1976 CATALOG

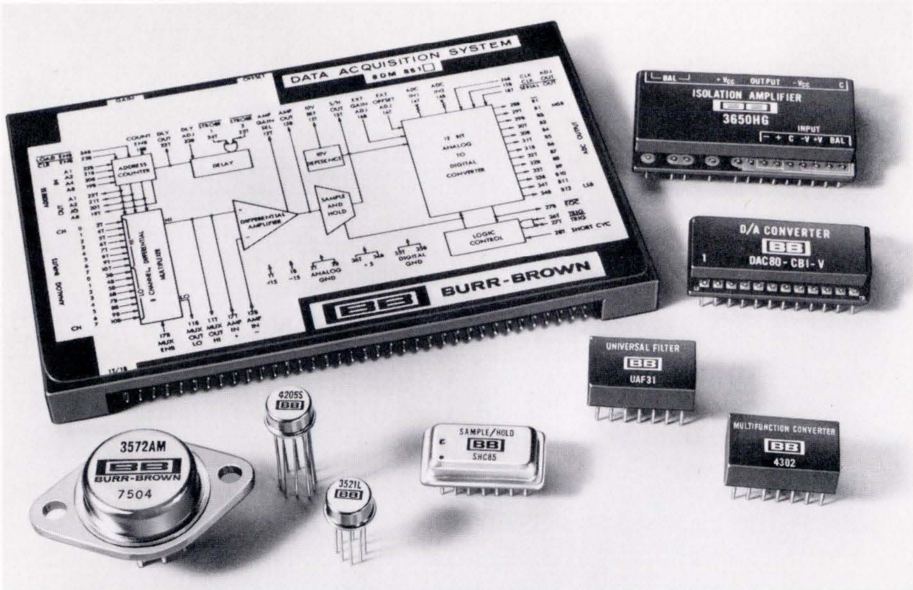
A WORLD LEADER IN...

Conversion/Control/Computation/Confidence

BURR-BROWN

BURR-BROWN 1976 CATALOG

MODEL INDEX


DATA ACQUISITION SYSTEM
BURR-BROWN
ISOLATION AMPLIFIER
3650HG
D/A CONVERTER
DAC80-CBI-V
UNIVERSAL FILTER
UAF31
MULTIFUNCTION CONVERTER
4302
SAMPLE/HOLD
SHC85
3572AM
BURR-BROWN
7504
4205S
3521L

BURR-BROWN

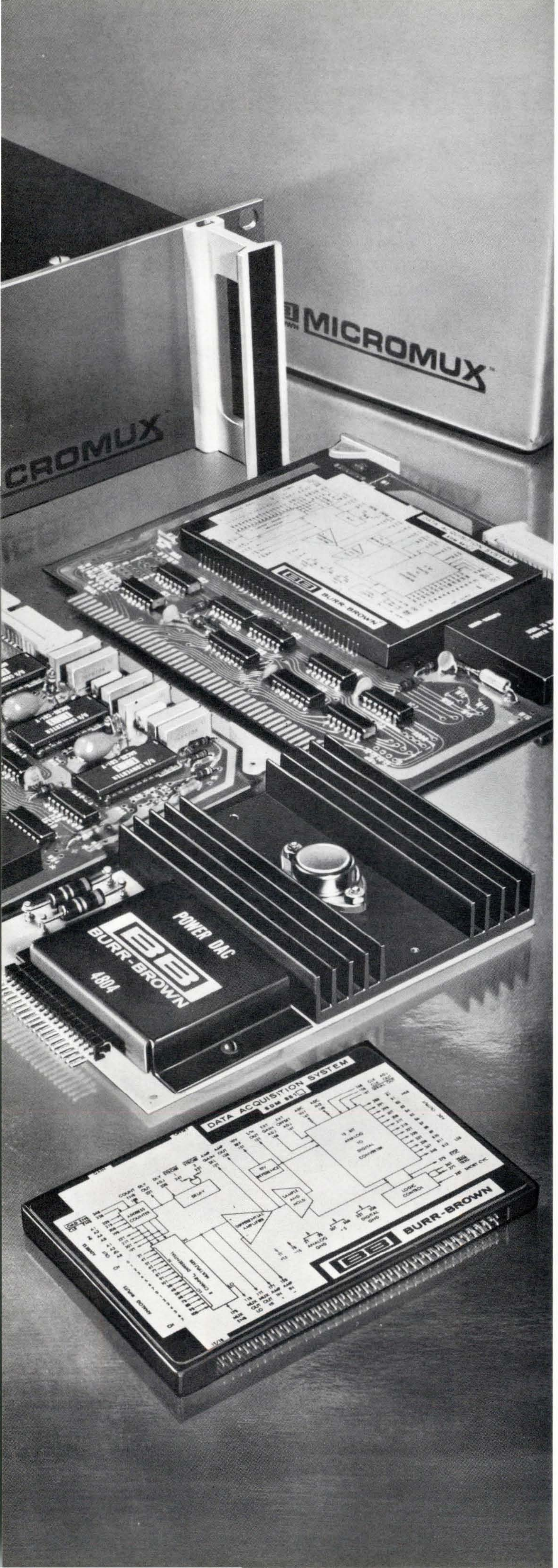
This catalog contains information on a selected group of Burr-Brown products – those that are usually the best choices for new designs. The product information is divided into seven sections: Data Acquisition and Computer I/O Systems, Data Conversion Products, Operational Amplifiers, Instrumentation 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 110 for details. Following the product information you will find a section giving package and pin-function information.

In addition to the recommended models that are described in this catalog, we continue to offer a large number of other standard products which are designed into literally thousands of applications throughout the world. A list of the most popular of these older models is given on the inside back cover along with a list of newer models that are similar in performance, but more cost effective.

To find a particular type of product, or other information about Burr-Brown, refer to the Table of Contents below. If you already have a particular model number in mind and wish to refer to the specifications, use the Model Number Index on the opposite page.

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

TABLE OF CONTENTS



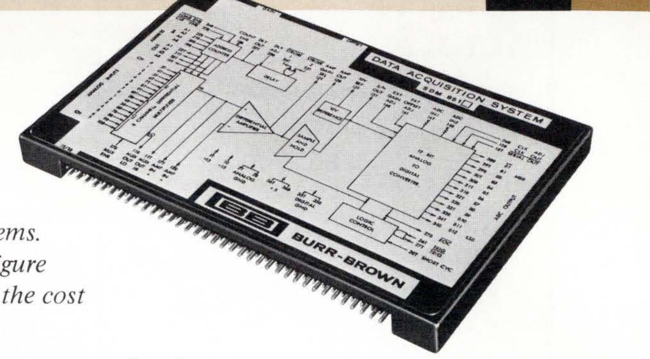
DATA ACQUISITION AND COMPUTER I/O SYSTEMS

Modular Data Acquisition Systems
Microcomputer I/O Systems
Remote Multiplexing Data Acquisition Systems
Digitally Programmed Voltage Sources

BURR-BROWN

MODULAR DATA ACQUISITION SYSTEMS

MODELS SDM850, SDM851, MXP320 AND MXP321



The standard "off the shelf" data acquisition system is here today in the Burr-Brown SDM850 and SDM851 modular data acquisition systems. With this set of compatible system building blocks, it is possible to configure complete data acquisition systems in one-fourth the space for one-tenth the cost previously possible.

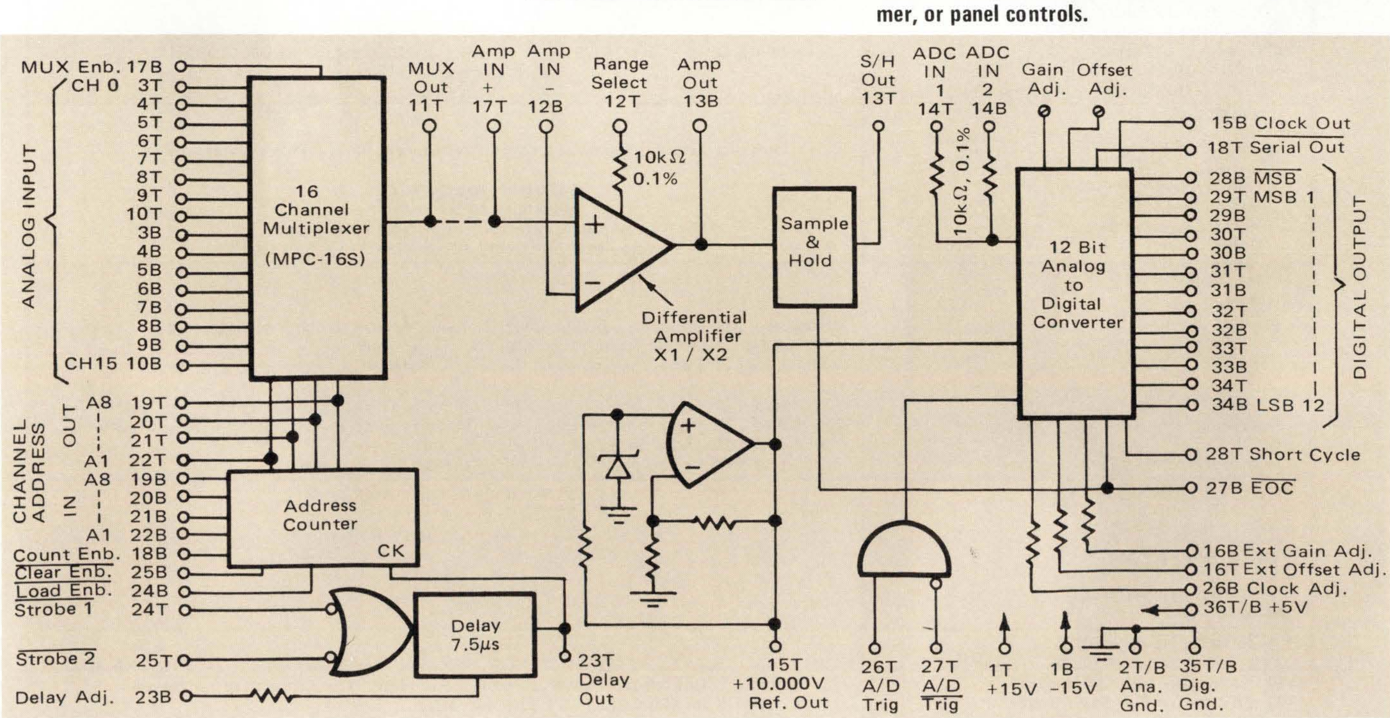
These systems contain all of the components necessary to multiplex and convert analog data into equivalent digital outputs at throughput sampling rates up to 50 kHz for 12 bit and 100 kHz for 8 bit resolutions. The Model SDM850 contains a 16 channel single-ended analog multiplexer, differential amplifier, sample/hold, 12 bit successive approximation A/D converter and programming logic. The Model SDM851 is the same as the SDM850 except that the analog multiplexer is an 8 channel differential configuration. These systems can be expanded to accept up to 256 single-ended or 128 differential analog channels with the MXP320 and MXP321 multiplexer expanders. The system may be mounted on a printed circuit card or vertically stacked in a card frame on one-half inch centers. The only requirements for system operation are input signals power and the interconnection of the system components into the desired operating configuration.

FEATURES

- **SAVES SPACE**
  Requires 75% less space than modules.
- **SAVES DESIGN TIME**
  System components are engineered to work together eliminating expensive design and interfacing costs.
- **LOW COST**
  $495 in unit quantities.
- **RELIABLE**
  Every system module is tested and burned in for 168 hours.

Detailed Brochure and Users Manual available on request!

- **EXPANDABLE**
  A complete set of compatible multiplexer expanders and DC/DC converter power supply lets you expand the system up to 128 differential or 256 single-ended channels.
- **FLEXIBLE**
  Use it in up to four operating modes as either a self-contained data acquisition system or control it externally with a digital computer, remote programmer, or panel controls.



SPECIFICATIONS

Typical @ 25°C and rated power supplies unless otherwise noted.

MODEL	SDM850	SDM851
ANALOG INPUTS		
Input Signal Ranges	0 to +5, 0 to +10, ±5, ±10 Volts	
Max. Input Voltage with no Damage to Inputs	±15 Volts	
Input Impedance	100 MΩ, 10 pF OFF Channel 100 pF ON Channel	
Bias Current	3nA @ 25°C 5 nA 0°C to 70°C	
Differential Bias Current	– –	2 nA @ 25°C 3 nA 0°C to 70°C
Differential Amplifier Gain	x 1 pin 12T grounded x 2 pin 12T to 13B	
DIGITAL INPUTS		
Address Inputs	One Standard TTL Load, positive true,	
Coding	4 bit binary	3 bit binary
Load Enable	One standard TTL Load, negative true, address loaded with strobe inputs.	
Clear Enable	One standard TTL Load, negative true, address loaded with strobe inputs.	
Strobe	One standard TTL Load, negative going edge clocks MUX address counter. Strobe 1 must be high to enable Strobe 2 and Strobe 2 must be high to enable Strobe 1.	
Count Enable	Two standard TTL Loads, positive true, logic "0" allows the strobe inputs to trigger the delay timer, but prevents the MUX address counter from being clocked.	
ADC Trigger	One standard TTL Load, a positive going edge at TRIG initiates conversion, a negative going edge at TRIG initiates conversion; TRIG must be "0" to enable TRIG; TRIG must be "1" to enable TRIG.	
Word Length	One standard TTL Load, grounded for 12 bit resolution, connected to the N + 1 bit output for N bit resolution.	
Multiplexer Enable	MOS drive, 4 volts minimum for logic "1", 0.8 volts maximum for logic "0", internal 1 kΩ pull-up resistor.	
TRANSFER CHARACTERISTICS		
THROUGHPUT RATE (min)	50 kHz, 20 μsec/channel	
RESOLUTION	12 bits	
NUMBER OF CHANNELS	16 Expandable to 256	8 Expandable to 128
ACCURACY(1)		
System RSS Accuracy @ 25°C	±0.025% FSR(2) @ 50 kHz throughput	
Linearity	±1/2 LSB, @ 50 kHz throughput	
Differential Linearity	±1/2 LSB, @ 50 kHz throughput	
Quantizing Error	±1/2 LSB	
Gain Error	Adjustable to Zero	
Offset Error	Adjustable to Zero	
Power Supply Sensitivity	±0.005% FSR/% change of supply voltage	
STABILITY OVER TEMPERATURE		
System Accuracy Drift (max)	±20 ppm/°C of Reading	
Linearity Tempco	±3 ppm of FSR/°C	
DYNAMIC ACCURACY		
Sample & Hold Aperture Time	55 ns	
Aperture Time Uncertainty	±5 ns	
Error for Full Scale Transition Between Successively Addressed Channels	1 LSB @ 50 kHz	
Differential Amplifier CMRR	70 dB @ 2 kHz 60 dB @ 10 kHz	
Channel Cross Talk	80 dB down @ 2 kHz, 73 dB @ 10 kHz for OFF Channel to ON Channel	
Sample & Hold Feedthrough	80 dB down @ 10 kHz	
Sample & Hold Decay Rate (max)	10 μV/μs	
OUTPUT		
Output Coding	Unipolar Straight Binary, Bipolar Offset Binary, Binary Two's Complement	
Controls		
Gain Trim(3)	Adjustable to zero error	
Offset Trim(3)	Adjustable to zero error	
A/D Conversion Time	11.5 μs nominal, externally adjustable from 8 μs to 20 μs	
Delay	7.5 μs nominal, externally adjustable from 4.5 μs to 20μs	
DIGITAL OUTPUTS		
Data Outputs		
Parallel	5 Standard TTL Loads to a maximum of 36 loads, positive true. Parallel, B1, B1---B12 buffered for protection from transmission line reflections.	
Serial	5 Standard TTL Loads, negative true, time serial data output beginning with B1.	
Address Outputs	5 Standard TTL Loads, positive true, 4 bit binary code, internal 1 kΩ pull-up resistors.	
Delay Out	5 Standard TTL Load, positive true during the delay period, triggered by Strobe input.	
Clock	5 Standard TTL Loads for synchronizing serial out data.	
End of Conversion (EOC)	5 Standard TTL Loads, positive true during the A/D conversion.	
POWER REQUIREMENTS	+15V ±3% @ +60 mA, 5 mV RMS ripple -15V ±3% @ -75 mA, 5 mV RMS ripple +5V ±5% @ +300 mA, 25 mV RMS ripple	
ENVIRONMENTAL		
Operating Temperature	0°C to 70°C	
Storage Temperature	-25°C to +85°C	
PACKAGE (See page 102)	(46)	

(1) No missing codes guaranteed.
(2) FSR means Full Scale Range.
(3) Gain and Offset controls are located on the module. The adjustment ranges are ±0.1% FSR for Gain and ±0.1% FSR for Offset.

MODELS MXP320 AND MXP321

Channel expansion is accomplished in groups of 32 single-ended or 16 differential input channels.

Unless external logic is used, one MXP321 Multiplexer Expander must be added to expand the number of analog input channels before any MXP320 Multiplexer Expander units can be used. The MXP321 contains a 32 channel multiplexer, the address expander and logic whereas the MXP320 has 32 analog multiplexer channels, but not logic. With no external logic, expansion up to 256 single-ended channels for the SDM850 and 128 for the SDM851 is possible with these expanders. These units are housed in the same size shielded case as the systems and have 72 pin mating connectors.

DCC20 DC/DC CONVERTER

The DCC20 DC/DC converter is a +5V to ±15VDC/DC converter that provides +120 mA current drive and 10^9 ohms, 80 pF isolation. Common-mode withstanding voltage is 500V. This unit is housed in a 2″ x 2″ x 0.375″ package. See Package 44 on page 101.

ORDERING INFORMATION

Model	Description	Unit Price*
SDM850	16 channel single-ended input, 50 kHz, 12 bit Modular Data Acquisition System	$495.00
SDM851	8 channel differential input, 50 kHz, 12 bit Modular Data Acquisition System	$495.00
MXP320	32 channel single-ended or 16 channel differential input analog multiplexer expander.	$220.00

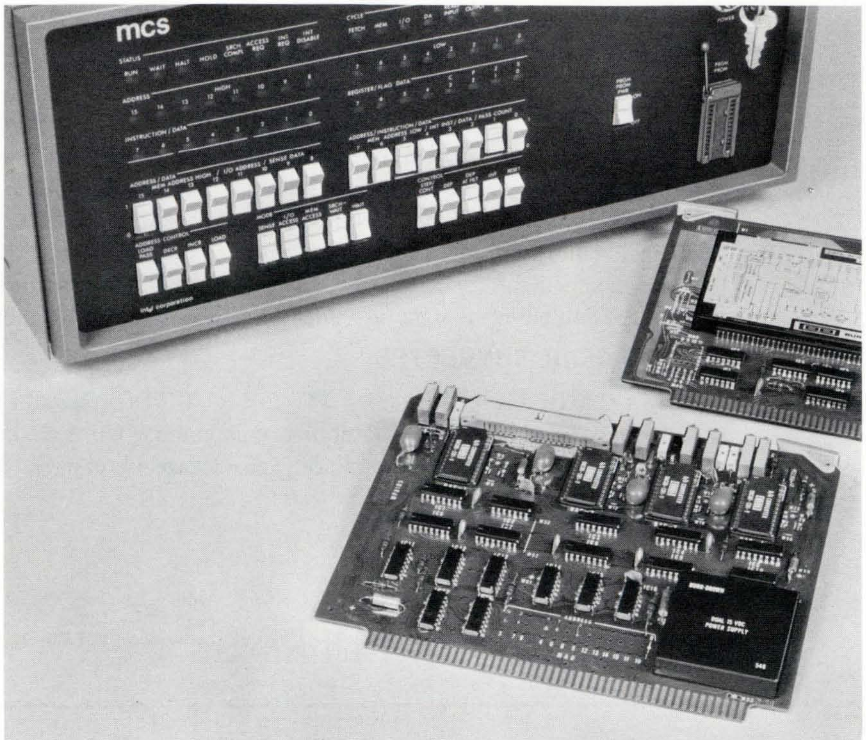
Model	Description	Unit Price *
MXP321	32 channel single-ended or 16 channel differential input analog multiplexer expander plus logic expansion for 17 to 256 single-ended or 9 to 128 differential channels.	$250.00
DCC20	+5V to ±15 VDC/DC Converter	$82.00†

* Prices of each module includes mating connector, Model 7200MC. Additional connectors $15.00 each. Quantity discounts available.

† DCC20 price does not include mating connector — Mating connector Model 1400MC — $5.00 each.

MP8104
ANALOG OUTPUT SYSTEM
MP8208 AND MP8216
DATA ACQUISITION SYSTEM

- **REDUCES SYSTEM DEVELOPMENT TIME**
  System engineered and specified plugs directly into Intellec® 8 Microcomputer
  Operates from Intellec's +5VDC power supply
- **EASY TO PROGRAM**
  Systems are treated as memory
- **EASY TO USE**
  All cabling and connectors are included



Coming soon! More Analog I/O Systems for: Motorola EXORciser (M6800) Intel MDS (8080 and series 3000)

These microcomputer peripherals provide two much needed functions that interface directly to Intel's Intellec® 8 microcomputer. The functions are: 1) Analog Data Acquisition and 2) Analog Output. The devices are electrically and mechanically compatible with any Intellec 8. Each analog system is contained on a single printed circuit board that is treated as memory input or output by the CPU. The cards will mate with any memory or I/O slot. The analog interface for each system is at a flat cable connector located at the edge of the board opposite the bus connector.

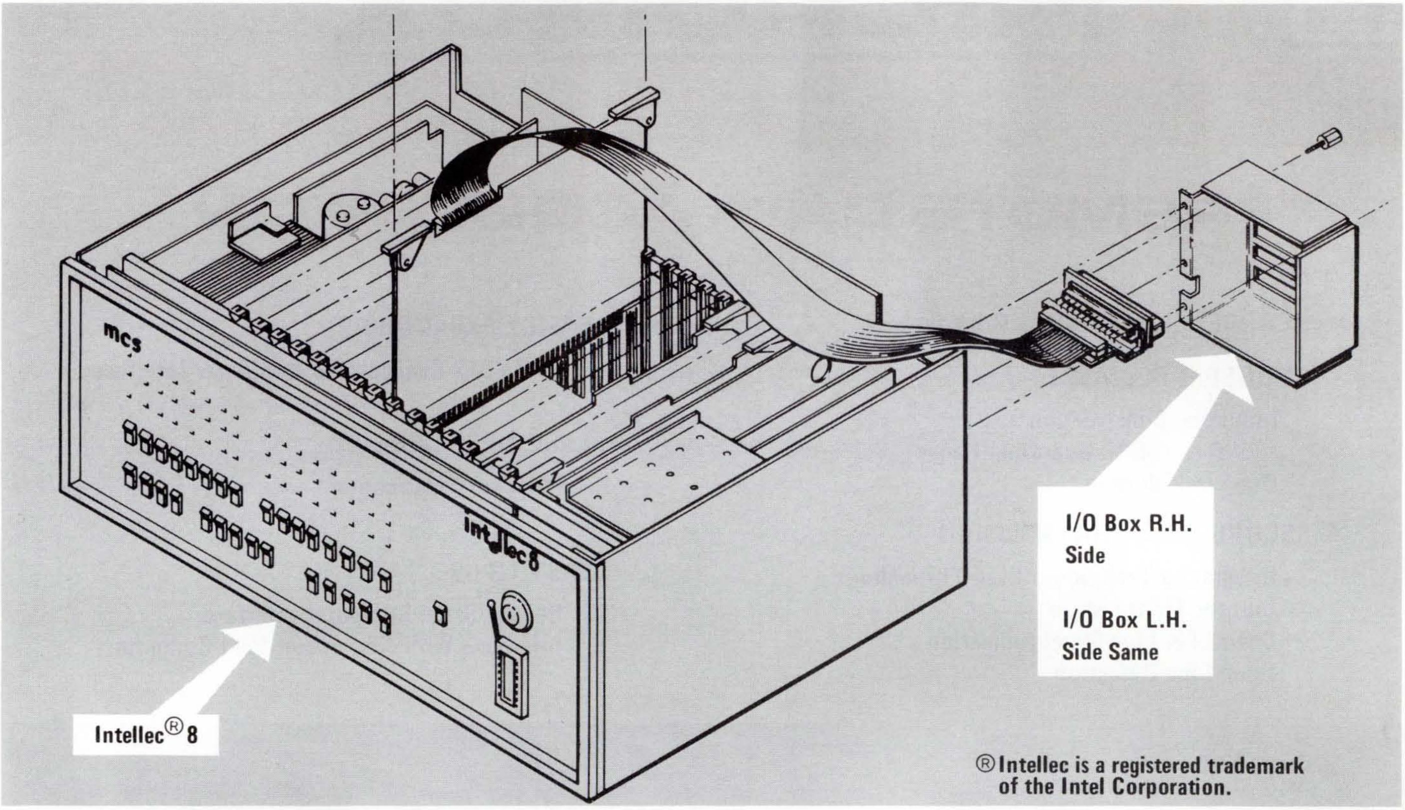
The Data Acquisition Systems consist of the MP8208, an 8 channel differential input system; and the MP8216, a 16 channel single-ended input system. Burr-Brown's SDM850 and SDM851 modular data acquisition systems are used to implement these systems. The data acquisition systems include an input multiplexer, instrumentation amplifier, sample/hold and 12 bit A/D converter along with all the necessary timing, decoding and control logic. The model 546 DC/DC converter (+5V to ±15V) is also used so that only the Intellec's +5VDC power supply is required.

The MP8104, an analog output system, provides four analog output channels (using four of Burr-Brown's hybrid 12 bit DAC80 D/A converters). This board also contains the 546 DC/DC converter to assure operation on +5VDC power. The input of the D/A converters are double buffered so that a complete 12 bit word can be strobed into a D/A converter's input register to minimize output glitches.

THEORY OF OPERATION

When programming with these peripherals, the user treats them as memory locations. Both the A/D converter output and the D/A converter input are 12 bit words,so two 8 bit memory locations are needed for each channel. But, because the address block occupied by each peripheral is strap selectable, it can be placed anywhere in memory. Since these units are treated as memory, a single instruction is all that's needed (with the Intellec 8, mod 80) to read an input channel or to set the input of a D/A converter. For instance, the LHLD (load) instruction followed by the proper address is used to read data from the MP8208 or MP8216. It will automatically select the desired channel, initiate conversion and when conversion is complete, transfer the A/D converter output for that channel to the Intellec's H and L registers. The eight least significant bits are read first followed by the four most significant bits. In earlier Intellec's (using the 8008 chip), two MOV instructions are needed.

All of these systems are jumpered at the factory with the first channel at address $FF00_{16}$ (1111 1111 0000 0000 in binary). Each subsequent channel is two memory locations past the start of the last channel so that the second channel is at location $FF02_{16}$ (1111 1111 0000 0010).



SPECIFICATIONS

All specifications typical at 25°C unless otherwise noted.

MP8208/8216 DATA ACQUISITION SYSTEM

ANALOG INPUT	
Number of analog inputs	
MP8208	8 differential
MP8216	16 single-ended
Input voltage range(1)	±10V, 0 to 10V, 0-5V (strap selectable)
Input overvoltage protection	±15V
Input Impedance	100 megohms
TRANSFER CHARACTERISTICS	
Resolution	12 bits binary
Throughput accuracy (max)	±0.025% FSR(2)
Temperature coefficient of accuracy	±0.002% FSR/°C
Conversion time(3)	20 microseconds
CMRR (for MP8208)	70 dB (DC to 1000 Hz)
DIGITAL INPUT/OUTPUT	
All signals compatible with Intellec Bus. Conversion starts when:	1) MAD 5 through MAD 15 equals the hardwired address. 2) DBIN and MEMR signals are present and 3) MAD 0 = 0 (even address)
An analog input channel is selected by:	MAD 1 through MAD 4
The output data bits are read into:	MDI 0 through MDI 7 (The 8 LSB's when conversion is complete, followed by the 4 MSB's when MAD 0 = 1)
TEMPERATURE RANGE	0 to 70°C

1) Connected at the factory for ±10 V range.
2) FSR is Full Scale Range (i.e., 20 V for ±10 V range, 10 V for 0 to +10 V range).
3) The internal sample/hold amplifier is in "hold" 7.5 microseconds after start of conversion.

Prices and specifications subject to change without notice.

MP8104 DAC OUTPUT SYSTEM

ANALOG OUTPUT	
Number of analog outputs	4
Output voltage range(1)	±10V,0-10V,±5V,0-5V,±2.5V @ 5 mA (strap selectable)
Output Impedance	1Ω
Output settling time	< 10 microseconds
TRANSFER CHARACTERISTICS	
Resolution	12 bits binary
Throughput accuracy (max)	±0.0125% FSR
Temperature coefficient of accuracy	
Unipolar	±0.003% FSR/°C
Bipolar	±0.0045% FSR/°C
DIGITAL INPUT/OUTPUT	
All signals are compatible with Intellec Bus. A new data word is strobed to a DAC's input register when:	1) MAD 3 through MAD 15 equals the hardwired address. 2) A write signal is present and 3) MAD 0 = 1
An analog output channel is selected by:	MAD 1 and MAD 2
The input data bits are read by:	DBO through DB7
TEMPERATURE RANGE	0 to 70°C

PRICES

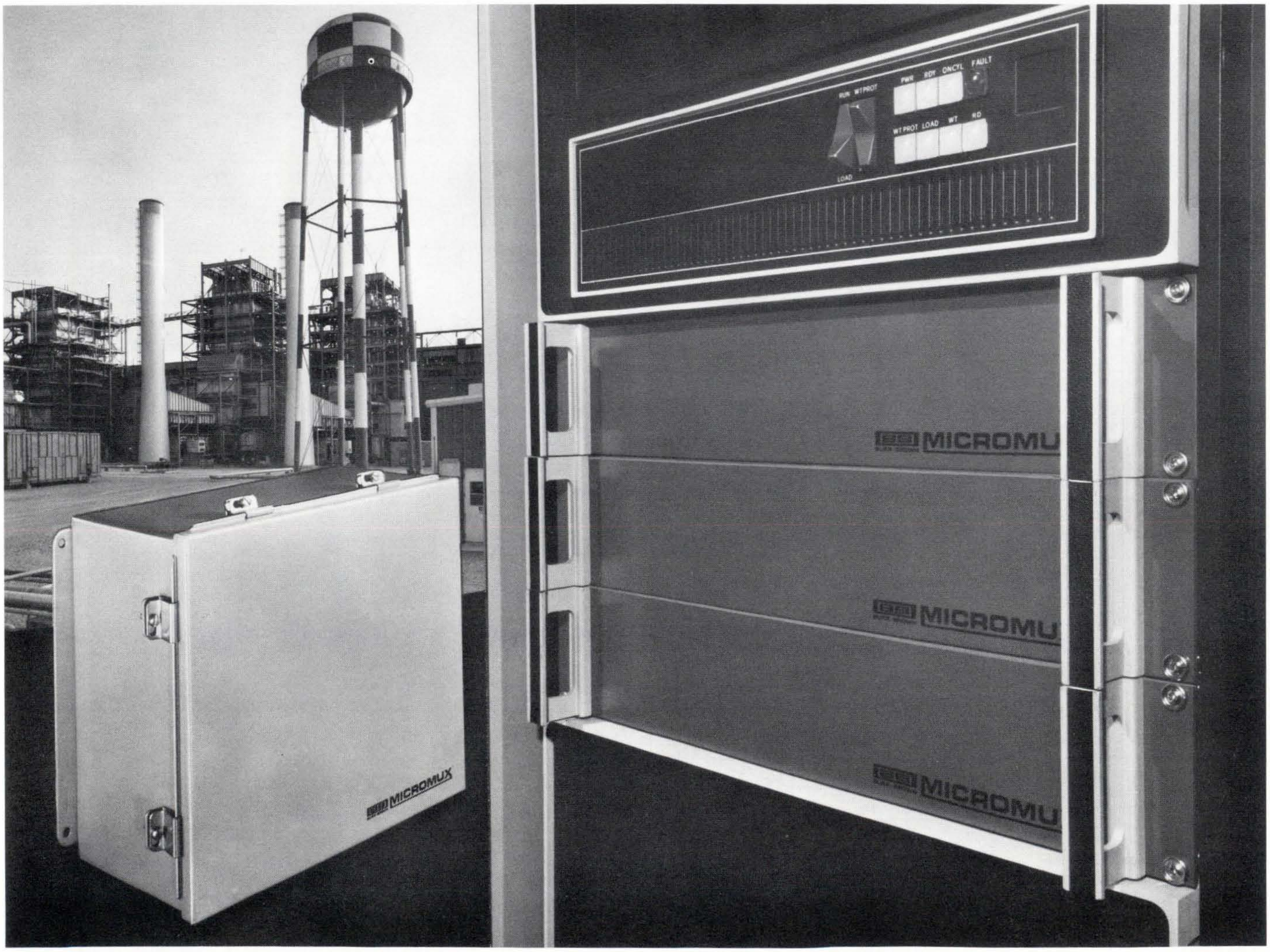
Model Number	Description *	1 - 4	5 - 9
MP8104	4 channel DAC output system	$695.00	$635.00
MP8208	8 channel differential data acquisition system	795.00	725.00
MP8216	16 channel single-ended data acquisition system	795.00	725.00

* Systems include all required cables and connectors.

MICROMUX™

REMOTE DATA ACQUISITION

- **REDUCES SIGNAL WIRING BY 94%**
- **RUGGED & RELIABLE**
  Industrial Construction
  -25°C to +85°C Operating Range
  One Week Burn-in
- **SECURE DATA TRANSMISSION**
  Integrating Techniques Used Throughout
  Current Transmission
  Channel & Line Synchronization
  Open Line Detection
- **EASILY EXPANDABLE**
  16 To 512 Channels Per Computer Interface
- **EASY TO SERVICE**
  Modular Construction
- **EASY TO USE**
  Built-in Serial Computer Interface
  Interfaces With All Popular Mini-Computers



Micromux is a low cost industrial remote data acquisition system designed to reduce wiring costs and improve data integrity. Micromux is ideally suited to monitoring thermocouples, environmental variables, equipment maintenance functions, levels, pressures and other process signals. It is a rugged system that comes complete and ready to use in standard industrial packaging with a built-in computer interface. Micromux consists of from one to four electrically isolated remote units connected to a receiver. Each remote unit multiplexes 16 analog or digital inputs and converts them to frequency-coded time-multiplexed digital signals. These signals are then transmitted on a wire pair as far as 1500M (5000 ft.) to the receiver. The receiver converts the frequency signal to a three digit BCD format and stores the latest data from all channels in its internal memory. Upon command, the receiver transmits the continuously updated channel information to a computer over a standard ASCII serial interface.

The environmentally rugged remote units are intended to be used near the sensors and transmitters that generate the remote signal inputs. AC power is not required at the remote units because power is supplied by the receiver on the same twisted wire pair used for signal transmission. The receiver is intended for use near a computer.

Detailed Product Data Sheet and User's Manual available on request!

Micromux is a money saving alternative to direct wiring of all signals to the computer room. Micromux reduces the process signal wiring required by a factor of 94%. This savings, especially with the cost of wire and labor steadily rising, can easily amount to several times the cost of Micromux. In addition, significant advantages can accrue because of reduced documentation requirements and simplified cable routing.

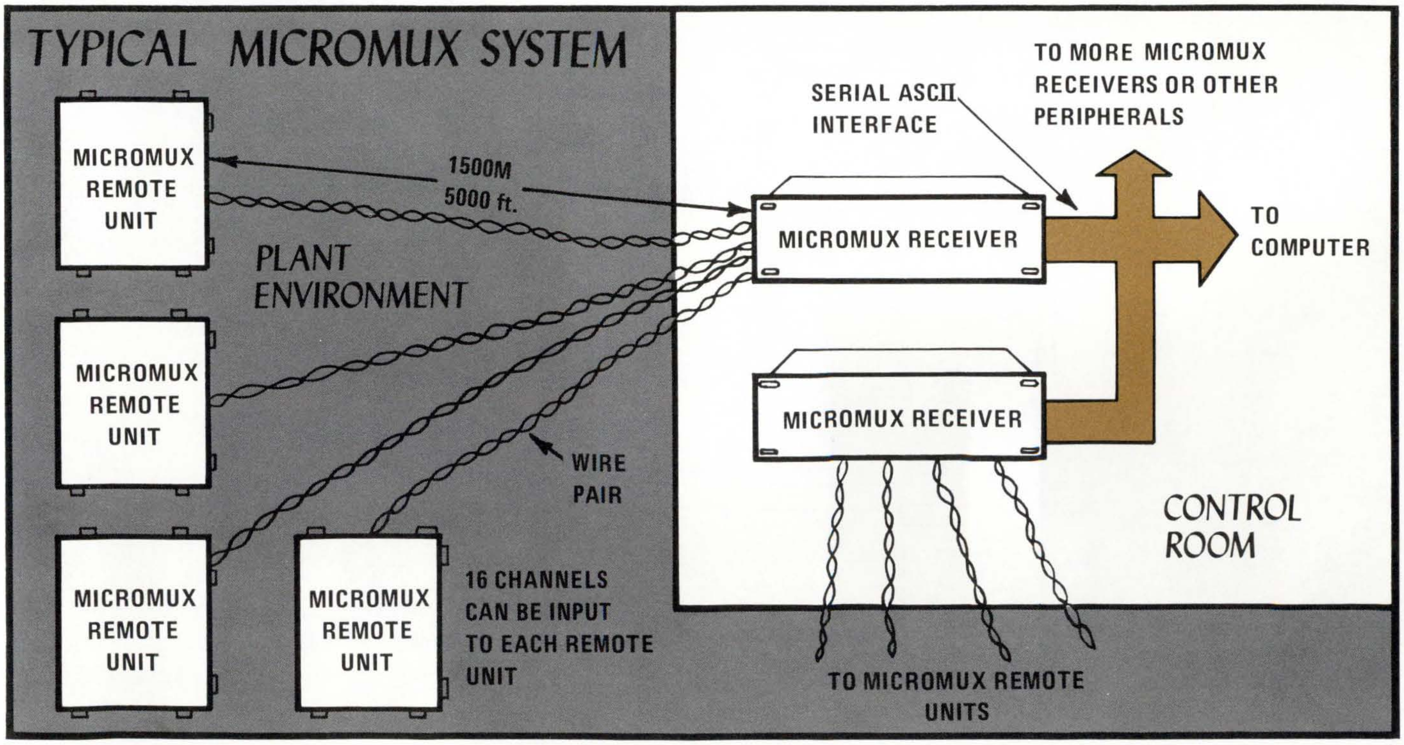
Since Micromux is a computer interfaced data acquisition system, a local multiplexer at the computer is not needed. Micromux is price competitive on this basis alone.

Micromux can be configured as a basic 16 channel system with one remote unit and one receiver. Up to four remote units can be connected to each receiver to achieve a capacity of 64 channels. And, as many as eight fully expanded receivers (512 data channels) can be connected to each communications interface of the computer.

PRICING

16 Channel Micromux System $2790.00
(Includes receiver and one remote unit)
Additional remote units: $1640.00

Contact Burr-Brown for pricing of the exact system that you require.



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.

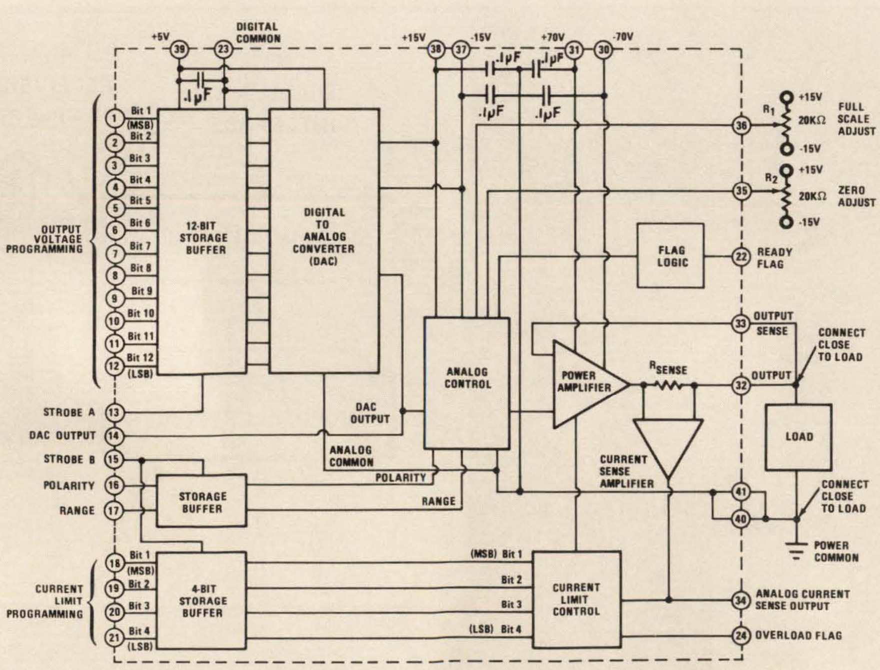
When operated in the voltage programming mode, a current sense output is available. Also, the internal current limiting level is digitally programmable.

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 (35) on page 98.

PRICE in 1 - 9 quantities:

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

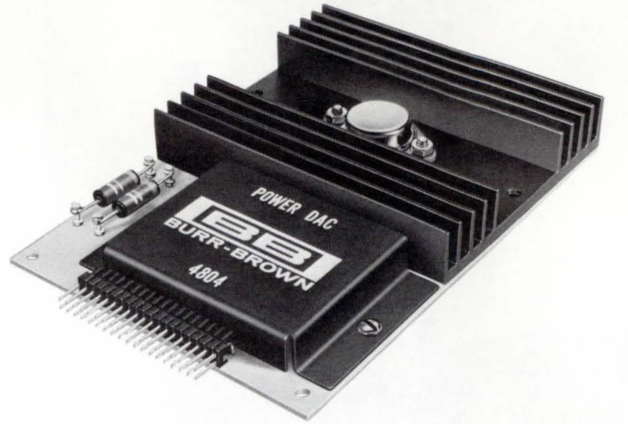
For additional details request data sheet PDS-306.



4800/4801 BLOCK DIAGRAM

MODEL 4804 - *Low Cost POWER DAC*

- **±30V, ±1 AMP OUTPUT**
- **±½LSB MAXIMUM NON-LINEARITY**
- **INPUT STORAGE REGISTER**
- **RESISTOR-PROGRAMMED VOLTAGE RANGE AND CURRENT LIMIT**
- **LOW COST: $209.00**



The 4804 is the first commercially available power DAC that delivers ±1 amp continuously with an output of ±30V. Semi-conductor test equipment and servo control systems designers can save both time and money by using this digitally-programmed voltage source. You can select an output voltage range up to ±30V with the addition of one external resistor while maintaining 12-bit resolution. Accuracy of the programmed voltage is ±0.05% of full scale with no external trimming. Offset and gain adjusting points are accessible if more accuracy is required, or if you wish to optimize performance at a particular value of output voltage.

The output current is limited to 1.25 amps to protect the load. By changing the values of two easily accessible resistors, you can vary the positive and negative current limits independently to suit your particular application. The 4804 power amplifier is capable of delivering two amps into a load continuously if the current limit resistors are changed and care is taken to keep the internal power dissipation below the absolute maximum rating.

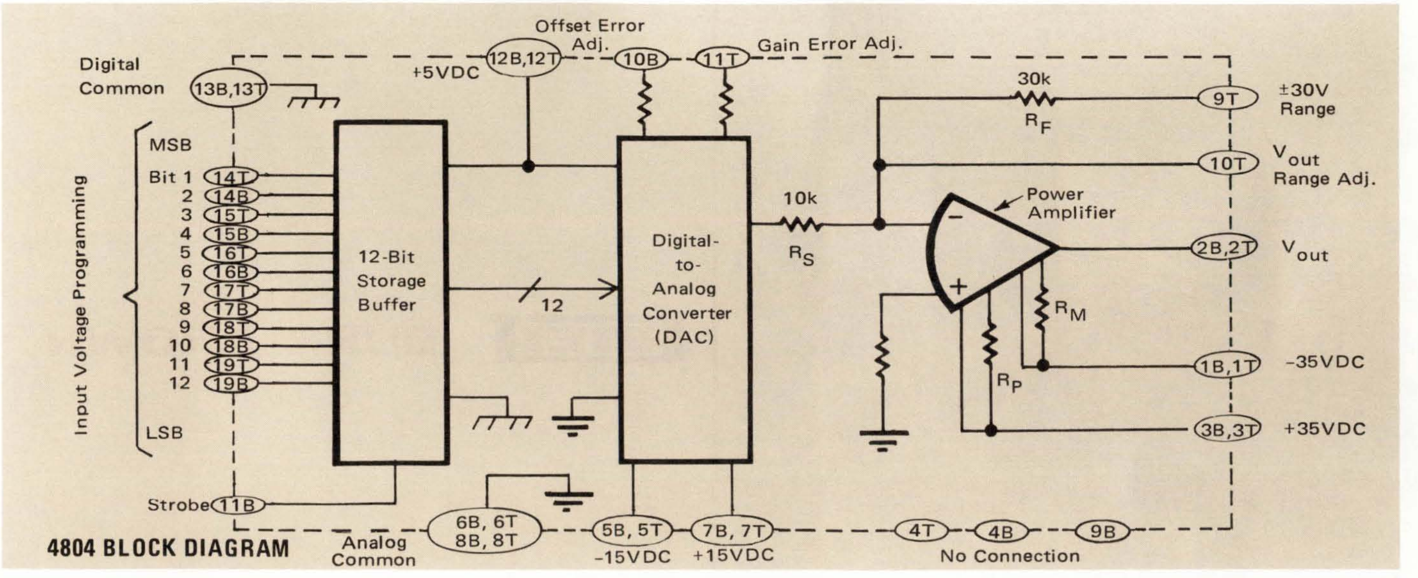
The package can dissipate up to 20 watts internally in free air at 25°C with no external heat sinking required. With a maximum package height of 0.875 inches, the 4804 will mount on a PC card in a card file close to the load. To further minimize voltage drops, the line resistance between the POWER DAC and the load can be placed inside the feedback loop of the output amplifier by using the V_{out} range adjust pin and an external feedback resistor. Remote sensing and grounding techniques to improve accuracy are described in the six-page product data sheet.

Over the 0°C to 70°C temperature range, gain and offset are guaranteed to drift less than ±50ppm per °C and ±70μV per °C, respectively. Settling time to within 0.01% of final reading is less than 100μs for any change in programmed output voltage.

For a more detailed description of the POWER DAC, including complete specifications, request PDS-335.

See package (47) on page 103.

PRICES	
(1 - 24) $209.00	(25 - 99) $188.00



4804 BLOCK DIAGRAM

DATA CONVERSION PRODUCTS

Analog-to-Digital Converters
Voltage-to-Frequency Converters
Digital-to-Analog Converters
Sample/Holds
Peak Detectors
Multiplexers

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.

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 serial 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.

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.

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 of ±0.01% will satisfy a majority of data acquisition and control applications.

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 MULTIPLEXERS accept continuous analog data from multiple data sources, select these sources one at a time, and present the selected data as time-multiplexed analog data to an accepting device such as a sample/hold or A/D converter. Burr-Brown's analog multiplexers accept a digitally coded (binary) channel address and provide the decoding for selecting the correct channel. All Burr-Brown analog multiplexers are constructed with CMOS-FET switches that are protected against electrostatic discharge (overvoltage protection).

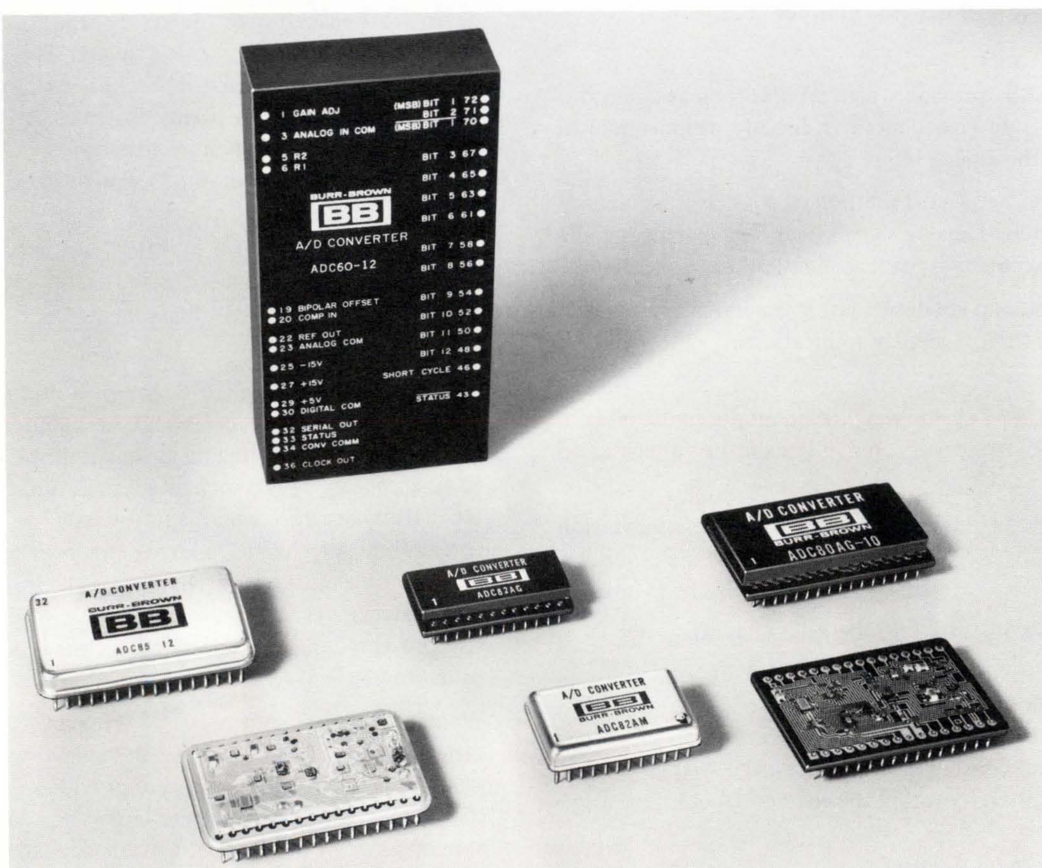
Transfer accuracies up to ±0.01% for either 4 or 8 channel differential or 8 or 16 channel single-ended sources with signal ranges up to ±10 volts are provided. All Burr-Brown CMOS analog multiplexers are latch-up proof, and are available in 16 or 28 pin DIP compatible packages.

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 ±7ppm/°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 some have a user connectable input buffer amplifier. All digital inputs and outputs are TTL compatible, and all units operate from ±15 VDC and +5 VDC power.

Our new hybrid IC Models, ADC80, ADC82, and ADC85 offer superior performance at attractive prices, and are packaged in tiny 24 and 32 pin DIP compatible metal and ceramic packages.



HIGH PERFORMANCE IC

ADC80 LOW COST 10 AND 12 BIT IC NEW!

Designed to save cost, space and weight with no sacrifice in performance, the ADC80 is a successive approximation A/D converter that provides 10 and 12 bit resolutions at conversion speeds up to 2 microseconds per bit. Complete with internal clock and reference, these A/D converters offer ±½ LSB maximum linearity error and ±30ppm/°C maximum gain drift over -25°C to +85°C. Input signal ranges of ±2.5, ±5, ±10, +5 and +10 volts are user programmable. Parallel and serial digital data is available in unipolar or bipolar TTL compatible binary codes. These low cost units are offered in 32 pin DIP compatible epoxy sealed ceramic packages.

ADC82 LOW COST 8 BIT IC NEW!

The ADC82 is a high performance A/D converter in hybrid IC form. Conversion time of the ADC82 is 2.8 microseconds. This unit is pre-trimmed to provide ±½ LSB absolute accuracy at 25°C and is complete with clock and internal reference. It is also flexible in application, providing user selectable input ranges of ±2.5, ±5, ±10, +5, +10, and +20 volts, plus a choice of parallel or serial output.

The ADC82 is hermetically sealed in a metal, 24 pin dual-in-line package and is specified for operation over the -25°C to +85°C temperature range (ADC82AM). The ADC82 is also available in a 24 pin ceramic (ADC82AG, -25° to +85°C).

FAST 10 AND 12 BIT IC
ADC85 -25° to +85°C, 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.

LOW DRIFT

ADC40 - LOW DRIFT ±7ppm/°C

The ADC40 family of 8, 10, and 12 bit A/D converters offer low drift performance and the optimum in modular packaging. Requiring only input signal and power, these self-contained units are designed for applications that require 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 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 encapsulated in 2″ x 4″ x 0.4″ modular packages.

HIGH SPEED

ADC60 - UP TO 1 MHz SAMPLING RATE

The 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.

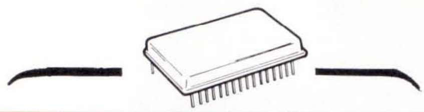
HIGH RESOLUTION, INTEGRATING

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 utilizes the delta sigma modulation principle whereby 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 closed conversion loop assures linear performance of ±0.005% ±1 count that is independent of clock frequency deviation 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 is available with unipolar or bipolor binary or BCD output codes.

ANALOG-to-DIGITAL CONVERTERS



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

MODEL	UNITS	ADC60 HIGH SPEED			ADC85C FAST IC		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	±0.195	±0.048	±0.024	±0.048	±0.012	0.048	±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	±5	±5	±5	±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(6)			CBI(7)			
Status(6)		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 89-93)		(25) B 2"x 4"x 0.75"			(26) 1.15" x 1.75" x 0.2" 32 Pin METAL DIP			
PRICE (1 - 9)		$195.00	$195.00	$235.00	$160.00	$195.00	$185.00	$225.00

Prices and specifications are subject to change without notice.

† Operates over the -25°C to +85°C temperature range with derated performance.

(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.

ORDERING INFORMATION

ADC60

ADC60 – XX

Basic Model Number — Number of Bits (8,10, 12 Bits)

ADC85

ADC85X – XX

Basic Model Number ADC85 or ADC85C — Number of Bits (10 or 12)

ADC40

ADC40 – XX – XXX

A/D Converter Family — Resolution Number of Bits (8,10, or 12) — Output Code (BIN or BCD)

MIL-STD-883 SCREENING
See pages 106 - 107

ADC40 LOW DRIFT				ADC80AG LOW COST IC		ADC82AM * WIDE TEMP IC	ADC82AG * LOW COST IC	ADC100 INTEGRATING, HIGH RESOLUTION			
8	10	12	3	10	12	8	8	16	16	4	4+
0 to +10				±2.5, ±5, ±10, 0 to +5, 0 to +10				±10	+10	—	—
				—		—		—	—	+10	±10
10^8				500Ω/V of FSR		500Ω/V of FSR		2 x 10^8			
100				100		100		3000			
4				1		1		2			
±0.1				±0.1		±0.05		±0.05			
±0.05				±0.05		±0.05		±0.02		±0.02	
±0.1				±0.1		±0.05		±0.05		±0.05	
±0.2	±0.048	±0.012	±0.05	±0.048	±0.012	±0.2		±0.005			
±1/2 LSB				±1/2 LSB		±1/2 LSB		±1 count			
0 to +70				-25 to +85		-25 to +85	-25 to +85	0 to +70			
±10	±10	±7	±10	±30		±50	±50	±10[4]	±10[4]	±10[4]	±5[4]
±2				±3		±5	±5				
±5	±5	±3	±5	±3		±25	±25				
Guaranteed (0 to +70°C min)				-25 to +85°C min		-25 to +85 min	-25 to +85 min	0 to +70			
20	30	30	30	21	25	2.8	2.8	50 to 200[8]		30	30
BIN[6a]			BCD[6b]	CBI[7]		CBI[7]		BOB	USB	BCD[6b]	SMD[9]
Logic "1" during conversion								Logic "0" during conversion			
±15 and +5				±15 and +5				±15 and +5			
±14.5 to ±15.5 and +4.75 to +5.25				±14 to ±16 and +4.75 to +5.25				±14.5 to ±15.5 and +4.75 to +5.25			
+30				+20		+20		+25			
-40				-20		-20		-15	-15	-20	-20
+300				+70		+70		+300			
(25) A 2" x 4" x 0.4"				(24) A 1.7" x 1.1" x 0.2" 32 pin Ceramic DIP		(27) C 0.8" x 1.4" x 0.2" 24 Pin METAL DIP	(28) B CERAMIC 0.8" x 1.4" x 0.2"	(25) C and D 2" x 4" x 0.4"			
$195.00	$225.00	$290.00	$275.00	$72.50	$77.50	*	*	$250.00	$250.00	$225.00	$250.00

(6a) 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
(6b) BCD - Unipolar Binary Coded Decimal

(7) 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
(8) 50 msec for 14 bits, 200 msec for 16 Bits.
(9) SMD = Sign Magnitude Decimal Code.

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

ADC80

ADC80AG – XX

Basic Model Number — Number of Bits (10 or 12)

ADC82

ADC82XX

Basic Model Number
ADC82AG - Ceramic Package
ADC82AM - Metal Package

ADC100

ADC100 – XXX

Basic Model Number — Output Code (BCD, SMD, USB, BOB)

Voltage-to-frequency conversion is a simple and low cost method of converting analog signals into an equivalent digital form. The output is a 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.

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.

coming soon*...

VFC32-100kHz IC

Low cost and compact in size, the VFC32 offers ±0.02% linearity and ±30ppm/°C gain drift for application where 5 digit resolution of faster update lower resolutions are required.

This V/F converter is packaged in a TO-99, and is specified for operation over a -25°C to +85°C temperature range.

The VFC32 requires only three external components and ±15VDC power, and may be operated over the 1 Hz to 10 kHz range of ±0.02% nonlinearity or 10 Hz to 100 kHz for ±0.05% nonlinearity for a 1mV to 10V input signal range.

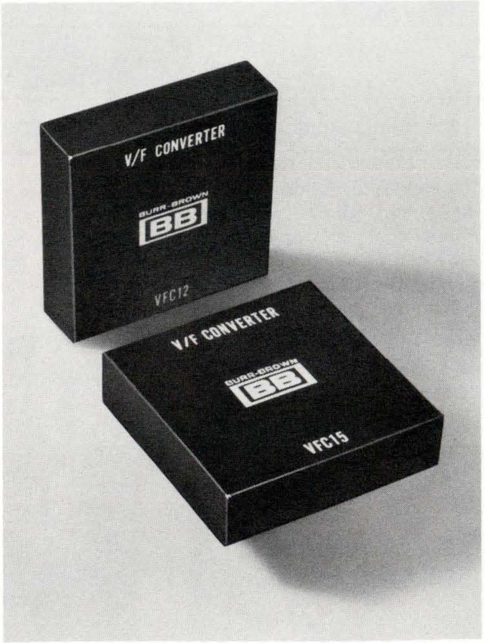
* (Available in mid - 76)

VFC12 AND VFC15 LOW COST 10/20 kHz Modular

Housed in a 1.5" x 1.5" x 0.4" module, these V/F converters offer ±0.01% linearity and ±20ppm/°C gain drift for 12 bit accuracy.

The VFC12 accepts 0 to 10 volt analog signals while Model VFC15 accepts 0 to 20 volt analog signals. The VFC12 operates over a 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.



SPECIFICATIONS

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

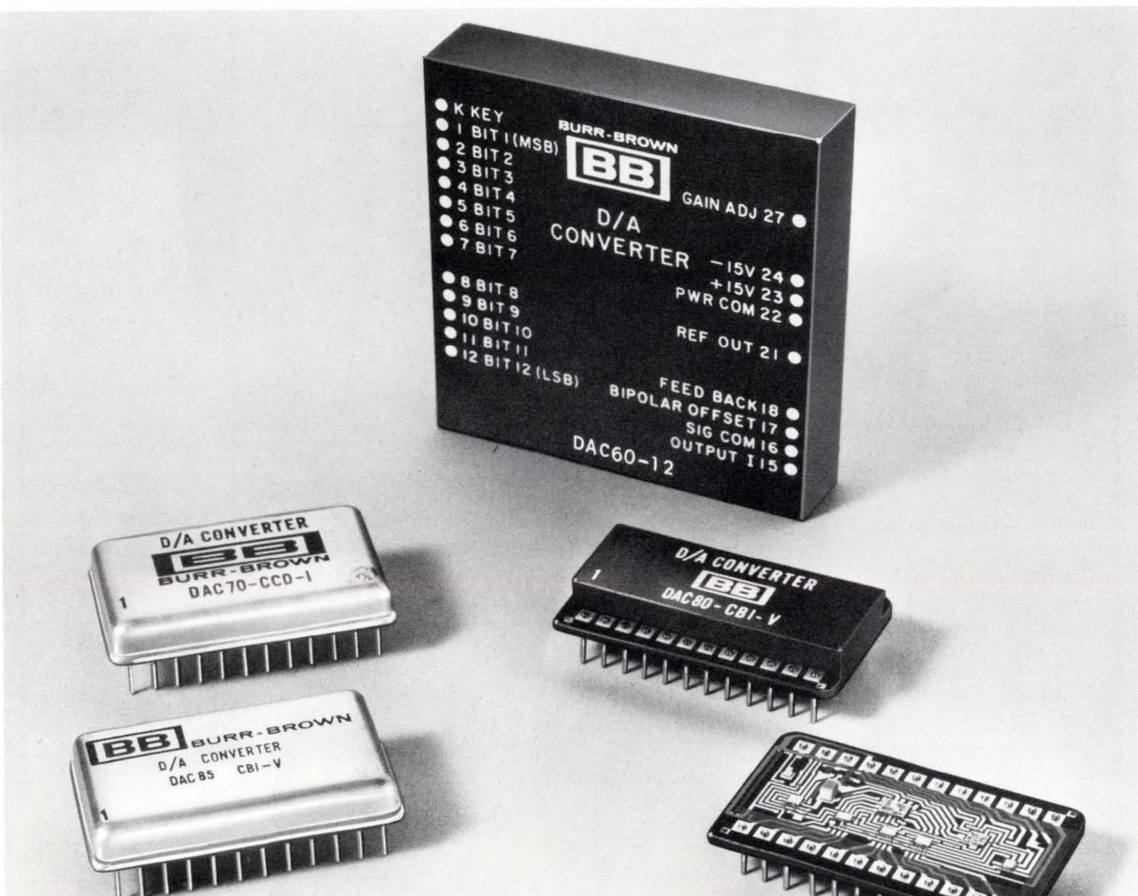
MODEL	VFC12	VFC15	VFC32*	UNITS
FREQUENCY RANGE	10	20	100	kHz
INPUT				
ANALOG INPUT				
Voltage Range	0 to +10	0 to +20	1mV to +10	V
Overrange, min	100	10	10	% of FSR(1)
Impedance	33	33	30	k Ω
Maximum Safe Input Voltage	22	22	15	V
INPUT POWER				
Rated Voltages(2)	±15 ±10%		±15(3)	VDC
Supply Drain				
Typical	±16		±3.5	mA
Maximum	±20		±5	mA
TRANSFER CHARACTERISTICS				
TRANSFER EQUATION	$f_{out} = 10^4 \frac{V_{in}}{10}$		$f_{out} = 10^5 \frac{V_{in}}{10}$	Hz
ACCURACY				
Full Scale Error	Adjustable (4)		Adjustable	
Offset Error (5)				
Typical	±0.002	±0.001	±0.01	% of FSR
Maximum	±0.01	±0.005		% of FSR
Linearity Error, max				
10 kHz Range	±0.01	–	±0.01	% of FSR
20 kHz Range	–	±0.01	–	% of FSR
100 kHz Range	–	–	±0.05	% of FSR
Power Supply Sensitivity	±0.005		±0.01	% of FSR/% V_s
STABILITY (0°C to +70°C)				
Full Scale Drift				
Voltage Input, max				
10 kHz Range	±50	±50	±50	ppm of FSR/°C
20 kHz Range	–	±50	–	ppm of FSR/°C
100 kHz Range	–	–	–	ppm of FSR/°C
Current Input	N/A	±35	N/A	ppm of FSR/°C
Offset Drift	±2		*	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		0 to +70	°C
Operating (derated specifications)	-25 to +85		-25 to +85	°C
Storage	-55 to +125		-55 to +125	°C
OUTPUT				
Waveform	Train of TTL/DTL compatible pulses			
Pulse Characteristics				
Logic 1 (High)	4.7 ±0.5		V_+ ±0.5	V
Logic 0 (Low)	0.2 ±0.1		0.2 ±0.1	V
Pulse Width	30		3	μsec
Fan Out	10 TTL Loads		3 TTL Loads	
Impedance	3		3	k Ω
Capacitive Load, max	1000		300	pF
PACKAGE DRAWING (see pages 82, 98)	(34) A 1.5″ x 1.5″ x 0.4″	(34) B	TO-99	
PRICE (1 - 24)	$37.00	$39.00	*	

(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) Range is ±9V to ±20V.
(4) Adjusted at factory for 9.900V = 10 kHz.
(5) May be externally adjusted to zero.

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

Digital-to-Analog CONVERTER HIGHLIGHTS

Our D/A converters have established a reputation for high quality, low 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 range of accuracy (±0.2% to ±0.003%) drift (±7ppm/°C to ±40ppm/°C gain drift), settling time (25 nanoseconds to 50 microseconds), and size, allowing you to choose the right product for your specific application. All are TTL compatible and operate from ±15 volt and +5 volt DC power supplies. Our line of monolithic and hybrid converters (DAC70, DAC80, DAC85 and DAC90) is easily the industry's broadest.



HIGH PERFORMANCE IC
NEW! DAC70-16 Bit Resolution

The DAC70 is the first 16 IC D/A converter complete with internal reference in a 24 pin metal DIP compatible package. Designed to provide wide dynamic range and preserve accuracy in a compact package, this D/A converter is excellent for use as a calibration standard and in many other applications including ATE and biomedical instruments. Two performance models are offered; the DAC70 (-25°C to +85°C) is specified for ±7ppm/°C max gain drift and ±0.003% max linearity error, and the DAC70C (0°C to +70°C) offers ±14 ppm/°C max gain drift and ±0.005% max linearity error. These units accept TTL compatible complementary 16 bit binary or 4 digit BCD digital input codes, and provide current output ranges of ±1 mA or 0 to -2 mA for driving an external op amp. The DAC70 settles to ±0.003% in 100 microseconds when the BB3500C op amp is used.

NEW! DAC90-8 Bit Monolithic

Designed with internal reference, this monolithic 8 bit D/A converter is optimum for many applications in microcomputer systems and in process control. It offers true 8 bit accuracy and in addition has low temperature drift. It's fast settling time (200 nsec to ±½LSB) makes it a good choice for use in building low cost A/D converters. The DAC90 is packaged in a 16 pin dual-in-line package and is available for both military and industrial temperature ranges.

Feedback resistors are included on the monolithic chip allowing the user to scale an external output amplifier for ranges of ±10 volts, ±5 volts, ±2.5 volts, 0 to +10 volts or 0 to +5 volts.

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 less than ±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 settles to ±0.01% in only 300 nanoseconds.

The DAC is packaged in a 1.40" x 0.80" x 0.25" 24 pin DIP compatible ceramic package.

DAC85-12 Bit Low Drift

The DAC85 12 bit D/A converter offers quality performance in a 24 pin dual-in-line metal package, is complete with internal reference and output amplifier, and is engineered to preserve the performance while providing sealed protection from severe environments.

Highly stable laser trimmed thin-film resistors and quad current switches provide low nonlinearities of ±0.012% over the 0 to 70°C temperature range (DAC85) or ±0.012% over the -25°C to +85°C temperature range (DAC85 and DAC 85LD). 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) version, 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.

DAC12QZ-12 Bit Low Cost Modular

If you need a widely second sourced 12 bit modular D/A converter, the BB Model DAC12QZ offers superior performance for lower cost. Utilizing laser trimmed thin-film resistor networks and Burr-Brown's quality construction, this 12 bit D/A converter is one of the best buys on the market today.

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 resolutions, provides ½ 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.

DIGITAL-to-ANALOG CONVERTERS

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

MODEL	UNITS	DAC80 LOW COST IC		DAC85C ECONOMY IC		DAC85 GENERAL PURPOSE IC	
RESOLUTION							
Binary	Bits	12		12		12	
Decimal	Digits		3		3		3
INPUT							
INPUT CODES(1) (2)							
Binary		CBI		CBI		CBI	
Decimal			CCD		CCD		CCD
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, – 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					
Output 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(5)					
Current Drain ±15V Supply, +5V Supply	mA	±25, +20					
Sensitivity	% of FSR/%	±0.002(3), ±0.02(4)					
PACKAGE DRAWING (See pages 92 - 101)		(28) A 0.8" x 1.4" x 0.25" CERAMIC		(27) A 0.8" x 1.4" x 0.22" METAL			
PRICE (1 - 9)		$26.50	$26.50	$69.00	$69.00	$89.00	$89.00

(1) All input codes are 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.

ORDERING INFORMATION

DAC70

DAC70X – XXX – X

Basic Model Number: DAC70 or DAC70C

Input Code:
CSB = 16 Bit Complementary straight Binary
COB = 16 Bit Compl. offset Binary
CCD = 4 digit compl. BCD

Output: I = Current

DAC90

DAC90 X X

Basic Model Number

Grade:
J = 0.8% 0 to +70°C
K = 0.4% 0 to +70°C
L = 0.2% 0 to +70°C
R = 0.8% –55 to +125°C
S = 0.4% –55 to +125°C
T = 0.2% –55 to +125°C

Package:
P = Plastic (J, K, L Grades)
G = Ceramic (R, S, T Grades)

NEW!

MIL-STD-883 SCREENING
See pages 106 - 107

NEW!

DAC85LD LOW DRIFT IC	DAC85ET WIDE TEMP IC	DAC70 HIGH RESOLUTION IC		DAC70C		DAC90* 8 BIT MONO		DAC12QZ LOW COST MODULAR	DAC60 ULTRA HIGH SPEED	
12	12	16	4	16	4	8		12	10	12
CBI	CBI	(7)	CCD	(7)	CCD	CSB, COB		BIN	CBI	
±0.012 ±0.1 ±0.05	±0.012 ±0.1 ±0.05	±0.003 ±0.05 ±0.05	±0.003	±0.005 ±0.05 ±0.05	±0.005	±0.2 ±5 —		±0.012 ±0.1 ±0.05	±0.048 ±0.05 ±0.001	±0.012
±10 ±1 — ±0.012† -25 to +85	±20 ±2 — ±0.024 -55 to +125	±7 ±1 — — -25 to +85		±14 ±1 — — 0 to +70		±80 — — ±0.2 -55 to +125	±40 — — ±0.2 0 to +70	±30 ±1 — ±0.012 0 to +70	— — ±30 ±0.05† 0 to +70	— — ±30 ±0.024†
3 (V_{out}), 0.3 (I_{out}) 20		100 (V_{out})$^{(6)}$, 50 (I_{out}) 1				0.20 (I_{out})		3 20	0.04 1000	0.15
0 to +5, 0 to +10 ±2.5, ±5, ±10 ±5 0.05		0 to +10$^{(6)}$ ±10$^{(6)}$ ±5$^{(6)}$ 0.05$^{(6)}$				N/A		0 to +5, 0 to +10 ±2.5, ±5, ±10 ±10 @ 5V Range 0.05	N/A	
0 to -2 ±1 ±2.5 15k/4.4k		0 to -2 ±1 ±2.5 15k/4.4k				0 to -2 ±1 -4 to +15 2k/1.6k		N/A	0 to -5 ±2.5 3.2/0.0 650/516	
±15, +5$^{(5)}$ ±25, +20 ±0.002$^{(3)}$, ±0.02$^{(4)}$		±15, +5 ±30, +25 ±0.001				±15 ±8 ±0.02		±15, +5 ±25, +20 ±0.002	±15 +45, -35 ±0.002	
(27) A 0.8" x 1.4" x 0.20" METAL		(27) B 0.8" x 1.4" x 0.20"				(45) 16 Pin DIP		(30) A 2" x 2" x 0.4"	(30) B 2" x 2" x 0.4"	
$150.00	$175.00	$149.00		$119.00		*		$49.00	$110.00	$118.00

(3) For -15V and +5V supplies.
(4) For +15V supply.
(5) The +5V supply can be eliminated by connecting the +5V pin to the ±15V supply.
(6) With external BB3500C op amp.
(7) Available with unipolar (CSB) or bipolar (COB) input codes.

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

DAC80, DAC85

DAC85XX – XXX – X

- Basic Model Number: DAC80, DAC85C, DAC85LD, etc.
- 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

- Basic Model Number
- Number of Bits (10 or 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 have that little extra called "Burr-Brown Quality."

NEW! SHC80- LOW COST IC

Designed to work with our IC A/D converters when low system cost is primary consideration, the SHC80 offers 10μsec acquisition time and 12 bit system compatibility. This sample/hold is complete with internal holding capacitor and has TTL/CMOS compatible mode control input levels. Input range of the SHC80 is ±10 volts and the throughput accuracy of ±0.01% is maintained for signals in this range.

The SHC80 is packaged in a 14 pin dual-in-line form and is available in both plastic and metal versions.

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.

SHC85- FAST 0.01% HYBRID IC

The SHC85 acquires up to ±10 volt signals in 5.5μsec 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.

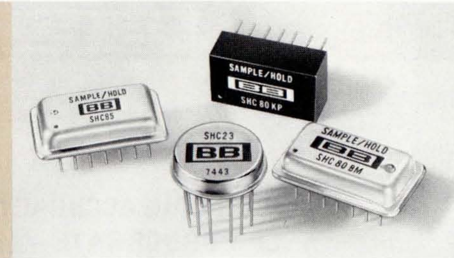
Two models are available – the Model SHC85 is specified for 0°C to +70°C operating temperature range and the SHC85ET is specified for -55°C to +125°C operating temperature range.

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

MODEL	UNITS
INPUT	
ANALOG INPUT	
Voltage Range	Volts
Impedance	Ω
Bias Current	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/°C
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 82 – 95)	
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.

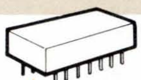
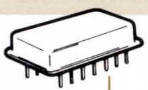


SHM60-HIGH SPEED AND SELECTABLE 1 to 1000 GAINS

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 microseconds 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.

MIL-STD-883 SCREENING
See pages 106 - 107


NEW! SHC85 FAST	NEW! SHC85ET WIDE TEMP IC	NEW! SHC80KP*	SHC80BM* LOW COST IC	SHC23(3) LOW COST	SHC23ET(3) WIDE TEMPERATURE	SHM60(4) HIGH SPEED
±10	±10	±10		±10	±10	±10
10^8	10^8	10^7		10^8	10^8	10^{11}
30	50	300		30	30	0.05
0.05	0.05	0.05		5	5	100
-50	-50	-50		-100	-100	-0.05
±15	±15	±15		±15	±15	±15
±13	±13	±13		±15	±15	+25/-15
±0.01	±0.01	±0.01		±0.01	±0.01	±0.01
5	5	10		70	70	1
1000	1000	1000		1000	1000	15
+1.0	+1.0	±1.0(7)		+1.0	+1.0	±1 to ±1000
±0.01	±0.01	±0.02		±0.01	±0.01	±0.01
±2	±2	±2		±2	±2	±3
500	500	500		20	20	5000
±2	±2	±3		±3	±3	±2
10	200(6)	10	30	0.1	2	100
0 to +70(6)	-55 to +125	0 to +70	-25 to +85	0 to +70	-55 to +125	0 to +70
200	200	75		20	20	400
20	20	5		1	1	25
4.5	4.5	10		60	60	1.0
5.0	5.0	12		70	70	1.5
30	30	30		50	50	12
±0.005	±0.005	±0.005		note 5	note 5	±0.005 max
±10	±10	±10		±10	±10	±10
±10	±10	±5		±5	±5	±20
0.1	0.1	0.5		1.0	1.0	1.0
(29) A 14 Pin DIP	(29) A 14 Pin DIP	(2) G	(29) B	(31) TO-8	(31) TO-8	(30) C 2" x 2" x 0.4"
$65 00	$89.00	*	*	$49.00	$80.00	$99.00

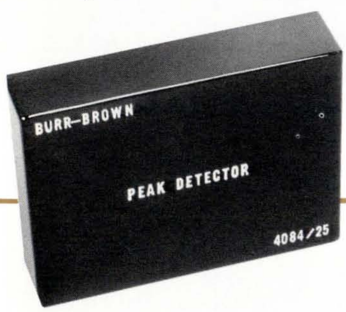
(3) Specification shown for 0.01μF holding capacitor.
(4) Specification shown for unity gain.
(5) Not specified. This parameter is a function of the holding capacitor and the circuit layout.
(6) Max droop at +125°C.
(7) May be increased by use of an external resistor.
* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

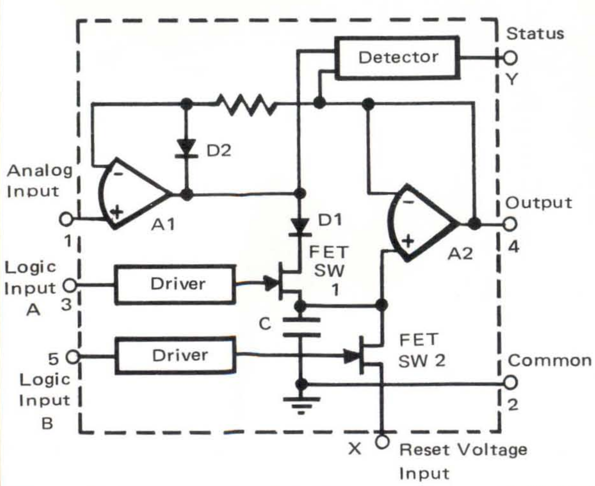
4084/25

- **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 +10V and, with a -10V voltage reference input, the 4084/25 will detect peaks between -10V and +10V.



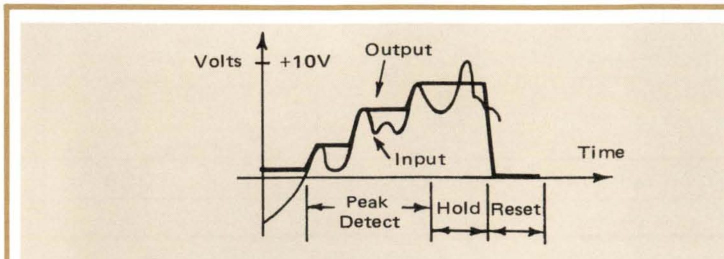


BLOCK DIAGRAM

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 99)	(38) 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

MULTIPLEXERS

MPC-4D, MPC-8S, MPC-8D, MPC-16S, 8-CHANNEL DUAL AND 16-CHANNEL SINGLE-ENDED CMOS-FET

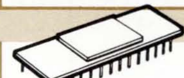
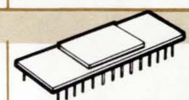
This family of CMOS FET analog multiplexers is offered in 4 and 8 channel differential or 8 and 16 channel single-ended configurations. The MPC-8S and MPC-16S are single-ended monolithic 8 and 16 channel analog multiplexers and the MPC-4D and MPC-8D are monolithic dual 4 and 8 channel analog multiplexers constructed with 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 TTL/CMOS compatible devices feature self-contained binary channel address coding. An ENABLE line is also made available which allows the user to individually enable an 8 or 16 channel group (MPC-8S or MPC-16S) or 4 or 8 channel group (MPC-4D or MPC-8D) facilitating channel expansion in either single-node or multi-tiered matrix configurations.

Digital and analog inputs are failure protected from either overvoltages 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. The MPC-8D and MPC-16S devices are housed in compact 28 pin dual-in-line packages. The MPC-4D and MPC-8S are in 16 pin DIL packages that measure just 0.6" wide. All units 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.

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

MODEL	MPC-4D * 4-CHANNEL DIFFERENTIAL	MPC-8D 8-CHANNEL DIFFERENTIAL	MPC-8S * 8-CHANNEL SINGLE-ENDED	MPC-16S 16-CHANNEL SINGLE-ENDED	UNITS
INPUT					
Analog Inputs					
Number of Input Channels					
Single-ended	N/A	N/A	8	16	Channels
Differential	4	8	N/A	N/A	Channels
Voltage Range	±15	±15	±15	±15	Volts
Maximum Safe Overvoltage	±V Supply ±20	±V Supply ±20	±V Supply ±20	±V Supply ±20	Volts
Reference Voltage Range		+4 to +20		+4 to +20	Volts
ON Characteristics					
ON Resistance (R_{on})	1.3	1.3	1.3	1.3	k Ω
R_{on} Drift vs Temperature	0.25	0.25	0.25	0.25	%/°C
R_{on} Mismatch					
Channel-to-Channel	50	50	50	50	Ω
Differential	50	50	N/A	N/A	Ω
Input Leakage Current	1	1	1	1	nA
OFF Characteristics					
OFF Resistance-to-Ground	10^{11}	10^{11}	10^{11}	10^{11}	Ω
Leakage Current	0.2	0.2	0.2	0.2	nA
Digital Inputs					
Channel Select					
No. of Bits	2(1)	3(1)	3(1)	4(1)	
Code	one of 4	one of 8	one of 8	one of 16	
Group Enable Bit	Logic "0" disables channels Logic "1" enables channel select				
Power Supply Requirements					
Supply Voltages (rated)	±15	±15	±15	±15	Volts
Supply Range +15V	+7 to +20	+7 to +20	+7 to +20	+7 to +20	Volts
-15V	-5 to -20	-5 to -20	-5 to -20	-5 to -20	Volts
Power Consumption	7.5	7.5	7.5	7.5	mW
DYNAMIC CHARACTERISTICS					
Gain Error (20 MΩ load), max	0.01	0.01	0.01	0.01	% of FSR
Crosstalk	0.005	0.005	0.005	0.005	% of OFF Channel Sig.
Settling Time to 0.01%	7	7	7	7	μsec
Common-Mode Rejection, min	120 dB	120 dB	N/A	N/A	
Switching Time					
Turn ON	0.5	0.5	0.5	0.5	μsec
Turn OFF	0.3	0.3	0.3	0.3	μsec
OUTPUT					
Voltage Range, min	±15	±15	±15	±15	Volts
Capacitance-to-Ground	50	50	50	50	pF
Operating Temperature Range	0 to +75	0 to +75	0 to +75	0 to +75	°C
PACKAGE DRAWING (See pages 96, 97)	(32) 16 pin DIP	(33)B 28 pin DIP	(32) 16 pin DIP	(33) A 28 pin DIP	
PRICES (1 - 9)	*	$45.00	*	$42.00	

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

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

OPERATIONAL AMPLIFIERS

General Purpose

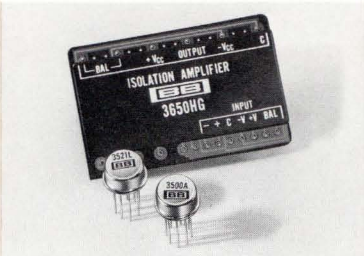
Low Drift

Low Bias Current

Wideband and Fast Settling

High Voltage and High Current

BURR-BROWN



OP AMP HIGHLIGHTS

All Burr-Brown op amps are listed in six application groups which correspond to the user's general design requirements. These groups include General Purpose, Low Drift, Low Bias Current, Wideband and Fast Settling, High Voltage and High Current, and Isolation Amplifiers. Features of some of the key products in each group are described on these pages.

GENERAL PURPOSE

LOW DRIFT, LOW NOISE IC; 3500 SERIES (pg. 34)

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. 35)

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/^{o}C DRIFT IC; 3500E (pg. 36)

The 3500E, based on the proven Burr-Brown 3500 series design, is a low drift unit (1 μV/^{o}C) 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. 36)

Close process control and careful grading by Burr-Brown make possible a new concept in IC op amps – drift matched pairs. Offset voltage and drift are matched to within 200 μV max and 1 μV/^{o}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; 3521 SERIES (pg. 36)

This series provides the hard to find combination of FET input bias currents and low offset voltage drift versus temperature. The five models in this family provide performance which ranges from the 3521H with maximum guaranteed specifications of 10 μV/^{o}C and 20 pA all the way to the 3521L with 1 μV/^{o}C and 10 pA. The low voltage drifts are obtained by using our own thin-film components and state-of-the-art laser trimming techniques. In addition to having low bias current and voltage drift the initial offset voltage is reduced by laser trimming to 250 μV max for most models. This is low enough so that for most applications further external trimming is not required and the cost of the trim pot and the adjustment labor may be eliminated. Low offset voltage, low drift, and low bias current-all in the same family of amplifiers makes the 3521 series truly unique.

BEST ACCURACY; 3291 CHOPPER SERIES (pg. 37)

When it comes to overall accuracy and stability versus temperature and time, chopper stabilized amplifiers just can't be beat. Guaranteed maximum offset voltage and bias current are as low as 20 μV and 50 pA. Drifts versus temperature are 0.1 μV/^{o}C max and 0.5 pA/^{o}C max. Add to this a minimum open loop gain of 140dB and the result is a closed loop accuracy which cannot be matched with any nonchopper op amp. A low profile package (0.4″ high), low price, and frequency response more than adequate for most applications make the 3291 series a "best buy" for high accuracy applications.

DIFFERENTIAL INPUT CHOPPER; 3354/25 (pg. 37)

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/^{o}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

NEW! 150nsec SETTLING TIME (0.01%) IC; 3554 (pg. 41)

This FET input op amp is designed specifically for amplification and conditioning of wideband data signals and fast pulses. It combines in a single IC specifications previously found only in separate specialized designs. Performance features include 150nsec max 0.01% settling time, 1000V/μs min slew rate, 800 MHz gain bandwidth product (G = 100) and 50 mA output current. Outstanding DC performance is still preserved; 0.5 μV max offset voltage and 5 μV/°C max drift (3554B).

While its performance is at the leading edge of the state-of-the-art, the 3554 does not sacrifice full flexibility, package desirability, or cost. It has a fully differential, low drift FET input stage, hermetically sealed TO-3 type package, and a low cost hybrid design offering excellent reliability. Because of its excellent overall performance, the 3554 can address almost any application where speed and bandwidth are important considerations. It is a particularly good choice for use in fast D/A converters, fast sampling circuits, multiplexer buffers, comparators, waveform generators, integrators, and fast current amplifiers.

NEW! 200 mA AT 2000 V/μs; 3553 (pg. 43)

The 3553 is a unity gain amplifier designed to be used as a separate output stage for an operational amplifier or as a stand alone buffer.

When used inside the feedback loop of an op amp to form a composite amplifier, the physical separation of the input amplifier and output power stage helps improve the accuracy of the total circuit by minimizing temperature effects caused by power dissipation.

The 3553 can also be used without an operational amplifier as a stand alone high input impedance, low output impedance buffer capable of driving ±200 mA into a 50Ω load at 2000 V/μs. While the gain is not precisely unity and the offset voltage and drift are translated directly to the output, the accuracy is still sufficient for many line driving applications where fast pulses or wideband signals are involved.

600 ns (0.01%) SETTLING TIME IC; 3550 (pg. 41)

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 capacitive loads). 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.

250 V/μs SLEW RATE IC; 3551 (pg. 41)

The 3551 is the externally compensated version of the popular 3550. It has all the desirable features of the 3550 plus the capability for the user to choose the frequency compensation best suited to his particular application. The unit is stable at closed loop gains above 10 volts per volt with no compensation and may be made unity gain stable with a single external 10 pF capacitor.

FAST SLEWING IC; 3505J and 3507J (pg. 40)

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 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. 40)

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.

LOW BIAS CURRENT

1 pA BIAS CURRENT IC; 3522 (pg. 38)

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.

0.1 pA BIAS CURRENT IC; 3523 (pg. 38)

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

0.01 pA BIAS CURRENT VARACTOR; 3430 (pg. 38)

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.

HIGH VOLTAGE & HIGH CURRENT

NEW! IC'S WITH UP TO 290V p-p OUT, 3580 SERIES (pg. 42)

This is the first family of IC op amps to provide output voltage swings as high as 290V 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 newest addition to the series, the 3583, will operate with supply voltages from ±35V to ±150V and will deliver a minimum of ±75 mA to its load. Thus, it will deliver over 10 watts to the load and will dissipate up to 15 watts of internal power.

All models are short circuit protected to ground and the 3581, 82 and 83 have special circuitry for input overvoltage protection. The amplifiers are packaged in an environmentally rugged, hermetically sealed, 8 pin TO-3 type package. The case is electrically isolated from the amplifier circuitry which makes heat sinking more efficient, easier and less expensive.

NEW!
60 WATTS TO LOAD; 3571, 3572 IC'S (pg. 43)

These new hybrid power amplifiers combine the versatility of FET operational amplifiers with the power capabilities of servo amplifiers. A unique combination of hybrid processing, laser trimming, and thermally efficient packaging provides output power capability and excellent input characteristics so the use of a separate preamplifier, sometimes required with other servo-type amplifiers, will not be required with the 3571 and 3572.

The minimum continuous output ratings are ±1A at ±30V and ±2A at ±30V for the 3571 and 3572 respectively. The peak current ratings are 2A and 5A and the internal power dissipation ratings are 33 and 50 watts. The amplifiers will operate over a supply range of ±15 to ±40 volts.

The class AB output stage gives low distortion and low quiescent current and is designed so that the load current limit may be adjusted with external resistors. This is particularly useful in driving permanent magnet motors where the high current seen during direction reversal (plugging) can demagnetize the motor.

The 3571 and 3572 have several other features which improve their usefulness. The output circuit has a unique protection feature which is only practical in integrated circuit amplifiers; self-contained automatic thermal sensing and shutoff. The hermetically sealed TO-3 type package improves reliability and withstands severe environments better than discrete component amplifiers. Also, the metal case is electrically isolated which simplifies mounting and reduces cost since the need for insulating spacers and bushings is eliminated.

POWER BOOSTER; 3329/03 (pg. 43)

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.

ISOLATION AMPLIFIERS (pg. 44)

This relatively new product group contains some of our most innovative new products. These amplifiers provide essentially total electrical isolation between input and output, and yet pass DC (and higher frequency) signals. This feature is useful in improving system signal quality by breaking troublesome ground loops. It allows the accurate measurement of small signals in the presence of large common-mode voltages and protects delicate instrumentation from damage due to large voltages. The low leakage currents associated with the isolation barrier can also provide protection of personnel against damage from electrical shock.

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	35	External Frequency Compensated IC, Mil Temp	93	±10	±5	1.0	20	1.2
3052	35	*	*	*	*	1.0	20	1.2
3053	35	*	*	*	*	0.9	15	0.9
3055	35	External Frequency Compensated IC	*	*	±10	1.0	20	1.2
3056	35	*	*	*	*	0.9	15	0.9
3057	35	*	90	*	*	0.7	10	0.6
3268/14	35	20 mA Output	114	±10	±20	1	100	6
3269/14	35	*	*	*	*	*	*	6
3271/25	37	±60 V to ±120 V Chopper Stabilized	140	±50 to ±110	±20	1	30	20
3291/14	37	Low Cost Chopper Stabilized	*	±10	±5	4	100	6
3292/14	37	*	*	*	*	*	*	6
3293/14	37	*	*	*	*	*	*	6
3329/03	43	100 mA Power Booster	Approx. 0	±10	±100	—	1000	—
3341/15C	41	100 mA Output, 1000 V/µs	100	±10	±100	50	10 MHz	1000
3342/15C	41	*	*	*	*	*	*	*
3354/25	37	Differential Input Chopper Stabilized	140	±10	±5	6	100	6
3355/25	37	*	*	*	*	*	*	*
3356/25	37	*	*	*	*	*	*	*
3400A	41	100 MHz, Differential Input	90	±10	±20	100	10 MHz	1000
B	41	*	*	*	*	*	*	*
3430J	38	Ultra Low Bias Current Varactor, Inverting	100	±10	±5	0.002	0.007	0.4 V/ms
K	38	*	*	*	*	*	*	*
3440J	37	Ultra Low Drift	110	±10	±10	1	10	0.6
K	37	*	*	*	*	*	*	*
L	37	*	*	*	*	*	*	*
3450	46	Transformer Coupled Amplifiers	94	±10	±5	—	1 (3)	—
3451	46	*	88	*	*	—	1 (3)	—
3452	46	*	94	*	*	—	1 (3)	—
3480J	37	Low Drift Chopper Amp.	140	±10	±10	100Hz (3)	2 - 50 Hz (3)	100V/sec
K	37	*	*	*	*	*	*	*
3500A	34	Low Drift Bipolar IC	93	±10	±10	1.5	10	0.6
B	34	*	*	*	*	*	15	1
C	34	*	*	*	*	*	15	1
R	34	Low Drift Bipolar IC, Mil Temp	*	*	*	*	10	0.6
S	34	*	*	*	*	*	15	1
T	34	*	*	*	*	*	15	1
3500E	36	1 µV/°C IC	100	±10	±10	1.5	12	0.8
3500MP	36	Matched Pair, IC	100	±10	±10	1.5	12	0.8
3501A	34	Low Bias Current, Bipolar IC	93	±10	±5	0.5	1.6	0.1
B	34	*	*	*	*	*	*	*
C	34	*	*	*	*	*	*	*
R	34	Low Bias Current, Bipolar IC, Mil Temp	*	*	*	*	*	*
S	34	*	*	*	*	*	*	*
3503 A	39	2.5V/µs Slew Rate FET IC	86	±10	±5	1.0	40	2.5
B	39	*	90	*	*	*	*	*
R	39	2.5V/µ Slew Rate FET IC, Mil Temp	86	*	*	*	*	*
S	39	*	90	*	*	*	*	*
3505J	40	Fast Slew IC, Internal Compensation	94	±10	±10	6	300	20
3506J	40	Wideband IC, *	106	±10	±10	12	50	4
3507J	40	Fast Slew IC, External Compensation	90	±10	±10	20	1200	80
3508J	40	Wideband IC, *	106	±10	±10	100 (5)	320	20
3521H	39	Low Drift FET IC	94	±10	±10	1.0	10	0.6
J	39	*	*	*	*	*	*	*
K	39	*	*	*	*	*	*	*
L	39	*	*	*	*	*	*	*
R	39	Low Drift FET IC, Mil Temp	*	*	*	*	*	*
3522J	38	Low Bias FET IC	94	±10	±10	1	10	0.6
K	38	*	*	*	*	*	*	*
L	38	*	*	*	*	*	*	*
S	38	Low Bias FET IC, Mil Temp	*	*	*	*	*	*
3523J	38	Ultra Low Bias FET IC	94	±10	±10	1	10	0.6
K	38	*	*	*	*	*	*	*
L	38	*	*	*	*	*	*	*
3540J	38	Lowest Cost FET IC	86	±10	±5	1	100	6
3542J	39	Low Cost FET IC	88	±10	±10	1	8	0.5
S	39	*	*	*	*	*	*	*
3550J	41	Fast Settling IC	100	±10	±10	10	1000	65
K	41	*	*	*	*	20	1500	100
S	41	Fast Settling IC, Mil Temp	*	*	*	10	1000	65
3551J	41	Wide Gain-Bandwidth IC	100	±10	±10	50 (5)	3800	250
S	41	Wide Gain-Bandwidth IC, Mil Temp	*	*	*	*	*	*
3553AM	43	200mA, 2000V/µs Buffer/Power Booster IC	0.95V/V	±10	±200	300(3)	32 MHz	2000
3554AM(8)	41	Fast Settling IC	106	±10	±50	800(5)	16 MHz	1000
BM	41	*	*	*	*	*	*	*
SM	41	Fast Settling IC, Mil Temp	*	*	*	*	*	*
3571AM	43	High Power IC	94	±30	±1A	0.5	16 kHz	3
3572AM	43	*	*	*	±2A	*	*	*
3580J	42	High Voltage IC	106	±13 to ±30(6)	±60	5	100	15
3581J	42	*	112	±27 to ±70(6)	±20	*	60	20
3582J	42	*	118	±65 to ±145(6)	±15	*	30	20
3583J (8)	42	*	118	±45 to ±145(6)	±75	*	*	30
3650HG (8)	47	Optically Coupled Isolation Amplifier	—	±10	±5	10 kHz(3)	—	0.8
JG (8)	47	*	*	*	*	*	—	*
3652HG (8)	47	*	*	*	*	*	—	*
JG (8)	47	*	*	*	*	*	—	*

*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
(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	1013	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	1011 ‖ 6 pF	1011 ‖ 12 pF	60 (+8, -10V)	1.1" x1.1" x 0.4"	65.00
*	±50	*	*	*	*	*	*	79.00
footnote (1)	±30	±0.01 pA	doubles/+10°C	3 x 1011 ‖ 30 pF	–	–	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	160(±2000V)(7)	2.3" x 3.5" x 0.7"	180.00
±20	50	-25 pA	doubles/+10°C	1011 ‖ 10 pF	1011 ‖ 10 pF	*	*	105.00
±0.3	5	-20 pA	*	1011 ‖ 10 pF	1011 ‖ 10 pF	*	*	135.00
±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	1011	1013	86	TO-99	6.70
±20	±25	-10 pA	*	*	*	*	*	18.00
±50	±75	-25 pA	*	*	*	*	*	18.00
±20	±25	-10 pA	*	*	*	*	*	25.00
±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	1011	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	1011	1012	90	TO-99	12.50
±0.5	±10	-5 pA	*	*	*	*	*	15.00
*	*	-1 pA	*	*	*	*	*	22.00
*	±25	-5 pA	*	*	*	*	*	26.00
±1	±50	-0.5 pA	doubles/+10°C	1012	1013	80	TO-99	25.00
±0.5	±25	-0.25pA	*	*	*	*	*	28.00
±0.5	±25	-0.1 pA	*	*	*	*	*	32.00
±5	±20	±15	±0.2	*	*	*	*	16.45
±20	±50	-25 pA	doubles/+10°C	1011	1011	80	TO-99	7.00
*	*	*	*	*	*	*	*	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	1011 ‖ 3 pF	1011 ‖ 3 pF	70	TO-99	22.50
*	*	*	*	*	*	*	*	39.00
±50	±300	-200 pA	doubles/+10°C	–	1011	–	TO-3	25.00
±1	±25	-100 pA	doubles/+10°C	1010 ‖ 3 pF	1011 ‖ 3 pF	60	TO-3	(8)
±0.5	±5	-100 pA	*	*	*	*	*	(8)
±1	±25	-50 pA	*	*	*	*	*	(8)
±2	±40	-100 pA	doubles/+10°C	1011 ‖ 10 pF	1011	90 dB	TO-3	60.00
*	*	*	*	*	*	*	*	65.00
±10	±30	-50 pA	doubles/+10°C	1011 ‖ 10 pF	1011	86	TO-3	40.00
±3	±25	-20 pA	*	*	*	110	*	65.00
*	*	*	*	*	*	*	*	79.00
*	*	*	*	*	*	*	*	(8)
±5	±25	40	0.3nA/°C	25	10^9	120 (±1500V)(7)	Triple wide DIP	(8)
±1	±15	*	*	*	*	*	*	(8)
±5	±50	50 pA	doubles/+10°C	10^{11}	10^{11}	*	*	(8)
±1	±30	*	*	*	*	*	*	(8)

(5) Gain-bandwidth product (6) Depends on power supply voltage $V_{out} = \pm(|V_{cc}| - 5)$VDC. (7) Isolation Mode Rejection.

(8) Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

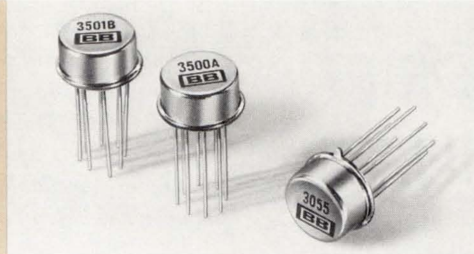
GENERAL PURPOSE AMPLIFIERS

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 82)	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).



MIL-STD-883 SCREENING
See pages 106 - 107

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 pages 82 - 83)	(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.

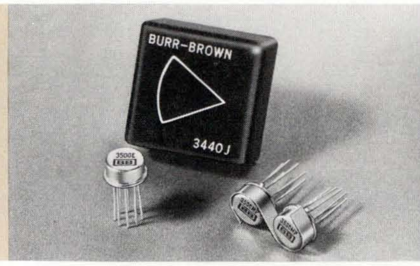
LOW DRIFT AMPLIFIERS

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 $\mu V/^oC$. The chopper stabilized amplifiers provide drift as low as 0.1 $\mu V/^oC$, and are now available in inverting, noninverting, and fully differential designs. They represent the best available in overall accuracy and long-term stability.

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

	BIPOLAR INPUT		FET INPUT				
MODEL	**3500E**	**3500MP(1)**	**3521**				
Industrial Temperature Range			H	J	K	L	
Military Temperature Range							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 82 - 84)	(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) A	1.8" x 2.4" x 0.6"		(7) B 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.

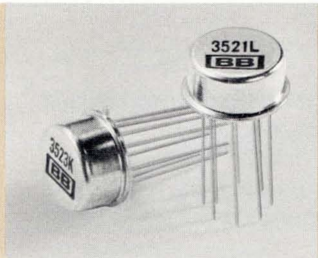
LOW BIAS CURRENT AMPLIFIERS

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



MODEL	INVERTING VARACTOR (1) 3430		ULTRA LOW BIAS CURRENT FET 3523			LOW BIAS CURRENT FET 3522				LOWEST COST FET 3540J
Industrial Temp. Range	J	K	J	K	L	J	K	L		
Military Temp. Range									S	
OPEN LOOP GAIN										
DC, rated load min	100 dB		94 dB			94 dB				86 dB
RATED OUTPUT, min	±10 V @ 5 mA		10 V @ 10 mA			±10 V @ 10 mA				±10V(±13V typ)@ 5 mA
OUTPUT IMPEDANCE	2 kΩ @ DC		100 Ω			100 Ω				—
FREQUENCY RESPONSE										
Small Signal Bandwidth (unity gain)	2 kHz		1 MHz			1 MHz				1 MHz
Full Power Bandwidth, min	7 Hz		10 kHz			10 kHz				100 kHz, typ
Slew Rate, min	0.4 V/ms		0.6V/μs			0.6V/μs				6 V/μs, typ
INPUT OFFSET VOLTAGE										
Initial @ 25°C, max	Adjusts to zero		±1mV	±500μV	±500μV	±1mV	±500μV	±500μV	±500μV	±50 mV
Drift vs. Temp.,max(μV/°C)	±30	±10	±50	±25	±25	±50	±10	±10	±25	±75
Drift vs. Supply Voltage	±500 μV/V		±25 μV/V			±25 μV/V				±200 μV/V
Drift vs. Time	±100 μV/mo		±5 μV/mo			±5 μV/mo				—
INPUT BIAS CURRENT										
Initial @ 25°C, max	±0.01 pA		-0.5pA	-0.25pA	-0.1pA	-10pA	-5pA	-1 pA	-5 pA	-50 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			±0.1 pA/V				—
INPUT OFFSET CURRENT										
Initial @ 25°C	—		±0.2pA	±0.1pA	±0.05pA	±2pA	±1pA	±0.5pA	±1pA	±0.5 pA
Drift vs. Temp.	—		doubles/+10°C			doubles/+10°C				doubles/+10°C
INPUT IMPEDANCE										
Differential	3×10^{11} Ω ‖ 30pF(2)		10^{12} Ω			10^{11} Ω				10^{10} Ω ‖ 2 pF
Common-Mode			10^{13} Ω			10^{12} Ω				10^{11} Ω ‖ 2 pF
INPUT NOISE										
Voltage, 0.01 Hz to 10Hz,p-p	10 μV(3)		5 μV			4 μV				13 μV
10 Hz to 10 kHz, rms	5 μV(4)		2 μV			2 μV				3 μV
Current, 0.01 Hz to 10 Hz,p-p	0.001 pA(3)		0.003 pA			0.3 pA				0.1 pA
10 Hz to 10 kHz, rms	0.002 pA(4)		0.01 pA			0.6 pA				0.15 pA
INPUT SIGNAL RANGE										
Common-Mode Voltage Range	—		± (|Supply| -5) V			± (|Supply| -5) V				± (|Supply| -5) V
Common-Mode Rejection	—		80 dB			90 dB				70 dB, min (90 dB, typ)
Maximum Safe Input Voltage	±300 V		± Supply			± Supply				±Supply
POWER SUPPLY										
Rated Voltage, Quiescent Current	+15 V @ +12, -6mA		±15 V @ ±4 mA			±15 V @ ±4 mA				±15V @ ±6mA
Voltage Range, Derated Performance	±12 to ±18 V		±5 V to ±20 V			±5 V to ±20 V				±5V to ±18V
TEMPERATURE RANGE										
Industrial Range	0°C to +70°C		0°C to +70°C			0°C to +70°C				0°C to +70°C
Military Range	—		—			-55°C to +125°C				-55°C to +125°C
PACKAGE DRAWING (See pages 82 – 84)	(9) 3.1" x 1.7" x 0.7"		(1) A TO-99			(1) A TO-99				(1) A TO-99
PRICE (1 - 9)	$59.00	$85.00	—	—	—	—	—	—	—	(1 – 24) / in 100's)
(1 - 24)	—	—	$25.00	$28.00	$32.00	$12.50	$15.00	$22.00	$26.00	$6.45 / $4.30

(1) Noninverting models also available: 3431J and 3431K (2) Input to common (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.

MIL-STD-883 SCREENING
See pages 106 - 107

2.5V/μs SLEW RATE FET		LOW COST FET		LOW VOLTAGE DRIFT FET				
3503		3542		3521				
A R	B S	J	S	H	J	K	L	R
86 dB	90 dB	88 dB		94 dB				
±10V @ 5mA		±10 V @ 10 mA		±10 V @ 10 mA				
3 kΩ		75 Ω		100 Ω				
1 MHz		1 MHz		1 MHz				
40 kHz		8 kHz typ		10 kHz				
2.5V/μs		0.5V/μs typ		0.6 V/μs				
±50mV	±20mV	±20 mV		±500μV	±250μV	±250μV	±250μV	±250μV
±75μV/°C	±25μV/°C	±50		±10	±5	±2	±1	±5
±200μV/V		±50 μV/V		±25μV/V				
±20μV/day		±100 μV/mo		5 μV/mo				
25 pA	10 pA	-25 pA		-20pA	-20pA	-15 pA	-10 pA	-20pA
doubles/+10°C		doubles/+10°C		doubles / +10°C				
0.05 pA/V		1 pA/V		0.1pA/V				
±5 pA	±2 pA	±2 pA		±2 pA				
doubles/+10°C		doubles/+10°C		doubles/+10°C				
10^{11} Ω ∥ 3 pF		10^{11} Ω		10^{11} Ω				
10^{13} Ω ∥ 3 pF		10^{11} Ω		10^{12} Ω				
13μV		2 μV		4 μV				
3μV		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|-4)V		± (|Supply| -5) V		± (|Supply| -5) V				
86 dB		80 dB		90 dB				
±Supply		±Supply		±Supply				
±15V @ ±6mA		±15V @ ±4mA		±15V @ ±4mA				
±4V to ±20V		±5V to ±20V		±5V to ±20V				
-25°C to +85°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				
— $6.70 / $18.00	— $18.00 / $25.00	— $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

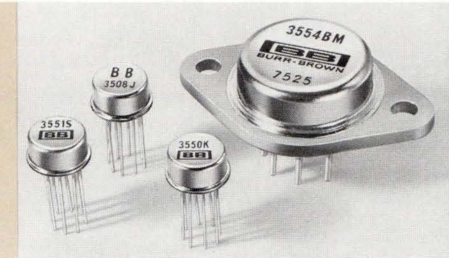
The op amps in this group have their designs optimized for wideband, fast slewing, and fast settling applications. Wideband and fast slewing op amps are ideally suited for video and pulse applications where high frequency response is necessary to follow the input waveform exactly. The fast settling op 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 82)	(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

don't miss. . .

±200 mA, 2000 V/μs
BUFFER AMPLIFIER/
POWER BOOSTER
SEE 3553AM . . . page 43



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

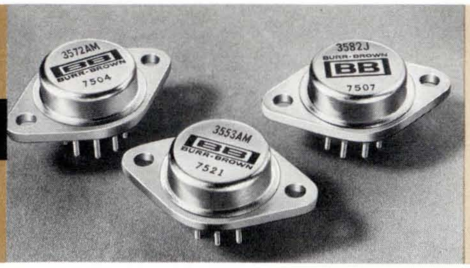
	±100 mA OUTPUT 1000 V/μsec		0.6 μsec max SETTLING			50 MHz GAIN-BANDWIDTH		100 MHz BW DIFFERENTIAL		NEW! 150 nsec SETTLING DIFFERENTIAL		
MODEL	**3341/15C**	**3342/15C**	**3550**			**3551**		**3400**		**3554***		
			J	**S**	**K**	**J**	**S**	**A**	**B**	**AM**	**SM**	**BM**
OPEN LOOP GAIN												
DC, no load min	100 dB min		100 dB			100 dB		90 dB min		106 dB		
RATED OUTPUT,	±10 V @ 100 mA		±10 V @ ±10 mA			±10 V @ 10 mA		±10 V @ 20 mA		±10 V @ 50 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		800 MHz(2)		
Full Power Bandwidth, min	10 MHz		1 MHz		1.5MHz	3.8MHz typ., C_f = 0		10 MHz		16 MHz C_f = 0pF		
Slew Rate, min	1000 V/μs		65V/μs		100V/μs	250V/μs typ., C_f = 0		1000 V/μs		1000V/μs C_f = 0pF		
Settling Time (0.1%)	400 ns		400 ns			400 ns, C_f = 10		400 ns		85 ns		
(0.01%)	550 nsec		1.0μs, max		0.6 μs, max	600 ns, C_f = 10		2 μs		150 ns max		
INPUT OFFSET VOLTAGE												
Initial @ 25°C, max	±1 mV		±1 mV			±1 mV		Adjusts to Zero		±1 mV		±0.5 mV
Drift vs. Temp., max	±25μV/°C	±50μV/°C	±50μV/°C			±50μV/°C		±100μV/°C	±50μV/°C	±25μV/°C		±5μV/°C
Drift vs. Supply Voltage	±500 μV/V		±500 μV/V			±500 μV/V		±300 μV/V		±500 μV/V		
INPUT BIAS CURRENT												
Initial @ 25°C, max	-100 pA		-100 pA			-100 pA		-100 pA		-100 pA	-50 pA	-100 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 ‖ 3pF		
Common-Mode	—		10^{11} Ω ‖ 3 pF			10^{11} Ω ‖ 3 pF		10^{11} Ω ‖ 12 pF		10^{11} Ω ‖ 3pF		
INPUT NOISE												
10 Hz to 10 kHz, rms	10 μV		4 μV			4 μV		5 μV		2 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)		60 dB		
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 @ ±30 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		±12V to ±18V		
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		0°C to +70°C		0°C to +70°C
Military				-55°C to +125°C							-55°C to +125°C	
PACKAGE DRAWING (See pages 82 – 84)	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"		⑥ D TO-3		
PRICE (1 - 9)	$79.00	$68.00	—	—	—	—	—	$65.00	$79.00	*	*	*
(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.

(2) Gain-Bandwidth product for Gain = 100 V/V.

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

MIL-STD-883 SCREENING
See page 106 - 107

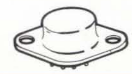


HIGH VOLTAGE AND HIGH CURRENT AMPLIFIERS

MIL-STD-883 SCREENING
See pages 106 - 107

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

NEW!

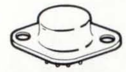


	HIGH VOLTAGE					CHOPPER STABILIZED
MODEL	**3580J**	**3581J**	**3582J**	**3583AM***	**3583JM***	**3271/25**
OPEN LOOP GAIN DC, no load	106 dB	112 dB	118 dB	118 dB		140 dB min
RATED OUTPUT, min						
@ Minimum Supply Voltage	±13V @ 60mA	±27V @ 30mA	±65V @ 15mA	±45V @ 75mA		±50V @ 20mA
@ Maximum Supply Voltage	±30V @ 60mA	±70V @ 30mA	±145V @ 15mA	±145V @ 75mA		±110V @ 20mA
OUTPUT IMPEDANCE	500Ω	2 kΩ	2 kΩ	2 kΩ		25 kΩ @ DC
FREQUENCY RESPONSE						
Small Signal Bandwidth (unity gain)		5 MHz				1 MHz
Full Power Bandwidth	100 kHz	60 kHz	30 kHz	30 kHz		30 kHz, min
Slew Rate	15 V/μs	20V/μs	20V/μs	30V/μs		20V/μs, min
Settling Time (0.1%)		12μs				
INPUT OFFSET VOLTAGE						
Inital @ 25°C, max	10mV	3mV	3mV	3mV		±50μV
Drift vs Temp., max	30μV/°C	25μV/°C	25μV/°C	25μV/°C		±1μV/°C
INPUT BIAS CURRENT						
Initial @ 25°C, max	-50 pA	-20 pA	-20 pA	-20 pA		±80 pA
Drift vs Temp.		doubles/+10°C				±2 pA/°C, max
INPUT IMPEDANCE						
Differential		$10^{11}\ \Omega \parallel 10$ pF				500 kΩ
Common-Mode		$10^{11}\ \Omega$				N/A
INPUT NOISE						
Voltage, 0.01 Hz to 10 Hz, p-p		5μV				20μV
10 Hz to 10 kHz, RMS	1μV	1.7μV	1.7μV	1.7μV		5μV
Current, 0.01 Hz to 10 Hz, p-p	1 pA	0.3 pA	0.3 pA	0.3 pA		200 pA
10 Hz to 10 kHz, RMS	—	—	—	—		50 pA
INPUT SIGNAL RANGE						
Common-Mode Voltage Range	$\pm(\lvert \text{Supply} \rvert -5)$V	$\pm(\lvert \text{Supply} \rvert -10)$V		$\pm(\lvert \text{Supply} \rvert -10)$V		Inverting Only
Common-Mode Rejection	86 dB	110 dB	110 dB	110 dB		
Maximum Safe Input Voltage		±Supply				±Supply
POWER SUPPLY						
Rated Voltage, Quiescent Current, max	±10mA	±8mA	±6.5mA	±8.5mA		±120V @ ±20mA
Voltage Range, Derated Performance	±18 to ±35	±32 to ±75	±70 to ±150	±50 to ±150V		±60V to ±120V
TEMPERATURE RANGE		0° to 70°C		-25° to +85°C	0° to +70°C	-25°C to +85°C
PACKAGE DRAWING (See page 83)		⑥A TO-3		⑥A TO-3		⑦B 2.4" x 1.8" x 0.6"
PRICE						
(1 - 9)						$175.00
(1 - 24)	$40.00	$65.00	$79.00	*	*	—
(100's)	27.00	43.00	53.00			

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

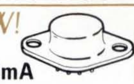
High voltage and high current amplifiers were developed by Burr-Brown to meet the special needs of the designer that are not met by the usual op amp design. The high voltage devices operate on wide ranges of supply voltage, either balanced or unbalanced, while providing good performance in the other 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 3570 and 3580 families have self-contained thermal sensing and shutoff which automatically prevents damage to the amplifier from overheating. The TO-3 packages are electrically isolated.

NEW!

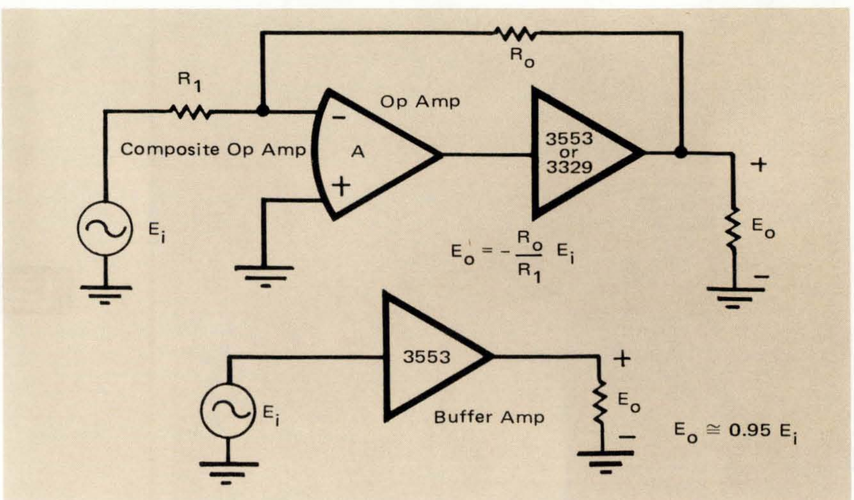


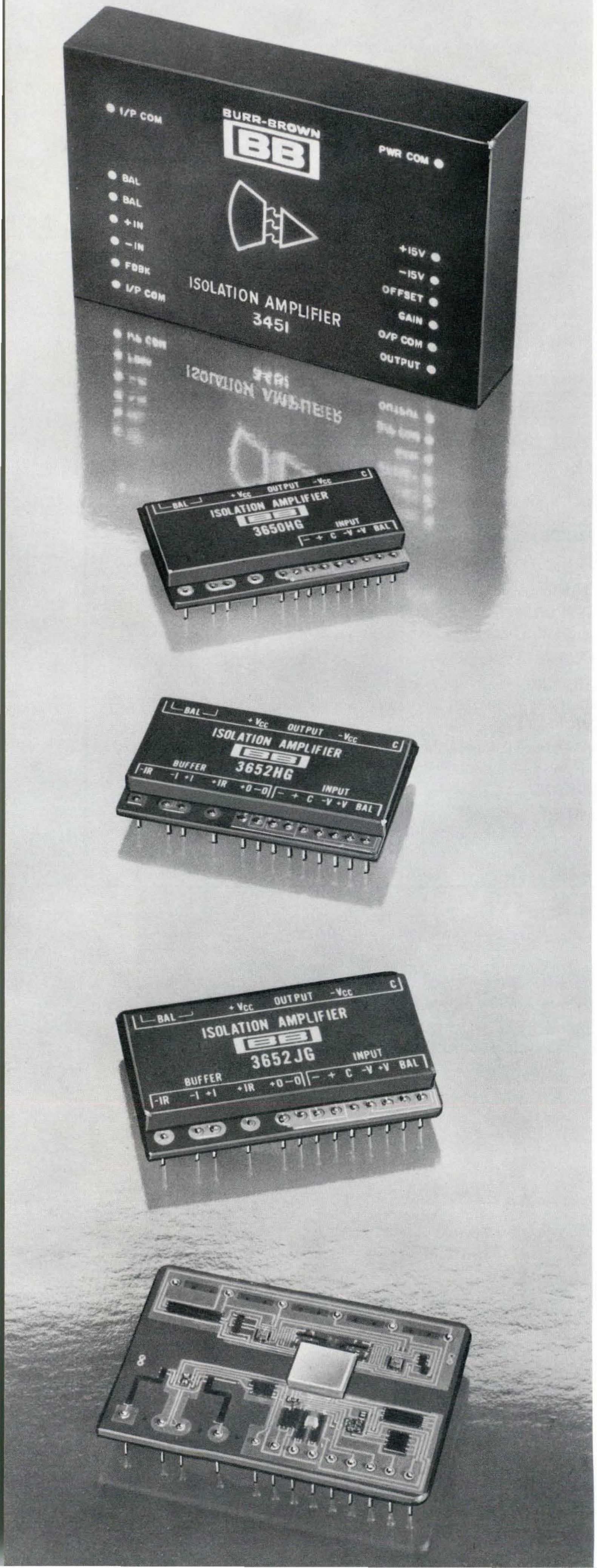
HIGH CURRENT AND VOLTAGE	
3571AM	**3572AM**
94, min dB @ RL = 5Ω	
±30V @ ±1A ±30V @ ±2A	±30V @ ±2A ±30V @ ±5A
2.5Ω	
500 kHz 16 kHz, typ 3V/μs, typ	
±2mV ±40μV/°C	
-100 pA doubles/+10°C	
10^{11} Ω ∥ 10 pF 10^{11} Ω	
4μV 3μV 1 pA 0.1 pA	
±(|Supply|-10)V 90 dB ±Supply	
±35V @ ±25mA ±15V to ±40V	
-25°C to +85°C	
(6)C TO-3	
$60.00 38.50	$65.00 42.00

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

BUFFER AMP/POWER BOOSTERS		
MODEL	NEW!  **200mA 2000V/μs 3553AM**	 **100mA 3329/03**
OPEN LOOP GAIN DC, no load	0.99V	0 dB approx.
RATED OUTPUT	±10V @ 200mA	±10V @ 100mA
OUTPUT IMPEDANCE	1Ω	10Ω @ DC
FREQUENCY RESPONSE		
Full Power Bandwidth, min	32 MHz	1 MHz
INPUT IMPEDANCE	10^{11}Ω	10 kΩ
INPUT SIGNAL RANGE		
Maximum Safe Input Voltage	±Supply	±Supply
POWER SUPPLY		
Rated Voltage, Quiescent Current, max	±15V @ ±80mA	±15V @ ±15mA
Voltage Range, Derated Performance	±5V to ±20V	±12V to ±18V
TEMPERATURE RANGE	-25°C to +85°C	-25°C to +85°C
PACKAGE DRAWING (see pgs. 82, 83)	(6)B TO-3	(2)F DIL Type
PRICE		
(1 - 24)	$25.00	$25.00

Power boosters are designed to provide increased output current when used in a composite amplifier configuration as shown below. The 3553 is designed to also be used as a stand alone buffer amplifier capable of driving 50 ohm loads with ±200 mA at 2000 V/μs.





ISOLATION AMPLIFIERS

Tranformer Coupled
Optically Coupled

BURR-BROWN

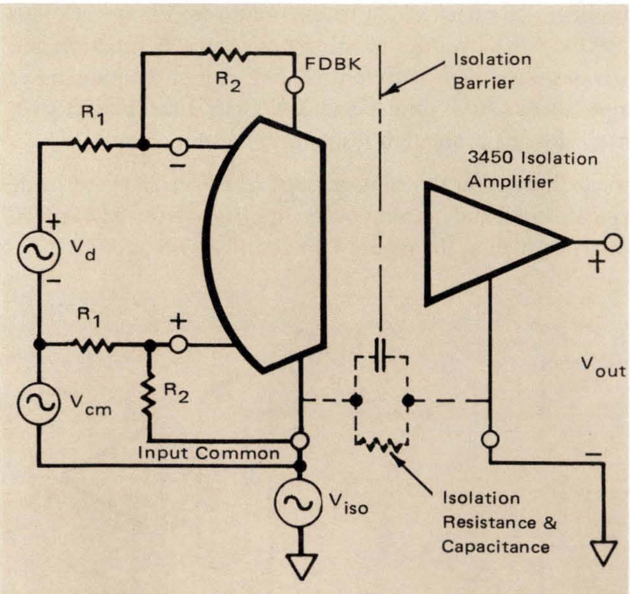
GENERAL INFORMATION

Isolation amplifiers are useful in providing three major benefits: 1) improving system performance by breaking troublesome ground loops; 2) protecting system components from damage due to large voltages; 3) protecting personnel against the danger of electrical shock.

Figure 1 shows a typical application of isolation amplifiers and will be used to define some of the terms. The isolation mode voltage, V_{iso}, is the voltage which exists across the isolation barrier, i.e., between the input common and the output common. The contribution of output referred error caused by the isolation mode voltage is $V_{iso}/IMRR$, where IMRR is the Isolation Mode Rejection Ratio.

Since these isolation amplifiers have differential inputs, a differential input signal (V_d) and a common-mode voltage (V_{cm}) can both be applicable. Both of these voltages are associated with only the input circuitry ("+", "–", and "input common") just as in any other differential input operational amplifier. For the differential configuration shown in Figure 1, V_{cm} causes an output referred error of (R_2/R_1) $(V_{cm}/CMRR)$. In many applications V_{cm} is negligible and a system voltage called "the common-mode voltage" is applied as V_{iso} in Figure 1.

The isolation voltage and isolation-mode rejection are defined by Figure 1. The leakage resistance and capacitance are also shown in that figure. These parasitic impedance are the reason the isolation-mode rejection is not infinite. They also explain its behavior with frequency. In some types of applications the "leakage current" is an important specification. It is the current which flows across the isolation barrier with some specified isolation voltage applied between the input and the output.



$$V_{out} = \frac{R_2}{R_1}\left[V_d + \frac{V_{cm}}{CMRR}\right] + \frac{V_{iso}}{IMRR}$$

FIGURE 1. Typical Isolation Amplifier Application.

Two isolation voltages are given in the electrical specification; "rated continuous" and "test voltage." Since it is impractical on a production basis to test a "continuous" voltage (infinite test time is implied), it is generally accepted practice to test at a significantly higher voltage for some reasonable length of time. For Burr-Brown's isolation amplifiers the "test voltage" is equal to 1000 volts plus two times the "rated continuous" voltage.

CHOICE OF AMPLIFIERS

Isolation amplifier performance requirements vary significantly, depending on the type of requirement. In some applications, bandwidth and speed of response are more important than gain accuracy and linearity. In these instances the best choice will be an optically coupled amplifier (see page 46). Optically coupled amplifiers from Burr-Brown are hybrid integrated circuits offering the additional advantages of small size, ruggedness, and superior reliability.

For applications where gain accuracy and linearity are of major importance, our family of transformer coupled amplifiers will usually offer the best choice (see page 48). They offer the versatility of an operational amplifier front-end and some units also provide isolated DC power for use in input signal conditioning. A block diagram of a typical transformer coupled isolation amplifier is shown in Figure 2.

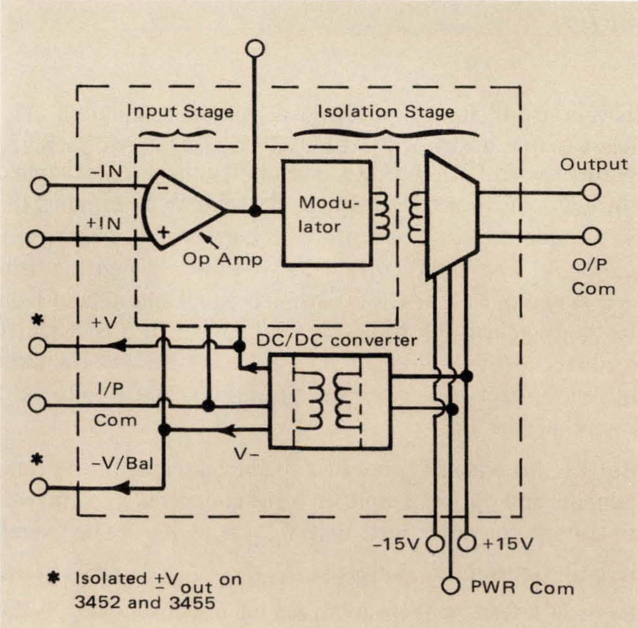
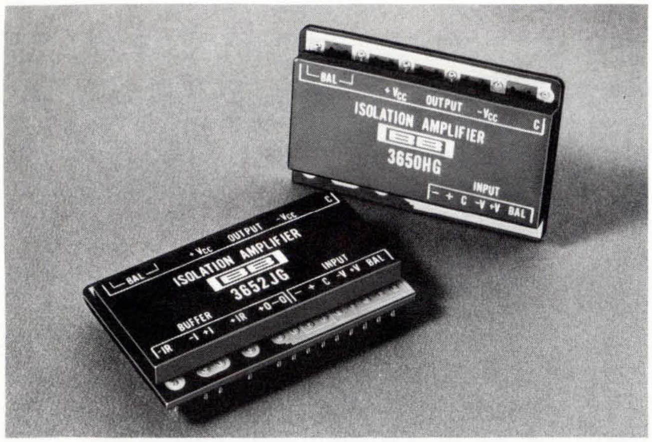


FIGURE 2. Simplified Block Diagram of Transformer Coupled Isolation Amplifiers.



The 3650 and 3652 are the industry's first optically coupled isolation amplifiers. Compared to transformer coupled units they have the advantages of smaller size, lower cost, wider bandwidth and integrated circuit reliability.

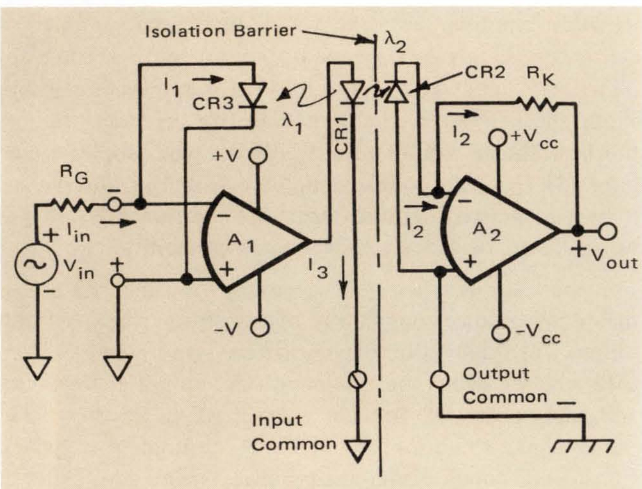


FIGURE 3. Improved Linear Isolator.

The basic principals of operation are shown in Figure 3. The heart of the design is the LED, CR1, and the two matched photo diodes, CR2 and CR3. The input voltage V_{in} is applied through a gain setting resistor, R_G, which determines the magnitude of input current. This current, I_{in}, and the amplifier A_1 cause the current I_3 to flow through the light emitting diode CR1. CR1 transmitts equal amounts of light to the matched photo diodes, CR2 and CR3. The negative feedback configuration of A_1, CR1 and CR3 and the large open loop gain of A_1 cause an equilibrium condition to exist such that $I_1 = I_{in}$.

But I_2 also equals I_{in} because of the matching of the components and optics. Amplifier A_2 is connected as a current-to-voltage converter such that $V_{out} = I_2\ R_K$. The overall isolator transfer function is then $V_{out} = V_{in}\ (R_K/R_G)$ where R_K is an internal one megohm scaling resistor and R_G is the user supplied gain setting resistor. Thus, the final transfer function is $V_{out} = V_{in}\ \frac{10^6}{R_G}$.

The use of matched feedforward and feedback circuits in the isolator yields several benefits. The accuracy of the transfer function is dependent on matching (CR2 to CR3 and λ_1 to λ_2) rather than on the magnitude of the output of the LED. Thus, the gain accuracy does not degrade with use. The linearity of the circuit is also greatly increased. This is a result of the negative feedback used and the matching of the optics.

LOWEST COST; 3650 (Pg. 47)

A simple application of the 3650 is shown in Figure 4. The output is a current dependent voltage source, V_s, whose value depends on the input current I_{in}. The 3650 has a voltage-out current-in transfer function of one volt per microamp. Inputs which are current sources may be connected directly to the 3650. When voltage sources are used, the input current is derived by using gain setting resistors in series with the inputs.

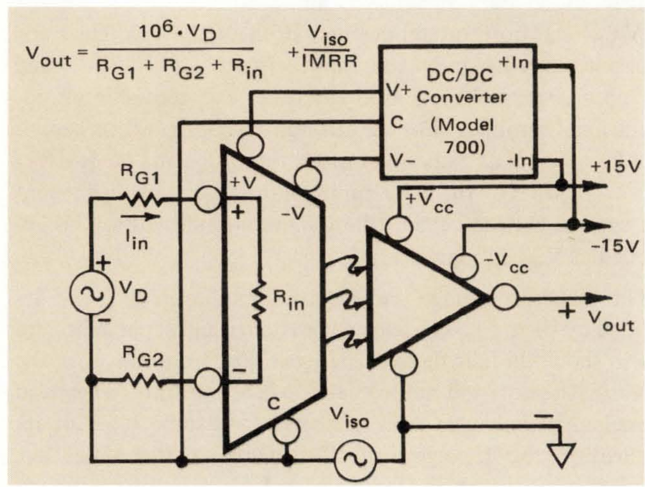


FIGURE 4. Application of 3650.

The 3652 is similar to the 3650 except that unity gain buffer amplifiers have been added to the input (see Figure 5). This gives the 3652 a voltage-in voltage-out transfer function and provides very high differential and common-mode input impedances (10^{10} ohms) and low bias currents (50 pA). Internal input protection resistors are also included.

Isolated power for the 3650 and 3652 may be obtained from separate input and output power supplies or from a DC-to-DC converter such as the model 700 described on page 79.

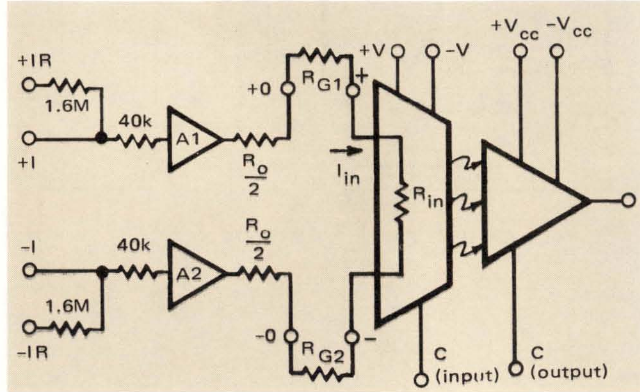


FIGURE 5. Simple Model of 3652.

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

MODEL	3650HG*	3650JG*	3652HG*	3652JG*
ISOLATION				
Isolation Voltage (V_{ISO})				
Rated Continuous, (min)	1500Vp or DC		1500Vp or DC	
Test Voltage, (min)	4000Vp		4000Vp	
Isolation Mode Rejection (IMR)				
DC	120 dB RTO		120 dB RTO	
60 Hz, zero source unbalance	100 dB RTO		100 dB RTO	
Leakage Current, 240V/60 Hz (max)	0.5μA		0.5μA	
Isolation Impedance				
Capacitance	3pF		3pF	
Resistance	50 x $10^9\Omega$		50 x $10^9\Omega$	
GAIN				
Gain Equation				
for current sources	$G_I = 10^6$ Volt/Amp			
for Voltage sources	$G_V = \frac{10^6}{R_{G1}+R_{G2}+R_{IN}}$ V/V		$G_V = \frac{10^6}{R_{G1}+R_{G2}+R_{IN}+R_O}$ V/V	
Input Resistance, R_{IN}, max	25Ω		25Ω	
Buffer Output Impedance, R_O	Not applicable		90Ω ±30Ω	
Gain Equation Error, max(2)	1.5%	0.5%	1.5%(1)	0.5%(1)
Gain Nonlinearity, max	±0.7%	±0.25%	±0.7%(1)	±0.25% (1)
Gain vs Temperature	+0.03%/°C	+0.01%/°C	+0.03%/°C(1)	+0.02%/°C(1)
Gain vs Time	±0.1%/1000 hrs		±0.1%/1000 hrs	
Frequency Response				
Slew Rate, min	0.8V/μs		0.8V/μs	
±3dB Frequency	10 kHz		10 kHz	
Distortion at 10 kHz	5%		5%	
INPUT STAGE(3)				
Input Offset Voltage, at 25°C max(2)	±5mV	±1mV	±5mV	±1mV
vs Temperature, max	±25μV/°C	±15μV/°C	±50μV/°C	±30μV/°C
Input Bias Current, at 25°C max(2)	40nA		50pA	
vs Temperature	0.3nA/°C		doubles every +10°C	
Input Offset Current	effects included in output offset		10pA	
vs Temperature			doubles every +10°C	
Input Impedance				
Common-mode	$10^9\Omega$		$10^{11}\Omega$	
Input Noise				
Voltage, 0.1 to 100 Hz	10μVp-p		10μVp-p	
10 Hz to 10 kHz	4μVRMS		5μVRMS	
Input Voltage Range				
Common-Mode, linear operation	±(|V| -5)V		±(|V| -5)V	
,without damage, @+, -	+V, -V		+V, -V	
,@ + I, -I	N.A.		±300V for 10mS(4)	
,@ +IR, -IR	N.A.		±3000V for 10mS(4)	
Differential, without damage, @+, -	±V		±V	
,@ +I, -I	N.A.		±600V for 10mS(4)	
,@ +IR, -IR	N.A.		±6000V for 10mS(4)	
Common-Mode Rejection	90dB @ 60 Hz, 5kΩ imbalance		80dB @ 60 Hz, 5kΩ imbalance	
Power Supply (Input Stage Only)				
Voltage (@ "+V" and "-V")	±10V to ±18V		±10V to ±18V	
Current				
Quiescent	±1.2mA		±3mA	
with ±10V output, max(5)	+10mA or -10mA		+15mA or -15mA	
OUTPUT STAGE				
Output Voltage, min	±10V @ ±5mA		±10V @ ±5mA	
Output Offset Voltage, at 25°C max	±25mA	±10mV	±25mV	±10mV
vs Temperature, max	±700μV/°C	±350μV/°C	±700μV/°C	±350μV/°C
Output Noise Voltage				
0.1 to 100 Hz	65μVp-p		65μVp-p	
10 Hz to 1 kHz	65μVRMS		65μVRMS	
Power Supply (Output Stage Only)				
Voltage ("$+V_{cc}$" and "$-V_{cc}$")	±10V to ±18V		±10V to ±18V	
Current				
Quiescent	±6mA max, ±3mA typ		±6mA max, ±3mA typ	
with ±5mA output, max	±11mA		±11mA	
TEMPERATURE RANGE				
Specification	0°C to 70°C		0°C to 70°C	
Operating	-25°C to +85°C		-25°C to +85°C	
PACKAGE DRAWING (see page 89)	(24) B		(24) C	
PRICE	*	*	*	*

(1) Gain error terms specified for inputs applied through buffer amplifiers (i.e., ±I or ±IR pins)
(2) Trimmable to zero.
(3) Input stage specifications at +I and -I inputs for 3652 unless otherwise noted.
(4) Continuous rating is 1/3 pulse rating.
(5) Load current is drawn from only one supply lead at a time, other supply current at quiescent level.

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

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

MODEL	3450	3451	3452	3455[6]
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 typ		
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 typ		
vs. Supply	±0.1nA/V	±0.5 pA/V		
Input Impedance				
Differential	10^7 Ω	10^{11} Ω		
Common-Mode[2]	5×10^9 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			
Differential (w/o damage), min	±15V			
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	1.5 kHz	2 kHz		
Settling Time				
to 0.01%	5 ms			
to 0.1%	1 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[6]				
Operating, continuous, min	±500V, peak		±2000V,peak	
Tested for 1 sec, min (5)	±2000 V		±5000V (6)	
Output Voltage, min	±10 V			
Output Current, min	±5 mA			
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]	±2mV	±5mV	±5mV	
vs. Temp., max	±500μV/°C			
vs. Supply	±500μV/V			
vs. Time	±100μV/mA			
Input Power Requirements				
Voltage	±14 to ±16 VDC			
Current, quiescent, max	+30/-5mA			
, full load, max	+35/-10mA		+55/-10mA	
TEMPERATURE RANGE				
Specification	-25°C to +85°C			
Operating	-25°C to +85°C			
Storage	-25°C to +125°C			
PACKAGE DRAWING (See page 85)	(11)	3.5" x 2.3" x 0.7"		
PRICE (1 - 9)	$180.00	$105.00	$135.00	$140.00

1) For 3450 and 3451 current drawn from FDBK pin must be ⩽ 5mA. For 3452 the sum of the current drawn from FDBK pin and either "–V/Bal" or "+V" pins (i.e., + or – isolated current) must be ⩽ 11mA.
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.
5) All units 100% tested for 1μA max leakage current at test voltage.
6) The 3455 is identical to the 3452 except for two additional specifications. Each 3455 is tested with an isolation voltage of 2500V/60 Hz for one minute. Also, each unit is specified at 2μA max leakage current with 240/60 Hz isolation voltage.

This family of isolation amplifiers has a true uncommitted differential input operational amplifier and offers input/output isolation. The various models are rated at ±500 to ±2000V of continuous isolation voltage (factory tested at ±2000 to ±5000 volts). They all have self-contained DC-to-DC converters and two modules provide isolated ±15 VDC at the input for powering circuitry such as bridges and other active devices. Low voltage drift bipolar or low bias current FET input stages are available.

These transformer coupled models use a pulse width modulation technique to provide excellent accuracy (±0.01% linearity). The use of PW modulation also minimizes the problems of electro-magnetic interference that some amplitude modulated designs have exhibited.

LOW DRIFT; 3450

The 3450 has a low drift 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 ±1 μV/°C and gain linearity is ±0.01%. Isolation mode rejection is 160 dB at ±500VDC.

LOW BIAS CURRENT; 3451

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 is 160 dB at ±500VDC.

2000 VOLTS ISOLATION; 3452

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

MINIMUM LEAKAGE CURRENT; 3455

The 3455 is identical to the 3452 except that it has additional specifications for isolation test voltage and leakage. Each unit is tested at an isolation voltage 2500V/60 Hz for 1 minute and is guaranteed for leakage current of less than 2 μA with 240V/60 Hz of isolation voltage.

INSTRUMENTATION AND DATA AMPLIFIERS

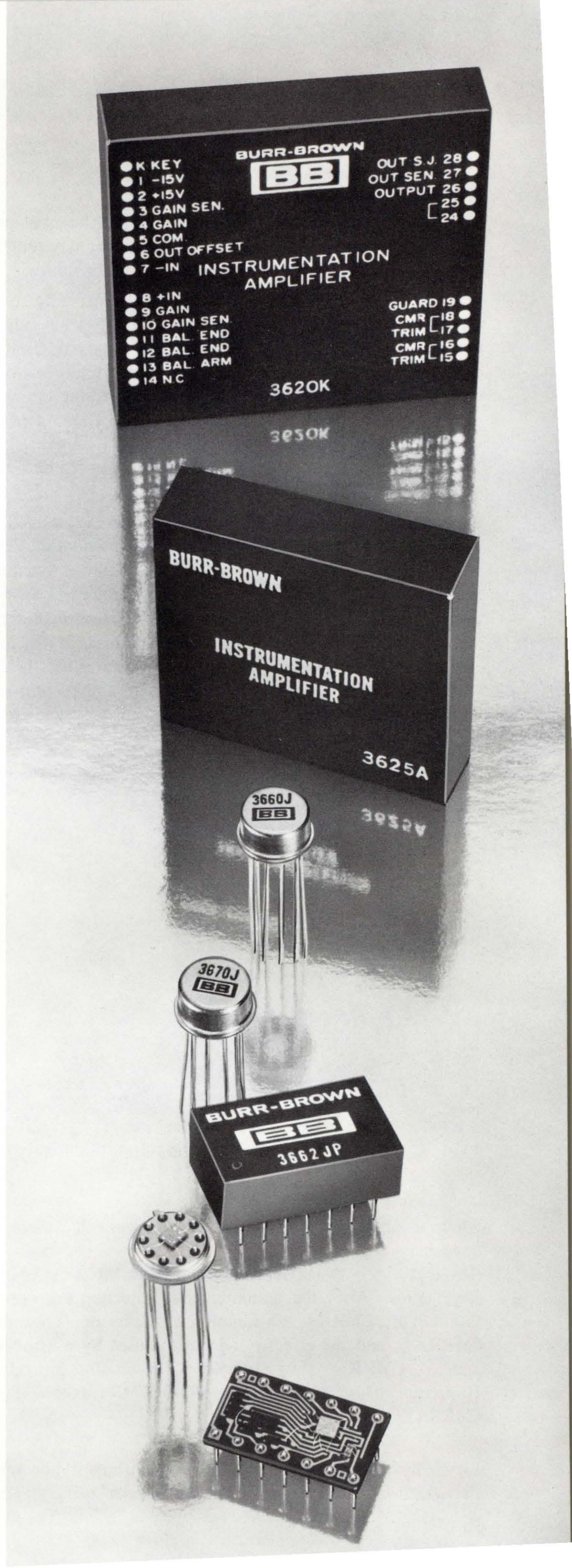
Low Drift

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.

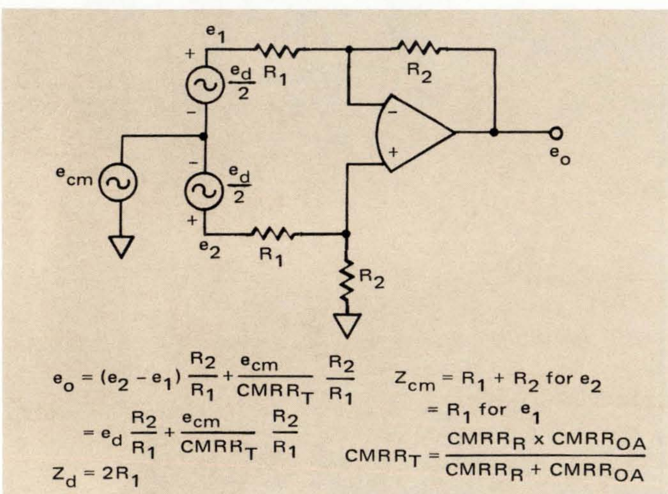


FIGURE 1. Single Op Amp, Differential Input Configuration.

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.

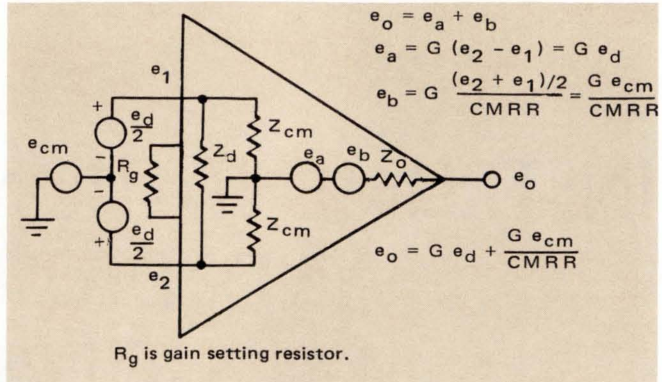


FIGURE 2. Model Of An Instrumentation Amplifier.

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 36) 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 51) 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.

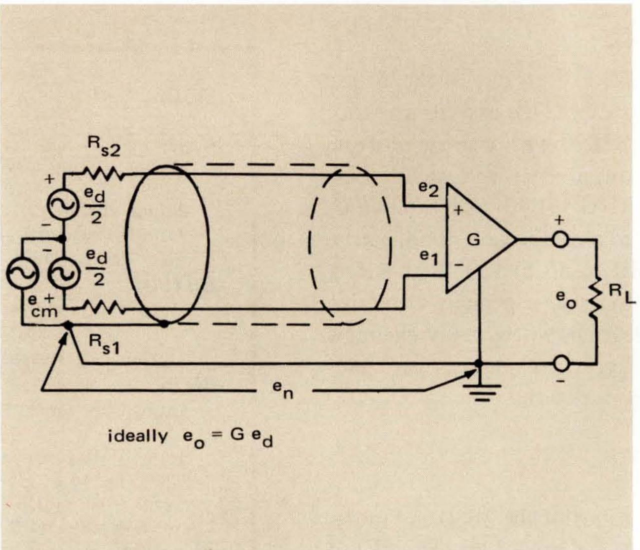


FIGURE 3. Typical Application of Instrumentation Amplifier.

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 50). 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 $R_{s2} = 0$, $R_{s1} = 1k\Omega$, $e_{cm} + e_n = 10V$, 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:

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

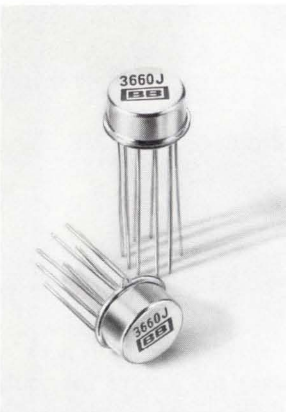
If the full scale input is 10 mV then the error due to voltage drift is:

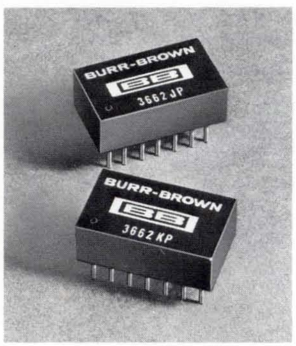
$$\text{Error} = \frac{0.1mV}{10mV} = 1\% \text{ of full scale}$$

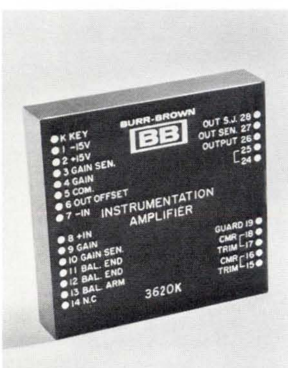
INPUT BIAS AND OFFSET CURRENTS

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.)







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 preamplifier per channel is desired, the 3660 is the obvious choice.

3662-LOW OFFSET

The 3662 has all the desirable features of the 3660 and more. It contains laser trimmed thin-film and thick-film networks so that only a single outside gain settling resistor is required. The offset voltages are laser trimmed down for a level where further adjustment will normally not be required. It is packaged in a plastic DIP for ease of use.

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 secondstage amplifier which makes possible gains of up to 10,000. Wirewound 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.

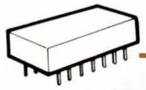
3625-0.5μV/^{o}C

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.

MODEL
GAIN
Gain Equation
Range of Gain
Gain Nonlinearity, G=100, ma
Gain Temp. Coeff., G=100
OUTPUT
Rated Output, Voltage
Current
Output Impedance, DC, G=10
INPUT
Input Impedance, Differential
Common-Mo
Input Voltage Range
CMR, DC to 60 Hz
at G = 10, min, 1 kΩ Unbal.
at G = 1000, 1kΩ Unbal.
OFFSETS AND NOISE
Offset Voltage (RTI)(1)
@25^{o}C,max(2)
vs. Temperature,max(μV/^{o}C)
@ G = 1, max
@ G = 1000, max
vs. Supply G = 1000
vs. Time G = 1000
Bias Current(each input)
@25^{o}C max
vs. Temperature, max
Noise (RTI)(1) G = 100
Voltage, p-p,0.01Hz to 10Hz
rms, 10Hz to 10kHz
Current, p-p,0.01Hz to 10Hz
rms, 10Hz to 10kHz
DYNAMIC RESPONSE at G = 1
Small Signal Frequency Respo
For ±1% flatness, min
For ±3 dB flatness, min
Settling Time to within ±10m
of Output Final Value
Slew Rate
Full Power, G = 10
POWER SUPPLY
Rated Voltage
Voltage Range
Quiescent Supply Current, ma
TEMPERATURE RANGE
Specification
Operating
PACKAGE DRAWING
(See pages 82 – 87)
PRICE (1 - 24)
(100's)

MIL-STD-883 SCREENING
See pages 106 - 107



NEW!

3662		3620 LOWEST DRIFT			3625 LOW DRIFT, LOW COST			3660 LOW COST IC		
JP	KP	J	K	L	A	B	C	J	K	S
$G = \frac{100\,k\Omega}{R}$		$G = 1 + \frac{25\,k\Omega}{R}$			$G = 10 + \frac{20\,k\Omega}{R}$			$G = \frac{100\,k\Omega}{R}$		
1 to 1000		1 to 10,000			10 to 1000			1 to 1000		
±0.1%	±0.05%	±0.01%			±0.02%, typ			±0.1%	±0.03%	±0.03%
±0.006%/°C		±0.001%/°C			±0.001%/°C			±0.004%/°C		
±10V		±10V			±10V			±10V		
±10mA		±10mA			±5mA			±10mA		
0.15 Ω		0.1 Ω			2 Ω			0.15 Ω		
$\frac{2 \times 10^{10}}{G}\,\Omega \parallel 9\,pF$		300 MΩ ∥ 3 pF			$5 \times 10^9\,\Omega \parallel 3\,pF$			$\frac{2 \times 10^{10}}{G}\,\Omega \parallel 9\,pF$		
$2 \times 10^{10}\,\Omega \parallel 3\,pF$		1000 M Ω ∥ 3 pF			$5 \times 10^9\,\Omega \parallel 3\,pF$			$2 \times 10^{10}\,\Omega \parallel 3\,pF$		
±10V		±10V			±10V			±10V		
76 dB	84 dB	74dB			74dB			76dB	90dB	90dB
96 dB, min	104 dB, min	100dB (Balanced Source)			80dB (Balanced Source)			96 dB,min	110 dB,min	110 dB,min
$\pm(0.4 + \frac{100}{G})$ mV	$\pm(0.2 + \frac{30}{G})$ mV	$\pm(0.2 + \frac{0.5}{G})$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
$\pm(5 + \frac{1000}{G})$	$\pm(2 + \frac{400}{G})$	$\pm(2+\frac{10}{G})$	$\pm(0.5+\frac{10}{G})$	$\pm(0.25+\frac{10}{G})$	$\pm(3+\frac{10}{G})$	$\pm(1+\frac{10}{G})$	$\pm(0.5+\frac{10}{G})$	$\pm(10+\frac{1000}{G})$	$\pm(2+\frac{500}{G})$	$\pm(2+\frac{500}{G})$
±1005μV/°C	±402μV/°C	±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
±6μV/°C	±2.4μV/°C	±2μV/°C	±0.51μV/°C	±0.26μV/°C	±3μV/°C	±1μV/°C	±0.5μV/°C	11μV/°C	±2.5μV/°C	2.5μV/°C
±13μV/V		±20μV/V			±2 μV/V			±13μV/V		
±3.5μV/mo		±3μV/mo			±10μV/mo			±3.5μV/mo		
+300nA		±25nA			±60 nA			200nA		
-2.0nA/°C		±0.5nA/°C			±0.75 nA/°C			-1.5 nA/°C	-1.5nA/°C	-2 nA/°C
12μV		1μV			5 μV			12μV		
2.3μV		0.6μV (10Hz to 1kHz)			2μV			2.3μV		
150pA		200pA			200pA			150 pA		
50pA		35pA			30pA			50 pA		
10kHz typ		1.5kHz			500Hz			10kHz, typ		
74kHz typ		10 kHz			5 kHz			72 kHz, typ		
20μsec		200 μsec			400 μsec			20 μsec		
1.8V/μsec		0.3V/μsec			0.8 V/μsec			1.8V/μsec		
28kHz		5 kHz			10kHz			28kHz		
±15VDC		±15VDC			±15VDC			±15VDC		
±7VDC to ±20VDC		±12 VDC to ±18 VDC			±12 VDC to ±18 VDC			±7 VDC to ±20 VDC		
±6mA		±14mA			±8 mA			±6 mA		
0°C to +70°C		0°C to +70°C			-25°C to +85°C			0°C to +70°C		-55°C to +125°C
-55°C to +125°C		-40°C to +85°C			-40°C to +85°C			-55°C to +125°C		
(2) H DIP		(12) A 2" x 2" x 0.4"			(13) 1.5" x 1.5" x 0.4"			(16) TO-100		
$15.00	$23.00	$90.00(3)	$125.00(3)	$155.00(3)	$32.00	$49.00	$66.00	$12.30	$20.00	$32.00
9.75	14.95	—	—	—	24.00	38.00	47.00	8.20	13.30	21.30

Specifications at 25°C and rated supply voltage unless otherwise noted. Prices and specifications are subject to change without notice.
(1) RTI = referred to input, may be referred to output by multiplying by gain, G. (2) May be trimmed to zero. (3) 1 - 9 quantity

HIGH INPUT IMPEDANCE, LOW BIAS CURRENT INSTRUMENTATION AMPLIFIERS

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.

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 "bootstrapped" 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 59.

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 J	3621 K	3621 L	Wideband FET 3622 J	3622 K	Low Cost FET IC 3670 J	3670 K	3670 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.85 - 87)	(14) A 1.13"x 1.13" x 0.5"			(12) C 2"x 2"x 0.4"		(16) TO-100		
PRICE (small qty)	$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 - 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 86.

SINGLE-ENDED INPUT - 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 85.

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%/°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/°C		±1μV/°C	
2nd Stage	±20μV/°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/°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 pages 86 – 87)	(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%/°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/°C	±5μV/°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 pages 85, 87)	(12) B, (17) 2" x 2" x 0.4"	
PRICE (1 - 9)	$120.00	$145.00

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 87)	(17) Rack Mounting Pkg.
PRICE (1 - 9)	$325.00

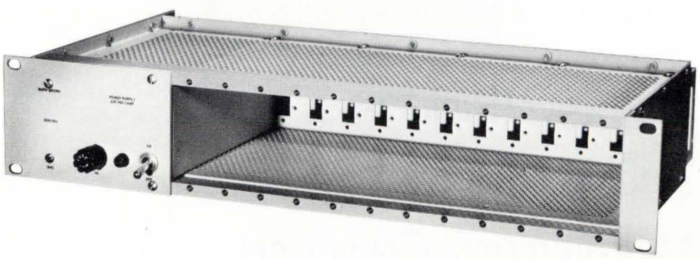
Prices and specifications are subject to change without notice.

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.

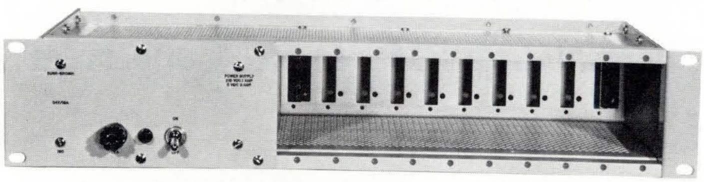
All of the enclosures will accept any of the rack-mounting amplifiers described, including the /16 and /16A options of the modular amplifiers. The connector mounting plate at the rear of these enclosures will accept either the 10 pin connector of /16 modules or the 30 pin connector of /16A modules. Thus,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



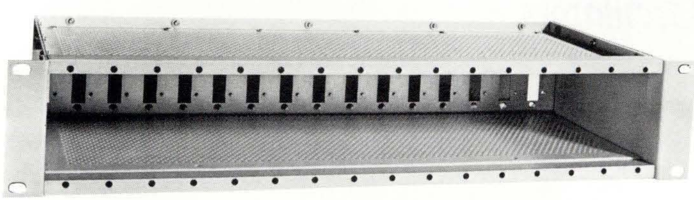
506/16A

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



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



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

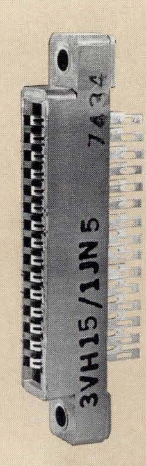
10 PIN CONNECTOR – 1600 MC

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

Logarithmic Amplifiers

Comparators

Oscillators

BURR-BROWN

MULTIPLIER/DIVIDERS

The Burr-Brown family of four-quadrant multipliers is one of the broadest available anywhere. These low-priced, laser-trimmed, integrated circuits cover an accuracy range from 2% to 0.1%. The product line spans temperature ranges from commercial to full military, allowing the user to select a particular performance range without paying for specifications he doesn't need. All models are self-contained except for external trimming, and in most cases such trimming is unnecessary. These devices can be used as modulators, voltage-controlled gain elements, dividers, square rooters, and to perform other analog computations. All give you the reliability you expect from Burr-Brown.

HIGH ACCURACY DUAL-in-LINE 4204 AND NEW 4206

The laser-trimmed 4204 and 4206 four-quadrant analog IC multipliers are the first IC's to offer 0.25% accuracy without the use of external components. These devices use the log/antilog technique to yield 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.

DIFFERENTIAL-INPUT LASER-TRIMMED- 4205

The first IC multiplier to eliminate the need for all external components—the 4205 takes advantage of Burr-Brown's expertise in monolithic circuitry, thin-film technology, and advanced laser-trimming techniques. The 4205 meets its guaranteed performance specifications with no external components to trimming. The result is greater system 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.

NEW! HIGH ACCURACY DEDICATED ANALOG DIVIDER 4291

The 4291 hybrid IC divider offers high accuracy over a 100 to 1 dynamic range with no external components required, and the specified accuracy can be achieved with denominator voltages as low as 100 mV.

The unique circuit approach produces a two-quadrant divider with performance that exceeds that of conventional multiplier/dividers. With the addition of several external resistors to null the offset and gain errors, an accuracy of 0.1% can be achieved with denominator voltages down to 10 mV.

The Burr-Brown 4291 is the lowest-priced dedicated analog divider available offering such high performance. Manufacturers of industrial control system and analytical instruments will find the 4291 to be a low-cost,accurate solution to many of their signal processing problems.

LOW COST, IC TYPE 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 with 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.

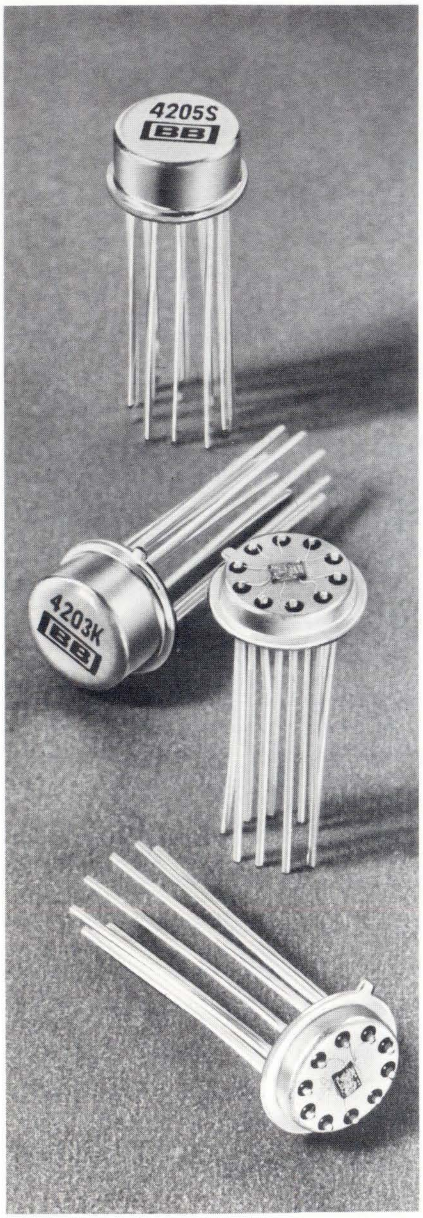
ANALOG MULTIPLIER SELECTION GUIDE

Accuracy at 25°C	0°C to +70°C	-25°C to +85°C	-55°C to +125°C
0.25% max no trimming required 0.1% typ. ext. trimmed	4206K (1 - 24) $46.00 (25 - 99) 43.00 (100 - 249) 34.00	4204K $64.00 61.00 47.00	4204S * $72.00 69.00 54.00
0.5% max no trimming required 0.2% typ. ext. trimmed	4206J (1 - 24) $32.00 (25 - 99) 30.00 (100 - 249) 24.00	4204J $49.00 45.00 37.00	(see 4204S)
1% max no trimming required	4205K (1 - 24) $36.00 (25 - 99) 30.00 (100 - 249) 24.00	(see 4205S)	4205S $48.00 39.00 31.50
2% max no trimming required	4205J (1 - 24) $26.00 (25 - 99) 21.00 (100 - 249) 16.00	(selected 4205J's available)	(selected 4205J's available)

* Drifts 0.02%/°C max

IC MULTIPLIER/DIVIDERS

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

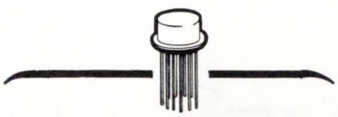


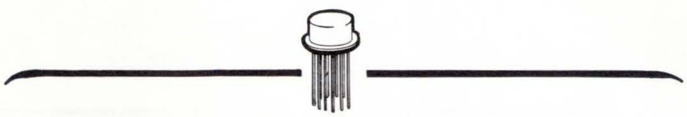
MODEL	4203J	4203K	4203S
TOTAL ERROR[1] @ +25°C			
No Ext. Trim	±2%, max	±1%, max	±1%, max
External Trim	±1%	±0.6%	±0.6%
vs. Temperature		±0.04%/°C	
vs. Supply		±0.2%/%	
OUTPUT OFFSET			
@ +25°C (X=Y=0)	±20 mV	±20 mV	±20 mV, max
vs. Temperature		±0.4 mV/°C	
vs. Supply		±10 mV/%	
NONLINEARITY			
X (X=20 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 87)	(18) B TO-100	(18) B TO-100	(18) B TO-100
PRICE (1 - 24)	$26.00	$36.00	$48.00
(25 - 99)	20.50	30.00	39.00
(100 - 249)	16.00	24.00	31.50

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

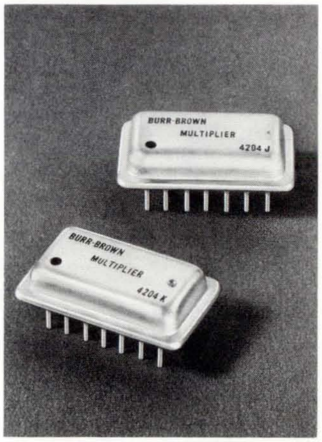
Prices and specifications are subject to change without notice.

MIL-STD-883 SCREENING
See pages 106 - 107

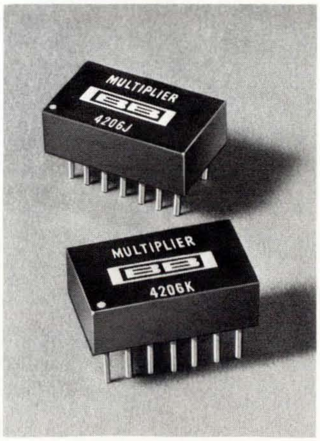




	4201J	4205J	4205K	4205S
	— ±2%, max ±0.04%/°C ±0.2%/%	±2%, max ±1%	±1%, max ±0.6% ±0.04%/°C ±0.2%/%	±1%, max ±0.6%
	ext. adj. ±0.4 mV/°C ±10 mV/%	±20 mV	±20 mV ±0.4 mV/°C ±10 mV/%	±20 mV, max
	±0.8% ±0.2%	±0.8% ±0.2%	±0.5% ±0.2%	±0.5% ±0.2%
	— 20 mV p-p — 20 mV p-p		50 mV p-p 20 mV p-p 50 mV p-p 20 mV p-p	
	25V/μsec		25 V/μsec	
	1 MHz 40 kHz 10 kHz		1 MHz 40 kHz 10 kHz	
	600 μV rms		600 μV rms	
	±10 V ±Supply		±10 V ±Supply	
	±10V @ ±5 mA		±10 V @ ±5 mA	
	±15 VDC ±12 to ±18 VDC ±4.5 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	-65°C to +150°C	-55°C to +125°C
	(18) B TO-100		(18) A TO-100	
	$22.50 18.00 15.00	$26.00 21.00 16.00	$36.00 30.00 24.00	$48.00 39.00 31.50



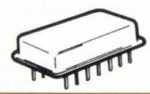
MORE
IC MULTIPLIER/
DIVIDERS
NEXT PAGE
→



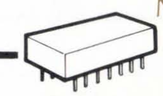
IC MULTIPLIER/DIVIDERS

MIL-STD-883 SCREENING
See Pages 106 - 107

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



NEW!



NEW!

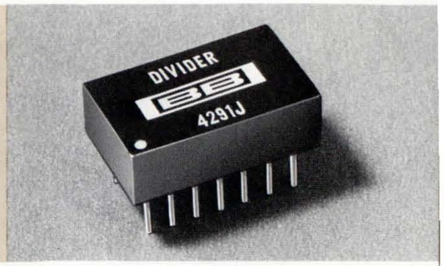
MODEL	4204J	4204K	4204S	4206J	4206K
TOTAL ERROR[1] @ +25°C					
No. Ext. Trim	±0.5% max (2)	±0.25%, max(2)	±0.25%, max (2)	±0.5%, max(2)	±0.25%, max
External Trim	±0.2%	±0.1%	±0.1%	±0.2%	±0.1%
vs Temperature	±0.01%/°C	±0.01%/°C	±0.02%/°C max	±0.01%/°C	
vs Supply	±0.02%/%	±0.02%/%	±0.02%/%	±0.02%/%	
OUTPUT OFFSET					
@ +25°C (X = Y = 0)	±15mV	±5mV	±5mV	±15mV	±15mV
NONLINEARITY					
X (X = 20V p-p, Y = +10 VDC)		±0.05%		0.05%	
Y (Y = 20V p-p, X = +10 VDC)		±0.05%		0.05%	
FEEDTHROUGH @ 50 Hz					
X = 0, Y = 20V p-p (no ext. trim)		10mV p-p		10mV p-p	
Y = 0, X = 20V p-p (no ext. trim)		10mV p-p		10mV p-p	
SLEW RATE		1V/μsec		1V/μsec	
BANDWIDTH					
Small Signal, -3 dB		250 kHz		250 kHz	
1% Amplitude Error		33 kHz		33 kHz	
1% Vector Error		2.5 kHz		2.5 kHz	
OUTPUT NOISE, 10 Hz - 10 kHz		300μV RMS		300μV RMS	
INPUT VOLTAGE, Rated		±10V		±10V	
Abs. max		±Supply		±Supply	
OUTPUT RATING		±10V @ ±5mA		±10V @ ±5mA	
POWER REQUIREMENTS, Rated		±15 VDC		±15 VDC	
Operating Range		±14 to ±16 VDC		±14 to ±16 VDC	
Quiescent Current		+15mA, -8.5mA		+15mA, -8.5mA	
TEMPERATURE RANGE					
Specification	-25°C to +85°C		-55°C to +125°C	0°C to +70°C	
Storage		-55°C to +125°C		-55°C to +125°C	
PACKAGE DRAWING (see pgs. 82, 87)	(19) C	0.86" x 0.5" x 0.22"		(2) C 0.80" x 0.5" x 0.25"	
PRICE (1 - 24)	$49.00	$64.00	$72.00	$32.00	$46.00
(25 - 99)	45.00	61.00	69.00	30.00	43.00
(100 - 249)	37.00	47.00	54.00	24.00	34.00

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

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

Prices and specifications are subject to change without notice.

TWO-QUADRANT ANALOG DIVIDER



4291

- **EASY TO USE –**
  Optimized for analog division
  No external components required
- **HIGH ACCURACY**
  0.25% max for D ⩾ 100 mV
- **WIDE DYNAMIC RANGE**
  10 mV ⩽ D ⩽ 10V
- **SMALL SIZE**
  14 - Pin dual-in-line package

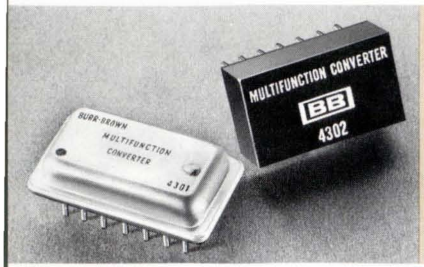
The 4291 uses a unique Burr-Brown circuit which has been optimized for the demanding task of analog division. Although any of the analog multipliers from the preceeding pages can be used as dividers, the resulting output is accurate only over a limited range of denominator voltage. The same is true of competitive multipliers. For really accurate division over a wide dynamic range of the denominator, the 4291 provides far superior performance. For instance, the 4291K is accurate to ±0.25% without external trimming for a 100: 1 range of denominator voltage. If external trimming is employed, the denominator range can be extended to 1000: 1 (10mV to 10V) and the total accuracy improved to ±0.1%. Thermal drift is sufficiently low to maintain good accuracy over a wide temperature range.

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

NEW!

MODEL	4291H	4291J	4291K
Transfer Function		$E_O = 10\frac{N}{D}$	
ACCURACY			
Total Error			
No external trims, (max), D > 100mV	±1%	±0.5%	±0.25%
With external trims, D > 10mV	±0.25%	±0.1%	±0.1%
Error vs. Temperature		±0.03%/°C	
Error vs. Supply		±0.15%/%	
AC PERFORMANCE, D = +10V			
Small signal, -3 dB		400 kHz	
Full Power Response		20 kHz	
0.5% amplitude error		15 kHz	
0.5% vector error		600 Hz	
Slew rate		1.25 V/μsec	
INPUT CHARACTERISTICS			
Rated Input voltage N, (N ⩽ D)		±10V	
D, (D > 0)		+10V	
Maximum safe level, N, D		± supply	
Imput Impedance N, D		25 kΩ	
OUTPUT CHARACTERISTICS			
Rated output voltage, min		±10V	
Rated output Current, min		±5 mA	
Output Impedance		0.1Ω	
Output Noise, 10 Hz to 10 kHz, D = +10V		300 μV, RMS	
POWER SUPPLY REQUIREMENTS			
Rated supply		±15 VDC	
Operating range		±14 to ±16 VDC	
Quiescent current		+15 mA, -8.5 mA	
TEMPERATURE RANGE			
Operating		-25°C to +85°C	
Storage		-40°C to +85°C	
PACKAGE DRAWING (See page 82)		(2) E 0.8" x 0.5" x 0.25"	
PRICES (1 - 24)	$34.00	$42.00	$53.00
(25 - 99)	29.00	38.00	48.00
(100 - 249)	24.00	29.00	41.00

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



MULTIFUNCTION CONVERTERS

4301 AND NEW. . .4302

$$E_0 = V_Y \left(\frac{V_Z}{V_X}\right)^m$$

- **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**

The Hybrid Multifunction Converters from Burr-Brown can make just about any analog computation you might need. Add a few external resistors and these tiny 14 pin dual-in-line units can multiply, divide, square, square root or square a ratio. Add a few inexpensive active and passive devices, and they can perform true rms, vector sums, sine, cosine, or arctangent conversion functions. Highly accurate in all configurations, they are low in cost, and particularly useful for rapid realtime computations or signal processing. And, if you want to linearize a function by raising a voltage or a voltage ratio to an arbitrary power, they will do that too!

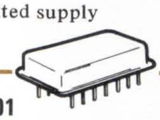
The 4301 is hermetically sealed and shielded in a metal package, and the 4302 commercial version comes in our new hybripak plastic package. Both units are fully specified over a temperature range from -25°C to +85°C and are pin-for-pin compatible.

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 $\left(\frac{Y}{X}\right)$	±0.6%
$\sqrt{X^2 + Y^2}$	±0.07%

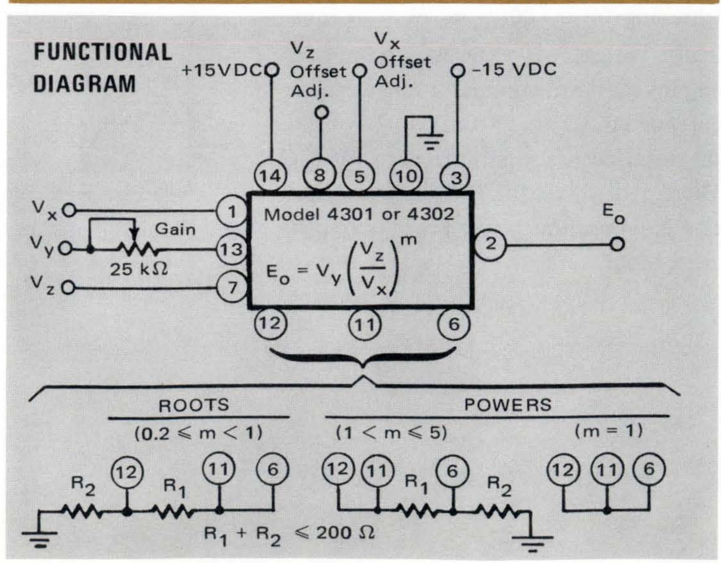
Typical accuracies expressed as a % of output full scale (+10 VDC) at 25°C.

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

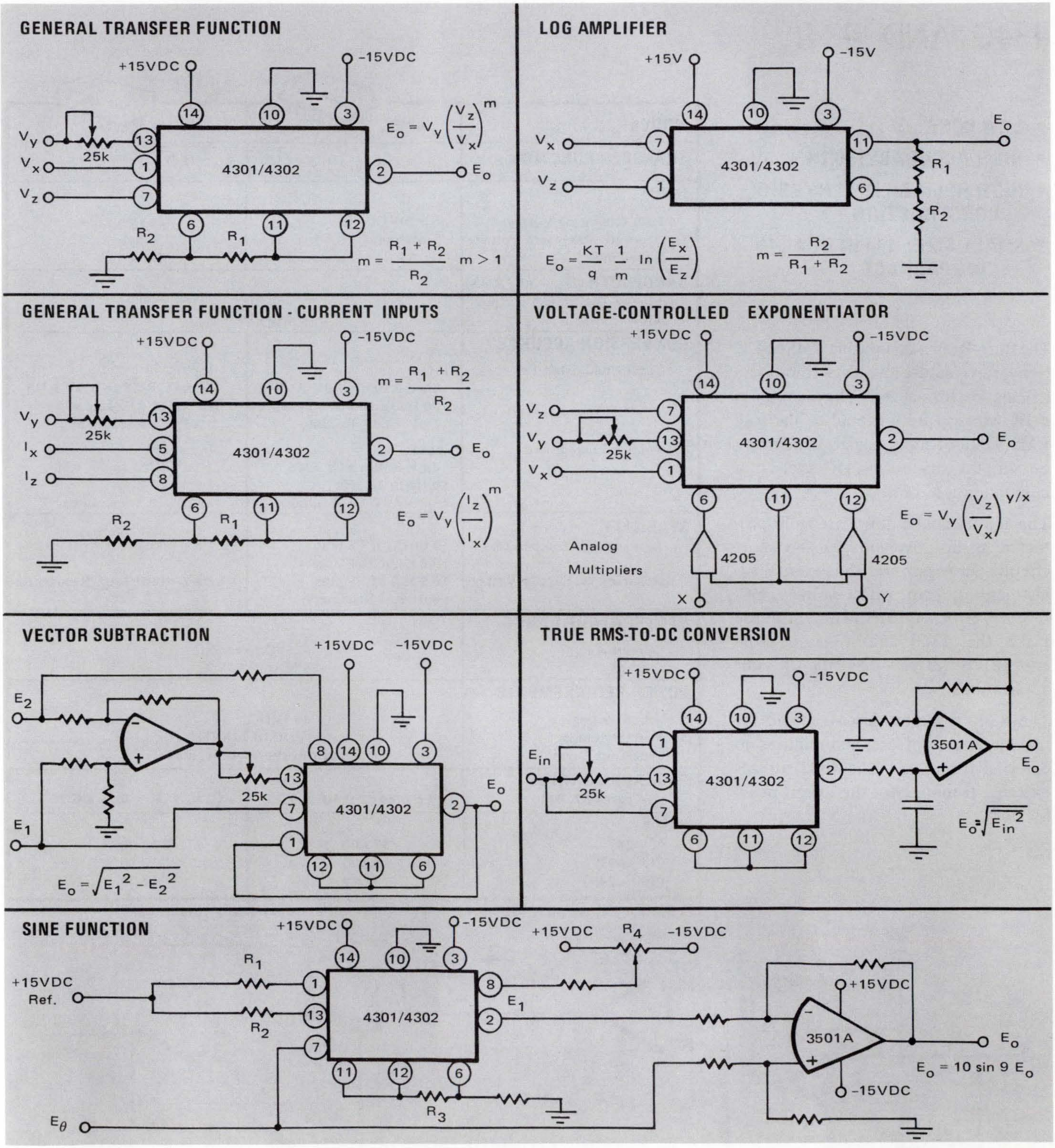
NEW!



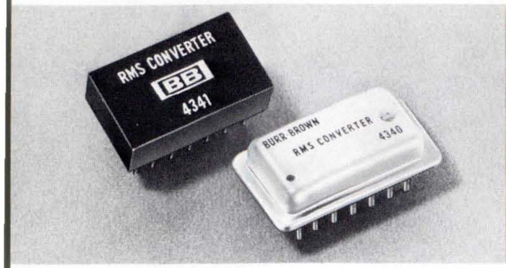
MODEL	4301	4302
TRANSFER FUNCTION	$E_o = V_Y \left(\frac{V_Z}{V_X}\right)^m$	
RATED OUTPUT		
Voltage	+10.0 V	
Current	5 mA	
INPUT		
Signal Range	$0 \leq (V_X, V_Y, V_Z) \leq +10$ V	
Absolute Maximum	$(V_X, V_Y, V_Z) \leq \pm$ Supply	
Impedance (X/Y/Z)	100 kΩ/90 kΩ/100 kΩ	
EXPONENT RANGE		
Roots ($0.2 \leq m < 1$)	$m = \frac{R_2}{R_1 + R_2}$ Refer to Functional Diagram	
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 pages 82, 87)	(19) A 0.86" x 0.50" x 0.22"	(2) D 0.8" x 0.5" x 0.25"
PRICE		
(1 - 24)	$69.00	$34.00
(25 - 99)	59.00	28.00
(100 - 249)	48.00	23.50



Shown below are several examples which illustrate the versatility of Burr-Brown's Multifunction Converters:



For more applications, including cosine and arctangent generation, vector sums, squaring, and square-rooting circuits, request PDS-307 (4301) or PDS-326 (4302) and application note AN-70.



COMPUTING TRUE RMS-to-DC CONVERTERS

4340 AND 4341

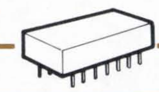
- **LOW COST**
- **HIGH ACCURACY: ±0.2% ±2mV**
- **HIGH RELIABILITY: HYBRID CONSTRUCTION**
- **SMALL SIZE: 14-PIN DUAL-IN-LINE PACKAGE**

The Burr-Brown computing RMS-to-DC Converters feature low cost without sacrificing performance. They compute a DC voltage proportional to the true RMS value of input signals which may be complex wave forms, DC levels, or a combination of both.

The inputs and outputs are fully protected against overvoltages and short circuits. Provisions for the external adjustment of gain, offset voltage, DC-reversal error, and frequency response make the 4340 and 4341 versatile enough to fill the majority of your applications.

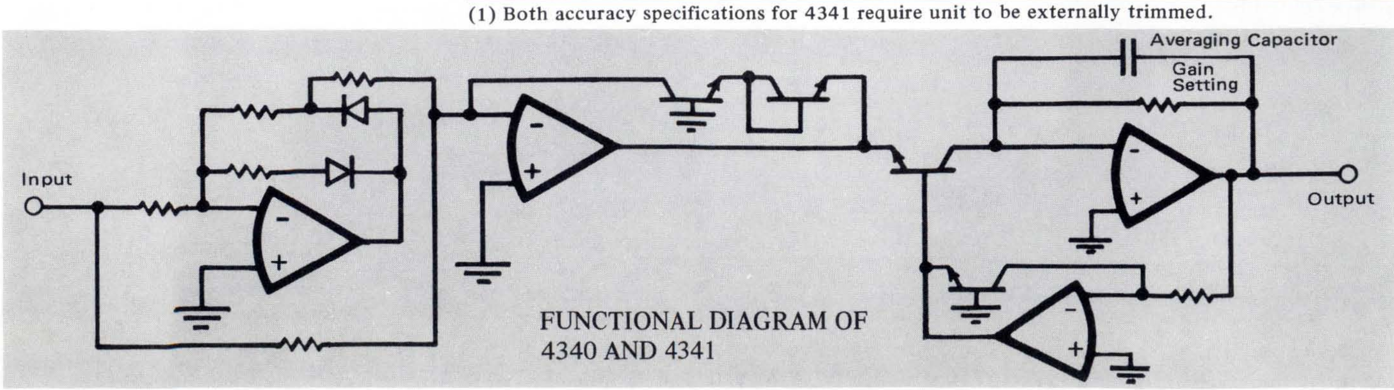
The 4340 is factory laser-trimmed for maximum ease of use, and requires no external trimming. The 4341 utilizes external trimming for the lowest possible cost.

NEW!



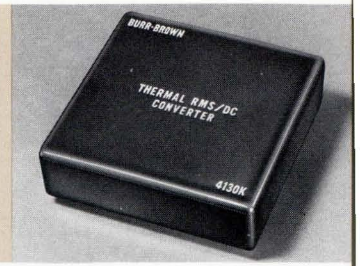
MODEL	**4340**	**4341**
TRANSFER FUNCTION	$E_{out}\text{ (DC)} = \sqrt{\frac{1}{T}\int_{o}^{T} E_{in}^{2}(t)\,dt}$	
INPUT		
Peak Operating Voltage	±10VDC	±10V
Absolute Maximum Voltage	±Supply	±Supply
Impedance	5 kΩ	5 kΩ
BANDWIDTH (E_{in} = 1V, RMS)		
±1% of Theoretical Output	80 kHz	
-3dB	450 kHz	
CONVERSION ACCURACY		
Total Unadjusted Error, max	Input: 10mV RMS to 7.0V RMS 100 Hz to 10 kHz sine wave ±2mV ±0.2% Reading	Input: (1) 500mV RMS to 5.0V RMS DC to 10 kHz sine wave ±0.5% of Reading max
Total Adjusted Error	Input: 10mV RMS to 1V RMS 50 Hz to 20 kHz ±0.3mV ±0.1% Reading	Input: (1) 10mV RMS to 7V RMS DC to 20 kHz ±2mV ±0.2% Reading
STABILITY		
Accuracy vs. Temperature	±0.001% of FS plus ±0.01% of Reading/°C	±0.1mV ±0.01% of Reading/°C
Accuracy vs. Supply Voltage	±0.001% of FS plus ±0.01% of Reading/%	±0.1mV ±0.01% of Reading/%
TEMPERATURE RANGE		
Operating	-25°C to +85°C	
Storage	-55°C to + 125°C	
POWER REQUIREMENTS		
Rated Voltage	±15VDC	
Voltage Range	±14VDC to ±16VDC	
Quiescent Current	±12mA, typ/±24mA, max	
PACKAGE DRAWING (see pages 82, 87)	(19) B 0.86″ x 0.50″ x 0.22″	(2) B 0.8″ x 0.5″ x 0.25″
PRICE		
(1 - 24)	$75.00	$26.00
(25 - 99)	62.00	22.50
(100 - 249)	51.50	19.00

(1) Both accuracy specifications for 4341 require unit to be externally trimmed.



FUNCTIONAL DIAGRAM OF 4340 AND 4341

THERMAL TRUE RMS-to-DC CONVERTERS



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 ultilized 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	$E_o = \sqrt{E_i^2}$	*
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 88)	(20) 2" x 2" x 0.6"	
PRICE (1 - 9)	$139.00	$175.00
(10 - 24)	127.00	165.00
(25 - 99)	125.00	155.00

* 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.

NEW! 4127

ACCEPTS INPUTS OF EITHER POLARITY

Packaged in a ceramic, dual-in-line package (double wide) the 4127 is the first hybrid logarithmic amplifier that accepts input signals of either polarity from current or voltage sources. A special purpose monolithic chip, developed specifically for logarithmic conversions, functions accurately for up to six decades of input current and four decades of input voltage. In addition, a newly-developed current inverter and a precise internal reference allow pin-programming of the 4127 as a logarithmic, log ratio, or antilog amplifier. The table below shows the list of transfer functions that the 4127 can generate.

To further increase its versatility (and reduce your system cost) the 4127 has an uncommitted operational amplifier in its package that can be used as a buffer, inverter, filter or gain element.

The 4127 is available with initial accuracies (log conformity) of 0.5% and 1.0%, and operates over an ambient temperature range of -10°C to +70°C.

With its versatility and high performance, the 4127 has many applications in signal compression, transducer linearization, and phototube buffering. Manufacturers of medical equipment, analytical instruments, and process control instrumentation will find the 4127 a low-cost solution to many signal processing problems.

Availability: February 1976

Price: Under $30 (small quantities)

PIN-PROGRAMMABLE FUNCTIONS

$E_o = A \log |\pm I_1|$

$E_o = A \log |\pm E_1|$

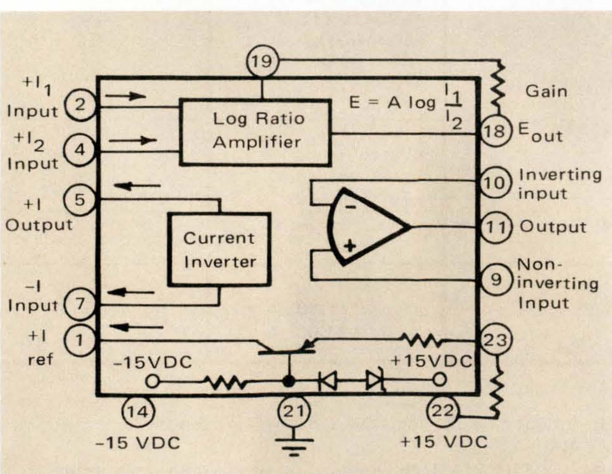
$E_o = A \log \left|\frac{\pm I_1}{\pm I_2}\right|$

$E_o = \text{antilog}\left(\frac{E_{IN}}{A}\right)$

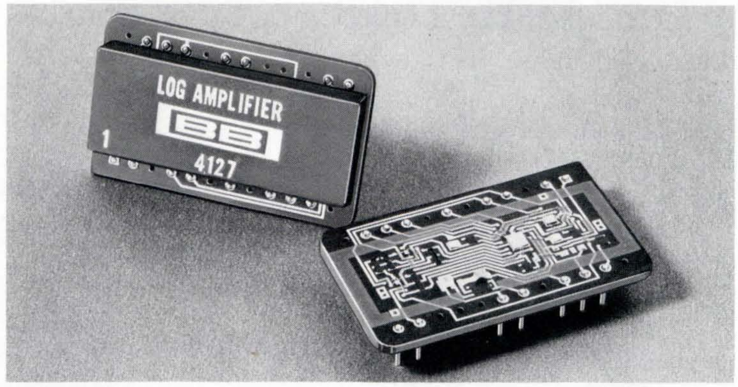
$E_o = A \log \left|\frac{\pm E_1}{\pm E_2}\right|$

$E_o = A \log \left|\frac{\pm I_1}{\pm E_2}\right|$

$E_o = A \log \left|\frac{\pm E_1}{\pm I_2}\right|$



BLOCK DIAGRAM

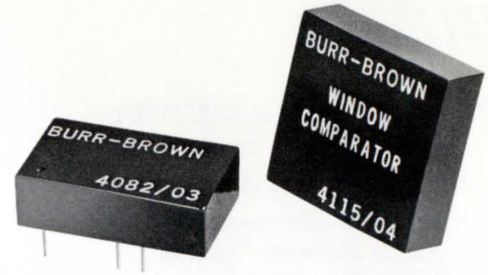


Specifications typical at 25°C and rated supply voltage unless otherwise noted.

MODEL	4127JG *	4127KG *
INPUT		
Current source input, pin 4	+1 nA to +1 mA	
Current source input, pin 7	-1 nA to -1 mA	
Reference current input, pin 2	±1 μA to +1 mA	
Absolute maximum input	±10 mA or ±supply voltage	
ACCURACY, % of FULL SCALE		
Current source inputs: 1 nA to 1 mA	1% max	0.5% max
Voltage input: 1 mV to 10V	1% max	0.5% max
FREQUENCY RESPONSE		
-3 dB small signal at current input $E_{out} = A \log I$		
I = 100 μA	90 kHz	
I = 10 μA	50 kHz	
I = 1 μA	5 kHz	
I = 100 nA	250 Hz	
I = 10 nA	80 Hz	
Step response to within ±1% of final value (I_R = 1 μA, A = 5)	10 msec	
STABILITY		
Scale factor drift (ΔA/°C)	±0.0005A/°C	
Reference current drift (ΔI_R/°C)		
1 μA < I_R < 1 mA	±0.001 I_R/°C	
400 nA < I_R < 1 μA	±0.003 I_R/°C	
Input offset current drift (ΔI_S/°C)	10 pA @ 25°C, doubles every 10°C of temp increase	
Input offset voltage drift	±10 μV/°C	
Accuracy vs supply variation		
Reference current	±0.001 I_R/V	
Input offset voltage	±300 μV/V	
Input noise		
Current input	1 pA RMS, 10 Hz to 10 kHz	
Voltage input	10 μV RMS, 10 Hz to 10 kHz	
OUTPUT		
Voltage	±10V	
Current	±5 mA	
Impedance at A = 5	10 Ω	
UNCOMMITTED OP AMP CHARACTERISTICS		
Input offset voltage	5 mV	
Input bias current	40 nA	
Input impedance	1 MΩ	
Large signal voltage gain	85 dB	
Output current	5 mA	
TEMPERATURE RANGE		
Specification	0°C to +60°C	
Operating	-10°C to +70°C	
Storage	-55°C to +125°C	
POWER SUPPLY REQUIREMENTS	±15 VDC @ ±15 mA	
PACKAGE DRAWING (see page 93)	(28) C 0.8" x 1.4" x 0.25"	
PRICE	*	

* Specifications are tentative. Contact your nearest Burr-Brown sales office for confirmation, pricing and availability.

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.



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.

4115- WINDOW-DUAL LIMIT

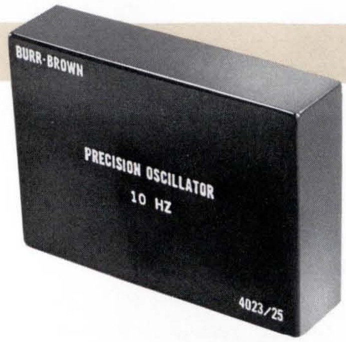
Model 4115/04 is a hybrid IC window comparator in a double width DIP. The unit has three inputs; one for a voltage that sets the upper limits, another for a voltage that sets the lower limits, and the third for a signal input. There are three mutually exclusive outputs; HIGH, GO, and LOW. When an output 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 98, 99)	(36) 0.76"x 0.46"x 0.25"	(37) 0.76"x 0.76"x 0.25"	
PRICE (1 - 9)	$36.00	$49.00	

OSCILLATOR



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

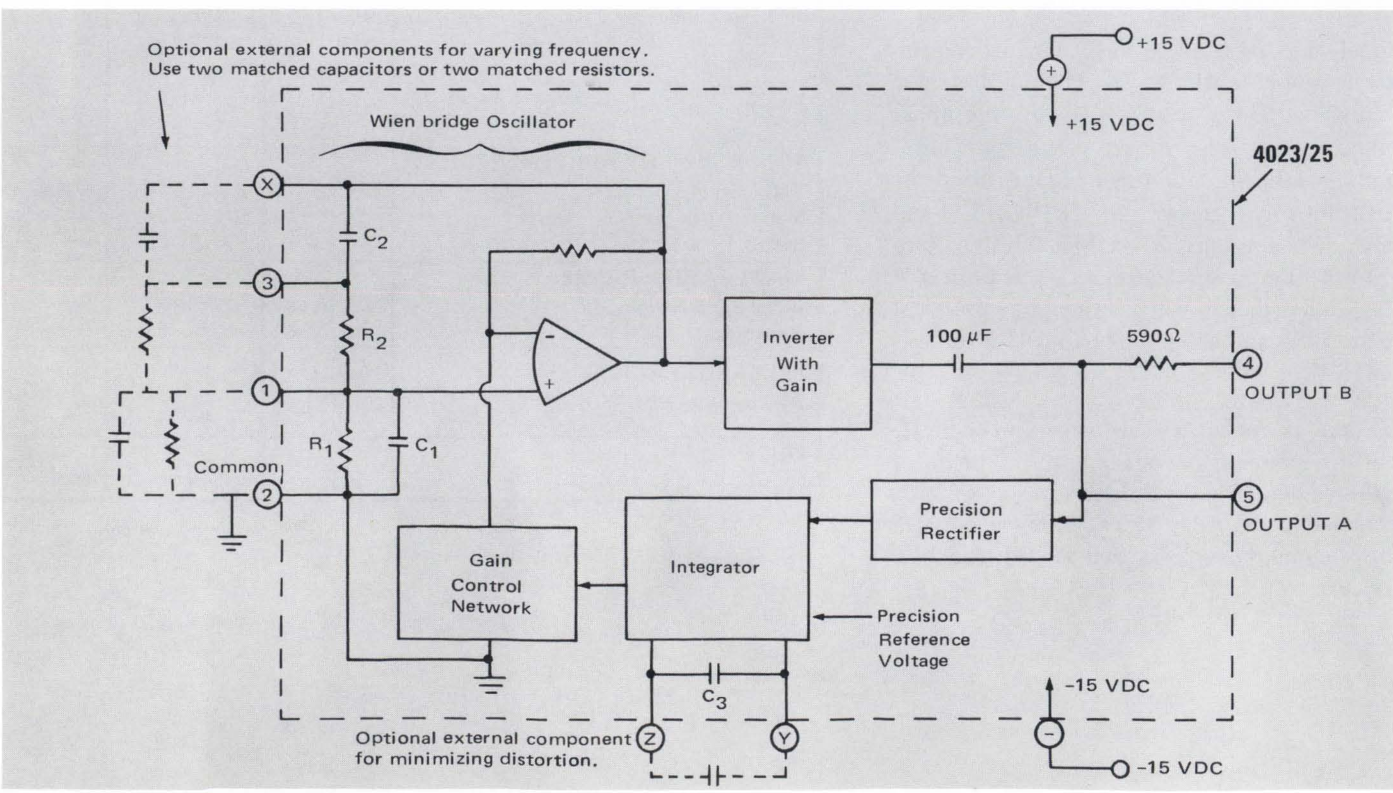
The 4023/25 is an all solid-state ultra-stable sine-wave oscillator. Both output amplitude and frequency are constant, and the stability of both with time and temperature variations is excellent. High-performance Burr-Brown IC operational amplifiers are used in the 4023/25 to form a Wien bridge oscillator 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 88)	(22) A 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

UAF31, UAF21/25, AND UAF 11/15

LOW COST

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
UAF11/15 – 0.001 Hz to 20 kHz

EPOXY OR HERMETIC DUAL-IN-LINE PACKAGE

Universal Active Filters (UAF's) are complete 2-pole active filters with the addition of three or 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.

Burr-Brown's Universal Active Filters are low cost, versatile units that the user can easily tailor to any active filtering application. They 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.

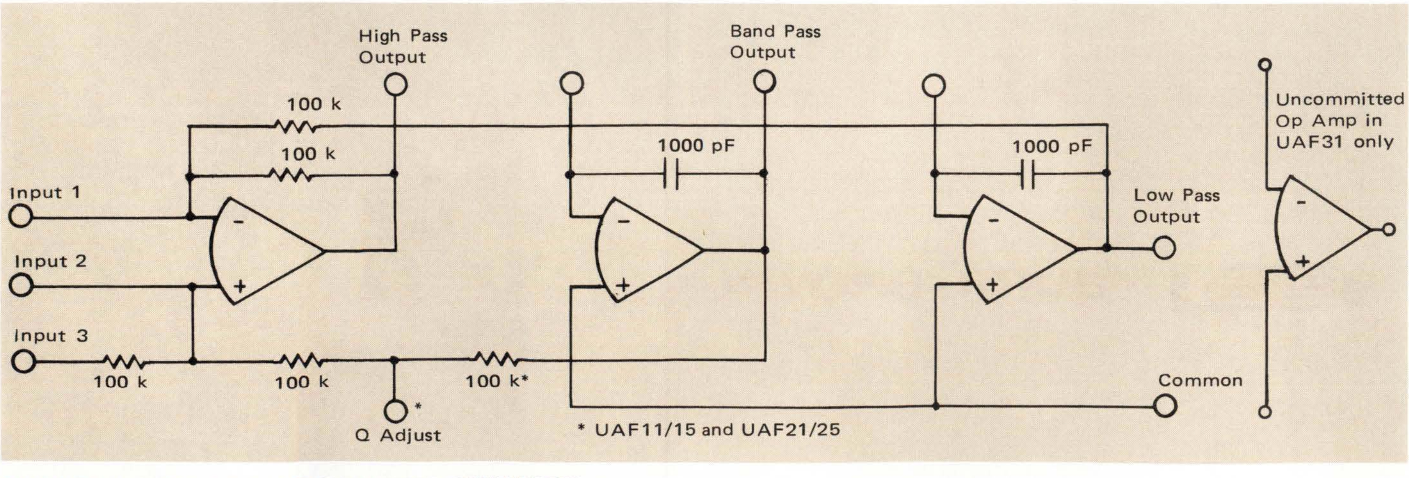
Since UAF's are so versatile and flexible, they can be stocked by the user in quantity for use as building blocks whenever the requirement arises. This means instant availability and that purchases may be made in volume to take advantage of quantity price discounts.

We have an individual data sheet available for each Universal Active Filter that explains the simple design procedures necessary to build complete 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 UAF's 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.

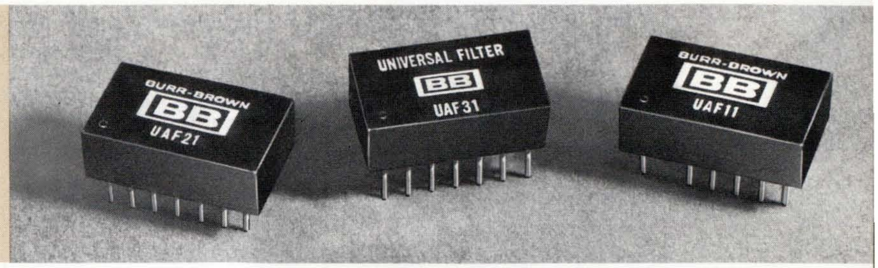
The UAF as shown in the Figure below can be connected in a variety of configurations: One UAF is required for every two poles of low pass or high pass filters. One UAF is required for each pole-pair of band pass or band reject filters. The three basic second order transfer function forms are:

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

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	UAF31	UAF11/15	UAF21/25(1)	UNITS
INPUT				
Input Bias Current	±40	±100	±15	nA
Input Voltage Range	±10	±10	±10	V
Input Resistance	100 k	100 k	100 k	Ω
TRANSFER CHARACTERISTICS				
Frequency Range (f_o)	0.001 to 25 k	0.001 to 20 k	0.001 to 200k	Hz
f_o Accuracy(2)	±1, max	±1/±5, max	±1/±5, max	%
f_o Stability(3) (over temp. range)	±0.002	±0.005	±0.005	%/°C
Q Range	0.5 - 500	0.5 – 500	0.5 - 500 (4)	––
Q Stability (5)				
@ f_o Q $\leq 10^4$	±0.01	±0.025	±0.01	%/°C
@ f_o Q $\leq 10^5$	±0.025	±0.1	±0.025	%/°C
Gain Range	0.1 to 50	0.1 to 50	0.1 to 50	V/V
OUTPUT				
Peak to Peak Output Swing(6)		0.6		
$f_o \leq$ 10 kHz	20	20	20	V
$f_o \leq$ 20 kHz	14	10	20	V
$f_o \leq$ 100 kHz	2	2	20	V
Output Offset				
(at L.P. output with unity gain)	±20	±10	±10	mV
Output Impedance	1	2	10	Ω
Noise(7)	200	200	200	μV (rms)
Output Current	5	10	10	mA
POWER SUPPLIES				
Rated Power Supplies	±15	±15	±15	V
Power Supply Range(8)	±5 to ±18	±5 to ±18	±5 to ±18	V
Supply Current @ ±15V (Quiescent)	±12, max	±9, max	±9, max	mA
TEMPERATURE RANGE				
Specification Temperature Range				
Epoxy	-25 to +85	-25 to +85	-25 to +85	°C
Hermetic	N/A	-55 to +125	-55 to +125	°C
Storage Temperature Range	-25 to +85	-55 to +125	-55 to +125	°C
PACKAGE DRAWING (see pgs.82, 99)	(2) A Epoxy	(39) Epoxy or Hermetic	(39) Epoxy or Hermetic	
PRICE	(See below)			

Prices and specifications are subject to change without notice.

MIL-STD-883 SCREENING
See pages 106 – 107

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 band pass 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_0 Accuracy	Package	Price (1 - 9)	Price (100 - 499)
UAF31	0.001 to 25 kHz	±1%	epoxy	$19.00	$13.00
UAF11	0.001 to 20 kHz	±1%	epoxy	30.00	17.50
UAF15	0.001 to 20 kHz	±5%	epoxy	29.00	16.00
UAF21	0.001 to 200 kHz	±1%	epoxy	47.00	34.00
UAF25	0.001 to 200 kHz	±5%	epoxy	46.00	33.00
UAF11H	0.001 to 20 kHz	±1%	hermetic	35.00	22.50
UAF15H	0.001 to 20 kHz	±5%	hermetic	34.00	21.00
UAF21H	0.001 to 200 kHz	±1%	hermetic	52.00	39.00
UAF25H	0.001 to 200 kHz	±5%	hermetic	51.00	38.00

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.

	BAND PASS SINGLE TUNED				
MODEL(1)	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 Hz 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 100)	(41) 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.

	LOW PASS BUTTERWORTH				LOW PASS BESSEL (Linear Phase)			
MODEL(1)	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 Hz to 20k Hz				1 Hz 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. 100)	(40) A 1.5" x 1.5" x 0.4"	(41) A 2" x 2" x 0.4"	(42) A 3" x 2.1" x 0.4"		(40) A 1.5" x 1.5" x 0.4"	(41) A 2" x 2" x 0.4"	(42) 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 Hz to 20kHz ±1% ±0.03%/°C —		
		0 ± 0.5dB		
1	2	5 ±10%	10	20
		100 µV 10 Ω ±5 mA		
		±20 mA		
		(42) 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 Hz to 20k Hz ±2% ±0.05%/°C				1Hz to 20k Hz ±2% ±0.05%/°C				1 Hz 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		
(40) A 1.5" x 1.5" x 0.4"	(41) A 2" x 2" x 0.4"	(42) A 3" x 2.1" x 0.4"		(40) A 1.5" x 1.5" x 0.4"	(41) A 2" x 2" x 0.4"	(42) A 3" x 2.1" x 0.4"		(40) 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 filters which have inverting outputs.

M — 58RO

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 ⩽ Q ⩽ 20
1 pole pair 2 ⩽ Q ⩽ 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 ⩽ Q ⩽ 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 = 58RO, 580 Hz = 5800, 5800 Hz = 5801

STANDARD SERIES

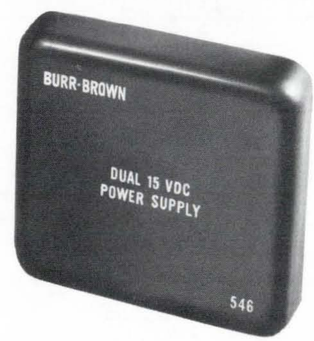
- LOW COST
- OFF THE SHELF DELIVERY
- DIRECT PC CARD MOUNTING
- STANDARD PIN CONFIGURATION
- ±15V AND +5V DC
- 25mA to 1000mA CURRENT CAPABILITY
- INTERNATIONAL INPUT VOLTAGE RATINGS AVAILABLE
- CURRENT LIMITED OUTPUTS

Burr-Brown's standard series of power supplies offers a wide range of output voltage, output current, and AC input voltage combinations. All are available in a standard package at very attractive prices.

These supplies have current-limited outputs to protect the supplies in an overload condition or temporary output short to common. In addition, two of the +5V supplies have overvoltage protection which limits the maximum output voltage to +7.0 volts in the event of a power supply failure or fault condition.

DC/DC CONVERTERS

- REGULATED ±15V DC FROM UNREGULATED DC INPUT
- FAST RESPONSE TIME
- HIGH OUTPUT CURRENT CAPABILITY WITH CURRENT LIMIT PROTECTION
- SMALL SIZE

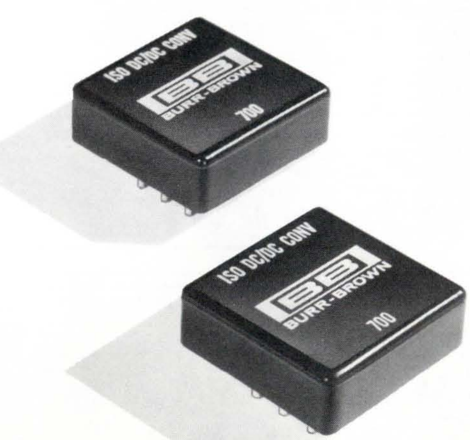


The Modular DC to DC Converters from Burr-Brown provide maximum flexibility for systems design. The Model 546 is particularly useful for powering analog interface circuitry and digital systems and the package height is less than 0.4″. It responds to full load transients in less than 10 μs which makes it excellent for driving A/D and D/A converters.

Model 510A/25 and 528 feature wide temperature operation and trimmable output voltages for optimum accuracy. These supplies tolerate a wide range of input voltages which make them ideally suited for local regulators. Stable ±15 VDC can be supplied at the point of use with no need for cumbersome or unstable remote voltage sensing circuitry.

ISOLATED DC/DC CONVERTER

- HIGH ISOLATION BREAKDOWN VOLTAGE
- LOW COUPLING CAPACITANCE: 8pF
- LOW EMI, FULLY SHIELDED



The Model 700 is intended for applications where isolation between input and output is a prime requirement. It converts a 10 to 18 volt input to a dual output of the same magnitude. Regulation, if required, can be added externally. A frequency-stable oscillator running at 130 kHz controls the converter avoiding spikes due to transformer saturation. All components except the transformer, rectifiers, and filter capacitors are contained in a thick-film hybrid IC to provide reliable operation.

AC/DC CONVERTERS

MODEL	Dual ±15 VDC Supplies					5 VDC Logic Supplies		
	527	550	551	552	553	560	561	562
RATED OUTPUT Voltage (nom) Current (max)	±15V ±100mA	±15V ±25mA	±15V ±50mA	±15V ±100mA	±15V ±200mA[3]	5V[1] 250mA	5V[1,2] 500mA	5V[1,2] 1.00A[3]
PERFORMANCE								
RATED INPUT Voltage Frequency	115/230[4] 47 - 420 Hz	105 - 125 VAC, @ 50 - 400 Hz (For international voltage ratings, see Note 5)						
OUTPUT V ERROR	±1%	±1%	±1%	±1%	±1%	±1%		±1%
REGULATION No Load to Full Load (max) Over Rated Line V (max)	±.2% ±.2%	±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%
OUTPUT VOLTAGE TEMP. COEF. %/°C	±0.02	±0.02	±0.02	±0.02	±0.02	±0.02		±0.02
OUTPUT RIPPLE and (mV_{RMS}) **NOISE** @ Full Load (max)	1.0	2.0	1.0	1.0	1.0	1.0		1.0
TEMPERATURE RANGE Rated Operation Storage	-25° to +85° -25° to +85°	-25°C to +71°C -25°C to +85°C				-25°C to +71°C -25°C to +85°C		
PACKAGE DWG. (see pgs. 88, 101)	(23) A	(43)	(43)	(43)	(43)	(43)	(43)	(43)
PRICE (1 - 9)	$59.00	$28.00	$42.00	$54.00	$74.00	$44.00	$52.00	$72.00

Typical performance @ 25°C unless otherwise noted.

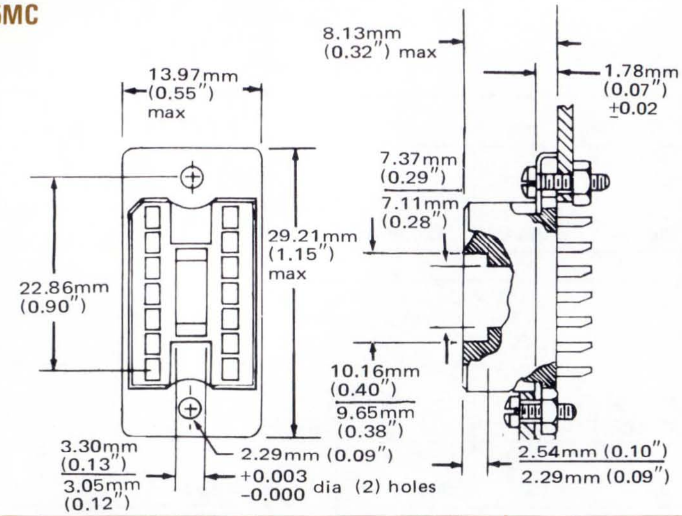
DC/DC CONVERTERS ±15VDC OUTPUT

MODEL	Low Profile	Wide Temperature		Isolated
	546	510A/25	528	700
RATED OUTPUT Voltage (nom) Current (max)	±15V ±120mA	±15V ±100mA	±15V ±200mA	±10 to ±18V ±30mA
PERFORMANCE				
RATED INPUT VOLTAGE	4.5 to 5.5 VDC	22 to 34 VDC		±10 to ±18V
OUTPUT V ERROR	±0.5%	±0.5%[3]		±1V
REGULATION No Load to Full Load (max) Over Rated Line V (max)	±0.1% ±0.1%	±1.0% ±0.1%	±0.1% ±0.1%	35mV/mA, typ 1V/V
OUTPUT VOLTAGE TEMP. COEF. %/°C	±0.02	±0.01	±0.02	±0.02
OUTPUT RIPPLE and NOISE @ Full Load (max)	0.8mV RMS 20mV p-p	2.0mV, RMS 100mV, p-p	20mV, p-p	80mVp
TEMPERATURE RANGE Rated Operation Storage	-25°C to +71°C -55°C to +100°C	-25°C to +85°C -40°C to +85°C		-25°C to +85°C -55°C to +125°C
ISOLATION VOLTAGE, Continuous	500 VDC	500 VDC		1000VRMS AC 1500VDC
PACKAGE DWG. (see pgs. 86, 88, 101)	(44)	(22) B	(23) B	(14) B
PRICE (1 - 9)	$79.00	$179.00	$179.00	$33.00

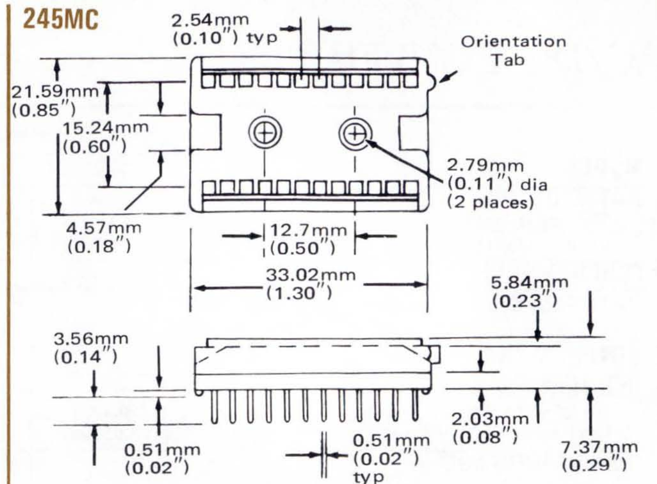
NOTES:

(1) The output may be connected as +5V or -5V.
(2) These 5V supplies have overvoltage protection which limits the output voltage to 7V (max) in a fault condition.
(3) Derate the current output for operation above 50°C by these factors: 553: -5mA/°C, 562: -25mA/°C.
(4) Model 527 will accept either 115 VAC or 230 VAC inputs. See package drawing (23) A for connection information.
(5) For international voltage ratings specify: Option E: 205 - 240 VAC, 50 - 400 Hz
No extra charge. Option H: 220 - 260 VAC, 50 - 400 Hz
Option F: 90 - 110 VAC, 50 - 400 Hz

145MC

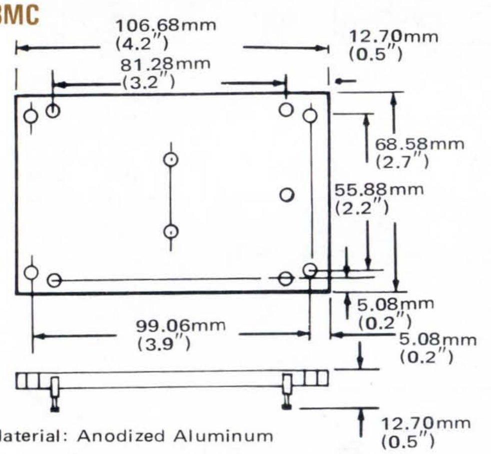


245MC



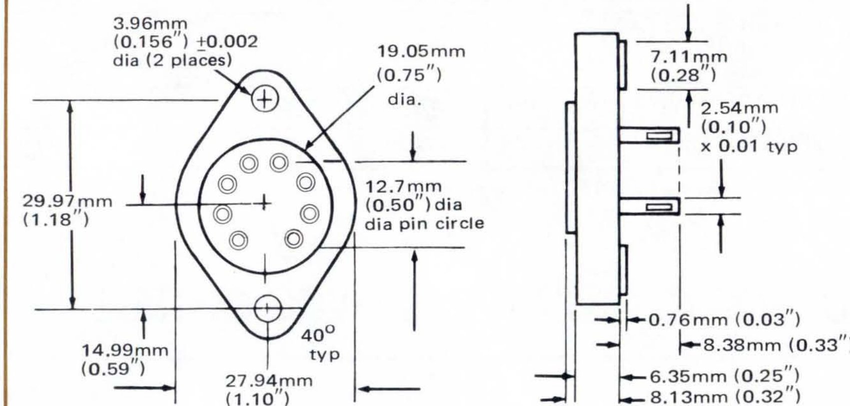
Material: Body & Plate: Diallyl Phthalate

548MC

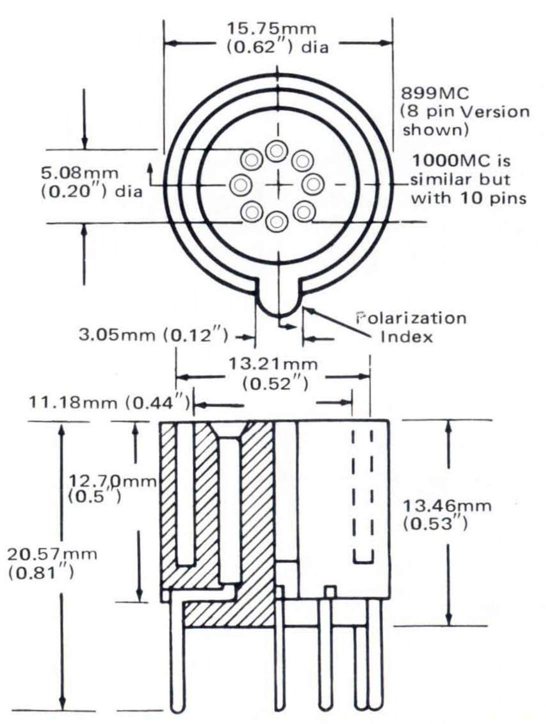


Material: Anodized Aluminum

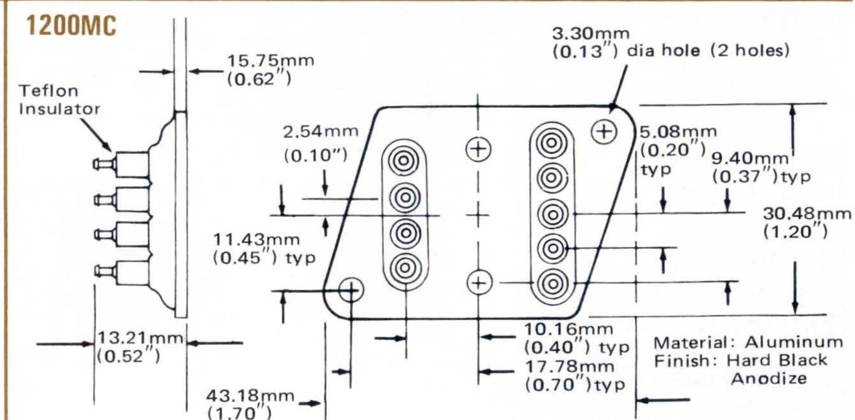
803MC



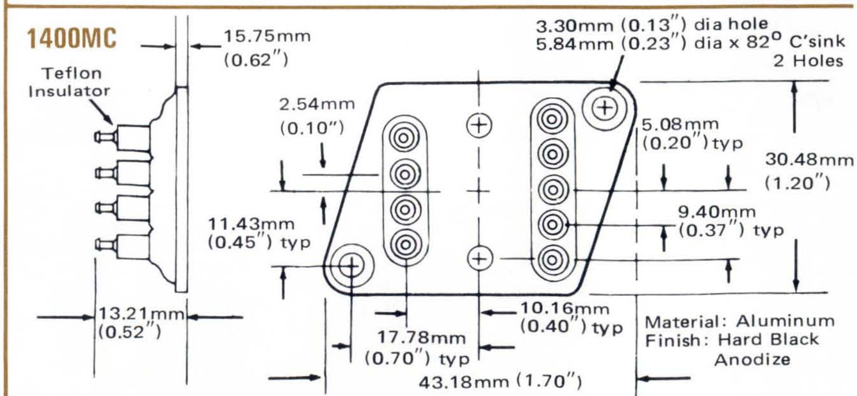
899MC & 1000MC



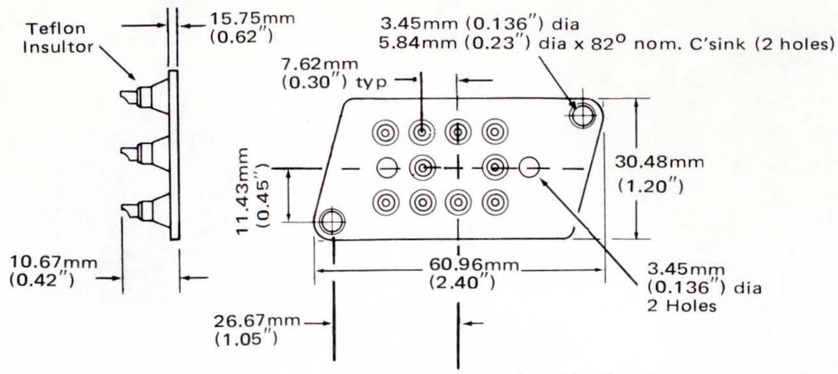
1200MC



1400MC

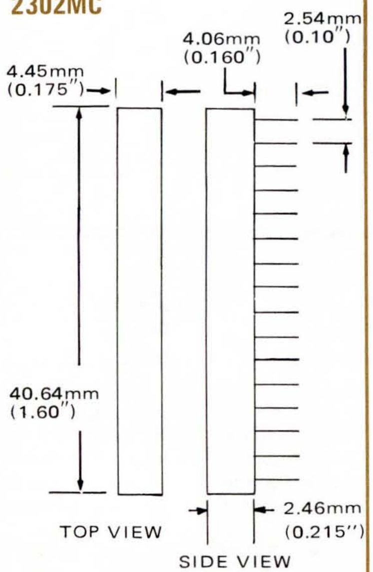


1500MC



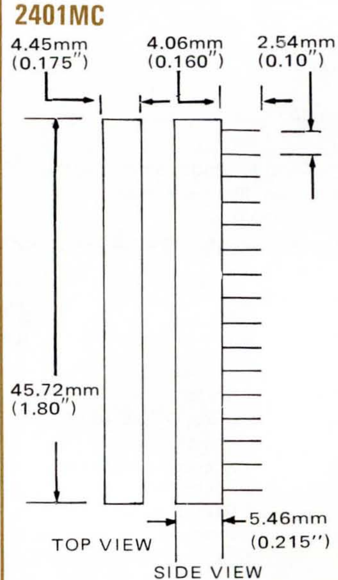
Material: Aluminum
Finish: Hard Black Anodize

2302MC



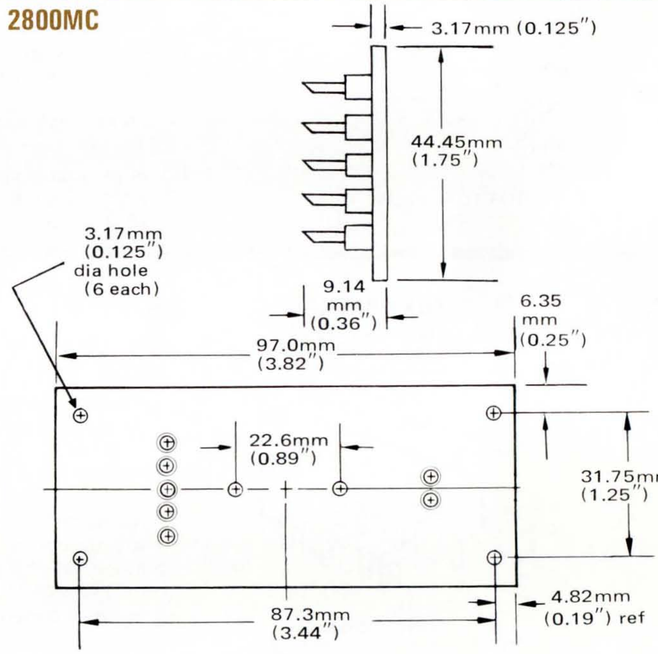
A set of two 16-pin connector strips for PC board mounting.

2401MC

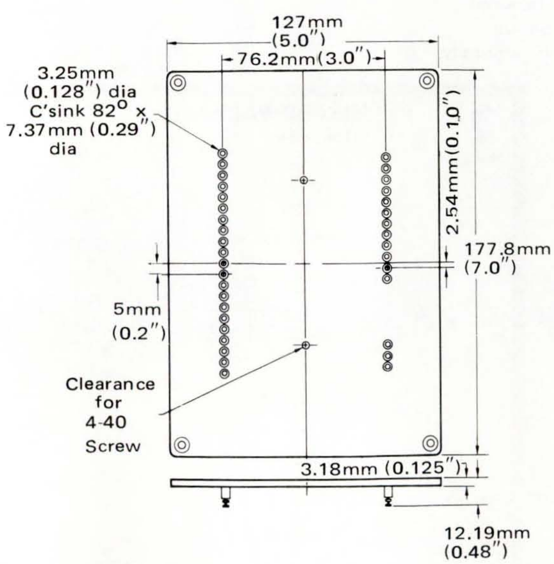


A set of four 18-pin connector strips for PC board mounting.

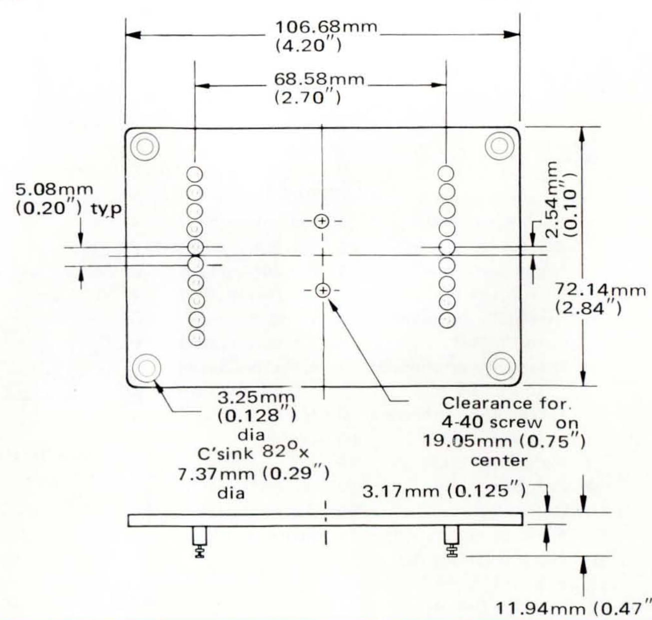
2800MC



4301MC



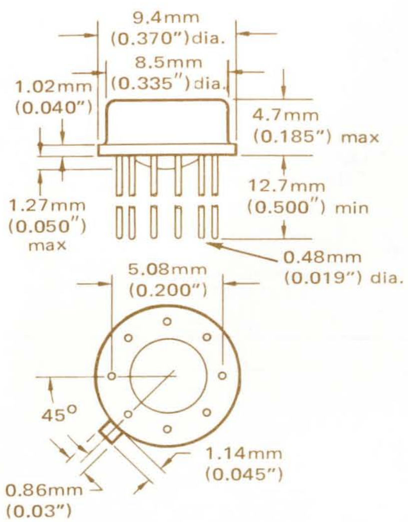
4400MC



1

TO-99 PACKAGE

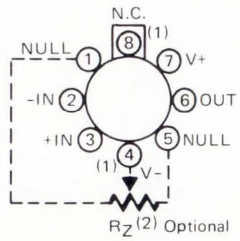
Connector: 899 MC



BOTTOM VIEW

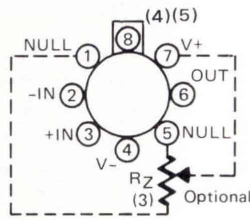
A

TOP VIEW



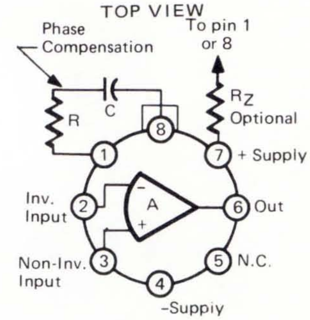
B

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.

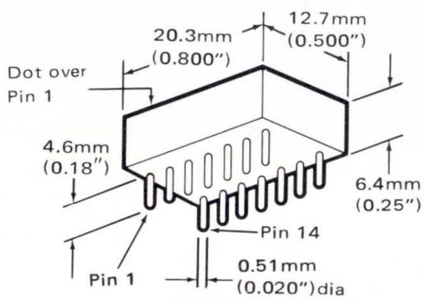
(4) 3550 - Pin 8 is connected to case.

(5) Pin 8 is bandwidth control for 3507, 3508, 3551
(C_f from pin 8 to common, 3507 and 3508)
(C_f from pin 6 to pin 8, 3551)

2

EPOXY PACKAGE

Connector: 145 MC



Pin spacing: 2.5mm (0.1")

Row spacing: 7.6mm (0.30")

PIN CONNECTIONS

A

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

B

4341

1 Input
2 Input Offset Adjust
3 Negative Supply
4 Averaging Capacitor Connector
5 Gain Setting
6 Output
7 No Connection
8 Low Level Accuracy Adj.
9 No Connection
10 Common
11 No Connection
12 DC Reversal Error Adj.
13 DC Reversal Error Adj.
14 Positive Supply

C

4206

1 E_z Input
2 Output
3 Negative Supply
4 Feedthrough Adj.
5 No connection
6 No connection
7 E_x Input
8 Internal Reference
9 No Connection
10 Common
11 Feedthrough Adj.
12 Offset Adj.
13 E_y Input
14 Positive Supply

D

4302

1 V_x Input
2 Output
3 Negative Supply
4 No Connection
5 Input Offset Adj.
6 Exponent Setting
7 V_z Input
8 Input Offset
9 No Connection
10 Common
11 Exponent Setting
12 Exponent Setting
13 V_y Input
14 Positive Supply

E

4291

1 Gain Error Adj.
2 Output
3 Negative Supply
4 D Input Offset Adj.
5 Internally connected to Pin 1
6 Internally connected to Pin 14
7 Internally connected to Pin 8
8 Reference Voltage
9 D Input
10 Common
11 N Input Offset Adj.
12 Output Offset Adj.
13 N Input
14 Positive Supply

F

3329/03

1 No connection
2 No connection
3 No connection
4 No connection
5 + Input
6 No connection
7 Negative Supply
8 No connection
9 No connection
10 Output
11 No connection
12 No connection
13 No connection
14 Positive Supply

G

SHC80 (1)

1 +In
2 -15V
3 Mode Control
4 An Com.
5 -In
6 C_{ext}
7 Output
8 No connection
9 V_L
10 Logic Return
11 No Connection
12 +15V
13 Offset
14 Adjust

Note (1): Height of SHC80 is 5.1mm (0.20")

H

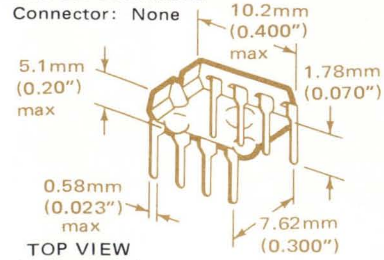
3662

1 Gain
2 V_{osi}
3 V_{osi}
4 V_{oso}
5 V_{oso}
6 $-V_{cc}$
7 Ref
8 Sense
9 Out
10 $+V_{cc}$
11 No connection
12 Gain
13 -In
14 +In

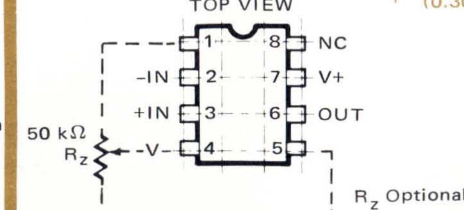
3

MINI-DIP PACKAGE

Connector: None

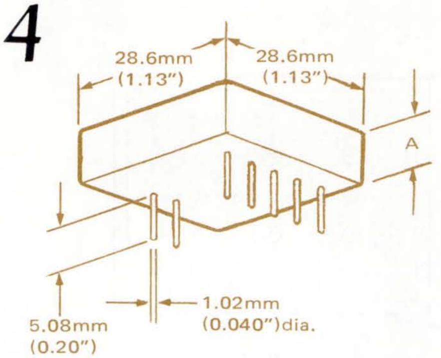


TOP VIEW



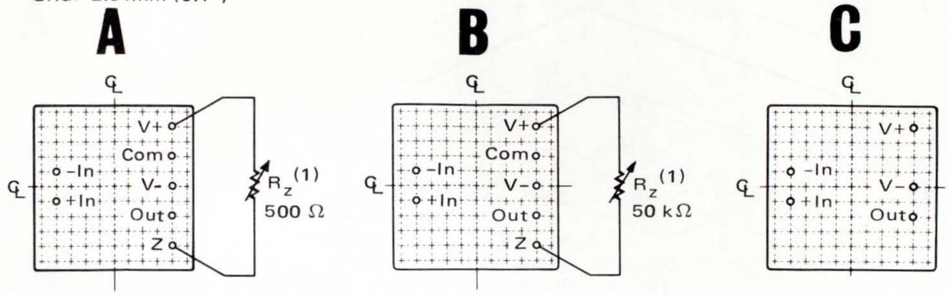
Dimple appears over Pin space #1

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")

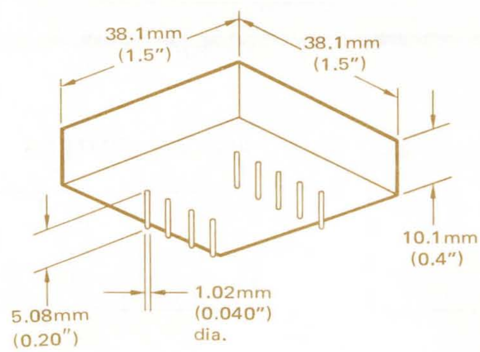


(1) R_z required for operation
May be fixed resistor at $R_z/2$.

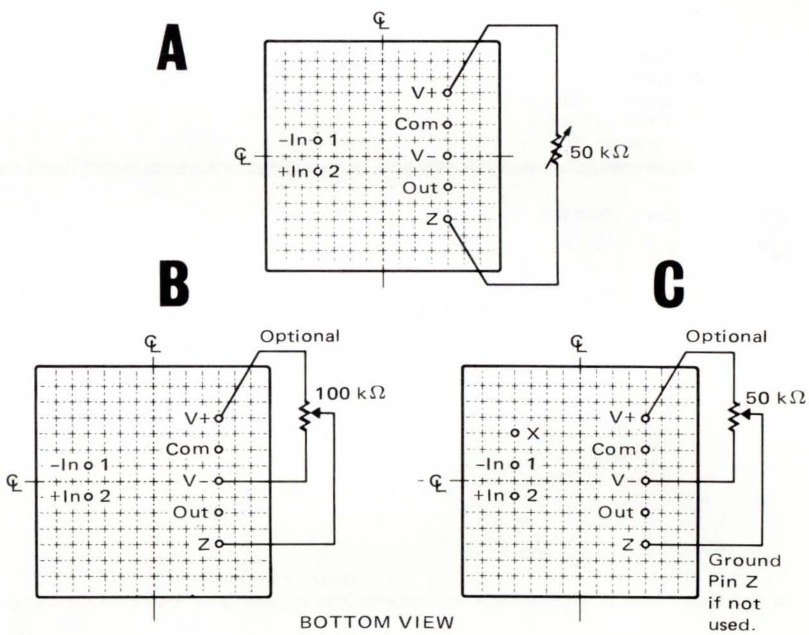
BOTTOM VIEWS

5

Connector: 1400MC



Grid: 2.54mm (0.1")

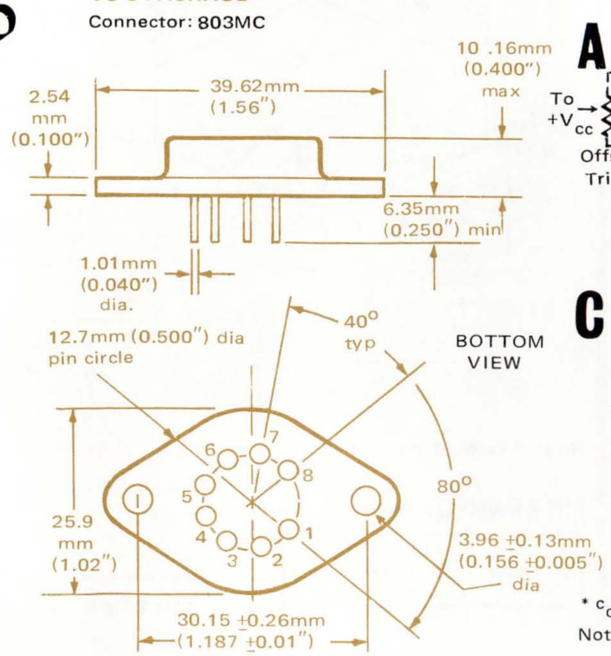


BOTTOM VIEW

6

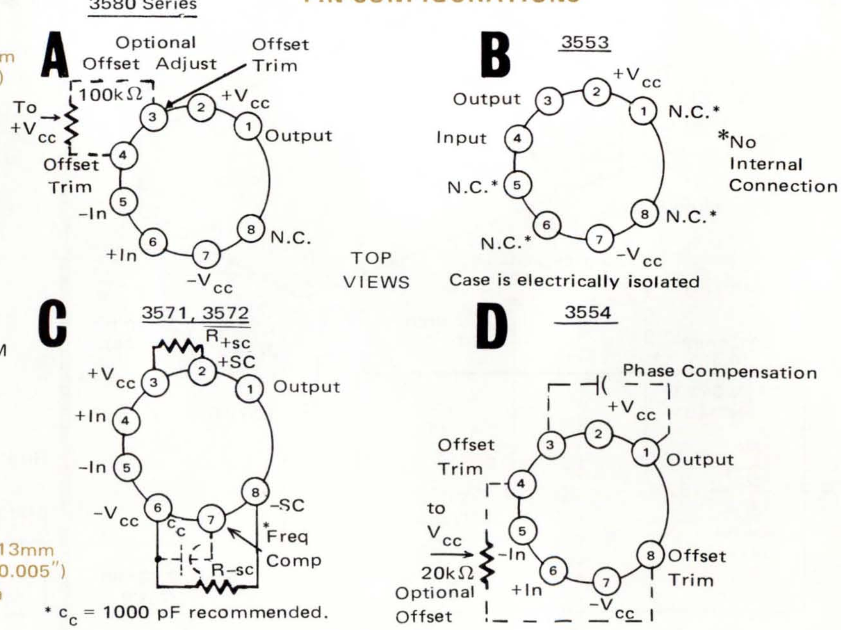
TO-3 PACKAGE

Connector: 803MC



BOTTOM VIEW

PIN CONFIGURATIONS

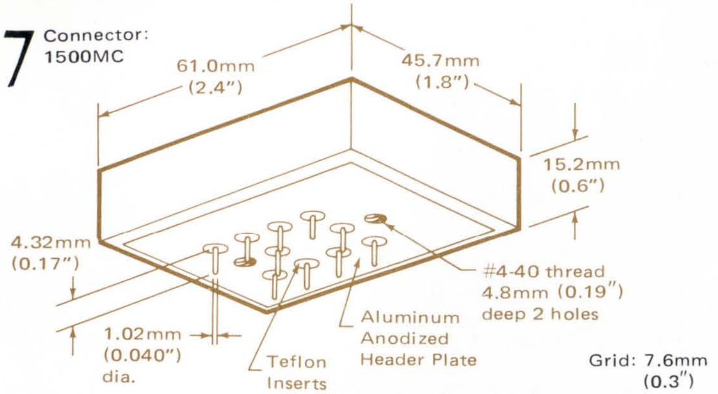


TOP VIEWS

* c_c = 1000 pF recommended.
Not required for gains above 10V/V.

7

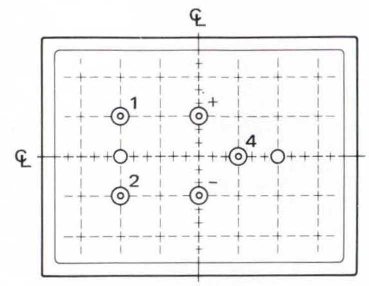
Connector: 1500MC



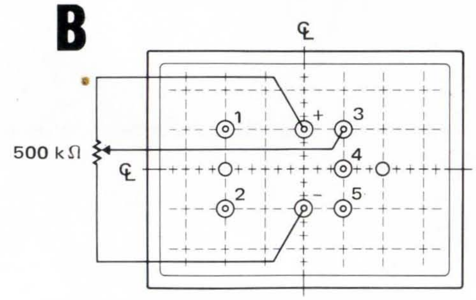
Grid: 7.6mm (0.3")

BOTTOM VIEWS

A



B

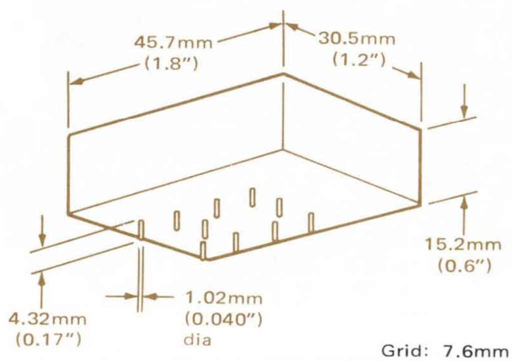


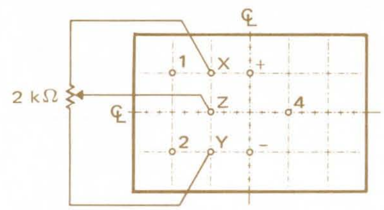
PIN CONNECTIONS

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

8

Connector: 1500 MC





BOTTOM VIEW

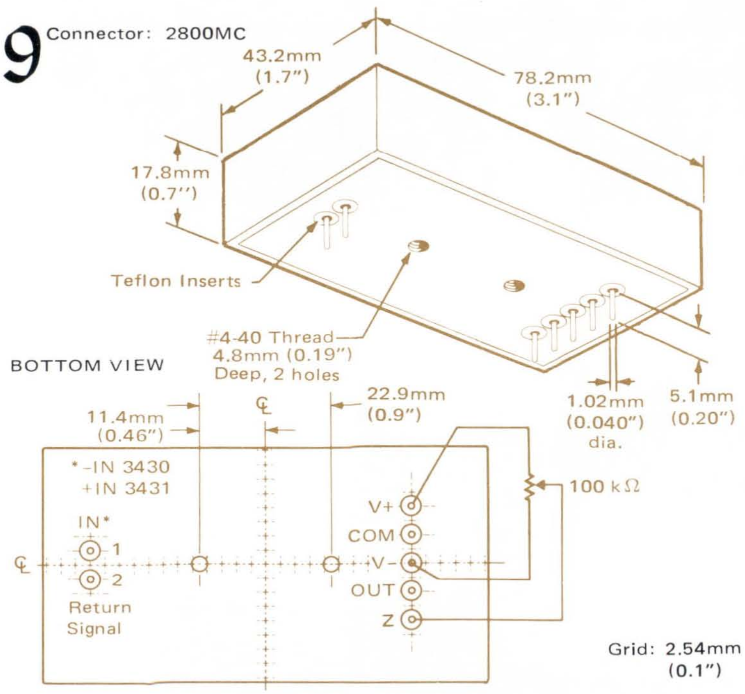
Grid: 7.6mm (0.3")

PIN CONNECTIONS

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

9

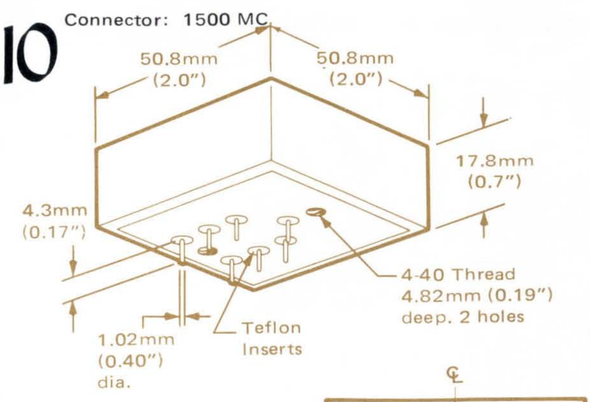
Connector: 2800MC



Grid: 2.54mm (0.1")

10

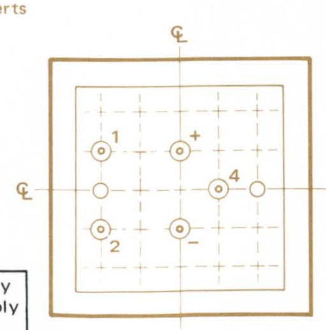
Connector: 1500 MC



Grid: 7.6mm (0.3")

PIN CONNECTIONS

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

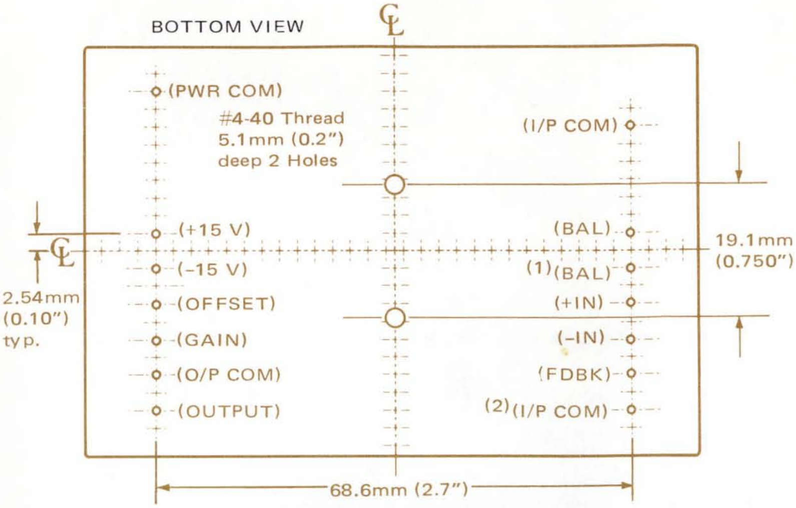


BOTTOM VIEW

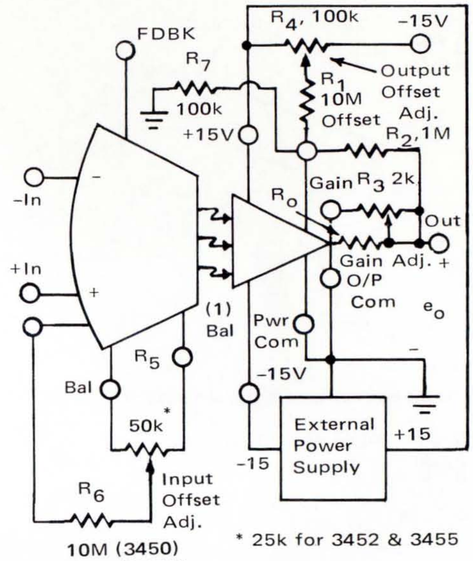
11

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")

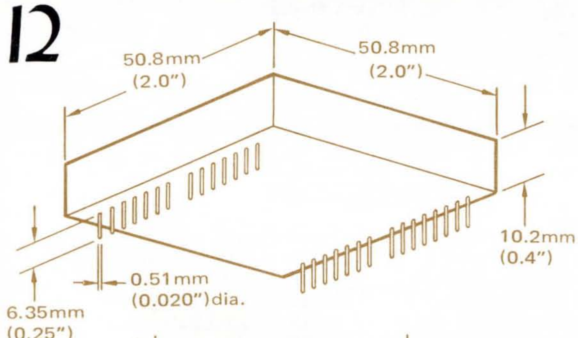


(1) This terminal labeled "V/Bal" on Model 3452 and 3455.
(2) This terminal labeled "+V" on Model 3452 and 3455.

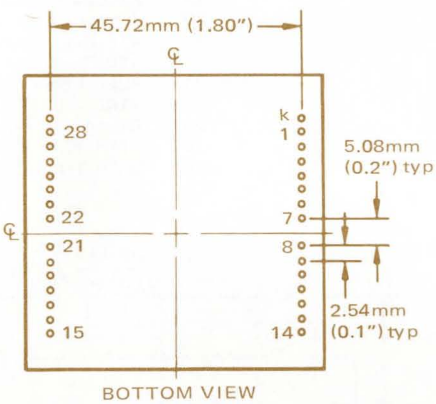


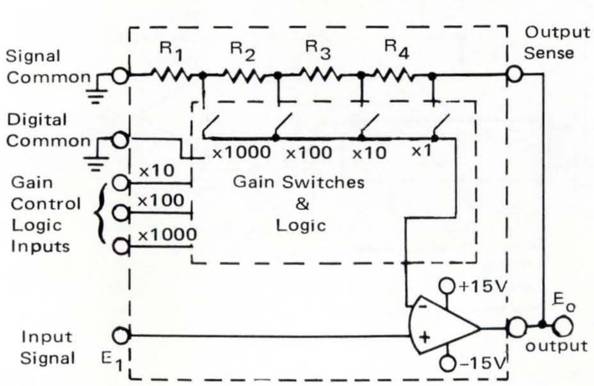
Note: All external adjustments are optional.

12



Connector: 2302MC





FUNCTION DIAGRAM - 3602

Grid: 2.5mm (0.1")

PIN CONNECTIONS

Pin designations appear on top of modules

A — 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) } 10k Optional
12	Balance (end)
13	Balance (arm)
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 — 3602

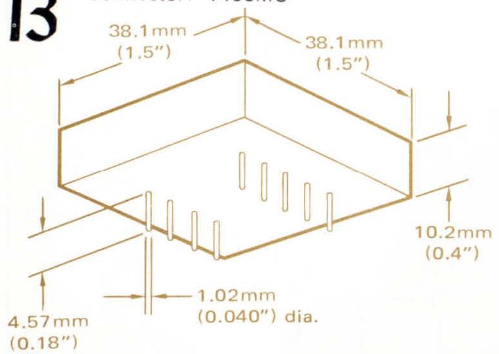
k	No Connection
1	-15 VDC
2	+15 VDC
3	No Pin
4	No Pin
5	Analog Common
6	No Pin
7	No Pin
8	Non-Inverting Input
9	No Pin
10	No Pin
11	Offset (end) } 2k Optional
12	Offset (end)
13	Offset (arm)
14	No Pin
15	No Pin
16	x10 Gain
17	x100 Gain
18	x1000 Gain
19	+5 VDC
20	No Pin
21	No Pin
22	No Pin
23	Digital Common
24	No Pin
25	No Pin
26	Output
27	Output Sense
28	No Pin

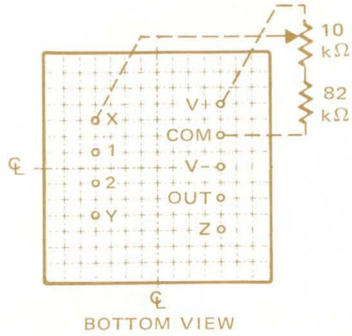
C — 3622

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

13

Connector: 1400MC





BOTTOM VIEW

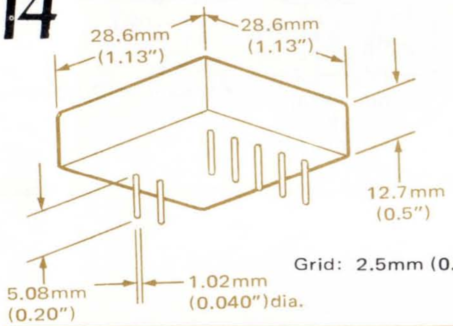
Grid: 2.5mm (0.1")

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

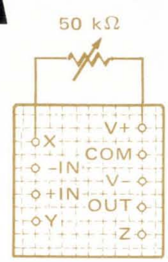
14

Connector: 1200 MC



Grid: 2.5mm (0.1")

A

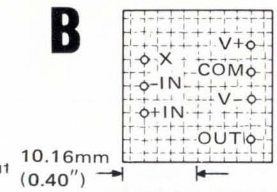


BOTTOM VIEW

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

B



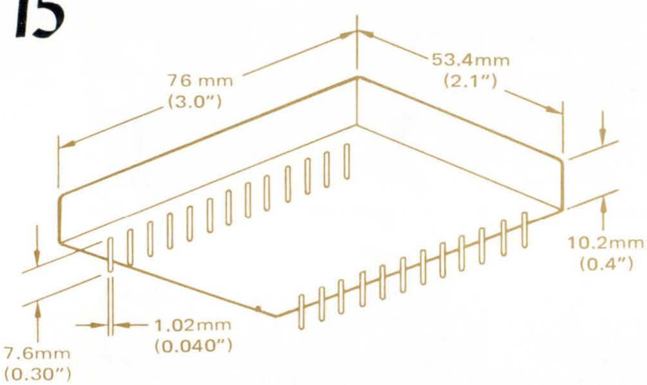
BOTTOM VIEW

PIN CONNECTIONS

X	Input Shield	V+	$+V_{out}$
–In	Input common	Com	Output Com
+In	$+V_{in}$	V–	$-V_{out}$
		Out	Output Shield

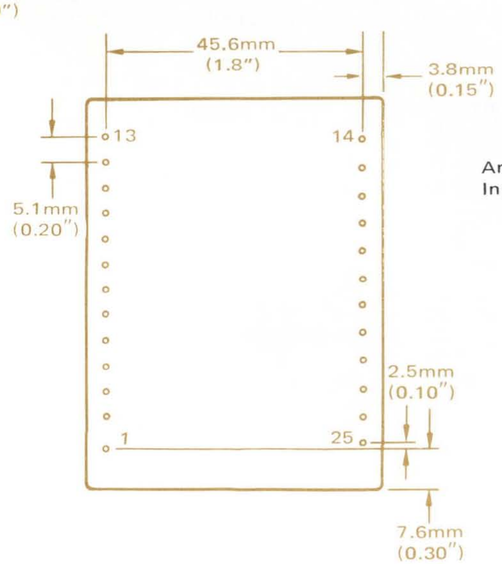
15

Connector: None

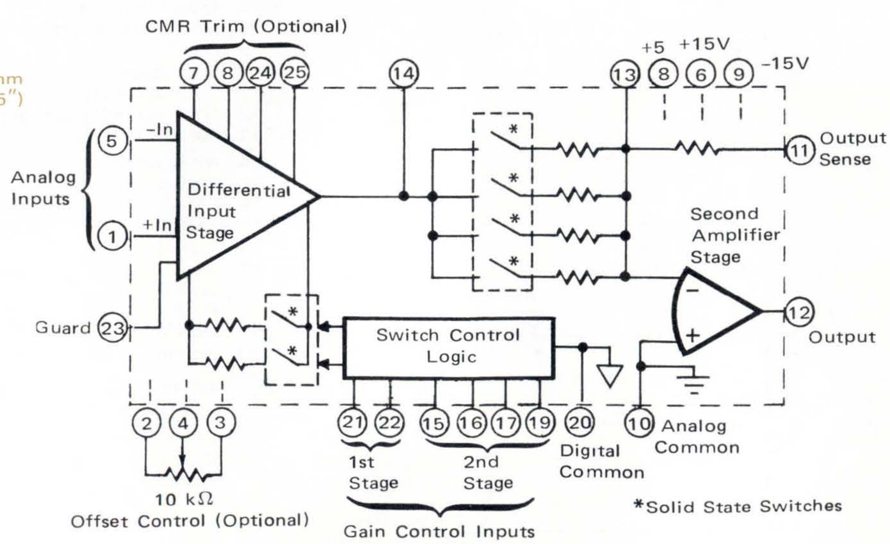


PIN CONNECTIONS

1	Non-Inverting Input	15	x8 Logic Input
2	External Balance (end) } 10k Optional	16	x4 Logic Input
3	External Balance (end)	17	x2 Logic Input
4	External Balance (arm)	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		



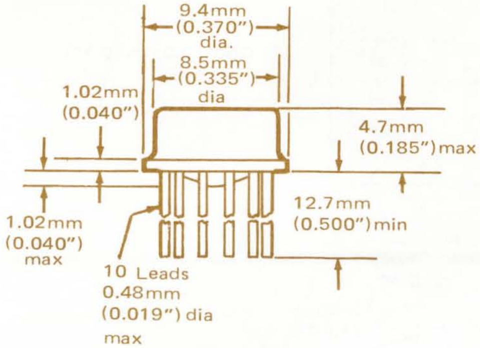
BOTTOM VIEW

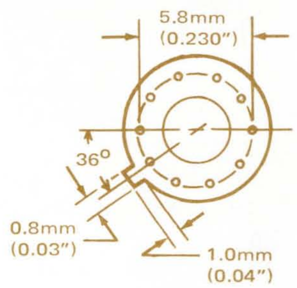


FUNCTIONAL DIAGRAM-MODELS 3600 and 3601

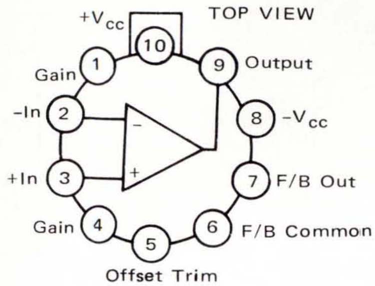
16 TO-100 PACKAGE

Connector: 1000MC

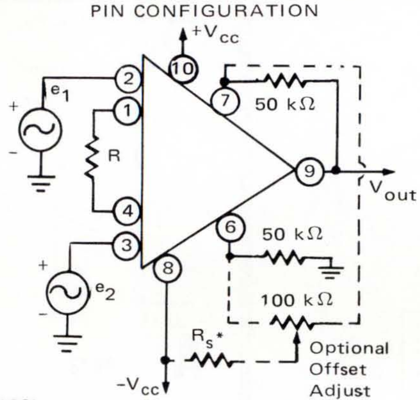




BOTTOM VIEW



PIN CONFIGURATION

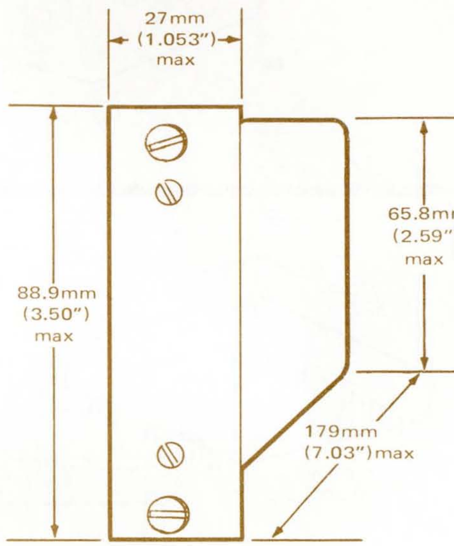


$V_{out} = \frac{100k}{R} (e_2 - e_1)$

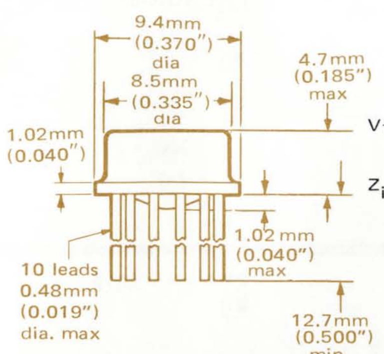
*50 kΩ 3660K, S
0 Ω 3660J, 3670J, K, S

17 /16 PACKAGE

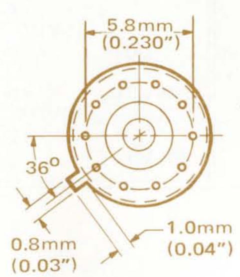
Connector: Burndy 4206P5 furnished with each unit.



18 TO-100 PACKAGE

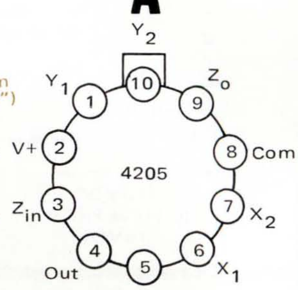


Pin 5 connected to case.

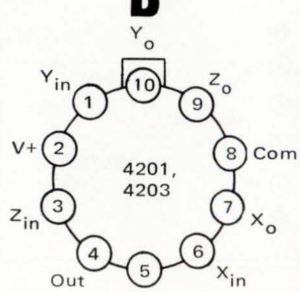


BOTTOM VIEW

A

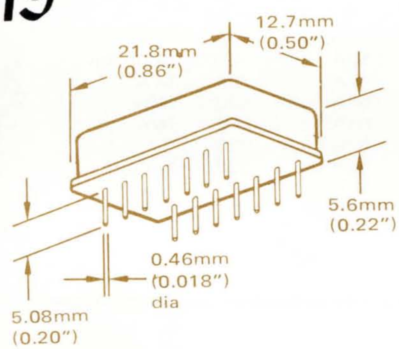


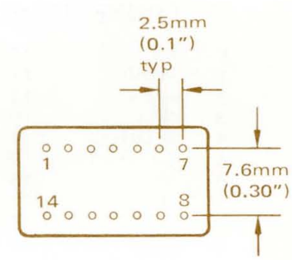
B



TOP VIEW

19





BOTTOM VIEW

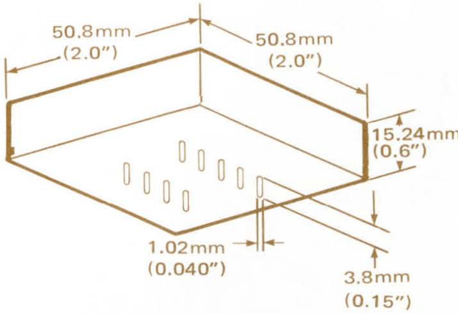
Pin 1 is identified by a black dot on the top surface.

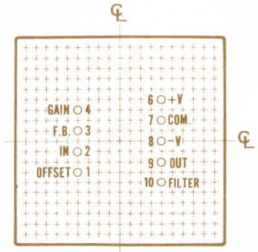
PIN CONNECTIONS

Pin	A 4301	B 4340	C 4204
1	X Input	Input	E_z
2	Output	External C_H	Output
3	-15 VDC	-15 VDC	-15 VDC
4	No Connection	Offset, External C_L	Feedthrough Adj.
5	X Offset	Gain	No Connection
6	m_A	Output	No Connection
7	Z Input	No Connection	E_x
8	Z Offset	No Connection	Internal Reference
9	No Connection	No Connection	No Connection
10	Common	Common	Ground
11	m_B	No Connection	Feedthrough Adj.
12	m_C	DC Reversal Adj.	Offset Adj.
13	Y Input	DC Reversal Adj.	E_y
14	+15 VDC	+15 VDC	+15 VDC

20

Connector: 1400 MC



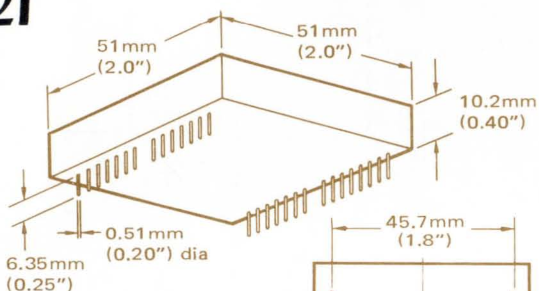


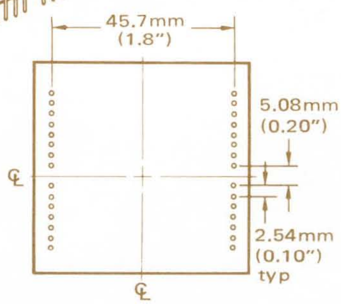
Grid: 2.5mm (0.1")

BOTTOM VIEW

21

Connector: 2302MC





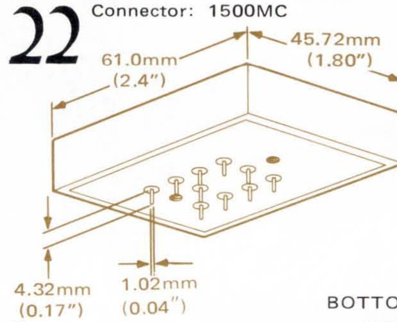
BOTTOM VIEW

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

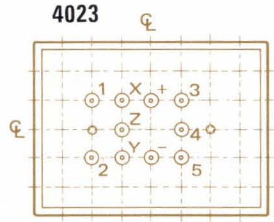
Connector: 1500MC



Grid: 7.6mm (0.3")

BOTTOM VIEWS

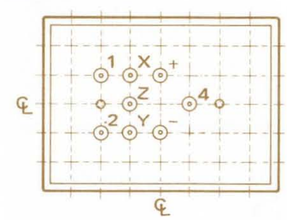
A 4023



PIN CONNECTIONS

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

B 510

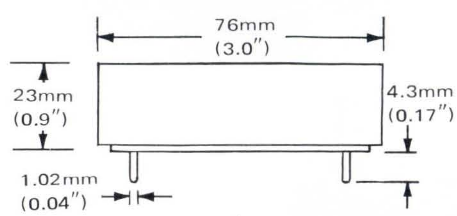


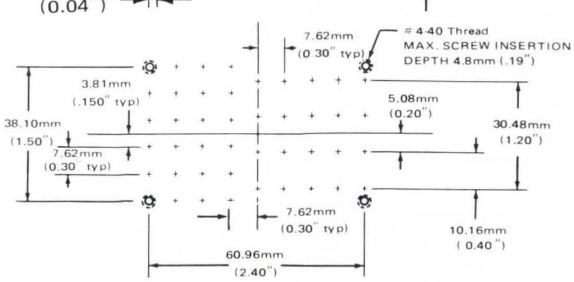
PIN CONNECTIONS

1	+15
2	-15
X	+Trim
Z	Common
Y	-Trim
+	$+V_{in}$
-	$-V_{in}$

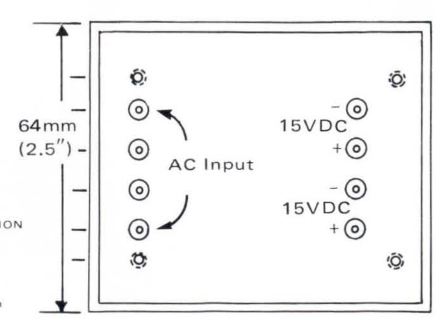
23

527/528

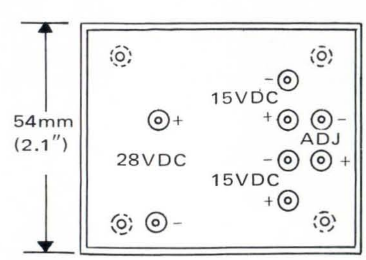




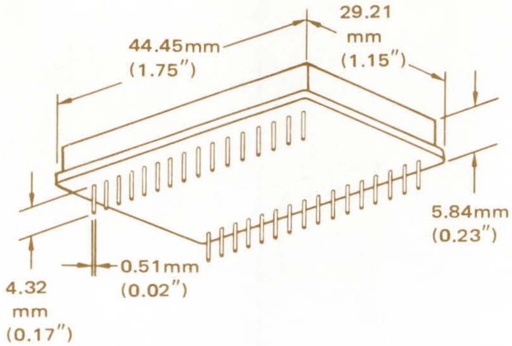
A 527

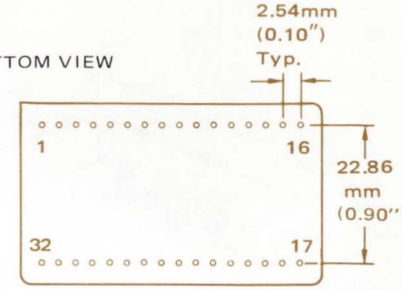


B 528



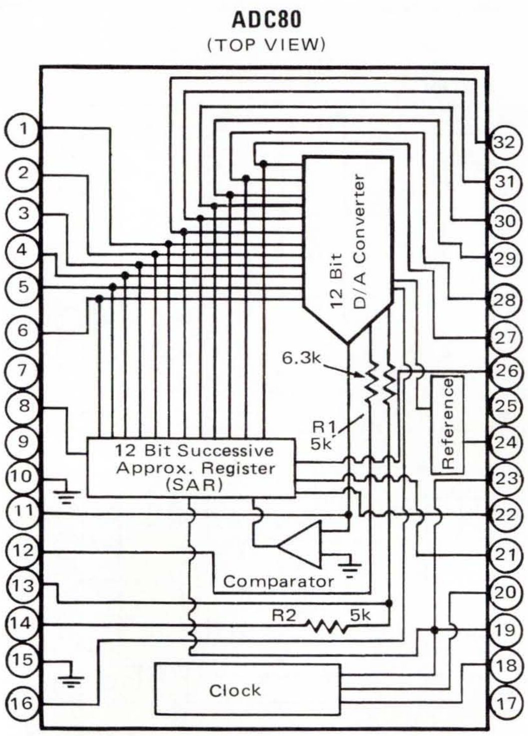
24 Connector: 2302MC





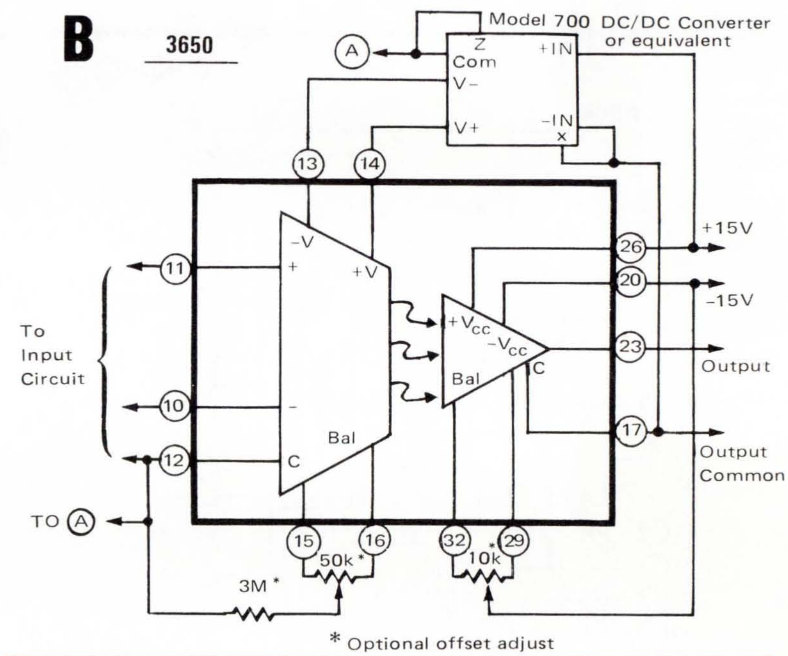
Case: Ceramic

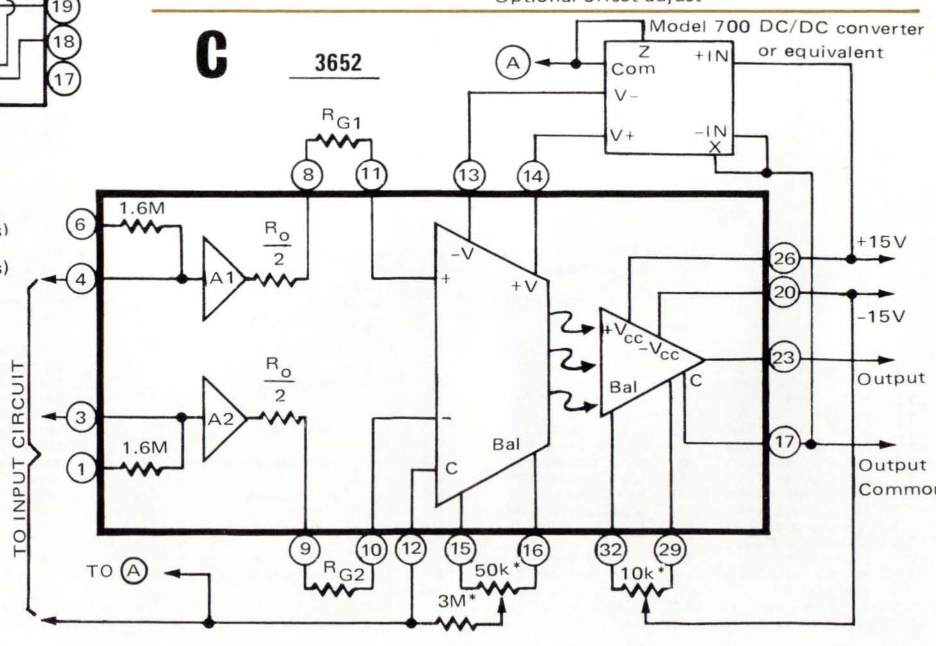
CONNECTION DIAGRAMS



PIN CONNECTIONS

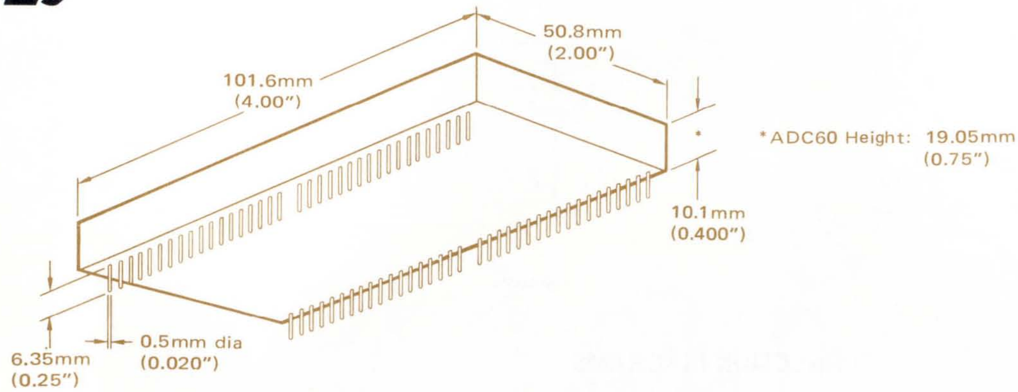
1. Bit 6
2. Bit 5
3. Bit 4
4. Bit 3
5. Bit 2
6. Bit 1 (MSB)
7. +5V Analog
8. Bit 1 (MSB)
9. +5V Digital
10. Digital Common
11. Comparator IN
12. Bipolar Offset
13. R1 10V Range
14. R2 20V Range
15. Analog Common
16. Gain Adjust
32. Bit 7
31. Bit 8
30. Bit 9
29. Bit 10 (LSB–10 Bits)
28. Bit 11
27. Bit 12 (LSB–12 Bits)
26. Serial out
25. –15V
24. Ref. out (+6.2V)
23. Clock out
22. Status
21. Short Cycle
20. Clock Inhibit
19. External Clock
18. Convert Command
17. +15V

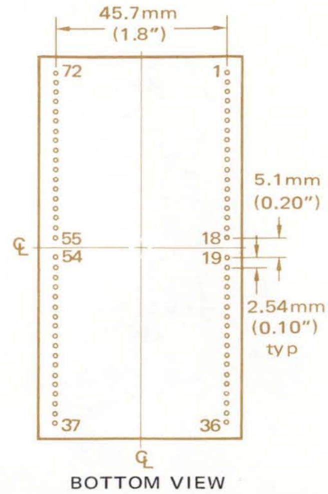




25

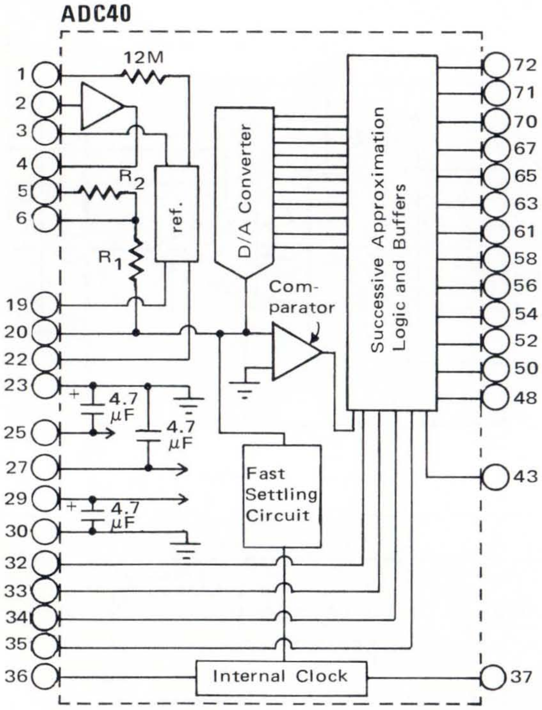
Connector: 2401MC





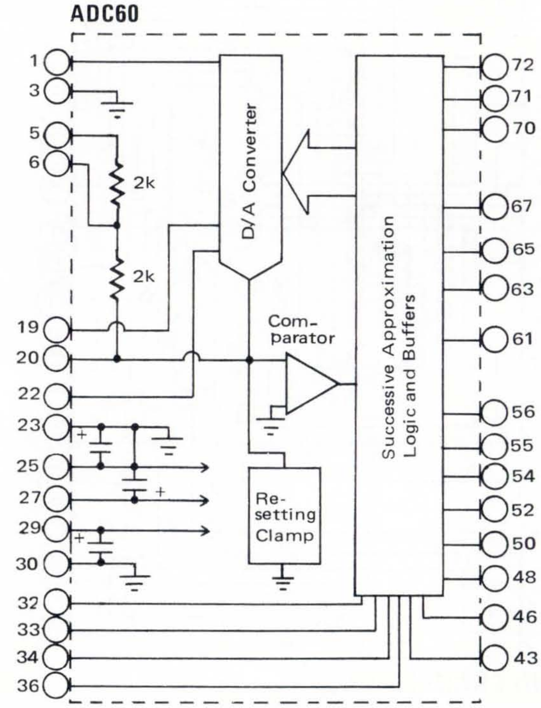
CONNECTION DIAGRAMS

A



TOP VIEWS

B



PIN CONNECTIONS

ADC40

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)

*Not connected for 10-bit models.

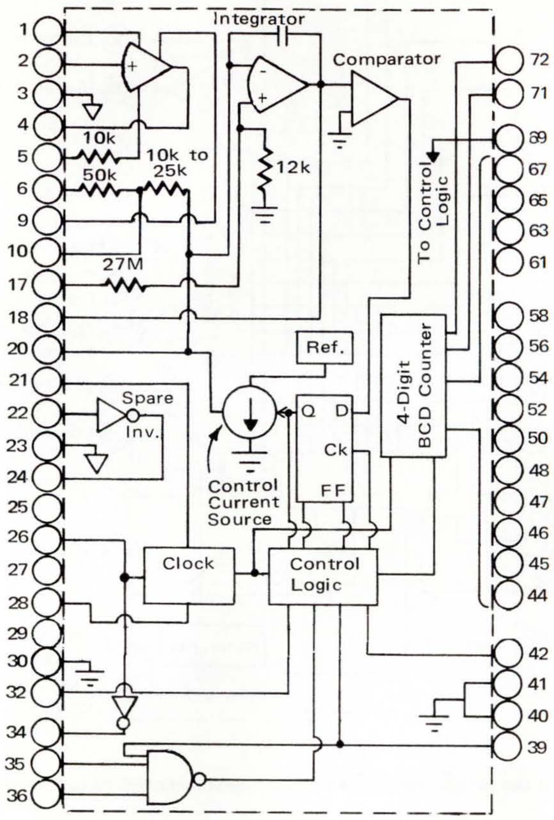
ADC60

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 (2)
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 (3)
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 (1)	72	Bit 1 (MSB)

(1) LSB - 12 bit models
(2) LSB - 10 bit models
(3) LSB - 8 bit models

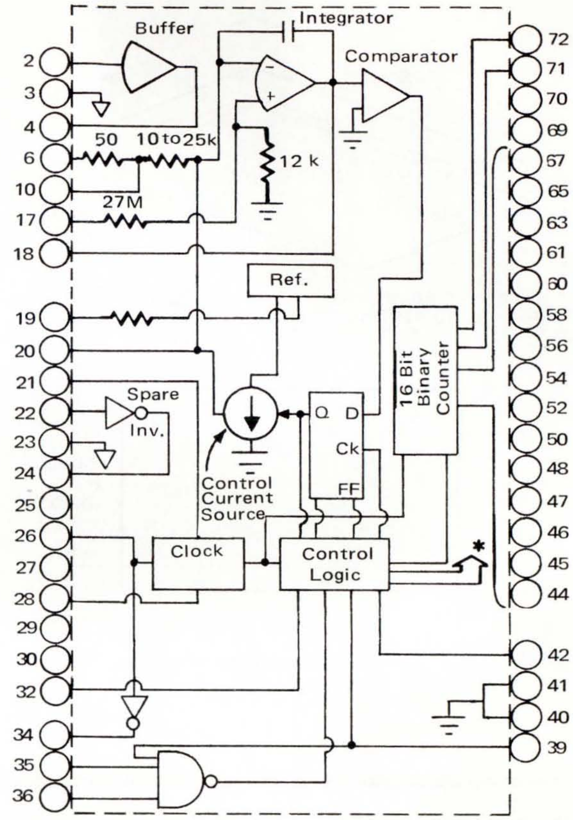
CONNECTION DIAGRAMS

ADC100 (BCD & SMD)



TOP VIEWS

ADC100 (USB & BOB)



* To pins 60, 69 & 70

PIN CONNECTIONS

ADC100 (BCD & SMD)

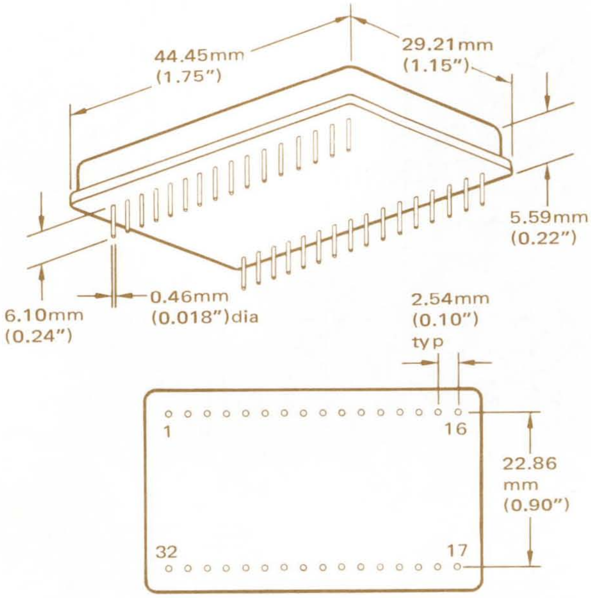
1	-Adjust	37	No Connection
2	Buffer In	38	No Connection
3	An Com.	39	End of Convert
4	Buffer Out	40	Dig. Common
5	-Adjust	41	Dig. Common
6	Unbuff. In	42	Term. In
7	No Connection	43	No Connection
8	No Connection	44	Bit 16
9	Sign. Out	45	Bit 15
10	Gain Adjust	46	Bit 14
11	No Connection	47	Bit 13
12	No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

ADC100 (USB & BOB)

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

26

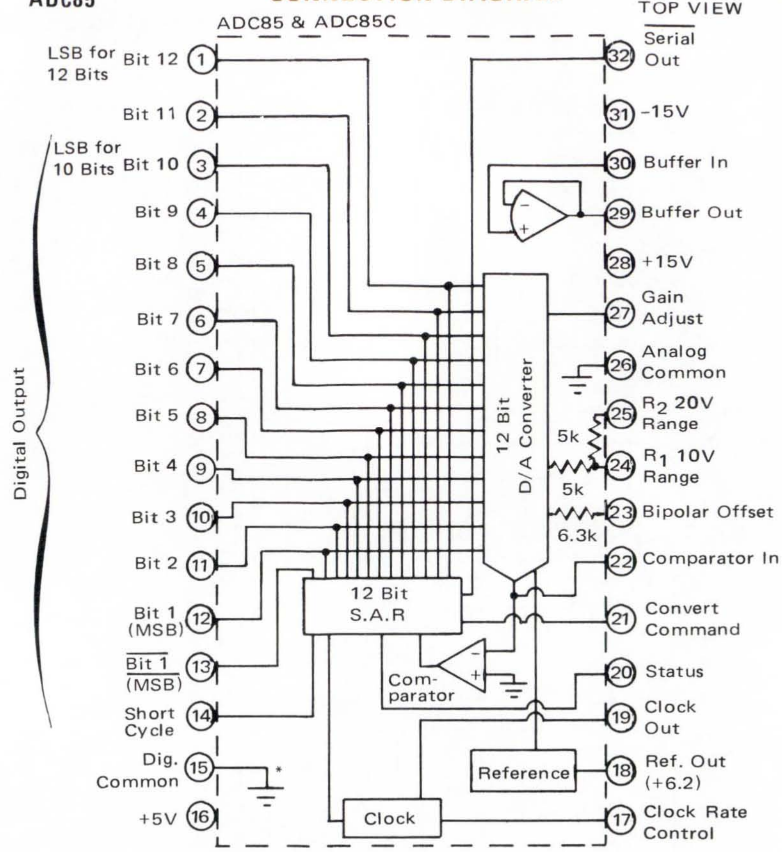
Connector: 2302MC



BOTTOM VIEW

ADC85

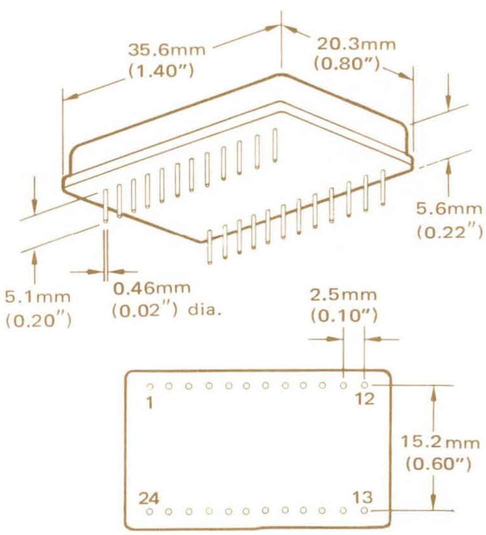
CONNECTION DIAGRAM



* Digital Common is internally connected to case.

27

Connector: 0245MC

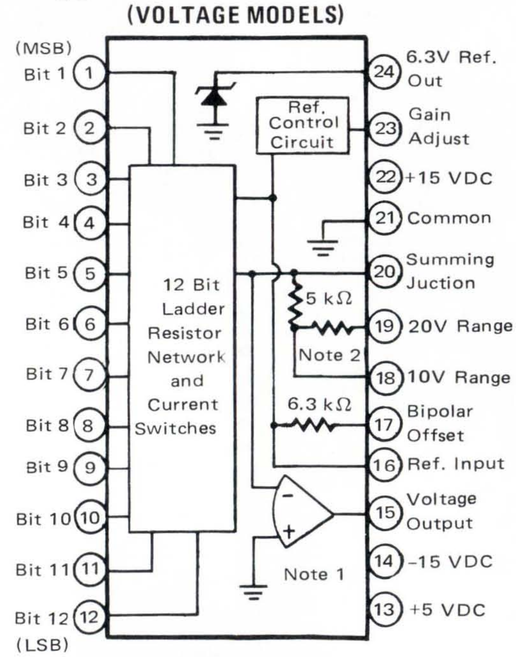


BOTTOM VIEW

A

DAC85
(VOLTAGE MODELS)

TOP VIEW

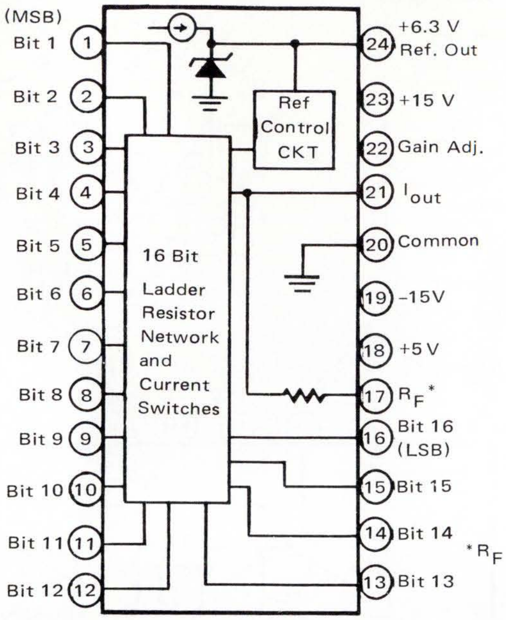


Note 1: Amplifier not included in current output models.

Note 2: 3 kΩ for CCD models
5 kΩ for CBI models

B DAC70

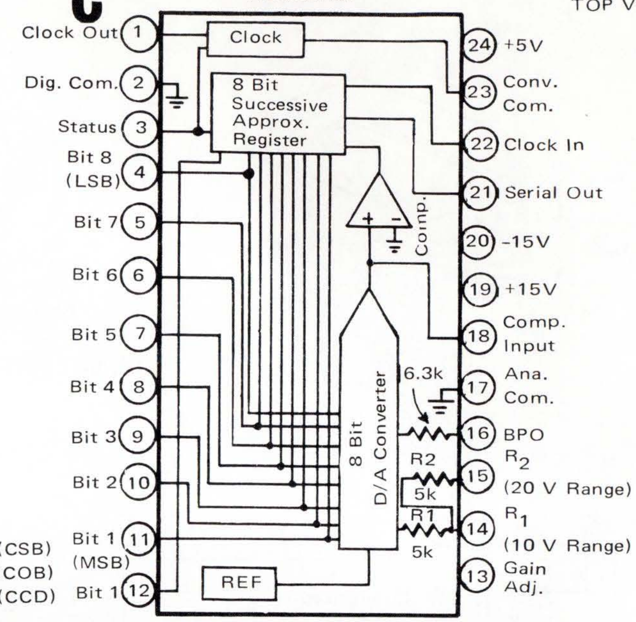
TOP VIEW



*R_F = 5k (CSB)
10k (COB)
8k (CCD)

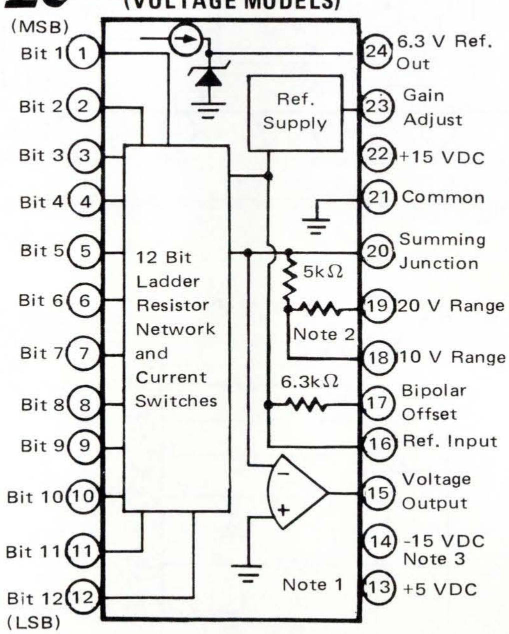
C ADC82AM

TOP VIEW



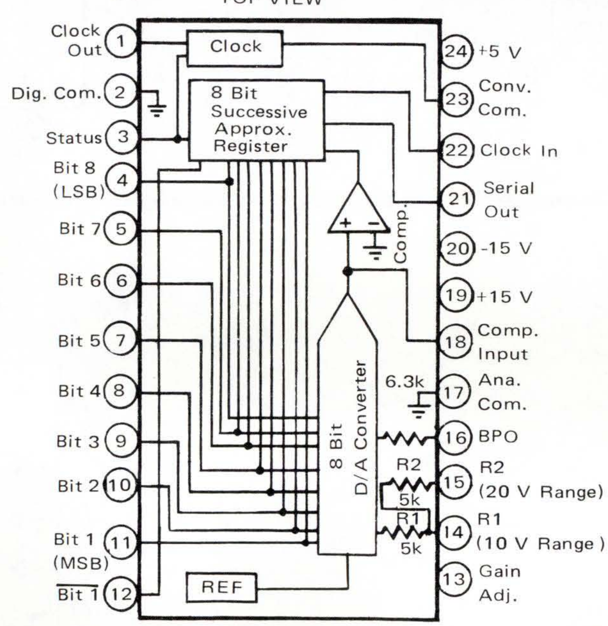
28 A DAC80 **(VOLTAGE MODELS)**

TOP VIEW



B ADC82AG

TOP VIEW



C 4127

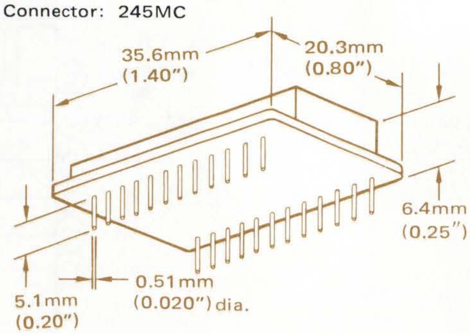
1 I_{Ref} Output
2 I_{Ref} Input
4 +I Input
5 Current Inverter Output
7 Current Inverter Input
9 Op Amp +Input
10 Op Amp −Input
11 Op Amp Output
13 Make No Connection
14 Negative Supply
18 Log Output
19 Gain Adjust
21 Common
22 Positive Supply
23 I_{Ref} Bias

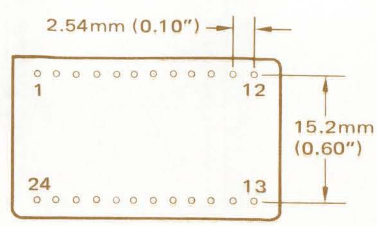
*No Pin on 3,6,8,12,15,16,17,20,24

Note 1: Amplifier not included in current output models.
Note 2: 3kΩ for CCD models
5kΩ for CBI models
Note 3: +5 V supply input may be connected to +5 V supply if +5 V supply is not available

This will increase internal power dissipation by 200 mW.

Connector: 245MC



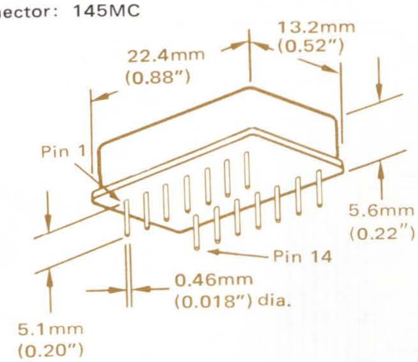


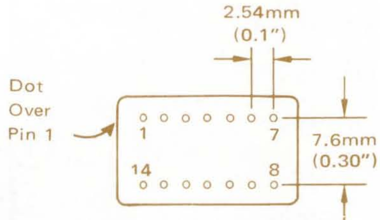
BOTTOM VIEW

Case: Black Ceramic

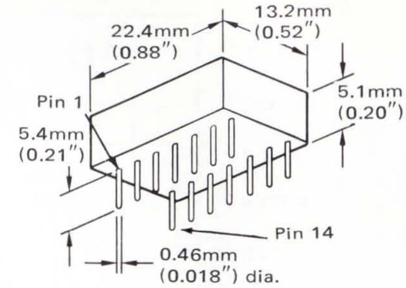
29

Connector: 145MC





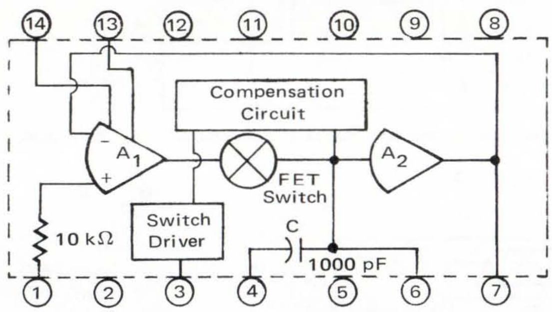
BOTTOM VIEW
Pin Spacing: 2.5mm (0.1")
Row Spacing: 7.6mm (0.3")



CONNECTION DIAGRAMS

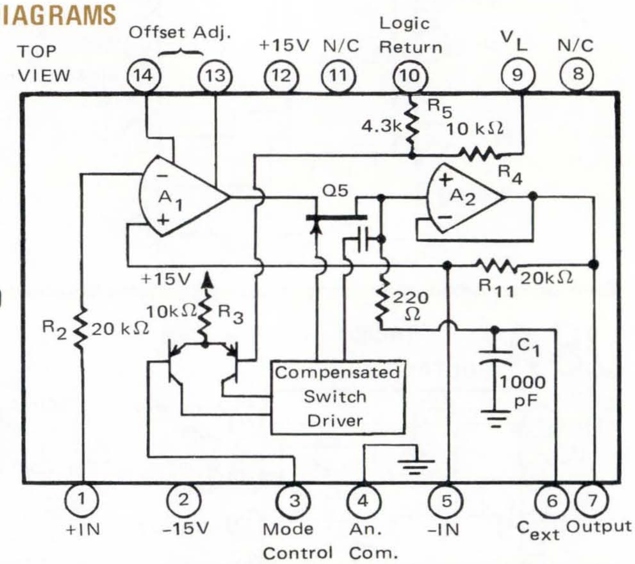
A

SHC85



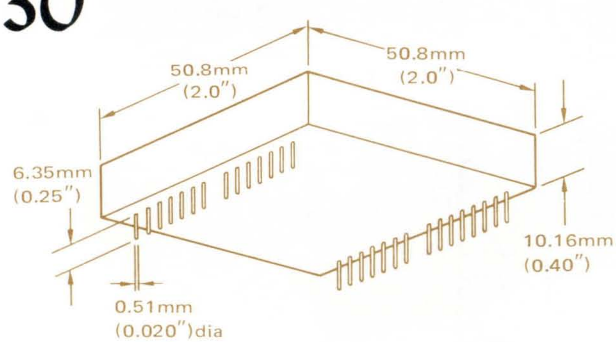
B

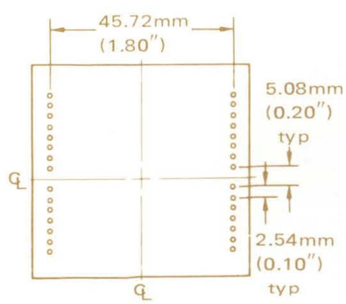
SHC80



30

Connector: 2302MC



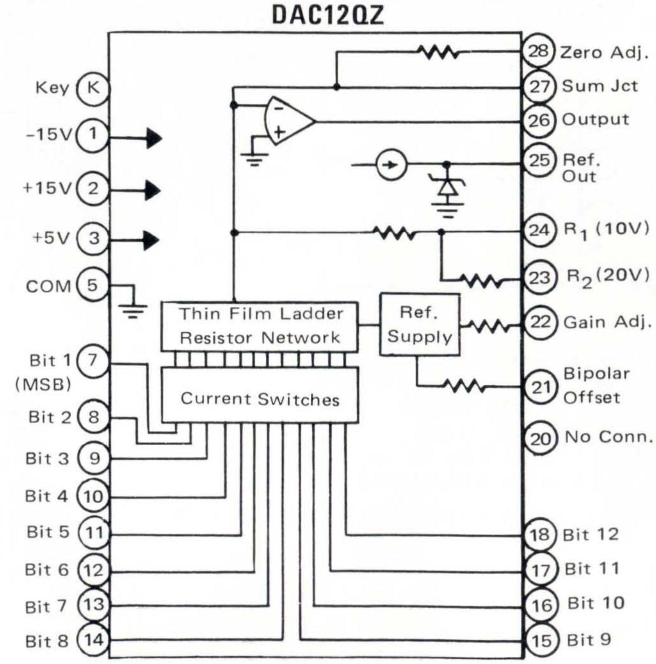


BOTTOM VIEW

A

CONNECTION DIAGRAMS

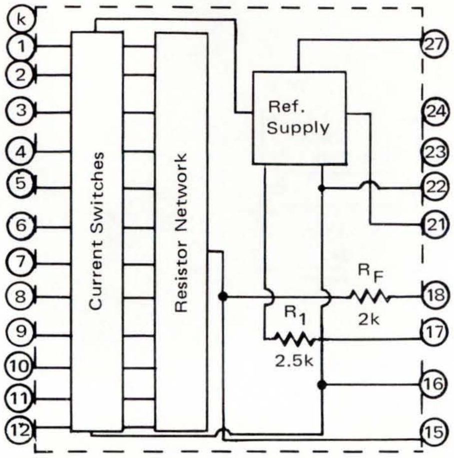
DAC12QZ



TOP VIEW

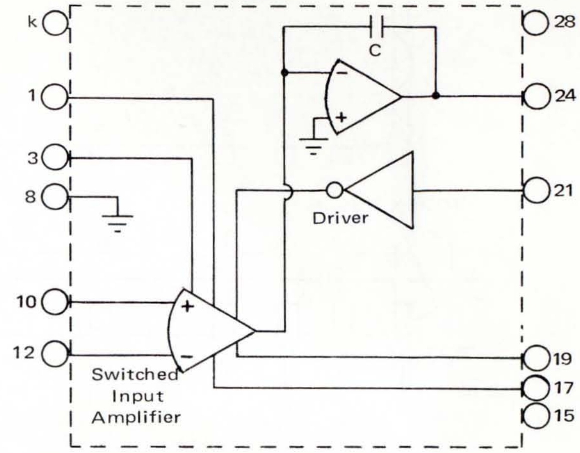
B

DAC60



C

SHM60



TOP VIEWS

PIN CONNECTIONS

DAC60

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

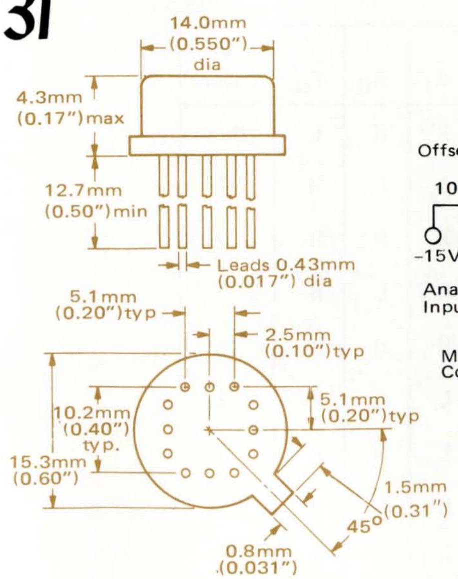
PIN CONNECTIONS

SHM60

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

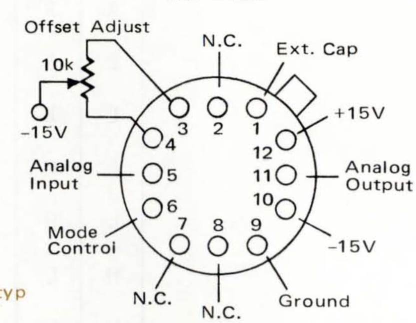
31

Connector: None



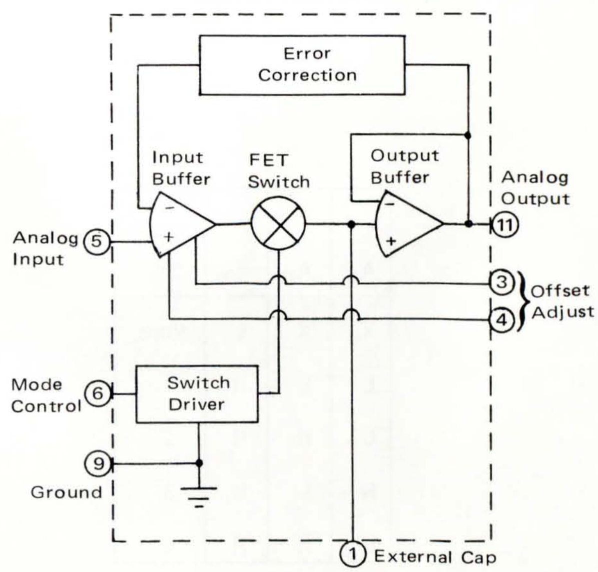
PIN CONFIGURATION

TOP VIEW



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

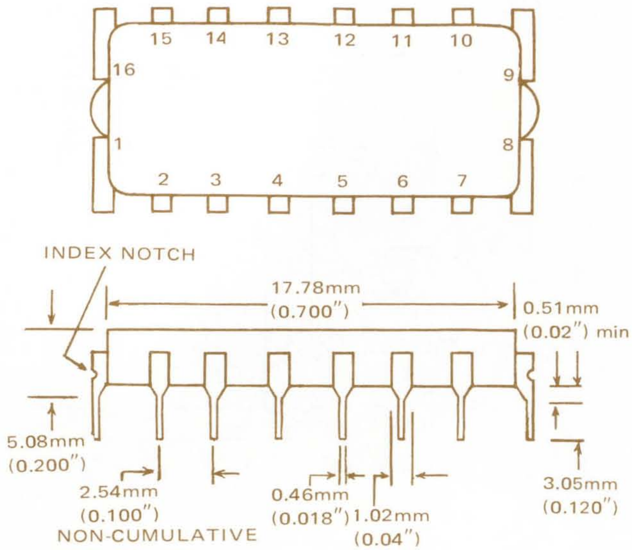
CONNECTION DIAGRAM SHC23

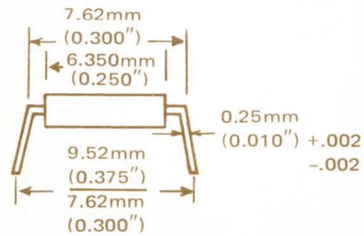


32

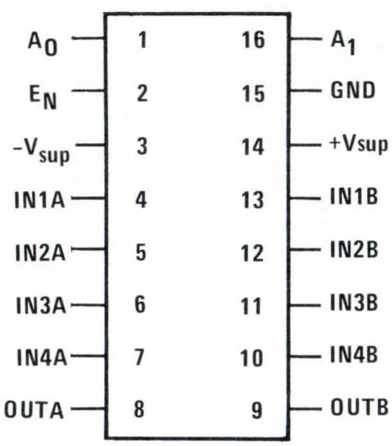
MPC4D AND MPC8S

16 Pin Ceramic Lead Frame TOP VIEW Connector: None

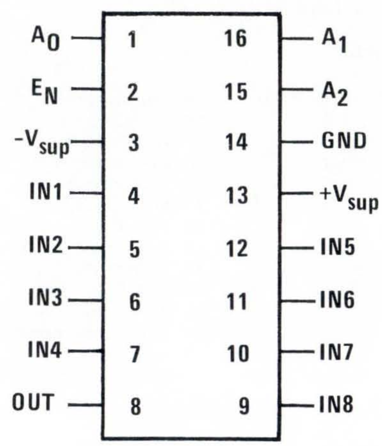




MPC4D



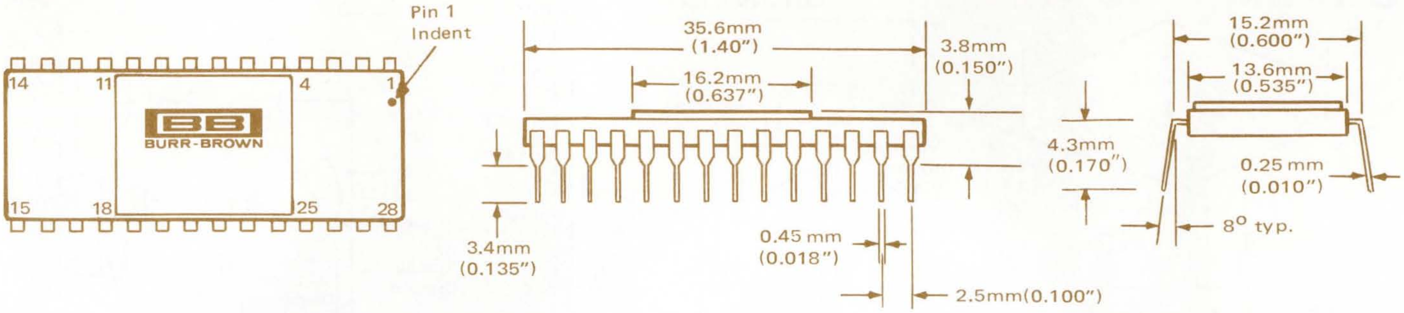
MPC8S



A_1	A_0	E_N	On Switch Pair
X	X	L	None
L	L	H	1
L	H	H	2
H	L	H	3
H	H	H	4

A_2	A_1	A_0	E_N	"On" Channel
X	X	X	L	None
L	L	L	H	1
L	L	H	H	2
L	H	L	H	3
L	H	H	H	4
H	L	L	H	5
H	L	H	H	6
H	H	L	H	7
H	H	H	H	8

33 Connector: None



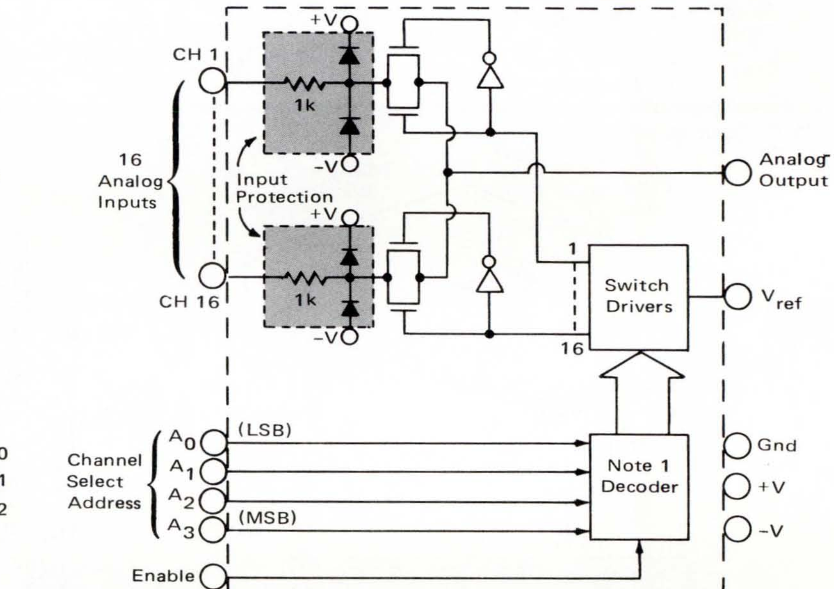
MPC16S PIN CONFIGURATION

A

TOP VIEW

+V Supply	1	28	Out
NC	2	27	-V Supply
NC	3	26	IN 8
IN 16	4	25	IN 7
IN 15	5	24	IN 6
IN 14	6	23	IN 5
IN 13	7	22	IN 4
IN 12	8	21	IN 3
IN 11	9	20	IN 2
IN 10	10	19	IN 1
IN 9	11	18	Enable
GND	12	17	Address A_0
V_{ref}	13	16	Address A_1
Address A_3	14	15	Address A_2

CONNECTION DIAGRAM



(1) Inputs protected

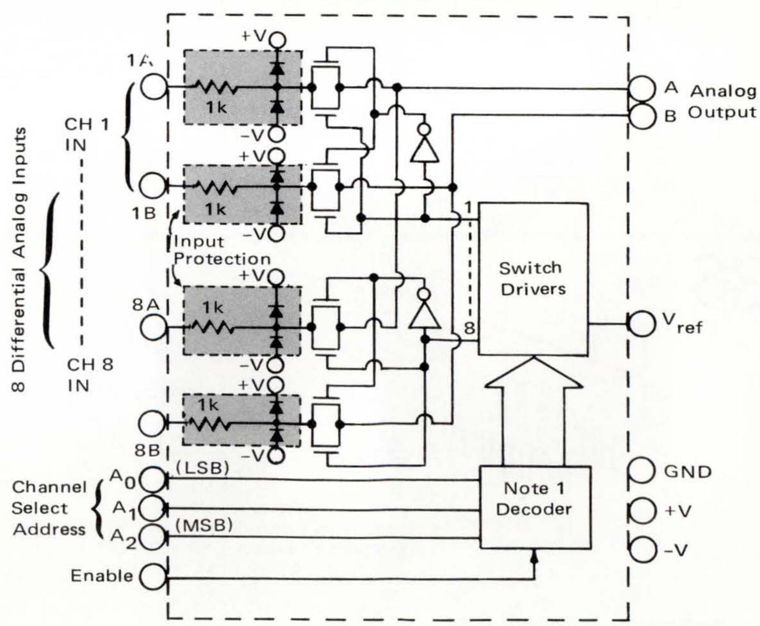
MPC8D PIN CONFIGURATION

B

TOP VIEW

+V Supply	1	28	Out A
Out B	2	27	$-V_{supply}$
NC	3	26	IN 8A
IN 8B	4	25	IN 7A
IN 7B	5	24	IN 6A
IN 6B	6	23	IN 5A
IN 5B	7	22	IN 4A
IN 4B	8	21	IN 3A
IN 3B	9	20	IN 2A
IN 2B	10	19	IN 1A
IN 1B	11	18	Enable
GND	12	17	Address A_0
V_{ref}	13	16	Address A_1
NC	14	15	Address A_2

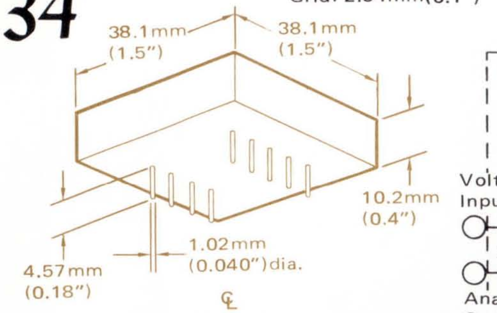
CONNECTION DIAGRAM

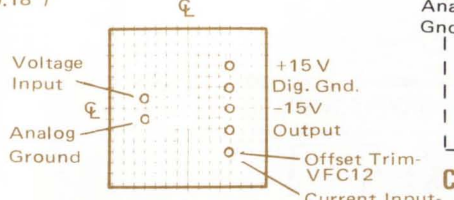


(1) Inputs protected.

34

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

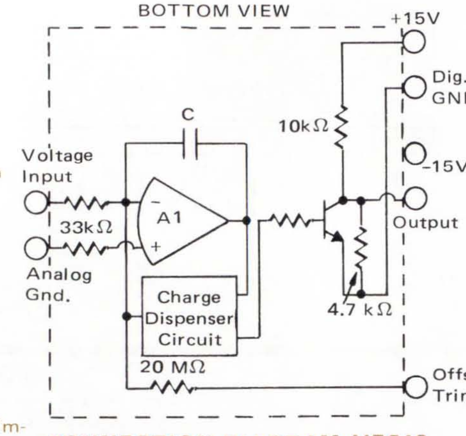




BOTTOM VIEW

A

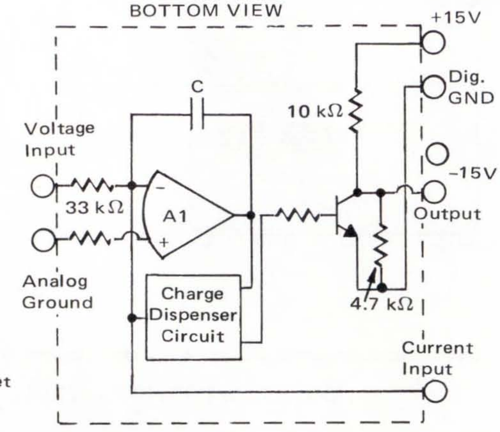
BOTTOM VIEW



CONNECTION DIAGRAM-VFC12

B

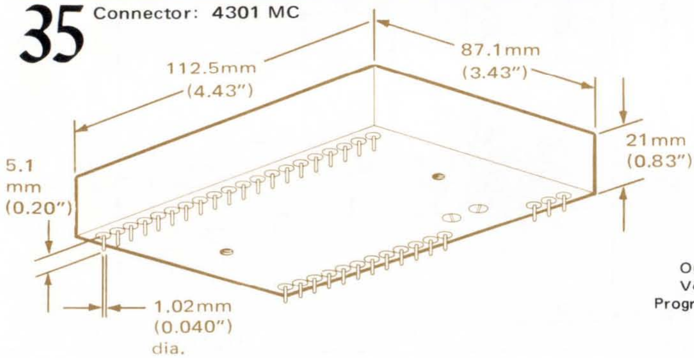
BOTTOM VIEW

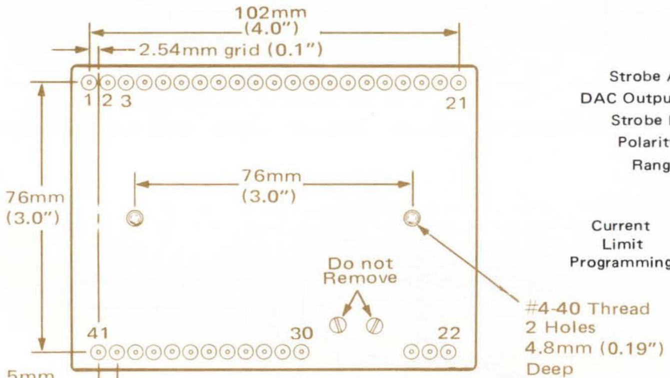


CONNECTION DIAGRAM- VFC15

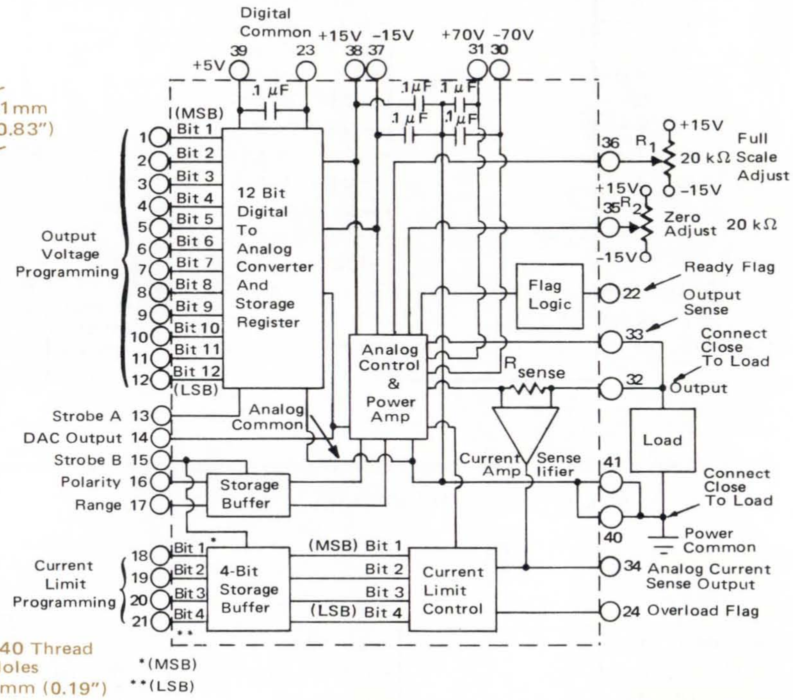
35

Connector: 4301 MC





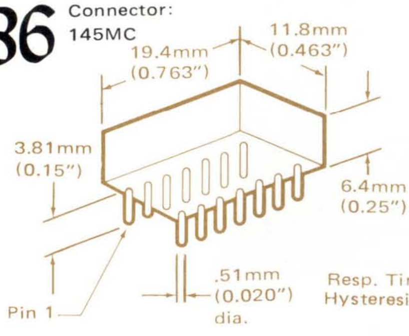
BOTTOM VIEW

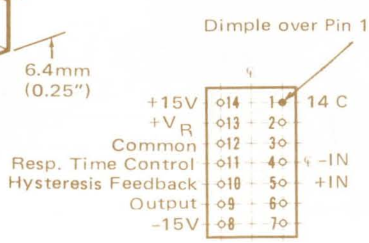


CONNECTION DIAGRAM – 4800 and 4801

36

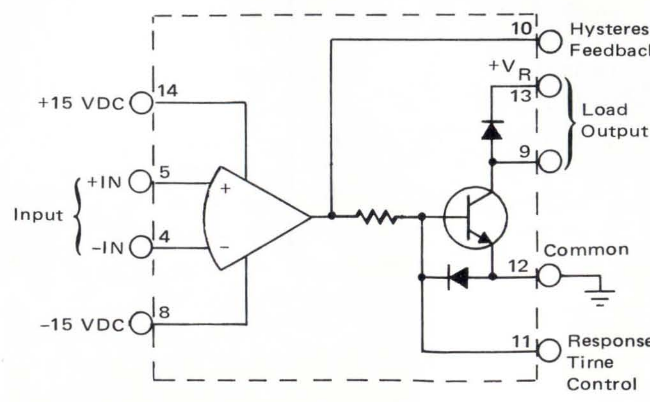
Connector:
145MC





BOTTOM VIEW

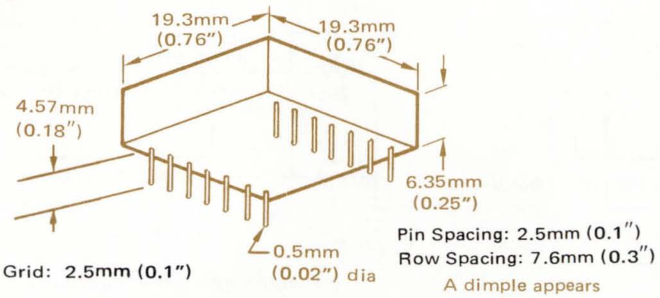
Pin Spacing: 2.5mm (0.1")
Row Spacing: 7.6mm (0.3")



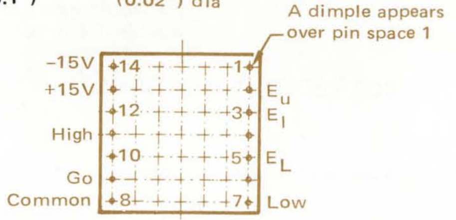
CONNECTION DIAGRAM – 4082/03

37

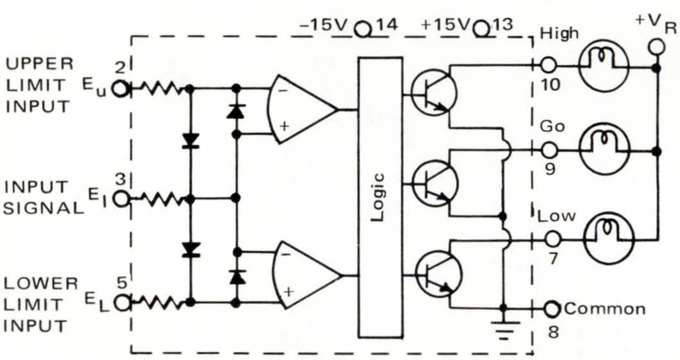
Connector: 245MC



Grid: 2.5mm (0.1")



BOTTOM VIEW



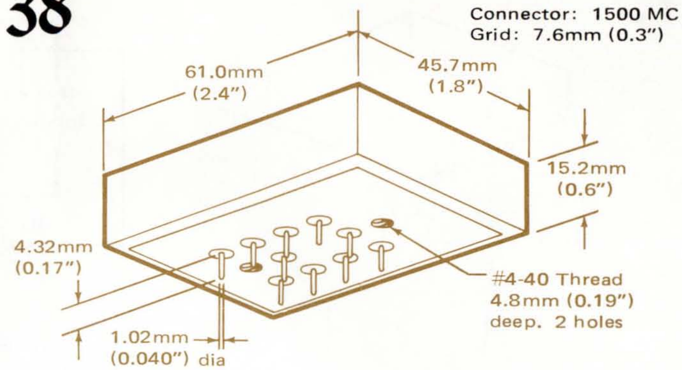
CONNECTION DIAGRAM – 4115/04

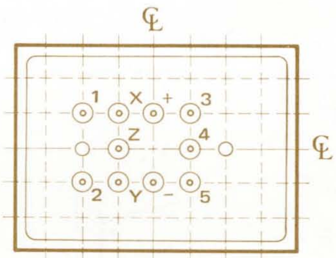
	$E_u < E_I$	$E_L < E_I < E_u$	$E_I < E_L$
HIGH	ON	OFF	OFF
GO	OFF	ON	OFF
LOW	OFF	OFF	ON

TRANSFER CHARACTERISTICS–4115/04

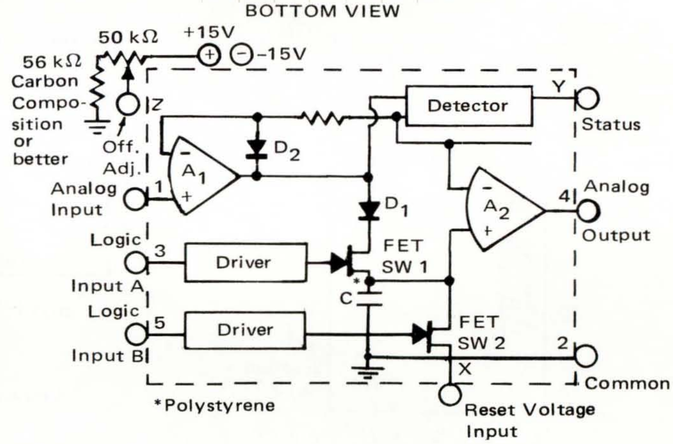
38

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





BOTTOM VIEW



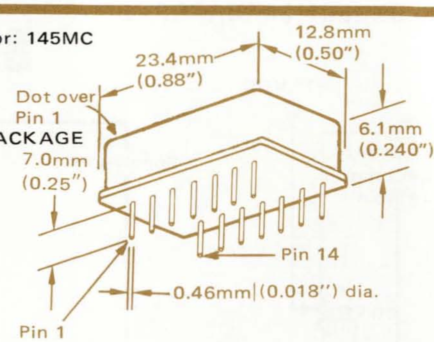
CONNECTION DIAGRAM – 4084/25

39

Connector: 145MC

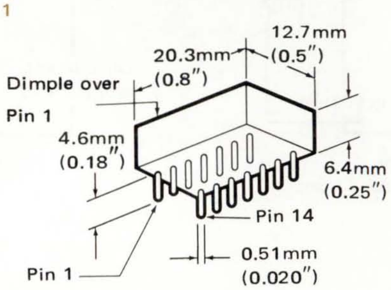
HERMETIC PACKAGE

UAF11H,
UAF15H,
UAF21H,
UAF25H



EPOXY PACKAGE

UAF11,
UAF15,
UAF21,
UAF25



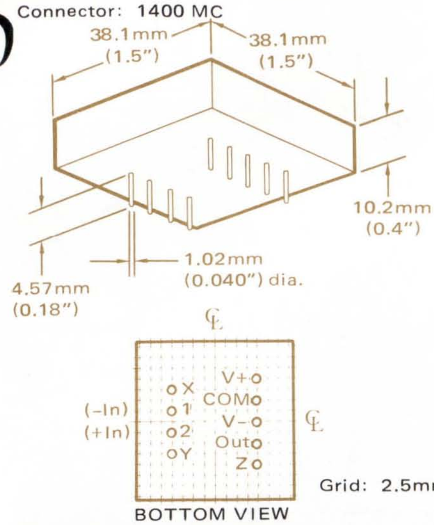
PIN CONNECTIONS

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

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

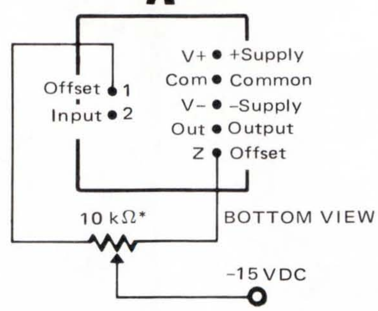
40

Connector: 1400 MC



Grid: 2.5mm (0.1")

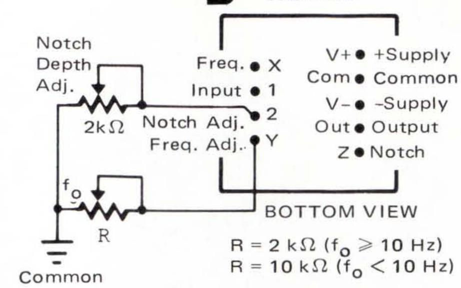
A



*For untrimmed operation leave adjustment pins open.

2 Pole Low Pass

B TRIMMED



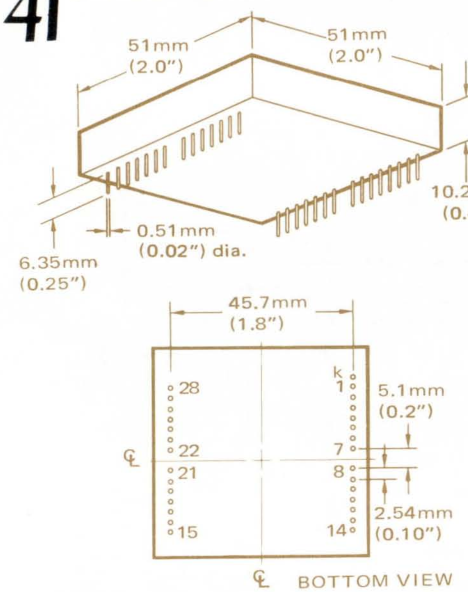
For untrimmed operation, leave pin 2 and pin Y open while tying pin X and pin Z to ground.

Band Reject

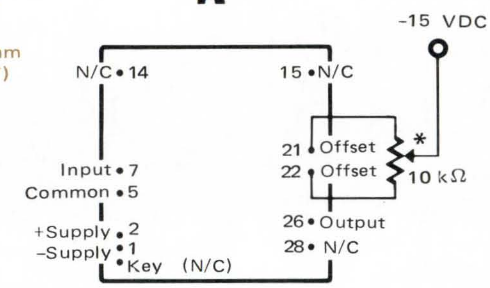
CONNECTION DIAGRAMS

41

Connector: 2302MC



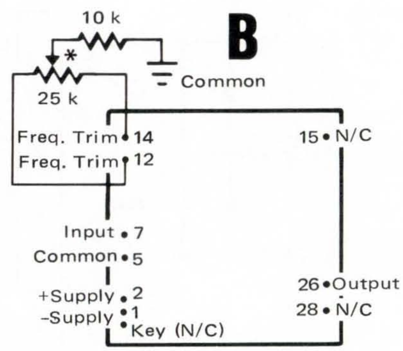
A



BOTTOM VIEW

4 Pole Low Pass

B



BOTTOM VIEW

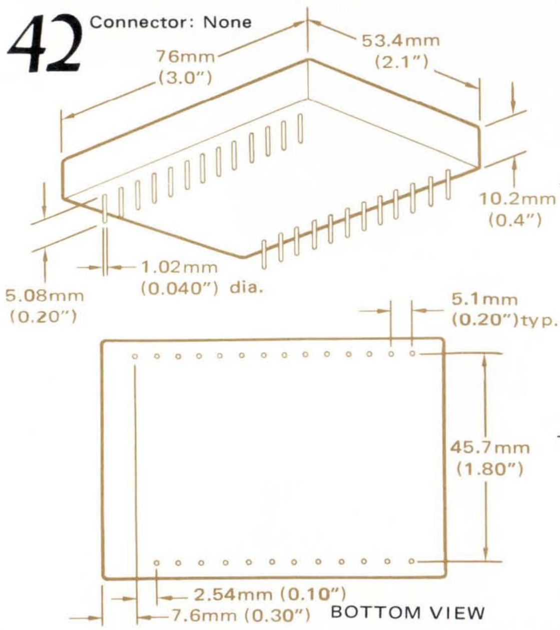
*For untrimmed operation leave adjustment pins open.

2 Pole Band Pass

CONNECTION DIAGRAMS

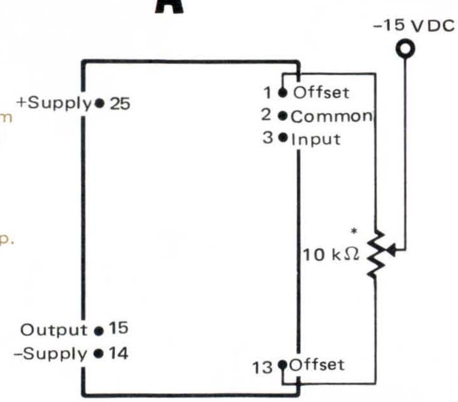
42

Connector: None



CONNECTION DIAGRAMS

A

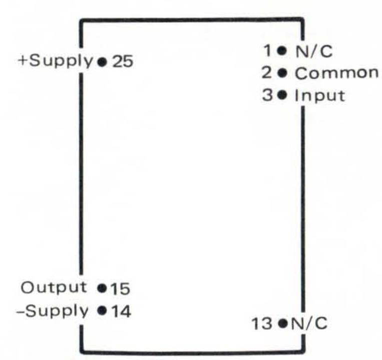


BOTTOM VIEW

* For untrimmed operation leave adjustment pins open.

6 and 8 Pole Low Pass

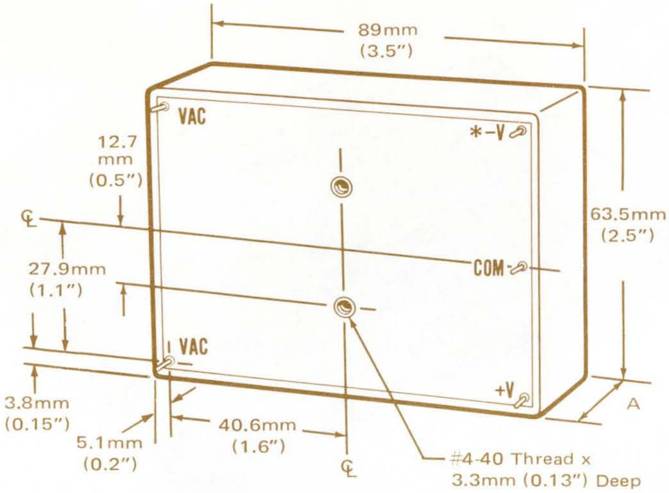
B



BOTTOM VIEW

4 Pole Band Pass

43 Connector: 548 MC

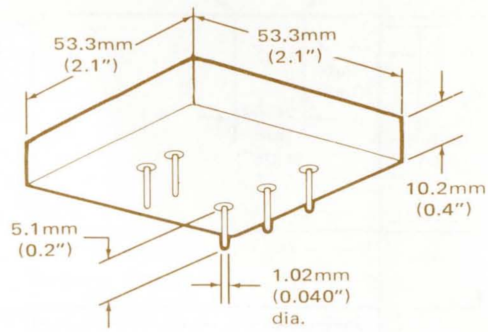


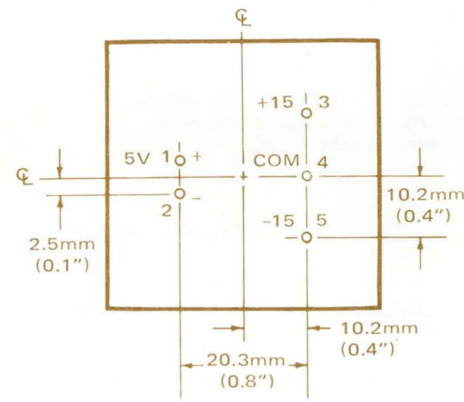
Pin Dia.: 1.02mm (.04")
*No connection for Models 550, 561, 562.

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

44 Connector: 1400 MC

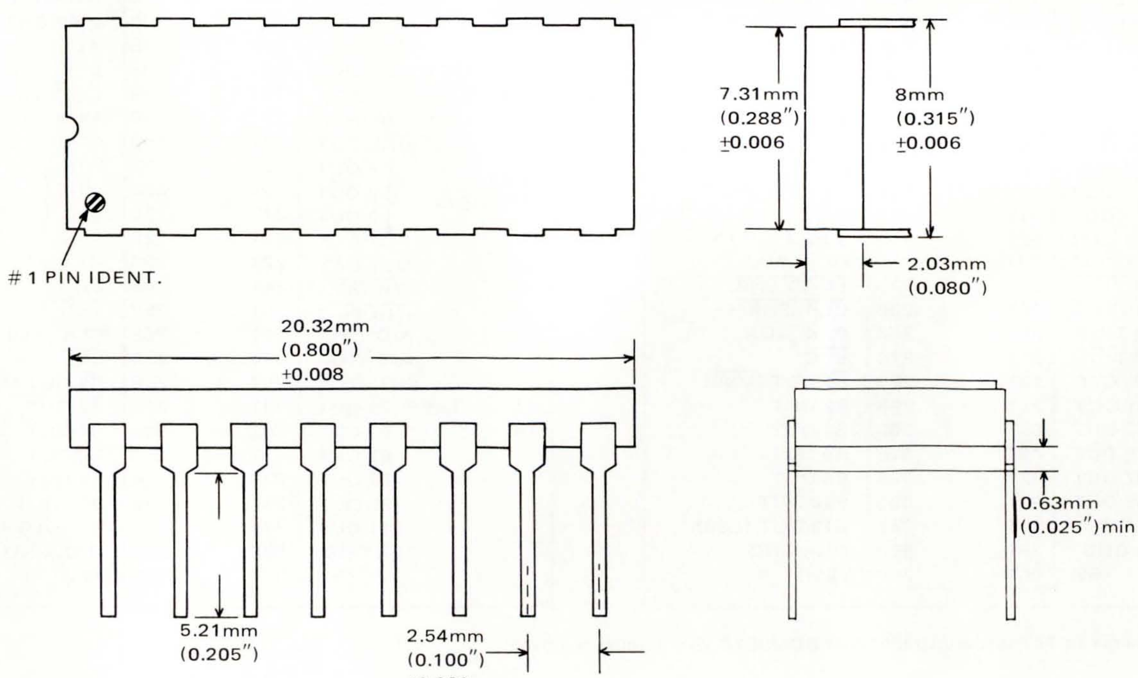
546





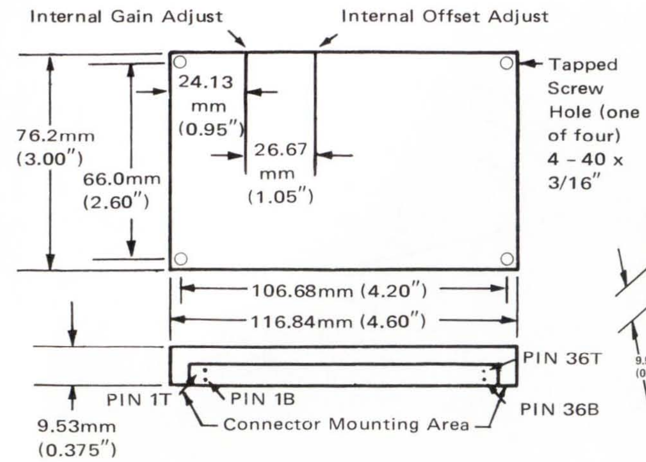
BOTTOM VIEW

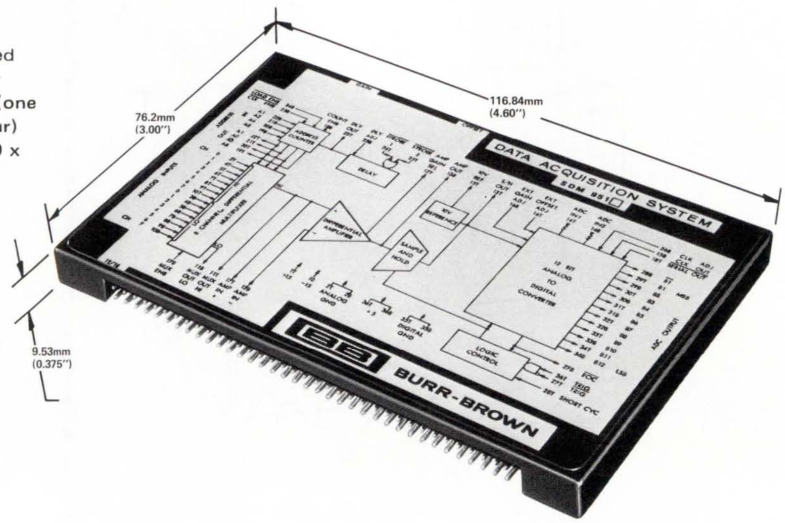
45 DAC90



46

SDM850/851, MXP320/321





MATING CONNECTOR: 7200MC
CASE MATERIAL: INSULATED STEEL
CONNECTOR PINS: GOLD FLASHED
WEIGHT: 200 GRAMS (7 OZ.)

PACKAGE AND PIN CONFIGURATIONS

SDM850 CONNECTOR PIN DIAGRAM

+15V	1T	1B	-15V
ANA. GND.	2T	2B	ANA. GND.
CH 0 IN	3T	3B	CH 8 IN
CH 1 IN	4T	4B	CH 9 IN
CH 2 IN	5T	5B	CH 10 IN
CH 3 IN	6T	6B	CH 11 IN
CH 4 IN	7T	7B	CH 12 IN
CH 5 IN	8T	8B	CH 13 IN
CH 6 IN	9T	9B	CH 14 IN
CH 7 IN	10T	10B	CH 15 IN
MUX OUT	11T	11B	N/C
RANGE SEL	12T	12B	AMP IN LO
S & H OUT	13T	13B	AMP OUT
ADC IN 1	14T	14B	ADC IN 2
+10V REF. OUT	15T	15B	CLK OUT
EXT. OFFSET ADJ.	16T	16B	GAIN ADJ.
* AMP IN HI	17T	17B	MUX ENB.
SERIAL OUT	18T	18B	COUNT ENB.
MUX ADDRESS LINES: 8 OUT	19T	19B	8 IN (MUX ADDRESS LINES)
4 OUT	20T	20B	4 IN
2 OUT	21T	21B	2 IN
1 OUT	22T	22B	1 IN
DLY OUT	23T	23B	DLY. ADJ.
STROBE 1	24T	24B	LOAD ENB.
STROBE 2	25T	25B	CLR. ENB.
A/D TRIG	26T	26B	CLK. ADJ.
A/D TRIG	27T	27B	EOC
SHT. CYC.	28T	28B	B1 OUT (MSB)
(MSB) B1 OUT	29T	29B	B2 OUT
B3 OUT	30T	30B	B4 OUT
B5 OUT	31T	31B	B6 OUT
B7 OUT	32T	32B	B8 OUT
B9 OUT	33T	33B	B10 OUT
B11 OUT	34T	34B	B12 OUT (LSB)
DIG. GND.	35T	35B	DIG. GND.
+5V	36T	36B	+5V

SDM851 CONNECTOR PIN DIAGRAM

+15V	1T	1B	-15V
ANA. GND.	2T	2B	ANA. GND.
CH 0 IN	3T	3B	CH 0 RTN
CH 1 IN	4T	4B	CH 1 RTN
CH 2 IN	5T	5B	CH 2 RTN
CH 3 IN	6T	6B	CH 3 RTN
CH 4 IN	7T	7B	CH 4 RTN
CH 5 IN	8T	8B	CH 5 RTN
CH 6 IN	9T	9B	CH 6 RTN
CH 7 IN	10T	10B	CH 7 RTN
MUX HI OUT	11T	11B	MUX LO OUT
RANGE SEL	12T	12B	AMP IN LO
S & H OUT	13T	13B	AMP OUT
ADC IN 1	14T	14B	ADC IN 2
+10V REF. OUT	15T	15B	CLK. OUT
EXT. OFFSET ADJ.	16T	16B	GAIN ADJ.
* AMP IN HI	17T	17B	MUX ENB.
SERIAL OUT	18T	18B	COUNT ENB.
MUX ADDRESS LINES: 8 OUT	19T	19B	8 IN (MUX ADDRESS LINES)
4 OUT	20T	20B	4 IN
2 OUT	21T	21B	2 IN
1 OUT	22T	22B	1 IN
DLY OUT	23T	23B	DLY ADJ.
STROBE 1	24T	24B	LOAD ENB.
STROBE 2	25T	25B	CLR. ENB.
A/D TRIG	26T	26B	CLK. ADJ.
A/D TRIG	27T	27B	EOC
SHT. CYC.	28T	28B	B1 OUT (MSB)
(MSB) B1 OUT	29T	29B	B2 OUT
B3 OUT	30T	30B	B4 OUT
B5 OUT	31T	31B	B6 OUT
B7 OUT	32T	32B	B8 OUT
B9 OUT	33T	33B	B10 OUT
B11 OUT	34T	34B	B12 OUT (LSB)
DIG. GND.	35T	35B	DIG. GND.
+5V	36T	36B	+5V

* Internally jumpered to 17T (order SDM850A or SDM851A with jumper removed).

MXP321 CONNECTOR PIN DIAGRAM

	+15V	1T	1B	-15V	
	ANA. GND.	2T	2B	ANA. GND.	
ANALOG INPUTS	CH 0	3T	3B	CH 16	ANALOG INPUTS
	1	4T	4B	17	
	2	5T	5B	18	
	3	6T	6B	19	
	4	7T	7B	20	
	5	8T	8B	21	
	6	9T	9B	22	
	CH 7	10T	10B	CH 23	
	MUX 0 - 15 OUT	11T	11B	MUX 16 - 31 OUT	
ADDRESS IN	A16	12T	12B	N/C	
	A32	13T	13B	N/C	
ANALOG INPUTS	CH 8	14T	14B	CH 24	ANALOG INPUTS
	9	15T	15B	25	
	10	16T	16B	26	
	11	17T	17B	27	
	12	18T	18B	28	
	13	19T	19B	29	
	14	20T	20B	30	
	CH15	21T	21B	CH 31	
	ADDR. DET. IN	22T	22B	ADDR. DET. IN	
		23T	23B		
	0 - 15 ENABLE	24T	24B	16 - 31 ENABLE	
	ADDR. DET. IN	25T	25B	ADDR. DET. IN	
		26T	26B		
	16 - $\overline{32}$	27T	27B	$\overline{16}$ - 32	
	16 - $\overline{32}$	28T	28B	CARRY	
ADDRESS IN	A1	29T	29B	A1	ADDRESS OUT
	A2	30T	30B	A2	
	A4	31T	31B	A4	
	A8	32T	32B	A8	
	ADDR. DET. OUT	33T	33B	CLOCK IN	
	$\overline{\text{LOAD ENB.}}$	34T	34B	$\overline{\text{CLEAR ENB.}}$	
	DIG. GND.	35T	35B	DIG. GND.	
	+5V	36T	36B	+5V	

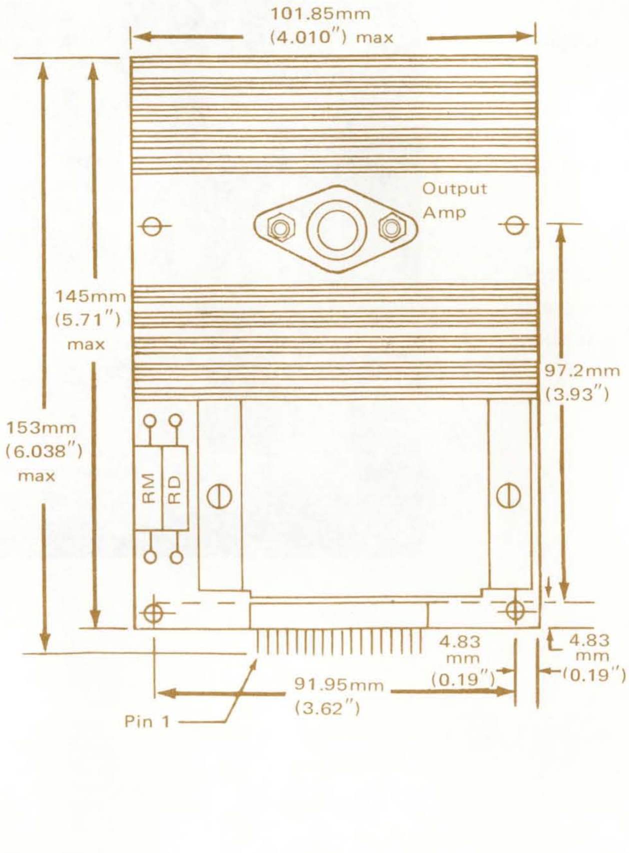
MXP320 CONNECTOR PIN DIAGRAM

	+15V	1T	1B	-15V	
	GND.	2T	2B	GND.	
ANALOG INPUTS	CH 0	3T	3B	CH 16	ANALOG INPUTS
	1	4T	4B	17	
	2	5T	5B	18	
	3	6T	6B	19	
	4	7T	7B	20	
	5	8T	8B	21	
	6	9T	9B	22	
	CH 7	10T	10B	CH 23	
	MUX 0 - 15 OUT	11T	11B	MUX 16- 31 OUT	
	N/C	12T	12B	N/C	
	N/C	13T	13B	N/C	
ANALOG INPUTS	CH 8	14T	14T	CH 24	ANALOG INPUTS
	9	15T	15B	25	
	10	16T	16B	26	
	11	17T	17B	27	
	12	18T	18B	28	
	13	19T	19B	29	
	14	20T	20B	30	
	CH15	21T	21B	CH 31	
	N/C	22T	22B	N/C	
	N/C	23T	23B	N/C	
	0 - 15 ENABLE	24T	24B	16 - 31 ENABLE	
	N/C	25T	25B	N/C	
	N/C	26T	26B	N/C	
	N/C	27T	27B	N/C	
	N/C	28T	28B	N/C	
	N/C	29T	29B	A1	ADDRESS OUT
	N/C	30T	30B	A2	
	N/C	31T	31B	A4	
	N/C	32T	32B	A8	
	N/C	33T	33B	N/C	
	N/C	34T	34B	N/C	
	GND.	35T	35B	GND.	
	N/C	36T	36B	N/C	

47

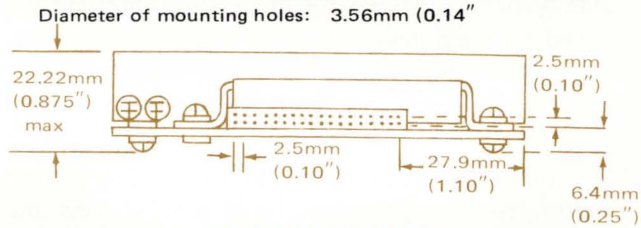
4804

TOP VIEW



Material: Extruded, black-anodized, aluminum heat sink and discrete components mounted on glass epoxy printed circuit board.

4804 Connector: 806MC
Recommended mating PC card: Amp 1 - 86063 - 5
Connectors: Flexible: Scotchflex 3417 - 0000
Diameter of mounting holes: 3.56mm (0.14″



PIN CONNECTIONS

BOTTOM	PIN	TOP
-35V	1	-35V
Output	2	Output
+35V	3	+35V
N/C	4	N/C
-15V	5	-15V
Ana. Com.	6	Ana. Com.
+15V	7	+15V
Ana. Com.	8	Ana. Com.
N/C	9	+30V Range
Offset Adj.	10	Range Adj.
Strobe	11	Gain Adj.
+5V	12	+5V
Dig. Com.	13	Dig. Com.
Bit 2	14	Bit 1
Bit 4	15	Bit 3
Bit 6	16	Bit 5
Bit 8	17	Bit 7
Bit 10	18	Bit 9
Bit 12	19	Bit 11

CORPORATE ORIENTATION AND EXPERTISE...

Over the past few years, Burr-Brown has emerged as a leading supplier of data conversion and signal conditioning components. With the introduction of several products that are new to this catalog, we have now begun a major thrust into data acquisition and data output systems. Our primary expertise lies in the interfacing of physical process signals to the computing or recording equipment used for monitoring and control. Our basic purpose is to help our customers to improve their productivity and lower their costs.

We have a well-established reputation for quality products that perform reliably, and we've earned it, through attention to details in design and manufacture and through a comprehensive quality assurance program. Our testing and screening capabilities are second to none and allow us to offer complex products with verified performance and reliability.

PRODUCT DEVELOPMENT...

Our production capabilities are also unique to our industry. They include thin-film, thick-film, and bipolar monolithic processing, automated and semi-automated laser trimming, and a comprehensive packaging capability. This ability to manufacture high performance components at low cost gives us an inherent advantage when we combine these components into more complex modules and systems.

We've introduced in excess of 30 new microcircuit products during the past 18 months, and already have combined many of these into higher level products addressing specific customer needs. The coming year will see the pace of innovation accelerating and will yield an even greater number of new and, we think, exciting products.

SERVICE . . .

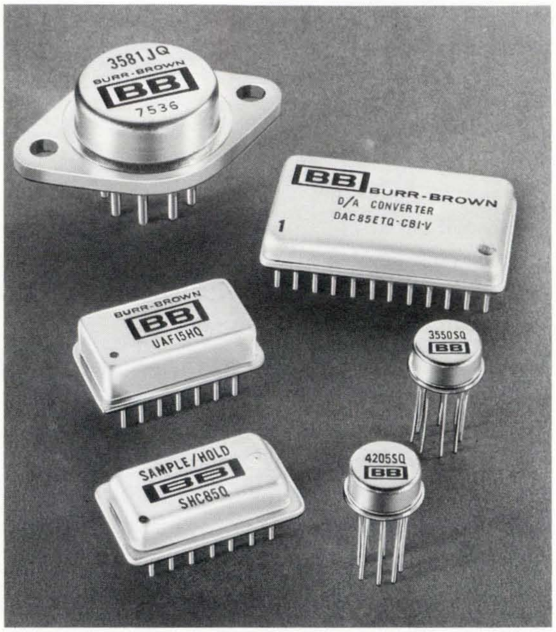
Because of our strong orientation to customer needs, we pride ourselves on the quality of our service. This manifests itself in several ways – competent and prompt applications assistance, rapid delivery of products, comprehensive product literature, and responsiveness to your request for special testing of products.

Our Tucson based applications engineering staff is as near to you as the telephone. Highly skilled 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. Detailed applications assistance is also available from our field sales offices in the New York, Chicago, Los Angeles, and San Francisco areas, the United Kingdom, France, Japan, and West Germany.

In addition to our field sales offices, we have 22 United States sales representative offices, and over 30 exclusive engineering representatives in as many countries around the globe serving over 5,000 customers.

We look forward to the opportunity of serving you.

HIGH RELIABILITY PROGRAMS



Burr-Brown's High Reliability Programs have been developed to meet the increasing need for extremely high product reliability – even beyond that offered by standard Burr-Brown integrated circuits. Such requirements are not limited to military and aerospace programs, but in fact are equally important in the control of industrial processes, medical patient monitoring, and in other applications where failure may be expensive or hazardous.

THE Q PROGRAM...

The reliability requirements of most applications can be met by subjecting standard Burr-Brown microcircuits to a program of additional reliability screening. This additional screening – The Burr-Brown Q Program – consists of a sequence of thermal and mechanical stress procedures, plus a verification of package hermeticity. Q screening is available for most of our monolithic and hybrid products in hermetic packages. The diagram below illustrates the screening sequence. This screening is applied to 100% of Q product candidates. Those which pass the sequence satisfactorily and meet all electrical specifications are then marked with a Q suffix (e.g. a 3521J which passes the Q sequence satisfactorily becomes a 3521JQ).

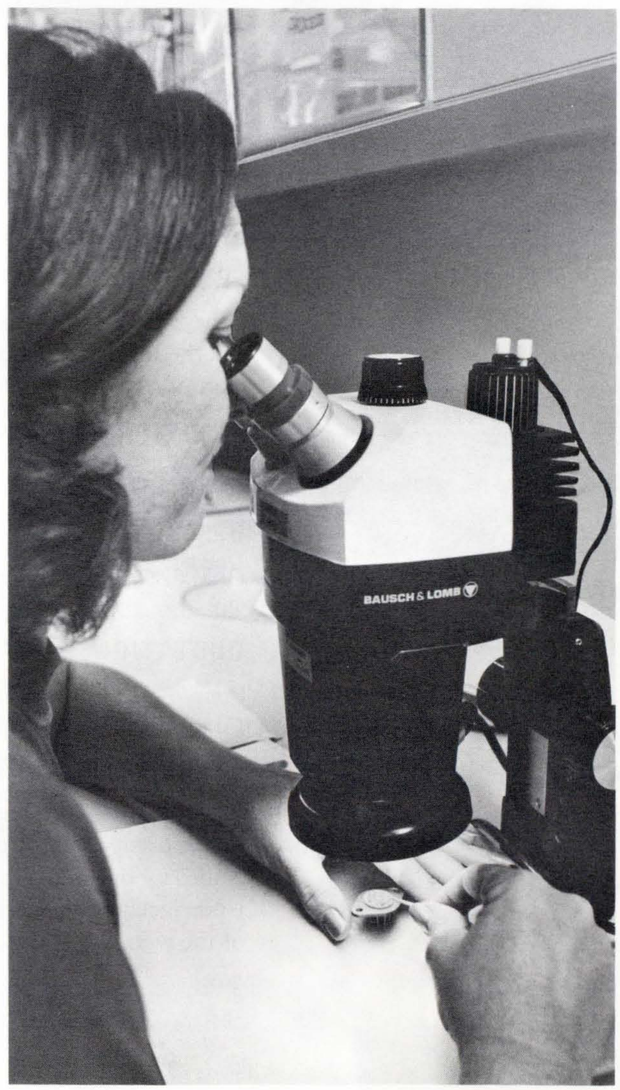
SCREENING SEQUENCE...

SCREEN		PROCEDURE
1	INTERNAL VISUAL INSPECTION (precap)	Burr-Brown QC4118 (copies available on request)
2	100% ELECTRICAL TEST (postcap)	Per appropriate Burr-Brown product data sheet
3	STABILIZATION BAKE	Mil-Std-883, Method 1008
4	TEMPERATURE CYCLING	Mil-Std-883, Method 1010
5	CONSTANT ACCELERATION (centrifuge)	Mil-Std-883, Method 2001
6	HERMETICITY, GROSS LEAK	Mil-Std-883, Method 1014
7	HERMETICITY, FINE LEAK	Mil-Std-883, Method 1014
8	BURN-IN	Mil-Std-883, Method 1015
9	FINAL ELECTRICAL TEST	Per appropriate Burr-Brown product data sheet

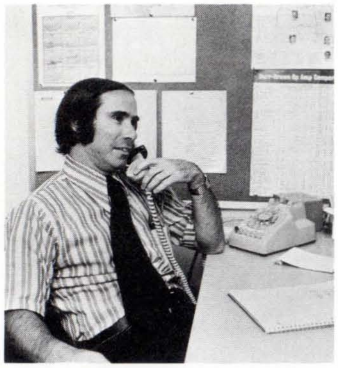
MIL-STD-883...

In addition to the Q program, Burr-Brown offers a smaller number of products built to the requirements of Mil-Std-883, for Class B devices. These products are assembled on a special production line devoted solely to high reliability products. Visual inspection procedures used are those specified in methods 2010.1 and 2017 of Mil-Std-883.

Minimum order sizes and lot set-up charges apply to products processed on this line. Contact your local Burr-Brown sales engineer for information on models available.



INTERFACING WITH BURR-BROWN



PLACING AN ORDER

Orders may be placed with any authorized Burr-Brown field sales representative, field sales office, or with our headquarters in Tucson via letter, telephone, TWX, or TELEX. 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.

TECHNICAL ASSISTANCE

Burr-Brown has a large and highly competent field sales force, backed up by an experienced staff of applications specialists. They will be most happy to assist you in selecting the right product for your application. This service is available, without charge, from all sales offices and from our headquarters in Tucson.

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.

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.

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.

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.

BURR-BROWN

SALES OFFICES

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

ILLINOIS, Addison (312) 832-6520

NEW YORK CITY (Metro), Great Neck (516) 466-2650

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

UNITED STATES REPRESENTATIVES

ALABAMA
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Tel: (205) 881-6220

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Burr-Brown Research Corp.
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ARKANSAS
(See Dallas, Texas)

CALIFORNIA (Northern)
Burr-Brown Research Corp.
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CALIFORNIA (Southern)
Burr-Brown Research Corp.
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(213) 941-7000

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Denver
Enterprise 6730 (toll free)

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MECO, Inc.
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(See Pennsylvania, Eastern)

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E.C. Electronics Sales, Inc.
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(See Massachusetts)

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Burr-Brown Research Corp.
Tel: (516) 466-2650

NEW JERSEY (Southern)
QED Electronics Inc.
Tel: (215) 925-8711

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Albuquerque
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Burr-Brown Research Corp.
Great Neck
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NEW YORK
Advanced Components Corp.
N. Syracuse
Tel: (315) 699-2671

Endicott
Tel: (607) 785-3191

Scottsville
Tel: (716) 889-1429

Clinton
Tel: (315) 853-6438

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BCS Associates
Tel: (919) 273-1918

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Sheridan Associates Inc.
Cincinnati
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Beachwood
Tel: (216) 831-0130

Dayton
Tel: (513) 277-8911

OKLAHOMA
Norvell Associates Inc.
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OREGON
Hayes Technical
Tel: (503) 238-0001

PENNSYLVANIA (Eastern)
QED Electronics Inc.
Tel: (215) 925-8711

PENNSYLVANIA (Western)
Sheridan Associates Inc.
Pittsburgh
Tel: (412) 244-1640

RHODE ISLAND
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S. CAROLINA
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TEXAS
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Houston
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Burr-Brown Research Corp.
Salt Lake City
Zenith 6730 (toll free)

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Tel: (403) 276-9658

800 Windmill Road
Burnside Industrial Park
Dartmouth, Nova Scotia
B3B 1L1
Tel: (902) 469-7865

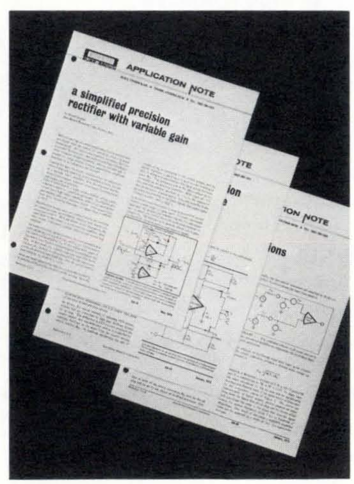
LITERATURE

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 on page 109.

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:



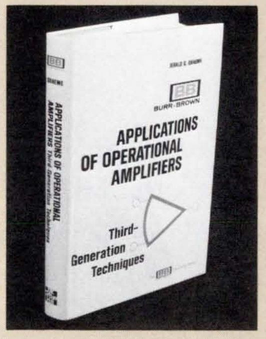
AN-51	"A Primer on Analog Multiplier Specs"
AN-54	"Programmable Data Amplifiers"
AN-55	"Analog Modules Multiply User's Options"
AN-56	"Sample & Hold or High Speed A/D Converters?"
AN-58	"D/A Converter Differential Linearity Error - It Really Shows Up!"
AN-59	"Don't Forget D/A Converter Tempco!"
AN-60	"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-67	"A Noninverting Differentiator"
AN-68	"Don't Overlook the Noise of Op Amp Feedback Resistors"
AN-70	"Analog Shaping"
AN-73	"Using IC Multipliers"
AN-74	"Controlled Current Source is Versatile and Precise"
AN-75	"Instrumentation Amplifiers"
AN-76	"Monolithic Thermal Converter permits Wideband RMS AC-Measurement"
AN-78	"Simplified Precision Rectifier has Variable Gain"
AN-79	"Principles of Data Acquisition and Conversion."

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.

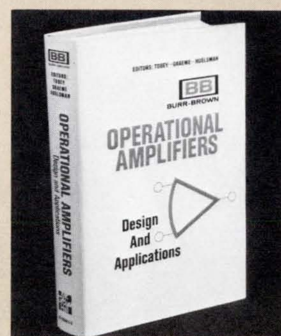
This volume presents and explains those operational amplifier applications which have evolved since publication of its companion volume, *Operational Amplifiers–Design and Applications.*

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.

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SHM41	SHC85
501	552
541	552
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1506/15	3500B
1507/15	3500B
1516/15	3500A
1517/15	3500A
1520/15	3329/03
1538A/25	3293/14
1540/15	3580J
1541/25	3581J
1543/15	3580J
1547/15	3580J
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1556/15	3521J
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3021/15	3500B
3022/15	3500B
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3116/12C	3522K
3117/12C	3500B
3118/12C	3500B
3119/12C	3500A
3129/15	3521K
3138/25	3581J, 3582J
3161/25	3625A
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3227/03	3500A
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3349/03	3521H
3350/03	3522J
3352/03	3500B
3401A	3550K
3401B	3550K
3402A	3550K
3402B	3550K
3403A	3550J
3403B	3550J
3420J	3521J
3420K	3521K
3420L	3521L
3421K	3523L
3421L	3523K
3460	3580J, 3581J, 3582J
4029/25	4206J
4030/25	4206K
4031/25	4206J
4034/25	SHC85
4035/25	SHC85
4094/15C	4203J
4095/15	4205J
4096/15	4205K
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CHANGES FOR 1976 CATALOG LI-229

PAGE 46:

Please note changes in FIGURE 4.
+In now goes to +15V and -In goes to Ground (See new diagram).

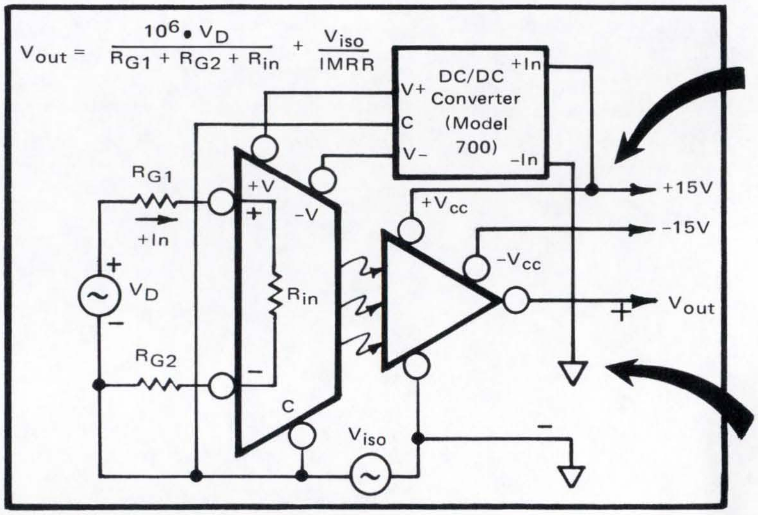


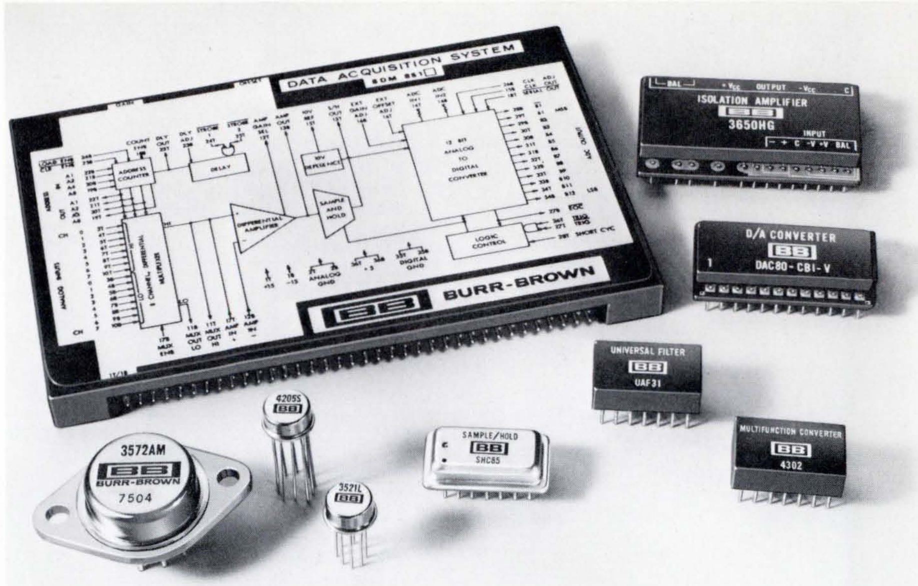
FIGURE 4. Application of 3650.

PAGE 48:

The Output Offset Voltage vs. Temperature is now ±100μV/°C and NOT ±500μV/°C.

Output Offset Voltage @ 25°C(4)	±2mV	±5mV	±5mV
vs. Temp., max		±100μV/°C	
vs. Supply		±500μV/V	
vs. Time		±100μV/mA	

MODEL INDEX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