MIL 1018 REV 963

R. Larson

AC SPARK PLUG DIVISION General Motors Corporation Milwaukee, Wisconsin	XDE 34-T-35
	ENGINEERING DESIGN INFORMATION EXHIBIT
APOLLO GSE OSCILLOGRAPH SIGNAL SELECTOR BLOCK I (SERIES 100) SYSTEM DESIGN CRITERIA	By W. Hines / Date 2/3/65

1. SCOPE

1.1 This document establishes the system performance for the Apollo GSE Oscillograph Signal Selector (hereinafter referred to as the RSS) Panel.

2. Applicable Documents

2.1 Unless otherwise indicated, the following documents shall form a part of this design criteria:

1002018	General Specification for Apollo Ground Support Equipment
1902164	Diagram, Mechanization Oscillograph Signal Select
1902166	Diagram, Mechanization Measurement Reference Power Supplies.
1902168	Diagram, Mechanization GSE Grounding
1902160	Diagram, Mechanization Test Select Panel (TES)
1902163	Diagram, Mechanization Signal Selection and Measurement
XDE-34-T-32	Signal Identification & Test Point Location for Series 100 GSE

3. REQUIREMENTS

3.1 General - The function of the RSS in the Optics Inertial Analyzer (OIA) is to provide signal and reference selection to the eight Oscillograph channels and to the "B" Scope, and to provide reference voltages to the GSE monitor equipment as per XDE-34-T-32.

3.2 Circuits - The circuits required in the RSS to perform the necessary systems and subsystems functions are as follows:

3.2.1 800 cps, 0° Buffer Amplifiers required to buffer and isolate the following:

a. 800 cps 28 V 1% IMU

b. 800 cps 28 V 1% Optics

3.2.2. 800 cps, 90° Buffer Amplifiers required to buffer and shift the phase of the following:

a. 800 cps 0° ISS Ref.

b. 800 cps 0° Optics Ref.

3.2.3 A 3200 cps Buffer Amplifier is required to buffer and isolate the 3200 cps 2 V Feedback.

3.2.4 A variable 800 cps phase shifter and selector is required to select and shift the phase of either of the following:

a. 800 cps 0° ISS Ref.

b. 800 cps 0° Optics Ref.

3.2.5 A variable 3200 cps phase shifter is required to shift the phase of the 3200 cps Ref.

3.2.6 Oscillograph Signal and Reference Selectors are required to couple signals and reference voltages to the fixed oscillograph channels as follows:

a. Oscillograph Channel 1 AC

b. " " 2 AC

c. " " 7 DC

d. " " 8 DC

3.2.7 Oscillograph Signal and Reference Selectors are required to couple signals and reference voltages to the switchable oscillograph channels as follows:

a. Oscillograph Channel 3 AC/DC

b. " " 4 "

c. Oscillograph Channel 5 AC/DC

d. " " 6 "

3.2.8 Scope Signal and Reference Selectors are required to isolate and couple signals and references to Scope "B" (lower beam) as follows:

a. Scope "B" Input (Channel 2)

b. Scope "B" Reference (Ext. Horizontal Input)

3.3 Performance - The circuits listed in paragraph 3.2 shall perform to the following requirements.

3.3.1 800 cps 0° Buffer Amplifier

3.3.1.1 Input Signal - The amplifier shall perform as specified with 28 V rms ± 1 per cent, 800 ±8 cps applied across its input. The input shall be isolated from the output, Signal Lo, Power Lo, & chassis ground.

3.3.1.2 Output Phase - The output voltage phase with respect to the input voltage shall be 0° ±1°.

3.3.1.3 Output Signal - With the following loads applied, the amplifier output signal shall be 30V rms max with less than 1 per cent distortion:

a. Minimum Load: 1.5K ±5 percent resistor.

b. Nominal Load: 1K ± 5 percent resistor, in parallel with a 0.01 μfd ± 5 percent capacitor in parallel with a 500 mh ± 5 percent inductor.

c. Maximum Load: 700 ±5 percent resistor, in parallel with a 0.01 μfd ± 5 percent capacitor, in parallel with a 100 mh ± 5 percent inductor.

3.3.1.4 Voltage Gain - The amplifier shall have a voltage gain of 1V/V ± 1 percent.

3.3.1.5 Voltage Gain Stability - The amplifier shall have a voltage gain stability of ± 1 percent with respect to time and temperature.

3.3.1.6 Input Impedance - The input impedance of the amplifier shall be 75 K ohms or greater.

3.3.1.7 Noise - The noise of the amplifier shall be less than 50 mv with the input shorted and the following applied loads:

a. 700 ± percent resistor in parallel with a 0.01 μfd ±5 percent capacitor, in parallel with a 100 mh ± percent inductor.

b. 1.5K ±5 percent resistor in parallel with a 0.01μfd ±5 percent capacitor, in parallel with a 100 mh ±5 percent inductor.

3.3.1.8 Distortion - The distortion of the amplifier shall be less than 1 percent with conditions specified in para. 3.3.1.1 and 3.3.1.3.

3.3.2 800 cps, 90° Buffer Amplifier

3.3.2.1 Input Signal - The amplifier shall perform as specified with 28V rms ±1 percent 800±16 cps applied across its input.

3.3.2.2. Output Phase - The output voltage phase with respect to the input voltage shall be 90° ±1.5°

3.3.2.3 Voltage Gain - The amplifier shall have a voltage gain of 0.39 V/V ±2 percent.

3.3.2.5 Input Impedance - The input impedance of the amplifier shall be 8.5K ohms or greater.

3.3.2.6 Noise - The noise of the amplifier shall be less than 100 mv rms with the input shorted and a load across its output consisting of 4000 ohm ±5 percent resistor connected in parallel with a 4700 μf ±5 percent capacitor.

3.3.2.7 Distortion - The distortion of the amplifier shall be less than 1 percent with conditions specified in para. 3.3.2.1 and 3.3.2.3.

3.3.3 3200 cps Buffer Amplifier

3.3.3.1 Input Signal - The amplifier shall perform as specified with 2V rms ±2 percent, 3200 cps ±2 percent applied across its input. The input shall be isolated from the output, signal Lo, Power Lo & chassis ground.

3.3.3.2 Output Phase - The output voltage phase with respect to the input voltage shall be $0^{\circ} \pm 1^{\circ}$.

3.3.3.3 Voltage Gain - The amplifier shall have a voltage gain of 5.5±2.0 percent.

3.3.3.4 Voltage Gain Stability - The amplifier shall have a voltage gain stability of ±1 percent with respect to time and temperature.

3.3.3.5 Input Impedance - The input impedance of the amplifier shall be 100K ohms or greater.

3.3.3.6 Noise - The noise of the amplifier shall be less than 100 mv with the input pins shorted.

3.3.3.7 Distortion - The distortion of the amplifier shall be less than 1 percent with conditions specified in para. 3.3.1.1 and 3.3.1.3.

3.3.4 Variable 800 cps Phase Shifter and Selector

3.3.4.1 Input Signal - Shall have the capability of being switched from 800 cps ISS to 800 cps Optics and have a lighted indicator designating which is selected. The phase shifter shall perform as specified with 28.0 ± 0.25 volt rms, 800 cps ± 0.1% excitation.

3.3.4.2 Phase Accuracy & Rotation - With 0° on the indicator the phase of the output of the phase shifter shall be within $\pm 1^{\circ}$ of both of the 800 cps buffer amplifier inputs. With the variable phase angle indicator varied from 0° through 360° the phase of the output shall lead the input to the 800 cps 0° buffer amplifiers within $\pm 3.5^{\circ}$ of the indication. The variable phase angle indicator shall be graduated in increments of 2° maximum.

3.3.4.3 Output Signal - With a 20K ohm load the output shall be adjustable from 24.15 volts rms to 31.5 volts rms. The variation in output voltage amplitude for phase rotation from 0° through 360° shall be ± 4% maximum with respect to the 0° output.

3.3.5 Variable 3200 cps Phase Shifter

3.3.5.1 Input Signal - The phase shifter shall perform as specified with 11.0± 0.1 volts rms, 3200 ±3.2 cps excitation.

3.3.5.2 Phase Accuracy & Rotation - With 0° on the indicator the phase of the output of the phase shifter shall be within $\pm 1^{\circ}$ of the 3200 cps buffer amplifier input. With the variable phase angle indicator varied from 0° through 360° the phase of the output shall lead the input to the 3200 cps buffer amplifier within $\pm 3.5^{\circ}$ of the indication. The variable phase angle indicator shall be graduated in increments of 2° maximum.

3.3.5.3 Output Signal - With a 20K ohm load the output shall be adjustable from 9.2 volts rms to 12.0 volts rms. The variation in output voltage amplitude for phase rotation from 0° through 360° shall be $\pm$ 4% maximum with respect to the 0° output.

3.3.6 Oscillograph Signal and Reference Selector (Fixed Channels)

3.3.6.1 Circuit Capability - The selector shall be capable of switching dry circuit level AC or DC signals. Only one type of signal will be used at any time, therefore the AC and DC signals must be on separate sections of the selector with a capability of switching between sections when the oscillograph preamplifier is changed from AC to DC or DC to AC. The selection of a DC section will be made by a ground supplied when a DC preamplifier is installed. The AC preamplifier (demodulator) will break this ground and select the AC section.

Each selector shall have a minimum of 15 signal positions and an off position. One of the signal positions shall be an auxilliary position on which any desired signal may be applied.

The proper reference to the AC demodulator shall be selected automatically when an AC signal is selected. The reference for an AC signal applied to the auxilliary input will be selected externally.

3.3.7 Oscillograph Signal and Reference Selector (Switchable channels)

3.3.7.1 Circuit Capability - The selector shall have the same capabilities as the fixed channels in 3.3.6.1 with some additional requirements.

Since a DC preamplifier and an AC demodulator will always be in the switchable channels some additional switching will be required. A manual AC/DC selector is required to supply 27 VDC to a switching circuit in the Oscillograph Console for DC preamplifier selection.

3.3.8 Scope "B" Signal and Reference Selector

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3.3.8.1 Circuit Capability - The selector circuit shall be capable of switching dry circuit level signals and selecting one of nine signal positions or an off position. One of the signals shall be an auxiliary input position originating from an external source. The output shall be transformer isolated. The isolation transformer shall meet the following requirements:

a.	Voltage Ratio	At 1000 cps shall be 1:1 ±1%.
b.	Inductance	Shall be 2 henries minimum with 8 volts, 1000cps, 5 madc.
c.	Phase Shift	At 1000 cps shall be 1° maximum.
d.	Frequency Response	Shall be ±1 db from 300 cps to 100 KC with no peak greater than 3 db below 500 KC. Phase shift shall be 45° maximum from 20 cps to 500 KC.
e.	DC Resistance	Shall be 48± 6 ohms for the primary and secondary windings.

W. Hines mcc

W. Hines
Systems Mechanization
APOLLO GSE

W. J. Cattoi

W. J. Cattoi Group Head
Systems Mechanization
APOLLO GSE

WH:lr