

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE 34-T-51	REV	
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 1

R. Hanson

REQUIREMENT FOR COMMERCIAL EQUIPMENT IN APOLLO GSE

SERIES 100 - BLOCK II - LEM COMPATIBLE

1.0 INTRODUCTION

1.1 SCOPE

This document establishes the requirements for the commercial equipment incorporated into the APOLLO GSE consoles. The following commercial equipment is required for GSE monitoring and control functions:

- (a) Galvanometer
- (b) Waveform Generator
- (c) Phase Angle/Phase Sensitive Voltmeter
- (d) Oscilloscope, Dual Beam
- (e) Oscilloscope, Monitor
- (f) Strip Chart Recorder
- (g) Digital Voltmeter
- (h) Counter
- (i) Printer
- (j) Variable DC Power Supply

2.0 APPLICABLE DOCUMENTS

2.1 The following specification and drawings of the issue in effect on the date of this document form a part of this document.

ND Performance/Design & Product Configuration Requirements GSE for Apollo
 ND 2900213 GSE Grounding Mechanization Diagram (Blk II - LEM) G&N System
 ND 2900214 GSE Grounding Mechanization Diagram (Blk II - Series 100 Compatible)

3.0 REQUIREMENTS

3.1 GALVANOMETER

3.1.1 General Requirements - The Galvanometer will be used as a null meter for the voltage bridge in the Precision Current Monitor. This null meter must have a minimum full scale reading of 10 μ volts with a resolution of 1 μ volt to determine that the voltage developed across a current sampling resistor or scale factor resistor has been balanced to within 1 μ volt by a precision calibrated voltage source of opposite polarity. The magnitude of the voltage required to effect a null will vary over a period of time and these variations expressed in parts per million are an indication of the proper operation of the PIPA loop. A full scale range of at least 1 volt with steps down to the 10 μ volt full scale range is required to reduce null meter sensitivity when the bridge error is high at the start of the nulling procedure. Since the null meter is used in a bridge circuit its input impedance must be at 500 K ohm to avoid loading of the bridge sections.

AC*SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 2

3.1.2 DETAILED REQUIREMENTS

1. Use instrument as DC Null Meter (center scale zero)
2. Voltage Range: 10 uv to 1 volt full scale
3. Input Impedance: 500 K Ω or greater
4. Input isolated from chassis and chassis isolated from power low.
5. Input Power: 115 volts + 10% 60 cps
6. 19" standard rack mount 24" max. depth
7. Rear Panel input access only

3.2 WAVEFORM GENERATOR

3.2.1 General Requirements - The Waveform Generator will be used to supply sinusoidal input signals to the airborne stabilization loops to determine the closed loop frequency response. The frequency response curve will be created by determining the loop gain at a number of frequencies in the range of .1 cps to 200 cps. The unit should be capable of supplying at least 10 volts peak to peak into a load of 10 K ohms or greater.

3.2.2 DETAILED REQUIREMENTS

- | | |
|---------------------|--|
| 1. Output Frequency | .1 cycle/sec. to 200 cps
DC level output shall be 0 + 200
mv dc max. at 2V AC P.P. |
| 2. Accuracy | 3% over the required freq. range |
| 3. Waveform | sinusoidal, square |
| 4. Distortion | less than 5% |
| 5. Voltage Output | 0 to 10 volts peak to peak into
a load of 10K ohms or greater.
Output must be isolated from chassis. |
| 6. Power | 115 volt 60 cps (isolated from
chassis and signal low) |
| 7. Dimensions | Rack mount 19" wide less than
24" deep |
| 8. Output Terminals | Output terminals accessible from
rear panel only |

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 3

3.3 PHASE ANGLE/PHASE SENSITIVE VOLTMETER

3.3.1 General Requirements - The Phase Angle/Phase Sensitive Voltmeter is required to measure the total or in-phase component of ac voltages at 800 and 3200 cps. The meter must also measure the angle between the signal and its respective reference. The range of magnitude will be from 1 mv to 30 volts rms. The meter will be used to measure servo error signals and power supply voltages. Therefore, the input impedance should be 500K ohms or greater to avoid loading problems.

3.3.2 DETAILED REQUIREMENTS

1. Measure Total Voltages
2. Measure In-Phase Voltages Harmonic and Quadrature Rejection 40 db min.
Measure Angles (Electrical Phase Shift $0^{\circ} - 360^{\circ}$)
3. Measurement Range 0 - 30 volts rms
4. Frequency of voltages 800, 3200 cps as PAVM
200 cps to 25Kc as VTVM
5. Accuracy:
As voltmeter $+2\%$ FS as VTVM 200-3200 ~
 $+5\%$ FS as VTVM 3200 ~ -17.5KC
 $+10\%$ FS as VTVM 17.5KC to 25KC
 $+3\%$ FS as PAVM 800 and 3200 cps

As angle meter $\pm 1^{\circ}$ from direct dial reading
6. Input Impedance Greater than 500K ohms (800 cps & 3200 cps)
7. Reference Voltage 10 \pm 2 Volts 3200 cps
28 \pm 2 Volts 800 cps
8. Reference Voltage input impedance 25K ohms min.
9. Power 115 volts \pm 10% 60 cps \pm 5 cps
10. Rack Mount: Dimensions 19" wide x 24" deep
11. Input, reference and power isolated from case and from each other.
12. Rear Panel input access only.

3.4 OSCILLOSCOPE, DUAL BEAM

3.4.1 General Requirements - The Dual Beam Oscilloscope will be used in system and subsystem calibration and checkout to observe nulls, check

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 4

noise on power supplies, waveforms and to determine phase relationships between floating, isolated pulses as well as between the output of power supplies and their driving pulses. The vertical plug-in amplifiers must be differential amplifiers or have isolated inputs except for channel 1 of the "B" scope. External isolation transformers with proper shielding may be used. The scope must have two completely independent beams because the time required to operate the electronic switching in a dual trace display is long enough to make the phase relationship measurements erroneous.

Channel 2 of Scope "B" must be isolated. The input impedance should be as high as good design prerequisites allow. The isolation transformers chosen must meet the requirements as specified below.

A delay line (approx. 300 nanoseconds) must be provided between the trigger circuit and the vertical deflection circuit of channel 1 for Scope "B". This delay line may be external to the oscilloscope. In this way, the leading edge of any wave shape could be viewed regardless of synchronization.

3.4.2 DETAILED REQUIREMENTS

1. Horizontal Sweep Generators

- a) Sweep Generator Switching Capability - Two identical generators (A&B). To be used independently, simultaneously, or B sweep delayed by A. In the latter, A is intensified during B.
- b) Sweep range - 1 usec/div to 5 sec/div in calibrated steps. 10X Magnifier to expand any 1 div. --this permits a max. sweep rate of .1 usec/div.
- c) Delay - B sweep delayed by A sweep
Delay period 1 usec to 50 sec continuously adjustable (1-10 times the sweep rate selected on the A sweep generator)
Horizontal Amplifier (External Input)
Sensitivity 100 mv/div adjustable
Z in 100 K
Bandpass dc to 350 Kc
- d) Trigger sense
+ slope selection, ac or dc, A or B sweeps (triggerable by either A or B inputs (internal position)).
Rear Panel access for External A sweep trigger.
Rear Panel input access only.

2. Vertical Amplifier -- Scope A

Differential Input 50 - 1 differential rejection ratio
Z 1 meg//150 Pf
Bandpass dc to 300 Kc
Rise time approx. 1 usec.

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 5

Sensitivity 1 mv/cm - 20v/cm in fixed calibrated steps
with variable uncalibrated over-ride.

This unit will be used to monitor waveforms with a DC level such as DC power supplies, floated signals, and pulses with long duration pulse widths (non-critical rise time). It will also be used for monitoring any signal available from the crossbar. (800 cps, 3200 cps, DC Error Signals, etc.)

3. Vertical Amplifier -- Scope B -- Channel 1 & 2 (Dual Trace)

Rear Panel input access only
Sensitivity 10mv/cm--10v/cm (each channel) in calibrated steps.
Bandpass 400* ω to 10mc*
Rise time 35*nanosecond approx.

*Inputs must be isolated for all input signals for Channel 2 only. The isolation will probably be accomplished by the use of transformers. The type of transformer used will determine the bandpass, input impedance and rise time.

4. Operating Mode Capability

Channel 1 only, Channel 2 only, Chopped, alternate sweep.

5. Channel 1 of Scope B

This channel will only be used to monitor pulses or critical wave shapes. Present critical requirements are: .5 to 10 usec pulse widths, 150 nanosecond rise time, (minimum) 3 volts to 20 volts amplitude, plus or minus polarity (not necessarily referenced to OvdC). The repetition rate for these signals will vary from random non-synchronous pulses to a max. rate of 512 KPPS synchronous.

6. Channel 2 of Scope B

This channel will only be used to monitor the ac error signals that are available to the strip chart recorder via the Oscillograph Select Panel (800 cps and 3200 cps signals)

3.5 OSCILLOSCOPE, MONITOR

3.5.1 General Requirements - The Monitor Oscilloscope will be used to provide a continuous visual indication of the amplified signal generator outputs from the accelerometers and gyros. These signals, in the range of 1mv - 5 volt will be displayed as lissajous figures with a reference signal of 10 volts rms and a frequency of 3200 cps. The figures will indicate the state of the suspension in each instrument.

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE 34-T-51	REV	
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 6

3.5.2 DETAILED REQUIREMENTS

1. Signal Input

- a) 1mv to 5 volts ac
- b) Frequency - 3200 cps
- c) Input impedance -- 500K ohms or greater (Isolated)

2. Reference Input

- a) Input level - 10 ± 2 Vac
- b) Frequency - 3200 cps
- c) Input impedance - 1 megohm or greater (isolated)

3. Power Requirements - 105-125V, 60 cps (isolated from chassis and signal low)

4. Inputs - Rear Panel only

3.6 STRIP CHART RECORDER

3.6.1 General Requirements - The Strip Chart Recorder will be used for system and subsystem testing and trouble-shooting. It will be used wherever time correlated events must be monitored and/or recorded. It will also be used for monitoring events that vary slowly with time or conversely where stability with respect to time must be demonstrated. There are present requirements for monitoring as many as six AC signals simultaneously or 6 DC signals simultaneously plus various other combinations of both. There is no requirement for ever monitoring more than eight signals at any one time.

Therefore, a basic 8 channel recorder used with various combinations of interchangeable AC or DC preamp modules should be used. The combinations of AC or DC preamps in use at any time may be selected electrically or mechanically.

3.6.2 DETAILED REQUIREMENTS

1. AC Preamp Module (Phase Sensitive Demodulator)

- a) Sensitivity : 1mv/mm
- b) Signal input range: 1 mv to 28V
- c) Range Switch (MV/MM): 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000
- d) Reference input range: 9 volts to 115 volts
- e) Input Impedance:

Signal	80 K ohms (min.)
Reference	190 K ohms (min.)
- f) Drift: Less than .25mv/hr. after 3 min. warm-up.
- g) Zero Offset: Must have full scale offset adjustability.
- h) Calibration: Internal, 10 mv from Ref. Signal
- i) Reference Frequencies: 800 cps, 3200 cps
- j) Quadrative Rejection: 80 :1 min.

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 7

- k) Full Scale Deflection: ± 20 mm (Center scale-zero level)
- l) Isolation: Signal and Reference lows isolated from chassis and shielded.
- m) A three position switch must be on front panel of demodulator to select any one of three variable potentiometers. One switch position will switch the calibration pot for $800\sim$ into the reference circuit and another position will switch the calibration pot for $3200\sim$ into the reference circuit. The third position will switch a pot, which is adjustable from the front panel of the demodulator, into the reference circuit to allow the reference phase to be varied throughout the ranges listed below while a signal is being recorded. Two of the pots must be located for internal adjustment only. They must be capable of correcting for a phase shift through a range of $\pm 30^\circ$ from a reference source of 1-50 ohms output impedance. One pot will be used for $800\sim$ and the other for $3200\sim$ phase shift correction during calibration only and will remain fixed, after calibration. The third pot must have a phase shift range of $\pm 50^\circ$ for $3200\sim$ and $\pm 30^\circ$ for $800\sim$ references with the same source impedance as specified above.
- n) The bandpass filter selection must be independent from the carrier frequency selection and calibration functions.

2. DC Preamp Module

- a) Sensitivity: 5mv/mm
- b) Signal input range: 5mv to 400 volts
- c) Range Switch (V/cm): .05, .1, .2, .5, 1, 2, 5, 10, 20, and a 10:1 attenuator switch V/cm to V_{mm}
- d) Input Impedance: 10 megohms (differential input)
- e) Common Mode Rejection: Greater than 40db DC to 100 cps at max. gain
- f) Drift: Less than 2 mv equivalent input/hr. (max. gain)
- g) Isolation: Differential Input (hi and low)
- h) Calibration: .5 volts internally supplied
- i) Zero Offset: Must have full scale offset adjustability.

3. Writing Unit (Pen and Driver)

- a) Linearity: .5% of Full Scale 40mm P/P deflection
- b) Undistorted Amplitude: DC-40cps (40mm P/P), DC-80cps (20mm P/P)
DC-120 cps (10mm P/P)
- c) Response Time: 70% in 5 msec

4. Recorder Main Frame

- a) Speed: $1/2\text{mm/sec}$ to 200mm/sec in calibrated steps; plus a mm/sec to cm/hr switch
- b) Writing method: Ink or electric
- c) Inputs: Inputs to Pre-amps and Drive Modules accessible from rear panel only

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 8

d) Isolation: Power, Signal and Reference lows isolated from chassis and from each other

3.7 DIGITAL VOLTMETER

3.7.1 General Requirements - A Digital Voltmeter is required to measure the magnitudes of the AC and DC power supplies and the signals in the A/B system. The AC voltages will vary in magnitude from 1 mv to 115 volts rms. The DC voltages will vary in magnitude from 1 mv to 250V. A digital readout of 4 digits will be required to give the proper readings. The DVM must have an output coded BCD (8421) code and ten line decimal code capable of driving a printer.

3.7.2 DETAILED REQUIREMENTS

1. Input Range DC - + 1 millivolt to + 300 volts minimum
2. Accuracy DC - + .05% of reading + 1 digit
3. Input Impedance DC - 1 megohm minimum at null or off-null
4. Polarity Sensing - Automatic
5. Input Circuit DC - Signal low shall be DC isolated from chassis and the input circuit shall be AC and DC isolated from the console.
6. Printer Output - BCD coding showing digit readouts (4) and polarity or AC symbol and decimal coding showing decimal point placement.
7. Input Range AC - 1 millivolt to 300 volts minimum rms.
8. AC Accuracy - With a sine wave input the max. error should be as follows:

0 - .9999 Range	+ .1% of reading + 1 digit for 400~ to 3200~
0 - 9.999 and higher ranges	+ .05% of full scale + .1% of the reading for 400~ to 3200~
	+ .05% of full scale + .5% of the reading for 60~
0 - 9.999 volt range	+ .05% of full scale + .5% of reading at 25.6KC
9. Input Impedance AC - .9 megohm minimum for 0 to 9.999 volt range and 1 megohm min for all other ranges
10. Frequency Response - 60 cps to 26 KC
11. Input Circuit AC - Signal low shall be DC isolated from chassis and power low, and the input circuit shall be AC and DC isolated from the console.
12. No. of digits - Four (4)
13. Remote AC/DC mode selection in addition to manual mode selection
14. Print complete - output data to printer inhibited (held constant) until print complete signal is received from printer
15. Single Print command - Printer will print data held in voltmeter whenever command is initiated.
16. Ranging DC and AC - Automatic with a minimum of 3 ranges
17. Power - 115 volts + 10%, 60 cps (isolated from chassis and signal low)
18. Mounting - Standard 19 inch rack.

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 9

3.8 COUNTER

3.8.1 General Requirements - The counter has to perform four functions:

1. count events (accumulate),
2. count events with respect to time (frequency),
3. count time with respect to events (period),
4. count events with respect to other events (ratio).

3.8.2 DETAILED REQUIREMENTS

1. The internal clock frequency must be a unit multiple of a power of 10 (100 KC or greater) so that the counter can display in real time without need of a conversion factor. The clock should have a frequency divider control (unit multiples of powers of 10) so that the count gate enable period can be extended during frequency function and a greater time interval can be displayed during a period function.
2. The count gate enable period must be controlled by a preset counter (N_1) for all functions except count. In the count function position the count gate is always enabled (must be manually reset).
3. The counting devices must be able to count forward or backward; however, the direction of counting will be fixed with respect to the input. A visual display must indicate whether the accumulated count is + or - and when the count gate is enabled.
4. Inputs (Rear panel access only)
 - a) A Input: 1 mc count rate (maximum), 1 volt rms minimum sensitivity. (Data input)
 - b) B Input: 100 KC count rate (maximum), 1 volt rms minimum sensitivity. (Data input)
 - c) C Input: 100 KC count rate (maximum), 1 volt rms minimum sensitivity. (External Clock Input)
 - d) D Input: 100 KC count rate (maximum), 1 volt rms minimum sensitivity. (Gate Control Data Input)

NOTE: All inputs except "C" must have individual attenuation and + slope (trigger) controls.

5. Input Select - Front Panel Switch

- a) A "A" input is connected to the counting units.
- b) A-B "A" input is connected to the forward counting units
"B" input is connected to the backward counting units

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 10

- c) C-sense "C" input (either internal clock or external C) is connected to the counting units

6. Function Select - Front Panel Switch

- a) Count - Either A or A-B inputs will be counted until manually reset.

$$\text{equation} = \frac{A}{\text{count gate enabled}} \quad \text{or} \quad \frac{A-B}{C_{ge}} \quad (C_{ge})$$

- b) Frequency - Either A or A-B inputs will be counted for a preset standard period of time.

$$\text{equation} = \frac{A}{N_1 C} \quad \text{or} \quad \frac{A-B}{N_1 C} \quad \text{or} \quad \frac{A}{N_1 C/X} \quad \text{or} \quad \frac{A-B}{N_1 C/X}$$

NOTE: C can be reduced by the frequency divider (C/X)

- c) Ratio or Period - Either A, A-B or C is counted for a present number of D inputs.

$$1. \text{ equation (Ratio)} = \frac{A}{N_1 D} \quad \text{or} \quad \frac{A-B}{N_1 D}$$

$$2. \text{ equation (Period)} = \frac{C \text{ int}}{N_1 D} \quad \text{or} \quad \frac{C \text{ ext}}{N_1 D} \quad \text{or} \quad \frac{C \text{ int/x}}{N_1 D}$$

- d) N_1 Test - Test of N_1 Preset

$$\text{equation} = \frac{N_1}{N_1 C}$$

7. Outputs:

- a) Visual

1. 6 digit in-line readout
2. gate open light
3. + or - accumulated count

- b) Electrical

1. N_1 gate pulse (occurs after N_1 events)
2. 6 digit BCD Data and symbol (+, -) for printer 8421 code
3. Contact closure to indicate positions of Function Select and Input Select switches.

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 11

8. Misc. Controls (Front Panel)

a) Clock frequency divider

$10^0, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}$ (positions)

b) Manual reset

c) Variable display time control (Discrete Decade steps and an infinite position)

d) 6 digit Preset (N_1) Count Selector

3.9 PRINTER

3.9.1 General Requirements - A Printer is required to record the information obtained from a DVM, a reversing preset counter and the computer test set switching unit. This information will be presented to the printer coded as ten line decimal or BCD. The printer must accept both codes and must be able to print up to a maximum of 12 columns of data.

3.9.2 DETAILED REQUIREMENTS

1. Twelve columns per line

2. DVM Input (Print out is black)

Column Numbers

10, 11, 12
8
9

Signal code (0-9) }
Decimal point (0-7) } 10 line
Blank (0-9) } Module

7
2, 3, 4, 5
1, 6

Symbols +, -, AC, * } 4 line BCD
Voltage Data (0-9) } Module (8421)
Blank (0-9) } (Code)

3. Counter Input (Print out is red)

Column Numbers

8, 9, 10, 11, 12
7

Signal & Function coding } 10 line Module
Symbol +, - } 4 line BCD

1, 2, 3, 4, 5, 6

Counter Data } Module (8421)

4. AGC Input (Print out is red)

Column Numbers

8, 9, 10, 11, 12
7
6

Blank (10 line modules)
Blank
Signal Code } 4 line module BCD (8421)

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51		REV
	BY W. Hines	DATE Sept. 20, 1965	TOTAL PAGES 13	PAGE 12	

4. Column Numbers (Continued)

1, 2, 3, 4, 5 Data)

5. Print Command - Manual & Automatic

6. Max. Print Rate - 3 lines/sec. or greater

7. Power - 115 volts \pm 10% 60 cps

8. Print Complete Signal -- Releases data source when printer has been loaded.

9. Inputs - Accessible from rear panel only and isolated.

3.10 VARIABLE DC POWER SUPPLY

3.10.1 General Requirements - A Variable DC Power Supply is required to check the guidance and navigation system for proper operation at the high and low limits of spacecraft input voltage. The nominal voltage output should be +28 volts dc and be continuously variable to \pm 15% of the nominal when delivering 50 amp. The output impedance (DC to 4Kcps) should be a maximum of .08 ohms (from remote terminals looking towards power supply). The unit must be capable of having its output shorted with no damage to the supply and an over voltage protection network, to protect the A/B in event of excessively high output voltages, must also be included.

3.10.2 DETAILED REQUIREMENTS

1. Input Requirements

- a) Voltage 105 - 125 single phase
- b) Frequency 50 - 60 cps

2. Output Requirements

- a) Voltage +28 VDC continuously variable +25V to +32V at remote sense terminals. (Resolution: 250 mv. min.)
- b) Current 50 amps over the adjustable voltage range
- c) Ripple - 10 mv max. (DC to 120 cps)
- d) Noise - 250 mv (Frequencies 400 cps and above)
- e) Short circuit protection required to prevent damage to power supply if output terminals are shorted.
- f) Output impedance (from remote terminals) at DC .010 ohms maximum, DC-4KC .08 ohms, 4KC-100KC .8 ohms
- g) Isolated from chassis and power low (input power transformer should be adequately shielded)

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	EXPERIMENTAL DESIGN EXHIBIT	XDE	34-T-51	REV
	BY W. Hines	DATE	Sept. 20, 1965	TOTAL PAGES 13 PAGE 13

- h) Stability - 1 $\frac{1}{8}$ hr
- i) Regulation - Variations due to: Line .5%, Load .5%
- j) Standard 19" mount rack
- k) Over-voltage protection - The voltage at the remote terminals shall not rise above +38 VDC in the event that loss of remote sense control or remote voltage adjust control should occur.

Approved:

W. J. Cattoi
W. J. Cattoi - Group Head
System Mechanization
APOLLO GSE

WJH/sj

W. J. Hines *MRC*
W. J. Hines
System Mechanization
APOLLO GSE