

OPERATING AND SERVICE MANUAL

K05-5060A

LINEAR PHASE COMPARATOR

SERIAL NO. S-7418 AND ABOVE

00000-8-21

OPERATING AND SERVICE MANUAL

FOR

K05-5060A

LINEAR PHASE COMPARATOR

SERIAL NO. S-7418 AND ABOVE

The Model K05-5060A Linear Phase Comparator receives a frequency standard signal of 100 kHz, 1 MHz, or 5 MHz on one channel and the same frequency from a second source on another channel. These two frequencies are processed within the instrument to provide a dc output which is proportional to the phase difference between the two input signals. The dc output can be used to drive a potentiometer or galvanometer type recorder for a permanent record of the phase difference.

PREPARATION FOR USE

Set 115/230 volt switch on the rear panel to expose the correct numbers for the ac line voltage used. Connect power cord to the instrument and an ac receptacle. Turn power switch on and select 5 MHz, 1 MHz, or 100 kHz position to correspond with the frequencies to be applied. To calibrate the ZERO ADJ and FULL SCALE ADJ controls, apply the same input frequency source to both INPUT 1 and INPUT 2. Then connect the recorder to be used to the rear panel OUTPUT jack. Push ZERO ADJ button and adjust ZERO ADJ control for zero output as indicated on the recorder. Push FULL SCALE ADJ button and adjust FULL SCALE ADJ control for full scale on recorder. The adjustment range of the front-panel FULL SCALE ADJ control may be centered by the COARSE FULL SCALE control on the rear of the instrument. Repeat the zero and full scale adjustments until both outputs are correct.

OPERATION

After the K05-5060A is calibrated, connect the two frequencies to be compared to INPUT 1 and INPUT 2. The input level should be between 0.5 V rms and 1.1 rms for both inputs. The dc for driving a recorder is from the rear panel OUTPUT jack. Use both OUTPUT terminals, since both are above ground.

CIRCUIT DESCRIPTION

The K05-5060A power supply circuits provide regulated +20 volts dc to operate the instrument. The output voltage is adjustable by a control mounted on the power supply printed circuit board. Input voltage to the K05-5060A can be 115 or 230 V ac, $\pm 10\%$, 48 to 440 Hz as selected by a rear panel SELECTOR switch.

The K05-5060A phase comparator assembly circuits consist of two channels which receive the two input signals to be compared and control the on/off duty cycle of a flip-flop circuit. The rectangular wave output from the flip-flop is integrated to give an output dc signal which is proportional to the phase difference between the two input signals. For 5 MHz and 1 MHz input frequencies, an oscillator is switched in and heterodyned with the input signals to produce a 50 kHz signal in both channels.

The full scale width of the Recorder chart is equal to the period of the input signal (that is, for 1 MHz input, chart width is 1 microsecond). To compute the frequency error of the frequency under test, use the relation-

ship $E = \frac{\theta}{T}$; where E is the frequency error, θ is the measured phase difference in microseconds, and

T is the elapsed measurement time in microseconds. For example, if the Recorder chart indicates a full width variation (1 microsecond for 1 MHz input signal) during an elapsed measurement time of 1 hour, the frequency error is:

$$E = \frac{\theta}{T} = \frac{1}{(60)(60)(1 \times 10^6)} = 3.2 \times 10^{-10} \text{ or } 3.2 \text{ parts in } 10^{10} \text{ frequency error.}$$

Encl: None
maa75028



INTERNAL ADJUSTMENTS

The K05-5060A has three internal adjustments; two on phase comparator assembly A1 and one on power supply assembly A2. Schematic diagrams are included for these two assemblies. Adjust the controls as outlined in the following steps:

- a. Remove K05-5060A top and bottom covers. Apply power by connecting power cord to rear-panel jack and ac line.
- b. Connect a DC Voltmeter between red and black wires providing the output from power supply assembly printed circuit board on bottom of instrument.
- c. Adjust control A2R10 for +20 volts dc output. Disconnect DC Voltmeter. The power supply is protected from overload or a short circuit by an internal circuit in integrated circuit A2U1.
- d. Set selector switch to 5 MHz and apply 5 MHz signal at INPUT 2.
- e. Connect Oscillator to Q4 collector (on phase comparator assembly A2 at top of instrument). Tune L4 to 50 kHz. The signal will be approximately 1 volt peak-to-peak.
- f. Connect Oscilloscope to Q9 base. Signal should be a negative pulse of approximately 1 volt.
- g. Set selector switch to 1 MHz and apply 1 MHz signal at INPUT 1.
- h. Connect Oscilloscope to Q14 collector. Tune L3 to 50 kHz (approximately 1 volt p/p signal).
- i. Connect Oscilloscope to Q10 base. Signal should be negative pulse (approximately 1 volt). This completes the adjustments.



TABLE OF REPLACEABLE PARTS

CKT REF.	HP PART NO.	DESCRIPTION
A1	05060-92068	Phase Comparator Board Assembly
A2	05060-91170	Power Supply/Input Assembly
The above assemblies are listed separately in later pages.		
C1	0180-2188	C: fxd, alum elect, 1500 μ F, 40 Vdcw
DS1	1450-0419	Indicator light, neon/white lense
F1	2110-0018	Fuse: 0.25 amp, slo-blo, 115 V
	2110-0017	Fuse: 0.15 amp, slo-blo, 230 V
J1	1251-2357	Receptacle, power: 3-pin, male
J2, J3	1250-0083	Connector: BNC
J4	1510-0008	Binding post: red
J4	0340-0086	Insulator binding post
J4	1510-0009	Binding post: black
J4	0340-0090	Insulator binding post
P1		Power cord plug (part of W1)
Q1	1854-0063	Transistor, Si: NPN type 2N3055
R1-R6	-----	Not Assigned
R7	2100-0408	R: var, comp, 250 ohms 30%, 1/2W
R8	2100-0067	R: var, comp, linear, 250 ohms 10%, 1/2W
R9-R11	-----	Not Assigned
R12	2100-0153	R: var, comp, linear, 2000 ohms 2%, 1/2W
S1	3101-0030	Switch, power: SPST
S2	3101-1234	Switch, Slide: DPDT (115/230V conversion)
S3	05060-92049	Switch, Rotary: 2 pole 3 position
S4, S5	3101-0014	Switch, push button
T1	9100-3013	Transformer, power
W1	8120-1348	Power cord
XF1	1400-0084	Body, fuseholder

MISCELLANEOUS

5060-8575	Cover, top
5000-8563	Cover, side
5000-8581	Cover, bottom
5060-0728	Foot Assembly
5060-0702	Frame Assembly side
0370-0026	Knob, zero and full scale
0370-0077	Knob, frequency selector
05060-92034	Panel: front
05060-91163	Panel: rear
1490-0032	Stand, tilt

TABLE OF REPLACEABLE PARTS FOR
05060-92068 PHASE COMPARATOR ASSEMBLY A1

CKT REF.	HP PART NO.	DESCRIPTION
A1	05060-92068	Phase Comparator Assembly
The above assembly contains the following replaceable parts. The following reference designators are abbreviated. Add a prefix of A1 to form a complete reference designator for any part.		
C1	0170-0085	C: fxd, mylar, 0.1 μ F 20%, 50 vdcw
C2, C3	0150-0121	C: fxd, cer, 0.1 μ F +80% -20%, 50 vdcw
C4	0170-0085	C: fxd, mylar, 0.1 μ F 20%, 50 vdcw
C5-C7	0150-0121	C: fxd, cer 0.1 μ F +80% -20%, 50 vdcw
C8	0160-0128	C: fxd, cer, 212 μ F 20%, 25 vdcw
C9	0150-0121	C: fxd, cer, 0.1 μ F +80% -20%, 50 vdcw
C10	0140-0180	C: fxd, mica, 2000 pf 2%, 300 vdcw
C11	0140-0185	C: fxd, mica, 0.01 μ F 5%, 100 vdcw
C12	0160-0128	C: fxd, cer, 2.2 μ F 20%, 25 vdcw
C13	0160-0938	C: fxd, mica, 1000 pf 5%
C14	0160-0128	C: fxd, cer, 2.2 μ F 20%, 25 vdcw
C15	0180-0106	C: fxd, tant elect, 60 μ F 20%, 6 vdcw
C16	0180-0113	C: fxd, tant elect, 100 μ F +20% -15%, 30 vdcw
C17	0140-0191	C: fxd, mica, 56 pf 5%, 300 vdcw
C18, C19	0150-0121	C: fxd, cer, 0.1 μ F +80% -20%, 50 vdcw
C20, C21	0170-0085	C: fxd, mylar 0.1 μ F 20%, 50 vdcw
C22	0140-0179	C: fxd, mica, 1000 pf 2%, 300 vdcw
C23	0140-0162	C: fxd, mica, 4700 pf 10%, 300 vdcw
C24	0140-0204	C: fxd, mica, 47 pf 5%, 500 vdcw
C25	0140-0200	C: fxd, mica, 390 pf 5%, 300 vdcw
C26	0140-0156	C: fxd, mica, 1500 pf 2%, 300 vdcw
C27	0140-0187	C: fxd, mica, 0.027 μ F 5%, 100 vdcw
C28, C29	0170-0094	C: fxd, mylar, 0.047 μ F 20%, 50 vdcw
C30	0140-0216	C: fxd, mica, 120 pf 2%, 300 vdcw
C31	0170-0085	C: fxd, mylar, 0.1 μ F 20%, 50 vdcw
C32, C33	0150-0121	C: fxd, cer, 0.1 μ F +80% -20%, 50 vdcw
C34, C36	0170-0085	C: fxd, mylar, 0.1 μ F 20%, 50 vdcw
C35, C37	0150-0121	C: fxd, cer, 0.1 μ F +80% -20%, 50 vdcw
C38	0160-0128	C: fxd, cer, 2.2 μ F 20%, 25 vdcw
C39	0150-0121	C: fxd, cer, 0.1 μ F +80%, -20%, 50 vdcw
C40	0140-0180	C: fxd, mica, 2000 pf 2%, 300 vdcw
C41	0140-0185	C: fxd, mica, 0.01 μ F 5%, 100 vdcw
C42	0160-0128	C: fxd, cer, 2.2 μ F 20%, 25 vdcw
C43	0160-0938	C: fxd, mica 1000 pf 5%
C44	0160-0128	C: fxd, cer, 2.2 μ F 20%, 25 vdcw
C45	0180-0106	C: fxd, tant elect, 60 μ F 20%, 6 vdcw
C46	0140-0191	C: fxd, mica, 56 pf 5%, 300 vdcw
C47	0140-0216	C: fxd, mica 120 pf 2%, 300 vdcw
CR1	1901-0033	Diode, Si: 100 ma at +1v, 180 PIV, 1N485B
CR2, CR3	1902-0032	Diode, breakdown: 5.49V 5%, 400 MW
CR4-CR9	1901-0033	Diode, Si: 100 ma at +1V, 180 PIV, 1N485B
L1	9140-0072	Coil: fxd, 5 mh 10%, 100 ma
L2	9140-0107	Coil: fxd, 27 μ h 10%, 200 ma
L3	05060-92037	Coil: var, 550 μ h
L4	05060-92036	Coil: var, 30 μ h
L5	9140-0072	Coil: fxd, 5 mh 10%, 100 ma
L6	9140-0107	Coil: fxd, 27 μ h 10%, 200 ma
Q1-Q7	1854-0005	Transistor, Si: NPN, type 2N708



**TABLE OF REPLACEABLE PARTS FOR
05060-92068 PHASE COMPARATOR ASSEMBLY A1 (Cont'd)**

<u>CKT REF.</u>	<u>HP PART NO.</u>	<u>DESCRIPTION</u>
R1	0757-0950	R: fxd, met film, 12K ohm 2%, 1/8 W
R2	0757-0952	R: fxd, met film, 15K ohm 2%, 1/8 W
R3	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R4	0757-0894	R: fxd, met film, 56 ohm 1%, 1/8 W
R5	0757-0383	R: fxd, met film, 18.2 ohm 1%, 1/8 W
R6	0757-0929	R: fxd, met film, 1600 ohm 2%, 1/8 W
R7	0757-0917	R: fxd, met film, 510 ohm 2%, 1/8 W
R8	0757-0950	R: fxd, met film, 12K ohm 2%, 1/8 W
R9	0757-0952	R: fxd, met film, 15K ohm 2%, 1/8 W
R10	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R11	0757-0900	R: fxd, met film, 100 ohm 2%, 1/8 W
R12	0757-0911	R: fxd, met film, 300 ohm 2%, 1/8 W
R13	0757-0346	R: fxd, met film, 10 ohm 1%, 1/8 W
R14	0757-0929	R: fxd, met film, 1600 ohms 2%, 1/8 W
R15	0757-0944	R: fxd, met film, 6800 ohms 2%, 1/8 W
R16	0757-0917	R: fxd, met film, 510 ohm 2%, 1/8 W
R17	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R18	0757-0924	R: fxd, met film, 1000 ohm 2%, 1/8 W
R19	0757-0900	R: fxd, met film, 100 ohm 2%, 1/8 W
R20	-----	Not Assigned
R21	0757-0955	R: fxd, met film, 20K ohm 5%, 1/8 W
R22	0757-0928	R: fxd, met film, 1500 ohm 2%, 1/8 W
R23	0757-0924	R: fxd, met film, 1000 ohm 2%, 1/8 W
R24	0757-0938	R: fxd, met film, 3900 ohm 2%, 1/8 W
R25	0757-0904	R: fxd, met film, 150 ohm 2%, 1/8 W
R26, R27	0757-0806	R: fxd, met film, 243 ohm 1%, 1/2 W
R28	0757-0383	R: fxd, met film, 18.2 ohm 1%, 1/8 W
R29, R30	0757-0955	R: fxd, met film, 20K ohm 2%, 1/8 W
R31	0727-0251	R: fxd, carbon film, 683.7K ohm 1%, 1/2 W
R32	0757-0954	R: fxd, met film, 18K ohm 2%, 1/8 W
R33	0757-0930	R: fxd, met film, 1800 ohm 2%, 1/8 W
R34	0757-0937	R: fxd, met film, 3600 ohm 2%, 1/8 W
R35	0757-0912	R: fxd, met film, 330 ohm 2%, 1/8 W
R36	0757-0937	R: fxd, met film, 3600 ohm 2%, 1/8 W
R37	0757-0930	R: fxd, met film, 1800 ohm 2%, 1/8 W
R38	0757-0900	R: fxd, met film, 100 ohm 2%, 1/8 W
R39	0757-0922	R: fxd, met film, 820 ohm 2%, 1/8 W
R40	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R41	0757-0959	R: fxd, met film, 30K ohm 2%, 1/8 W
R42	0757-0948	R: fxd, met film, 10K ohm 2%, 1/8 W
R43	0757-0924	R: fxd, met film, 1000 ohm 2%, 1/8 W
R44	0757-0948	R: fxd, met film, 10K ohm 2%, 1/8 W
R45	0757-0939	R: fxd, met film, 4300 ohm 2%, 1/8 W
R46	0757-0914	R: fxd, met film, 390 ohm 2%, 1/8 W
R47	0757-0912	R: fxd, met film, 330 ohm 2%, 1/8 W
R48	0757-0926	R: fxd, met film, 1200 ohm 2%, 1/8 W
R49	0757-0948	R: fxd, met film, 10K ohm 2%, 1/8 W
R50	0757-0912	R: fxd, met film, 330 ohm 2%, 1/8 W
R51	0757-0926	R: fxd, met film, 1200 ohm 2%, 1/8 W
R52, R53	0757-0948	R: fxd, met film, 10K ohm 2%, 1/8 W

**TABLE OF REPLACEABLE PARTS FOR
05060-92068 PHASE COMPARATOR ASSEMBLY A1 (Cont'd)**

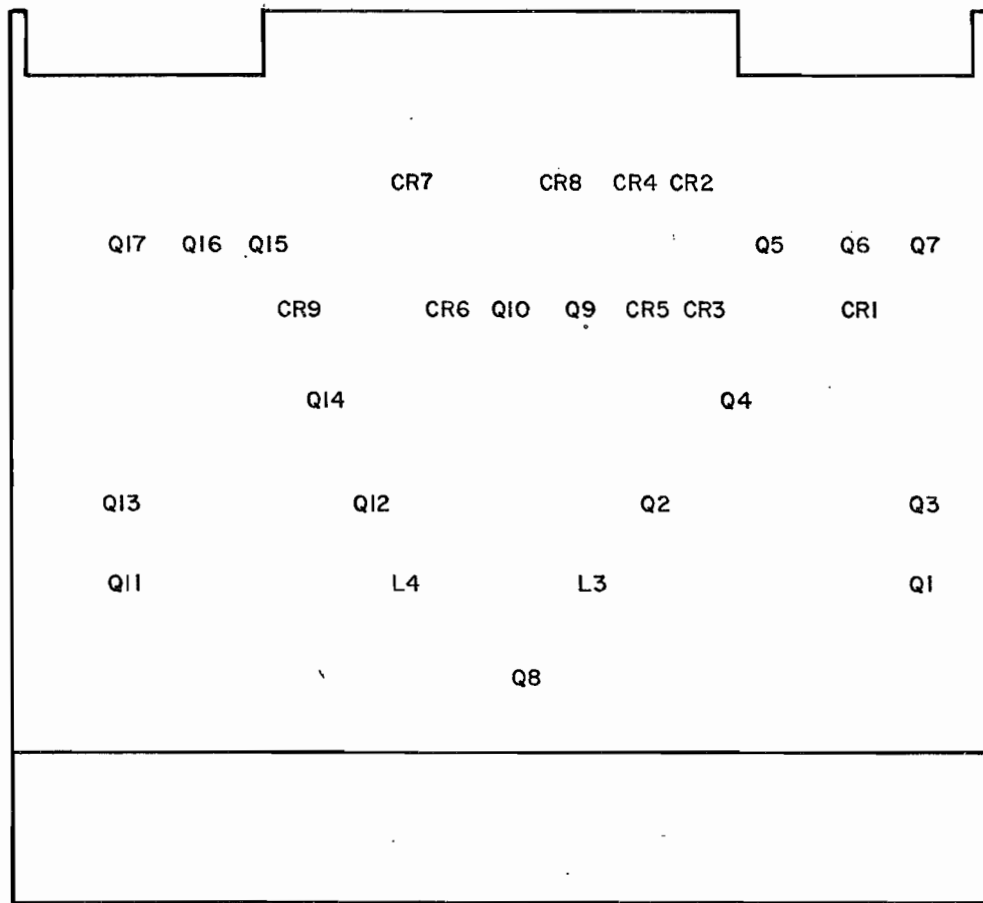
<u>CKT REF.</u>	<u>HP PART NO.</u>	<u>DESCRIPTION</u>
R54	0757-0930	R: fxd, met film, 1800 ohm 2%, 1/8 W
R55	0757-0914	R: fxd, met film, 390 ohm 2%, 1/8 W
R56	0757-0950	R: fxd, met film, 12K ohm 2%, 1/8 W
R57	0757-0952	R: fxd, met film, 15K ohm 2%, 1/8 W
R58	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R59	0757-0894	R: fxd, met film, 56 ohm 2%, 1/8 W
R60	0757-0383	R: fxd, met film, 18.2 ohm 1%, 1/8 W
R61	0757-0929	R: fxd, met film, 1600 ohm 2%, 1/8 W
R62	0757-0917	R: fxd, met film, 510 ohm 2%, 1/8 W
R63	0757-0950	R: fxd, met film, 12K ohm 2%, 1/8 W
R64	0757-0952	R: fxd, met film, 15K ohm 2%, 1/8 W
R65	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R66	0757-0900	R: fxd, met film, 100 ohm 2%, 1/8 W
R67	0757-0911	R: fxd, met film, 300 ohm 2%, 1/8 W
R68	0757-0346	R: fxd, met film, 10 ohm 1%, 1/8 W
R69	0757-0929	R: fxd, met film, 1600 ohm 2%, 1/8 W
R70	0757-0944	R: fxd, met film, 6800 ohm 2%, 1/8 W
R71	0757-0917	R: fxd, met film, 510 ohm 2%, 1/8 W
R72	0757-0931	R: fxd, met film, 2000 ohm 2%, 1/8 W
R73	0757-0924	R: fxd, met film, 1000 ohm 2%, 1/8 W
R74	0757-0900	R: fxd, met film, 100 ohm 2%, 1/8 W
R75	-----	Not Assigned
R76	0757-0955	R: fxd, met film, 20K ohm 2%, 1/8 W
R77	0757-0928	R: fxd, met film, 1500 ohm 2%, 1/8 W
R78	0757-0924	R: fxd, met film, 1000 ohms 2%, 1/8 W
R79	0757-0938	R: fxd, met film, 3900 ohm 2%, 1/8 W
R80	0757-0904	R: fxd, met film, 150 ohm 2%, 1/8 W
R81	0757-0383	R: fxd, met film, 18.2 ohm 1%, 1/8 W
R82, R83	0757-0955	R: fxd, met film, 20K ohm 2%, 1/8 W
R84	0727-0251	R: fxd, carbon film, 683.7K ohm 1%, 1/2 W
R85	0757-0954	R: fxd, met film, 18K ohm 2%, 1/8 W
R86	0757-0930	R: fxd, met film, 1800 ohm 2%, 1/8 W
R87	0757-0937	R: fxd, met film, 3600 ohm 2%, 1/8 W
R88	0757-0912	R: fxd, met film, 330 ohm 2%, 1/8 W
R89	0757-0937	R: fxd, met film, 3600 ohm 2%, 1/8 W
R90	0757-0930	R: fxd, met film, 1800 ohm 2%, 1/8 W
R91, R92	0757-0939	R: fxd, met film, 4300 ohm 2%, 1/8 W

TABLE OF REPLACEABLE PARTS FOR
05060-91170 POWER SUPPLY/INPUT ASSEMBLY A2

<u>CKT REF.</u>	<u>HP PART NO.</u>	<u>DESCRIPTION</u>
A2	05060-91170	Power Supply/Input Assembly

The above assembly contains the following replaceable parts. The following reference designators are abbreviated. Add a prefix of A2 to form a complete reference designator for any part.

C1	0150-0096	C: fxd, cer, 0.05 μ F +80 -20%, 100 Vdcw
C2	0140-0234	C: fxd, mica, 500 pF 1%, 300 Vdcw
C3	0150-0121	C: fxd, cer, 0.1 μ F +80 -20% 50 Vdcw
CR1	1901-0028	Diode, Si: 400 PIV, 750 ma
U1	1820-0196	Intgtd Ckt: linear voltage regulator
R1	0757-0972	R: fxd, film, 100K ohm 2% 1/8 W
R2, R3	0757-0894	R: fxd, film, 56 ohms 2%, 1/8 W
R4, R5	0757-0917	R: fxd, film, 510 ohm 2%, 1/8 W
R6, R7	0757-0894	R: fxd, film, 56 ohm 2%, 1/8 W
R8	0813-0028	R: fxd, 1 ohm 10% 1W
R9	0757-0939	R: fxd, flm, 4300 ohm 2%, 1/8 W
R10	2100-1986	R: var, cement, 1000 ohm 10%, 1/2 W
R11	0757-0934	R: fxd, film, 2700 ohm 2% 1/8 W

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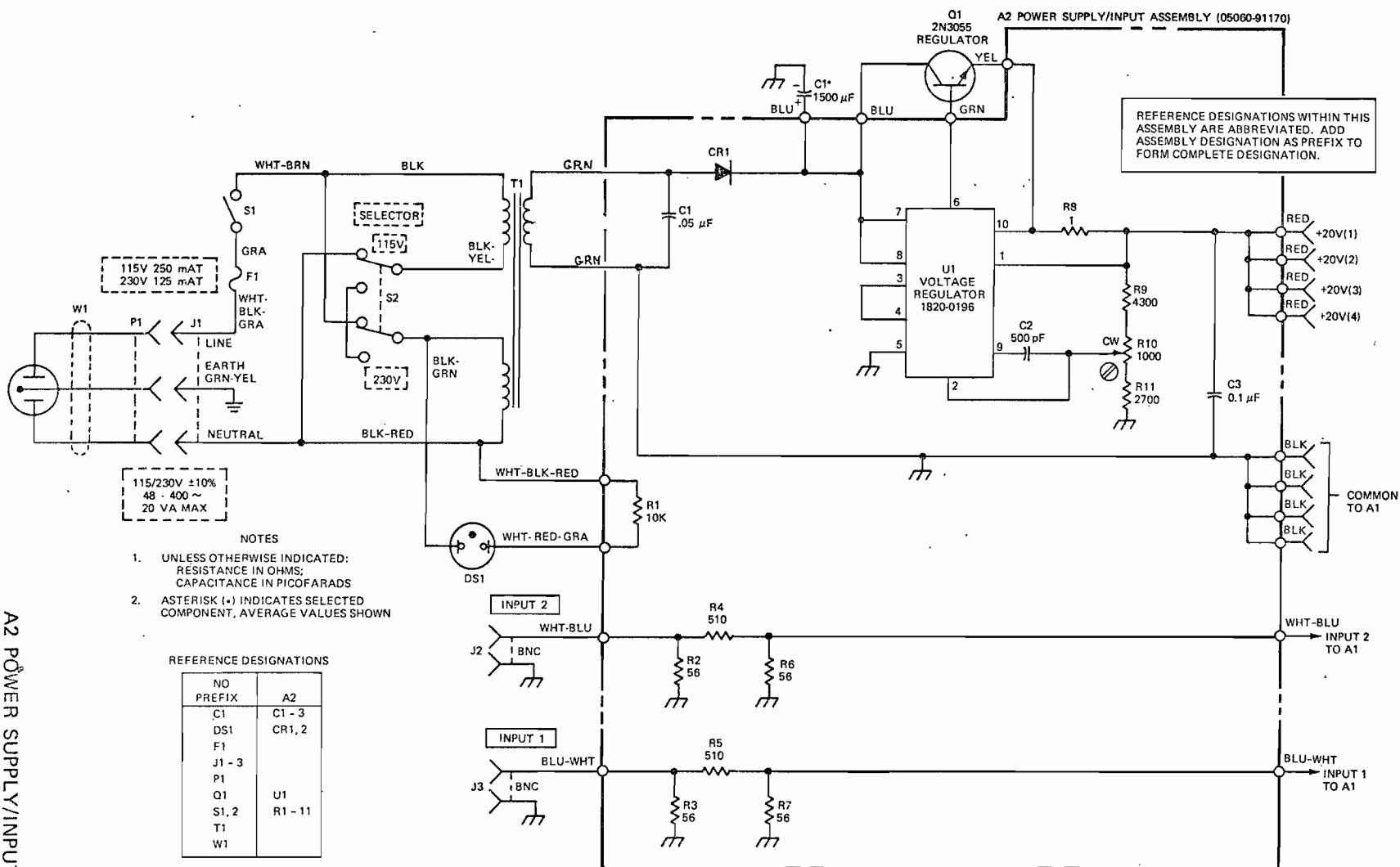
FRONT PANEL

00000-B-21

12-8 00000

HEWLETT-PACKARD COMPANY

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

A2 POWER SUPPLY/INPUT ASSEMBLY
K05-5060A

AI PHASE COMPARATOR ASSEMBLY (05060-92067)

