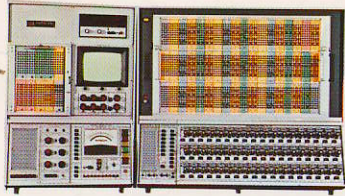


Covers the World

HITACHI 505 Analog Computer






The HITACHI 505 is produced by HITACHI, LTD., the leading manufacturer of Analog Computers in Japan. Not only recognized as a leader among Japanese enterprises, HITACHI also maintains an important and respected position in international business circles.


The HITACHI 505 is an all-transistorized, $\pm 100V$ desk top analog computer offering large machine accuracy and hybrid computer capabilities.

High reliability and extreme stability — thanks to its all solid-state design (even choppers!) — results in easy operation and a totally maintenance-free concept. Expandable modular design permits direct expansion to the maximum limit.


Routine simulations, as well as complex and difficult computations requiring high speed, unique function generation capabilities, and precision can be accurately solved on the HITACHI 505 by the engineer, researcher or scientists.

Hybrid Orientation

 The HITACHI 505 is a well-designed hybrid oriented computer; especially, facilities offered by built-in digital logic elements and further hybrid capability presented by expandability of servo-set computing elements.

 Facilities offered by this ANALOG/HYBRID system are:

- (1) Sequential computation and control facilities
- (2) Track and hold facilities
- (3) Multi-mode control facilities
- (4) Event-counting and time-counting facilities
- (5) Simulation of including logical element

 The HITACHI 505 can organize an ANALOG/DIGITAL hybrid system by combination with a digital computer for general use, presenting a dependable service for analysis of complex scientific problems.

Special Features

1 The computer basically consists of solid-state D.C. amplifiers provided with FET chopper circuits in order to boast high reliability and to eliminate mechanical troubles. These amplifiers have a 100 volt 20 ma output with low drift and a high S/N ratio for extreme accuracy.

2 Electronic mode control integrators are adopted; a flexible selection of integrator gains from 1 to 1,000, and the ratio between real time and time in the high-speed repetitive mode of 1 to 0.001, permit easy operator control for computing and readout speed. Moreover, direct control of the integrator from digital logic elements can be performed.

3 The completely shielded, color-coded, detachable patchboard has been designed with the programmer in mind. Most connections may be made with low-capacity bottle plugs. Also, a unique method for temporary labelling of the potentiometers is provided.

4 Readout of solutions is obtained with a 4-digit DVM or a 3-channel 9" oscilloscope. Repeating operations are synchronously performed with sweep time of the oscilloscope, and operation control is achieved through the oscilloscope. Electronically generated scales are displayed on the tube face, providing an accurate reference during readout of solutions. Solutions are also available externally for a X-Y plotter or other monitoring devices.

5 A timer which can be optionally and independently set up as 3-channels realizes time sequence of every possible combination.

6 Another unique operation element of the HITACHI 505 is a new 2-variable function generator. This is especially effective in aircraft industries, automobile and rolling stock industries, and chemical engineering fields. This two-variable function generator, in particular, is a novel silicon transistor device featuring 25 noninteracting fixed breakpoints. A large selection of other function generators is available for special purposes, including: 3 different fixed breakpoint function generators; 1 variable breakpoint function generator; 2 trigonometric function generators; 2 log function generators; and 2 X² function generators.

Configuration Guide

Components		Suffix Next HITACHI 505 (Ex. HITACHI-505-10)									
Description	Model	10		20		30		40		80	
		Quantity of Units	Quantity of Circuits	Quantity of Units	Quantity of Circuits	Quantity of Units	Quantity of Circuits	Quantity of Units	Quantity of Circuits	Quantity of Units	Quantity of Circuits
Dual DC Amplifier	DA-151	5	10	10	20	15	30	20	40	40	80
Dual Integrator	IN-151	2	4	4	8	6	12	8	16	16	32
Potentiometer Panel	PT-251	1	18	1	18	2	36	3	54	6	108
Potentiometer Patch Unit	PT-151	3		3		6		9		18	
Multiplier	EM-151	—	—	—	—	3	3	5	5	10	10
Function Generator Patch Unit	FG-151	—		—		1		2		4	
Function Generator Card	FG-051 (A)	—	—	—	—	1	1	2	2	4	4
Function Generator Card	FG-051 (B)	—	—	—	—	1	1	2	2	4	4
Function Generator Patch Unit	FG-152	—		—		1		1		2	
Function Generator Card	FG-052	—	—	—	—	2	2	2	2	4	4
Square Function Generators	FG-154A	—	—	—	—	—	—	1	4	1	4
Logarithmic Function Generators	FG-155A	—	—	—	—	—	—	1	4	1	4
Free Diodes	FD-151	1	10	1	10	1	10	1	10	2	20
Voltage Comparators	CP-151	—	—	—	—	1	4	1	4	2	8
Function Switch Panel	FS-151	1		1		1		1		2	
Triangular Wave Generator	TW-051	—		—		1		1		2	
Trunks	TR-151	—	—	—	—	1	40	1	40	2	80
Mode Control Panel	MC-151	1		1		1		1		2	
Readout Panel	OC-151	1		1		1		1		2	
Control Panel	CT-251	1		1		1		1		1	
Timer	TM-253	1		1		1		1		1	
Output Selector Panel	SL-252	1		1		1		1		2	
Overload Indicator Panel	OL-252	1		1		1		1		2	
Power Supply	PS-051	1		1		1		1		2	
Digital Voltmeter	(EI-620)	—		1		1		1		1	
Analog Console	CS-505C	1		1		1		1		2	
Control Console	CS-505B	1		1		1		1		1	
Patch Panel	PP-505	1		1		1		1		2	
Patching Kit	PK-505	1		2		2		3		5	
Test Unit	MU-051	1		1		1		1		1	
Function Generator Setting Unit	FU-051	—		—		1		1		1	
Service Handle		1		1		1		1		1	
Cable for Expansion		—		—		—		—		1	

Digital Voltmeter

This digital voltmeter, with the following properties, is used for digital readings of potentiometer coefficient and amplifier outputs.

Display:	5 digits
DC ranges:	Full scale ± 9.999 plus overrange to ± 12.000 volts Full scale ± 99.99 plus overrange to ± 120.00 volts Full scale ± 750 volts
Ranging:	Manual and automatic
Ratio range:	1:0.0000 to 1:1.2000
Sensitivity:	1 millivolt on basic range, DC and Ratio
Resolution:	0.01% of F.S.
Accuracy:	$\pm 0.01\%$ of reading $\pm 0.01\%$ of F.S. at ASA reference conditions
Input impedance:	10 volt range . . . 1,000 megohms minimum 100 volt range . . . 10 megohms 750 volt range . . . 10 megohms
Polarity:	Automatic polarity indication

Oscilloscope

Independent waveform of three channels can be observed on a large scope display area. Further, repeating operations of the HITACHI 505 can be synchronized with sweep time of oscilloscope.

Main specifications are as follows:	
Indicator unit:	9-inch square cathode ray tube
Vertical axis:	3-channels 200V, 100V, 50V, 20V, full scale, frequency response: 10 KC
Horizontal axis:	Self-exciting sweep: 2S, 1S, 500mS, 200mS, 100mS, 50mS, 20mS, and 10mS (8-steps) External sweep: 200V, 100V, 50V, 20V
Scale:	Electronic: vertical, horizontal 11 each
Brightness control	Each channel can be controlled separately.

Dual Amplifier

Featuring an all solid-state circuit using FET choppers, this dual amplifier has the following capacities.

Output voltage & current:	Above $\pm 100V$, 20 mA
Frequency characteristics:	300 KC min.
Open loop gain (DC):	156 dB type.
Open loop gain (100 cps):	90 dB type.
Open loop gain (1,000 cps):	70 dB type.
Offset voltage:	20 μV type.
Output drift:	50 $\mu V/8h$ max.

In addition to the above, a quad amplifier unit and a high-capacity dual amplifier unit can be utilized.

Dual Integrator

This integrator, using a high-accuracy condenser, can be directly controlled from the output of digital logic or other voltage signals.

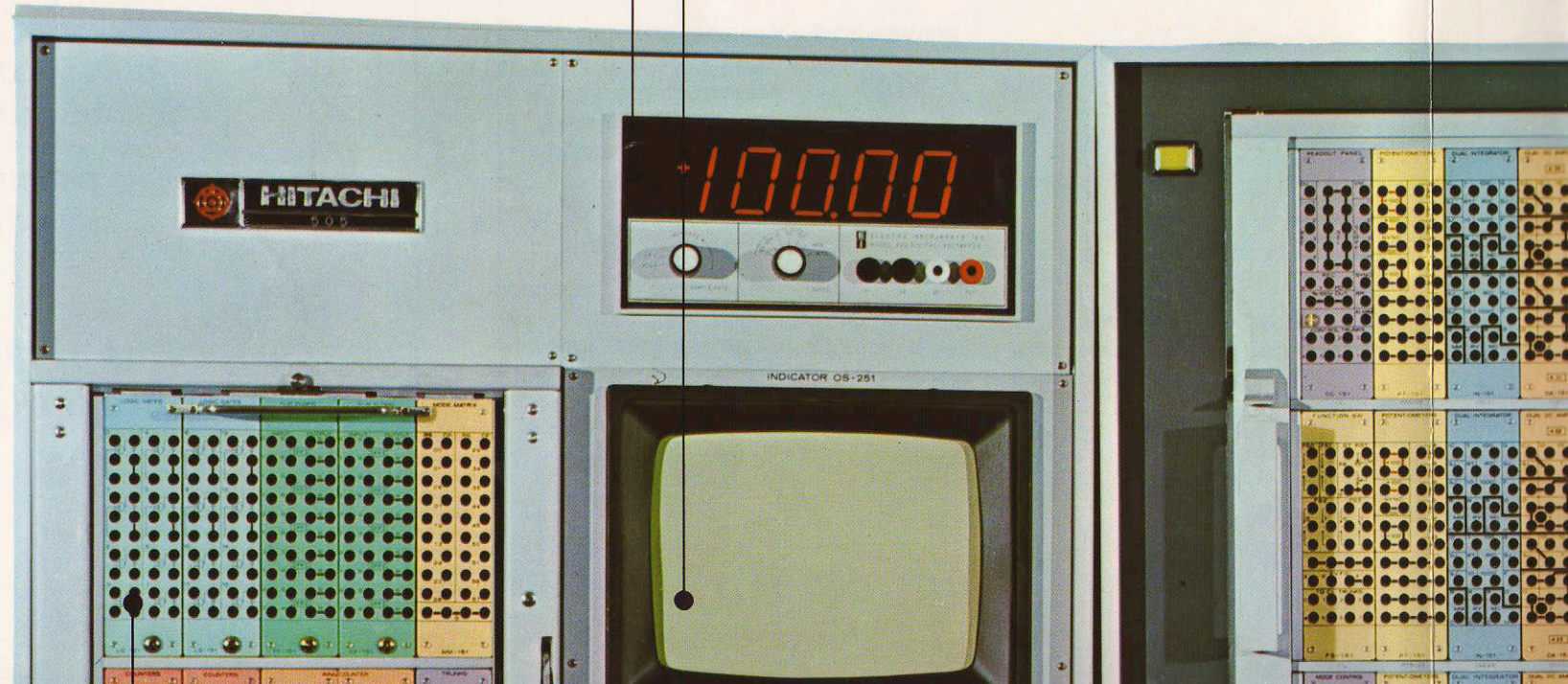
Integrating capacitors:	1 $\mu F \pm 0.01\%$ 0.1 $\mu F \pm 0.1\%$ 0.01 $\mu F \pm 1\%$ 0.001 $\mu F \pm 5\%$ Freely selectable
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Mode control:
High-speed iterative
computing mode: Reset, compute, & hold
In addition to the above, a high-capacity EMC integrator unit is available.

HITACHI

505

analog computer



Multiplier

No adjustment is required for this stable multiplier. High accuracy is obtained by superimposing a triangular wave.

Static error: $\pm 0.05\%$ typ.
Dynamic error: $\pm 0.2\%$ max.
Frequency response: 10 KC (100 V DC \times 100 V p-p)
Operating functions: Multiplication; division; squaring

A high-accuracy multiplier ($\pm 0.02\%$ typ.) is also available.

Function Generator

There are many types of function generators available; however, the following properties comprise a representative one:

Variable function generator
Number of polygonal lines: 10
Maximum slope: 5V/V
Frequency response: 20 KC
Input voltage: 0 to +100 V
0 to -100 V

In addition to the above, a trigonometric function generator unit, square function generator unit, logarithmic function generator unit, two-variable function generator unit, and universal variable function generator unit are available.

Time Delay

This is an electronic transfer delay element based upon padé second order approximation; a fourth order transfer delay circuit can be easily constructed according to required programming.

Delay error: $\pm 2\%$ max. (Range A & B)
Amplitude error: 0.5% max.
Delay range: 0.1 to 10 sec.: A
0.01 to 1 sec.: B
0.001 to 0.1 sec.: C
0.0001 to 0.01 sec.: D

Automatic Operator

Major parts of circuits for solving boundary value problems and for plotted adjustment in parameters are integrated to simplify operations.

Free Diodes

These are diodes for producing nonlinear characteristics such as saturation, dead-zone, hysteresis, and so forth.

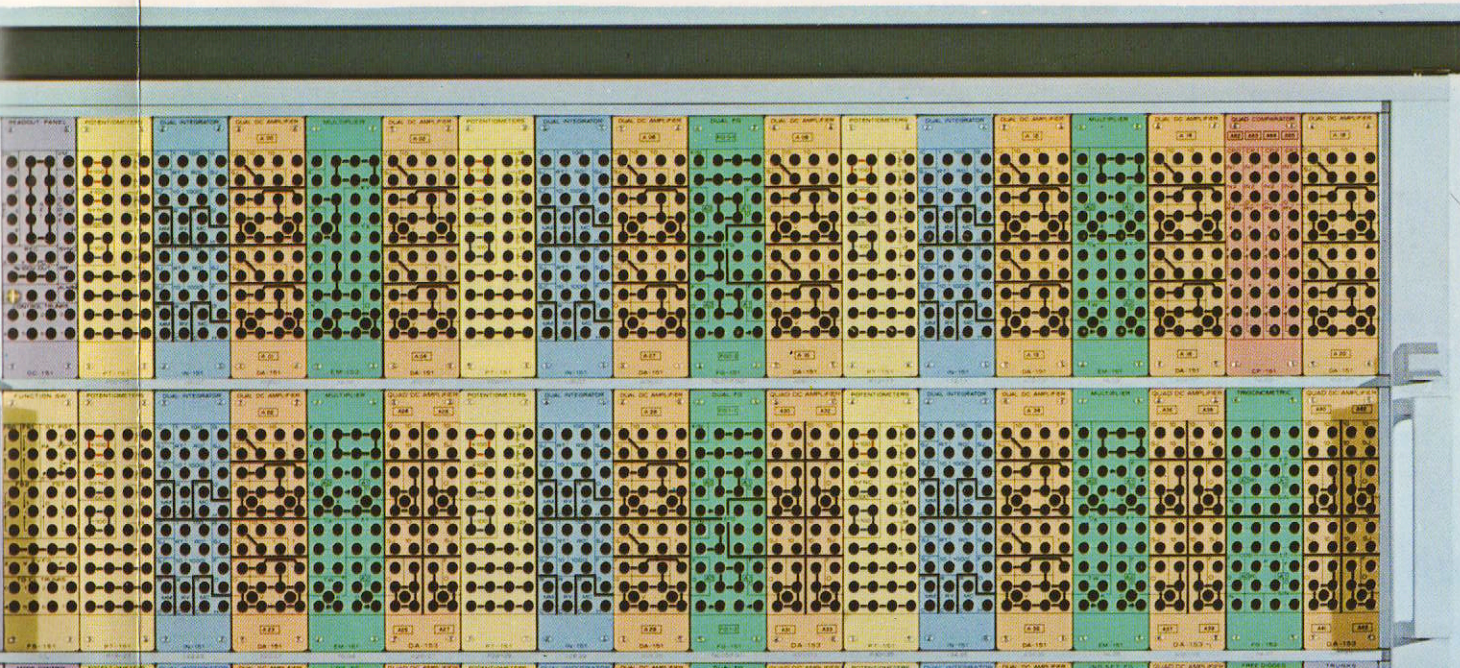
Number of diodes: 10
Number of resistors: 10
Resistance value: $1M\Omega \pm 0.1\%$

Voltage Comparator

This unit, used for voltage comparison, has a built-in amplifier with very small drift and excellent sensitivity.

Number of input: 2 inputs per channel
Sensitivity: 50mV min.
Response time of relay: 5mS max. or $500\mu\text{S}$ max.
Output: DPDT transfer relay output and voltage output (response time $10\mu\text{S}$)

Furthermore, this comparator imparts hysteresis characteristics to the input of amplifier, in order to eliminate the influence of the input noise.



Note

The following components are available as options.

Quad Amplifier

Dual EMC Integrator

High Accuracy Multiplier

Trigonometric Function Generator

Universal Variable Function Generators

2-Variable Function Generators

Square Function Generator

Logarithmic Function Generator

High Speed Voltage Comparator

Analog Switch

Timer

Logic Operator Board

Hybrid Structure

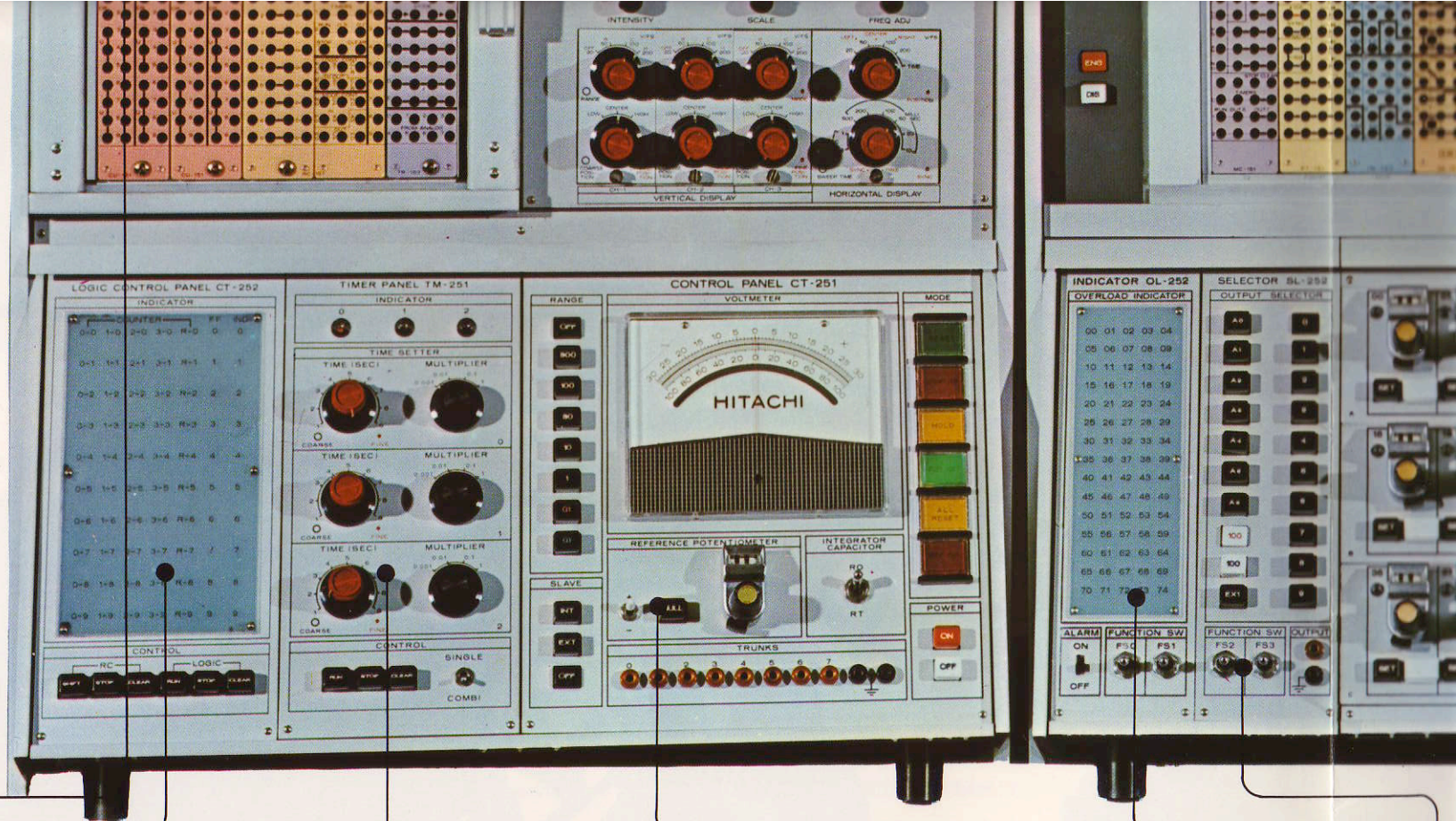
Servo-set Potentiometer

Servo-set Function Generator etc.

Oscilloscope

Potentiometer Indication Plate

Accessory Box



Digital Logic Element

Various logic elements are provided on this unit; used in performing automatic operation and logic circuit simulation by programming on a pre-patch panel.

Supplied elements and quantities are as follows:

Ring counter unit:	1
Mode matrix unit:	1
Flip-flop unit:	2
Logic gate unit:	2
Trunk unit:	1
Counter unit:	2
Pre-patch panel:	1

Timer

This timer is used for iterative computations and repeating operations. By using three independent timers, wide applications become possible. Main specifications are as follows:

- The timer circuits are silicon semiconductors, providing maximum reliability.
- Four steps of the scale 10S, 1S, 100 mS, 10 mS, can be selected on the panel.
- The timers can be controlled either manually or automatically.
- Mode control for the integrator can be operated by the timer output.
A simple 5-step timer for repeating operations is available.

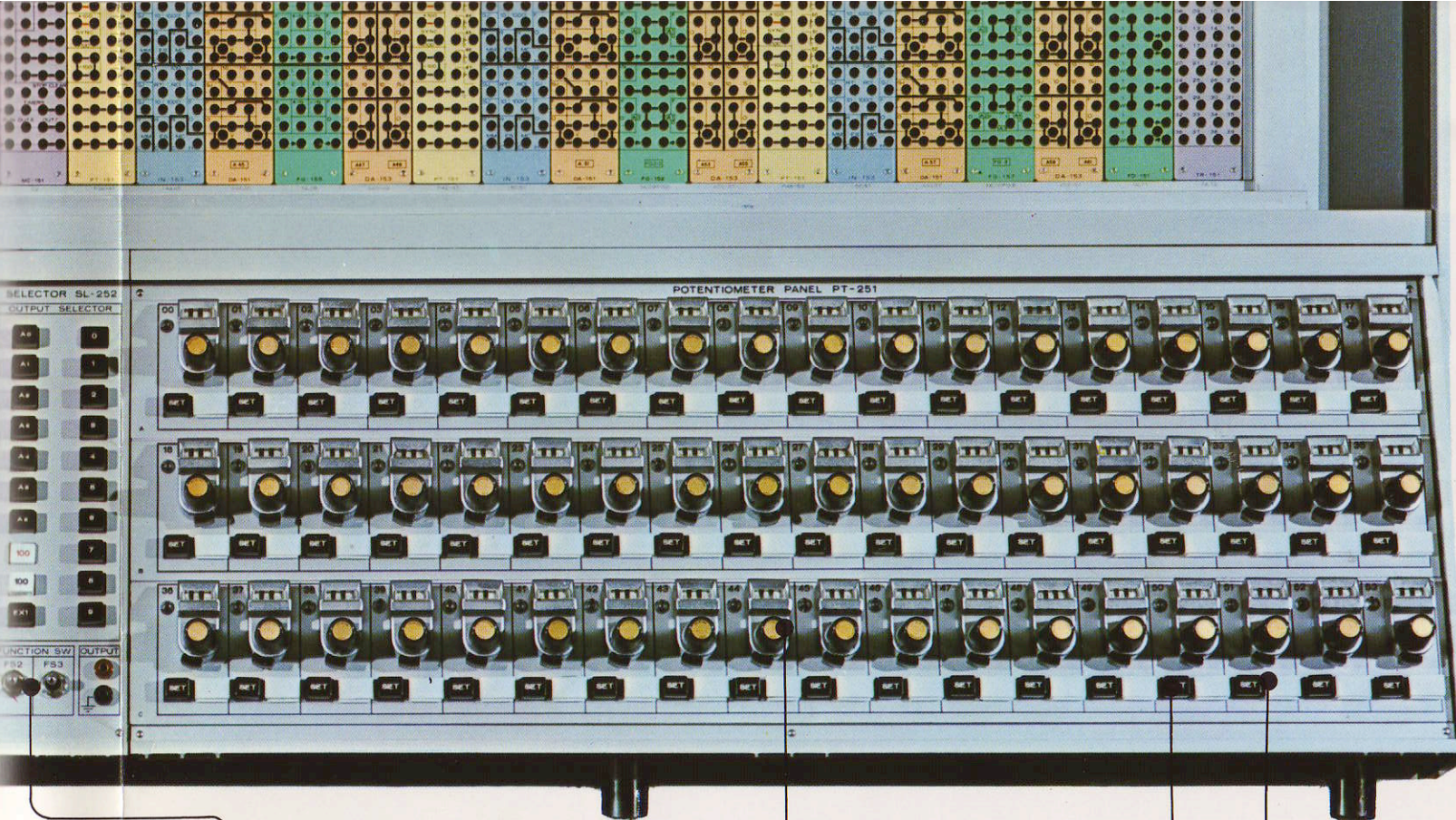
Logic Control Panel

This panel performs various controls of the digital logic element and indications of operation conditions; included are ring counter and flip-flop indications, and manual control.

Control Panel

This panel has the following functions:

- Mode Control
Reset, Compute, Hold, Pot Set, All-Reset and Rep-Op.
- Voltmeter
To improve readout accuracy, this large, square voltmeter is provided with a reflector mirror.
Range: 300V, 100V, 30V, 10V, 1V, 0.1V
- Reference Potentiometer
Linearity: $\pm 0.1\%$
Resolution: 0.01%
Resistance Value: 10K Ω
- Power Control
ON-OFF control of HITACHI 505 power source
- Integrator Capacitor Selection
- Trunks



Output Selector

On this panel the output of the computing elements are selected and called by push buttons. It incorporates the following properties:

- Outputs of maximum 62 DC amplifier and comparators are manually selected by push buttons.
- Standard voltages of positive 100 volts and negative 100 volts are also readout manually by push button selection.
- External signals can be selected.
- Two function switches are provided on the panel, their terminals connected to the function switch panel for manually switching over for optional signal and for ON-OFF operation.

Overload Indicator

This unit indicates overload of the DC amplifiers during computing and reveals unbalance conditions during a balance check by neon lamps, simultaneously generating audible signals. Two function switches are provided on the panel.

Potentiometer Set Buttons

Address selection of the potentiometer is performed by these push buttons. The selected potentiometer is accurately indicated by neon lamp.

Potentiometer

This is a potentiometer with a protective device. It is easy to set up by using an address push button and a digital dial.

Number of potentiometers: 18/panel
 Resistance: 30 K Ω
 Resolution: 0.01%
 Selection indication: Neon lamp

Potentiometer Indication Plate

Symbols in the equation corresponding to the constant set by the potentiometer or operator's notes are written on this plate, held in place by magnetic attraction.

Writing is done by pencil; erasing is easily accomplished for inscribing new symbols.

Size	Analog Console	37½(W)×33¼(H)×22"(D)
	Control Console	22½(W)×33¼(H)×22"(D)
Weight	Analog Console	350 lbs.
	Control Console	180 lbs.
Power Requirements	Voltage	115 V AC
	Frequency	50 or 60 c/s
	Power	500 VA


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