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NEC MODEL TPS-5.5
TERMINAL POTENTIAL STABILIZER

The Model TPS-5.5 Terminal Potential Stabilizer (TPS) accepts signals from a generating voltmeter when operating in GVM MODE or from energy analysis slits when operating in SLIT MODE. Either signal is sent to a vacuum triode which controls the resistance to ground of a set of corona needles facing the high voltage terminal. As the signal varies, resistance to ground varies which controls the rate of charge transferred from the terminal to the corona needles. In this way, the voltage of the terminal is precisely controlled if adequate charging current is provided.

The Model TPS-5.5 also incorporates a signal from Capacitive Pick Off (CPO) plates. This CPO signal adds “derivative control” (dV/dt) to the “proportional control”(V) of either the GVM or SLIT feedback modes of operation. A block diagram is attached which shows the general circuit description of this “proportional plus derivative” control system.

As shown in the diagram, two CPO plates are used so that the summing of their signals minimizes the effect of the column vibration, leaving a resulting signal sum to represent d\V/dt more closely than would the signal from a single CPO plate. This CPO signal is used in both the GVM and SLIT modes and, therefore, in the AUTO mode which is the automatic selection between GVM and SLIT modes of operation. The signals from the two CPO plates are separately amplified and conditioned to drive the signal through the cables to the location of the main TPS control chassis. In this TPS chassis, the signal sum is formed, which is also available for monitoring by an oscilloscope, and the sum is gain-adjusted for use within both the GVM and SLIT control loops.

SUMMARY OF OPERATING MODES

GVM MODE - The GVM signal is amplified and rectified by the GVM amplifier located near the GVM at the pressure vessel. This signal is conditioned to drive a cable to the TPS in the main control console. Within the TPS chassis the signal, which also drives a front panel display showing terminal potential, is compared with the desired terminal voltage (TV) to form the error signal, GVM - TV. GVM - TV is then combined with the CPO signal, conditioned to establish proper gain and phase margins, and is subsequently applied to the grid of the vacuum triode which controls resistance to ground of the corona needles which face the high voltage terminal.

SLIT MODE - Each of the two SLIT signals is logarithmically amplified, sent the TPS chassis and combined to form Log(HE) - Log(LE). This subtraction of logarithms, forming a slit error signal, is dependent on relative transverse beam displacement but independent of beam current. The slit error signal is then combined with the CPO

signal, conditioned to establish proper gain and phase margins, and is subsequently applied to the vacuum triode which controls resistance to ground of the corona needles which face the high voltage terminal.

AUTO MODE - The GVM mode is always selected unless the amount of beam current intercepting both image slit elements exceeds a preset, adjustable value (factory set to 10 nA) and the actual terminal voltage is within 50 kV of the front panel setting of terminal voltage (TV). When these conditions are met and continue to exist, the TPS automatically operates in SLIT mode. When the current on either slit elements drops below the preset slit current threshold, control automatically reverts to GVM mode.

As stated previously, the CPO feedback signal is incorporated in both the GVM and SLIT modes. Without the CPO feedback, the higher values of GVM and SLIT low-frequency gains desired to stabilize the terminal potential cannot by reached without causing the control loop to oscillate. However, with CPO feedback, low-pass GVM and SLIT signal bandwidths can be lessened because the desired higher frequency components are provided by the CPO signal. This allows higher system gains with correspondingly improved DC stability of the terminal voltage. A graph follows which shows actual data taken from the NEC 6SDH-2, 2 MV tandem Pelletron, under control of the Model TPS-5.5, at the Louvre Art Museum in Paris, France.

ADDITIONAL FEATURES

The Model TPS-5.5 is capable of manually controlling and monitoring the position of a motor positioned corona probe assembly.

When used with certain NEC charging controllers, the TPS-5.5 is also capable of preventing the accelerator terminal from reaching an overvoltage condition. This is accomplished through the use of the GVM signal to transfer control of charging current to a predetermined lower charging level whenever the error signal GVM - TV indicates that overcharging is occurring. The value for TV is set via a ten-turn potentiometer.

The standard Model TPS-5.5 has a dynamic corona current control range of 0 - 200 μA. An option is available to increase this range to 500 μA. This is useful when the beam current injected exceeds 100 μA.

SUMMARY

-- Modes - GVM, SLIT, AUTO

-- Includes CPO feedback for fast error correction and improved DC error

-- Overvoltage protection is a settable fraction of the terminal voltage when used with certain NEC charging controllers

-- Probe current linearly proportional to error signal eliminates nonlinear effects of vacuum tube

-- Remote probe position control

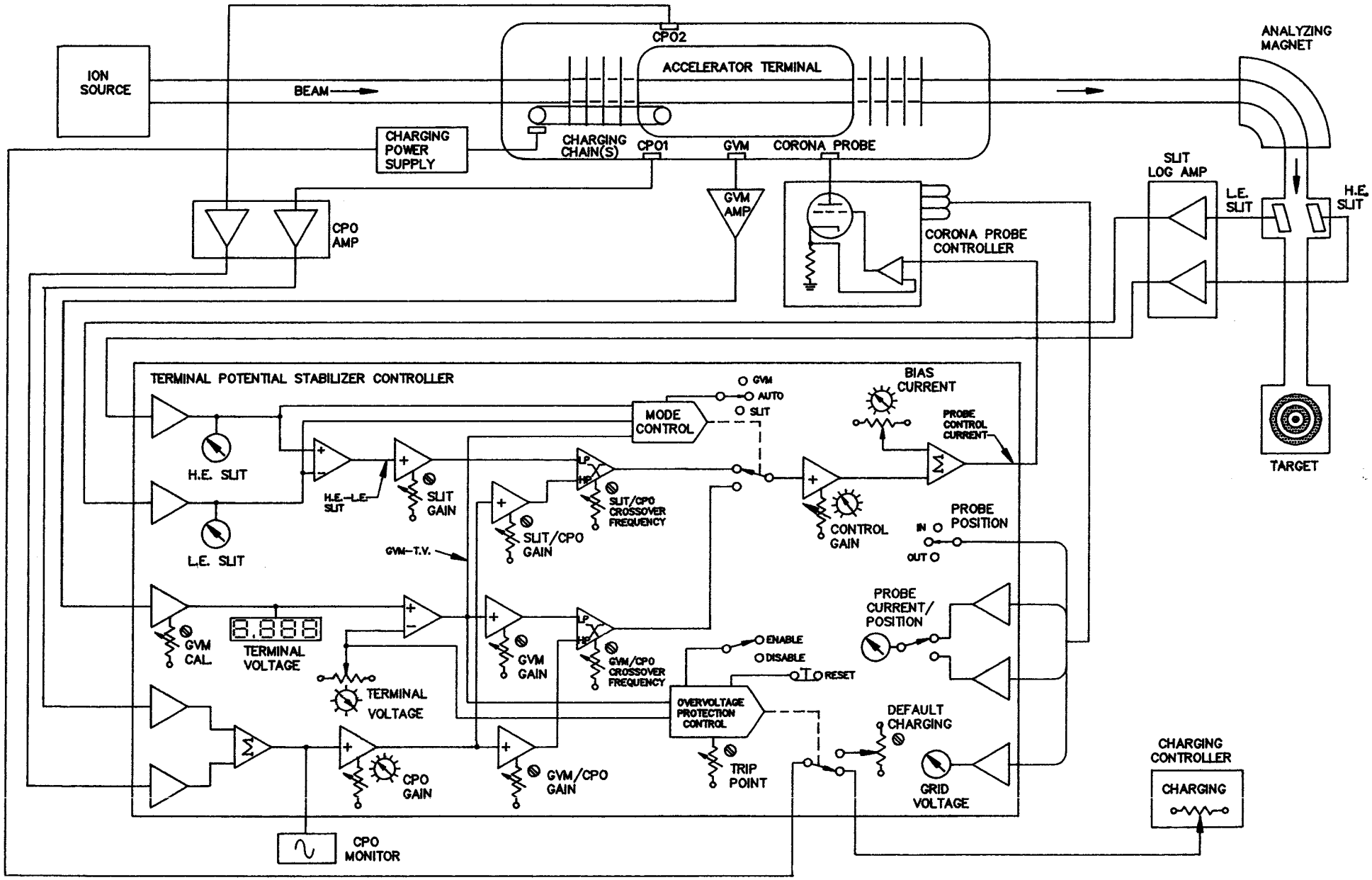
-- Slit log amps for 1 nA to 100 μA

-- Corona probe currents up to 200 μA (500 μA optional)

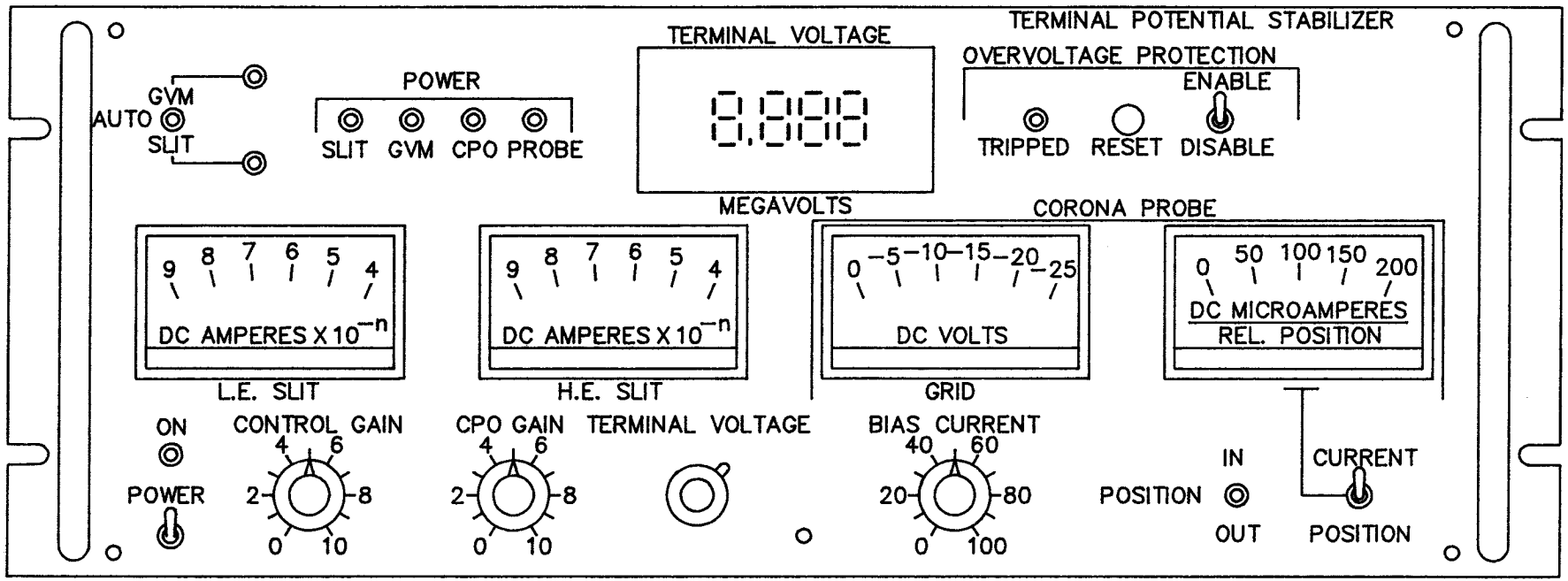
-- Front panel displays of terminal potential, slit currents, grid voltage, probe current/position

-- Data logging of terminal potential, probe current, mode, overvoltage protection status (0 - 10 Volt signal or contact closure)

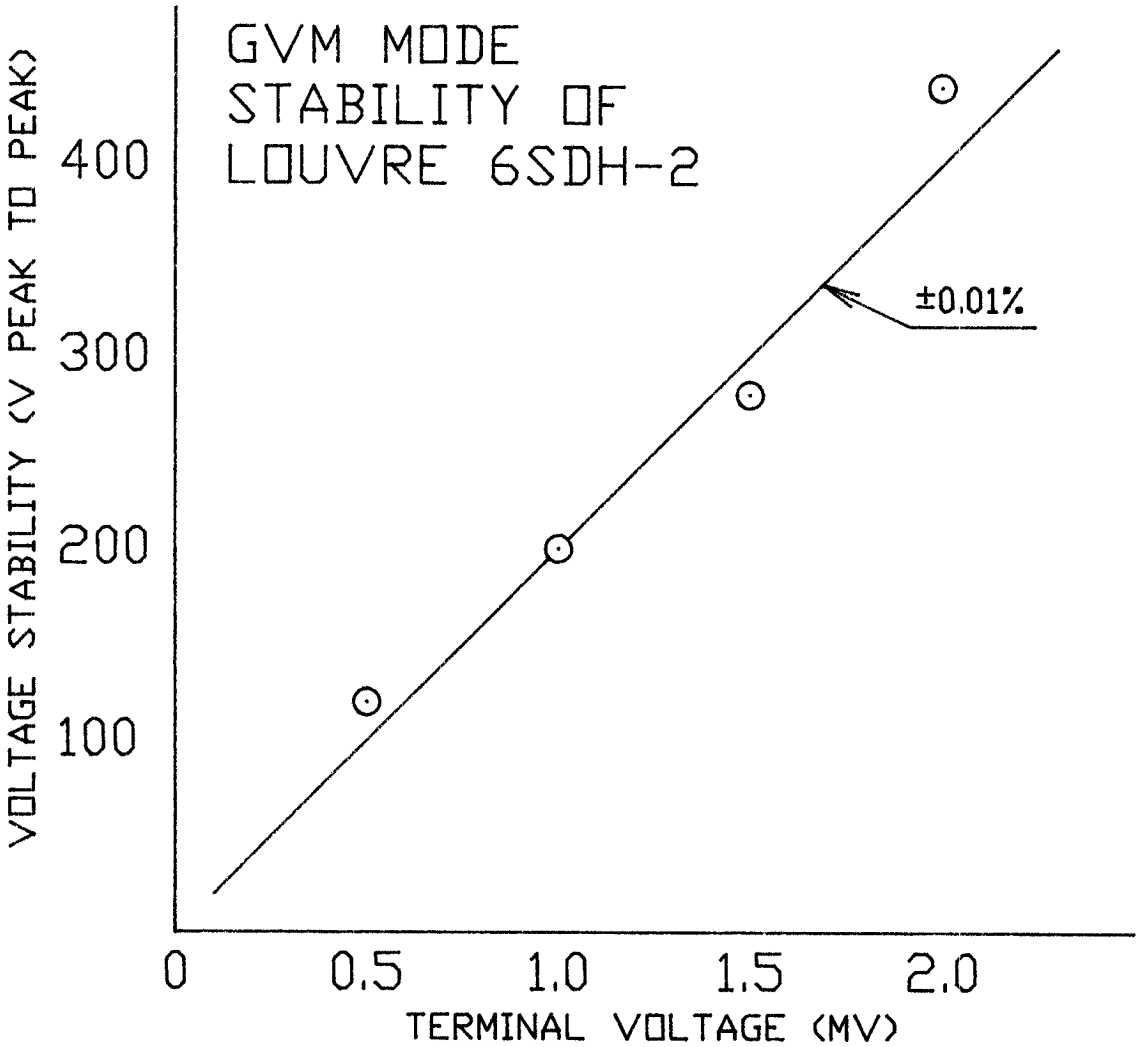
-- Stability ±0.01% when operated on Pelletron system



TPS–5.5 TERMINAL POTENTIAL STABILIZER BLOCK DIAGRAM



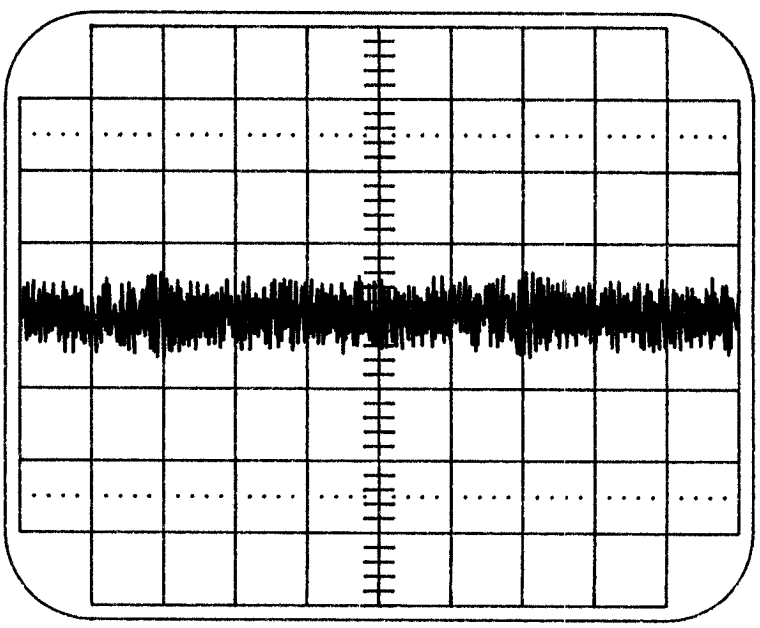
TPS–5.5 TERMINAL POTENTIAL STABILIZER CONTROLLER
FRONT PANEL CONTROLS AND INDICATORS.



CAPACITOR PICK-OFF VOLTAGE

Vertical Scale
0.025%/Div

Horizontal Scale
1 sec/Div



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