# function module instrumentation

*The Flexible "Building Block" Method of Designing Analog Computational and Control Systems*

CONTROL PRODUCTS DIVISION

BELL & HOWELL

# Why Bell & Howell?

*The Talent to Originate . . .*
*The Ability to Produce*

Bell & Howell and function modules are virtually synonymous in the process and instrumentation fields. Bell & Howell pioneered the development of function modules, and over the years, our engineers have used them to build a wide range of custom analog systems for some of the most progressive companies in America's major industries. Development of the function modules was a natural extension of Bell & Howell Control Products Division's long experience in advanced solid state technology. Our high reliability operational amplifiers are used as the basic elements from which function modules are fabricated. Use of the op amp principle makes possible employment of the most advanced analog computer techniques and offers a full range of functions with a high order of analog computer accuracy. A complete line of transmitters, recorders and controllers to complement the function module line are also available from stock as standard products.

*Bell & Howell Quality Assurance Program*

The Control Products Division of Bell & Howell has installed a quality assurance program that has been certified by one of the nuclear equipment manufacturers to comply with their interpretation of the AEC-10CFR50, Appendix B. The procedures established by this program apply to all products manufactured by the Control Products Division whether for nuclear or non-nuclear installations.

# The Function Module Concept

*A Tested Approach to Analog Computational Control Systems Design*

Standard instruments, such as process controllers, recorders, flow computers, etc., are available to solve many of the complex problems of industrial process control, however, nearly every plant demands some new or specialized types of instrumentation. These special control systems, in most instances, have proved to be unprofitable to both manufacturer and user because of the disproportionate amount of engineering time and money they required. Consequently, they are often not as well designed as their standard counterparts.

A solution to this problem, pioneered and field tested by Bell & Howell Control Products Division, is the function module approach which consists of compatible pre-engineered modules or building blocks. These blocks, each performing a specific function or group of functions, are standards, not specials. They are well engineered, thoroughly tested, and available from stock.

Using Bell & Howell's building block approach, a user can now construct a wide variety of special control systems with a high degree of confidence in both initial and continued performance. The tasks performed by the systems may vary widely, but they are easy to maintain and operate since they are constructed from the same family of standard modules.

# The Function Module Family

The function module family is made up of five basic groups: Input Signal Conversion, Algebraic Function, Dynamic Response, Logic Functions and Output Signal Conversion. Within this family of five, more than forty different units are available, all with consistent electrical levels, performance specifications, and mounting dimensions. The standard electrical level, common to all inputs and outputs (except for interface units) is 10 volts DC. Computation tolerances are from 0.01% to 0.1%. The bandwidth of typical linear units exceeds 10Kc.

The input and output voltages of all Control Products Division function modules are analogous to measurements of the process variables in engineering units (e.g. temperature in degrees F or C, pressure in PSI, etc.). The desired relationship between the input and output in engineering units is maintained by selecting the proper coefficients. This is called scaling the module. Coefficients are encapsulated precision resistors which are easily attached to the module terminal face. Coefficients for both inputs and outputs are available in standard value fixed, selector trimmable, and special value fixed configurations.

These common characteristics provide for: a complete line of instruments with no missing links; straight-forward and conservative design and use of accepted circuit standards for compatibility with existing equipment. There are no requirements for nuisance elements such as sign inverters.

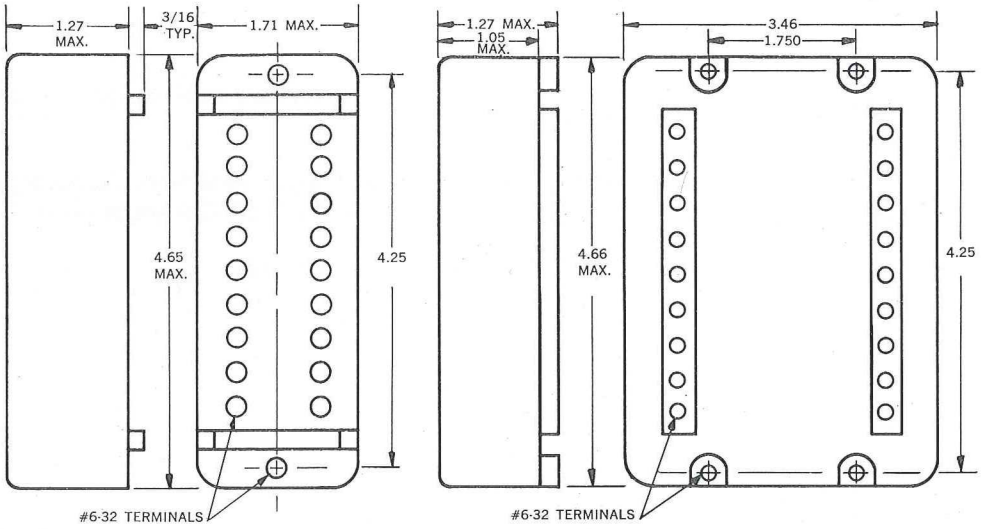
# Applications

The major advantage of using Function Modules is their universal application. These units are completely compatible with one another and can also operate effectively with older types of instrumentation. They are specifically designed for high reliability in continuous industrial environments to facilitate all phases of system construction, use, planning and assembly. Use of the function module approach allows for ease of expansion into large scale and fully integrated systems that can include supervision by a computer for simultaneous control of all variables and optimization of the specific control process.

## FEATURES

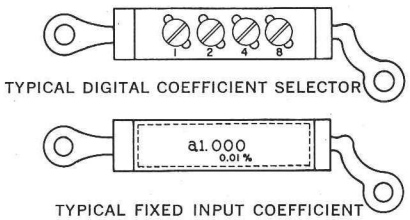
Flexibility:
Modules can be used in many combinations.
High Accuracy:
Computation Tolerance from 0.01% to 0.1%.
Highest Reliability:
Even corrosive atmospheres, vibration, and shock will not damage components.

Low Cost:
Standard modules permit tailored instrumentation free of unwanted features.
Lowest Maintenance:
Replacement of factory repairable modules minimizes maintenance and simplifies troubleshooting.




SINGLE-WIDTH MODULE

DOUBLE-WIDTH MODULE




TYPICAL DIGITAL COEFFICIENT SELECTOR

TYPICAL FIXED INPUT COEFFICIENT

## COLOR CODED BY FUNCTION

Function Modules can be instantly identified by their color. This list illustrates the variety of modules available under each color coded type of function:

**INPUT SIGNAL CONVERSION (GREEN)**

19-101B Millivolt Preamplifier
19-102 Milliamp Input
19-105 Voltage Follower
19-106 Pulse Rate Converter
19-116 D-C Input Converter
19-118B Pneumatic-to-Electric (Black)
19-119 Isolated Milliamp Input

**OUTPUT SIGNAL CONVERSION (WHITE)**

19-201 Milliamp Output
19-202 Milliamp Output (High Load)
19-205 Current-to-Pneumatic Transducer (Gray)
19-211 Counter Drive (Black)
19-212 Voltage to Frequency Converter

**ALGEBRAIC FUNCTIONS (YELLOW)**

19-301A Adder/Subtractor
19-302 Multiplier/Divider
19-303 Square Root
19-306 Function Segment (Adjustable)
19-308A 10-Turn Coefficient Potentiometer
19-309 Multiplier
19-315A Inverse 10-Turn Coefficient
19-316 Square Root with Reference
19-317 Adjustable Limit
20-318 Log/Antilog
19-319 Booster
20-320 Dual Potentiometer/Amplifier
20-321 Dual Amplifier

**DYNAMIC RESPONSE FUNCTIONS (BLUE)**

19-407A Dynamic Response Module available as:
Sample and Hold
Integrator
Proportional Plus Reset
First Order Lag
Differentiator
19-415A Rate Switch
19-417A Three Term Blind Control
20-418A Peak Remembering Selector
20-419A Sample and Hold
19-422 Adjustable Lag

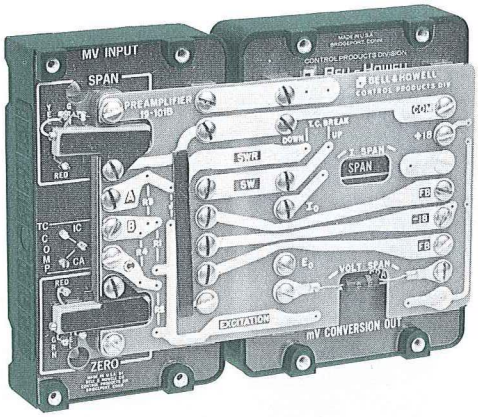
**LOGIC FUNCTIONS (RED)**

19-501 Voltage Comparator
19-502 Amplitude Selector
19-504 Signal Selector Switch
19-506 Relay
19-507 One Shot
19-508 Alarm with and without Relay
19-509 Memory/Not (Flip-Flop)
19-510 Time Delay
19-511 Dual Not (Logic Inverter)
19-512 Dual Amplifier (Logic Amplifier)
19-513 AND Gate
19-514 OR Gate
19-515 Deviation Comparator

**POWER SUPPLIES (BLACK)**

19-601A ±18 Volt Supply (300 mA)
19-603C ±10 Volt Reference (Orange)
19-605 ±15 Volt Supply (300mA)
19-621 ±18 Volt Supply (100 mA)
19-622 ±15 Volt Supply (125 mA)

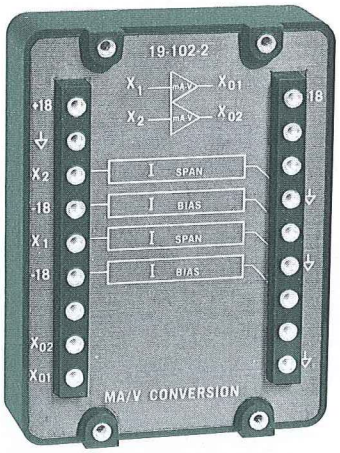
# Input signal conversion modules




**The 19-101B Millivolt Preamplifier** is an accurate, transistor chopper-stabilized, high gain amplifier designed to convert d-c input signals in the millivolt range to an isolated 0/10V, 1/5, 4/20 or 10/50mA output. It can be used with strain gages, thermocouples, resistance thermometers, radiation pyrometers and electro-magnetic flowmeters.

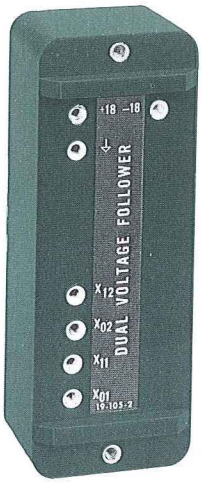
The 19-101B features Input-Output Isolation, Accuracy ± 0.1% and T/C Reference Junction Compensation.

*Literature Reference Bulletin 19101B*




**The 19-102 Milliamp Input Module** converts 1 to 5, 4 to 20, or 10 to 50 milliampere transmission signals to the 0 to 10 volt variable used in Bell & Howell Function Module Systems. Scaling and biasing are performed by a pair of precision coefficients mounted on the module screw terminals.

*Literature Reference Bulletin 19102*



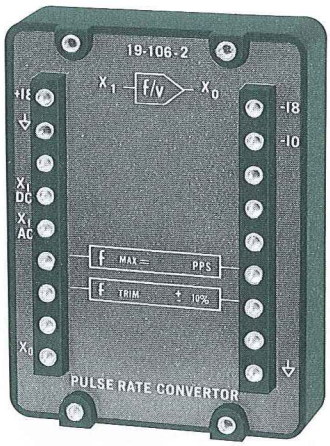

**The 19-105 Voltage Follower** is used as an input buffer or impedance matcher. It is used whenever the voltage source has a larger impedance or is located at a remote point. The Voltage Follower is also used with slidewire devices.

*Literature Reference Bulletin 19105*

**The 19-106 Pulse Rate Converter** is used to convert pulse rate or frequency signals into a 0/10V DC voltage proportional to the pulse rate frequency. The module will accept pulse amplitudes over a very wide range and will work with very small pulse widths, thus making it suitable for accepting the outputs of most tachometer sensors and flowmeters.

The 19-106 may be scaled for 10 volt output for any frequency input between 20 and 10,000 Hz.

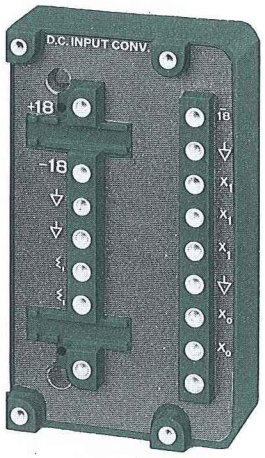
*Literature Reference Bulletin 19106*




**The 19-116 DC Input Conversion** is used primarily to convert DC signals up to 50 volts to proportional 0 to 10 volt DC signals for inputs to Bell & Howell Function Modules. It is also capable of converting current signals from 1mA up to 50mA into proportional 0 to 10 volt DC signals. Input ranges can be changed in the field. An internal RC noise filter is included in this module to filter noise from the output signal.

Terminal linearity is within 0.1% of a straight line connecting actual end points.

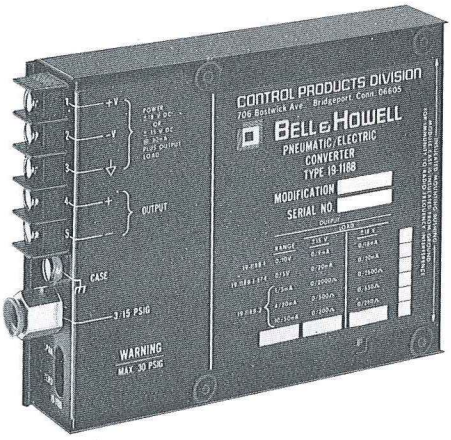
*Literature Reference Bulletin 19116*

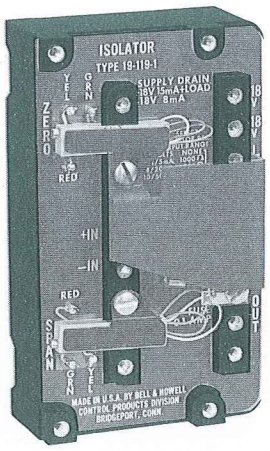



**19-118B Pneumatic-to-Electric Converter** provides a means of converting pneumatic to electric signals and serves as an accurate interface between the pneumatic process controls and any modern day computer.

Terminal linearity is within 0.1% of a straight line connecting actual end points.

*Literature Reference Bulletin 19118*



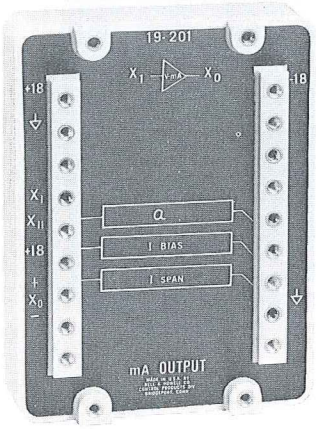



**The 19-119 Isolation Module** is used to isolate computing systems and other instruments from the signal source in a current loop. This eliminates the ground loop problem between computing or recording instruments. This module makes Control Products Division instruments and function modules compatible with other equipment in the loop without the need to consider ground points.

The 19-119 can receive inputs of 1-5, 4-20 or 10-50mA and provides outputs of 0-10V or 0.4 to 2V.

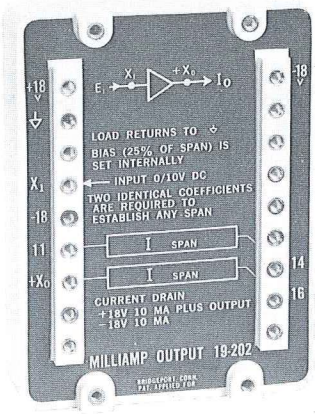
*Literature Reference Bulletin 19119*

## Output signal conversion modules




**The 19-201 Milliamp Output Module** provides a permanently calibrated current output signal to either the 1 to 5, 4 to 20, or 10 to 50 milliampere range. The output is insensitive to load resistance variations. This module is used to feed current input devices that have input terminals isolated from common.

*Literature Reference Bulletin 19201*

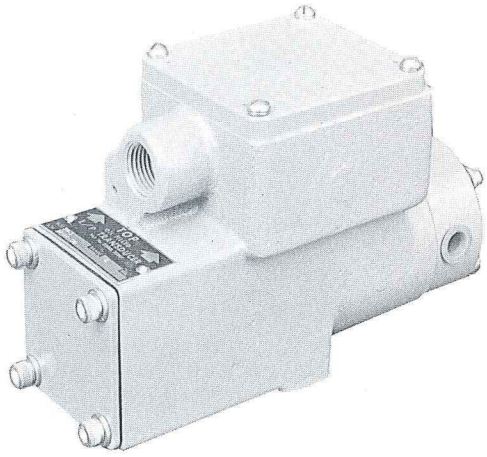


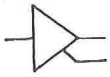

**The 19-202 Milliamp Output** provides the same function as the 19-201 Milliamp Output for loads that are returned to common.

*Literature Reference Bulletin 19202*

**The 19-205 Current-to-Pneumatic Transducer** provides pneumatic output signal of 3 to 15 psi linearly proportional to a D.C. mA input. This unit features 0.2% repeatability, ±0.25% linearity and a 0.05% F.S. dead zone.

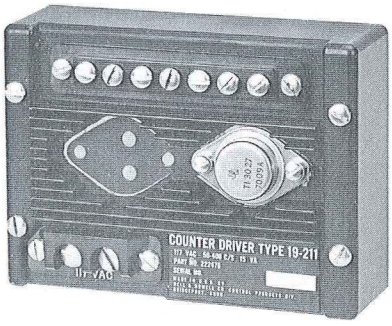
*Literature Reference Bulletin PL205*

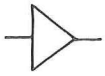




**The 19-211 Counter Driver Module** receives an impulse or square wave input. This input amplitude must be 4 volts peak-to-peak or greater at a maximum rate of 10 p.p.s. and provides a synchronous 50 millisecond pulse output. The output pulse is 24 volts and can provide up to 750 milliamps suitable to drive electro-mechanical counters and relays.

*Literature Reference Bulletin 19211*

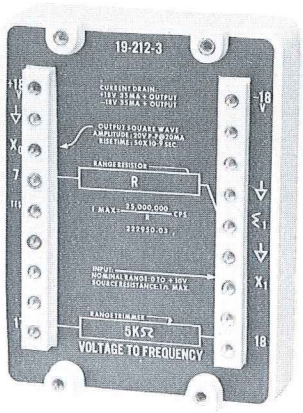


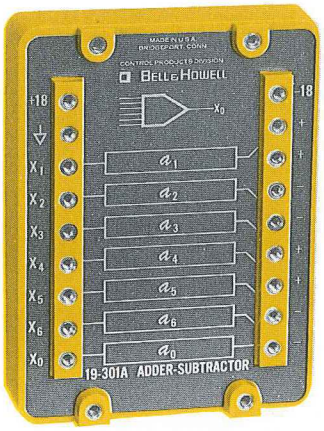
**The 19-212 Voltage-to-Frequency Module** produces a square wave output with frequency proportional to the input voltage.

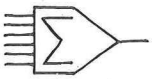
A 0 to 10V input provides an output frequency from 0 to f max. Hz. The f max. is determined by an external coefficient which mounts on the module. On the 19-212-1, f max. may be selected between .1 to 10 Hz; on the 19-212-2 between 10 to 1000 Hz and on the 19-212-3 between 1000 to 10,000 Hz.

*Literature Reference Bulletin 19212*



# Algebraic function modules

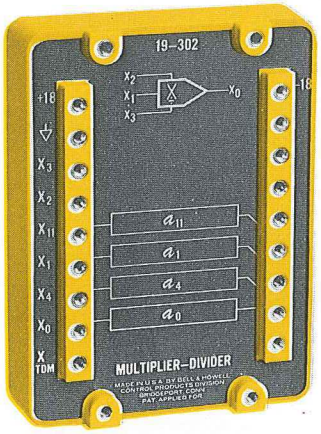


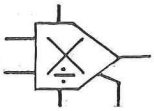



**The 19-301A Adder/Subtractor Module** solves the equation $E_0 = a_0 (\pm a_1E_1 \pm a_2E_2 \pm a_3E_3 \pm a_4E_4 \pm a_5E_5 \pm a_6E_6)$. It is a complete function contained within a single unit and is useable over four quadrants. The Adder/Subtractor Module accepts up to six inputs. Each input may be either added or subtracted depending on the arrangement of externally mounted coefficients.

The 19-301A features an accuracy of 0.1%. Nominal inputs and outputs are ± 10V. Variations are scaled externally by encapsulated coefficient resistors fastened to terminals on the face of the module.

*Literature Reference Bulletin 19301A*



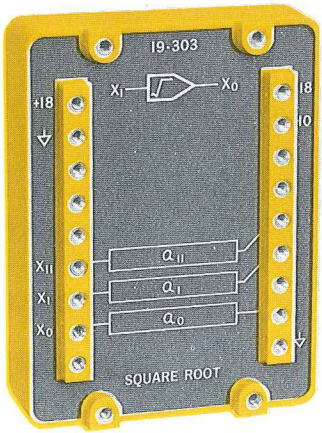



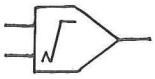
**The 19-302 Multiplier/Divider Module** provides an output voltage signal which is the product of two input signal voltages divided by a third signal voltage. It solves the equation:

$$E_0 = a_0 \left[ \frac{(a_1E_1 + a_{11}E_{11})}{E_3} E_2 - a_4E_4 \right] \text{ Volts}$$

The pulse width-height modulation technique used gives a full scale accuracy of better than 0.1%. A typical application of this module is its use calculating compensated gas flow.

*Literature Reference Bulletin 19302*



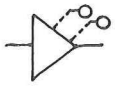
**The 19-303 and 19-316 Square Root Modules** are designed for positive-quadrant operation. They extract the square root of one input or the square root of the sum of two inputs. The Square Root Modules solve the equation:

$$X_0 = a_0 \sqrt{10 (a_1X_1 + a_{11}X_{11})}$$

The difference between the 19-303 and 19-316 is that the 19-303 requires an external 10 Volt Reference while the 19-316 has an internally generated 10 Volt Reference.

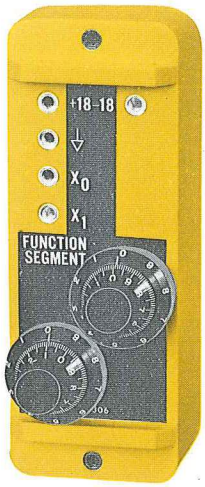
These modules have a high accuracy: 0.1% at full scale output and 1.0% at 10% scale output. A common application of the Square Root Module is flow computation.

*Literature Reference Bulletin 19303*



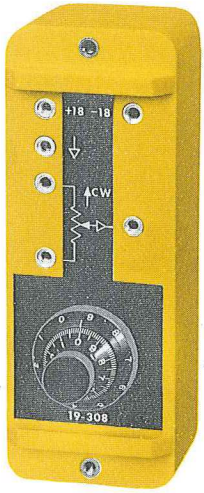
**The 19-306 Adjustable Function Segment** is often required to relate one function in terms of another. This relationship is often a complex curve. The curve may be approximated by a number of straight lines. Any required number of line segments may be used; the correct number being a question of accuracy versus cost. Used with the 19-301A, each 19-306 linearizes a single segment of the function generator. The function curve may be directly set up from graphic information.

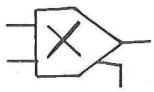
*Literature Reference Bulletin 19306*



**The 19-308A Ten-Turn Adjustable Coefficient** is used in module systems where a variable gain factor with a range of 0 to 1.0 is required. The module consists of a 10-turn precision potentiometer with a turns counting dial labeled 0 to 1 followed by a buffer amplifier. Calibration & linearity is ±0.3%.

*Literature Reference Bulletin 19308A*



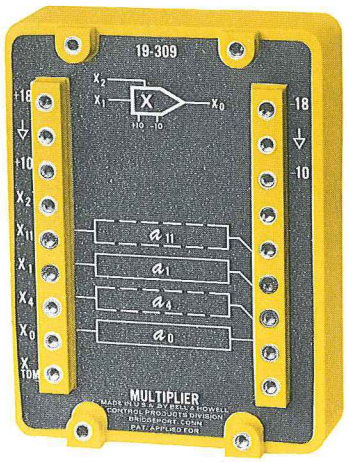



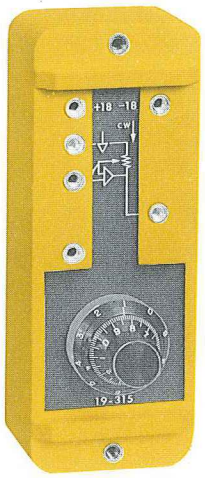
**The 19-309 Multiplier** will generate an output signal which is proportional to the product of two input signals. It solves the equation:

$$E_0 = a_0\left[\frac{(a_1E_1 + a_{11}E_{11})}{10}E_2 - a_1E_1\right]$$

This module employs the pulse width-height modulation technique to provide very accurate, moderately fast computation for process control or simulation.

*Literature Reference Bulletin 19302*

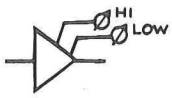




## The 19-315A Ten-Turn Inverse Coefficient $(\frac{1}{K})$

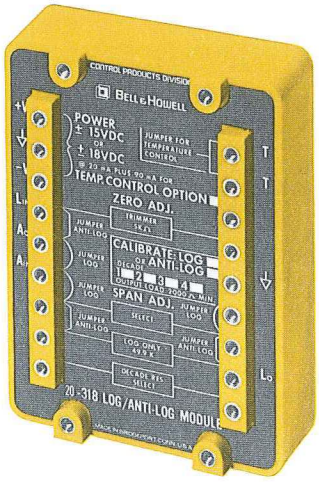
is used in module systems where a variable gain factor greater than 1.0 is required. The module consists of a ten-turn precision potentiometer with a turns counting dial labeled 0 to 1 connected in the feedback circuit of an amplifier connected as a voltage follower. The gain is the reciprocal of the dial setting. This module is normally used for a gain of less than 10 (dial setting of .1 or greater).

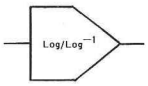
*Literature Reference Bulletin 19315A*




**The 19-317 Adjustable Limit Module** is used to set maximum and minimum voltage limits on the output of computing modules and controllers. The 19-317 features sharp limits, accurate settings, low leakage, and fast recovery.

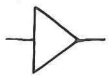
*Literature Reference Bulletin 19317*



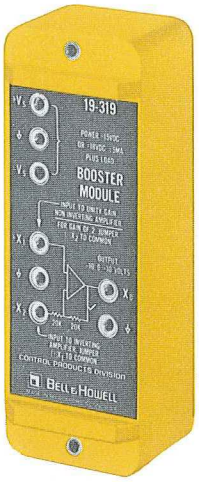

**The 20-318 Log/Antilog Module** achieves accurate Log/Antilog functions proportional to varying input voltages. Matched transistors form the precision log element with maximum thermal stability. A selection of 1, 2, 3 or 4 standard decades are available in both Log and Antilog Modes. Special decades between 2/5 to 4 are available on order. Mode conversion is provided by means of external jumper connections.

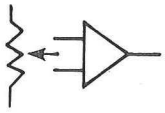
*Literature Reference Bulletin 20318*



**The 19-319 Booster Module** has a booster circuit added to an IC operational amplifier to increase the output capability of the 20-Series function modules. It is used to operate loads up to 30 mA. Normal operation would be a unity gain, noninverting amplifier. It has the added flexibility to be easily connected for a gain of two (2) in a noninverting mode.

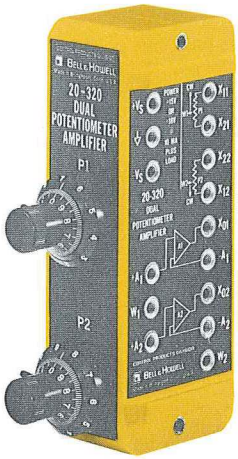
*Literature Reference Bulletin 19319*

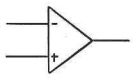


**The 20-320 Dual Potentiometer/Amplifier Module** contains two precision wire-wound potentiometers and two bipolar I.C. operational amplifiers. Both ends of the potentiometer windings and its wiper are brought out to the wiring terminals to facilitate setting ratios or signal attenuations.

*Literature Reference Bulletin 20320*



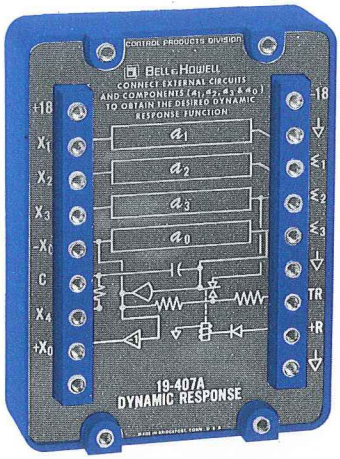



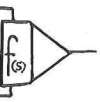
**The 20-321 Dual Amplifier** contains two uncommitted amplifiers, internally trimmed, which provide the means of applying classical operational amplifier techniques without the worry of external trimming. The unit is also available with an external standard printed circuit component board.

Using standard textbook methods, circuits can be designed and assembled on the external P. C. card enabling ease of interface with the rest of the Function Module family.

*Literature Reference Bulletin 20321*

# Dynamic Response Functions

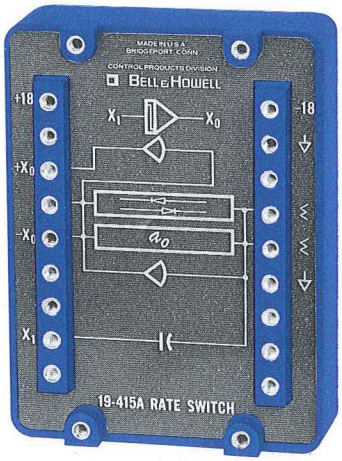


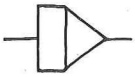



**The 19-407A Dynamic Response** is a versatile function module which is designed to perform a variety of time based analog functions. It is ideal for control applications where variables change with time. By using conventional analog computer programming and scaling techniques, this basic module performs Integration, Differentiation, Sample-and-Hold/Track-and-Hold, and First Order Lag Functions.

The versatility of this module is greatly enhanced by its ability to sum as many as three inputs and perform its programmed function on the sum.

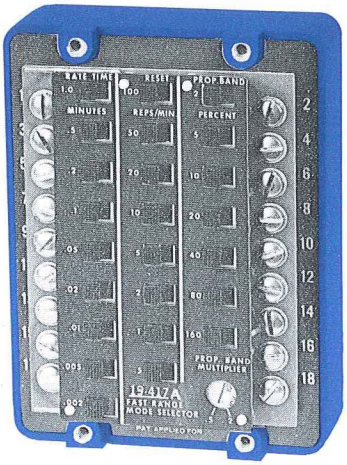
*Literature Reference Bulletin 19407A*



**The 19-415A Rate Switch Module** provides a full range positive output for an increasing input voltage and a full range negative output for an input voltage with negative slope with respect to time. The minimum input rate of change for full range output is ±4 millivolt/second.

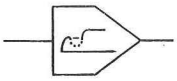
*Literature Reference Bulletin 19415A*



**The 19-417A Three-Term Blind Controller** is a complete proportional plus reset plus rate controller, which minimizes process overshoot by including a reset recovery anticipation circuit.

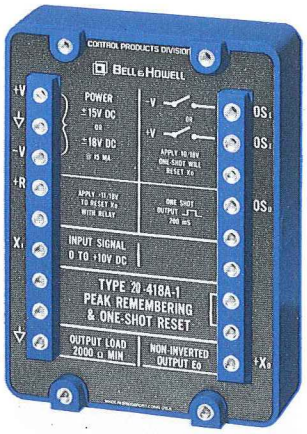
The 19-417A can be applied wherever a requirement exists for a conventional controller without the need for information display or when this information is to be displayed remotely. The 19-417A is used extensively for unattended station control. The 19-417A features reset recovery anticipation, reset anti-windup, current & voltage outputs, and manual-auto switching.

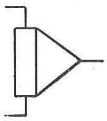
*Literature Reference Bulletin 19417A*



**The 20-418A Peak Remembering Module** has peak selection and memory capabilities. Its output voltage is equal to the most positive voltage that the input voltage has seen since the last point in time that the module has been reset. Reset is accomplished by applying a positive 11 to 18 volt signal to the module RESET terminal (R).

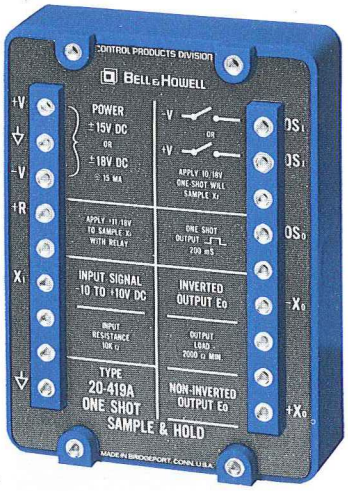
*Literature Reference Bulletin 20418A*

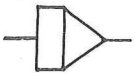


**The 20-419A Sample & Hold Module** provides an analog memory capability. When the Sample input is energized with a positive 12 to 18 volt signal, an internal one-shot is triggered for 200 ms. During this interval, the output voltage of the module is set to the same value as the signal input voltage. The output maintains this value until the Sample input voltage is set again. At this time a new value is "sampled" at the signal input and "held" at the output.

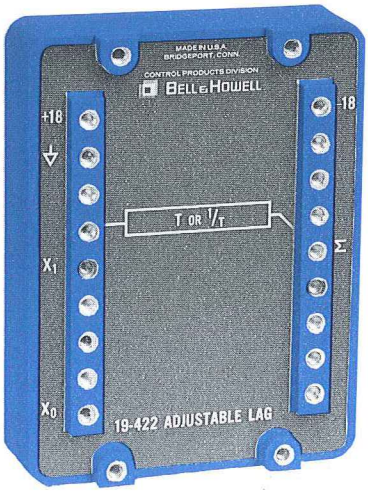
*Literature Reference Bulletin 20419A*



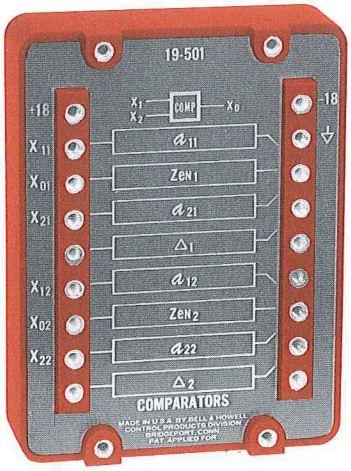



**The 19-422 Adjustable Lag** provides an output voltage which is a first order approximation of the input voltage, delayed by an adjustable amount of time. It consists of an RC circuit followed by an F.E.T. operational amplifier with an extremely high-input impedance and a gain of $+1.000 \pm 0.01\%$.

*Literature Reference Bulletin 19422*

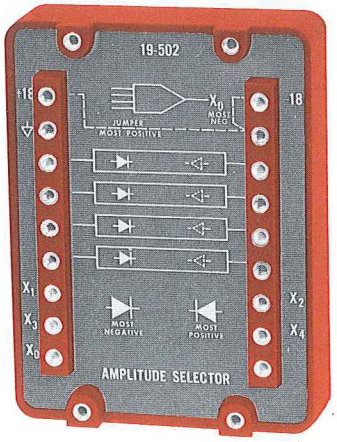


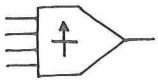
# Logic functions



**The 19-501 Voltage Comparator** is used to compare two voltages of opposite sign. The result of this comparison is indicated by a voltage swing at the output of an operational amplifier. This may be used to drive a relay, operate a solid-state switch, control an alarm, or perform a variety of other functions. The 19-501 is available in one or two channels.

*Literature Reference Bulletin 19501*

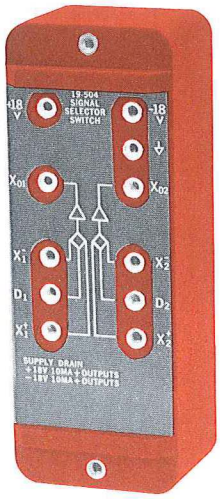


**The 19-502 Amplitude Selector** is a 4-channel precision selector whose output is equal to the most positive or the most negative of its inputs, depending upon the external connections on the module. As many 19-502 modules as needed may be placed together to select the most positive or most negative of any number of input signals.

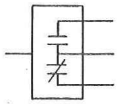
The 19-502 features high resolution and four-quadrant operation.

*Literature Reference Bulletin 19502*



**The 19-504 Signal Selector Switch** contains two high speed switching transistors which act as a single-pole, double-throw switch. These may be used independently or may be connected together to form complex switching or logic networks.

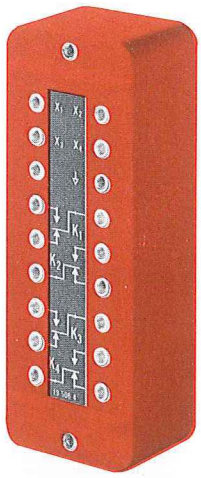
*Literature Reference Bulletin 19504*

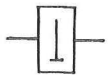


**The 19-506 Relay Module** is double-encased in plastic housings to assure reliable operation, even in severe industrial environments, and is available with one-to-four relays, each providing one SPDT contact.

The 19-506 can be used in conjunction with Bell & Howell logic modules or from other sources capable of delivering 7 mA or more into a 1,000-ohm coil.

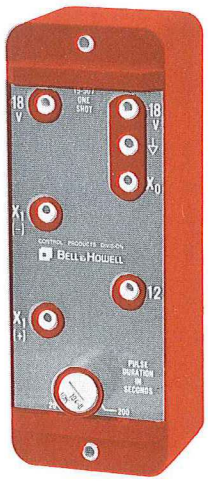
*Literature Reference Bulletin 19506*





**The 19-507 One-Shot Module** consists of an operational amplifier connected as a monostable multi-vibrator. It gives a positive pulse output which may be triggered by either a positive going or negative going input transition. The 19-507 features adjustable pulse width.

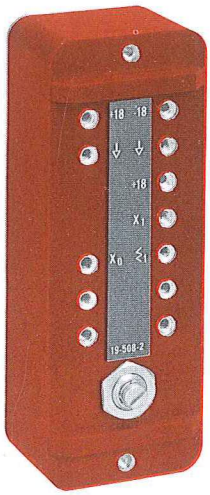
*Literature Reference Bulletin 19507*

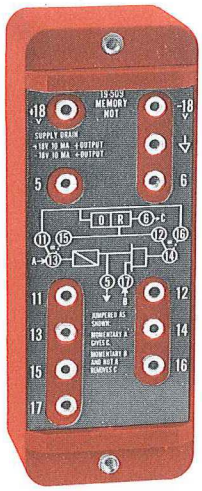


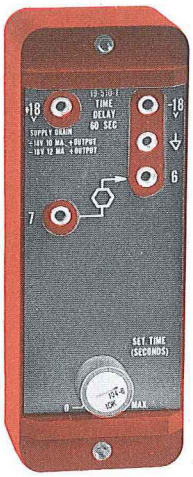

**The 19-508 Alarm Comparator** produces a logic output or contact closure to indicate whether the input voltage is above or below the voltage set on the potentiometer on the face of the module.

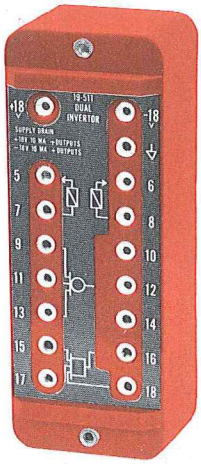
The 19-508 features voltage or contact closure output.

*Literature Reference Bulletin 19508*






**The 19-509 Memory/Not Module** contains three separate logic functions: a set-reset flip-flop; a not, which is an inverting logic amplifier; and an And Gate.

*Literature Reference Bulletin 19509*

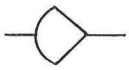
**The 19-510 Time Delay Module** is a logic module whose output goes positive a set time after the input goes positive. The output goes negative at the same time the input goes negative.

The model 19-510-1 has an adjustable time delay of 6-60 seconds and the model 19-510-2 has an adjustable time of 1-10 seconds.

*Literature Reference Bulletin 19510*

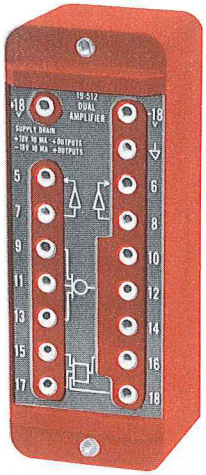
**The 19-511 Dual Not Module** provides a power gain and logic inversion. This module contains two logic inverting amplifiers, a three-input Or Gate, and a three-input And Gate.

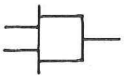
*Literature Reference Bulletin 19511*



**The 19-512 Dual Amplifier Module** provides a power gain to logic signals. The Dual Amplifier Module contains two amplifiers, a three-input Or Gate, and a three-input And Gate.

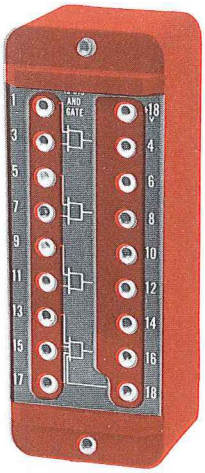
*Literature Reference Bulletin 19512*



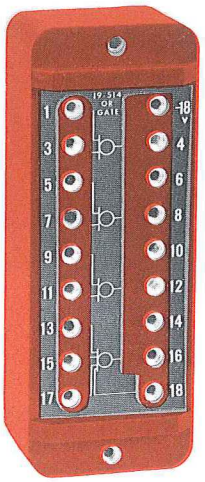
**The 19-513 "AND" Gate Module** contains three 2-input And Gates and one 4-input And Gate. Plus five to eighteen volts is the true state, and minus five to eighteen volts is the false state.

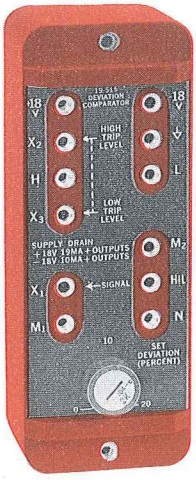
*Literature Reference Bulletin 19513*



**The 19-514 "OR" Gate Module** contains three 2-input Or Gates and one 4-input Or Gate. Plus five to eighteen volts is the true state and minus five to eighteen volts is the false state.

*Literature Reference Bulletin 19514*



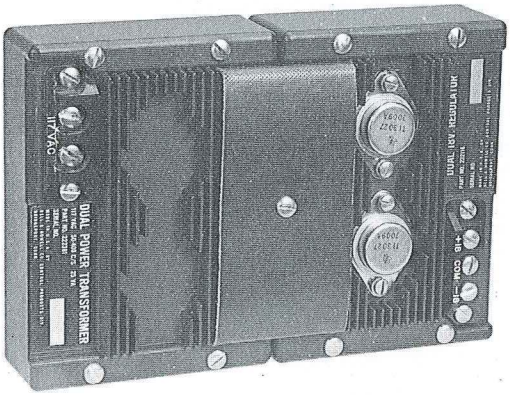


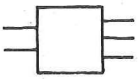



**The 19-515 Deviation Comparator Module** compares two input signals. A potentiometer, mounted on the face of the module, sets the amount of deviation between the two inputs to cause an alarm. Under normal conditions, the modules three-outputs are at —15 volts. During alarm, the "Hi or Low" output swings to +10 volts to indicate an alarm condition, and either the "Hi" or "Low" output swings to +10 volts to indicate the direction of the deviation. The 19-515 features high alarm, low alarm, and high or low alarm.

*Literature Reference Bulletin 19515*

## Power supplies

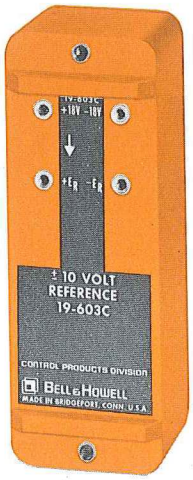


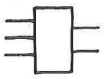



**The 19-601A ±18V Power Supply (300 mA)** is used to energize Control Products Division Function Module instrumentation when the power source is 100 to 130 volts in the frequency range from 50 to 60 Hz. (Optional 200 to 260 volts)

The accuracy is such that the supply can be used as a ±18 volt reference in many applications or to excite strain gages and other measurement bridges. The 19-601A features high reliability and performance and low noise.

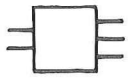
*Literature Reference Bulletin 19601A*



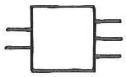
**The 19-603C ±10 Volt Reference Supply** is a basic reference standard for computing systems. The 19-603 features high accuracy — permanently calibrated to within 0.025% and low thermal drift — less than 0.1% per 50°F change.

*Literature Reference Bulletin 19603C*



**The 19-605 ±15 Volt Power Supply** is designed expressly to power operational amplifiers. Basic specifications are the same as the 19-601A. Power supply is shown with M-27 Mounting Bracket.

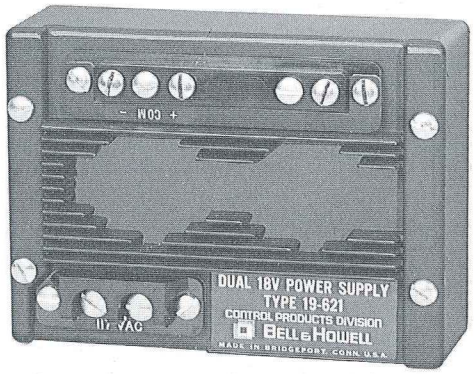
*Literature Reference Bulletin 19605*

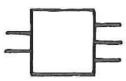


**The 19-621 ±18 Volt Low Cost Power Supply** is used to energize function module instrumentation with a power source of 105 to 125 volts in the frequency range of 50 to 60 Hz. Its accuracy is such that it can be used as a reference supply; load regulation to 5mV; with loads up to 100 mA.

The 19-621 features high reliability and accuracy. The outputs are permanently set to within ±0.5% of its nominal voltage. Low thermal drift, 0.5% per 50°F change. Transverse noise and ripple is less than 2mV R.M.S.

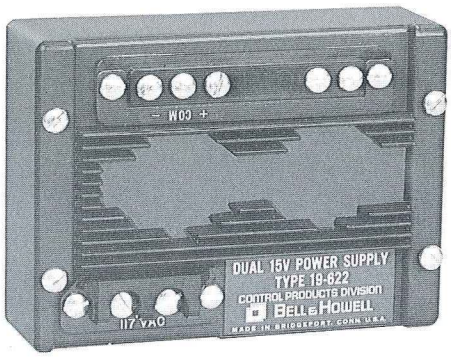
*Literature Reference Bulletin 19621*



**The 19-622 ±15 Volt Low Cost Power Supply** features the same specifications as the 19-621 except with loads up to 125mA.

*Literature Reference Bulletin 19622*



# Services

## APPLICATION ENGINEERING

The Control Products Division Application Engineering Group has the major objective of continuously preparing detailed information covering a wide range of applications. This information, as it is produced, is made available to users and prospective users in the form of Custom Product Applications and Function Module Application Bulletins.

Design of Function Module systems follows standard textbook techniques; thus, many users are able to accomplish their own engineering without difficulty.

Whenever necessary, Control Products Division offers application assistance for solving complex problems related to a customer's specific need.

## WARRANTY POLICY

The warranty period on all Function Modules is one year from the shipment date stamped on each module and covers defects in workmanship and material as defined in the terms and conditions stated on the reverse side of the Control Products Division Quotation Form, unless modified by contract.

Upon receipt and proper determination of repairability of modules returned for repair or replacement, appropriate credit or charges will be made in accordance with the following policy.

## EXCHANGE & REPAIR POLICY

Modules in Warranty — Defective
Full credit if not damaged by customer.

Should module repair or replacement become necessary after expiration of the warranty period, credit of 30% of the current module price will be allowed if the returned module is in repairable condition.

Upon notice from Control Products Division, nonrepairable modules out of warranty will be scrapped 30 days after they are received, unless the customer requests that they be returned.

## SERVICE POLICY

Service to our customers is essential to the success of our business. The repair and return of equipment is a very important part of this service. The following is the standard repair handling procedure.

1. Normal turn-around time of repairs will be two weeks. Repairs will be expedited by contacting the Service Manager directly. Emergency replacements will be made upon request within 24 hours.
2. All matters pertaining to repairs should be directed to the Service Manager's attention.
3. Customers should send as much information as possible relative to disposition and problems experienced.
4. A replacement stock will be maintained by field service to expedite emergency repairs.
5. Field service will make a special test on units with intermittent problems.
6. Field service maintains a failure log and provides the customer with a failure report upon request.

## FIELD SERVICE

Systems employing Function Modules frequently include a large number of other CPD control instruments and equipment such as recorders, controllers, converters, and valves. If startup assistance is desired, on-site assistance of CPD engineers can be arranged at nominal cost.

## QUOTATION REQUIREMENTS

A quotation form is enclosed with this bulletin to assist you in determining your function module requirements. If a quotation on a function module system is desired, please fill out the enclosed form; give as much information as possible and mail it directly to Control Products Division, attention Product Sales Manager. An answer to your quotation will be promptly delivered to you by our area representative.

# Packaging

A wide variety of pre-engineered packaging options are available for assembling the function modules into economical computational control systems.

These packaging options include, but are not limited to the following:

## FUNCTION MODULE FRAMES

Frames which hold up to five double-width Function Modules are available for mounting on panels and other surfaces. A 21 x 17-inch plate which accommodates up to three frame sets (15 double-width modules and external wiring blocks) is available for bolting to any surface. Plates are designed for installation in standard wall mounting cases described below.

## WALL MOUNTING CASES

A wall mounting case with space for up to 30 double-width modules holds two standard plate and frame assemblies. The 24 x 24 x 8-inch wall mounting box is oil and dust tight. An air purge kit is available.

## SURFACE MOUNTING CASES

Two weatherproof surface mounting cases are offered — single and dual. Each single case accommodates up to four double-width Function Modules. Modules mount on channels composed of top-and-bottom rails which slide into the case. Each channel holds two double-width modules. The assembly also includes a front facing external-terminal block with 18 screw terminals. The cases are 9⅛-inches deep. The base of the single case occupies a space 7½″ high by 7″ wide, and the dual case a space 7½″ high by 13″ wide.

## TEN CHANNEL RACK MOUNTING CASE

This case holds up to ten Function Module channels with five single-width module spaces per channel. Air purging and up to ten engraved service tags are available. Also, a choice can be made between front or rear field wiring terminals.

## PANEL MOUNTING CASES

Available in single-width and double-width versions, these cases house controllers and Function Module systems. The single-width case is 2⅞″ wide x 8⅛″ high x 20⅜″ long. The double-width case is 5¼″ wide x 8⅛″ high x 22⅝″ long. The additional length of the double-width case accommodates a power supply.

Refer to Bell & Howell "Packaging for Control Systems" brochure.

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BELL & HOWELL