and 5 Amp Peak Output Current @ ±30 VDC Output*
- *±15 VDC to ±40 VDC Power Supplies*
- *Internal Thermal Protection*
- *Adjustable Current Limits*
- *Low Distortion*
- *TO-3 Package*



High voltage and high current amplifiers were developed by Burr-Brown to meet the special needs of the designer that are not met by the usual op amp design. The high voltage devices operate on wide ranges of supply voltage, either balanced or unbalanced, while providing good performance in the other parameters. The wideband amplifiers provide up to 100 mA into 50 Ω loads and also give all-around good performance; notably in frequency response. The 3580 family has self-contained thermal sensing and shutoff which automatically prevents damage to the amplifier from overheating. The TO-3 package can dissapate over 3 watts without a heatsink.

NEW! HIGH VOLTAGE AND CURRENT

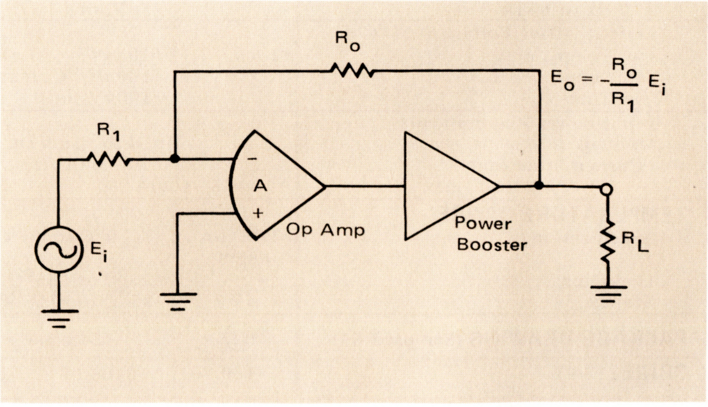
3580J	3581J	3582J
106 dB, typ	112 dB, typ	118 dB, typ
±13 V @ 60 mA ±30 V @ 60 mA —	±27 V @ 30 mA ±70 V @ 30 mA —	±65 V @ 15 mA ±145 V @ 15 mA —
500Ω	2 kΩ	2 kΩ
100 kHz, typ 15 V/μs, typ	3 MHz, min 60 kHz, typ 20V/μs, typ 12 μs	30 kHz, typ 20 V/μs, typ
10 mV 30 μV/°C	3 mV 25 μV/°C	3 mV 25 μV/°C
-50 pA	-20 pA doubles every 10°C	-20 pA
	10^{11} Ω ‖ 10 pF 10^{11} Ω	
1 μV 1 pA —	5 μV 1.7 μV 0.3 pA —	1.7 μV 0.3 pA —
±(|Supply|-8) V 86 dB	±(|Supply| -10) V 110 dB ±Supply	110 dB
±10 mA ±18 to ±35 VDC	±8 mA ±32 to ±75 VDC	±6.5 mA ±70 to ±150 VDC
	0°C to 70°C	
	6 TO-3	
— $40.00	— $65.00	— $79.00

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

POWER BOOSTERS

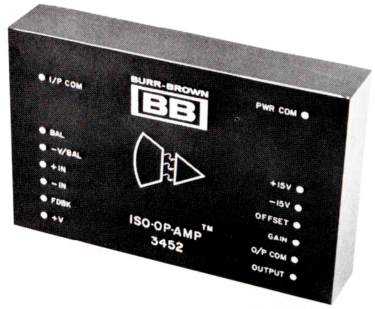
	500 mA	100 mA
MODEL	**3069/49**	**3329/03**
OPEN LOOP GAIN DC, no load	0 dB approx.	0 dB approx.
RATED OUTPUT	±10V @ 500mA	±10V @ 100mA
OUTPUT IMPEDANCE	2 Ω @ DC	10 Ω @ DC
FREQUENCY RESPONSE		
Full Power Bandwidth, min	50 kHz	1 MHz
INPUT IMPEDANCE	15 kΩ	10 kΩ
INPUT SIGNAL RANGE		
Maximum Safe Input Voltage	±Supply	±Supply
POWER SUPPLY		
Rated Voltage,Quiescent Current,max	±15V@ ±50mA	±15V@ ±15 mA
Voltage Range,Derated Performance	±12V to ±18V	±12V to ±18V
TEMPERATURE RANGE	-25°C to +85°C	-25°C to +85°C
PACKAGE DRAWING (See pages 63,65)	10 2"x 2"x 0.7"	2 B DIL Type
PRICE (1 - 9)	$83.00	$25.00

Power boosters are designed to provide increased output current when used as power output stages with a wide variety of low power op amps. The booster operates at approximately unity gain and is used inside the feedback loop as illustrated below. The open loop gain of the op amp/booster is equal to that of the op amp alone, except that the very low output impedance of the power booster (open loop) is typically less than that of the op amp by a factor of 10 to 100. Because the booster has a wideband response, it will normally not affect stability of the op amp circuit.



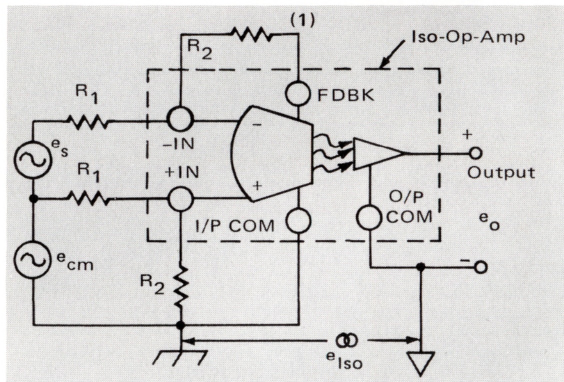
ISO-OP-AMP™

The Iso-Op-Amp is a unique new product from Burr-Brown. As the name implies, it is a true differential input operational amplifier that offers input/output isolation of up to 2000 volts continuously (factory tested up to 5000 volts). This superior isolation is accomplished by transformer coupled techniques which utilize a proprietary feedback technique. This provides outstanding gain linearity and stability. The Iso-Op-Amp is an uncommitted op amp which can be operated in the noninverting, inverting or difference amplifier configurations, and may be connected in the current-to-voltage configuration. The model 3452 provides isolated ±15 VDC power at the input.

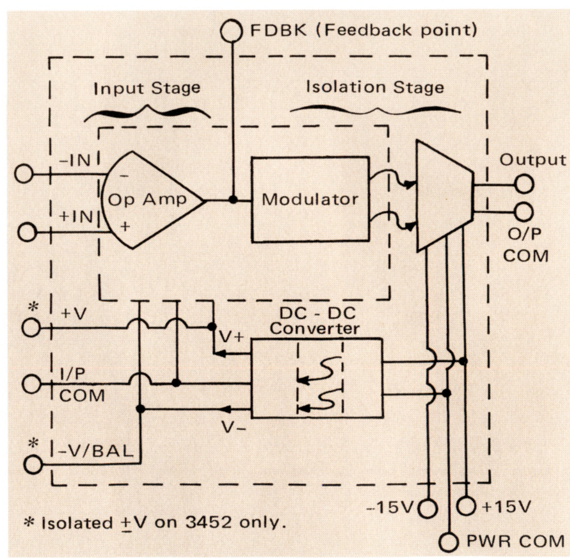


Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	3450	3451	NEW! 3452
INPUT STAGE SPECIFICATIONS(1)			
Open Loop Gain, min	94 dB	88 dB	94 dB
Input Offset Voltage @ 25°C(4), max	±0.55mV	±20mV	±0.30mV
vs. Temp., max	±1.0µV/°C	±50µV/°C	±5.0µV/°C
vs. Supply	±50µV/V	±50µV/V	±25µV/V
vs. Time	±10µV/mo	±100 µV/mo	
Input Bias Current @ 25°C, max	±50 nA	-25 pA	-20 pA
vs. Temp., max	±0.5nA/°C	doubles/10°C	
vs. Supply	±0.2nA/V	±1 pA/V	
Input Offset Current @ 25°C	±30nA,max	±2 pA	
vs. Temp., max	±0.3nA/°C	doubles/10°C	
vs. Supply	±0.1nA/V	±0.5 pA/V	
Input Impedance			
Differential	10^7 Ω	10^{11} Ω	
Common-Mode(2)	5 x 10^9 Ω	10^{11} Ω	
Input Noise			
Voltage, 0.01 Hz - 10 Hz	0.8µV,p-p	2µV,p-p	4µV,p-p
10 Hz - 1 kHz	1.2µV,rms	3µV, rms	2µV,rms
Current 0.01 Hz - 10 Hz	30pA,p-p	0.3pA,p-p	0.3pA,p-p
10 Hz - 1 kHz	50pA,rms	0.6pA,rms	0.6pA,rms
Input Voltage Range			
Common-Mode(2) (operating), min	±10V, min		
Differential (w/o damage), min	±15V, min		
Common-Mode(2) Rejection	100	80	90
Isolated Power Available			
Voltage	—	—	±15V +0 -10%
Current, max	—	—	±10 mA
Ripple @ 100 kHz	—	—	100mV,p-p
ISOLATION STAGE SPECIFICATIONS			
Gain (without trimming)(4), 1 V/V	±0.1%	±0.5%	
vs. Temp.	±10ppm/°C	±50 ppm/°C	
Nonlinearity, max	±0.01%	±0.05%	±0.05%
Frequency Response, -3 dB	1 kHz		
Settling Time			
to 0.01%	20 ms		
to 0.1%	2 ms		
Isolation Impedance(3)	10^{12} Ω ‖ 16 pF		
Isolation Mode(3) Rejection			
DC	160 dB, min		
60 Hz	120 dB, min		
Isolation(2) Voltage			
Operating, continuous, min	±500V, peak		±2000V,peak
Tested for 1 sec, min	±2000 V		±5000V
Output Voltage	±10 V, min		
Output Current	±5 mA, min		
Output Impedance, DC	0.2 Ω		
Output Noise			
0.01 Hz to 10 Hz	7µV,p-p		
10 Hz to 1 kHz	25µV, rms		
Output Offset Voltage @ 25°C(4)	±2 mV	±10 mV	±5 mV
vs. Temp., max	±100µV/°C, max		
vs. Supply	±100µV/mo		
vs. Time			
Input Power Requirements			
Voltage	±14 to ±16 VDC		
Current, quiescent	+30/-5mA, max		
, full load, max	+35/-10mA		+55/-10mA
TEMPERATURE RANGE			
Specification	-25°C to +85°C	0°C to 70°C	
Operating	-25°C to +85°C		
Storage	-25°C to +125°C		
PACKAGE DRAWING (See page 65)	11	3.5" x 2.3" x 0.7"	
PRICE (1 - 9)	$180.00	$105.00	$135.00



ISO-OP-AMP IN DIFFERENTIAL CONFIGURATION.



SIMPLIFIED BLOCK DIAGRAM.

Notes:

(1) Smallest allowable feedback resistor is 2kΩ for 3450 and 3451; 10 kΩ for 3452.

(2) Common-mode parameters are measured at the +IN and -IN pins with respect to the I/P COM pin.

(3) Isolation mode parameters are measured at the I/P COM pin with respect to the PWR COM pin and O/P COM pin.

(4) Errors may be trimmed to zero.

INSTRUMENTATION AND DATA AMPLIFIERS

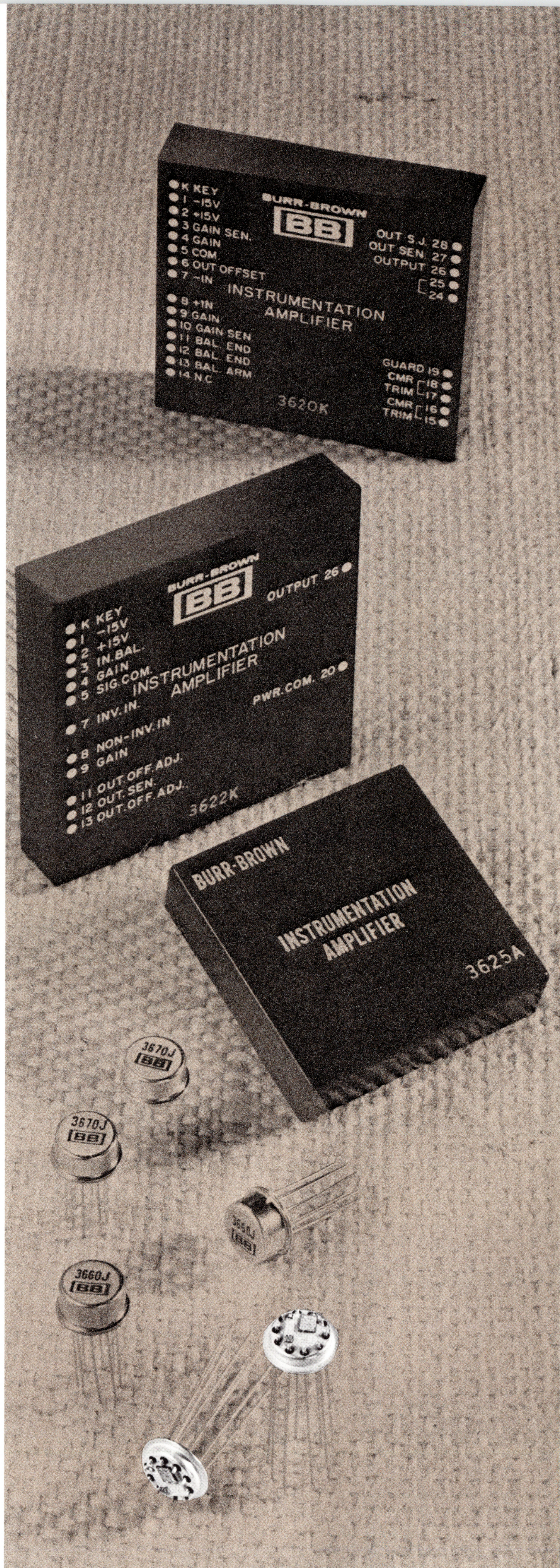
Low Drift

Low Bias Current

Programmable Gain

Variable Gain

Rack Mounting



BURR-BROWN

WHAT ARE THEY?

An Instrumentation Amplifier is a closed loop differential input gain block. It is a committed circuit whose primary function is to accurately amplify the voltage applied to its inputs.

Ideally, the instrumentation amplifier responds only to the difference between the two input signals ($e_2 - e_1$) and exhibits extremely high impedance between the two input terminals (differential input impedance) and from each input to ground (common-mode input impedance). The transfer function of the gain block is $e_o = G(e_2 - e_1)$ where G is the amplifier gain which is normally set by the user with a single external resistor.

NOT AN OP AMP

An instrumentation amplifier differs fundamentally from an op amp. An op amp is an open loop uncommitted device whose closed loop performance depends on the external networks used to close the loop. While an op amp can be used to get the same basic transfer function as an instrumentation amplifier, it is generally difficult (often impossible) to achieve the same level of performance. The use of an op amp usually leads to design tradeoffs when it is necessary to amplify low level signals in the presence of common-mode voltages while maintaining high input impedances.

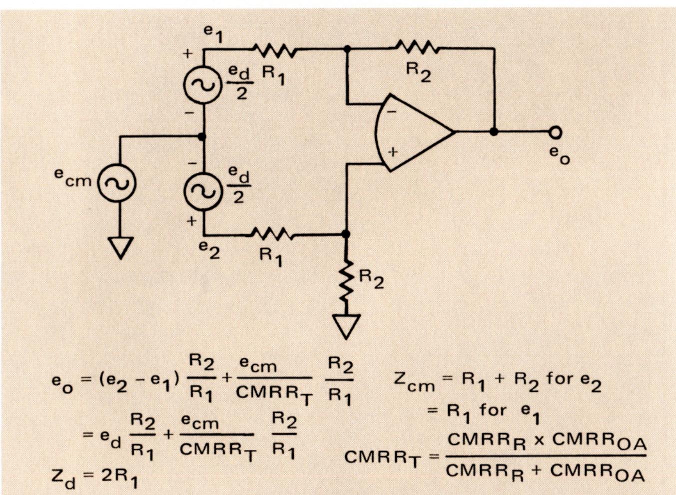


FIGURE 1. Single Op Amp, Differential Input Configuration.

When a single op amp is used (see Figure 1), there are opposing constraints if there is a need for both high gain ($R_2 \div R_1 >> 0$, i.e. R_1 small) and high input impedances (R_1 large). Also, the common-mode rejection ratio of the total circuit, $CMRR_T$, is a function of the op amp's rejection, $CMRR_{OA}$, and the effective rejection caused by resistor mismatches, $CMRR_R$. [For example, ±0.1% resistors in a gain of 10 circuit can have a CMR of only 69 dB (CMR (dB) = $20 \log_{10}$ CMRR (V/V))].

Figure 2 shows the simple model of an instrumentation amplifier which eliminates most of the problems of using op amps.

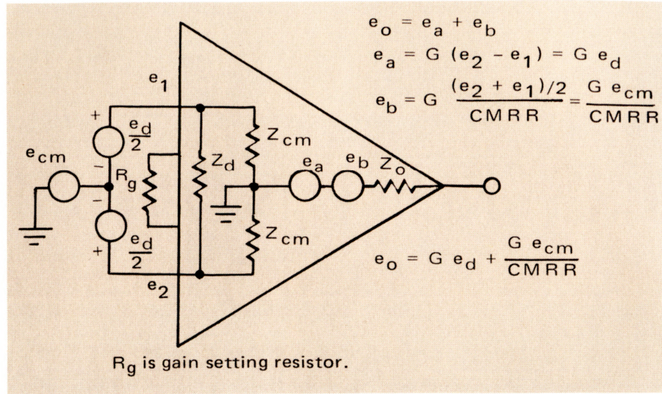


FIGURE 2. Model Of An Instrumentation Amplifier.

WHAT ARE THE ALTERNATIVES?

There are three basic alternatives available when you have a need to accurately amplify signals in the presence of common-mode voltages and noise and maintain high input impedances.

1. Build a single op amp circuit in a differential input configuration.
2. Build a circuit of multiple op amps interconnected to form an instrumentation amplifier.
3. Buy a committed instrumentation amplifier.

Some of the shortcomings of the first alternative were just discussed. One additional problem is that gain changes are difficult. Two resistors need to be changed and match and tracking must be maintained.

The second and third alternatives are usually the most realistic. There are a number of multiple op amp circuits, each with its own set of advantages and disadvantages(1), which might be suitable in a particular application. There are also available low drift op amps and matched pairs of amplifiers (see 3500E and 3500MP page 28) for use in such circuits.

The build or buy alternatives are swinging heavily towards buy. The appearance of relatively low cost monolithic instrumentation amplifiers (see the 3660, page 41) is a step towards making the building of one's own instrumentation amplifiers as obsolete as building one's own op amps.

PUT IT ALL TOGETHER

The instrumentation amplifiers in this section do put it all together to solve your instrumentation amplifier problems.

High Common-Mode Rejection – to preserve system accuracy in the presence of common-mode voltage.

High Input Impedance – to prevent errors due to source loading and source impedance unbalance.

Small, Hermetically Sealed Packages – to take up less board space and to improve reliability.

Low Cost – to make it easy on the budget.

(1) J. Graeme *"Applications of Operational Amplifiers - Third Generation Techniques"*, McGraw-Hill, 1973.

TYPICAL APPLICATION

A typical application of instrumentation amplifiers is amplification of a remote low level signal source (see Figure 3). This section will develop equations to quantify the effect of some of the error sources in such applications.

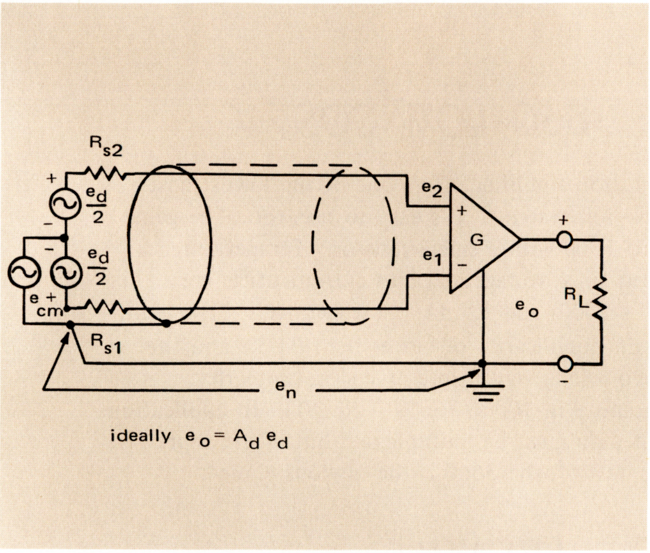


FIGURE 3. Typical Application of Instrumentation Amplifier.

COMMON-MODE REJECTION

The common-mode voltage which appears at the amplifier's input terminals is defined as $E_{cm} = (e_2 + e_1)/2$. This may consist of some common-mode voltage in the source itself, e_{cm}, (such as bridge excitation) plus any noise voltage, e_n, between the source common and the amplifier common.

This will cause an error voltage of $\frac{E_{cm} \times G}{CMRR}$ to appear at the output. Referred to the input (RTI), the error voltage is $E_{cm} \div CMRR$. If $E_{cm} = 5V$ and the CMR = 100 dB the error voltage (RTI) is $5 \div 10^5 = 0.05$ mV. If the full scale value of e_d is 10 mV, this is a 0.5% error (as percent of full scale).

INPUT IMPEDANCE

The instrumentation amplifier provides a load on the source of $Z_i = Z_d \parallel (Z_{cm}/2)$ (see Figure 2, page 38). If the source impedance is $R_S = R_{S1} + R_{S2}$ the gain error caused by this loading is:

$$\text{Gain Error} = 1 - \frac{Z_i}{Z_i + R_s} = \frac{R_s}{Z_i + R_s} \cong \frac{R_s}{Z_i} \text{ if } Z_i > R_s$$

If R_s is 10 kΩ and Z_i is 10 MΩ

$$\text{Gain Error} \cong \frac{10 \times 10^3}{10 \times 10^6} = 10^{-3} = 0.1\%$$

SOURCE IMPEDANCE UNBALANCE

If the source impedances are unbalanced then the source voltages ($e_{cm} + e_n$) are divided unequally upon the common-mode impedances and a differential signal is developed at the amplifiers input. This error signal cannot be separated from the desired signal. In the circuit in Figure 3, if $R_{s2} = 0$, $R_{s1} = 10k$, $e_{cm} + e_n = 10V$, and $Z_{cm} = 100M\Omega$, then the effect of unbalance is to generate a voltage.

$$e_2 - e_1 = 10V - 10V\frac{10^8}{10^8 + 10^3} = 10V\frac{10^3}{10^8 + 10^3} \cong \frac{10V}{10^5} = 0.1mV$$

if e_d full scale is 10 mV then this error is

$$\text{Error} = \frac{0.1mV}{10\ mV} = 1\% \text{ of full scale}$$

OFFSET VOLTAGE AND DRIFT

Most instrumentation amplifiers are two stage devices — they have a variable gain input stage and a fixed gain output stage. Because of this, the amplifiers offset voltage and offset voltage drift vs. temperature are both composed of two components, one of which is a function of gain. If V_i and V_o are the offset voltages of the input and output stages respectively then the amplifiers total offset voltage referred to the input (RTI) is E_{os} (RTI) = $V_i + V_o / G$ where G is the amplifier's gain. [Note that E_{os} (RTO) = E_{os} (RTI) x G].

The initial offset voltage is usually adjustable to zero and therefore, the voltage drift is the more significant term since it cannot be nulled. If $\Delta V_i / \Delta T = 2\ \mu V/^oC$ and $\Delta V_o / \Delta T = 500\ \mu V/^oC$ and the amplifier in a gain of 1000V/V is nulled at 25°C, then at 65°C the offset voltage will be

$$E_{os}(RTI)_{65^o} = 40^oC\ [2\mu V/^oC + (500\mu V/^oC\ /\ 1000V/V)\ ] = 40^oC\ (2.5\mu V/^oC) = 100\mu V = 0.1\ mV$$

If the full scale input is 10 mV then the error due to voltage drift is

$$\text{Error} = \frac{0.1mV}{10mV} = 1\% \text{ of full scale}$$

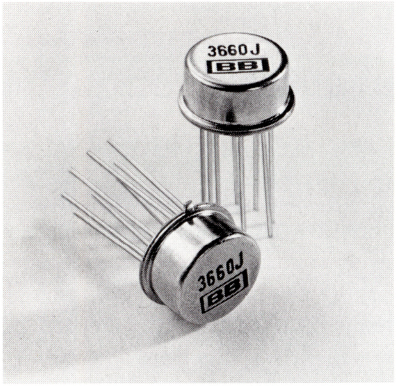
INPUT BIAS AND OFFSET CURRENTS

The input bias currents are the currents that flow out of (or into) either of the two inputs of the amplifier. They are the base currents for bipolar input stages and the JFET leakage currents for FET input stage. Offset currents are the difference of the two bias currents.

The bias currents flowing into the source resistances will generate offset voltages of $E_{os2} = I_{B2} \times R_{s2}$ and $E_{os1} = I_{B1} \times R_{s1}$. If $R_{s1} = R_{s2} = R_s/2$ the offset voltage at the input is $E_{os2} - E_{os1} = I_{os} \times R_s/2$. This input referred offset error may be compared directly with the input voltage to compute per cent error. (Note that the source must be returned to power supply common or R_s will be infinite and the amplifier will saturate.)

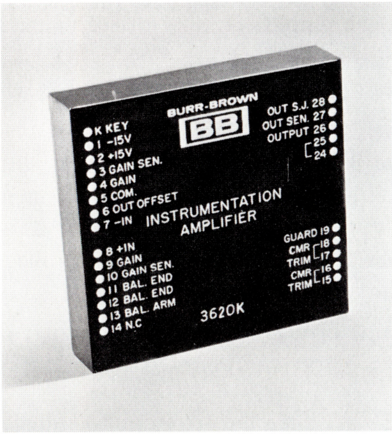
LOW DRIFT INSTRUMENTATION AMPLIFIERS

NEW! MODEL 3660-LOW COST IC



The 3660 IC instrumentation amplifier offers one of the lowest cost solutions for data acquisition systems. It's easy to use, too. The gain may be varied from 1 to 1000 with a single resistor. Temperature errors are greatly reduced since voltage and bias current drifts are less than 2.5 μV/^{o}C (G = 1000) and 1.5 nA/^{o}C, respectively. The high input impedance, the gain nonlinearity of better than 0.03% and the CMR of up to 110 dB go a long way to preserve signal integrity. Prices are especially attractive in 100's (3660J - $8.20). In applications where many channels of data must be multiplexed, but where a pre-amplifier per channel is desired, the 3660 is the obvious choice.

MODEL 3620 - VERSATILE

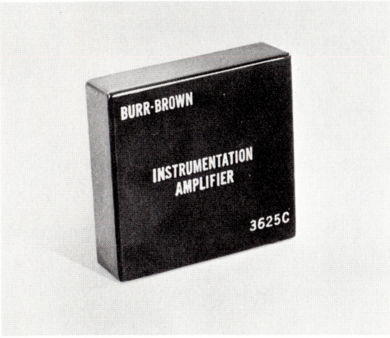


The 3620K represents the "top of the line" in our instrumentation amplifiers and is the best choice for signal source impedances up to 10 kΩ. Key performance specifications are input voltage drift of 0.25 μV/^{o}C max (G = 1000), equivalent input noise of 1 μV p-p, and linearity of 0.01%. Common-mode rejection is typically 100 dB at G = 100.

Special features include an active guard-driver output, output sensing, output offsetting, provision for bandwidth reduction, and a second-stage amplifier which makes possible gains of up to 10,000. Wire-wound resistors are used throughout for gain stability.

The 3620 is packaged in a low-profile (2 "x 2 "x 0.4 ") module suitable for PC board mounting. The rack mounting options, 3620J/16,3620K/16 and 3620L/16, offer excellent performance in a shielded, plug-in package.

MODEL 3625-0.5μV/^{o}C



Burr-Brown's 3625 family is optimum for applications where cost is a paramount factor, but where input signal quality cannot be sacrificed.

This amplifier offers voltage drift and input noise approaching that of the 3620 series. However, by eliminating some of the applications flexibility of the 3620, the 3625 achieves surprisingly low cost, while maintaining high performance standards.

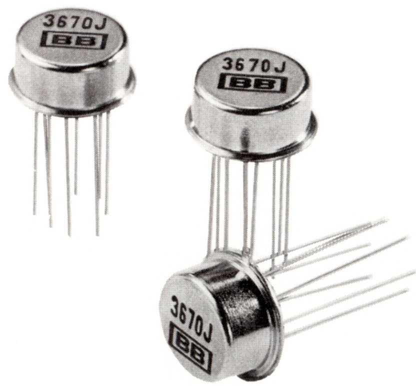
Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	LOWEST DRIFT 3620			LOW DRIFT, LOW COST 3625			NEW! LOW COST IC 3660		
	J	K	L	A	B	C	J	K	S
GAIN									
Gain Equation	$G = 1 + \frac{25\,k\Omega}{R}$			$G = 10 + \frac{20\,k\Omega}{R}$			$G = \frac{100\,k\Omega}{R}$		
Range of Gain	1 to 10,000			10 to 1000			1 to 1000		
Gain Nonlinearity, G=100, max	±0.01%			±0.02%, typ			±0.1%	±0.03%	±0.03%
Gain Temp. Coeff., G=100	±0.001%/°C			±0.001%/°C			±0.004%/°C		
OUTPUT									
Rated Output, Voltage	±10V			±10V			±10V		
Current	±10mA			±5mA			±10mA		
Output Impedance, DC, G=100	0.1 Ω			2 Ω			0.15 Ω		
INPUT									
Input Impedance, Differential	300 MΩ ‖ 3 pF			5×10^9 Ω ‖ 3 pF			$\frac{2 \times 10^{10}}{G}$ Ω ‖ 9 pF		
Common-Mode	1000 MΩ ‖ 3 pF			5×10^9 Ω ‖ 3 pF			2×10^{10} Ω ‖ 3 pF		
Input Voltage Range	±10V			±10V			±10V		
CMR, DC to 60 Hz									
at G = 10, min, 1 kΩ Unbal.	74dB			74dB			76dB	90dB	90dB
at G = 1000, 1kΩ Unbal.	100dB (Balanced Source)			80dB (Balanced Source)			96 dB,min	110 dB,min	110 dB,min
OFFSETS AND NOISE									
Offset Voltage (RTI)(1) @25°C,max(2)	$\pm(0.2 + \frac{0.5}{G})$mV			$\pm(0.25 + \frac{1.2}{G})$ mV			$\pm(6+\frac{600}{G})$ mV	$\pm(1 + \frac{300}{G})$mV	$\pm(1+\frac{300}{G})$mV
vs. Temperature,max(µV/°C)	$\pm(2+\frac{10}{G})$	$\pm(0.5+\frac{10}{G})$	$\pm(0.25+\frac{10}{G})$	$\pm(3+\frac{10}{G})$	$\pm(1+\frac{10}{G})$	$\pm(0.5+\frac{10}{G})$	$\pm(10+\frac{1000}{G})$	$\pm(2+\frac{500}{G})$	$\pm(2+\frac{500}{G})$
@ G = 1, max	±12µV/°C	±10.5µV/°C	±10.5µV/°C	±4µV/°C (G=10)	±2µV/°C (G=10)	±1.5µV/°C (G=10)	1010µV/°C	502µV/°C	502µV/°C
@ G = 1000, max	±2µV/°C	±0.51µV/°C	±0.26µV/°C	±3µV/°C	±1µV/°C	±0.5µV/°C	11µV/°C	2.5µV/°C	2.5µV/°C
vs. Supply G = 1000	±20µV/V			±2 µV/V			±13µV/V		
vs. Time G = 1000	±3µV/mo			±10µV/mo			±3.5µV/mo		
Bias Current(each input)									
@25°C max	±25nA			±60 nA			200nA		
vs. Temperature, max	±0.5nA/°C			±0.75 nA/°C			-1.5 nA/°C	-1.5nA/°C	-2 nA/°C
Noise (RTI)(1) G = 100									
Voltage, p-p,0.01Hz to 10Hz	1µV			5 µV			12µV		
rms, 10Hz to 10kHz	0.6µV (10Hz to 1kHz)			2µV			2.3µV		
Current, p-p,0.01Hz to 10Hz	200pA			200pA			150 pA		
rms, 10Hz to 10kHz	35pA			30pA			50 pA		
DYNAMIC RESPONSE at G = 100									
Small Signal Frequency Response									
For ±1% flatness, min	1.5kHz			500Hz			10kHz, typ		
For ±3 dB flatness, min	10 kHz			5 kHz			72 kHz, typ		
Settling Time to within ±10mV of Output Final Value	200 µsec			400 µsec			20 µs		
Slew Rate	0.3V/µsec			0.8 V/µsec			1.8V/µsec		
Full Power, G = 10	5 kHz			10kHz			28kHz		
POWER SUPPLY									
Rated Voltage	±15VDC			±15VDC			±15VDC		
Voltage Range	±12 VDC to ±18 VDC			±12 VDC to ±18 VDC			±7 VDC to ±20 VDC		
Quiescent Supply Current, max	±14mA			±8 mA			±6 mA		
TEMPERATURE RANGE									
Specification	0°C to +70°C			-25°C to +85°C			0°C to +70°C		-55°C to +125°C
Operating	-40°C to +85°C			-40°C to +85°C			-55°C to +125°C		
PACKAGE DRAWING (See pgs. 66-67)	12 A 2" x 2" x 0.4"			13 1.5" x 1.5" x 0.4"			16 TO-100		
PRICE (1 - 9)	$90.00	$125.00	$165.00	—	—	—	—	—	—
(1 - 24)	—	—	—	$32.00	$49.00	$66.00	$12.30	$20.00	$32.00

(1) RTI = referred to input, may be referred to output by multiplying by gain, G. (2) May be trimmed to zero.
Prices and specifications are subject to change without notice.

HIGH INPUT IMPEDANCE, LOW BIAS CURRENT INSTRUMENTATION AMPLIFIERS

NEW! MODEL 3670-LOW COST FET IC



This FET IC instrumentation series provides maximum bias current of 10 pA and a gain nonlinearity of 0.05%. Exceptional performance, especially when you consider the very low cost. Input impedance is $10^{13}\ \Omega$ and CMR ranges from 60 dB to 100 dB depending on gain and model.

The excellent performance, small size, low cost, and integrated circuit reliability of the 3670 series make it a natural choice for applications such as thermocouples, strain gages, bridges, and other low-level, high-impedance transducers.

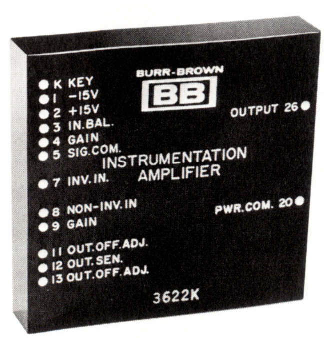
MODEL 3621- $10^{11}\Omega$ Z_{in}

The Model 3621 instrumentation amplifier gives the best performance where signals from high impedance sources must be amplified in the presence of common-mode voltages. It is ideal for use in industrial, biomedical, and geophysical applications with differential transducers such as strain gages and biological probes. And, it also performs well as a recorder preamplifier and in gain switching circuits.

This amplifier has an input stage which uses junction FET's and a "boostrapped" design to give extremely high input impedance and very low input current. Input current at either input is less than 10 pA and the differential input current is typically less than 1 pA. Thus, the 3621 operates quite satisfactorily with source impedances up to 100 MΩ. Through the use of a monolithic FET input pair and heavy negative feedback, the 3621 has a CMR of 100 dB and a gain nonlinearity of just ±0.02%.

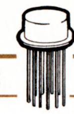
Two package options are available. The standard package is a 1.13"x 1.13"x 0.5"epoxy module suitable for soldering directly on a PC board or for mounting in a type 1200MC connector. For rack-mounting applications, a shielded, plug-in enclosure is available. The rack-mounting unit and powered rack adapter are described on page 47.

MODEL 3622-WIDEBAND FET



The Model 3622 is designed specifically for use with wideband and pulse signals and in data acquisition systems with very high throughput rates. Unique properties include wide bandwidth (2 MHz min. at gain of 100) and extremely fast slewing rate (150 V/μsec) plus fast settling characteristics. The FET input stage eliminates the large input currents normally associated with very fast amplifiers. High frequency CMR of the 3622 is also very good, providing effective rejection of broadband common-mode noise.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.



MODEL	High Impedance, FET Input 3621			Wideband FET 3622		NEW! Low Cost FET IC 3670		
	J	K	L	J	K	J	K	S
GAIN								
Gain Equation	$G=1+\frac{200\ k\Omega}{R}$			$G=1+\frac{10\ k\Omega}{R}$		$G=\frac{100\ k\Omega}{R}$		
Range of Gain	1.01 to 2000			1.01 to 1000		1 to 1000		
Gain Nonlinearity, G=100,max	±0.02%			±0.1%		±0.1%(1)	±0.05% (1)	±0.05%(1)
Gain Temp. Coeff., G=100	±0.002%/°C			±0.002%/°C		±0.0035%/°C	±0.0035%/°C	±0.007%/°C
OUTPUT								
Rated Output, Voltage	±10V			±10V		±10V		
Current	±10mA			±20mA		±10mA		
Output Impedance, DC, G=100	0.3 Ω			0.2Ω to 50kHz		0.15 Ω		
INPUT								
Input Impedance, Differential	10^{11} Ω ‖ 5 pF			10^{11} Ω ‖ 3 pF		10^{11} Ω ‖ 9 pF		
Common-Mode	10^{13} Ω ‖ 3 pF			10^{11} Ω ‖ 3 pF		10^{13} Ω ‖ 7 pF		
Input Voltage Range	±8V			±8V		±8V		
CMR, DC to 60 Hz								
at G=10, min, 1 kΩ Unbal.	70 dB			60 dB (up to 10kHz)		76dB	84dB	84dB
at G=1000, 1kΩ Unbal.	100 dB(Balanced Source)			90 dB (up to 10kHz)		90dB	100dB	100dB
OFFSETS AND NOISE								
Offset Voltage(RTI)(2) @ 25°C, max (3)	$\pm(2+\frac{100}{G})$mV			$\pm(2+\frac{200}{G})$ mV		$\pm(10+\frac{600}{G})$mV	$\pm(5+\frac{300}{G})$mV	$\pm(5+\frac{300}{G})$mV
vs. Temperature,max(μV/°C)	$\pm(50+\frac{500}{G})$	$\pm(15+\frac{150}{G})$	$\pm(5+\frac{50}{G})$	$\pm(25+\frac{3000}{G})$	$\pm(10+\frac{3000}{G})$	$\pm(50+\frac{1000}{G})$	$\pm(25+\frac{500}{G})$	$\pm(25+\frac{500}{G})$
@ G = 1, max	±550μV/°C	±165μV/°C	±55μV/°C	±3025μV/°C	±3010μV/°C	±1050μV/°C	±525μV/°C	±525μV/°C
@ G = 1000, max	±50μV/°C	±15μV/°C	±5μV/°C	±28μV/°C	±13μV/°C	±51μV/°C	±25.5μV/°C	±25.5μV/°C
vs. Supply G = 1000	20μV/V			200 μV/V		±25 μV/V		
vs. Time G = 1000	50μV/mo			50 μV/mo		±11.5μV/mo		
Bias Current(each input)@25°C,max	10pA			20pA		-10pA		
vs. Temperature, max	doubles/+10°C			doubles/+10°C		doubles/+10°C		
Noise(RTI)(2) G = 100								
Voltage, p-p,0.01Hz to 10Hz	2μV			5μV		15 μV		
rms, 10Hz to 10kHz	2μV			2μV		3.3 μV		
Current, p-p,0.01Hz to 10Hz	0.5pA			0.5pA		0.25 pA		
rms, 10Hz to 10kHz	1pA			1pA		0.15pA		
DYNAMIC RESPONSE at G = 100								
Small Signal Frequency Response								
For ±1% flatness, min	2 kHz			100 kHz		5 kHz, typ		
For ±3 dB flatness, min	10 kHz			2 MHz		36 kHz, typ		
Settling Time to within ±10mV of Output Final Value	100 μsec			1μsec		31μsec		
Slew Rate	0.3V/μsec			150V/ μsec		1.8 V/ μsec		
Full Power, G = 10	5 kHz			3 MHz		28kHz		
POWER SUPPLY								
Rated Voltage	±15VDC			±15VDC		±15VDC		
Voltage Range	±12 VDC to ±18 VDC			±12 VDC to ±18VDC		±7 VDC to ±20 VDC		
Quiescent Supply Current, max	±5mA			±30mA		±6mA		
TEMPERATURE RANGE								
Specification	0°C to +70°C			0°C to +70°C		0°C to +70°C		-55°C to +125°C
Operating	-40°C to +85°C			-25°C to +85°C		-55°C to +125°C		
PACKAGE DRAWING(See pgs.66-67)	14 1.13"x 1.13" x 0.5"			12 C 2"x 2"x 0.4"		16 TO-100		
PRICE (1 - 9)	$39.00	$49.00	$65.00	$91.00	$114.00	$22.00	$28.00	$40.00

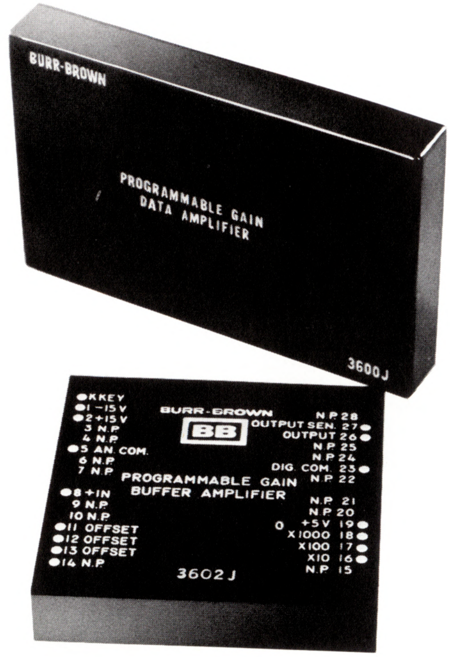
(1) At frequencies below 10 Hz linearity is a function of load current and gain. Linearity given is for I_o = 1 mA. See Product Data Sheet for details.

(2) RTI = referred to input. May be referred to output by multiplying by gain G.

(3) May be trimmed to zero.

Prices and specifications are subject to change without notice.

PROGRAMMABLE GAIN AMPLIFIERS



- SIMPLE TO INTERFACE
- LOW COST PER CHANNEL
- IMPROVED DYNAMIC RANGE

These programmable gain amplifiers are precision components designed for use in fully automated data acquisition systems. They may be operated under direct control of a digital computer or they may be controlled by auto-ranging techniques. In either case, the wide range of programmable gains extends the dynamic range of the system without increasing the resolution and accuracy required of A/D converters in the system. The result is lower total cost.

Models 3600, 3601, and 3602 are the first programmable gain amplifiers to be packaged in modular form suitable for PC board mounting. The small size of the modules, and their low profile, permit their integration into densely packaged systems.

Digital control signals required for gain selection are compatible with TTL logic levels.

DIFFERENTIAL INPUT-MODELS 3600 and 3601

- DIFFERENTIAL INPUT – 100 dB CMR
- BINARY OR BCD PROGRAMMING
- LOW DRIFT – 1 μV/°C
- LOW NOISE – 1 μV, p-p

These differential input amplifiers are the best choice for conditioning of low-level signals. Common-mode noise is effectively rejected by the differential input and an active guard-driving feature. A low-noise monolithic input stage with excellent DC stability provides the ability to amplify millivolt level signals without introducing significant drift and noise errors. Precision resistor networks and heavy negative feedback yield gain accuracy of 0.1% and gain linearity of 0.01% without external adjustment.

Models 3600 and 3601 have two stages – a differential first stage followed by a single-ended second stage. Gain switching takes place in both stages. However, because both stages have low drift, the output voltage drift is very low for all gains. The input stage is switched in gain multiples of 1-16-256 for Model 3600, and 1-10-100 for Model 3601. The second stage is switched in gain multiples of 0 through 15 steps of 1 (4-bit straight binary). Thus there are 46 possible gains for each model, ranging from 0 to 3840 for Model 3600 and from 0 to 1500 for Model 3601. A functional diagram is shown on page 67.

SINGLE-ENDED INPUT-MODEL 3602

- HIGH INPUT IMPEDANCE – 10^{11} Ω
- LOW DRIFT FET INPUT – 5μV/°C
- FAST SETTLING – 0.01% in 50μsec

Model 3602 is a high input impedance, buffer amplifier whose gain is programmable by digital signals in gain steps of 1, 10, 100, and 1000. It utilizes precision resistor networks; solid-state switches; and low-drift, high-gain FET operational amplifiers to achieve excellent gain accuracy, linearity, and low drift characteristics. The FET input stage has extremely high input impedance (10^{11} Ω || 3 pF) and very low input leakage current (10 pA). Input offset may be externally trimmed to zero as desired. A functional diagram is shown on page 66.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	3600J	3601J	3600K	3601K
GAIN				
Accuracy (all settings), max	±0.1%			
Gain Nonlinearity	±0.01%			
Stability	±0.02% in 6 mos.			
Temp. Coefficient	±0.005%/$^{\circ}$C			
Logic Levels for Gain Switching				
"0" Level	Less Than +0.4V			
"1" Level	Greater Than +2.4 V			
OUTPUT				
Rated Output, Voltage	±10 V			
Current	±10 mA			
Impedance	0.1 Ω			
INPUT IMPEDANCE				
Differential	50 MΩ			
Common-Mode	50 MΩ			
INPUT OFFSET VOLTAGE				
(Adjustable to zero)				
vs. Temperature, 1st Stage, max	±3μV/$^{\circ}$C		±1μV/$^{\circ}$C	
2nd Stage	±20μV/$^{\circ}$C			
vs. Time, 1st Stage	±10μV/mo			
2nd Stage	±50μV/mo			
vs. Supply Voltage, 1st Stage	±20μV/V			
2nd Stage	±50μV/V			
INPUT CURRENT				
Bias Current @ 25°C (either input)	±20 nA			
vs. Temperature	±0.5nA/$^{\circ}$C			
INPUT NOISE				
0.01 Hz to 10 Hz, 1st Stage	1 μV, p-p			
2nd Stage	30μV, p-p			
10 Hz to 10 kHz, 1st Stage	1μV, rms			
2nd Stage	15μV, rms			
COMMON-MODE				
CMR: DC to 100Hz, at min gain	80dB			
Input Voltage Range	±10V			
Over Voltage Protection	Up to ±Supply			
Common-Mode Return, max	10 MΩ			
DYNAMIC RESPONSE				
Frequency Response, ±3 dB	10 kHz @ all gains			
Gain Flatness ±0.01%	100 Hz @ all gains			
Slew Rate	0.3V/μsec			
Settling Time to within ±10 mV of Output Final Value	300μsec with both gain step and input step			
POWER REQUIREMENTS				
Analog Supply	±15VDC @ ±30 mA + Load			
Digital Supply	+5 VDC @ 8 mA			
Regulation	1% (±15 VDC, 10% (+5 VDC)			
TEMPERATURE RANGE				
Specifications	0°C to +70°C			
Operating	-25°C to +85°C			
PACKAGE DRAWING (See page 67)	15 17 3" x 2.1" x 0.4" & Rack Mounting Pkg.			
PRICE (1 - 9)	$225.00		$275.00	

Prices and specifications are subject to change without notice.

MODEL	3602J	3602K
GAIN		
Gain Steps	1, 10, 100, and 1000	
Gain Accuracy at 25°C, max	±0.1%	
vs. Temperature	±0.001%/$^{\circ}$C	
Nonlinearity, max		
Up to ±5V Input	±0.02%	
Up to ±10V Input	±0.05%	
OUTPUT		
Rated Output	±10 V, ±20 mA	
Output Impedance		
at Maximum Gain	2Ω	
at Minimum Gain	0.05Ω	
INPUT		
Input Impedance	10^{11}Ω	
Input Voltage Range	±10V	
OFFSETS AND NOISE		
Offset Voltage (referred to input)		
at 25°C, max	±1 mV	
vs. Temperature, max	±20μV/$^{\circ}$C	±5μV/$^{\circ}$C
vs. ±15 V Power Supply	±150μV/V	
Input Bias Current, max	10pA	
Input Noise (RTI) at max gain		
0.01 Hz to 10 Hz	3 μV p-p	
10 Hz to 1 kHz	2 μV rms	
DYNAMIC RESPONSE		
Small Signal Response (±3 dB)		
at Maximum Gain	5 kHz	
at Minimum Gain	2 MHz	
Slew Rate	16 V/μsec	
Settling Time to Within ±1 mV of Output Final Value		
at Maximum Gain	200 μsec	
at Minimum Gain	5 μsec	
GAIN SWITCHING		
(TTL Logic Levels)		
Gain Control Logic Inputs		
Logical 1	+2 V min	
Logical 0	+0.8V max	
Loading	1 TTL Load	
Settling Time to Within ±1 mV of Output Final Value	50μsec @ min gain 230 μsec @ max gain	
POWER Analog Supply,		
Rated Value	±15 VDC	
Supply Range	±14 VDC to ±16 VDC	
Supply Drain		
at Quiescent	+16 mA, -7 mA	
at Rated Output	+36 mA, -27 mA	
Logic Supply, Rated Value	+5 VDC	
Supply Range	+4.8 VDC to +5.2 VDC	
Supply Drain	24 mA	
TEMPERATURE RANGE		
Specification	0°C to +70°C	
Storage	-55°C to +100°C	
PACKAGE DRAWING (See page 66)	12 B 2" x 2" x 0.4"	
PRICE (1 - 9)	$120.00	$145.00

MODEL 3640
LOW DRIFT, LOW NOISE

The 3640 offers excellent performance at a surprisingly low cost. The direct-coupled, differential input stage provides resolution of microvolt signals through the use of a low noise, monolithic amplifier. Low DC input drift is assured by proprietary input stage balancing techniques. Linearity of 0.01% and gain accuracy of 0.1% are achieved through the use of heavy negative feedback and precision, high stability resistors.

Front panel gain controls allow selection of calibrated first stage gains of 1, 3, 10, 30, 100, 300, and 1000, and second stage gains of 1 to 4. Thus the overall gain can be varied from 1 to 4000. Common-mode rejection may be trimmed to correct for source impedance unbalance. Output voltage may be adjusted for up to ±1 V output offset.

An active guard driver output is available for driving the multiplexer shield in two wire, multi-channel systems.

Provisions are incorporated for both bandwidth reduction and addition of a ±100 mA power booster.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	3640
GAIN	
Range of DC Gain	1-4000
Gain Steps — 1st Stage	1,3,10,30,100,300,1000
Gain Vernier — 2nd Stage	1-4
Gain Accuracy (switched steps)	±0.1%
Nonlinearity, max	±0.01%
Temp. Coefficient, Gain = 100	±0.001%/°C
OUTPUT	
Rated Output Voltage	±10V
Output Current	±10 mA
Output Impedance	±0.1 Ω
Output Current Limits	
Typical	±25 mA
Maximum	±40 mA
INPUT RATINGS	
Input Impedance, Differential, min	300MΩ
Common-Mode, min	500MΩ
Input Voltage Range	±10 V
CMR, DC to 100 Hz, Gain = 100, min	100 dB
OFFSETS AND NOISE	
Input Bias Current @ 25°C, max	±25 nA
vs. Temperature	±0.5 nA/°C
Output Offset Voltage, Gain = 1000	
vs. Temperature, max	±1 mV/°C
vs. Supply	±100 mV/V
vs. Time	±3 mV/mo
Output Offset Voltage, Gain = 1.0	
vs. Temperature	±150μV/°C
vs. Supply	±300μV/V
vs. Time	±50μV/mo
Output Voltage Noise (1 Hz to 1 kHz)	
Gain = 1000	1 mV, rms
Gain = 1.0	10 μV, rms
DYNAMIC RESPONSE	
Small Signal Bandwidth, Gain = 100	
1% Absolute Accuracy	1.5kHz
±3 dB Accuracy	15kHz
Output Slew Rate	0.3 V/μsec
POWER SUPPLY REQUIREMENTS	
Rated Supply Voltage	±15 VDC
Supply Current Drain	
Quiescent, max	±25 mA
at Rated Output, max	±35 mA
TEMPERATURE RANGE	
Rated Specifications	0°C to +60°C
Operating	-25°C to +85°C
PACKAGE DRAWING (See page 67)	17 Rack Mounting Pkg.
PRICE (1 - 9)	$325.00

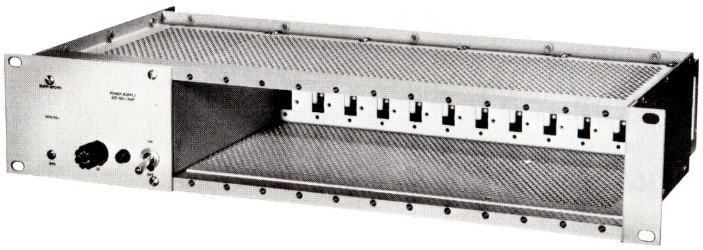
Prices and specifications are subject to change without notice.

ENCLOSURES FOR RACK MOUNTING AMPLIFIERS

Burr-Brown Rack Adapters provide efficient mounting space and well-regulated DC power for up to 12 amplifiers. The low cost of these enclosures, combined with the uniquely low-priced, high performance instrumentation amplifiers described in this section of the catalog, result in optimum per channel cost.

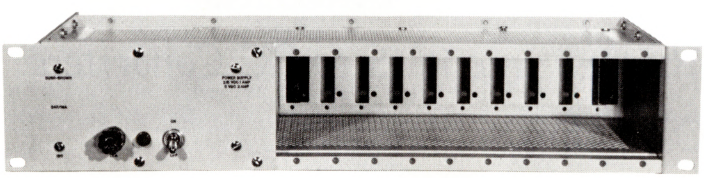
All of the enclosures will accept any of the rack-mounting amplifiers described, including the /16 and /16A options of the modular amplifiers. The connector mounting plate at the rear of these enclosures will accept either the 10 pin connector of /16 modules or the 30 pin connector of /16A modules. Thus, both /16 and /16A modules can be combined in a single enclosure.

These enclosures provide extremely efficient use of rack space. Front panel dimensions are only 3.5" x 19.00" and only 9.0" of rack depth is required.



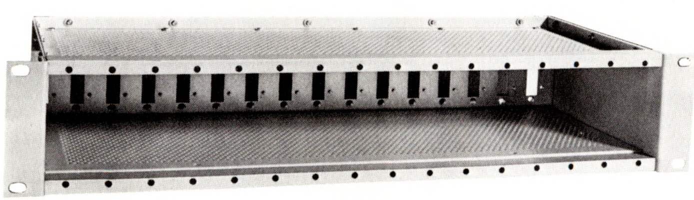
MODEL 506/16A

The 506/16A provides mounting space for 12 plug-in modules of the /16 or /16A type. The internal DC power supply of the 506/16A provides +15VDC and -15VDC rated at 1.0 ampere (each side). Regulation of this supply is ±0.1%, line and load. Input power for the 506/16A can be either 105 to 125 VAC or 210 to 250 VAC with a frequency range of 47 - 420 Hz. PRICE $429.00



MODEL 547/16A

The 547/16A is similar to the 506/16A, but has a +5 VDC, 2 ampere power supply, in addition to the ±15V, ±1.0 ampere analog supply. The +5 V supply is desirable for systems using programmable gain amplifiers, A/D converters, D/A converters, and other circuitry involving digital logic. The 547/16A provides mounting space for 10 plug-in modules. PRICE $525.00



MODEL 1600A/R

The 1600A/R is an unpowered Rack Adapter designed for use where DC power is already available, or where adequate power for additional modules is available from a 506/16A or 547/16A. Space is provided for 16 of the plug-in modules. PRICE $149.00

CONNECTORS...

30 PIN CONNECTOR – 1601 MC

Mates with all /16A modules. This mating connector is furnished with each/16A module, and mounts in models 506/16A, 547/16A, and 1600A/R. Price (additional connectors)$6.00

10 PIN CONNECTOR – 1600 MC

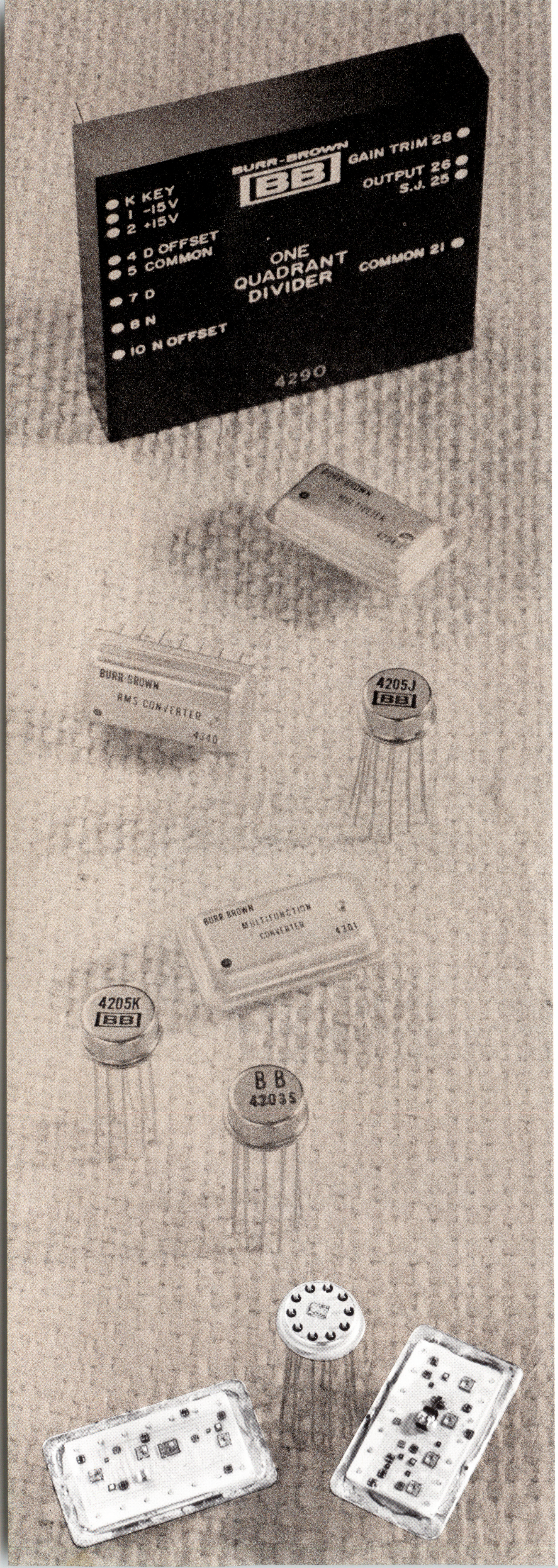
Mates with all /16 modules. This mating connector is furnished with each/16 module, and mounts in models 506/16A, 547/16A, and 1600A/R. Price (additional connectors) $6.00

BLANK PANEL – 1600 BP

Blank front panels (one module width) for rack adapters to provide uniform appearance of the rack. Price $4.00

1600 MC

1601 MC



ANALOG CIRCUIT FUNCTIONS

Multiplier/Dividers

Analog Dividers

Multifunction Converters

True RMS-to-DC Converters

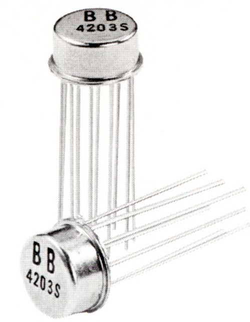
Thermal True RMS-to-DC Converters

Oscillators

BURR-BROWN

MULTIPLIER/DIVIDERS

The Burr-Brown family of four-quadrant multipliers is one of the broadest available anywhere. Included is the first commercially available laser-trimmed IC multiplier. Each model can be used as a divider or square root converter simply by variation of the external pin connections. All models are self-contained except for external trimming and, in most cases, such trimming is unnecessary. All give you the reliability you expect from Burr-Brown.



DIFFERENTIAL INPUT-MODEL 4205

Laser trimmed and completely self-contained, the 4205 monolithic IC multiplier/divider needs no adjustments or external components to meet its guaranteed accuracies of 1% and 2%. And, this general purpose unit has differential inputs allowing flexibility in the choosing of algebraic sign for the operations of multiplying, dividing, and square rooting.

LOWEST COST, IC TYPE MODEL 4201J

The 4201J is a low cost version of the 4203, and is intended for use in applications where accuracy is somewhat relaxed. Although the 4201J is capable of 2% accuracy by externally trimming four potentiometers, it also can be operated to reduced accuracy with a single gain trim. Even this trim may be eliminated if a scaling adjustment is available elsewhere in the user's system.

NEW! HIGH ACCURACY DUAL-IN-LINE MODEL 4204

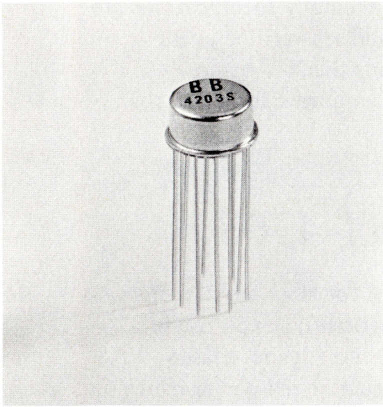
The laser trimmed 4204 four-quadrant analog IC multiplier is the first IC to offer 0.25% accuracy without the use of external components. The device uses the log/antilog technique to yield this high accuracy, plus low noise and moderate bandwidth. Accuracy specifications are guaranteed without external adjustments and are verified at Burr-Brown using an automatic tester which scans the X-Y plane. Maximum error at any point in the plane is required to be less than the specified values.

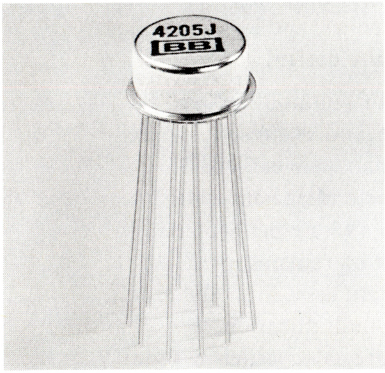
LASER TRIMMED-MODEL 4203

The first IC multiplier to eliminate the need for all external components—the 4203 takes advantage of Burr-Brown's expertise in monolithic circuitry, thin-film technology, and advanced laser-trimming techniques. The 4203 meets its guaranteed performance specifications with no external components or trimming. The result is greater systems reliability, space savings, and lower installed cost—the three most significant factors in any design.

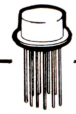
Hermetically sealed in a TO-100 package, this monolithic unit contains its own zener-regulated references, and as a result, is much less sensitive to supply voltage variations than were earlier IC multipliers. The 25V/μsec slew rate and the 1 MHz bandwidth are key performance factors for applications where delay phase shift must be minimized. Harmonic distortion remains low for frequencies well above 100 kHz, an important asset in modulation applications. In addition to four-quadrant multiplication, it also performs division and square-rooting of analog signals without the use of additional amplifiers.

IC MULTIPLIER/DIVIDERS





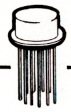
Specifications typical at 25°C and rated supply voltage unless otherwise noted.

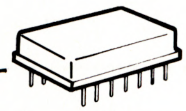


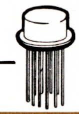
MODEL	4203J	4203K	4203S
TOTAL ERROR(1) @ +25°C			
No Ext. Trim	±2%, max	±1%, max	±1%, max
External Trim	±1%	±0.6%	±0.6%
vs. Temperature		±0.04%/°C	
vs. Supply		±0.2%/%	
OUTPUT OFFSET			
@ +25°C (X=Y=0)	±20 mV	±20 mV	±20 mV, max
vs. Temperature		±0.4 mV/°C	
vs. Supply		±10 mV/%	
NONLINEARITY			
X (X=20 V p-p, Y=+10 VDC)	±0.8%	±0.5%	±0.5%
Y (Y=20 V p-p, X=+10 VDC)	±0.2%	±0.2%	±0.2%
FEEDTHROUGH @ 50 Hz			
X=0, Y=20 V p-p (no ext. trim)		50 mV p-p	
(ext. trim)		20 mV p-p	
Y=0, X=20 V p-p (no ext. trim)		50 mV p-p	
(ext. trim)		20 mV p-p	
SLEW RATE		25V/μsec	
BANDWIDTH			
Small Signal, -3 dB		1 MHz	
1% Amplitude Error		40 kHz	
1% Vector Error		10 kHz	
OUTPUT NOISE, 10 Hz - 10 kHz		600 μV rms	
INPUT VOLTAGE, Rated		±10 V	
Abs. max		±Supply	
OUTPUT RATING		±10 V @ ±5 mA	
POWER REQUIREMENTS, Rated		±15 VDC	
Operating Range		±12 to ±18 VDC	
Quiescent Current		±4.5 mA	
TEMPERATURE RANGE			
Specification	0°C to +70°C	0°C to +70°C	-55°C to +125°C
Storage		-65°C to +150°C	
PACKAGE DRAWING (See page 68)	18 TO-100	18 TO-100	18 TO-100
PRICE (1 - 24)	\$26.00	\$36.00	\$48.00

(1) Total Error includes offset, nonlinearity, and feedthrough.

Prices and specifications are subject to change without notice.



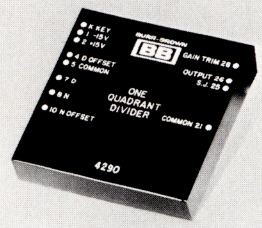




4201J	NEW! 4204J	NEW! 4204K	4205J	4205K	4205S
— ±2%, max ±0.04%/°C ±0.2%/%	±0.5%, max(2) ±0.2% ±0.01%/°C ±0.02%/%	±0.25%, max(2) ±0.1%	±2%, max ±1%	±1%, max ±0.6% ±0.04%/°C ±0.2%/%	±1%, max ±0.6%
ext. adj. ±0.4 mV/°C ±10 mV/%	±15 mV — —	±5 mV	±20 mV	±20 mV ±0.4 mV/°C ±10 mV/%	±20 mV, max
±0.8% ±0.2%	±0.05% ±0.05%		±0.8% ±0.2%	±0.5% ±0.2%	±0.5% ±0.2%
— 20 mV p-p — 20 mV p-p	10 mV p-p — 10 mV p-p —			50 mV p-p 20 mV p-p 50 mV p-p 20 mV p-p	
25V/μsec	1 V/μsec			25 V/μsec	
1 MHz 40 kHz 10 kHz	250 kHz 33 kHz 2.5 kHz			1 MHz 40 kHz 10 kHz	
600 μV rms	300 μV rms			600 μV rms	
±10 V ±Supply	±10 V ±Supply			±10 V ±Supply	
±10V @ ±5 mA	±10 V @ ±5 mA			±10 V @ ±5 mA	
±15 VDC ±12 to ±18 VDC ±4.5 mA	±15 VDC ±14 to ±16 VDC +15 mA, -8.5 mA			±15 VDC ±12 to ±18 VDC ±4.5 mA	
0°C to +70°C -65°C to +150°C	0°C to +70°C -55°C to +125°C		0°C to +70°C	-65°C to +150°C	-55°C to +125°C
(18) TO-100	(19) C 0.86" x 0.5" x 0.22"			(18) TO-100	
$22.50	$49.00	$69.00	$26.00	$36.00	$48.00

(2) With output loading of 10 kΩ or less.

ANALOG DIVIDER



MODEL 4290

- **EASY TO USE –**
  Optimized for analog division
- **IMPROVE SYSTEM ACCURACY – ±0.5%**
- **IMPROVE DYNAMIC RANGE –**
  Denominator range 10 mV to 10V
- **IMPROVE SYSTEM STABILITY –**
  Accuracy drift of ±0.01%/°C

The 4290 uses a unique Burr-Brown circuit which has been optimized for the demanding task of analog division. Although any of the analog multipliers from the preceeding pages can be used as dividers, the resulting output is accurate only over a limited range of denominator voltage. The same is true of competitive multipliers. For really accurate division over a wide dynamic range of the denominator, the 4290 provides far superior performance. For instance, the 4290 is accurate to ±0.5%, without external trimming, for a 100 : 1 range of denominator voltage. If external trimming of offset voltage is employed, the denominator range can be extended to 1000 : 1 (10 mV to 10V). Thermal drift is sufficiently low to maintain the accuracy over a wide temperature range.

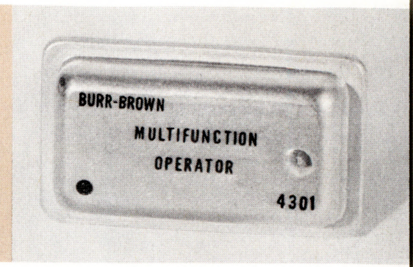
By addition of one external IC op amp, the 4290 can be converted to a two-quadrant divider for use with bipolar numerator signals. Scale factor of the 4290 is easily changed over a 100 : 1 range.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL		4290
DC PERFORMANCE		
Output Function		$E_o = \frac{10N}{D}$
ERRORS		
Total Error, @+25°C, max		±0.5%(50 mV)
vs. Temp. (-25°C to +85°C), max		±0.02%/°C
vs. Supply Voltage		±0.1%/V
Scale Factor (Gain); N=D=+10 V		
Initial Error, +25°C		±0.25%
vs. Temp. (-25°C to +85°C)		±0.005%/°C
vs. Supply Voltage		±0.1%/V
Nonlinearity (D = 10V, 5 mV ⩽ N ⩽ 10 V)		
Initial Nonlinearity, +25°C, typ		±0.1%
max		±0.3%
vs. Temp. (-25°C to +85°C)		±0.005%/°C
vs. Supply Voltage		±0.005%/V
DYNAMIC PERFORMANCE		
D = 10 VDC, N = 5 + 5 sin ωt		
Full Power Bandwidth (-3 dB)		10 kHz
Slew Rate		0.3 V/μs
OUTPUT NOISE		
5 Hz to 10 kHz: D = 10 V		200 μV rms
D = 0.1V		2 mV rms
INPUT CHARACTERISTICS		
Input Voltage		
For rated specifications	D	+0.1 V, min +10.0 V, max
(N ⩽ D at all times)	N	+5 mV, min +10.0 V, max
For Operation (4290 output may saturate for N >D)	N or D	+5 mV, min +15 V, max
Input Impedance	N or D	25 k Ω
OUTPUT CHARACTERISTICS		
Voltage, min		±10 V
Current, min		±5 mA
POWER REQUIREMENTS		
Rated Supply		±15 V
Operating Range		±14 to ±16 VDC
Quiescent Current		30 mA
TEMPERATURE RANGE		
Operating		-25°C to +85°C
Storage		-40°C to +85°C
PACKAGE DRAWING (See page 68)		21 2"x 2"x 0.4"
PRICE (1 - 9)		$79.00

Specifications apply for 0.1 V ⩽ D ⩽ 10 V and +5 mV ⩽ N ⩽ D unless otherwise noted. All percentage specifications refer to % of full scale = 10 V.

MULTIFUNCTION CONVERTER



NEW! MODEL 4301

$$E_o = V_Y\left(\frac{V_Z}{V_X}\right)^m$$

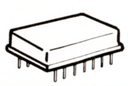
- **REDUCES YOUR INVENTORY –** Performs sine, cosine, $\tan^{-1}$, as well as multiply, divide, exponentiation, etc.
- **IMPROVES SYSTEM ACCURACY –** ±0.03% to ±0.25% Accuracy
- **ECONOMICAL –** Only $48 in 100's

Our hybrid 4301 Multifunction Converter can do just about any analog computation you might need. Add a few external resistors and this tiny 14 pin dual-in-line unit can multiply, divide, square, square root, or square a ratio. Add a few inexpensive active and passive devices, and this 3-input hermetically sealed and shielded workhorse can perform true rms, vector sums, sine, cosine, or arctangent conversion functions. It's highly accurate in all configurations, low in cost, and is particularly useful for rapid real-time computations or for signal processing equipment. And, if you want to linearize a function by raising a voltage or voltage ratio to an arbitrary power, it will do that, too!

FUNCTIONS	ACCURACY
MULTIPLY	±0.25%
DIVIDE	±0.25%
SQUARE	±0.03%
SQUARE ROOT	±0.07%
EXPONENTIATE	±0.15% (m = 5)
ROOTS	±0.2% (m = 0.2)
SINE θ	±0.5%
COSINE θ	±0.8%
ARCTAN $^{-1}\left(\frac{Y}{X}\right)$	±0.6%
$\sqrt{X^2 + Y^2}$	±0.07%

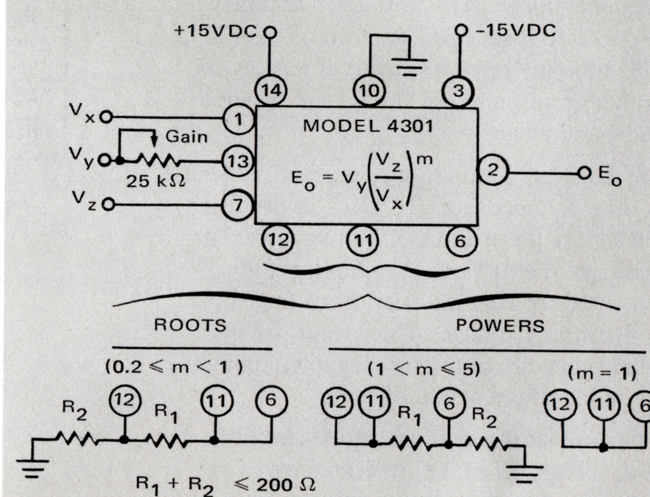
Typical accuracies expressed as a % of output full scale (+10 VDC) at 25°C.

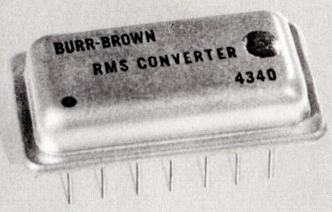
Specifications typical at 25°C and rated supply voltage unless otherwise noted.



MODEL	4301
TRANSFER FUNCTION	$E_O = V_Y\left(\frac{V_Z}{V_X}\right)^m$
RATED OUTPUT	
Voltage	+10.0 V
Current	5 mA
INPUT	
Signal Range	$0 \leq (V_X, V_Y, V_Z) \leq +10$ V
Absolute Maximum	$(V_X, V_Y, V_Z) \leq \pm$ Supply
Impedance (X/Y/Z)	100 kΩ/90 kΩ/100 kΩ
EXPONENT RANGE	Refer to Function Diagram
Roots ($0.2 \leq m < 1$)	$m = \frac{R_2}{R_1 + R_2}$
Powers ($1 < m \leq 5$)	$m = \frac{R_1 + R_2}{R_2}$
(m = 1)	$R_1 = 0$ Ω, R_2 not used
POWER REQUIREMENTS	
Rated Supply	±15 VDC
Range	±12 to ±18 VDC
Quiescent Current	±10 mA
TEMPERATURE RANGE	
Operating	-25°C to +85°C
Storage	-25°C to +85°C
PACKAGE DRAWING (See page 68)	(19) A 0.86"x 0.50"x 0.22"
PRICE (1 - 24)	$69.00

FUNCTIONAL DIAGRAM





TRUE RMS-to-DC CONVERTER

MODEL 4340

- **IMPROVES SYSTEM ACCURACY – ±2 mV ±0.2% of Reading**
- **SIMPLIFIES ASSEMBLY – No external components**
- **IMPROVES RELIABILITY – -25°C to +85°C Operation Rugged Hybrid Package**

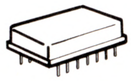
The Burr-Brown Model 4340 is a True RMS-to-DC Converter featuring high performance, low cost, and a small hermetic package. The 4340 will compute the True RMS value of a variety of signals applied to the input. The input signal may consist of complex AC waveforms as well as a DC voltage level. The output of the 4340 is a DC voltage, the amplitude of which is equal to the RMS value of the input voltage.

The 4340 will accept input voltages from 0 to 20 volts peak-to-peak over a wide input frequency range. The conversion accuracy of the 4340 is specified in terms of error in millivolts (mV) plus a percent of reading, as a function of input signal level over an input frequency range.

The 4340 has an input impedance of 5 kΩ and an output impedance of 1 Ω. This product will supply up to 5 mA of output current at a voltage of +10 VDC. The input is fully protected for conditions of overvoltage up to the supply voltage. The output will withstand short-circuit to power supply common for an indefinite period of time.

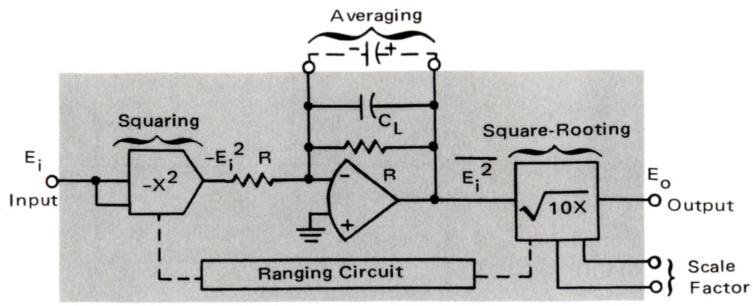
Provision for the external adjustment of gain, voltage offset, DC reversal error, and frequency response performance allow the user to improve upon the specified conversion accuracies to the degree required by the user's application.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.



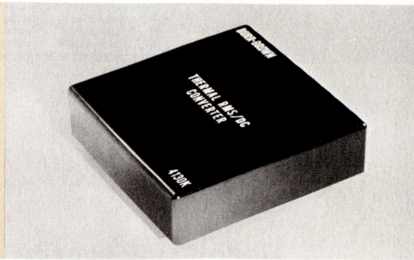
MODEL	NEW! 4340
TRANSFER FUNCTION	$E_o = \sqrt{\overline{E_i^2}}$
INPUT	
Peak Voltage	±10 VDC
Absolute Maximum Voltage	±Supply
Impedance	5 kΩ
OUTPUT	
Voltage	0 to +10 VDC
Current, min	+5 mA
Impedance	1 Ω
CONVERSION ACCURACY	
Total Unadjusted Error, max Input: 10 mV rms to 7.0 V rms 100 Hz to 10 kHz sine wave (1)	±2 mV ±0.2% Reading
Total Adjusted Error (2) Input: 10 mV rms to 1 V rms 50 Hz to 20 kHz (1)	±0.3 mV ±0.1% Reading
STABILITY	
Accuracy vs. Temperature	±0.001% of FS plus ±0.01% of reading per °C
Accuracy vs. Supply	±0.001% of FS plus ±0.01% of reading per %ΔV
TEMPERATURE RANGE	
Operating	-25°C to +85°C
Storage	-55°C to +125°C
POWER REQUIREMENTS	
Rated Voltage	±15 VDC
Voltage Range	±14 VDC to ±16 VDC
Quiescent Current	±12 mA
PACKAGE DRAWING (See page 68)	19 B 0.86" x 0.50" x 0.22"
PRICE (1 - 24)	$75.00

(1) Model 4340 will convert DC inputs. Lower frequency AC input signals will require the addition of external capacitors to preserve the accuracy.
(2) Performance with external trims.



FUNCTIONAL DIAGRAM OF MODEL 4340.

THERMAL TRUE RMS-to-DC CONVERTERS



MODEL 4130

- **INCREASE SYSTEM ACCURACY – ±0.05% Accuracy to 100 kHz**
- **INCREASE SYSTEM BANDWIDTH – ±2% Accuracy at 10 MHz**
- **MEASURE HIGH CREST FACTOR SIGNALS – 100:1 max crest factor**

The 4130 is a modular True RMS-to-DC Converter utilizing thermal techniques to produce high conversion accuracies over a wide range of frequencies and for a variety of waveforms. The heart of the 4130 is a unique thermal converter unit and circuit design, patented and manufactured by Burr-Brown, using hybrid and monolithic technologies.

Thermal conversion techniques are used to produce highly accurate, wideband RMS voltmeters by several instrument manufacturers. Burr-Brown is the first manufacturer, however, to produce such True RMS conversion capabilities in a compact module suitable for incorporation into universal and dedicated measurement applications.

The 4130 allows for the amplification and scaling of the input signal by the addition of an external operational amplifier chosen by the user based upon his particular conversion need. Also, the 4130 may be trimmed in order to optimize accuracy, output voltage offset, and low frequency response.

Competitive modular RMS-to-DC converters generally utilize a computing technique to produce the DC equivalent of an RMS input signal. This technique does not provide the accuracy and bandwidth capabilities of the thermal conversion method.

Additionally, the 4130 has important advantages over other thermal RMS converters utilized in instrumentation applications. One such advantage is the low DC reversal error of the thermal sensor which allows for accurate DC coupled measurements.

Specifications typical at 25°C and rated supply voltage unless otherwise noted. Specifications assume an ideal operational amplifier is used unless otherwise noted. User must supply operational amplifier.

MODEL	4130J	4130K
OUTPUT FUNCTION	$E_O = \sqrt{\overline{E_i^2}}$	*
TOTAL CONVERSION ACCURACY, max (1)	$0.05\% E_i + 0.05\%$ FS	$0.025\% E_i + 0.025\%$ FS
MIDBAND AND DC CHARACTERISTICS		
Nonlinearity	1.0 mV	0.4 mV
DC Reversal Error	0.2 mV	*
Output Noise, Peak (0.01 Hz to 100 Hz)	$(0.01 E_i + \frac{0.035}{E_i})$ mV	*
Output Stability vs. Temperature, max	$(0.2 E_i + \frac{0.06}{E_i})$mV/°C	$(0.1 E_i + \frac{0.03}{E_i})$mV/°C
vs. Supply	$(\frac{0.02}{E_i})$ mV/%	*
vs. Time	$(0.2 E_i + \frac{0.15}{E_i})$ mV/mo.	*
Warm-up to Rated Accuracy	15 minutes	30 minutes
DYNAMIC PERFORMANCE		
Bandwidth for Rated Accuracy, min	40 Hz to 100 kHz	*
Bandwidth for 2% Accuracy, min	to 10 MHz	*
3 dB Bandwidth	to 50 MHz	*
Settling Time to 0.1% (2)		
+20 dB Step	1 sec	*
–20 dB Step	2 sec	*
Overload Recovery Time	10 sec	*
INPUT CHARACTERISTIC (3)		
Input Voltage Range (RMS) for Specified Accuracy	0.1 V to 2.0 V	*
Crest Factor	100:1 to 5:1	*
Peak Input Voltage (Operating)	±11.2 V	*
Absolute Maximum Input	± Supply	*
Input Impedance	10 kΩ ‖ 30 pF	*
Input Bias Current, max	±2 mA	*
OUTPUT CHARACTERISTICS (3)		
Output Voltage	0.0 to +2.0 Vdc	*
Output Current	5 mA	*
Output Impedance	0.06 Ω	*
POWER SUPPLY (3)		
Rated Supply	±15 Vdc	*
Operating Range	±12 V to ±18 V	*
Quiescent Current	+60 mA, DC	*
	–30 mA, DC	*
Supply Current for 2.0 V rms Input and 400 Ω Output Load	+65 mA, rms	*
	–50 mA, rms	*
TEMPERATURE RANGE		
Specification	0°C to +70°C	*
Operation	–25°C to +70°C	*
Storage (power not applied)	–40°C to +100°C	*
PACKAGE DRAWING (See page 68)	20	2" x 2" x 0.6"
PRICE (1 - 9)	$139.00	$175.00

* Same as 4130J

(1) With external adjustment over the specified input voltage range. Full Scale is 2.0 V rms.

(2) Settling time is the total time from the application of the input step until the output is continuously within the specified accuracy error band.

(3) Model 4130 less operational amplifier.

MODEL 4023/25

- **SIMPLIFY SYSTEM ASSEMBLY –**
  Completely self-contained
- **INCREASE SYSTEM ACCURACY –**
  ±1% Frequency accuracy
  ±0.1% Sinewave distortion
- **INCREASE SYSTEM STABILITY –**
  ±0.04%/°C Frequency Stability;
  ±0.02%/°C Amplitude Stability

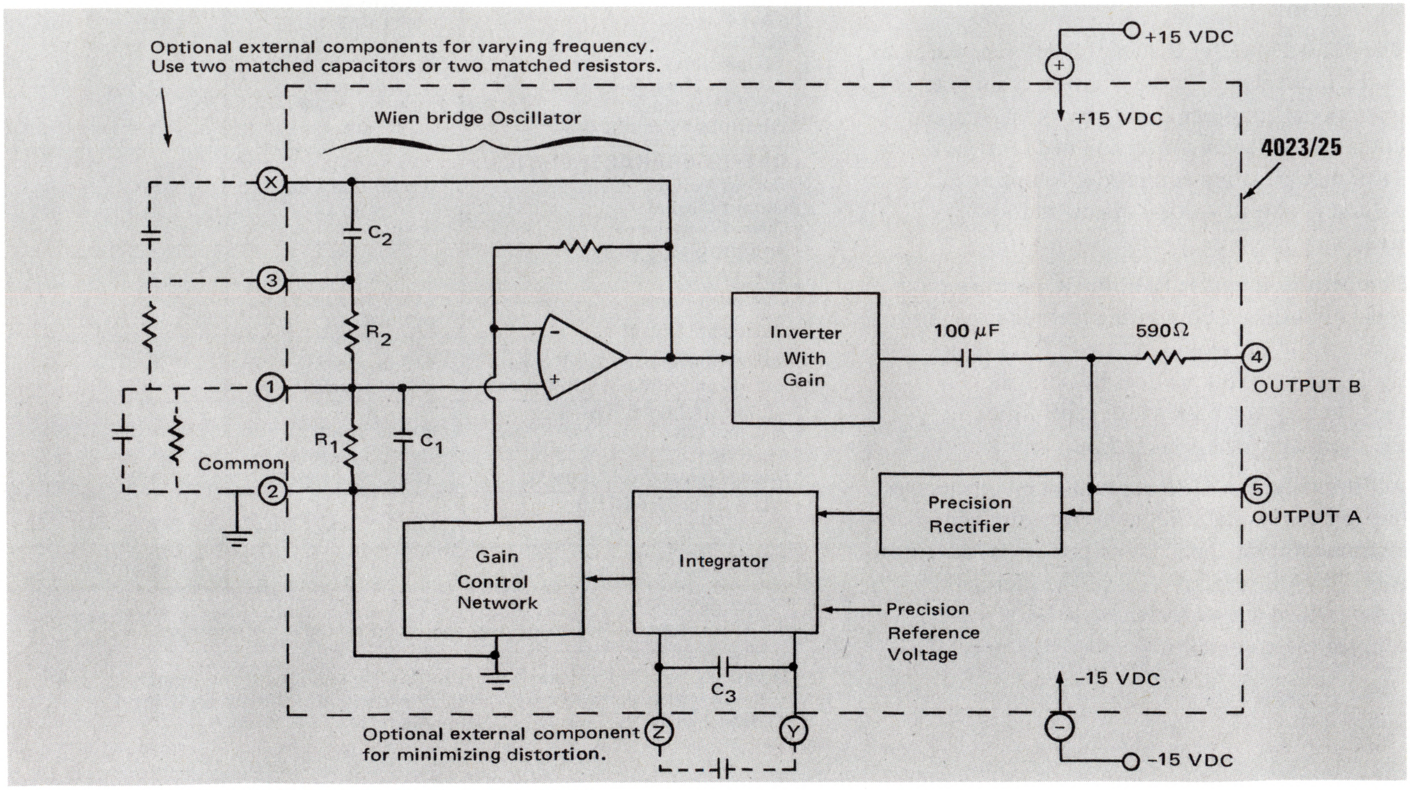
The 4023/25 is an all solid-state ultra-stable sine-wave oscillator. Both output amplitude and frequency are constant, and the stability of both with time and temperature variations is excellent. High-performance Burr-Brown IC operational amplifiers are used in the 4023/25 to form a Wienbridge oscillator circuit and to regulate the output amplitude. The frequency of oscillation is within ±1% of the customer-specified value.

If desired, external components may be added to trim the frequency to an exact value. Adding two external capacitors will lower the output frequency. The range of frequency adjustment is approximately 2 decades (within 10 Hz and 20 kHz).

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	4023/25
FREQUENCY RESPONSE	
Range	Customer specified - - may be any value from 10 Hz to 20 kHz.
Accuracy	±1% (Adjustable to zero)
Stability vs. Temperature, max	0.04%/°C
OUTPUT	
Amplitude - Output A	6 Vrms (±2%)
- Output B	3 Vrms with 600 Ω load (±2%)
Impedance - Output A	1 Ω
- Output B	600 Ω
Rated Load - Output A	1.2 kΩ
- Output B	600 Ω
Distortion, max	0.1%
AMPLITUDE STABILITY	
vs. Temperature, max	0.02%/°C
Noise and Jitter, max	0.02%
Long Term	0.1%
TEMPERATURE RANGE	
Operating	-25°C to +85°C
Storage	-55°C to +100°C
POWER REQUIREMENTS	
Rated Supply	±15 VDC
Supply Drain, max	±40 mA
PACKAGE DRAWING (See page 68)	22 2.4" x 1.8" x 0.6"
PRICE (1 - 9)	$154.00

Note: To order, specify Model 4023/25 and frequency.

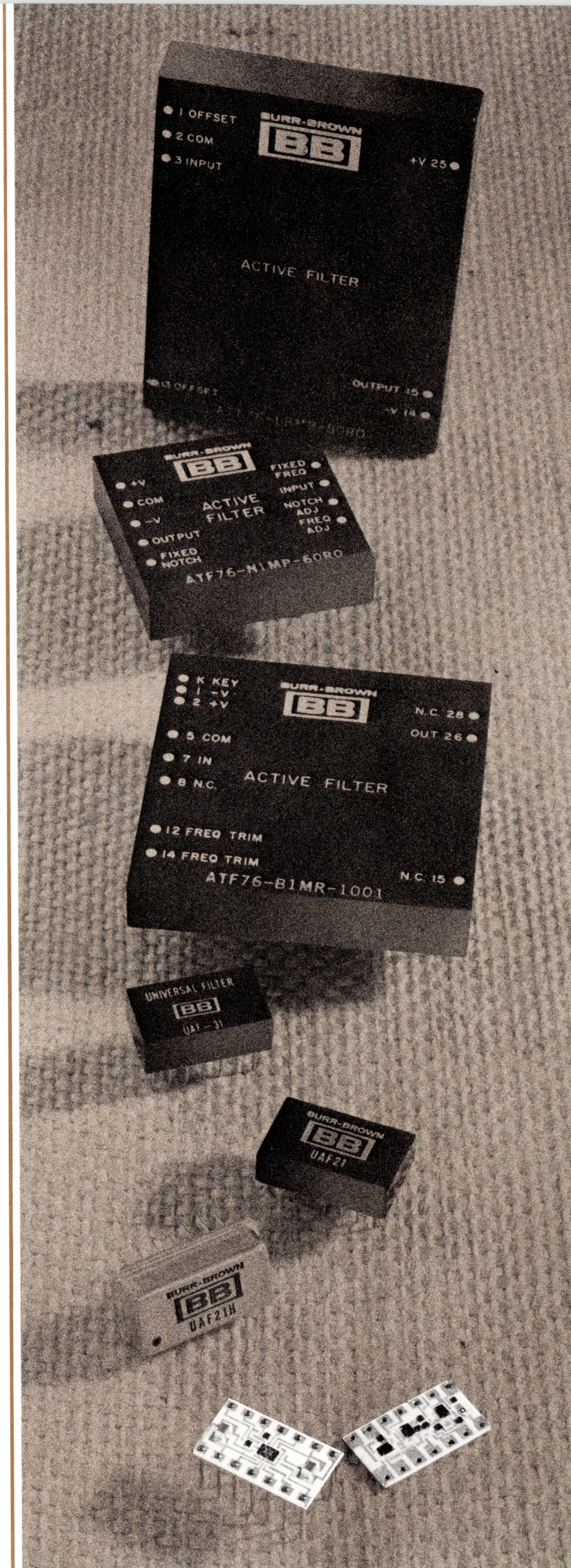


SIMPLIFIED SCHEMATIC DIAGRAM OF MODEL 4023/25

ACTIVE FILTERS

Universal Active Filters

Fixed Frequency Active Filters



BURR-BROWN

UNIVERSAL ACTIVE FILTERS

MODELS UAF31 AND UAF21/25

- **LOW COST – ONLY \$13.00 (100 quantity) for UAF31**
- **USER TUNABLE FREQUENCY, Q–FACTOR, and GAIN**
- **Q-FACTOR RANGE – 0.5 to 500**
- **WIDE FREQUENCY RANGES**
  UAF31 – 0.001 Hz to 25 kHz
  UAF21/25 – 0.001 Hz to 200 kHz
- **EPOXY or HERMETIC DUAL-IN-LINE PACKAGE**

Burr-Brown's Universal Active Filters (UAF's) are low cost, versatile units that the user can easily tailor to any active filtering application. These UAF's are excellent choices for use in communications equipment, test equipment (engine analyzers, aircraft and automotive test, medical test, etc.), servo systems, process control equipment, sonar and many others.

These UAF's are complete 2-pole active filters with the addition of three of four external resistors that provide the user easy control of the Q-factor, resonant frequency, and gain. Any complex filter response can be obtained by cascading these units. Three separate outputs provide low pass, high pass, and band pass transfer functions. A band reject (notch) transfer function may be realized simply by summing the high pass and low pass outputs.

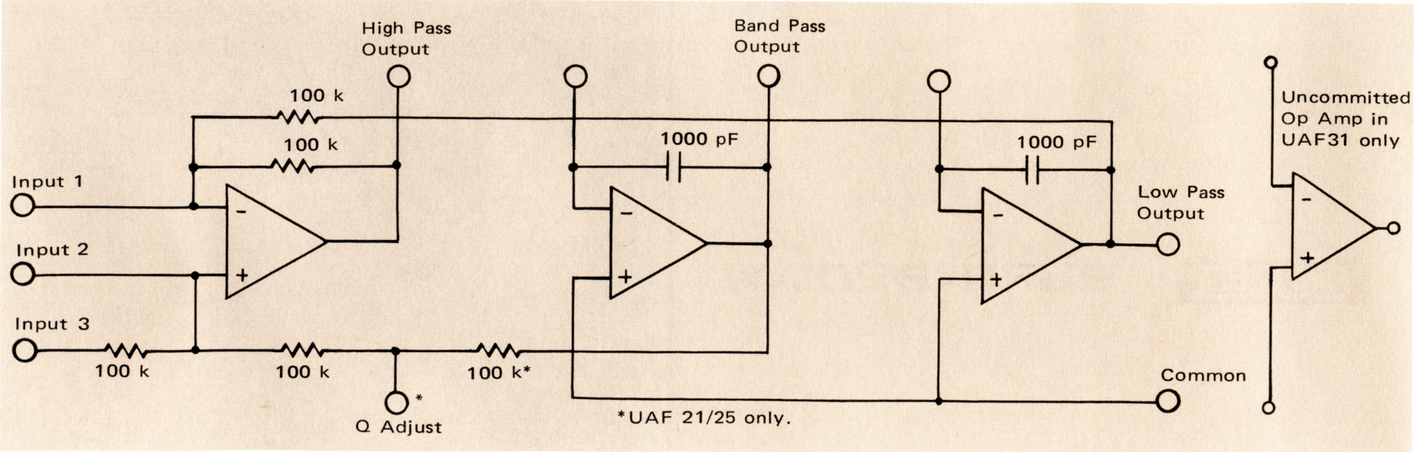
Since these UAF's are so versatile and flexible, they can be stocked by the user in quantity for use as building blocks whenever the requirement arises. This means instant availability and that UAF purchases may be made in volume to take advantage of quantity price discounts.

We have an individual data sheet available for these Universal Active Filters that explains the simple design procedures necessary to build active filters. It also includes all the necessary information for you to construct Bessel, Butterworth and Chebyschev low pass and high pass as well as band pass and band reject filters using these Universal Active Filters as building blocks. Computer programs are also included for the design of more complex Chebyschev low pass and multiple pole band pass filters. The data sheet is available from Burr-Brown or your local Representative.

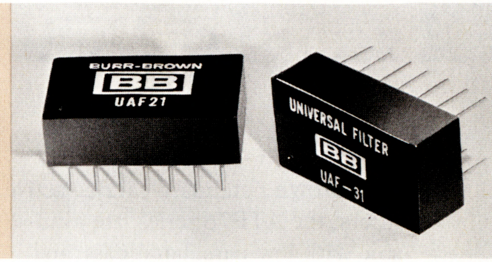
The UAF as shown in the Figure below can be connected in a variety of configurations: One UAF is required for every two poles of low pass or high pass filters. One UAF is required for each pole-pair of band pass or band reject filters. The three basic second order transfer function forms are:

$$T(\text{Low Pass}) = \frac{A_{LP}\,\omega_o^2}{s^2 + (\omega_o/Q)\,s + \omega_o^2} \qquad T(\text{Band Pass}) = \frac{A_{BP}(\omega_o/Q)s}{s^2 + (\omega_o/Q)\,s + \omega_o^2} \qquad T(\text{High Pass}) = \frac{A_{HP}\,s^2}{s^2 + (\omega_o/Q)\,s + \omega_o^2}$$

where $\omega_o = 2\pi f_o$.



UNIVERSAL ACTIVE FILTER SIMPLIFIED SCHEMATIC



Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	NEW! UAF31	UAF21/25(1)	UNITS
INPUT			
Input Bias Current	±40	±15	nA
Input Voltage Range	±10	±10	V
Input Resistance	100 k	100 k	Ω
TRANSFER CHARACTERISTICS			
Frequency Range (f_o)	0.001 to 25 k	0.001 to 200k	Hz
f_o Accuracy(2)	±1, max	±1/±5, max	%
f_o Stability(3) (over temp. range)	±0.002 ;	±0.005	%/°C
Q Range	0.5 - 500	0.5 - 500 (4)	--
Q Stability (5)			
@ f_o Q $\leqslant 10^4$	±0.01	±0.01	%/°C
@ f_o Q $\leqslant 10^5$	±0.025	±0.025	%/°C
Gain Range	0.1 to 50	0.1 to 50	V/V
OUTPUT			
Peak to Peak Output Swing(6)			
$f_o \leqslant$ 10 kHz	20	20	V
$f_o \leqslant$ 20 kHz	14	20	V
$f_o \leqslant$ 100 kHz	2	20	V
Output Offset			
(at L.P. output with unity gain)	±20	±10	mV
Output Impedance	1	10	Ω
Noise(7)	200	200	μV (rms)
Output Current	5	10	mA
POWER SUPPLIES			
Rated Power Supplies	±15	±15	V
Power Supply Range(8)	±5 to ±18	±5 to ±18	V
Supply Current @ ±15V (Quiescent)	±12, max	±9, max	mA
TEMPERATURE RANGE			
Specification Temperature Range			
Epoxy	-25 to +85	-25 to +85	°C
Hermetic	N/A	-55 to +125	°C
Storage Temperature Range	-25 to +85	-55 to +125	°C
PACKAGE DRAWING (See page 78)	38 Epoxy	38 Epoxy or Hermetic	
PRICE (See Below) (1 - 9)	$19.00	$54 to $62	

Prices and specifications are subject to change without notice.

NOTES:

(1) The UAF21/25 include two internal 0.002 μF power supply bypass capacitors.

(2) The accuracy of external frequency determining resistors must be added to this figure.

(3) T.C.R. of external frequency determining resistors must be added to this figure.

(4) Derated 50% from maximum.

(5) Q stability varies with both the value of Q and the resonant frequency f_o.

(6) Low pass output.

(7) Measured at the bandpass output with Q=50 over DC to 50 kHz.

(8) For supplies below ±10V, Q max will decrease slightly; filters will operate below ±5V.

ORDERING INFORMATION

	Frequency Range	f_o Accuracy	Package	Price (1 - 9)	Price (100 - 499)
UAF31	0.001 to 25 kHz	±1%	Epoxy	$19.00	$13.00
UAF21	0.001 to 200 kHz	±1%	Epoxy	57.00	40.00
UAF25	0.001 to 200 kHz	±5%	Epoxy	54.00	37.00
UAF21H	0.001 to 200 kHz	±1%	Hermetic	62.00	45.00
UAF25H	0.001 to 200 kHz	±5%	Hermetic	54.00	42.00

FIXED FREQUENCY ACTIVE FILTERS

Burr-Brown's standard catalog active filters, the ATF76 series, are available with low pass, band pass, and band reject characteristics. The filters in this series are packaged in space-saving 0.4" high modules ranging in size from 1.5" x 1.5" for 2 pole low pass and notch models to only 2.1" x 3.0" for 8 pole low pass models. All filters are complete units that are factory tuned with no external components required. All standard active filters operate from ±15 VDC power over a -25°C to +85°C temperature range.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL(1)	BAND PASS SINGLE TUNED				
	ATF76–B1*M	ATF76–B1*N	ATF76–B1*P	ATF76–B1*Q	ATF76–B1*R
FILTER ORDER No. of Poles	2				
INPUT					
Voltage Range	±10 V, min				
Impedance	100 k Ω, min				
FREQUENCY (f_c)					
Range	1 to 20kHz				
Accuracy	±1%				
Temp. Coeff.	±0.03%/°C				
Adj. Range	±3%				
GAIN					
Pass Band	0 ±0.5 dB				
SELECTIVITY (Q)					
Value	2	5	10	20	50
Tolerance	±10%				
OUTPUT					
Noise (2)	100 µV				
Impedance	10 Ω				
Current	±5 mA				
POWER SUPPLY CURRENT					
±15 VDC @ Quiescent(6)	±10 mA				
PACKAGE DWG. (See page 79)	(40) B 2" x 2" x 0.4"				
PRICE					
Model L (1 - 9)	$80.00				
Model L (10-24)	65.00				
Model M (1 - 9)	70.00				
Model M (10-24)	55.00				

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL(1)	LOW PASS BUTTERWORTH				LOW PASS BESSEL (Linear Phase)			
	ATF76–L2*B	ATF76–L4*B	ATF76–L6*B	ATF76–L8*B	ATF76–L2*L	ATF76–L4*L	ATF76–L6*L	ATF76–L8*L
FILTER ORDER No. of Poles	2	4	6	8	2	4	6	8
INPUT								
Voltage Range	±10 V				±10 V			
Impedance(5)	30 k Ω, min				30 k Ω, min			
FREQUENCY								
Range	1 to 20k Hz				1 to 20k Hz			
Accuracy	±2%				±2%			
Temp. Coeff.	±0.05%/°C				±0.05%/°C			
GAIN(9)								
Pass Band	0 dB, nom				0 dB, nom			
DC Accuracy	±0.05 dB, max				±0.05 dB, max			
Q-FACTOR	N/A				N/A			
OUTPUT								
Noise(2)	50 µV, rms				50 µV, rms			
Output Impedance	1 Ω				1 Ω			
Rated Current	±5 mA				±5 mA			
Offset at 25°C(8)	±2 mV				±2 mV			
Offset Drift -25°C to +85°C	±25 µV/°C		±50 µV/°C		±25 µV/°C		±50 µV/°C	
POWER SUPPLY CURRENT ±15 VDC @ Quiescent (7)	±6 mA	±10 mA	±14 mA	±18 mA	±6 mA	±10 mA	±14 mA	±18 mA
PACKAGE DWG. (See pg.79)	(39) A 1.5" x 1.5" x 0.4"	(40) A 2" x 2" x 0.4"	(41) A 3" x 2.1" x 0.4"		(39) A 1.5" x 1.5" x 0.4"	(40) A 2" x 2" x 0.4"	(41) A 3" x 2.1" x 0.4"	
PRICE								
Model L (1 - 9) (1-10 Hz)	$75.00	$89.00	$110.00	$135.00	$75.00	$89.00	$110.00	$135.00
Model L (10-24) (1-10 Hz)	61.00	77.00	92.00	121.00	61.00	77.00	92.00	121.00
Model M (1 - 9) (10-20k Hz)	69.00	79.00	100.00	125.00	69.00	79.00	100.00	125.00
Model M (10-24) (10-20k Hz)	57.00	67.00	84.00	111.00	57.00	67.00	84.00	111.00

*Insert L or M, depending on frequency required.
(1) See below for ordering information
(2) 10 Hz to 50 kHz with input grounded.
(3) -40 dB notch attenuation, minimum.
(4) ±3% f_c adjustment and notch depth adjustment.

ORDERING INFORMATION

ATF76 - B 2 M

ATF76
(Designates Series)

DEFINES FILTER TYPE
L = Low Pass
B = Band Pass
N = Notch

DESIGNATES NO. OF POLE OR POLE PAIRS OR ZERO PAIRS
Low Pass
2 = 2 poles
4 = 4 poles
6 = 6 poles
8 = 8 poles

Band Pass
1 = 1 pole pair
2 = 2pole pairs

Notch
1 = zero pair

GROSS FREQUENCY RANGE
L < 10 Hz
M ⩾ 10 Hz

BAND PASS STAGGER TUNED				
ATF76-B2*K	ATF76-B2*M	ATF76-B2*N	ATF76-B2*P	ATF76-B2*Q
4				
±10 V, min 100 k Ω, min				
1 to 20kHz ±1% ±0.03%/°C —				
0 ± 0.5dB				
1	2	5	10	20
±10%				
100 μV 10 Ω ±5 mA				
±20 mA				
(41) B 3" x 2.1" x 0.4"				
\$89.00 77.00 79.00 67.00				

Prices and specifications are subject to change without notice.

LOW PASS CHEBYSCHEV (±0.4 dB Ripple)				LOW PASS CHEBYSCHEV (±1.6 dB Ripple)				BAND-REJECT NOTCH		
ATF76-L2*C	ATF76-L4*C	ATF76-L6*C	ATF76-L8*C	ATF76-L2*D	ATF76-L4*D	ATF76-L6*D	ATF76-L8*D	ATF76-N1*M	ATF76-N1*N	ATF76-N1*P
2	4	6	8	2	4	6	8	2	2	2
±10 V 30 k Ω, min				±10 V 30 k Ω, min				±10 V 30 k Ω, min		
1 to 20k Hz ±2% ±0.05%/°C				1 to 20k Hz ±2% ±0.05%/°C				1 to 20k Hz ±2%(4) ±0.03%/°C		
0 dB, nom –0.4 dB, max				0 dB, nom –1.6 dB, max				0 dB, nom(3) ±0.05 dB, max		
N/A				N/A				2 ± 10%	5 ± 10%	10 ± 10%
50 μV, rms 1 Ω ±5 mA ±2 mV				50 μV, rms 1 Ω ±5 mA ±2 mV				200 μV, rms 1 Ω ±5 mA ±2 mV		
±25 μV/°C		±50 μV/°C		±25 μV/°C		±50 μV/°C		±25 μV/°C		
±6 mA	±10 mA	±14 mA	±18 mA	±6 mA	±10 mA	±14 mA	±18 mA	±10 mA		
(39) A 1.5" x 1.5" x 0.4"	(40) A 2" x 2" x 0.4"	(41) A 3" x 2.1" 0.4"		(39) A 1.5" x 1.5" x 0.4"	(40) A 2" x 2" x 0.4"	(41) A 3" x 2.1" x 0.4"		(39) B 1.5" x 1.5" x 0.4"		
\$75.00 61.00 69.00 57.00	\$89.00 77.00 79.00 67.00	\$110.00 92.00 100.00 84.00	\$135.00 121.00 125.00 111.00	\$75.00 61.00 69.00 57.00	\$89.00 77.00 79.00 67.00	\$110.00 92.00 100.00 84.00	\$135.00 121.00 125.00 111.00	\$79.00 67.00 69.00 55.00		

(5) For models with higher input impedance contact Burr-Brown or your local representative.
(6) ±9 to ±18 VDC power may be used.
(7) ±12 to ±18 VDC power may be used.
(8) The offset may be trimmed to zero, see pg. 79.
(9) All filters have noninverting outputs except the single tuned band pass and band reject filter which have inverting outputs.

M — 58R0

TYPE OF FILTER RESPONSE

Low Pass
B = Butterworth
C = Chebyschev - 0.4 dB nom ripple
D = Chebyschev - 1.6 dB nom ripple
L = Bessel

Band Pass
K for Q = 1(2 pole pairs only)
M for Q = 2
N for Q = 5
P for Q = 10
Q for Q = 20
R for Q = 50 (1 pole pair only)

S - Special Order ** indicate Q on order for
2 pole pairs $1 \leqslant Q \leqslant 20$
1 pole pair $2 \leqslant Q \leqslant 50$
**Add \$25 to order for each special Q value.

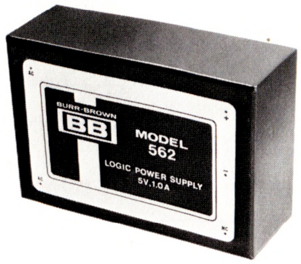
Notch
M for Q = 2
N for Q = 5
P for Q = 10
S for Q = Special** (indicate Q on order, $2 \leqslant Q \leqslant 10$)

CUTOFF OR CENTER FREQUENCY

For frequencies less than 100 Hz, use "R" to indicate decimal point. For frequencies greater than 100 Hz, the last digit indicates number of zeros following first 3 digits of frequency. For example: 58 Hz = 58R0, 580 Hz = 5800, 5800 Hz = 5801

STANDARD SERIES

- LOW COST
- STANDARD PIN CONFIGURATION
- SMALL SIZE
- DUAL AND SINGLE OUTPUTS
- 5 V to ±15 V
- 25 mA TO 1.0 A CURRENT OUTPUT
- EXCELLENT STABILITY FOR LINE, LOAD, & TEMP. VARIATIONS
- 50 TO 400 Hz INPUT
- OUTPUTS CURRENT LIMITED



Burr-Brown's standard series of power supplies offers a wide range of output voltage and current ratings all available in a standard package at very attractive prices. The standard supplies are current limited to protect the supply in an overload condition or output short to temporary common. In addition, two of the 5V supplies have overvoltage protection which limits the maximum output voltage to 7.0V in any power supply failure or fault condition.

DC-DC CONVERTER

- REGULATED ±15 VDC FROM UNREGULATED DC INPUT
- FAST TRANSIENT RESPONSE
- HIGH OUTPUT CURRENTS WITH CURRENT LIMIT PROTECTION

Burr-Brown's DC-DC Converter provides maximum flexibility in systems design. The Model 546 is particularly useful for powering analog interface circuitry in digital systems. It responds to full load transients in less than 10 μsec which makes it excellent for driving A/D and D/A converters where rapid current switching is involved. The 546 also features excellent input-output isolation to keep digital system noise out of analog systems.

Specifications typical at 25°C and rated supply voltage unless otherwise noted.

	STANDARD SERIES 115 VAC INPUT								DC-DC Converter ±15 VDC Output
	DUAL ±15 VDC SUPPLIES				5 VDC LOGIC SUPPLIES			Dual Supplies	FAST RESPONSE (2)
MODEL	550	551	552	553	560	561	562	570	546
RATED OUTPUT Voltage, nom / Current	±15V ±25mA	±15V ±50mA	±15V ±100mA	±15V ±200mA(4)	5V(1) 250mA	5V(1)(3) 500 mA	5V(1)(3) 1.00A(4)	±12V ±100mA	±15V ±100mA
PERFORMANCE									
RATED INPUT, Voltage / Frequency	105–125 VAC 50 –400 Hz								4.5 to 5.5 VDC DC
OUTPUT ERROR	±1%								±1%
REGULATION No Load to Full Load, max / Over Rated Line V, max	±0.1% ±0.05%	±0.05% ±0.05%	±0.05% ±0.05%	±0.05% ±0.05%	±0.1% ±0.05%	±0.1% ±0.05%	±0.1% ±0.05%	±0.05% ±0.05%	±0.1% ±0.1%
OUTPUT VOLTAGE TEMP. COEF. %/°C	±0.02								±0.02
OUTPUT RIPPLE and NOISE @ Full Load, max	2.0 mV rms	1.0mV rms							1.0mV rms 35mV, p-p
TEMPERATURE RANGE Rated Operation / Storage	-25°C to +71°C -25°C to +85°C								0°C to +71°C -25°C to +85°C
PACKAGE DRAWING (See page 80)	(42) 3.5"x 2.5" x 0.9"		(42) 3.5" x 2.5" x 1.3"		(42) 3.5"x 2.5" x 0.9"	(42) 3.5"x 2.5" x 1.3"		(42) 3.5"x 2.5" x 0.9"	(43) 2.1" x 2.1" x 0.4"
PRICE (1 - 9)	$28.00	$42.00	$54.00	$74.00	$44.00	$52.00	$72.00	$54.00	$79.00

(1) All single supplies may be connected for positive or negative output voltage.
(2) Output voltage settles to 0.1% of final output in 10 μsec. Output in 10 μsec for no load or full load to no load transient.
(3) These 5 V supplies have overvoltage protection which limits the output voltage to 7.0 volts, max, in a fault condition.
(4) Current derating factors must be used for operation above 50°C. These models only: Model 553, 5 mA/°C, Model 562, 25 mA/°C.

Prices and specifications are subject to change without notice.

CONNECTORS

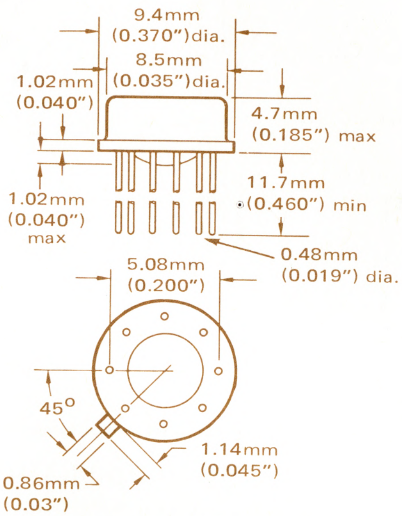
Although most customers prefer direct printed circuit board mounting for modular supplies, plug-in sockets are available for all power supplies. See page 80 for connector numbers.

OPERATIONAL AMPLIFIERS

1

TO-99 PACKAGE

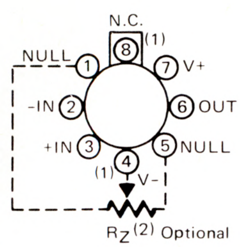
Connector: 0899 MC



BOTTOM VIEW

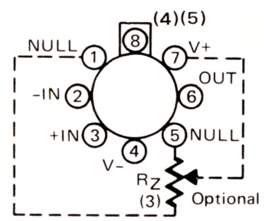
A

TOP VIEW



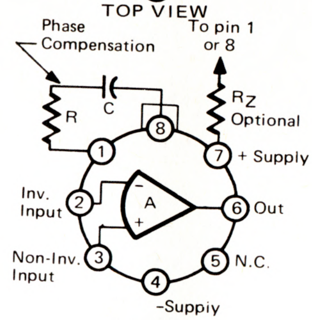
B

TOP VIEW



C

TOP VIEW



NOTE: Pin 4 connected to case.

(1) Pin 8 connected to case on 3542, 3521, 3522, 3523. Pin 4 connected to case on 3501, 3503, 3500.

(2) 50 kΩ: 3500, 3501
10 kΩ: 3540, 3521, 3522, 3523, 3542.

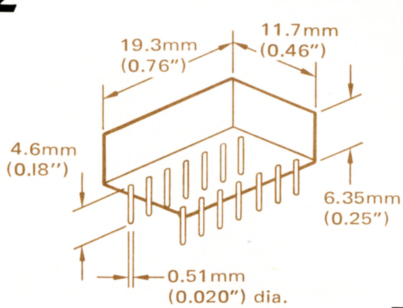
(3) 20 kΩ: 3505J, 3507J, 3550, 3551
100 kΩ: 3506J, 3508J.

(4) 3550 - Pin 8 is connected to case.

(5) Pin 8 is bandwidth control for 3507, 3508, 3551, (C_f from pin 8 to common)

2

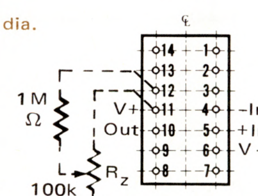
DUAL-IN-LINE PACKAGE



Connector: 0145 MC
Pin Dia: 0.51mm (0.020")

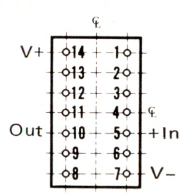
Pin Spacing: 2.54mm (0.1")
7.62mm (0.300") between pin rows

A



R_Z Optional

B

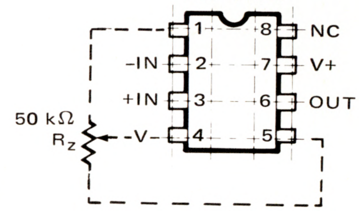


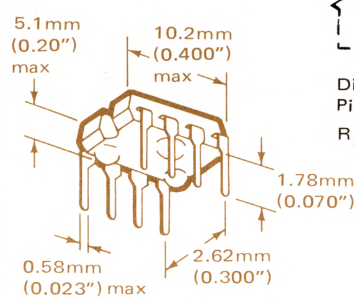
Bottom View

3

MINI DIP PACKAGE

TOP VIEW

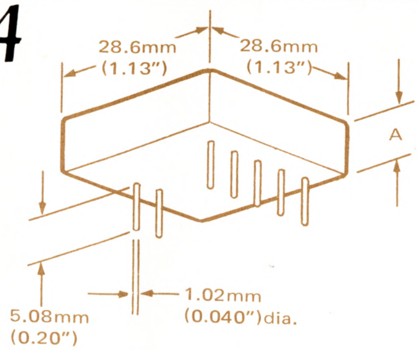




Dimple appears over Pin space #1

R_Z Optional

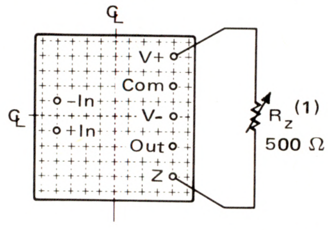
4



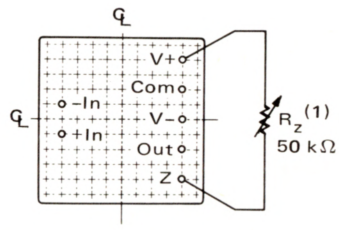
A Height: Pkg. 4A = 10.2mm (0.4")
Pkg. 4B, 4C, 4D = 12.7mm (0.5")

Connector: 1200 MC
Grid: 2.54mm (0.1")

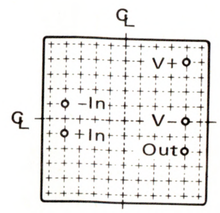
A B



C



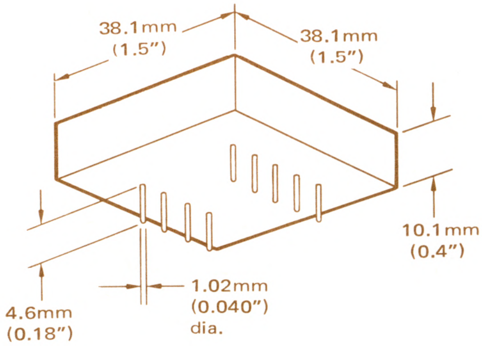
D



(1) R_Z required for operation
May be fixed resistor at $R_Z/2$.

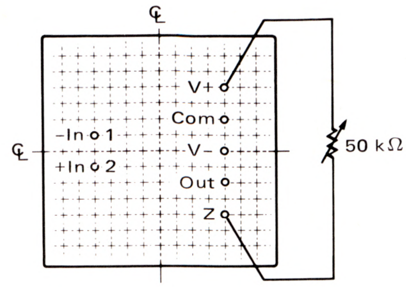
BOTTOM VIEWS

5

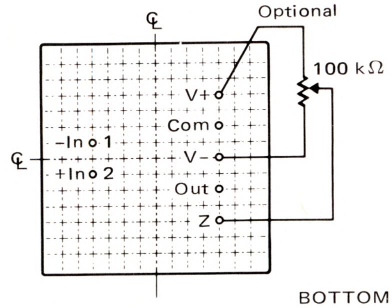


Connector: 1400 MC
Grid: 2.54mm (0.1")

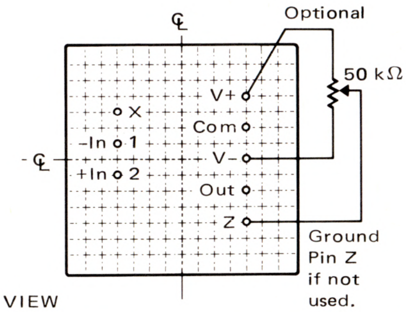
A



B



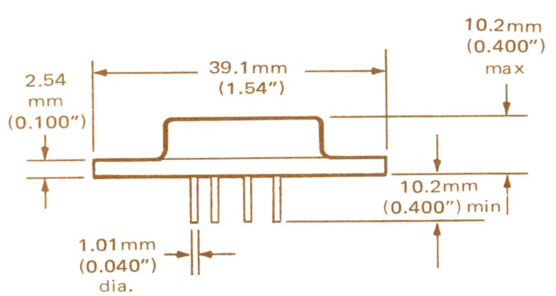
C

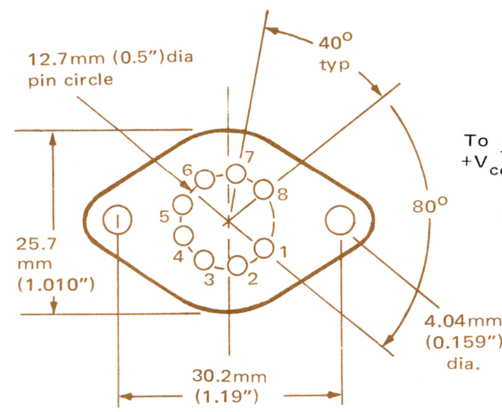


BOTTOM VIEW

6

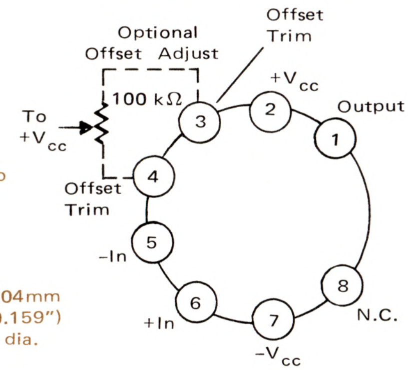
TO-3 PACKAGE
Connector: 0803MC





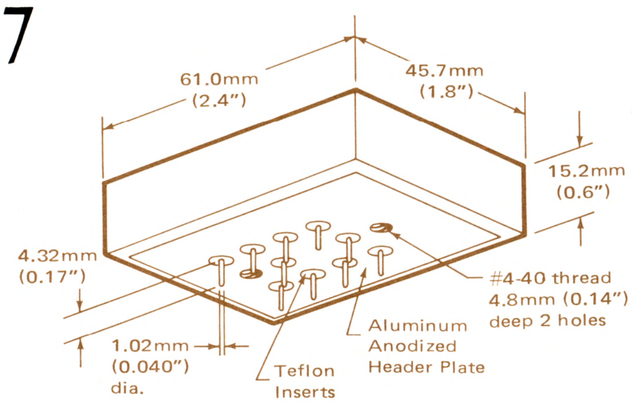
BOTTOM VIEW

PIN CONFIGURATION

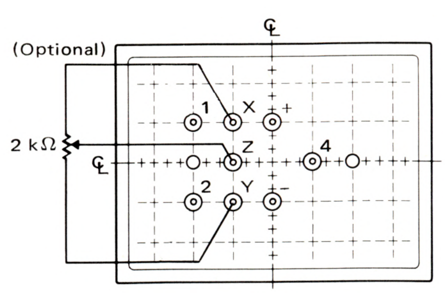


TOP VIEW

7

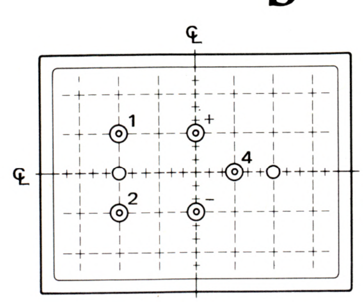


A

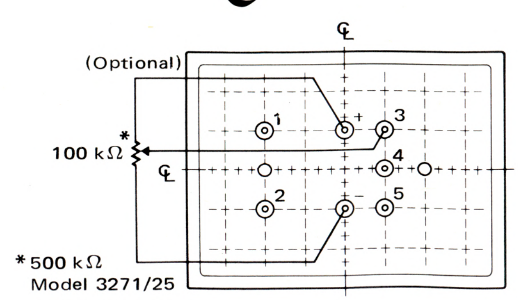


BOTTOM VIEW

B



C

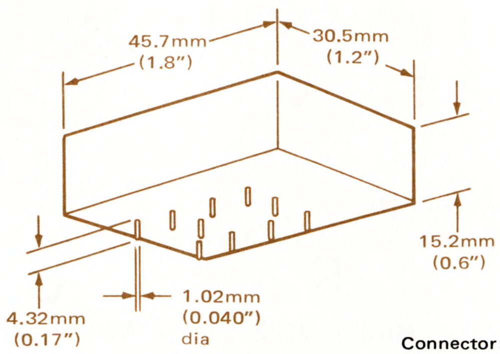


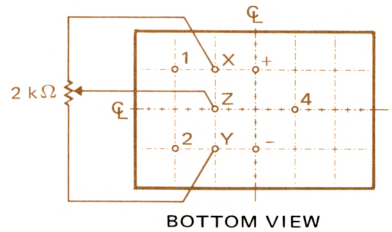
*500 kΩ
Model 3271/25

PIN CONNECTIONS

1 −In (N.C. Power Booster)
2 +In or Common
3 Trim
4 Out
5 Overload Signal
+ Positive Supply
− Negative Supply

8





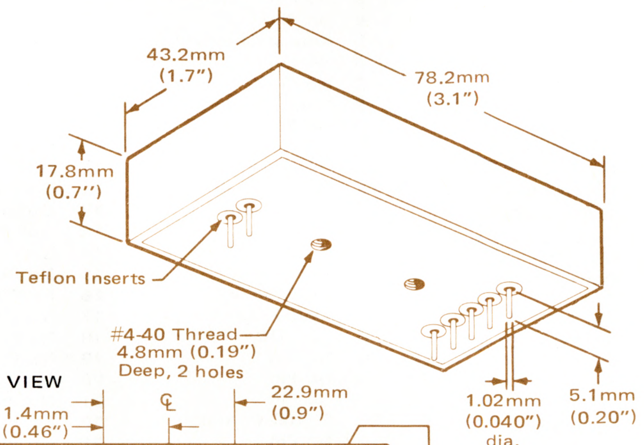
BOTTOM VIEW

Connector: 1500 MC
Grid: 7.6mm (0.3")

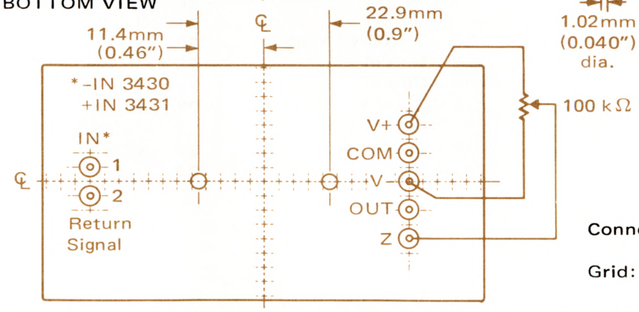
PIN CONNECTIONS

1	–IN	
2	+IN	
+	Positive Supply	
–	Negative Supply	
4	Out	

9

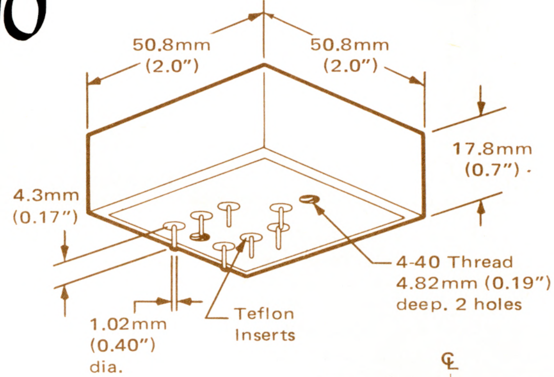


BOTTOM VIEW



Connector: 2800 MC
Grid: 2.54mm (0.1")

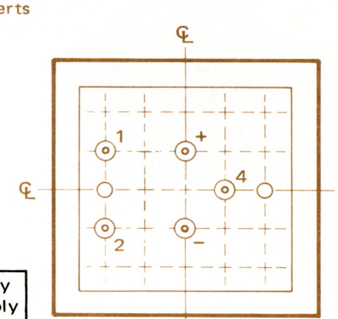
10



Connector: 1500 MC
Grid: 7.6mm (0.3")

PIN CONNECTIONS

1	NC	+	Positive Supply
2	Input	–	Negative Supply
		4	Out



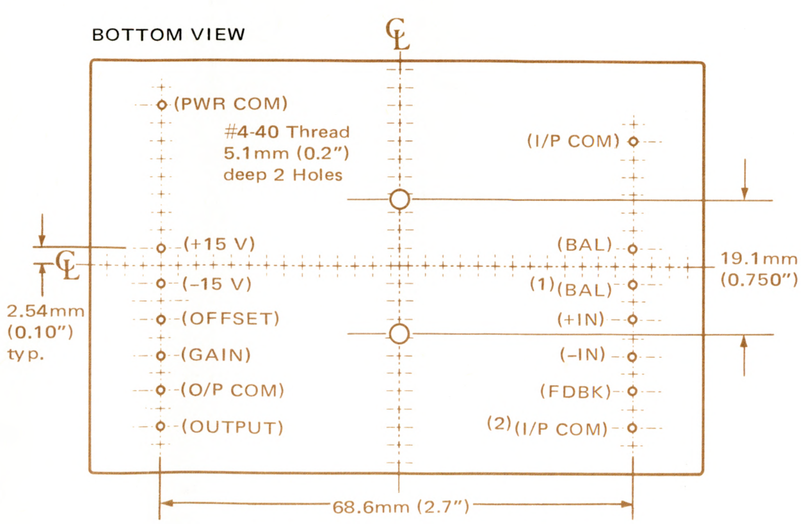
BOTTOM VIEW

11

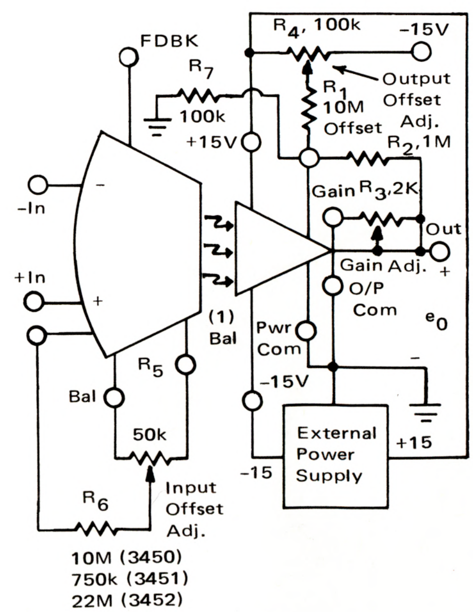
Connector: **4400 MC**
Grid: 2.5mm (0.1")
Pin Dia.: 1.02mm (0.040")

Length: 88.9mm (3.5")
Width: 58.4mm (2.3")
Height: 17.8mm (0.7")

BOTTOM VIEW



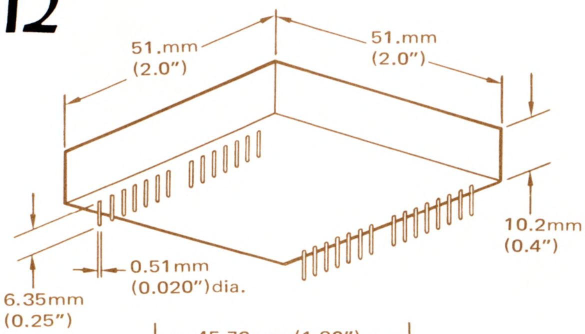
(1) This terminal labeled "V/Bal" on Model 3452
(2) This terminal labeled "+V" on Model 3452

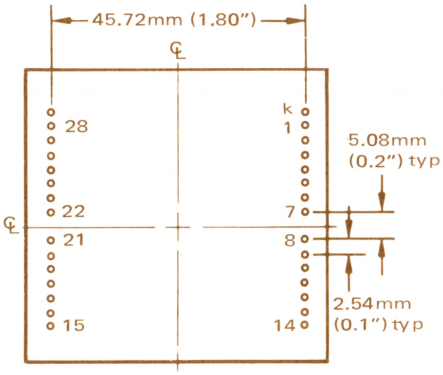


Note: All external adjustments are optional.

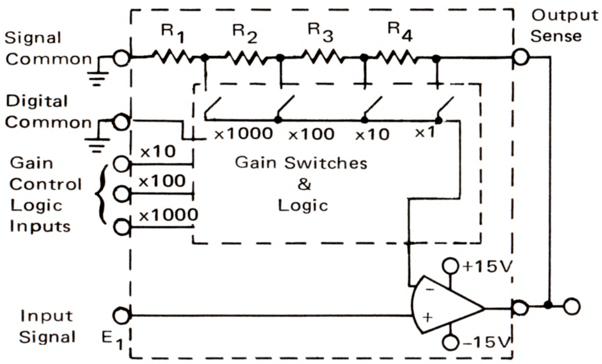
INSTRUMENTATION AMPLIFIERS

12





BOTTOM VIEW



FUNCTION DIAGRAM - 3602

PIN CONNECTIONS

Pin designations appear on top of modules

A — MODEL 3620

- k No Connection
- 1 −15 VDC
- 2 +15 VDC
- 3 Gain Sense
- 4 Gain
- 5 Common
- 6 Output Offset
- 7 Inverting Input
- 8 Non-inverting Input
- 9 Gain
- 10 Gain Sense
- 11 Balance (end)
- 12 Balance (end)
- 13 Balance (arm)

(11–13: 10k optional)

- 14 No Connection
- 15 CMR 1
- 16 CMR 1
- 17 CMR 2
- 18 CMR 2
- 19 Guard
- 20 No Pin
- 21 No Pin
- 22 No Pin
- 23 No Pin
- 24, 25 Jumper
- 26 Output
- 27 Output Sense
- 28 Output Summing Junction

B — MODEL 3602

- k No Connection
- 1 −15 VDC
- 2 +15 VDC
- 3 No Pin
- 4 No Pin
- 5 Analog Common
- 6 No Pin
- 7 No Pin
- 8 Non-Inverting Input
- 9 No Pin
- 10 No Pin
- 11 Offset (end)
- 12 Offset (end)
- 13 Offset (arm)

(11–13: 2k Optional)

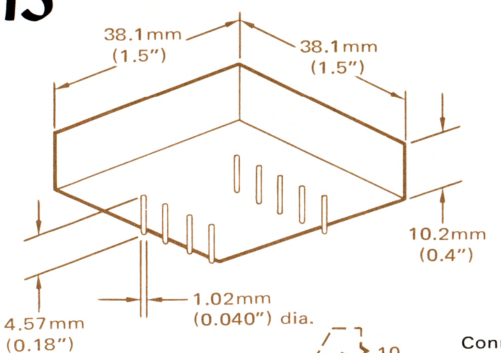
- 14 No Pin
- 15 No Pin
- 16 x10 Gain
- 17 x100 Gain
- 18 x1000 Gain
- 19 +5 VDC
- 20 No Pin
- 21 No Pin
- 22 No Pin
- 23 Digital Common
- 24 No Pin
- 25 No Pin
- 26 Output
- 27 Output Sense
- 28 No Pin

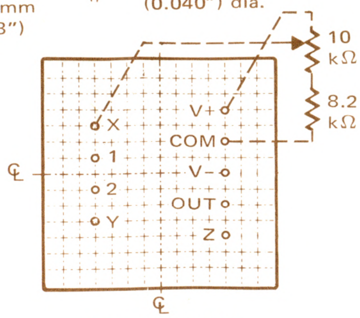
C — MODEL 3622

- k No Connection
- 1 −15 VDC
- 2 +15VDC
- 3 In Bal
- 4 Gain
- 5 Sig Common
- 6 No Pin
- 7 Inverting Input
- 8 Non-inverting Input
- 9 Gain
- 10 No Pin
- 11 Out Offset Adj.
- 12 Output Sense
- 13 Out Offset Adj.
- 14 No Pin
- 15 No Pin
- 16 No Pin
- 17 No Pin
- 18 No Pin
- 19 No Pin
- 20 Power Common
- 21 No Pin
- 22 No Pin
- 23 No Pin
- 24 No Pin
- 25 No Pin
- 26 Output
- 27 No Pin
- 28 No Pin

Connector: 2300 MC
Grid: 2.5mm (0.1")

13





BOTTOM VIEW

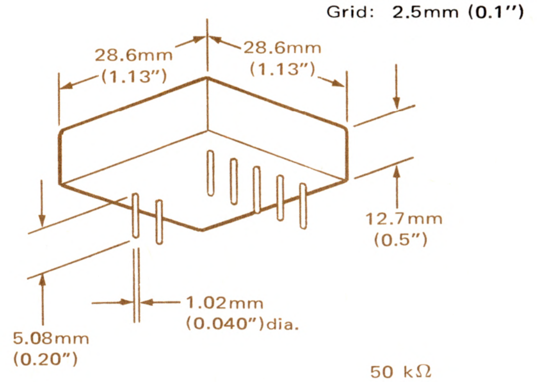
Connector: **1400 MC**
Grid: 2.5mm **(0.1")**

PIN CONNECTIONS

X	Offset Control
1	Inverting Input
2	Non-Inverting Input
Y	Gain Resistor
V+	+15VDC
COM	Common
V−	−15 VDC
OUT	Output
Z	Gain Resistor

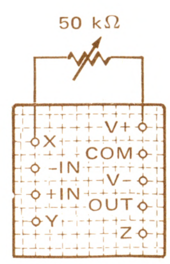
14

Connector: **1200 MC**
Grid: 2.5mm **(0.1")**



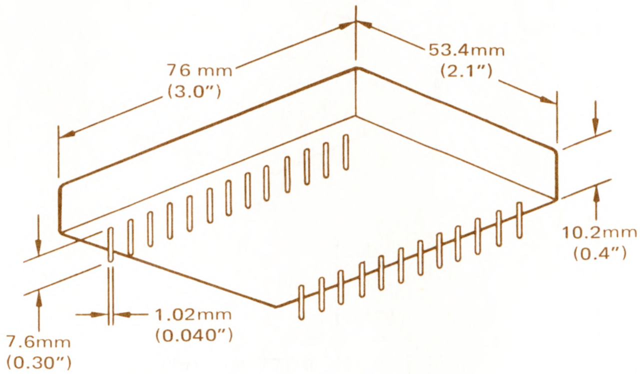
PIN CONNECTIONS

X	Offset Control
−IN	Inverting Input
+IN	Non-Inverting Input
Y	Gain Resistor
V+	+15 VDC
COM	Common
V−	−15 VDC
OUT	Output
Z	Gain Resistor



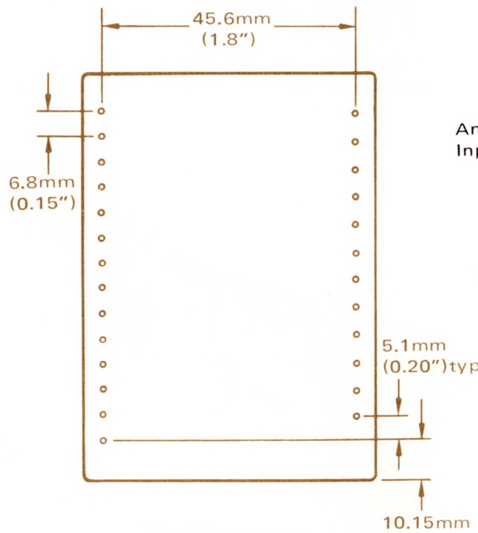
BOTTOM VIEW

15

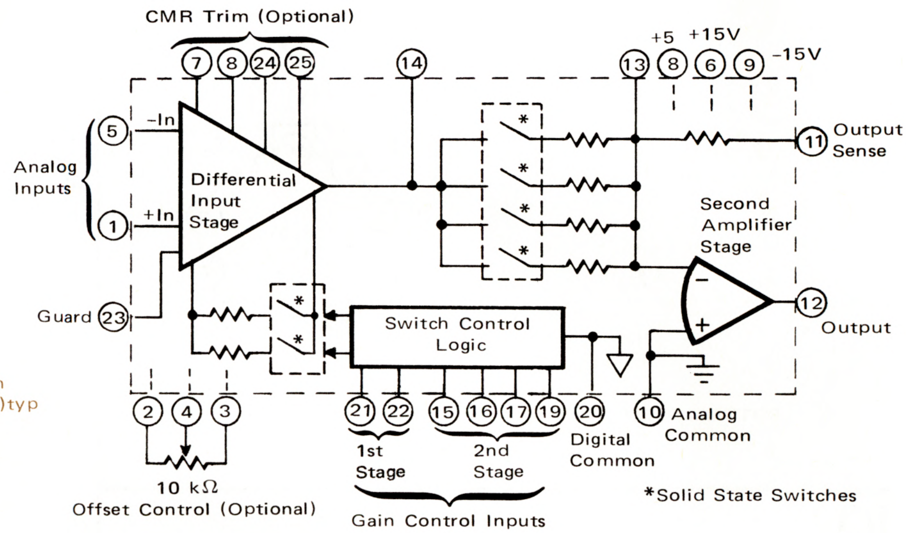


PIN CONNECTIONS

1	Non-Inverting Input	15	x8 Logic Input
2	External Balance (end) } 10k Optional	16	x4 Logic Input
3	External Balance (end) } 10k Optional	17	x2 Logic Input
4	External Balance (arm) } 10k Optional	18	+5 VDC Power
5	Inverting Input	19	x1 Logic Input
6	+15 VDC	20	Digital Common
7	CMR Trim	21	x16 Logic Input (3600) x10 (3601)
8	CMR Trim	22	x256 Logic Input (3600) x100 (3601)
9	-15 VDC Power	23	Guard
10	Analog Common	24	CMR Trim
11	Output Sense Point	25	CMR Trim
12	Output		
13	Summing Point		
14	Test Point		



BOTTOM VIEW

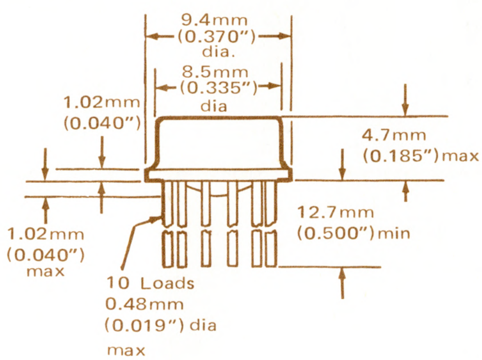


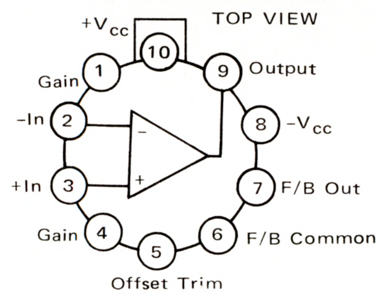
FUNCTIONAL DIAGRAM-MODELS 3600 and 3601

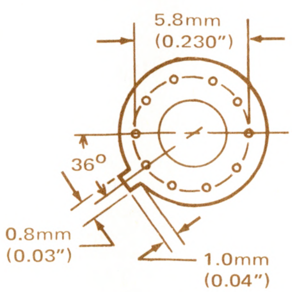
16

TO-100 PACKAGE

Connector: 0899 MC

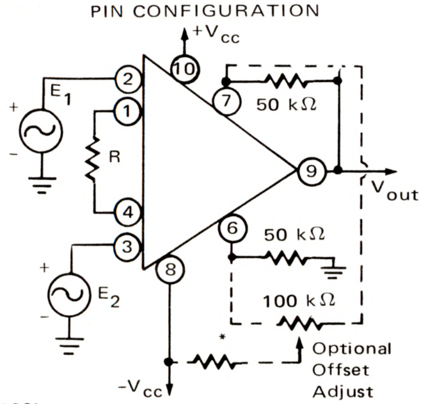






BOTTOM VIEW

PIN CONFIGURATION

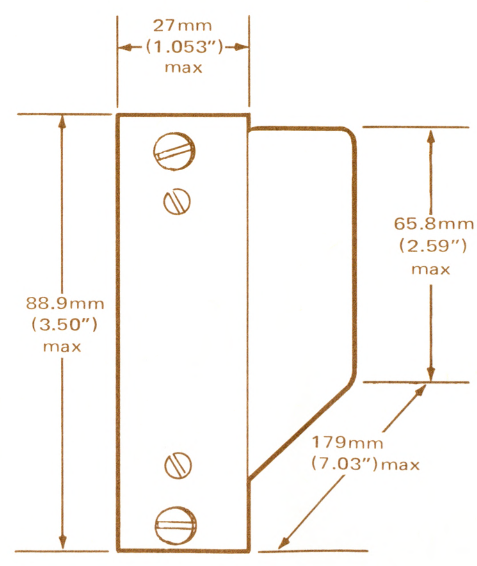


$$V_{out} = \frac{100k}{R}(E_2 - E_1)$$

*50 kΩ 3660K, S
0 Ω 3660J, 3670J, K, S

17

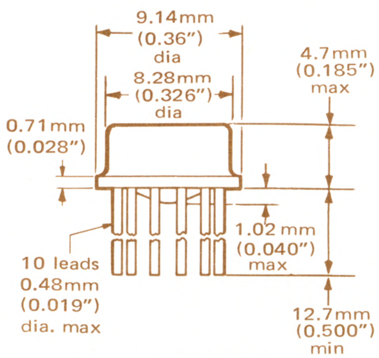
/16 PACKAGE



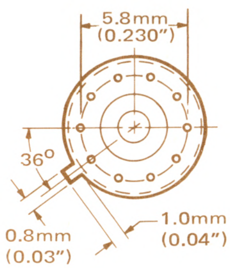
Connector: Burndy 4206P5 furnished with each unit.

ANALOG CIRCUIT FUNCTIONS

18

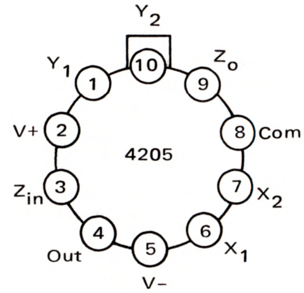


Pin 5 connected to case.

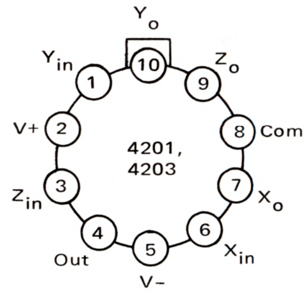


BOTTOM VIEW

A



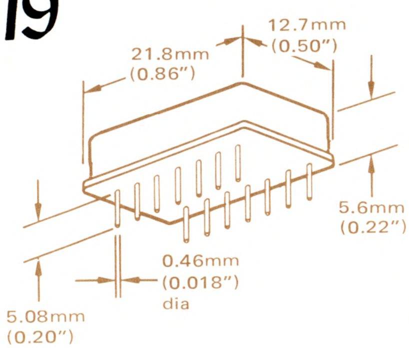
B

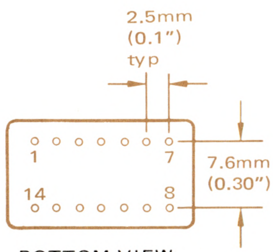


TOP VIEW

Connector: 0899 MC

19





BOTTOM VIEW

Pin 1 is identified by a black dot on the top surface.

PIN CONNECTIONS

A

MODEL 4301

1 X Input
2 Output
3 –15 VDC
4 No Connection
5 X Offset
6 m_A
7 Z Input
8 Z Offset
9 No Connection
10 Common
11 m_B
12 m_C
13 Y Input
14 +15 VDC

B

MODEL 4340

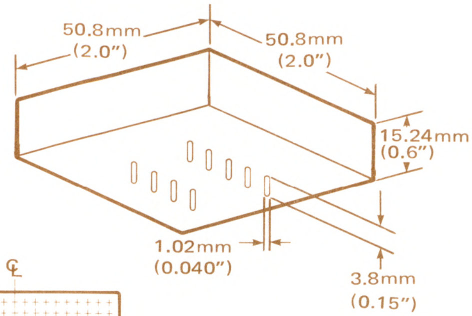
1 Input
2 External C_H
3 –15 VDC
4 Offset, External C_L
5 Gain
6 Output
7 No Connection
8 No Connection
9 No Connection
10 Common
11 No Connection
12 DC Reversal Adj.
13 DC Reversal Adj.
14 +15 VDC

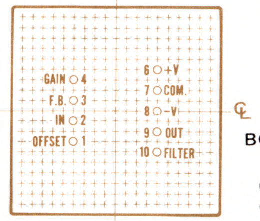
C

MODEL 4204

1 E_z
2 Output
3 –15 VDC
4 Feedthrough Adj.
5 No Connection
6 No Connection
7 E_x
8 Internal Reference
9 No Connection
10 Ground
11 Feedthrough Adj.
12 Offset Adj.
13 E_y
14 +15 VDC

20

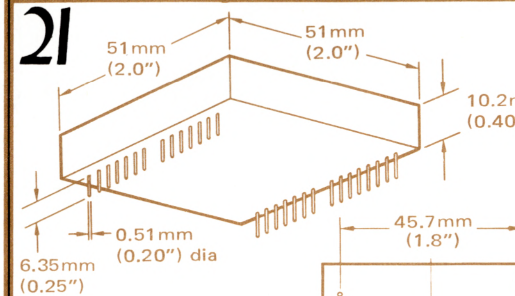


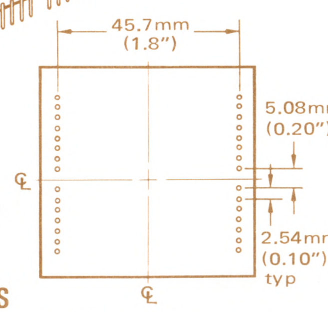


BOTTOM VIEW

Connector: **1400 MC**
Grid: **2.5mm (0.1")**

21



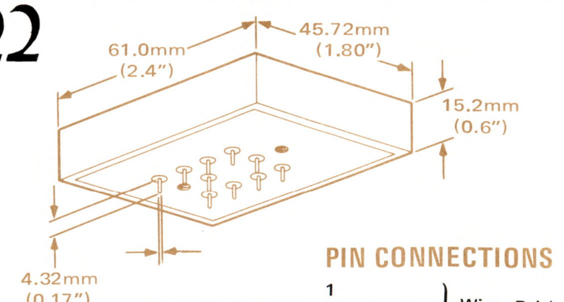


BOTTOM VIEW

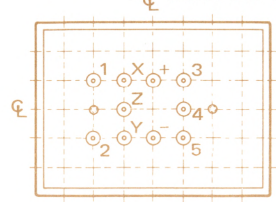
PIN CONNECTIONS

k	Key	10	N Offset	20	N/A
1	–15V	11	N/A	21	Common
2	+15V	12	N/A	22	N/A
3	N/A	13	N/A	23	N/A
4	D Offset	14	N/A	24	N/A
5	Common	15	N/A	25	S.J.
6	N/A	16	N/A	26	Output
7	D	17	N/A	27	N/A
8	N	18	N/A	28	Gain Trim
9	N/A	19	N/A		

22



BOTTOM VIEW

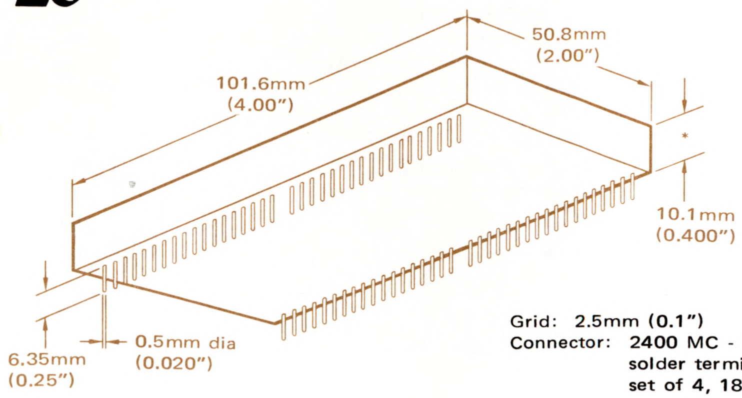


PIN CONNECTIONS

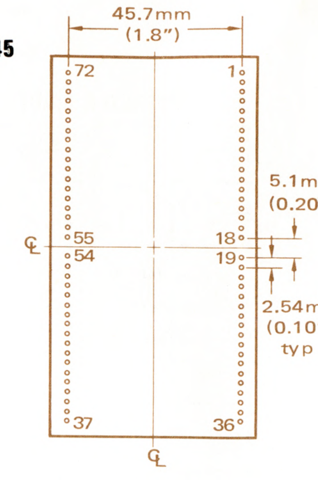
1 }
2 Common } Wien Bridge Terminals
3 }
4 Output A
5 Output B
Y } Integrator Terminals } Feedback
X }
(+) Positive Power +15 VDC
(–) Negative Power –15 VDC

DATA CONVERSION PRODUCTS

23 PACKAGE DRAWING MODELS: ADC40, ADC50, ADC55, ADC60, ADC100, DAC40 "B", DAC45



*ADC60 Height: 19.05mm (0.75")

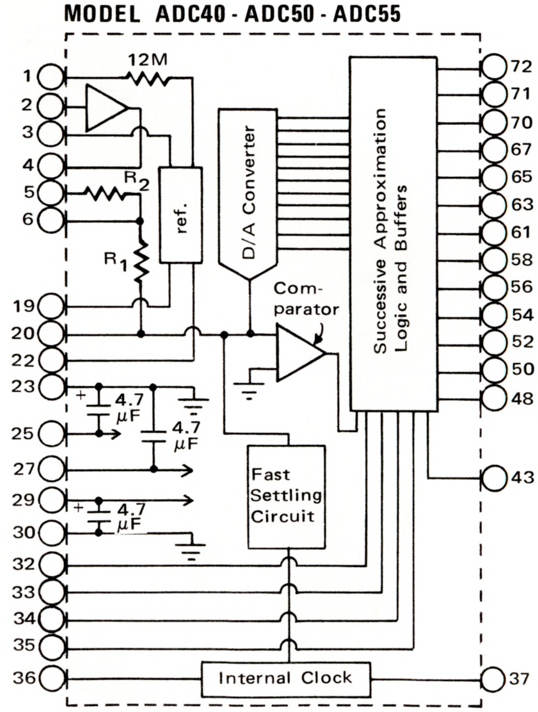


BOTTOM VIEW

Grid: 2.5mm (0.1")
Connector: 2400 MC - P.C. Card with solder terminals or 2400 MC set of 4, 18 pin connector strips.

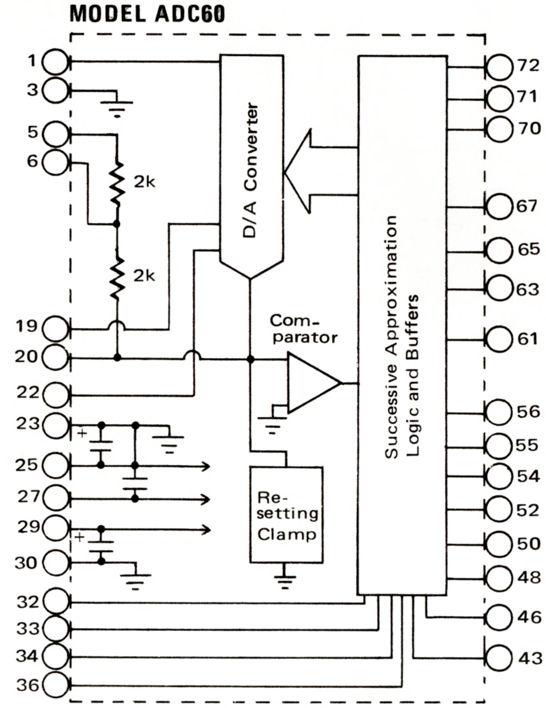
CONNECTION DIAGRAMS

A MODEL ADC40 - ADC50 - ADC55



TOP VIEWS

B MODEL ADC60



PIN CONNECTIONS

MODEL ADC40 - ADC50 - ADC55

1	Gain Adj.	25	−15V	49	No Connection
2	Analog In.	26	No Connection	50	Bit 11*
3	An. In. Com	27	+15V	51	No Connection
4	Buffer Out	28	No Connection	52	Bit 10
5	R_2	29	+5V	53	No Connection
6	R_1	30	Dig. Com.	54	Bit 9
7	No Connection	31	No Connection	55	No Connection
8	No Connection	32	Serial Out	56	Bit 8
9	No Connection	33	Status	57	No Connection
10	No Connection	34	Convert Command	58	Bit 7
11	No Connection	35	Clock In	59	No Connection
12	No Connection	36	Clock Out	60	No Connection
13	No Connection	37	Clock Inhibit	61	Bit 6
14	No Connection	38	No Connection	62	No Connection
15	No Connection	39	No Connection	63	Bit 5
16	No Connection	40	No Connection	64	No Connection
17	No Connection	41	No Connection	65	Bit 4
18	No Connection	42	No Connection	66	No Connection
19	Bipolar Offset	43	Status	67	Bit 3
20	Comp. In.	44	No Connection	68	No Connection
21	No Connection	45	No Connection	69	No Connection
22	Ref. Out	46	No Connection	70	Bit 1 (MSB)
23	Analog Com.	47	No Connection	71	Bit 2
24	No Connection	48	Bit 12*	72	Bit 1 (MSB)

MODEL ADC60

1	Gain Adj.	25	−15V	49	No Connection
2	No Connection	26	No Connection	50	Bit 11
3	Signal Com.	27	+15V	51	No Connection
4	No Connection	28	No Connection	52	Bit 10
5	R_2	29	+5V	53	No Connection
6	R_1	30	Digital Common	54	Bit 9
7	No Connection	31	No Connection	55	No Connection
8	No Connection	32	Serial Out	56	Bit 8
9	No Connection	33	Status	57	No Connection
10	No Connection	34	Convert Command	58	Bit 7
11	No Connection	35	No Connection	59	No Connection
12	No Connection	36	Clock Out	60	No Connection
13	No Connection	37	No Connection	61	Bit 6
14	No Connection	38	No Connection	62	No Connection
15	No Connection	39	No Connection	63	Bit 5
16	No Connection	40	No Connection	64	No Connection
17	No Connection	41	No Connection	65	Bit 4
18	No Connection	42	No Connection	66	No Connection
19	Bipolar Offset	43	Status	67	Bit 3
20	Comp. In	44	No Connection	68	No Connection
21	No Connection	45	No Connection	69	No Connection
22	Ref. Out	46	Short Cycle	70	Bit 1 (MSB)
23	Analog Com.	47	No Connection	71	Bit 2
24	No Connection	48	Bit 12	72	Bit 1 (MSB)

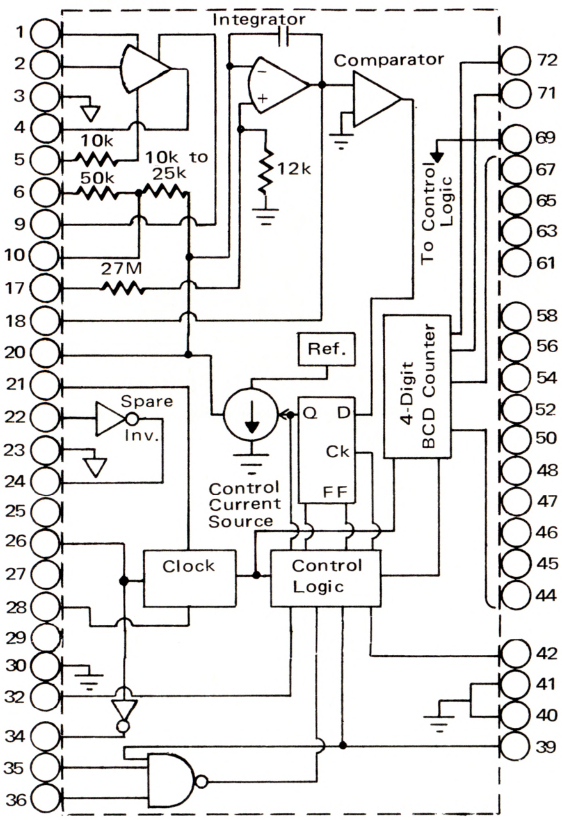
*Not connected for 10-bit models.

CONNECTION DIAGRAMS

TOP VIEWS

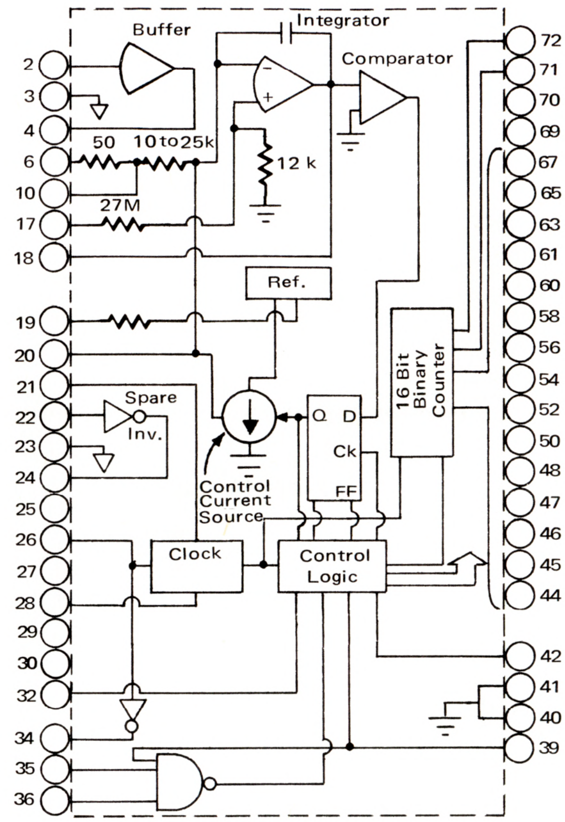
C

ADC100 (BCD & SMD)



D

ADC100 (USB & BOB)



PIN CONNECTIONS

ADC100 (BCD & SMD)

1. –Adjust
2. Buffer In
3. An Com.
4. Buffer Out
5. –Adjust
6. Unbuff. In
7. No Connection
8. No Connection
9. Sign. Out
10. Gain Adjust
11. No Connection
12. No Connection
13. No Connection
14. No Connection
15. No Connection
16. No Connection
17. Offset Adjust
18. TP
19. No Connection
20. Summing Junction
21. Clock Trim
22. Inv. In
23. An Common
24. Inv. Out
25. –15 V
26. Clock Out
27. +15 V
28. Clock In
29. +5 V
30. Dig. Common
31. No Connection
32. Current
33. No Connection
34. Clock
35. Conv. Command
36. Conv. Command
37. No Connection
38. No Connection
39. End of Convert
40. Dig. Common
41. Dig. Common
42. Term. In
43. No Connection
44. Bit 16
45. Bit 15
46. Bit 14
47. Bit 13
48. Bit 12
49. No Connection
50. Bit 11
51. No Connection
52. Bit 10
53. No Connection
54. Bit 9
55. No Connection
56. Bit 8
57. No Connection
58. Bit 7
59. No Connection
60. No Connection
61. Bit 6
62. No Connection
63. Bit 5
64. No Connection
65. Bit 4
66. No Connection
67. Bit 3
68. No Connection
69. Term. Out
70. No Connection
71. Bit 2
72. Bit 1 (MSB)

ADC100 (USB & BOB)

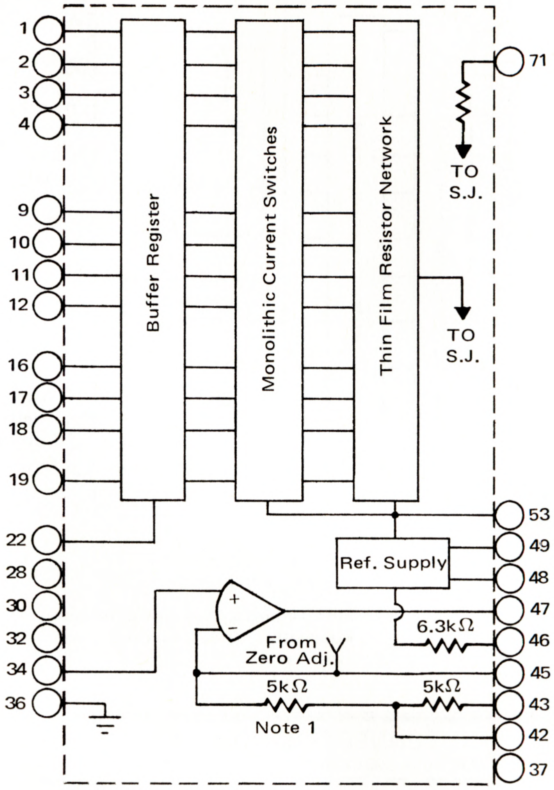
1. No Connection
2. Buffer In
3. An. Common
4. Buffer Out
5. No Connection
6. Unbuff. In
7. No Connection
8. No Connection
9. No Connection
10. Gain Adjust
11. No Connection
12. No Connection
13. No Connection
14. No Connection
15. No Connection
16. No Connection
17. Offset Adjust
18. TP
19. Bipolar Offset
20. Summing Junction
21. Clock Trim
22. Inv. In
23. An. Common
24. Inv. Out
25. –15 V
26. Clock Out
27. +15 V
28. Clock In
29. +5 V
30. Dig. Common
31. No Connection
32. Current
33. No Connection
34. Clock
35. Conv. Command
36. Conv. Command
37. No Connection
38. No Connection
39. End of Convert
40. Dig. Common
41. Dig. Common
42. Term. In
43. No Connection
44. Bit 16 (LSB)
45. Bit 15
46. Bit 14
47. Bit 13
48. Bit 12
49. No Connection
50. Bit 11
51. No Connection
52. Bit 10
53. No Connection
54. Bit 9
55. No Connection
56. Bit 8
57. No Connection
58. Bit 7
59. No Connection
60. 12 Bit Term.
61. Bit 6
62. No Connection
63. Bit 5
64. No Connection
65. Bit 4
66. No Connection
67. Bit 3
68. No Connection
69. 16 Bit Term.
70. 14 Bit Term.
71. Bit 2
72. Bit 1 (MSB)

CONNECTION DIAGRAMS

TOP VIEWS

E

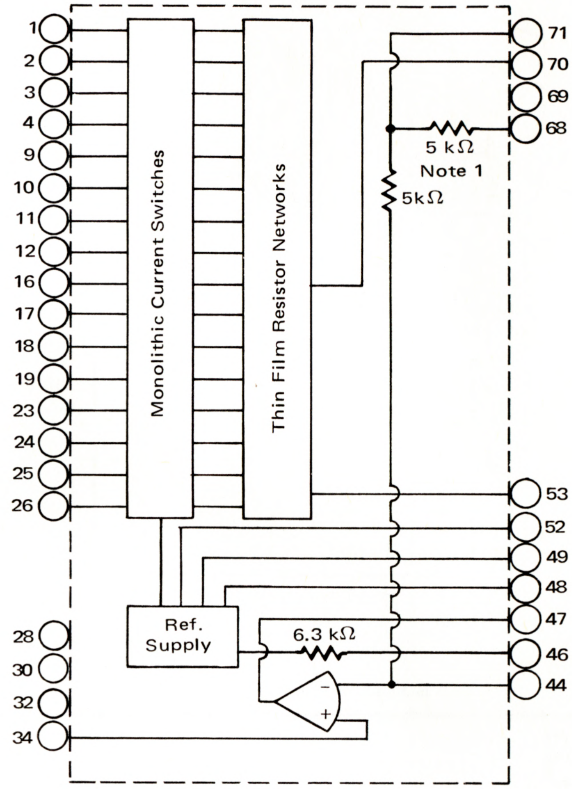
DAC40 ("B" MODELS)



Note 1: 5 kΩ for binary models
3 kΩ for BCD models

F

DAC45



Note 1: 5 kΩ for Binary models,
3 kΩ for BCD models.

PIN CONNECTIONS

DAC40 ("B" MODELS)

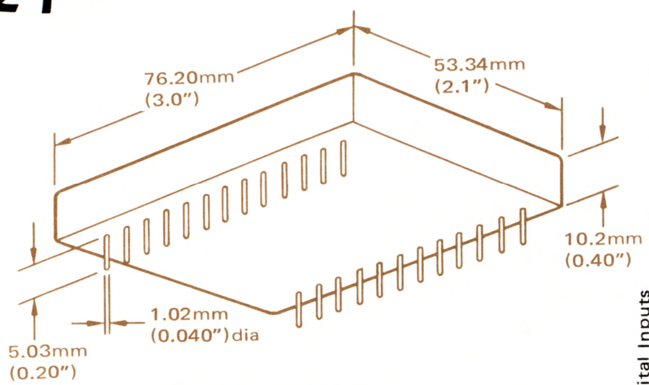
1. Bit 1 (MSB)
2. Bit 2
3. Bit 3
4. Bit 4
5. No Connection
6. No Connection
7. No Connection
8. No Connection
9. Bit 5
10. Bit 6
11. Bit 7
12. Bit 8
13. No Connection
14. No Connection
15. No Connection
16. Bit 9
17. Bit 10
18. Bit 11
19. Bit 12
20. No Connection
21. No Connection
22. Strobe
23. No Connection
24. No Connection
25. No Connection
26. No Connection
27. No Connection
28. +5 V
29. No Connection
30. + 15 V
31. No Connection
32. -5 V
33. No Connection
34. Analog Common
35. No Connection
36. Dig. Common
37. R_3 (not used)
38. No Connection
39. No Connection
40. No Connection
41. No Connection
42. R_1 -10V Range
43. R_2 -20V Range
44. No Connection
45. Sum Jct.
46. Bipolar Offset
47. Output
48. Gain Adj.
49. Gain Adj.
50. No Connection
51. No Connection
52. No Connection
53. Ref. Out
54. No Connection
55. No Connection
56. No Connection
57. No Connection
58. No Connection
59. No Connection
60. No Connection
61. No Connection
62. No Connection
63. No Connection
64. No Connection
65. No Connection
66. No Connection
67. No Connection
68. No Connection
69. No Connection
70. No Connection
71. Zero Adjust
72. No Connection

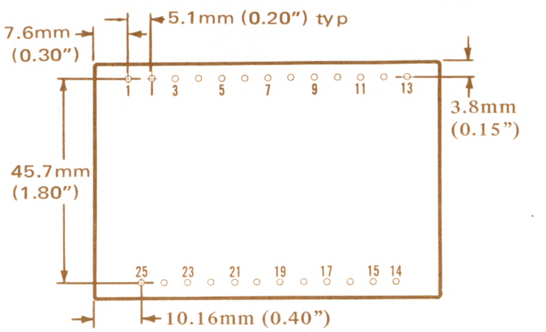
DAC45

1. Bit 1 (MSB)
2. Bit 2
3. Bit 3
4. Bit 4
5. No Connection
6. No Connection
7. No Connection
8. No Connection
9. Bit 5
10. Bit 6
11. Bit 7
12. Bit 8
13. No Connection
14. No Connection
15. No Connection
16. Bit 9
17. Bit 10
18. Bit 11
19. Bit 12
20. No Connection
21. No Connection
22. No Connection
23. Bit 13
24. Bit 14
25. Bit 15
26. Bit 16
27. No Connection
28. +5 V
29. No Connection
30. +15 V
31. No Connection
32. -5 V
33. No Connection
34. Common
35. No Connection
36. No Connection
37. No Connection
38. No Connection
39. No Connection
40. No Connection
41. No Connection
42. No Connection
43. No Connection
44. Amp In
45. No Connection
46. BP Offset
47. Amp Out
48. Gain Adjust
49. Gain Adjust
50. No Connection
51. No Connection
52. Ref. Out
53. Ref. In
54. No Connection
55. No Connection
56. No Connection
57. No Connection
58. No Connection
59. No Connection
60. No Connection
61. No Connection
62. No Connection
63. No Connection
64. No Connection
65. No Connection
66. No Connection
67. No Connection
68. R_2 20V Range
69. Current Out
70. R_1 10V Range
71. Zero Adjust
72. No Connection

24

MODEL DAC20



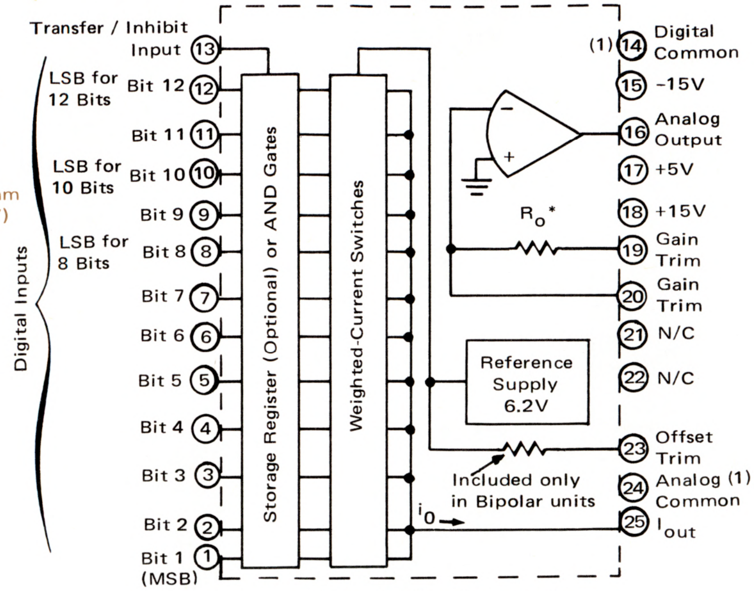


BOTTOM VIEW

Grid: 5.1mm (0.20")
Connector: None

CONNECTION DIAGRAM

BOTTOM VIEW

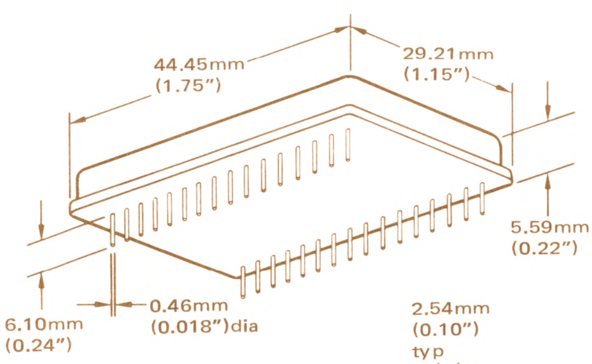


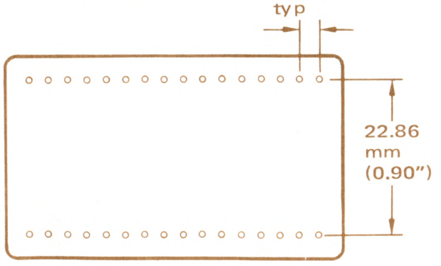
$*R_o$ = 5 kΩ, unipolar units
10kΩ, bipolar units
8 kΩ, BCD units

(1) Pins 14 and 24 are not connected internally. They must be connected externally.

25

MODEL ADC85



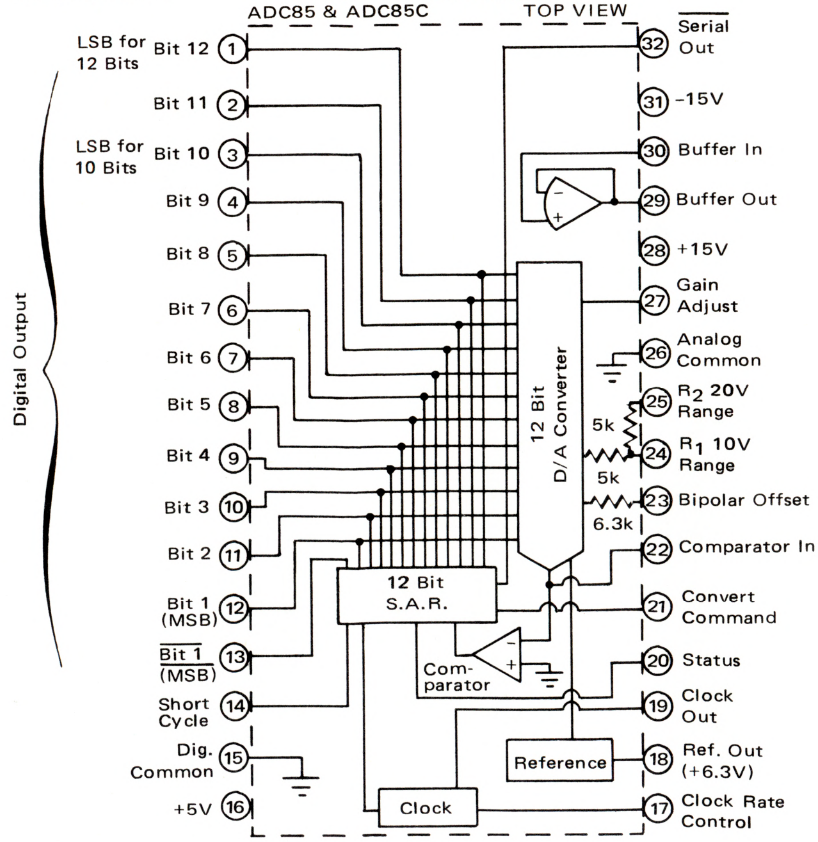


BOTTOM VIEW

Connector: 2302 MC set of two 16 pin connector strips

CONNECTION DIAGRAM

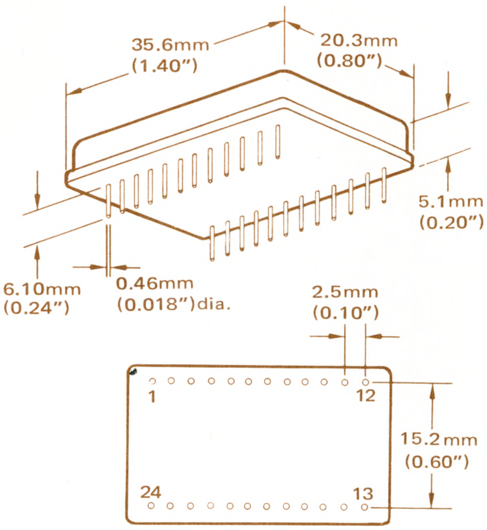
ADC85 & ADC85C TOP VIEW



*Digital Common is internally connected to case.

26

MODEL DAC85



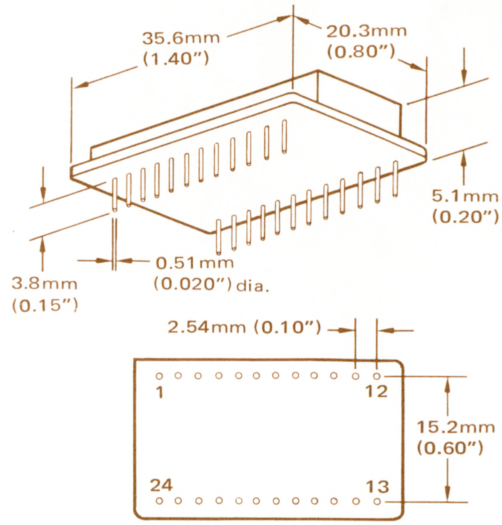
BOTTOM VIEW

Case: Kovar
Connector: 0245 MC

Note 1: Amplifier not included in current output models.
Note 2: 3 kΩ for CCD Models
5 kΩ for CBI Models

27

MODEL DAC80



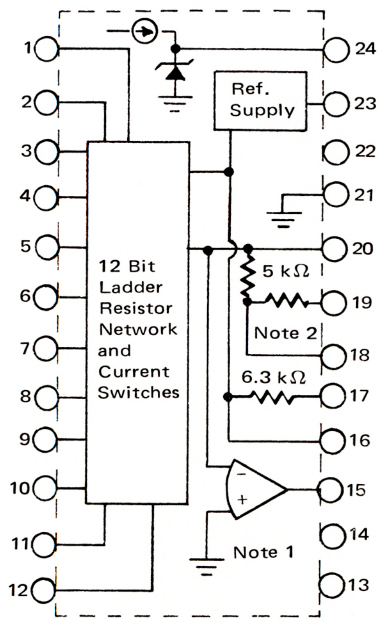
BOTTOM VIEW

Case: Ceramic
Connector: 0245 MC

CONNECTION DIAGRAM

DAC80 & DAC85
(Voltage Output Models)

TOP VIEW

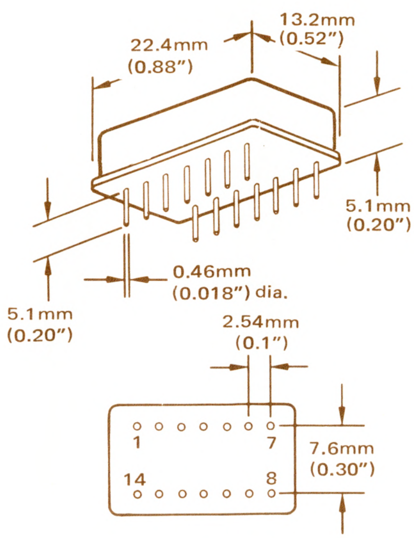


PIN CONNECTIONS

1	Bit 1 (MSB)	13	+5 VDC
2	Bit 2	14	–15 VDC
3	Bit 3	15	Voltage Output
4	Bit 4	16	Ref. Input
5	Bit 5	17	Bipolar Offset
6	Bit 6	18	10V Range
7	Bit 7	19	20V Range
8	Bit 8	20	Summing Junction
9	Bit 9	21	Common
10	Bit 10	22	+15 VDC
11	Bit 11	23	Gain Adjust
12	Bit 12 (LSB)	24	6.3V Ref. Out

28

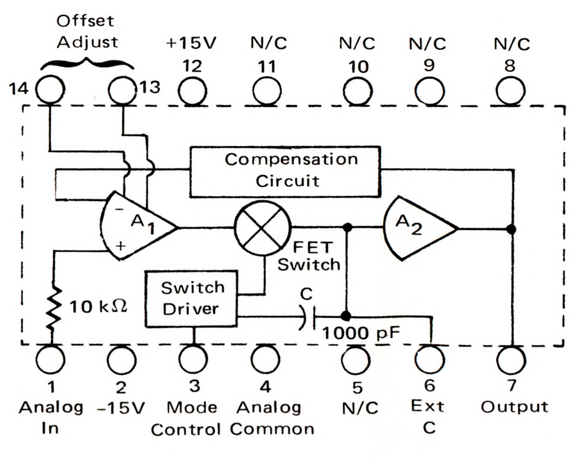
MODEL SHC85



BOTTOM VIEW

Connector: 0145 MC

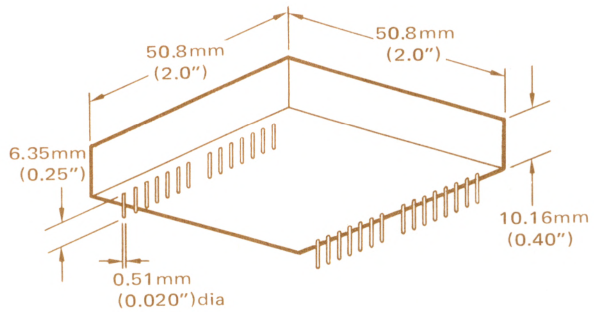
CONNECTION DIAGRAM

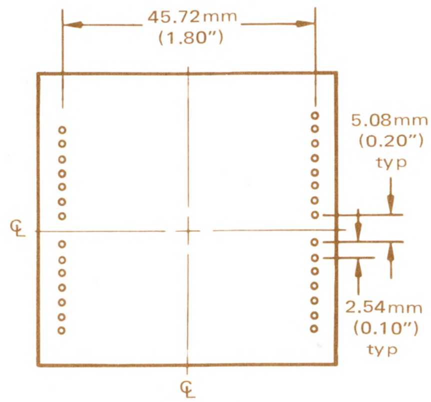


TOP VIEW

PACKAGE DRAWING MODELS DAC40"U", DAC60, SHM41, MPM8S

29



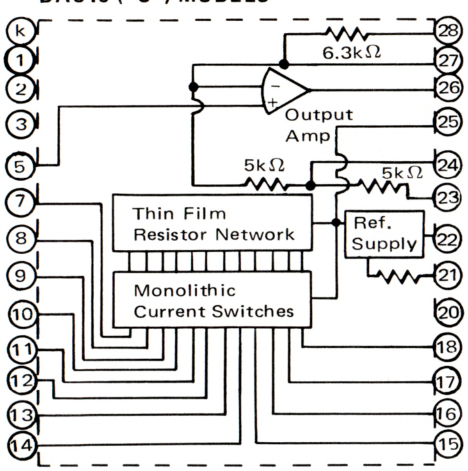


Connector: 2300 MC

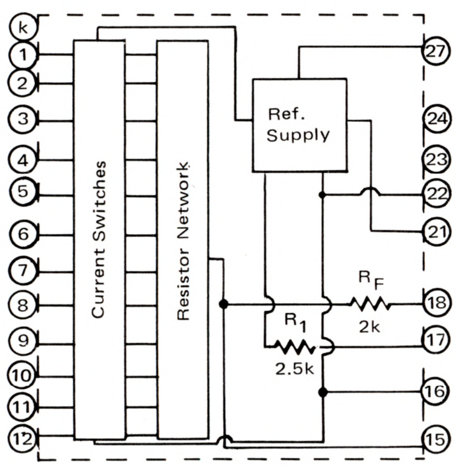
BOTTOM VIEW

CONNECTION DIAGRAMS

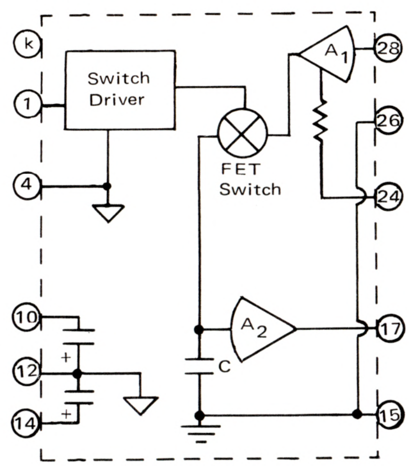
A — DAC40 ("U") MODELS



B — DAC60



C — SHM41



TOP VIEWS

PIN CONNECTIONS

DAC40 ("U") MODELS

k	Key	15	Bit 9
1	−15V	16	Bit 10
2	+15V	17	Bit 11
3	+5V	18	Bit 12
4	No Connection	19	No Connection
5	Power Common	20	R_3
6	No Connection	21	Bipolar Offset
7	Bit 1 (MSB)*	22	Gain Adj.
8	Bit 2	23	R_2
9	Bit 3	24	R_1
10	Bit 4	25	Ref. Out
11	Bit 5	26	Output
12	Bit 6	27	Sum. Jct.
13	Bit 7	28	Zero Adj.
14	Bit 8		

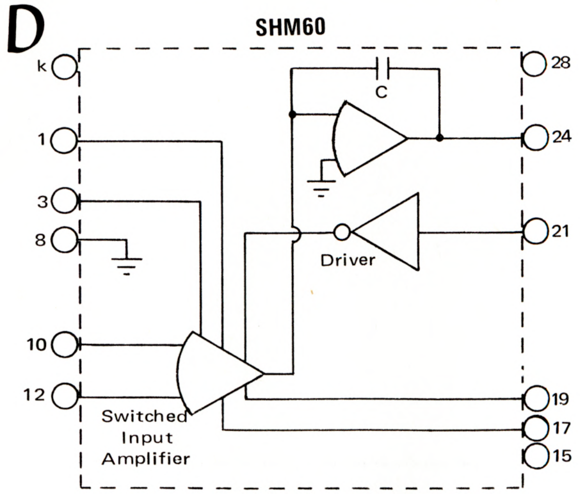
DAC60

k	Key	15	Output I
1	Bit 1 (MSB)	16	Sig. Com.
2	Bit 2	17	Bipolar Offset
3	Bit 3	18	Feedback
4	Bit 4	19	No Connection
5	Bit 5	20	No Connection
6	Bit 6	21	Ref. Out
7	Bit 7	22	Pwr. Com.
8	Bit 8	23	+15V
9	Bit 9	24	−15V
10	Bit 10	25	No Connection
11	Bit 11	26	No Connection
12	Bit 12	27	Gain Adj.
13	No Connection	28	No Connection
14	No Connection		

SHM41

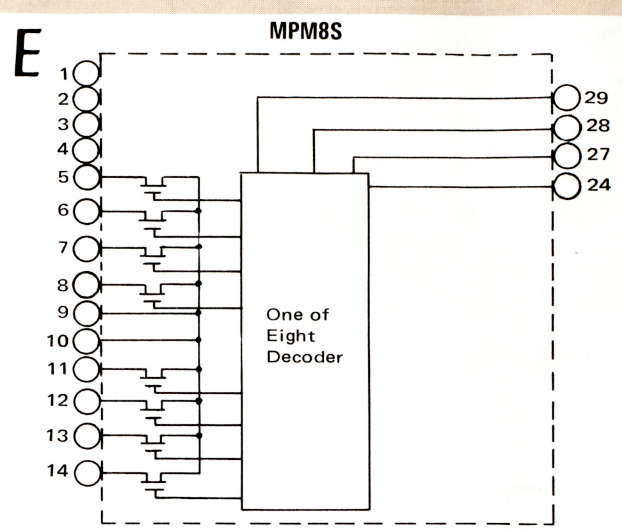
k	Key	15	Analog Com.
1	Logic	16	No Connection
2	No Connection	17	Output
3	No Connection	18	No Connection
4	Digital Com.	19	No Connection
5	No Connection	20	No Connection
6	No Connection	21	No Connection
7	No Connection	22	No Connection
8	No Connection	23	No Connection
9	No Connection	24	Offset
10	−15V	25	No Connection
11	No Connection	26	Analog Com.
12	Pwr. Com.	27	No Connection
13	No Connection	28	Input
14	+15V		

D



TOP VIEWS

E



PIN CONNECTIONS

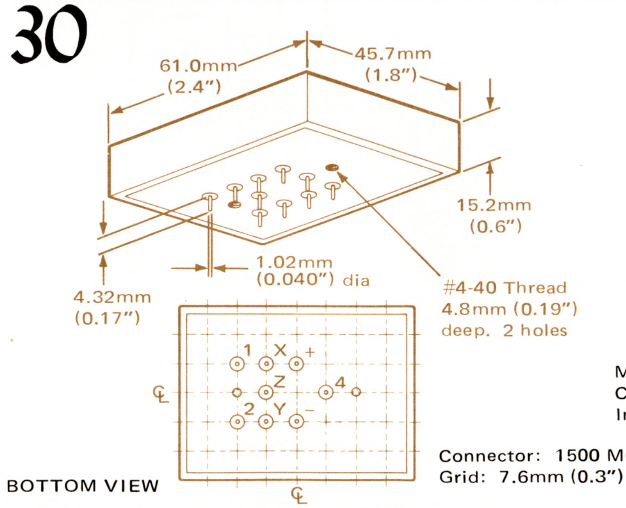
SHM60

k Key
1 Offset Adj.
2 No Connection
3 Offset Adj.
4 No Connection
5 No Connection
6 No Connection
7 No Connection
8 Common
9 No Connection
10 +Input
11 No Connection
12 –Input
13 No Connection
14 No Connection
15 –15V
16 No Connection
17 Charge Offset Adj.
18 No Connection
19 Charge Offset Adj.
20 No Connection
21 Logic
22 No Connection
23 No Connection
24 Output
25 No Connection
26 No Connection
27 No Connection
28 +15V

MPM8S

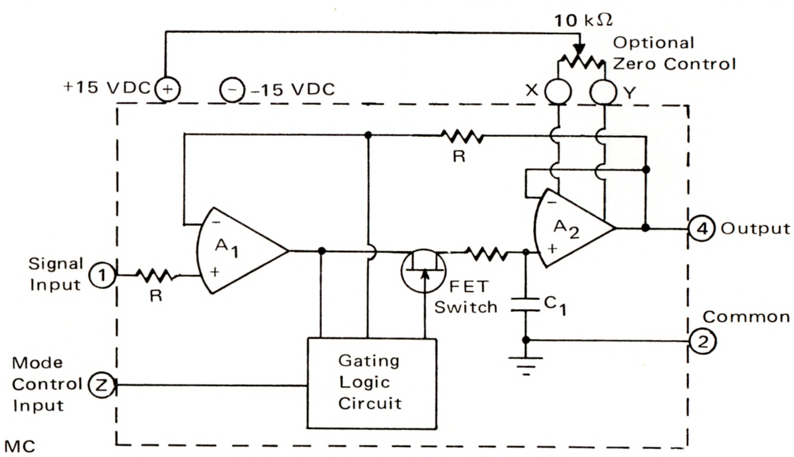
1 –15V
2 +15V
3 +5V
4 Common
5 CH 7 In
6 CH 6 In
7 CH 5 In
8 CH 4 In
9 Output
10 Output
11 CH 3 In
12 CH 2 In
13 CH 1 In
14 CH 0 In
15 No Connection
16 No Connection
17 No Connection
18 No Connection
19 No Connection
20 No Connection
21 No Connection
22 No Connection
23 No Connection
24 Inhibit
25 No Connection
26 No Connection
27 A (MSB)
28 B
29 C (LSB)

30



BOTTOM VIEW

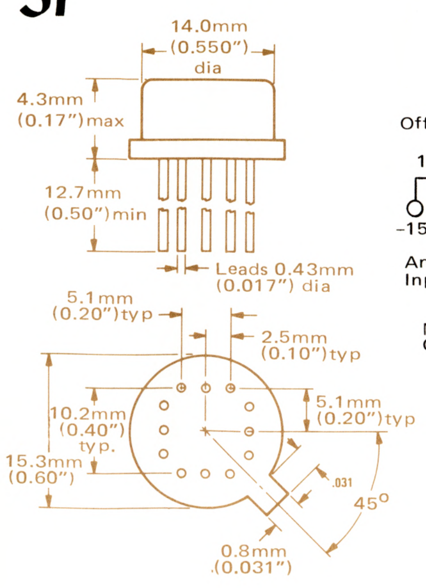
Connector: 1500 MC
Grid: 7.6mm (0.3")



CONNECTION DIAGRAM 4034/25

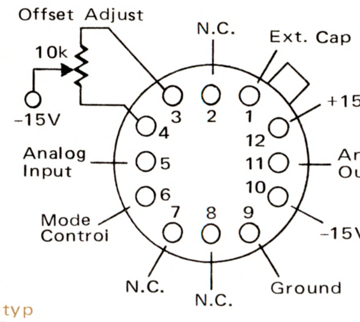
31

Connector: Robinson-Nugent MP-12100S



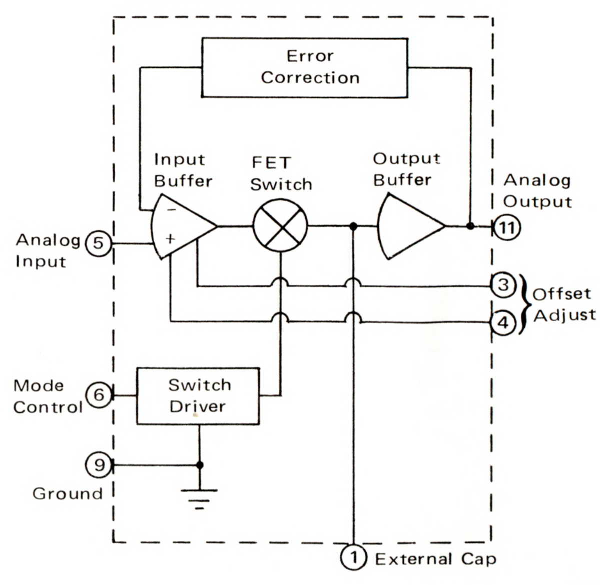
PIN CONFIGURATION

TOP VIEW



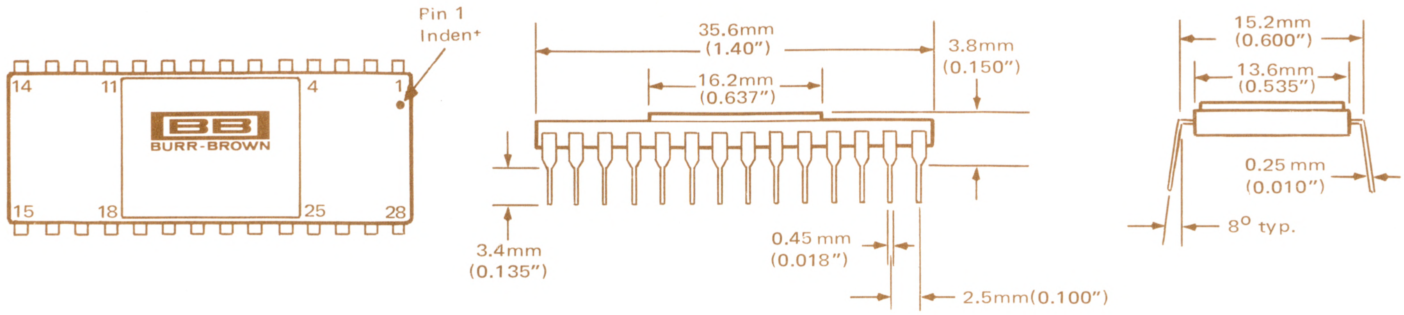
Note: Pins 2, 7, and 8 are not internally connected.

CONNECTION DIAGRAM SHC23



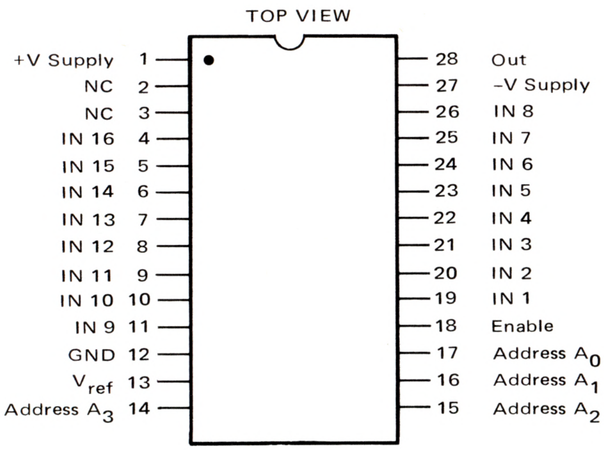
32

DIP PACKAGE

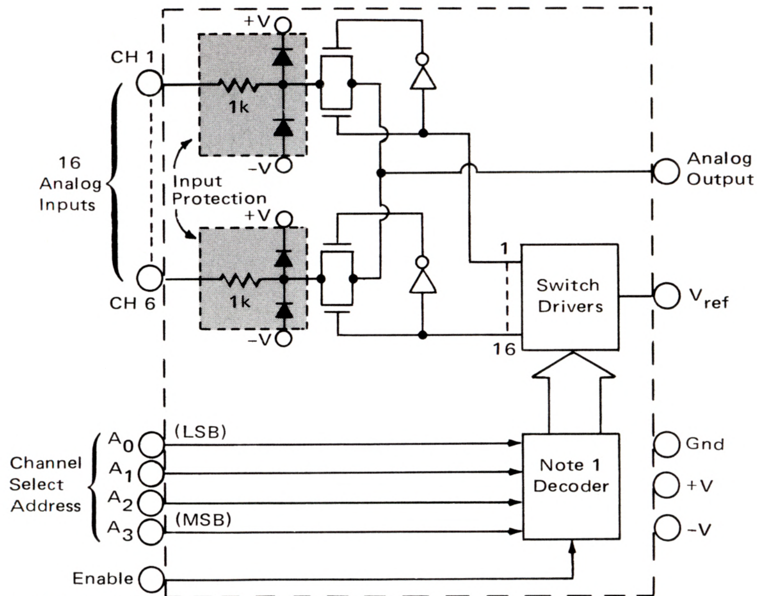


MPC16S PIN CONFIGURATION

A



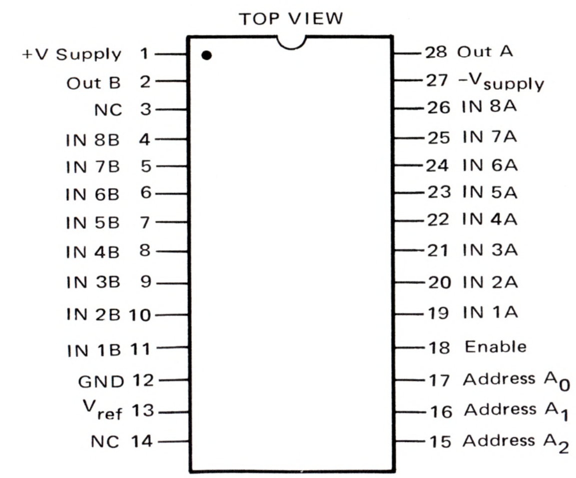
CONNECTION DIAGRAM



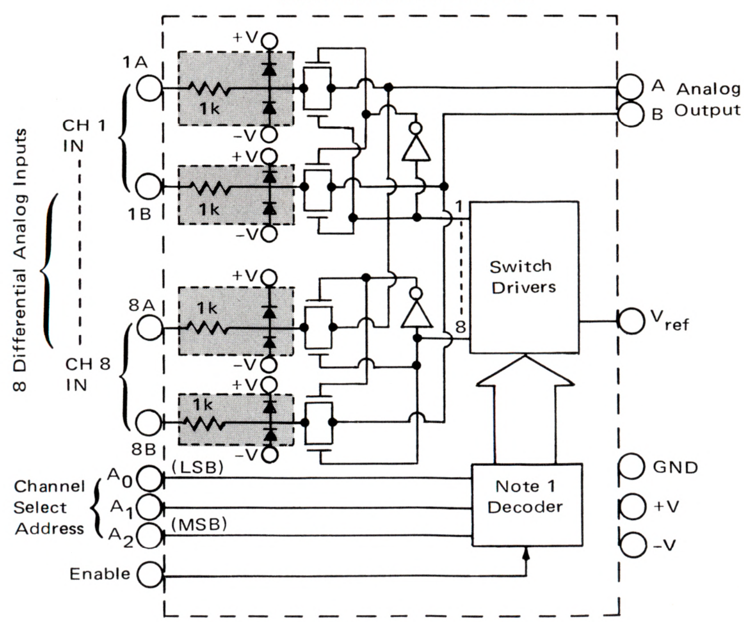
(1) Inputs protected

MPC8D PIN CONFIGURATION

B



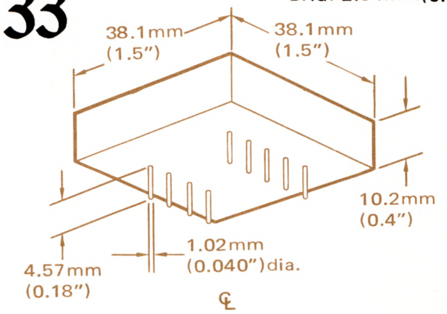
CONNECTION DIAGRAM

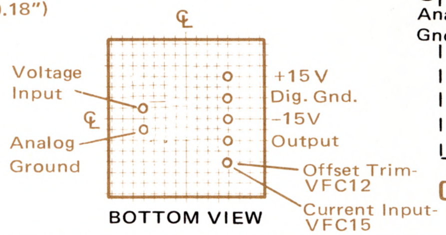


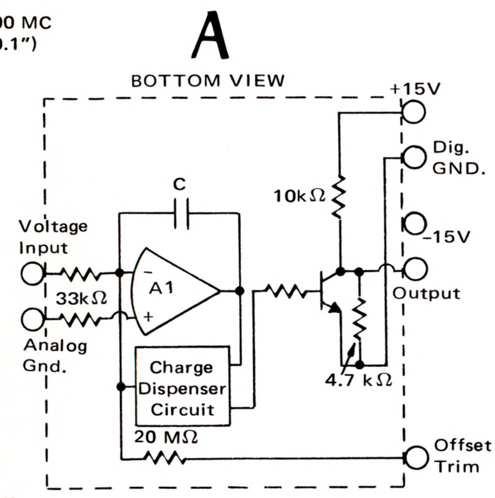
(1) Inputs protected.

33

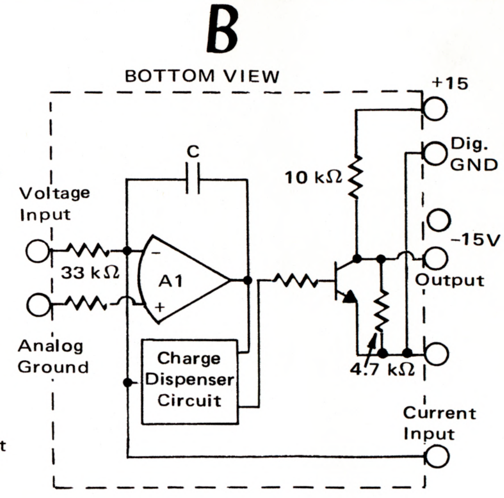
Connector: 1400 MC
Grid: 2.54mm(0.1")





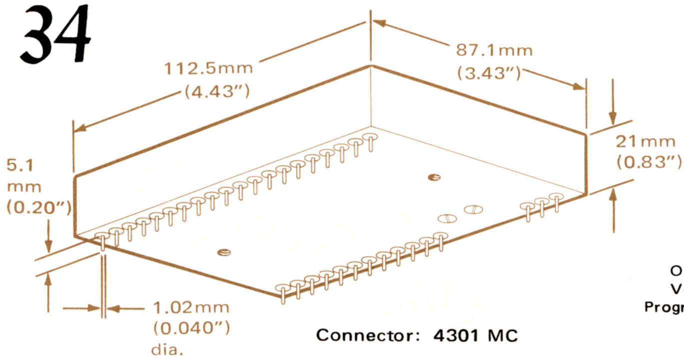


CONNECTION DIAGRAM-VFC12

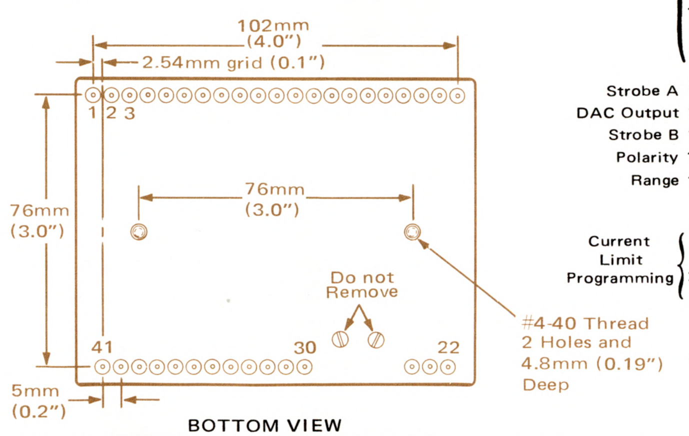


CONNECTION DIAGRAM- VFC15

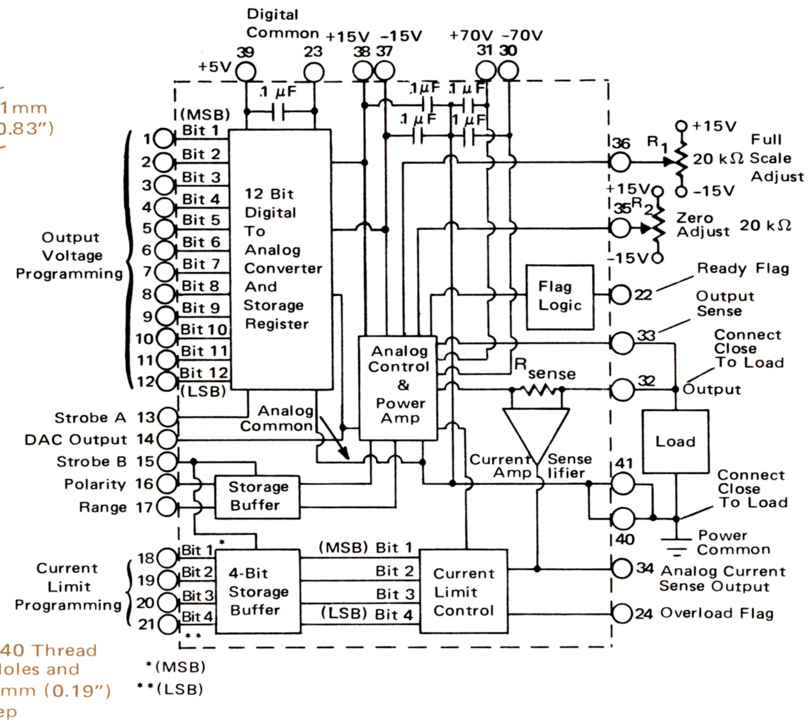
34



Connector: 4301 MC

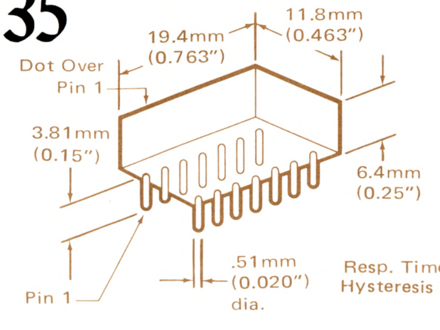


BOTTOM VIEW

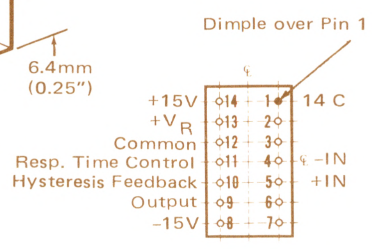


CONNECTION DIAGRAM – 4800 and 4801

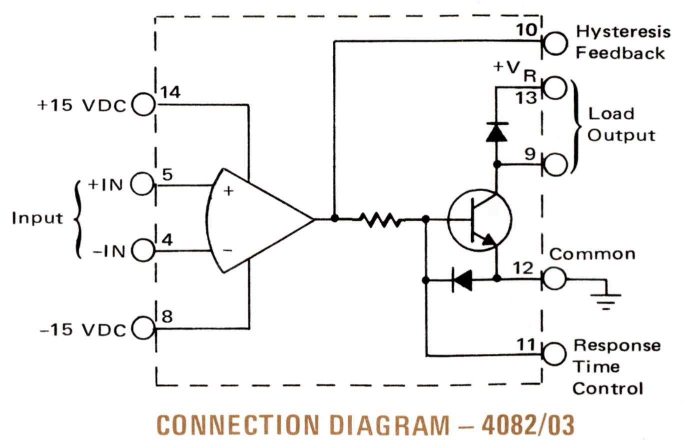
35



Connector: 0145 MC
Grid: 2.54mm (0.1")

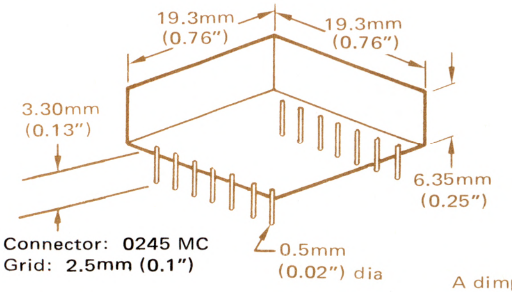


BOTTOM VIEW

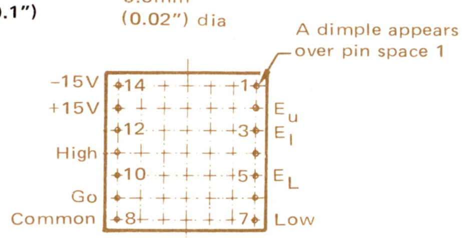


CONNECTION DIAGRAM – 4082/03

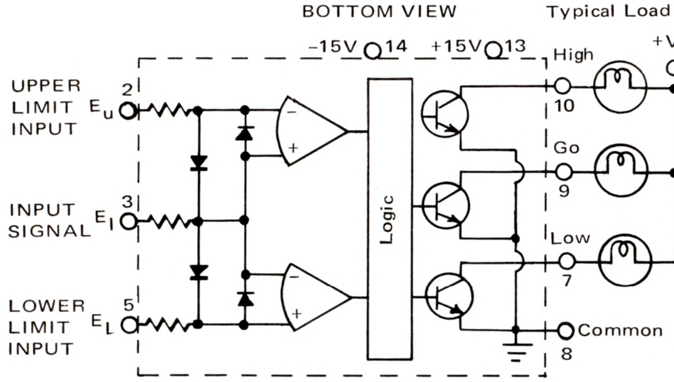
36



Connector: 0245 MC
Grid: 2.5mm (0.1")



BOTTOM VIEW



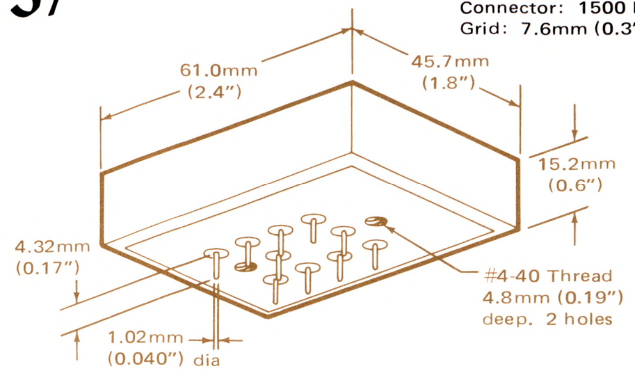
CONNECTION DIAGRAM – 4115/04

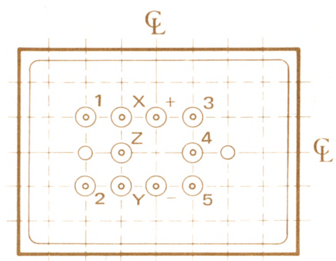
	$E_u < E_I$	$E_L < E_I < E_u$	$E_I < E_L$
HIGH	ON	OFF	OFF
GO	OFF	ON	OFF
LOW	OFF	OFF	ON

CONNECTION DIAGRAM AND TRANSFER CHARACTERISTICS–4115/04

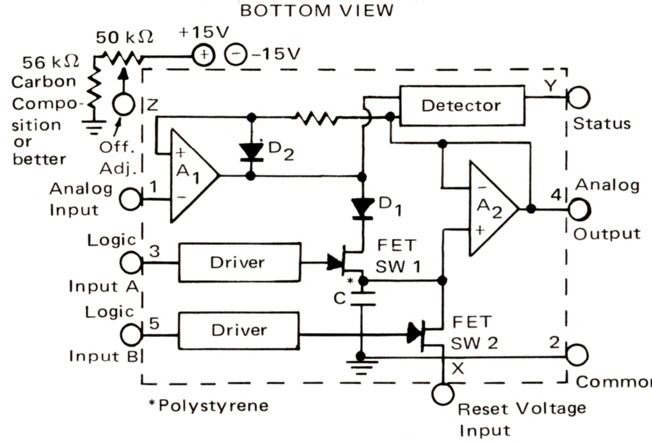
37

Connector: 1500 MC
Grid: 7.6mm (0.3")





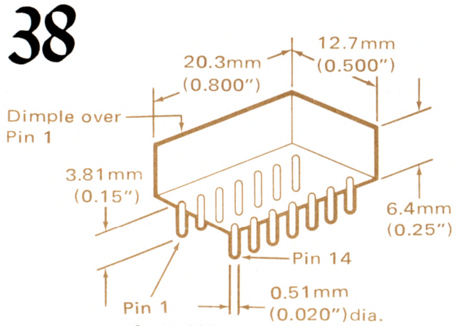
BOTTOM VIEW



CONNECTION DIAGRAM – 4084/25

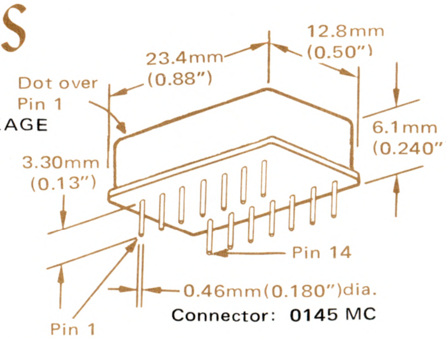
38

ACTIVE FILTERS



Connector: 0145 MC

EPOXY PACKAGE	HERMETIC PACKAGE
UAF21, UAF25, UAF31,	UAF21H, UAF25H



Connector: 0145 MC

PIN CONNECTIONS

Pin Spacing: 2.5mm (0.1"), Row Spacing: 7.6mm (0.30")

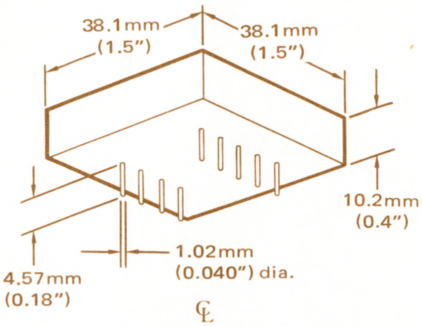
UAF31

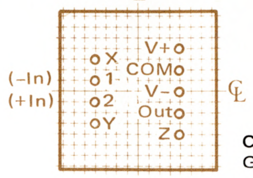
1 Frequency Adjust
2 Band Pass Output
3 Common
4 Positive Supply
5 Auxiliary Amp. Output
6 Auxiliary Amp + Input
7 Auxiliary Amp – Input
8 Frequency Adjust
9 Low Pass Output
10 Negative Supply
11 High Pass Output
12 Filter Input 2
13 Filter Input 1
14 Filter Input 3

UAF21/25, UAF21H/25H

1 High Pass Output
2 No Connection
3 Band Pass Output
4 Q Adj. Point
5 Common
6 + Supply
7 Low Pass Output
8 Frequency Adj.
9 –Supply
10 Frequency Adj.
11 No Connection
12 Input 1
13 Input 2
14 Input 3

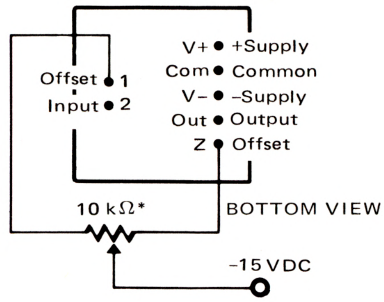
39





Connector: 1400 MC
Grid: 2.5mm (0.1")

A

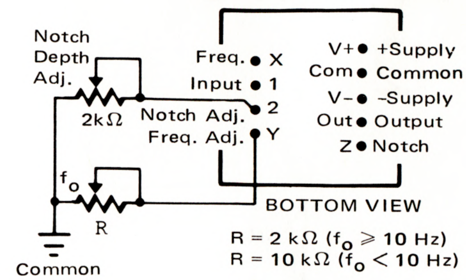


*For untrimmed operation leave adjustment pins open.

2 Pole Low Pass

B

TRIMMED



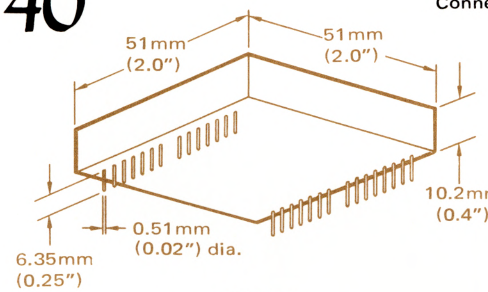
For untrimmed operation, leave pin 2 and pin Y open while tying pin X and pin Z to ground.

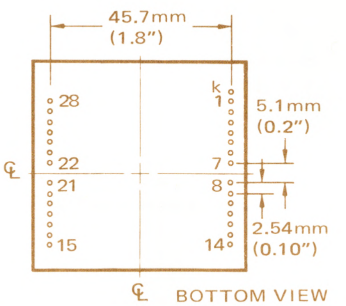
CONNECTION DIAGRAMS

Band Reject

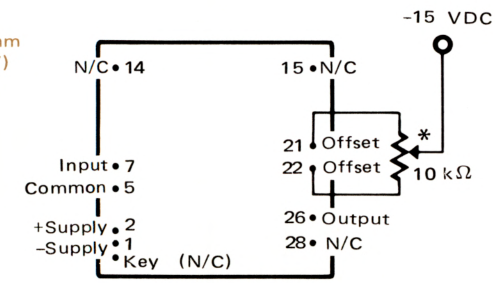
40

Connector: 2300 MC





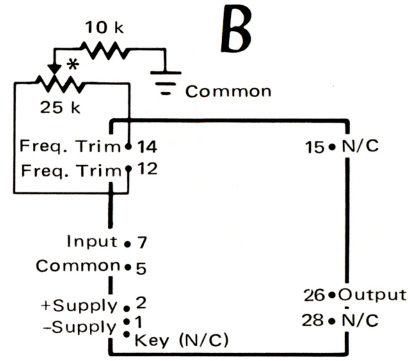
A



BOTTOM VIEW

4 Pole Low Pass

B



BOTTOM VIEW

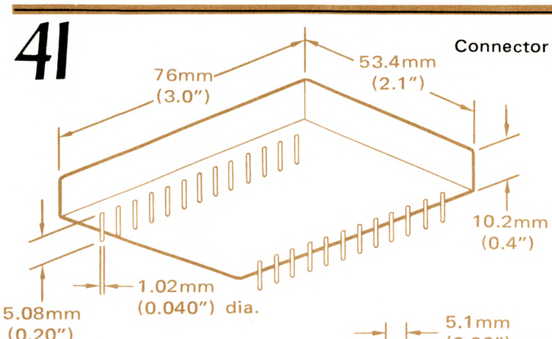
*For untrimmed operation leave adjustment pins open.

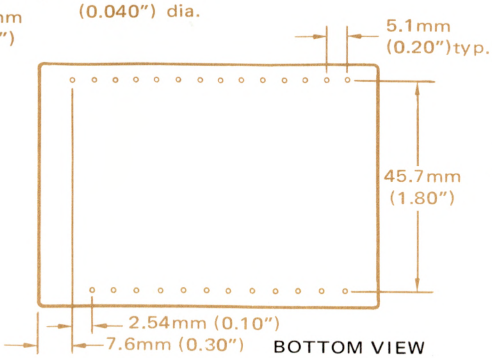
2 Pole Band Pass

CONNECTION DIAGRAMS

41

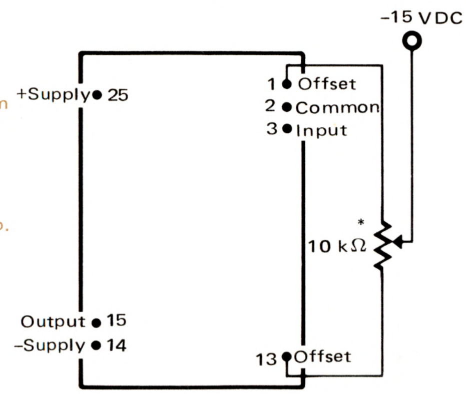
Connector: None





CONNECTION DIAGRAMS

A

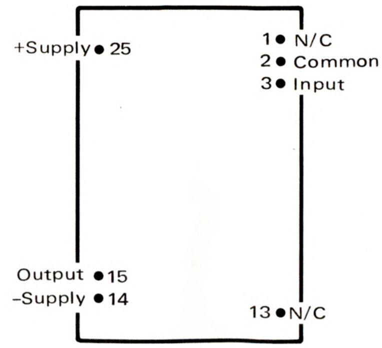


BOTTOM VIEW

* For untrimmed operation leave adjustment pins open.

6 and 8 Pole Low Pass

B



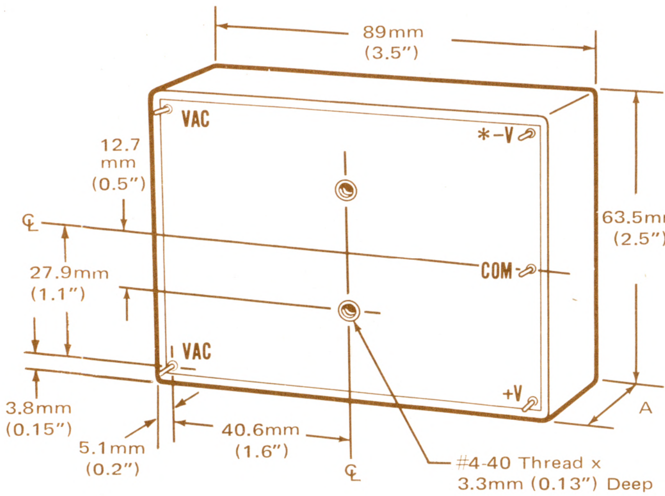
BOTTOM VIEW

4 Pole Band Pass

POWER SUPPLIES

Connectors are optional.

42



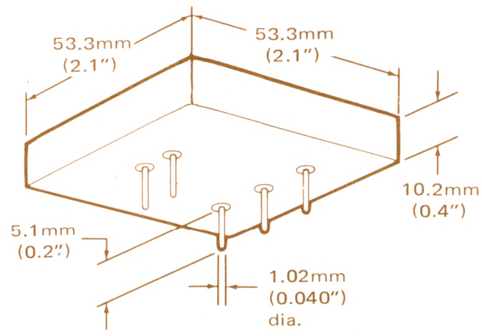
Connector: 0548 MC

Pin Dia.: 1.02mm (.04")
*No connection for Models 550, 561, 562.

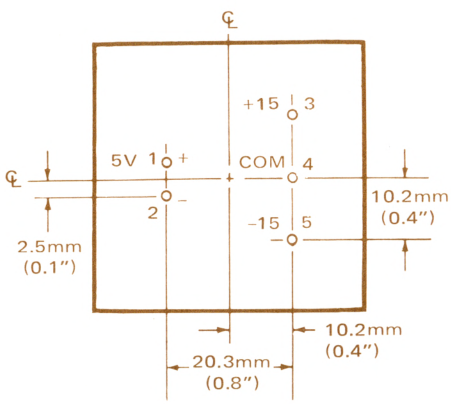
PKG. NO.	MODEL NUMBERS	DIMENSION "A"
A	550,551,560, 570	22.9mm (0.9")
B	552,553,561, 562	33.0mm (1.3")

43

MODEL 546



Connector: 1400 MC



BOTTOM VIEW

GENERAL INFORMATION

PLACING AN ORDER

Technical assistance in selecting the optimum product is available, without charge, from all sales offices.

When you place your order, please provide complete information on model number, option designations, product name, quantity desired, and ship-to and bill-to address. Orders may be placed with any authorized Burr-Brown field sales representative, or with our headquarters in Tucson via letter, telephone, TWX, or TELEX.

PRICES AND TERMS

Prices as listed in this catalog, unless otherwise noted, apply only to domestic USA customers; all other customers should contact their local Burr-Brown sales representative for price information.

All prices are FOB Tucson, Arizona, USA, in U.S. dollars. Applicable federal, state, and local taxes are extra. Terms are net 30 days. Prices and specifications are subject to change without notice.

OEM DISCOUNTS

OEM discounts are available on an order or contract basis. Corporate discount plans are available for catalog items. Consult your Burr-Brown Sales Office or headquarters for details.

QUOTATIONS

Price quotations made by Burr-Brown or its authorized field sales representatives are valid for 60 days. Delivery quotations are subject to reconfirmation at the time of order placement.

DATA SHEETS

Detailed specifications and application instructions are contained on product data sheets for each model. Simply contact your local Burr-Brown sales representative, or use the reply card from this catalog.

RETURNS AND WARRANTY SERVICE

When returning products for any reason, contact our Tucson headquarters first for authorization and shipping instructions. Returned units should be shipped prepaid and must be accompanied by the original purchase order number and date and an explanation of the malfunction. Upon receipt of the unit, Burr-Brown will verify the malfunction and will inform the customer of the warranty status, cost of repair, credits, and replacement units where applicable.

EVALUATION SAMPLES

When it is necessary to evaluate the performance of a product before purchasing, a 30 day no charge sample can be provided. Simply send in a regular purchase order stating "no charge 30 day evaluation unit". Units that have not been soldered, or otherwise altered, may be returned within the 30 day period for full credit. If the evaluation sample is retained for longer than 30 days, invoicing will be sent.

MODEL INDEX

MODEL INDEX

INSTRUMENTATION and DATA AMPLIFIERS

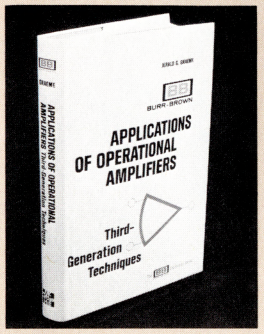
ANALOG CIRCUIT FUNCTIONS

ACTIVE FILTERS

POWER SUPPLIES

REFERENCE BOOKS
from Burr-Brown and McGraw-Hill

Applications of Operational Amplifiers-
THIRD GENERATION TECHNIQUES



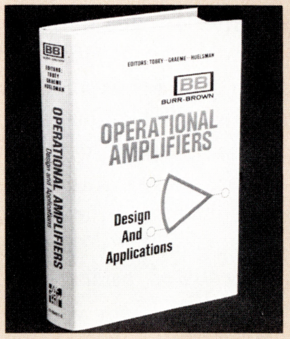
Over 230 Pages and 170 Illustrations presenting new, Third Generation Applications of Operational Amplifiers.

This volume presents and explains those operational amplifier applications which have evolved since publication of its companion volume, *Operational Amplifiers–Design and Applications.*

More than just a collection of circuits or theoretical analysis, the book presents numerous applications of operational amplifiers in a variety of electronic equipment: specialized amplifiers, signal controls, processors, waveform generators, and special purpose circuits. It is a storehouse of detailed practical information, featuring numerous circuit diagrams, circuit values, pertinent design equations, error sources, and test-based comments on the efficiency of the arrangements and devices.

Here is a highly useful, up-to-date reference source for all engineers, scientists and technicians involved with operational amplifier applications in electronics, instrumentation, process control, chemical and physical simulation, and other specialties.

Operational Amplifiers-
DESIGN AND APPLICATIONS



Over 475 Pages and 300 Illustrations covering Basic Theory, Circuit Design, Test Methods, and Applications of Operational Amplifiers.

Covering basic theory, test methods, amplifier design techniques, and applications, this pioneer work provides *practical* information which can be directly applied to instrumentation design.

The book is divided into two principal parts and two appendices. Part I considers the design of operational amplifiers, offers insight into the factors determining performance characteristics, and outlines the techniques available for their control. Part II presents a wide range of practical operational amplifier applications, and provides sufficient descriptions of operation to permit design adaption from the specific circuits described. In Appendix A the basic theory of operational amplifiers is reviewed to provide an accompanying reference. Appendix B gives concise definitions of the performance parameters used to characterize operational amplifiers, and provides associated test circuits. An indispensable book for the novice user and the expert alike.

PRICES, U.S. AND CANADA, (POSTPAID).

Applications of Operational Amplifiers–Third Generation Techniques .... *U.S.* **$14.00**

Operational Amplifiers–Design and Applications.... *U.S.* **$15.00**

WESTERN EUROPE: *Applications of Operational Amplifiers–Third Generation Techniques.* U.S. $15.25 or equivalent. *Operational Amplifiers–Design and Applications*..U.S. $17.00 or equivalent. Book prices postpaid from our European literature distribution center. Mail all Western European orders, with payment (Postal Money Orders NOT accepted) to: Burr-Brown Research Corporation, B.P. 7656, Schipol Centrum, Holland.

ELSEWHERE OUTSIDE THE U.S.A:
Price (Postpaid) is as follows:

South America
India
Israel
Africa
Australia
Japan
New Zealand

Applications of Operational Amplifiers–Third Generation Techniques *$18.00*

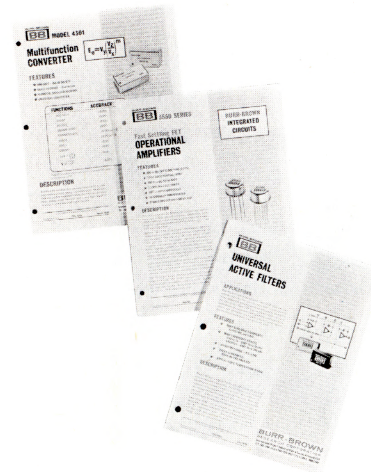
Operational Amplifiers–Design and Applications. . *$22.80*

Make payable to Burr-Brown Research Corporation in U.S. dollars (or equivalent in local currency). Postal Money Orders NOT accepted.

LITERATURE

PRODUCT DATA SHEETS...

Within the confines of the space available, each product shown in this catalog has been described in as much detail as possible. If and when you need more detailed information on a specific product, just ask for a copy of its Product Data Sheet. All products have one and it contains detailed specifications, operating instructions, performance curves, and application hints. This literature is written to make your design task easier and is yours for the asking. If you need more information on any product, you can either use the reply card in the back of this catalog, write or call us in Tucson, or call any of our Burr-Brown Sales Offices or Representatives listed inside the back cover of this catalog.



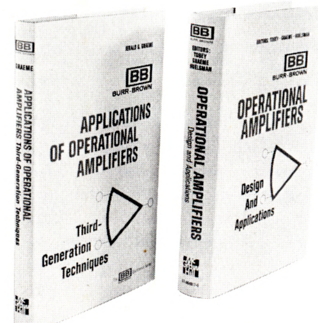
APPLICATION NOTES...

Burr-Brown engineers have compiled a mini-library of Application Notes to assist you in your designs. These notes are yours for the asking and are listed below:

AN-51	"A Primer on Analog Multiplier Specs"
AN-54	"Programmable Data Amplifiers"
AN-55	"Analog Modules Multiply User's Options"
AN-56	"Sample & Hold or High Speed A/D Converters?"
AN-58	"D/A Converter Differential Linearity Error - It Really Shows Up!"
AN-59	"Don't Forget D/A Converter Tempco!"
AN-60	"Protect Op Amps from Overloads"
AN-61	"Active Filter Design Examples Using UAF's"
AN-62	"Varying Comparator Hysteresis w/o Shifting Initial Trip Point"
AN-63	"Electronic Controller With An Equilibrium Sustaining Mode"
AN-64	"Combine Two Op Amps to Avoid the Speed Accuracy Compromise"
AN-65	"Check Five Op Amp Specs in One Test"
AN-66	"How to Select the Right D/A & A/D Converter"
AN-67	"A Noninverting Differentiator"
AN-68	"Don't Overlook the Noise of Op Amp Feedback Resistors"
AN-69	"A/D Converters"
AN-70	"Analog Shaping"
AN-73	"IC's are Multiplying"
AN-74	"Controlled Current Source is Versatile and Precise"
AN-75	"Instrumentation Amplifiers"

REFERENCE BOOKS...

Burr-Brown also has two operational amplifier reference books available. Written by Burr-Brown engineers, and published by McGraw-Hill, these books are fast becoming "the industry standard". See page 83 for details and ordering information.



BURR-BROWN REPRESENTATIVES

UNITED STATES REPRESENTATIVES

ALABAMA — Huntsville, (205) 881-6220 **ARIZONA** — Tucson, (602) 294-1431 **ARKANSAS** — (See Dallas, Texas) **CALIFORNIA** — Santa Ana (714) 835-0712, (213) 941-7000 — San Jose (408) 984-7700 **COLORADO** — Denver, Enterprise 6730 (toll free) **CONNECTICUT** — Enfield, (203) 745-9050 **FLORIDA** — Orlando, (305) 896-4881 **ILLINOIS** — Addison (312) 832-6520 **INDIANA** — (See Illinois) **IOWA** — (See Illinois) **MARYLAND** — Silver Spring, (301) 588-8134 **MASSACHUSETTS** — Wakefield, (617) 245-4870 **MICHIGAN** — Farmington, (313) 477-3800 **MINNESOTA** — Minneapolis, (612) 831-0229 **MISSOURI** — Florissant 314) 837-5200 **NEW JERSEY** — Camden, (215) 925-8711 **NEW MEXICO** — Albuquerque, Enterprise 6730 (toll free) **NEW YORK** — Syracuse, (315) 699-2671 — Endicott, (607) 785-3191 — Scottsville, (716) 889-1429 — Clinton, (315) 853-6438 — Great Neck, (516) 466-2650 **NORTH CAROLINA** — Greensboro, (919) 273-1918 **OHIO** — Cincinnati, (513) 761-5432 — Cleveland, (216) 831-0130 — Dayton, (513) 277-8911 **OKLAHOMA** — Tulsa, (918) 663-1247 **OREGON** — Portland, (503) 238-0001 **PENNSYLVANIA** — Pittsburgh, (412) 244-1640 — Philadelphia (See Camden, N.J.) **TEXAS** — Dallas, (214) 350-6771 — Houston, (713) 774-2568 **UTAH** — Salt Lake City, Zenith 6730 (toll free) **VIRGINIA** — (See Maryland) **WASHINGTON** — Seattle, (206) 763-2210 **WASHINGTON, D.C.** — (See Maryland) **WISCONSIN** — (See Illinois)

BURR-BROWN SALES OFFICES

HOME OFFICE — Tucson, Arizona (602) 294-1431

CALIFORNIA, Santa Ana (714) 835-0712, (213) 941-7000
San Jose (408) 984-7700

ILLINOIS, Addison (312) 832-6520

NEW YORK, Great Neck (516) 466-2650

FRANCE, Le Chesnay 954-3558

UNITED KINGDOM, Watford 33837

ROCKY MOUNTAINS, Toll Free Numbers
Albuquerque - ENTERPRISE 6730
Denver - ENTERPRISE 6730
Salt Lake City - ZENITH 6730

INTERNATIONAL REPRESENTATIVES

AUSTRALIA — Burwood, Victoria Phone: (03) 288 7100 — Adelaide, 232420 — Sydney, 318 243 **OESTERREICH** — Wien, Phone: 57 82 30 **BELGIQUE** — Bruxelles, Phone: (02) 49 99 00 **CANADA** — Mississauga, Ontario, Phone: (416) 678-1500 — Longueuil, P.Q., (514) 670-1212 — Ottawa, Ontario, (613) 829-9651 — N. Vancouver, B.C., (604) 980-4831 — Calgary, Alberta, (403) 276-9658 — Halifax, N.S., (902) 469-7865 **DANMARK** — Kobenhavn, Glostrup, Phone: (01) 96 88 44 **UNITED KINGDOM** — Watford, Phone: 33837 **FINLAND** — Helsinki, Phone: 13360 **FRANCE** — Le Chesnay, Phone: 954-3558 **BUNDESREPUBLIK DEUTSCHLAND** — Muenchen, Phone: 089 18 40 41 **NEDERLAND** — Breda, Phone: 01600-4 11 52 **INDIA** — Bombay, Phone: 551973 **ISRAEL** — Tel Aviv, Phone: 443126 **ITALIA** — Milano, Phone: 546.26.41 **JAPAN** — Tokyo, Phone: 03-244-3784~8 **NEW ZEALAND** — Auckland, Phone: 586-000 — Wellington, 555-869 **NORGE** — Oslo, Phone: 23 2530 **PORTUGAL** — Lisboa 2, Phone: 636072 **SOUTH AFRICA** — Johannesburg, Phone: 724-8274 **ESPANA** — Madrid, Phone: 457 28 00 **SVERIGE** — Stockholm, Phone: 380 370 **SCHWEIZ/SUISSE/SVIZZERA** — Zurich, Phone: 01/25 78 72

1975 CATALOG

BURR-BROWN RESEARCH CORPORATION • INTERNATIONAL AIRPORT INDUSTRIAL PARK • TUCSON, ARIZONA 85734