SHEET INDEX

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SUPPORTING INFORMATION

CATEGORY	NO.
MANUFACTURING TESTING REQUIREMENTS	X17995

SHEET INDEX NOTES

1. WHEN CHANGES ARE MADE IN THIS DRAWING, ONLY THOSE SHEETS AFFECTED WILL BE REISSUED.
2. THIS SHEET INDEX WILL BE REISSUED AND BROUGHT UP TO DATE EACH TIME ANY SHEET OF THE DRAWING IS REISSUED, OR A NEW SHEET IS ADDED.
3. THE ISSUE NUMBER ASSIGNED TO A CHANGED OR NEW SHEET WILL BE THE SAME ISSUE NUMBER AS THAT OF THE SHEET INDEX.
4. SHEETS THAT ARE NOT CHANGED WILL RETAIN THEIR EXISTING ISSUE NUMBER.
5. THE LAST ISSUE NUMBER OF THE SHEET INDEX IS RECOGNIZED AS THE LATEST ISSUE NUMBER OF THE DRAWING AS A WHOLE.

DWG ISSUE	CD ISSUE	DATE ISSUED	DRAWN	APPD
1	1	8-27-73	ADC JC	JP WJS JC
2A	2A	10-18-74	FN FJB	JP JHW LCM
3A	2A APP 1A	10-24-75	ADC JEH	JGS WEJ SSJ
4D	2A APP 2D	1-21-76	— JEH	BEM JHW FWS
5B	2A APP 3B	1-21-76	— JEH	BEM JHW FWS
6A	2A APP 4A	7-16-76	— JEH	JP JHW FWS
7A	2A APP 5A	11-12-76	— JEH	BJC JHW FWS
8D	2A APP 6D	5-25-77	— JEH	BEM JHW FWS
9B	2A APP 7B	3-22-78	— JEH	MTE JHW FWS

ISSUE 9B

1999

POWER SYSTEMS

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

AT&T-CO STANDARD

SD-82156-01-A1
21 SHEETS

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-A1

CPS A980 (MFR DISC)
350HZ OSCILLATOR

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.111
C5	578D,.154
C6	578D,.111
C7	542A,

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,1KΩ

RESISTOR

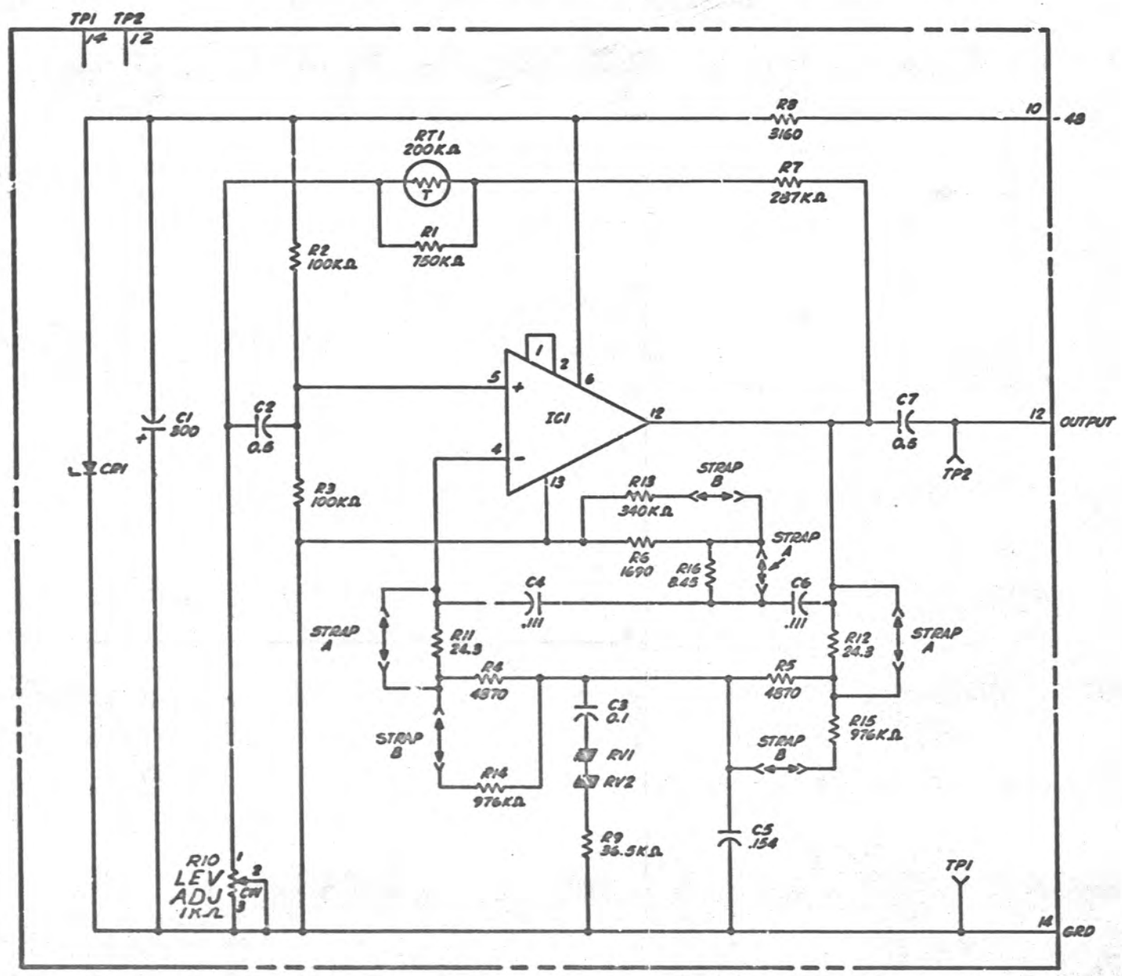
DESIG	CODE
R1	KS-20810,L1A,750KΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,4870
R5	KS-16312,L6F,4870
R6	KS-16312,L6F,1690
R7	KS-20310,L1A,287KΩ
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,36.5KΩ
R11	KS-20810,L1A,24.3
R12	KS-20810,L1A,24.3
R13	KS-20810,L1A,340KΩ
R14	KS-20810,L1A,976KΩ
R15	KS-20810,L1A,976KΩ
R16	KS-20810,L1A,8.45

THERMISTOR

DESIG	CODE
RT1	44A

VARISTOR

DESIG	CODE
RV1	100E
RV2	100E



INPUT/OUTPUT INFORMATION

1. DC INPUT
   - A) VOLTAGE
     - NORMAL -48.0V TO -52.0V
     - EMERGENCY -42.75V TO -53.5V
     - MAX. TRANSIENT -60V
   - B) CURRENT
     - 20K OHMS LOAD IMPEDANCE 13.4MA(MAX)
     - (INPUT VOLTAGE -53.5V)
2. AC OUTPUT
   - A) 2.60V RMS NORMAL, ADJUSTABLE ±.50V FOR THE FOLLOWING CONDITIONS:
     - 20K OHMS LOAD IMPEDANCE
     - -42.75V ≤ DC INPUT ≤ -53.5V
     - 0°C ≤ AMBIENT TEMP ≤ 60°C
   - B) 2.60V RMS (NO LOAD) TYPICAL
   - C) OUTPUT IMPEDANCE (100 OHMS) TYPICAL
   - D) HARMONIC DISTORTION ≥ 55DB BELOW FUNDAMENTAL SIG.
3. AMBIENT TEMPERATURE
   - A) 0°C TO 60°C
4. FREQUENCY
   - A) 350HZ ± 0.5%

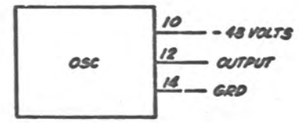
CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 350HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7), (RT1), (R10), (C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4), (R5), (R6), (C4), (C5), (C6) TO THE INVERTING INPUT OF (IC1). AT 350HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1) AND (C1).

MANUFACTURING REFERENCES

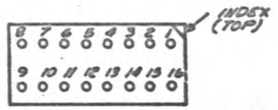
CATEGORY	NO.
CIRCUIT PACK CODE	A980
CONNECTOR ON FRAME	505B
MANUFACTURING TEST REQ	X-17995

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED,
   RESISTANCE VALUES ARE IN OHMS. CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:



3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ±0.3% OF 350HZ.

OUTPUT IMPEDANCE CHARACTERISTICS

WHEN OPERATING INTO A RESISTIVE LOAD THE OUTPUT IMPEDANCE IS TYPICALLY 100 OHMS WHEN THE OUTPUT VOLTAGE IS SET AT 2.60 VOLTS R.M.S. AND THE OUTPUT CURRENT IS LIMITED TO A MAXIMUM OF 1.0 MILLIAMPERE R.M.S.

CPS A980

ISSUE 8D

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-JI

BELL TELEPHONE LABORATORIES INCORPORATED

6S

SD-82156-01-JI

CPS A981 (MFR DISC)
440HZ OSCILLATOR

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.0953
C5	578D,.138
C6	578D,.0953
C7	542A

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,1KΩ

RESISTOR

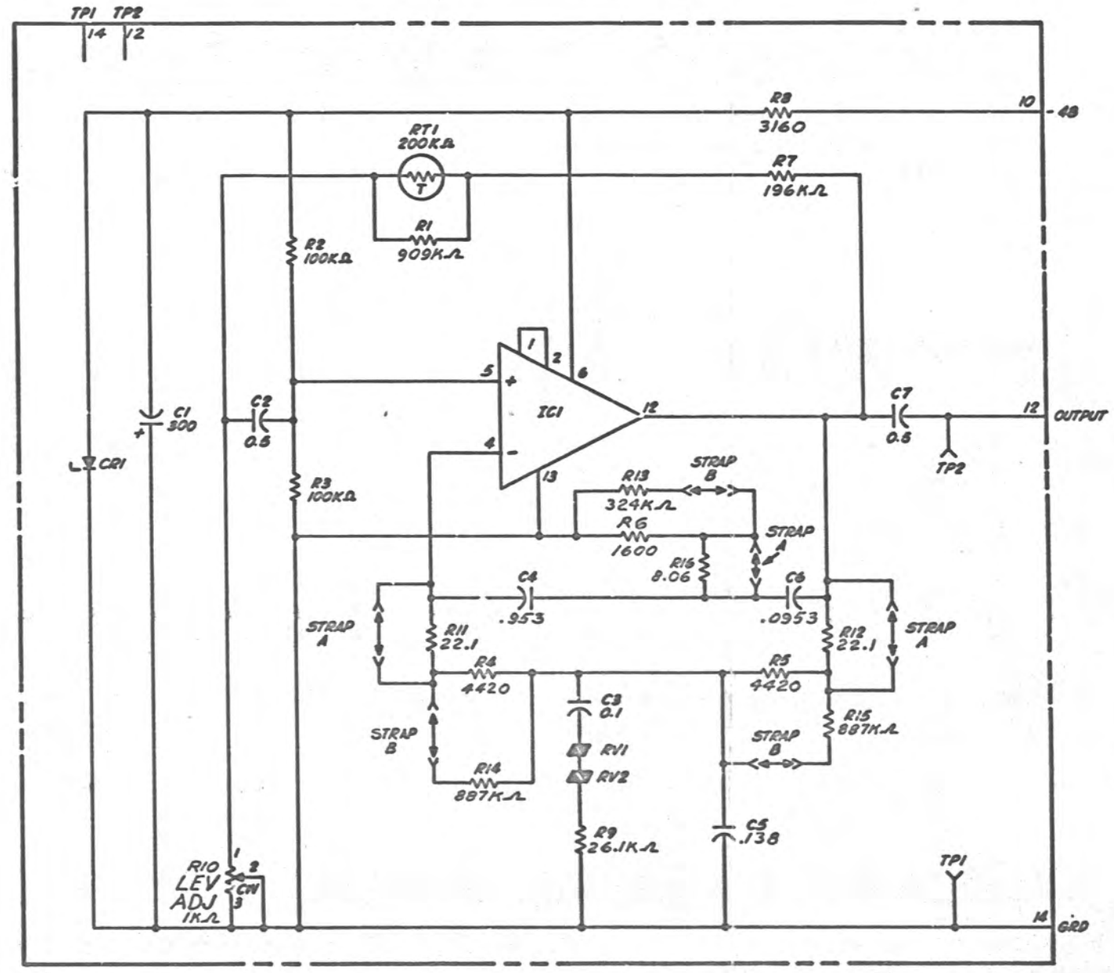
DESIG	CODE
R1	KS-20810,L1A,909KΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,4420
R5	KS-16312,L6F,4420
R6	KS-16312,L6F,1600
R7	KS-20810,L1A,196KΩ
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,26.1KΩ
R11	KS-20810,L1A,22.1
R12	KS-20810,L1A,22.1
R13	KS-20810,L1A,324KΩ
R14	KS-20810,L1A,887KΩ
R15	KS-20810,L1A,887KΩ
R16	KS-20810,L1A,8.06

THERMISTOR

DESIG	CODE
RT1	44A

VARISTOR

DESIG	CODE
RV1	100E
RV2	100E



INPUT/OUTPUT INFORMATION

1. DC INPUT
   a) VOLTAGE

NORMAL	-48.0V TO -52.0V
EMERGENCY	-42.75V TO -53.5V
MAX. TRANSIENT	-60V

   b) CURRENT
   20K OHMS LOAD IMPEDANCE 13.4 MA (MAX)
   (INPUT VOLTAGE -53.5V)

2. AC OUTPUT
   a) 2.60V RMS NORMAL, ADJUSTABLE ± .50V
   FOR THE FOLLOWING CONDITIONS:
   20K OHMS LOAD IMPEDANCE
   -42.75V ≤ DC INPUT ≤ -53.5V
   0°C ≤ AMBIENT TEMP ≤ 60°C
   b) 2.60V RMS (NO LOAD) TYPICAL
   c) OUTPUT IMPEDANCE (100 OHMS TYPICAL)
   d) HARMONIC DISTORTION ≥55db BELOW FUNDAMENTAL S16.
3. AMBIENT TEMPERATURE
   a) 0°C TO 60°C
4. FREQUENCY
   a) 440HZ ±0.5%

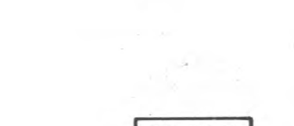
CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 440HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7),(RT1),(R1),(R10),(C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4),(R5),(R6),(C4),(C5),(C6) TO THE INVERTING INPUT OF (IC1). AT 440HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1) AND (C1).

MANUFACTURING REFERENCES

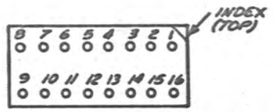
CATEGORY	NO.
CIRCUIT PACK CODE	A981
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X-17995

SYMBOL



NOTES.

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:



3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ±0.3% OF 440HZ

OUTPUT IMPEDANCE CHARACTERISTICS

WHEN OPERATING INTO A RESISTIVE LOAD THE OUTPUT IMPEDANCE IS TYPICALLY 100 OHMS WHEN THE OUTPUT VOLTAGE IS SET AT 2.60 VOLTS R.M.S. AND THE OUTPUT CURRENT IS LIMITED TO A MAXIMUM OF 1.0 MILLIAMPERE R.M.S.

CPS A981

ISSUE 8D

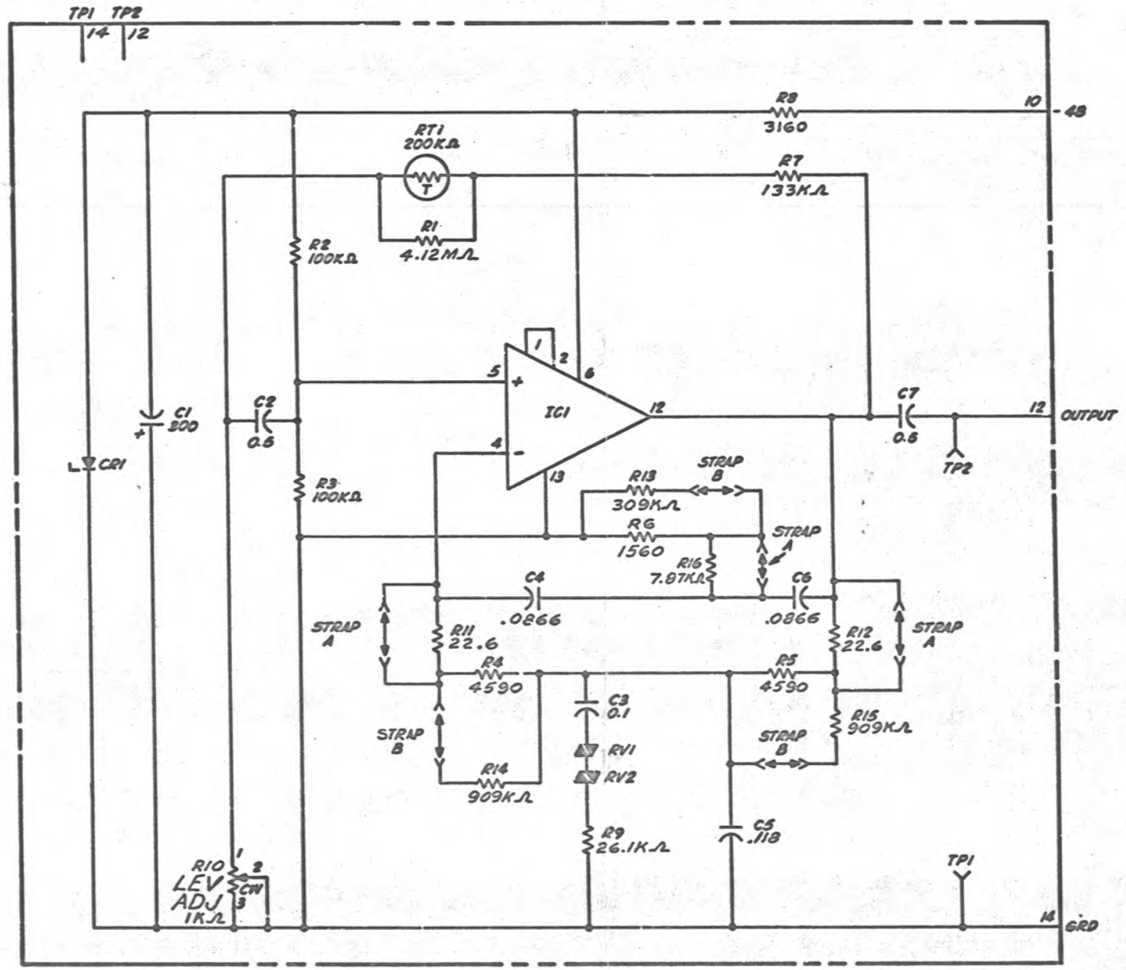
RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J2

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J2

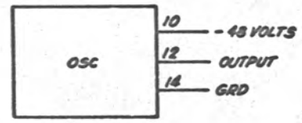
CPS A982 (MFR DISC)
480HZ OSCILLATOR



MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A982
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X-17795

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS,
   CAPACITANCE VALUES ARE IN MICROFARADS,
   VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:

3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ±.03% OF 480HZ.

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.0866
C5	578D,.118
C6	578D,.0866
C7	542A

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,.1KΩ

RESISTOR

DESIG	CODE
R1	145A,4.12MΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,4590
R5	KS-16312,L6F,4590
R6	KS-16312,L6F,1560
R7	KS-20810,L1A,133KΩ
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,26.1KΩ
R11	KS-20810,L1A,22.6
R12	KS-20810,L1A,22.6
R13	KS-20810,L1A,309KΩ
R14	KS-20810,L1A,909KΩ
R15	KS-20810,L1A,909KΩ
R16	KS-20810,L1A,7.87

THERMISTOR

DESIG	CODE
RT1	44A

VARISTOR

DESIG	CODE
RV1	100E
RV2	100E

INPUT/OUTPUT INFORMATION

1. DC INPUT
   a) VOLTAGE
      NORMAL -48.0V TO -52.0V
      EMERGENCY -42.75V TO -53.5V
      MAX. TRANSIENT -60V
   b) CURRENT
      20K OHMS LOAD IMPEDANCE 13.4 MA (MAX)
      (INPUT VOLTAGE -53.5V)
2. AC OUTPUT
   a) 2.60V RMS NORMAL, ADJUSTABLE ±.50V FOR THE FOLLOWING CONDITIONS:
      20K OHMS LOAD IMPEDANCE
      -42.75V ≤ DC INPUT ≤ -53.5V
      0°C ≤ AMBIENT TEMP ≤ 60°C
   b) 2.60V RMS (NO LOAD) TYPICAL
   c) OUTPUT IMPEDANCE (100 OHMS) TYPICAL
   d) HARMONIC DISTORTION ≥ 55 db BELOW FUNDAMENTAL SIG.
3. AMBIENT TEMPERATURE
   a) 0°C TO 60°C
4. FREQUENCY
   a) 480 HZ ± 0.5%

CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 480HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7),(RT1),(R1),(R10), (C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4), (R5),(R6),(C4),(C5),(C6) TO THE INVERTING INPUT OF (IC1). AT 480HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1) AND (C1).

OUTPUT IMPEDANCE CHARACTERISTICS

WHEN OPERATING INTO A RESISTIVE LOAD THE OUTPUT IMPEDANCE IS TYPICALLY 100 OHMS WHEN THE OUTPUT VOLTAGE IS SET AT 2.60 VOLTS R.M.S. AND THE OUTPUT CURRENT IS LIMITED TO A MAXIMUM OF 1.0 MILLIAMPERE R.M.S.

CPS A982

ISSUE 8D

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J3

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J3

CPS A983 (MFR DISC)
620HZ OSCILLATOR

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.0657
C5	578D,.0953
C6	578D,.0657
C7	542A

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,1KΩ

RESISTOR

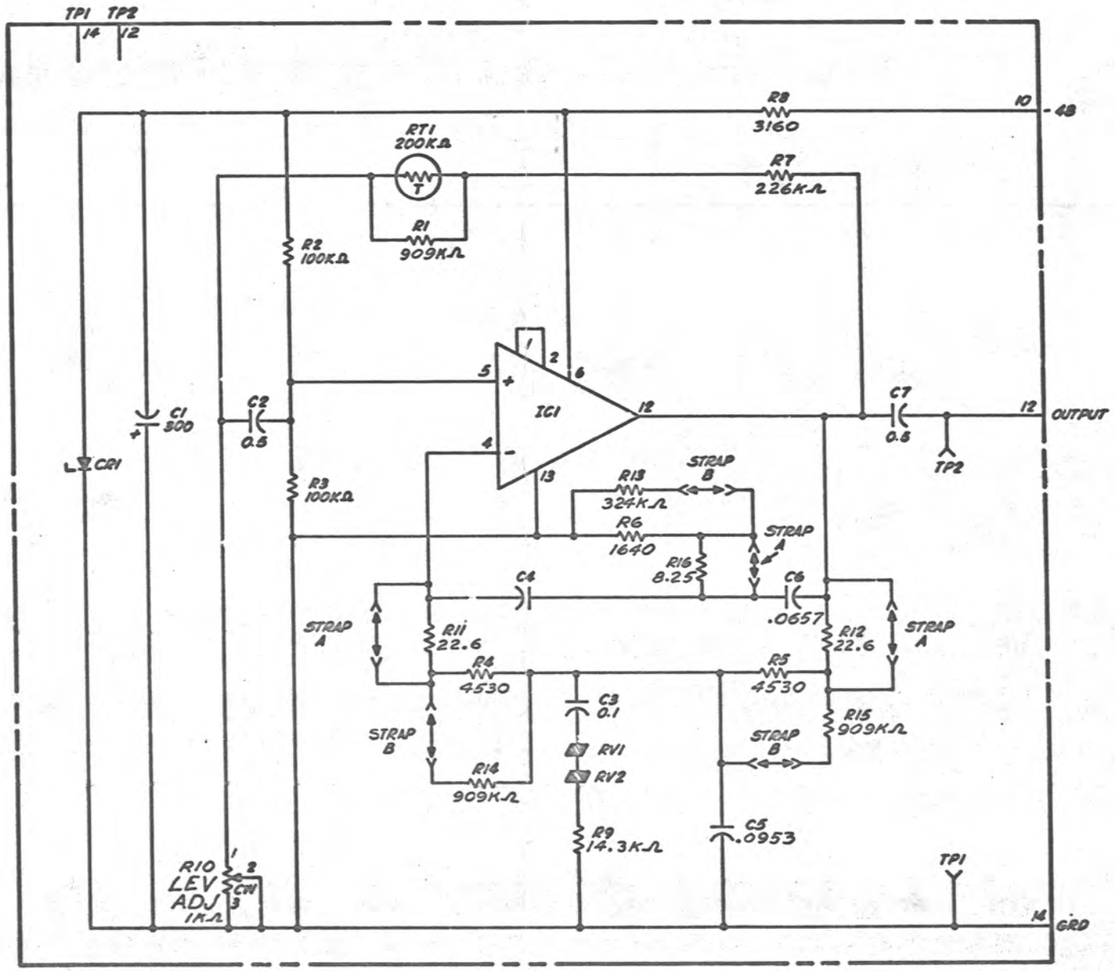
DESIG	CODE
R1	KS-20810,L1A,909,KΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,4530
R5	KS-16312,L6F,4530
R6	KS-16312,L6F,1640
R7	KS-20810,L1A,226KΩ
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,14.3KΩ
R11	KS-20810,L1A,22.6
R12	KS-20810,L1A,22.6
R13	KS-20810,L1A,324KΩ
R14	KS-20810,L1A,909KΩ
R15	KS-20810,L1A,909KΩ
R16	KS-20810,L1A,8.25

THERMISTOR

DESIG	CODE
RT1	44A

VARISTOR

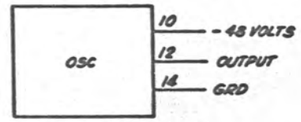
DESIG	CODE
RV1	100E
RV2	100E



MANUFACTURING REFERENCES

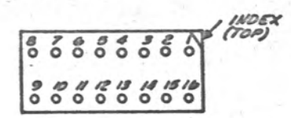
CATEGORY	NO.
CIRCUIT PACK CODE	A983
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X-17995

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS,
   CAPACITANCE VALUES ARE IN MICROFARADS,
   VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:



3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ±. 0.3% OF 620HZ.

INPUT/OUTPUT INFORMATION

1. DC INPUT
   a) VOLTAGE
      NORMAL -48.0V TO -52.0V
      EMERGENCY -42.75V TO -53.5V
      MAX. TRANSIENT -60V
   b) CURRENT
      20K OHMS LOAD IMPEDANCE 13.4 MA (MAX)
      (INPUT VOLTAGE -53.5V)
2. AC OUTPUT
   a) 2.60V RMS NORMAL, ADJUSTABLE ±.50V
      FOR THE FOLLOWING CONDITIONS:
      20K OHMS LOAD IMPEDANCE
      -42.75V≤ DC INPUT≤ -53.5V
      0°C ≤ AMBIENT TEMP≤ 60°C
   b) 2.60V RMS (NO LOAD) TYPICAL
   c) OUTPUT IMPEDANCE (100 OHMS) TYPICAL
   d) HARMONIC DISTORTION ≥55db BELOW FUNDAMENTAL SIG.
3. AMBIENT TEMPERATURE
   a) 0°C TO 60°C
4. FREQUENCY
   a) 620 HZ ±0.5%

CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 620HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7),(RT1),(R1),(R10), (C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4),(R5),(R6),(C4),(C5),(C6) TO THE INVERTING INPUT OF (IC1). AT 620HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1) AND (C1).

OUTPUT IMPEDANCE CHARACTERISTICS

WHEN OPERATING INTO A RESISTIVE LOAD THE OUTPUT IMPEDANCE IS TYPICALLY 100 OHMS WHEN THE OUTPUT VOLTAGE IS SET AT 2.60 VOLTS R.M.S AND THE OUTPUT CURRENT IS LIMITED TO A MAXIMUM OF 1.0 MILLIAMPERE R.M.S.

CPS A983

ISSUE 8D

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J4

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J4

CPS A1005
INTERRUPTER FOLLOWER RELAYS

COMPONENT LIST

RELAY

DESIG	K1		K2		K3		K4	
CODE	330A		330A		330A		330A	
OPTION								
X	CONT ARR	LOC	CONT ARR	LOC	CONT ARR	LOC	CONT ARR	LOC
2,5,10	BM	29A4	BM	29C4	BM	29E4	BM	29G4
3,4,8	BM	29B4	BM	29D4	BM	29E4	BM	29G4
1,9	COIL	29B4	COIL	29D4	COIL	29F4	COIL	29H4

RELAY NOT ADJUSTABLE, REPLACE WHEN THERE IS A MALFUNCTION.

DIODE

DESIG	CODE
CR1	446A
CR2	446A
CR3	446A
CR4	446A

INPUT/OUTPUT INFORMATION

WORKING LIMITS

WINDING	RATED RESISTANCE	TEST CURRENT MA DC		
	OHMS	SOAK	OPERATE*	RELEASE
SINGLE	1170 ± 10%	14.0	4.6	2.6

* AFTER SOAK

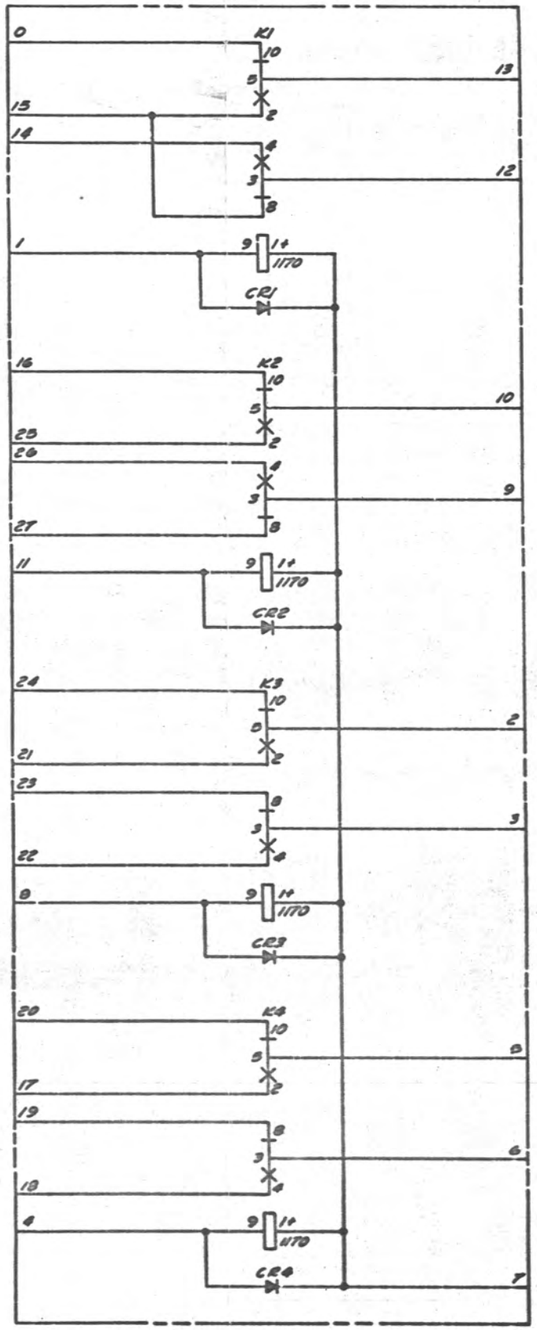
CIRCUIT DESCRIPTION

THIS CIRCUIT PACK PROVIDES THE INTERRUPTER FOLLOWER RELAYS WHICH ARE DRIVEN DIRECTLY FROM THE LOGIC OUTPUT OF THE INTERRUPTION CADENCE GENERATOR.

THE MERCURY RELAYS IN THIS PAKAGE MAY BE USED FOR THE ACTUAL INTERRUPTION OF THE TONES OR LOOPS OR THEY MAY BE USED TO DRIVE OTHER RELAYS.

THE NEGATIVE SIDE OF THE COIL OF EACH RELAY IS BROUGHT OUT TO A SEPARATE TERMINAL SO THAT EACH RELAY MAY BE OPERATED INDEPENDENTLY.

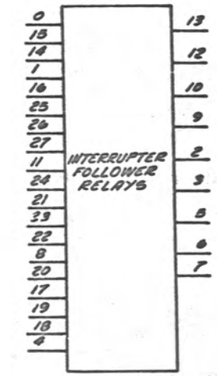
THE POSITIVE SIDE OF EACH COIL IS TIED TO A COMMON POINT. VOLTAGE TRANSIENT SUPPRESSION DIODES ARE PLACED ACROSS EACH COIL FOR PROTECTION.



MANUFACTURING REFERENCES

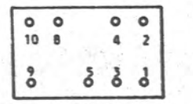
CATEGORY	NO.
CIRCUIT PACK CODE	A1005
CONNECTOR ON FRAME	905B

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED: VALUES PRECEDED BY THE SYMBOL + (PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENTS OF THE 330A RELAY ARE AS FOLLOWS:



BOTTOM VIEW

CPS A1005 ISSUE 1

RINGING, TONE AND SIGNALING CIRCUITS GENERAL USE CIRCUIT PACKS

SD-82156-01-J5

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J5

CPS A1006
INTERRUPTION CADENCE GENERATOR

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	701G,.464
C2	701G,2.15
C3	KS-19658,L25,300
C4	KS-16390,L7,200
C5	KS-16390,L7,200
C6	570EW
C7	KS-19774,L7,.01

DIODE

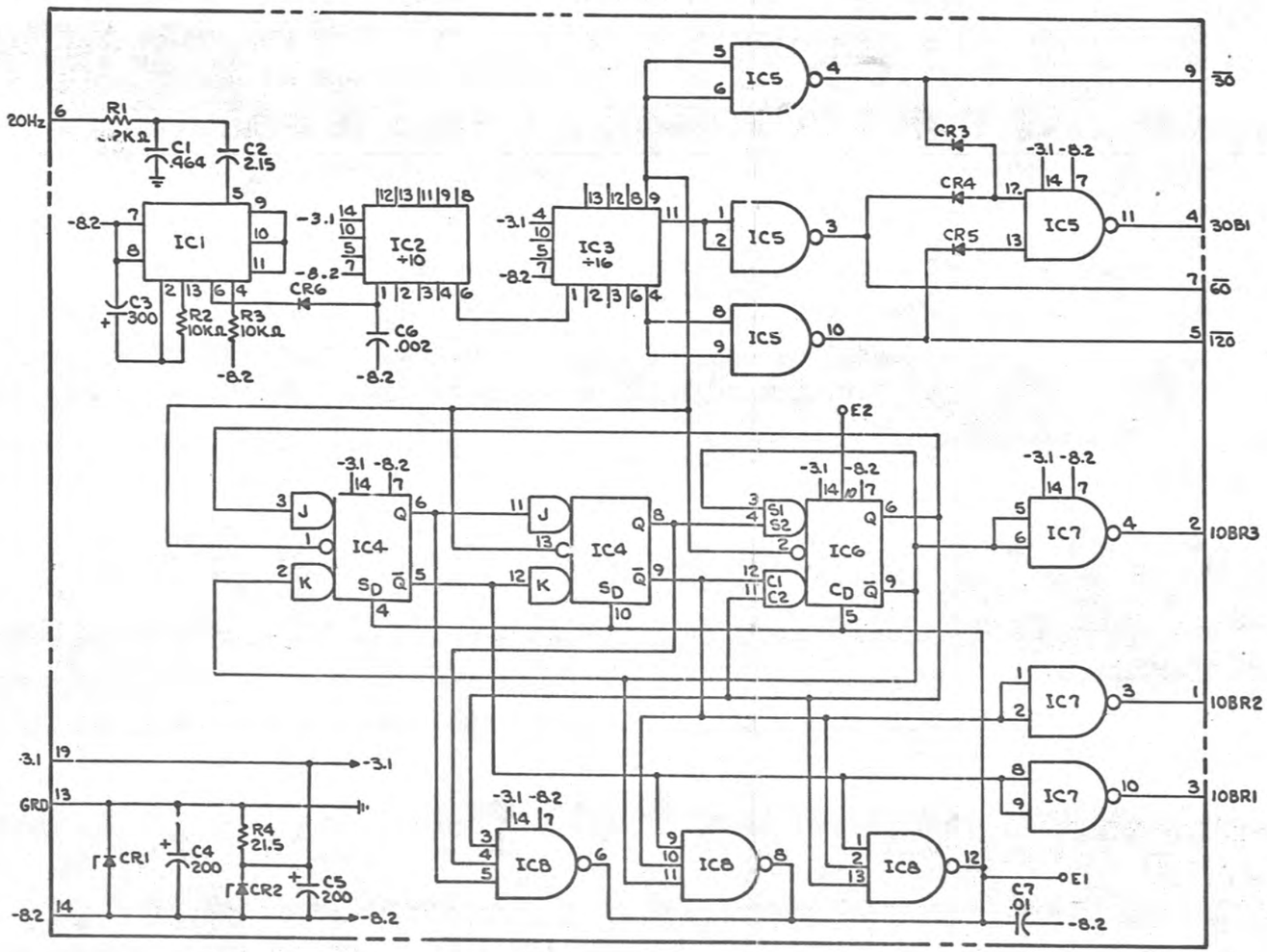
DESIG	CODE
CR1	485M
CR2	KS-19923,L6
CR3	458C
CR4	458C
CR5	458C
CR6	458C

INTEGRATED CIRCUIT

DESIG	CODE
IC1	KS-21095,L1
IC2	KS-20638,L2
IC3	KS-20638,L3
IC4	MOT MC 853L
IC5	KS-20638,L8
IC6	KS-20638,L6
IC7	KS-20638,L8
IC8	KS-20638,L5

RESISTOR

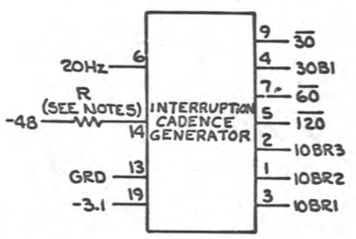
DESIG	CODE
R1	KS-13492,L1,6.2KΩ
R2	257A,10KΩ
R3	257A,10KΩ
R4	KS-14603,L3B,21.5



MANUFACTURING REFERENCES

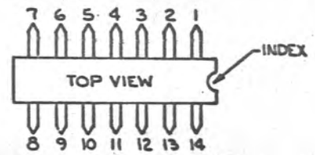
CATAGORY	NO.
CIRCUIT PACK CODE	A1006
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ.	X17795

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS
   CAPACITANCE VALUES ARE IN MICROFARADS
   VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. ⏚ GROUND RETURN.
3. TERMINAL ASSIGNMENTS OF THE INTEGRATED CIRCUITS ARE AS FOLLOWS:



4. WIRING ASSOCIATED WITH (IC1) IS CRITICAL. NO CHANGES SHALL BE MADE IN THIS CIRCUIT WITHOUT REFERENCE TO APPARATUS DRAWING FOR CIRCUIT PACK.
5. THE VALUE OF THIS RESISTOR IS DEPENDENT ON THE NUMBER OR RELAYS DRIVEN BY THE INTERRUPTER AS SHOWN BELOW

TOTAL NO. OF 1200Ω RELAYS CONNECTED FROM ALL OUTPUTS TO GROUND	VALUE OF SERIES DROPPING RESISTOR R SHOWN UNDER SYMBOL	
0-6	178Ω	KS-8512,L6B
7-12	154Ω	

2 RELAYS TO GRD IS MAXIMUM LOAD ON EACH OUTPUT.

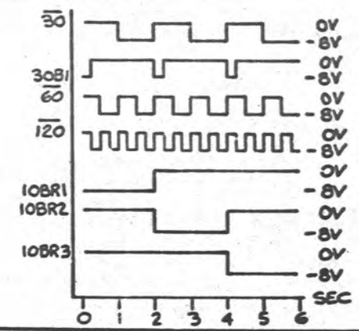
6. AT MAXIMUM INPUT VOLTAGE.
7. TYPICAL INPUT CURRENT AT -50V INPUT IS 235mA USING 178Ω RESISTOR AND 258mA USING 154Ω RESISTOR (SEE NOTE 5).

INPUT/OUTPUT INFORMATION

WORKING LIMITS

		NORMAL	EMERGENCY	NOTE
INPUT 20HZ	VOLTAGE RMS	84-110	75-110	
	VA	1.35		6
INPUT D.C.	VOLTAGE	-48 TO-52.5	-42.7 TO-53.5	8
	CURRENT	275 mA	245 mA	6,7
OUTPUT	VOLTAGE HIGH	-8.2±5%		
	VOLTAGE LOW	0.0		
	CURRENT MAX/OUTPUT	15 mA		
AMBIENT TEMP RANGE		0° TO 60°C		
TIMING AS PER SHOWN AT RIGHT				

OUTPUT TIMING



CIRCUIT DESCRIPTION

THIS CIRCUIT PROVIDES THE BASIC TIMING FOR THE INTERRUPTERS IN NUMBERS 1 & 2 ESS. THE INPUT SIGNAL, 20HZ, IS FED INTO (IC1), A ZERO CROSSING SWITCH. THE 40HZ SIGNAL IS THEN DIVIDED BY 10(IC2). THE 4HZ SIGNAL IS FURTHER DIVIDED BY (IC3) TO OBTAIN 30, 60; AND 120 IPM. THESE SIGNALS ARE FED INTO (IC5) TO OBTAIN THE THREE OUTPUTS, 30B1, 60 AND 120: A RING COUNTER COMPOSED OF (IC4) AND (IC6), USING 30 IPM AS AN INPUT, PROVIDES THE THREE BRUSHES OF CODE 1 GEN. (IC7) AND (IC5) ALSO PROVIDE ISOLATION FOR THE OUTPUT. (IC8) IS USED TO SET THE RING COUNTER TO THE CORRECT STATE IF NOISE OR OTHER TRANSIENTS CAUSE THE RING COUNTER TO JUMP TO AN INCORRECT MODE. UNDER NORMAL CONDITIONS ALL THE OUTPUTS OF (IC8) ARE HIGH WHICH DOES NOT AFFECT THE OPERATION OF THE RING COUNTER.

NOTES (CONT)

8. APPLIED TO SERIES RESISTOR R (SEE NOTE 5).
9. WIRE FOR JUMPERS ON CIRCUIT PACK ASSEMBLY SHALL BE 20 GAUGE PER KS-19195,L1.

CPS A1006

ISSUE 1

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

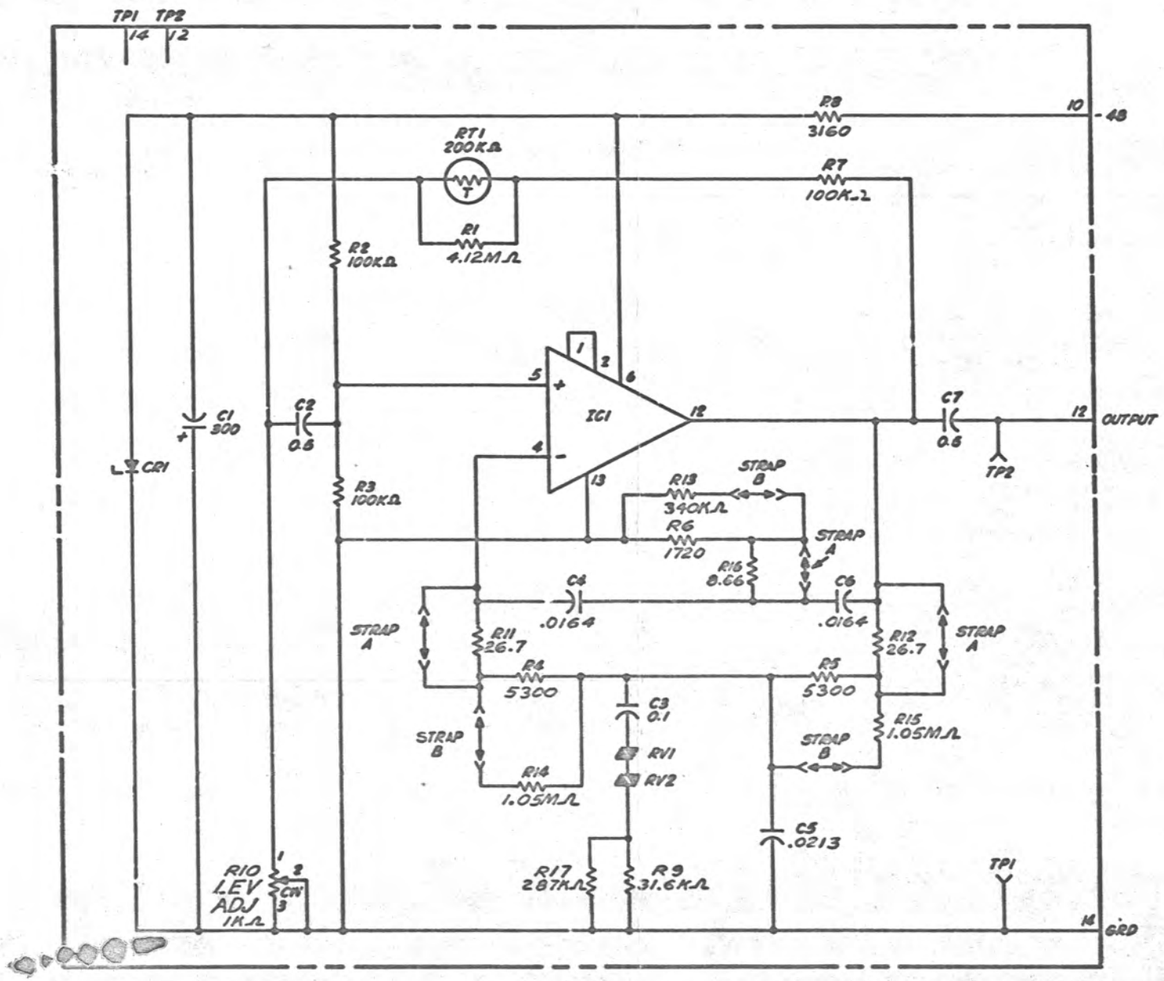
SD-82156-01-J6

BELL TELEPHONE LABORATORIES INCORPORATED

6S

SD-82156-01-J6

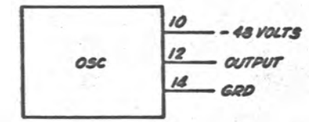
CPS A1026 (MFR DISC)
2225HZ OSCILLATOR



MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A1026
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X-17995

SYMBOL



COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.0164
C5	578D,.0213
C6	578D,.0164
C7	542A

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,1KΩ

RESISTOR

DESIG	CODE
R1	145A,4.12MΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,5300
R5	KS-16312,L6F,5300
R6	KS-16312,L6F,1720
R7	KS-20810,L1A,100KΩ
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,31.6KΩ
R11	KS-20810,L1A,26.7
R12	KS-20810,L1A,26.7
R13	KS-20810,L1A, 340KΩ
R14	KS-20810,L1A,1.05MΩ
R15	KS-20810,L1A,1.05MΩ
R16	KS-20810,L1A,8.66
R17	KS-20810,L1A,287KΩ

THERMISTOR

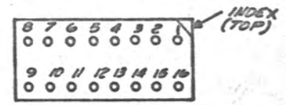
DESIG	CODE
RT1	44A

VARISTOR

DESIG	CODE
RV1	100E
RV2	100E

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS,
   CAPACITANCE VALUES ARE IN MICROFARADS,
   VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:



3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ± 0.3% OF 2225HZ.

INPUT/OUTPUT INFORMATION

1. DC INPUT
   a) VOLTAGE
      NORNAL -48.0V TO -52.0V
      EMERGENCY -42.75V TO -53.5V
      MAX. TRANSIENT -60V
   b) CURRENT
      20K OHMS LOAD IMPEDANCE 13.4 MA (MAX)
      (INPUT VOLTAGE -53.5V)
2. AC OUTPUT
   a) 2.60 V RMS NORMAL, ADJUSTABLE ±.50V
      FOR THE FOLLOWING CONDITIONS:
      20K OHMS LOAD IMPEDANCE
      -42.75V ≤ DC INPUT ≤ -53.5V
      0°C ≤ AMBIENT TEMP ≤ 60°C
   b) 2.60V RMS (NO LOAD) TYPICAL
   c) OUTPUT IMPEDANCE (100 OHMS)TYPICAL
   d) HARMONIC DISTORTION ≥55db BELOW FUNDAMENTAL SIG.
3. AMBIENT TEMPERATURE
   a) 0°C TO 60°C
4. FREQUENCY
   a) 2225 HZ ±0.5%

CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 2225HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7),(RT1),(R1),(R10),(C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4),(R5),(R6),(C4),(C5),(C6) TO THE INVERTING INPUT OF (IC1). AT 2225HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1), AND (C1).

OUTPUT IMPEDNACE CHARACTERISTICS

WHEN OPERATING INTO A RESISTIVE LOAD THE OUTPUT IMPEDANCE IS TYPICALLY 100 OHMS WHEN THE OUTPUT VOLTAGE IS SET AT 2.60 VOLTS R.M.S. AND THE OUTPUT CURRENT IS LIMITED TO A MAXIMUM OF 1.0 MILLIAMPERES R.M.S.

CPS A1026

ISSUE 8D

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

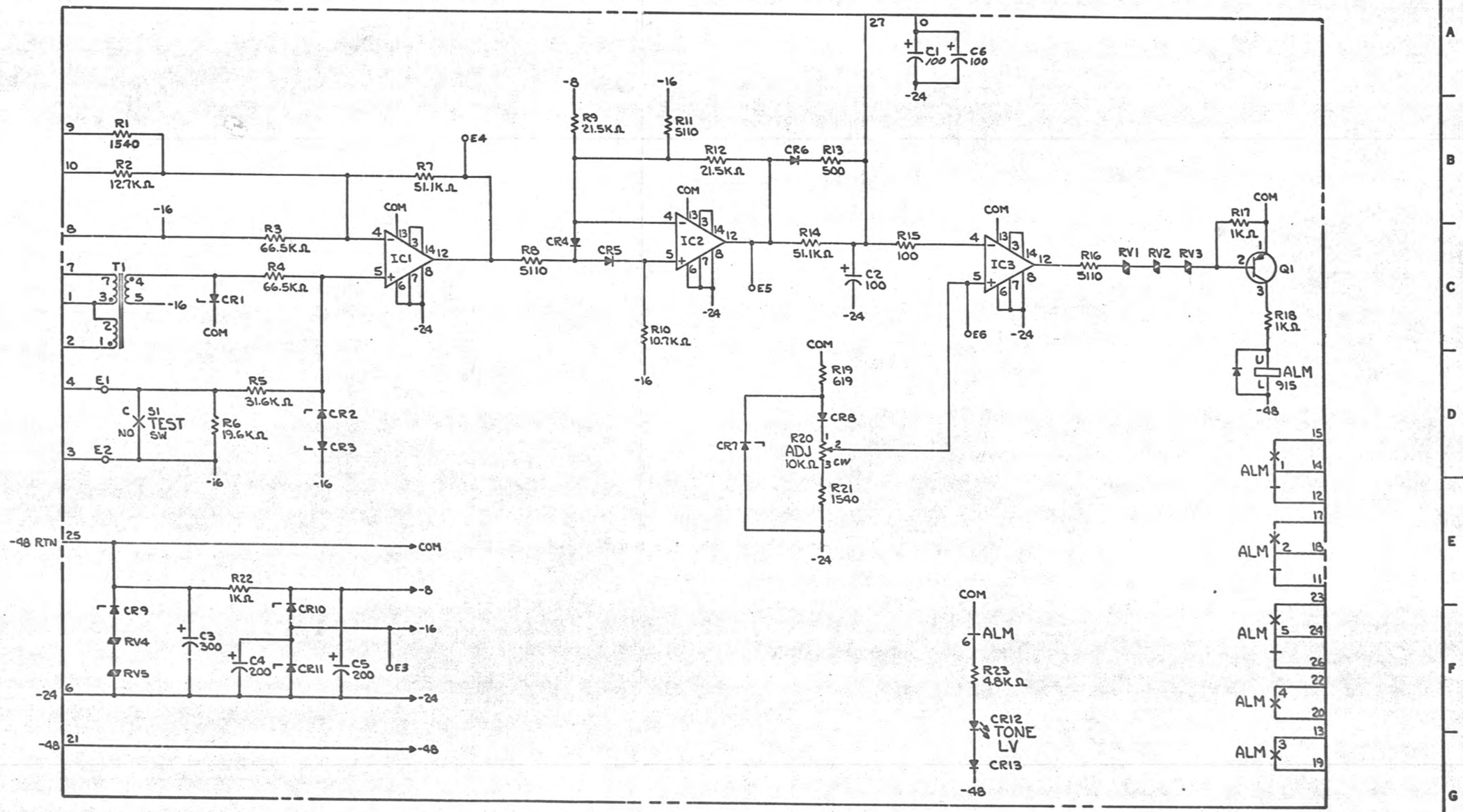
SD-82156-01-J7

BELL TELEPHONE LABORATORIES INCORPORATED 65

SD-82156-01-J7

PART OF CPS A1027

TONE LOW VOLTAGE MONITOR



CPS A1027

ISSUE 1

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

BELL TELEPHONE LABORATORIES INCORPORATED

SHEET 6S

SD-82156-01-J8A

SD-82156-01-J8A

PART OF CPS A1027

TONE LOW VOLTAGE MONITOR

COMPONENT LIST

RELAY

DESIG	ALM	
CODE	MB3A	
OPTION		
⊠	CONT ARR	LOC
6	B	BB/F7
5	EBM	BB/F9
4	M	BB/E9
3	M	BB/G9
2	EBM	BB/E9
1	EBM	BB/D9
COIL	⊠	BB/D9

RELAY NOT ADJUSTABLE.
REPLACE WHEN THERE
IS MALFUNCTION

CAPACITOR

DESIG	CODE
C1	KS-20362,L2, 100
C2	KS-20362,L2, 100
C3	KS-19658,L31, 300
C4	KS-19658,L24, 200
C5	KS-19658,L24, 200
C6	KS-20362,L2, 100

DIODE

DESIG	CODE
ALM	~~446A~~ 533G
CR1	~~446N~~ 808AF
CR2	446T
CR3	446T
CR4	~~446A~~ 533G
CR5	~~446A~~ 533G
CR6	~~446A~~ 533G
CR7	~~446E~~ 808AD
CR8	~~446A~~ 533G
CR9	426M
CR10	446T
CR11	446T
CR12	531A (SEE NOTE 6)
CR13	446A

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502W
IC2	502W
IC3	502W

POTENTIOMETER

DESIG	CODE
R20	KS-19055,L11, 10KΩ

RESISTOR

DESIG	CODE
R1	KS-20616,L1A, 1540
R2	KS-20616,L1A, 12.7KΩ
R3	KS-20616,L1A, 66.5KΩ
R4	KS-20616,L1A, 66.5KΩ
R5	KS-20616,L1A, 31.6KΩ
R6	KS-20616,L1A, 19.6KΩ
R7	KS-20616,L1A, 51.1KΩ
R8	KS-20616,L1A, 5110

RESISTOR (CONT)

DESIG	CODE
R9	KS-20616,L1A, 21.5KΩ
R10	KS-20616,L1A, 10.7KΩ
R11	KS-20616,L1A, 5110
R12	KS-20616,L1A, 21.5KΩ
R13	KS-20616,L1A, 500
R14	KS-20616,L1A, 51.1KΩ
R15	KS-20616,L1A, 100
R16	KS-20616,L1A, 5110
R17	KS-20616,L1A, 1KΩ
R18	KS-14603,L1A, 1KΩ
R19	KS-14603,L3C, 619
R21	KS-20616,L1A, 1540
R22	KS-20289,L3C, 1KΩ
R23	KS-20289,L6C, 4800

SWITCH

DESIG	CODE
S1	KS-19636,L6

TRANSFORMER

DESIG	CODE
T1	2532Y

TRANSISTOR

DESIG	CODE
Q1	51B

VARISTOR

DESIG	CODE
RV1	1000
RV2	1000
RV3	1000
RV4	1000
RV5	1000

DWG ISS	PREV FURN	STD	MFR DISC	SEE NOTE
9B	DIODES	533G 808AF 808AD	446A* 446N* 446E*	

* NONRECORD OPTION

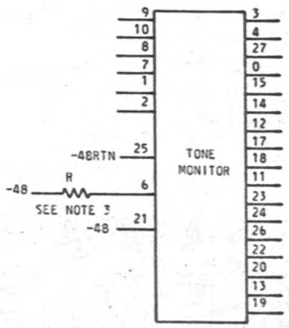
NOTES: (CONT)

6. A FEW EARLY PRODUCTION UNITS CONTAINED THE 517A DIODE.

MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A1027
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X17995

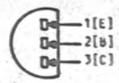
SYMBOL



NOTES:

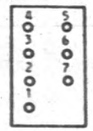
1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS,
   CAPACITANCE VALUES ARE IN MICROFARADS,
   VALUES PRECEDED BY A +(PLUS) OR -(MINUS) ARE IN VOLTS.

2. TERMINAL ARRANGEMENT OF THE 51B TRANSISTOR IS:

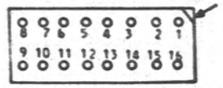


3. THIS RESISTOR IS EXTERNALLY MOUNTED FROM THE CIRCUIT PACK. IT IS A 681Ω 10W TYPE KS-8512, L4A OR EQUIV.

4. TERMINAL ARRANGEMENT FOR THE 2532Y TRANSFORMER IS:



5. TERMINAL ASSIGNMENT OF THE INTEGRATED CIRCUITS ARE AS FOLLOWS:



ISSUE 9B

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J88

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J88

PART OF CPS A1027

TONE LOW VOLTAGE MONITOR

INPUT/OUTPUT INFORMATION

1. DC INPUT

a) VOLTAGE*:

NORMAL: -48.00V TO -52.00
EMERGENCY: -42.75 TO -53.50
MAX TRANSIENT: -60.00

b) CURRENT (THE SUM OF THE CURRENTS ENTERING TERMINALS 6 AND 21).

NORMAL: 50 MA MAX., (NO SIGNAL INPUT)
(-48V TO -52V INPUT) 65 MA MAX., (WITH SIGNAL INPUT)
EMERGENCY:60MA MAX., (NO SIGNAL INPUT)
(-42.75V INPUT) 55MA MAX., (WITH SIGNAL INPUT)
EMERGENCY: 60MA MAX., (NO SIGNAL INPUT)
(-53.5V INPUT) 75MA MAX., (WITH SIGNAL INPUT)

* AN EXTERNAL RESISTOR IS REQUIRED. IT IS TO BE CONNECTED BETWEEN THE -48V BATTERY FEED AND TERMINAL 6 OF THE CIRCUIT PACK. SEE THE TONE LOW VOLTAGE MONITOR SYMBOL AND NOTE 3 ON SHEET J8B.

2. SIGNAL INPUT

a) VOLTAGE**:

50 MV TO 5.01V RMS APPLIED TO THE APPROPRIATE CIRCUIT PACK TERMINALS GIVEN IN THE TABLE BELOW.

b) SIGNAL FREQUENCY:
300 HZ TO 3000 HZ

c) OTHER PERMISSIBLE SIGNAL CHARACTERISTICS:

THE TONE LOW VOLTAGE MONITOR IS DESIGNED TO MONITOR CONTINUOUS AS WELL AS INTERRUPTED SIGNALS HAVING THE FOLLOWING CHARACTERISTICS:

1. SIGNAL LEVEL PRESENT FOR 2 SECONDS, THEN EQUAL TO ZERO FOR 4 SECONDS, THEN REPEATING AT THIS 10 IPM RATE. (THIS IS THE STANDARD 20HZ RINGING RATE).
2. SIGNAL PRESENT FOR 1/2 SECOND, THAN EQUAL TO ZERO FOR 1/2 SECOND, THEN REPEATING AT THIS 60 IPM RATE: (THIS IS THE STANDARD LINE BUSY INTERRUPTION RATE).
3. SIGNAL PRESENT FOR 1/4 SECOND, THEN EQUAL TO ZERO FOR 1/4 SECOND,THEN REPEATING AT THIS 120 IPM RATE.(THIS IS THE STANDARD TRUNKS BUSY INTERRUPTION RATE)..

** THE SPECIFIED RANGE PERTAINS TO THE UNINTERRUPTED VOLTAGE LEVEL.

d) SIGNAL INPUT IMPEDANCE:

SIGNAL INPUT APPLIED BETWEEN MONITOR TERMINALS	TYPICAL INPUT IMPEDANCE
1 AND 2	29KΩ
1 AND 7	117KΩ
2 AND 7	263KΩ

3. TONE MONITOR WIRING INFORMATION AS A FUNCTION OF SIGNAL VOLTAGE LEVEL AND CHARACTERISTIC (INTERRUPTION RATE).

TABLE

SIGNAL INPUT LEVEL IN RMS VOLTS						
GREATER THAN OR EQUAL TO	LESS THAN	CHARACTERISTICS OF SIGNAL VOLTAGE	TERMINAL 27 OF MONITOR CONNECTED TO TERMINAL 0	TERMINAL 8 OF MONITOR CONNECTED TO TERMINAL	VOLTAGE GAIN OF FIRST STAGE	SIGNAL INPUT APPLIED BETWEEN MONITOR TERMINALS
50MV	75MV	2 SEC ON, 4 SEC OFF	YES	9	15	1 AND 2
50MV	75MV	60 IPM, 120 IPM, CONTINUOUS	NO	9	15	1 AND 2
75MV	150MV	2 SEC ON, 4 SEC OFF	YES	9	15	1 AND 2
75MV	150MV	60 IPM,120 IPM, CONTINUOUS	NO	9	15	1 AND 2
150MV	225MV	2 SEC ON, 4 SEC OFF	YES	9	15	1 AND 7
150MV	225MV	60 IPM, 120 IPM, CONTINUOUS	NO	9	15	1 AND 7
225MV	500MV	2 SEC ON, 4 SEC OFF	YES	10	2.5	2 AND 7
225MV	500MV	60 IPM, 120 IPM, CONTINUOUS	NO	10	2.5	2 AND 7
500MV	1.00V	2 SEC ON, 4 SEC OFF	YES	10	2.5	1 AND 2
500MV	1.00V	60 IPM, 120 IPM, CONTINUOUS	NO	10	2.5	1 AND 2
1.00V	1.50V	2 SEC ON, 4 SEC OFF	YES	10	2.5	1 AND 7
1.00V	1.50V	60 IPM, 120 IPM, CONTINUOUS	NO	10	2.5	1 AND 7
1.50V	3.00V	2 SEC ON, 4 SEC OFF	YES	OPEN	0.75	1 AND 2
1.50V	3.00V	60 IPM, 120 IPM, CONTINUOUS	NO	OPEN	0.75	1 AND 2
3.00V	5.01V	2 SEC ON, 4 SEC OFF	YES	OPEN	0.75	1 AND 7
3.00V	5.01V	60 IPM, 120 IPM, CONTINUOUS	NO	OPEN	0.75	1 AND 7

4. MONITOR OUTPUT

a) ELECTRICAL

THE OUTPUT OF THE TONE MONITOR CONSISTS OF SEVERAL PAIRS OF ELECTRICALLY ISOLATED MAKE AND BREAK CONTACTS WHICH CHANGE STATE WHEN THE SIGNAL INPUT VOLTAGE DROPS BY 3dB OR MORE.

INPUT/OUTPUT INFORMATION (CONT)

b) VISUAL

A LIGHT EMITTING DIODE WHICH IS MOUNTED ON THE FRONT OF THE CIRCUIT PACK WILL LIGHT WHEN THE SIGNAL INPUT VOLTAGE DROPS BY 3dB OR MORE.

5) AMBIENT TEMPERATURE

THE MONITOR IS DESIGNED TO OPERATE FROM 0°C TO 65°C

6) SEE MANUFACTURING TESTING REQUIREMENTS X17995 FOR COMPLETE INFORMATION ON ADJUSTING THIS MONITOR.

CIRCUIT DESCRIPTION

A1027 TONE MONITOR

THIS CIRCUIT PACK IS A LOW VOLTAGE MONITOR WHICH WILL DETECT A 3 DB OR GREATER REDUCTION IN THE RMS LEVEL OF THE VOLTAGE AT THE INPUT TO THE MONITOR, TERMINALS 7 AND 1 OR 1 AND 2 OR 7 AND 2 DEPENDING UPON THE LEVEL AND CHARACTERISTIC OF THE VOLTAGE BEING MONITORED.

THIS CIRCUIT IS COMPRISED OF THREE STAGES. THE FIRST STAGE CONSISTS OF AN INPUT TRANSFORMER AND A VOLTAGE AMPLIFIER. THE SECOND STAGE CONSISTS OF A FULL WAVE RECTIFIER AND FILTER. THE THIRD STAGE CONSISTS OF A COMPARATOR DRIVING AN ALARM RELAY.

THE PRIMARY WINDING OF THE INPUT TRANSFORMER, T1 IS CONNECTED ACROSS THE TONE OUTPUT TO BE MONITORED.

THE APPROPRIATE TAPS (1-2),(1-7), OR (3-7) ARE SELECTED IN ACCORDANCE WITH THE VOLTAGE LEVEL TO BE MONITORED. THE SECONDARY WINDING (4-5) OF T1 IS FED INTO THE NON-INVERTING INPUT OF IC1 THROUGH A VOLTAGE DIVIDER CONSISTING OF R4,R5 AND R6.

THE VOLTAGE LEVEL OF THE TONE SIGNAL AT THE OUTPUT OF IC1 IS HELD TO THE 100mV TO 250mV RMS RANGE BY SELECTING THE APPROPRIATE VOLTAGE GAIN OF IC1. THIS IS DONE BY SHUNTING R3 WITH R1 FOR A VOLTAGE GAIN OF 15 OR WITH R2 FOR A GAIN OF 2.5. WHEN A MINIMUM GAIN IS REQUIRED, R3 IS NOT SHUNTED AND A GAIN OF 0.75 IS OBTAINED.

THE OUTPUT OF IC1 IS SUPERIMPOSED ON -16 VOLTS DC WHICH IS GENERATED BY THE SHUNT REGULATOR SUPPLY WHICH IS COMPOSED OF R22,CR10 AND CR11.

THE MONITOR MAY BE TESTED BY SHORTING R6. WITH R6 SHORTED, THE GAIN OF IC1 IS REDUCED BY 2.5 dB WHICH SIMULATES A DROP IN TONE LEVEL AT THE INPUT TO THE MONITOR. THUS, THE MONITOR IS CONSERVATIVELY RATED AS BEING CAPABLE OF DETECTING A 3dB DROP IN TONE VOLTAGE.

DIODES CR1,CR2 AND CR3 ARE USED FOR TRANSIENT SUPPRESSION.

THE SECOND STAGE CONSISTS OF A FULL-WAVE RECTIFIER, AN AMPLIFIER WITH A VOLTAGE GAIN OF 4 AND A FILTER. DIODES CR4 AND CR5 DIRECT THE AC TONE SIGNAL PRESENT AT THE OUTPUT OF IC1 TO THE APPROPRIATE INPUT OF IC2.

WHEN THE TONE SIGNAL IS GREATER THAN -16 VOLTS, CR5 CONDUCTS AND CR4 IS REVERSE BIASED. THE TONE SIGNAL THEN PASSES THROUGH CR5 AND THE RESISTOR DIVIDER, R8 AND R10 INTO THE NON-INVERTING INPUT OF IC2. A POSITIVE-GOING SIGNAL IS PRODUCED AT THE OUTPUT OF IC2. THE GAIN OF THE STAGE IN THIS MODE IS SET BY RESISTORS R9, R11,R12 AND THE RESISTOR DIVIDER PAIR R8 AND R10. WHEN THE TONE SIGNAL IS LESS THAN -16 VOLTS DIODE CR4 CONDUCTS AND CR5 IS REVERSE BIASED. THE SIGNAL NOW PASSES THROUGH R8 AND CR4 INTO THE INVERTING INPUT OF IC2 AND AGAIN PRODUCES A POSITIVE-GOING SIGNAL AT THE OUTPUT OF IC2. THE GAIN OF THE STAGE IN THIS MODE IS DETERMINED BY RESISTORS R8 AND R12. THE SELECTION OF RESISTORS WAS MADE SO THAT THE GAIN OF IC2 IN BOTH MODES OF OPERATION WERE EQUAL.

SINCE THE INPUT BIASING VOLTAGE FOR IC2 IS -16 VOLTS, THE OUTPUT QUIESCENT VOLTAGE OF IC2 WILL ALSO BE -16 VOLTS. SINCE THE POSITIVE-GOING RECTIFIED SIGNAL IS SUPERIMPOSED ABOVE THE -16 VOLT LEVEL,ONLY HALF OF THE AVAILABLE OUTPUT VOLTAGE SWING CAPABILITY WILL BE USED. A -8 VOLT LEVEL FED INTO THE INVERTING INPUT THROUGH RESISTOR R9 SHIFTS THE QUIESCENT LEVEL OF THE OUTPUT OF IC2 TO -24 VOLTS.

THE RECTIFIED SIGNAL CAN NOW USE THE ENTIRE OUTPUT VOLTAGE SWING CAPABILITY OF IC2 BEFORE CLIPPING OCCURS.

THE RECTIFIER OUTPUT IS FED THROUGH DIODE CR6 AND RESISTOR R13 TO FILTER CAPACITOR C2.

THE DC VOLTAGE ON C2 IS APPROXIMATELY EQUAL TO THE PEAK VALUE OF THE RECTIFIED SIGNAL. RESISTOR R14 PROVIDES A DISCHARGE PATH FOR C2. CAPACITOR COMBINATION C1,C6 MAY BE CONNECTED IN PARALLEL WITH C2 TO PROVIDE THE ADDITIONAL CAPACITANCE REQUIRED WHEN MONITORING TONES WITH 2 SECONDS OF TONE AND 4 SECONDS OF NO TONE INTERRUPTION RATE.

THE THIRD STAGE CONSISTS OF A COMPARATOR WHICH DRIVES AN ALARM RELAY. THE COMPARATOR, IC3, COMPARES THE DC VOLTAGE PRESENT ON C2 WITH THE VOLTAGE PRESENT ON THE WIPER-ARM OF THE POTENTIOMETER, R20. THIS VOLTAGE IS A PORTION OF THE VOLTAGE DEVELOPED ACROSS THE REFERENCE ZENER CR7. UNDER NORMAL OPERATING CONDITIONS, THE DC VOLTAGE ON C2 IS GREATER THAN THAT PRESENT ON THE WIPER-ARM OF R20. THIS RESULTS IN A LOW OUTPUT FOR IC3. TRANSISTOR Q1 IS SATURATED BY THE BIAS PROVIDED THROUGH R16,RV1,RV2 AND RV3. WITH Q1 ON, THE "ALM" RELAY IS HELD OPERATED. UNDER TROUBLE CONDITIONS WHEN THE LEVEL OF THE INPUT TONE DROPS, THE DC VOLTAGE ON C2 WILL CORRESPONDINGLY DROP. WHEN IT FALLS BELOW THE LEVEL PRESENT ON THE WIPER-ARM OF R20,THE OUTPUT OF IC3 SWITCHES HIGH TURNING OFF Q1 AND RELEASING THE "ALM" RELAY. THE LIGHT-EMITTING DIODE CR12 THEN LIGHTS INDICATING AN ALARM CONDITION. ADDITIONAL CONTACTS ON THE "ALM" RELAY ARE PROVIDED FOR PLANT ALARM INDICATIONS.

CPS A1027

ISSUE 1

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J8C

BELL TELEPHONE LABORATORIES INCORPORATED

SIZE 6S

SD-82156-01-J8C

CPS A1029

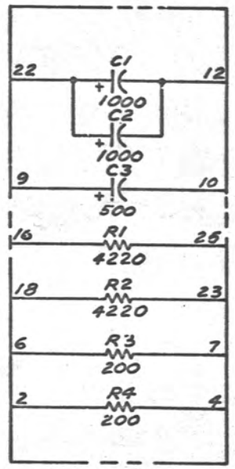
COMPONENT LIST

CAPACITOR

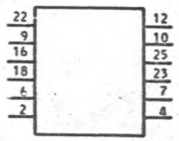
DESIG	CODE
C1	KS-19658,L29,1000
C2	KS-19658,L29,1000
C3	KS-19658,L37,500

RESISTOR

DESIG	CODE
R1	KS-20289,L6C,4220
R2	KS-20289,L6C,4220
R3	KS-2u289,L1A,200
R4	KS-20289,L1A,200



SYMBOL



INPUT/OUTPUT INFORMATION

NONE REQUIRED

CIRCUIT DESCRIPTION

NO CIRCUIT DESCRIPTION IS REQUIRED. SELECTED RESISTORS AND CAPACITORS IN CPA 1029 AND CPA 1030 COMBINED WITH RELAYS IN CPA 1005 PROVIDE THE APPROPRIATE R-C TIME CONSTANTS AND HOLDING CURRENTS NECESSARY TO OPERATE THE INTERRUPTER MONITORS FOR 10,60 OR 120 I.P.M SIGNALS.

CPS A1030

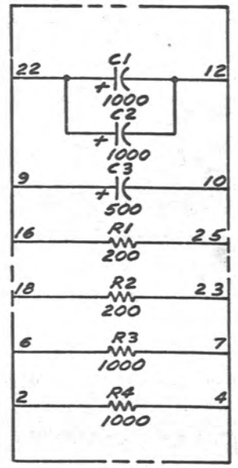
COMPONENT LIST

CAPACITOR

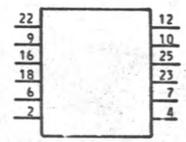
DESIG	CODE
C1	KS-19658,L29,1000
C2	KS-19658,L29,1000
C3	KS-19658,L37,500

RESISTOR

DESIG	CODE
R1	KS-20289,L1A,200
R2	KS-20289,L1A,200
R3	KS-20289,L1A,1000
R4	KS-20289,L1A,1000



SYMBOL



INPUT/OUTPUT INFORMATION

NONE REQUIRED

CIRCUIT DESCRIPTION

NO CIRCUIT DESCRIPTION IS REQUIRED. SELECTED RESISTORS AND CAPACITORS IN CPA 1029 AND CPA 1030 COMBINED WITH RELAYS IN CPA 1005 PROVIDE THE TIME CONSTANTS AND HOLDING CURRENTS NECESSARY TO OPERATE THE INTERRUPTER MONITORS FOR 10,60 OR 120 I.P.M. SIGNALS.

MANUFACTURING REFERENCES

CATEGORY	NO
CIRCUIT PACK CODE	
CPS A1029	A1029
CPS A1030	A1030
CONNECTOR ON FRAME	
CPS A1029	9058
CPS A1030	9058
MANUFACTURING TEST REQ	X17995

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS,
   CAPACITANCE VALUES ARE IN MICROFARADS,
   VALUES PRECEDED by THE SYMBOL +(PLUS)
   OR -(MINUS) ARE IN VOLTS.

CPS A1029 & A1030

ISSUE 1

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J9

BELL TELEPHONE LABORATORIES INCORPORATED

6S

SD-82156-01-J9

CPS A1052 (MFR DISC)
310HZ OSCILLATOR

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L25,300
C2	542A
C3	KS-19774,L5,.1
C4	578D,.132
C5	578D,.182
C6	578D,.132
C7	542A

DIODE

DESIG	CODE
CR1	446AD

INTEGRATED CIRCUIT

DESIG	CODE
IC1	502B

POTENTIOMETER

DESIG	CODE
R10	KS-16803,L5,1KΩ

RESISTOR

DESIG	CODE
R1	145A,4.12MΩ
R2	KS-20810,L1A,100KΩ
R3	KS-20810,L1A,100KΩ
R4	KS-16312,L6F,4640
R5	KS-16312,L6F,4640
R6	KS-16312,L6F,1600
R7	KS-20810,L1A,133K
R8	KS-20289,L4A,3160
R9	KS-20810,L1A,10.2KΩ
R11	KS-20810,L1A,23.7
R12	KS-20810,L1A,23.7
R13	KS-20810,L1A,324KΩ
R14	KS-20810,L1A,931KΩ
R15	KS-20810,L1A,931KΩ
R16	KS-20810,L1A,8.25
R17	KS-20810,L1A,287KΩ

THERMISTOR

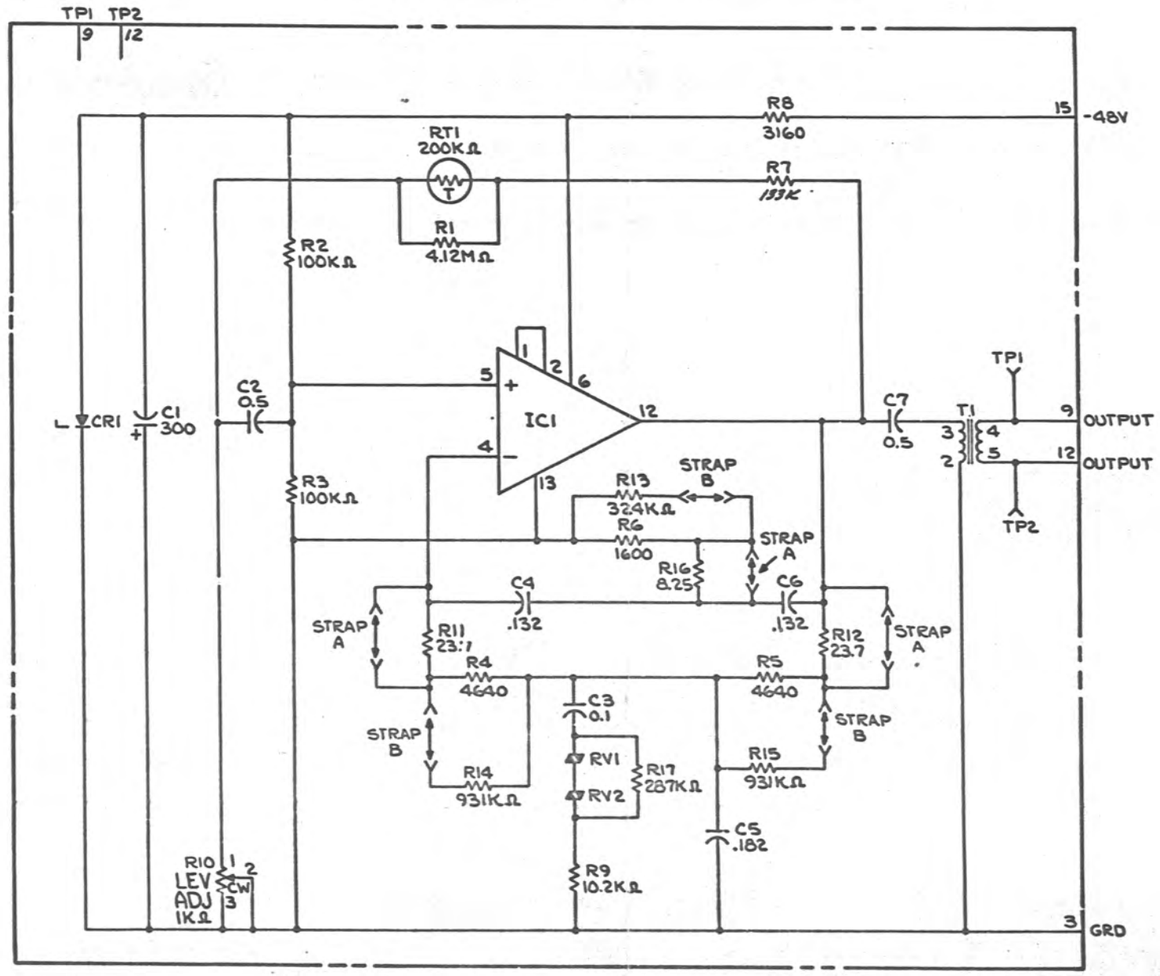
DESIG	CODE
RT1	44A

TRANSFORMER

DESIG	CODE
T1	2564R

VARISTOR

DESIG	CODE
RV1	100E
RV2	100E



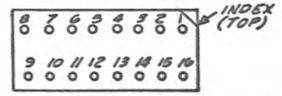
MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A1052
CONNECTOR ON FRAME	905B
MANUFACTURING TEST REQ	X-17995

SYMBOL

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PROCEEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. THE TERMINAL ASSIGNMENT OF THE 502B INTEGRATED CIRCUIT IS AS FOLLOWS:



3. STRAPS A AND B ARE CUT TO ADJUST THE OSCILLATOR FREQUENCY TO WITHIN ± 0.3% OF 310HZ.

INPUT/OUTPUT INFORMATION

1. DC INPUT
   A) VOLTAGE
      NORMAL -42.0V TO -52.0V
      EMERGENCY -42.75V TO -53.5V
      MAX. TRANSIENT -60V
   B) CURRENT
      600 OHMS LOAD IMPEDANCE 13.4MA(MAX)
      (INPUT VOLTAGE -53.5V)
2. AC OUTPUT
   A) 245MV ± 8.6%
      FOR THE FOLLOWING CONDITIONS
      600 OHMS LOAD IMPEDANCE
      -42.75V ≤ DC INPUT ≤ -53.5V
      0°C ≤ AMBIENT TEMP ≤ 60°C
   B) 250MV @ NO LOAD TYPICAL
   C) OUTPUT IMPEDANCE = 12 OHMS TYPICAL
   D) THIRD HARMONIC ≤ -60DBM
3. AMBIENT TEMPERATURE
   A) 0°C TO 60°C
4. FREQUENCY
   A) 310HZ ± 0.5%

CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE IS A 310HZ TWIN-T OSCILLATOR CONSISTING OF AN OPERATIONAL AMPLIFIER (IC1) AS THE GAIN ELEMENT AND TWO SEPARATE FEEDBACK PATHS. THE FIRST PATH (R7),(RT1),(R1),(R10),(C2) PROVIDE POSITIVE FEEDBACK BY TAKING A FRACTION OF THE OUTPUT SIGNAL AND RETURNING IT TO THE NON-INVERTING INPUT OF (IC1). THE OTHER PATH PROVIDES NEGATIVE FEEDBACK VIA A RC TWIN-T NETWORK (R4),(R5),(R6),(C4),(C5),(C6) TO THE INVERTING INPUT OF (IC1). AT 310HZ THE TWIN-T NETWORK PROVIDES NO TRANSMISSION AROUND THE NEGATIVE FEEDBACK PATH. DUE TO THE POSITIVE FEEDBACK THE CURRENT BECOMES REGENERATIVE AND CAUSES A SINE WAVE TO APPEAR AT THE OUTPUT TERMINALS. THE MAGNITUDE OF THE OUTPUT VOLTAGE IS ADJUSTED BY POTENTIOMETER (R10). LIMITING OF THE OUTPUT VOLTAGE IS ACCOMPLISHED BY COMPONENTS (C3),(RV1),(RV2),(R9),(R12). THE OSCILLATOR IS POWERED BY A SHUNT REGULATOR MADE UP OF (R8),(CR1) AND (C1).

CPS A1052

ISSUE 4D

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J10

BELL TELEPHONE LABORATORIES INCORPORATED

DRAWING SIZE 6S

SD-82156-01-J10

PART OF CPS 305A
TONE AMPLIFIER

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L9,1000
C2	KS-19774,L5,0.10
C3	KS-19774,L5,0.10
C4	KS-19658,L9,1000
C5	KS-20676,L3,1620 PF
C6	KS-20676,L3,1620 PF
C7	KS-19774,L1,0.01
C8	KS-19774,L9,1.0
C9	KS-19658,L67,450

DIODE

DESIG	CODE
CR1	426S
CR2	485F
CR3	485F
CR4	426AC
CR5	426AC
CR6	446A
CR7	426AG
CR8	426AG

INTEGRATED CIRCUIT

DESIG	CODE
IC1	535B

POTENTIOMETER

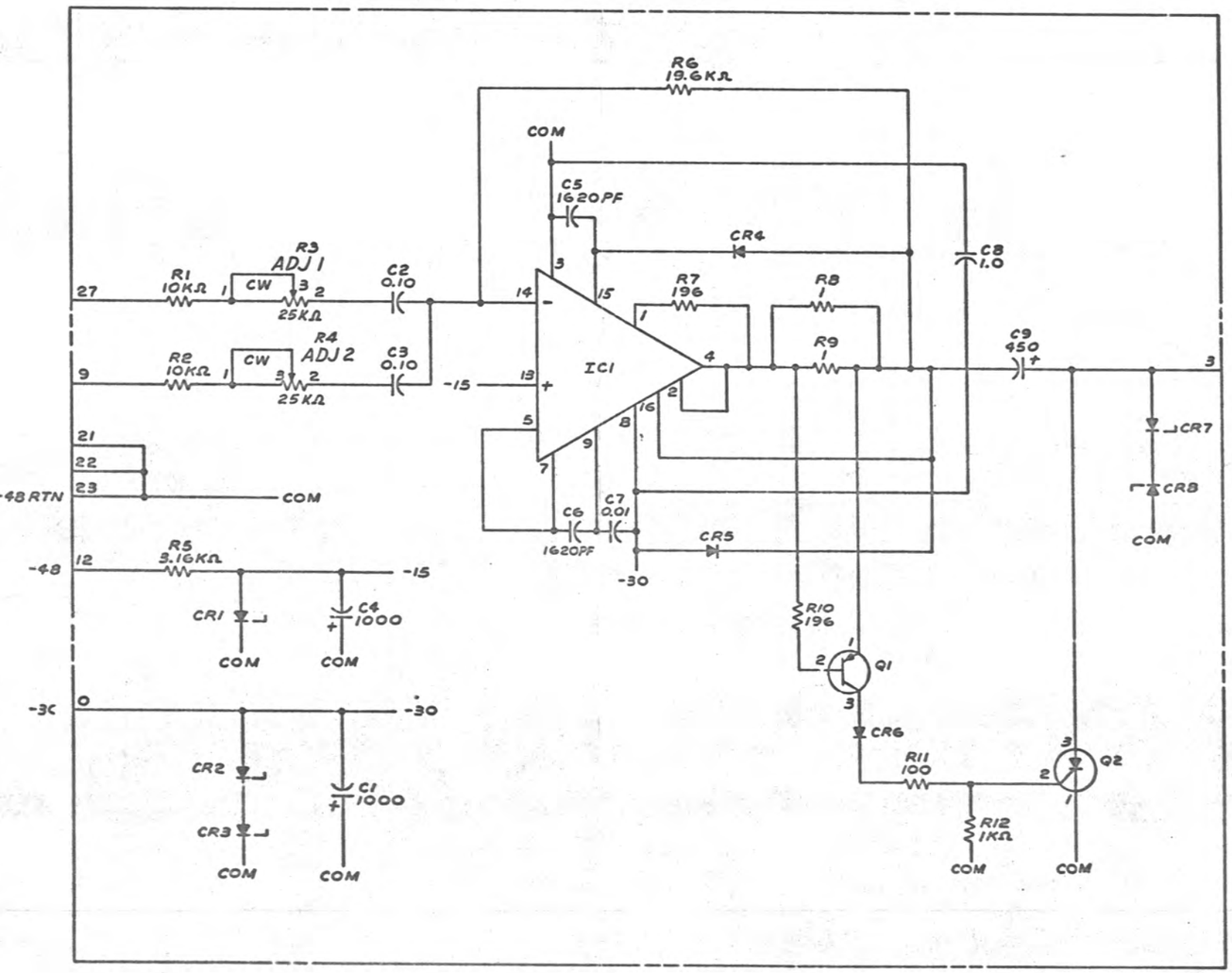
DESIG	CODE
R3	KS-19646,L3A,25KΩ
R4	KS-19646,L3A,25KΩ

RESISTOR

DESIG	CODE
R1	KS-20810,L1A,10KΩ
R2	KS-20810,L1A,10KΩ
R5	KS-20289,L6C,3.16KΩ
R6	KS-20810,L1A,19.6KΩ
R7	KS-20810,L1A,196
R8	KS-20289,L6C,1
R9	KS-20289,L6C,1
R10	KS-20810,L1A,196
R11	KS-20810,L1A,100
R12	KS-20810,L1A,1KΩ

TRANSISTOR

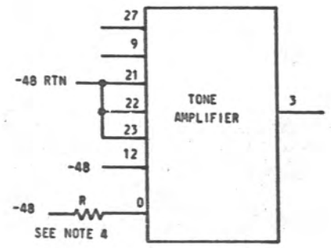
DESIG	CODE
Q1	51F
Q2	2N2324 (THYRISTOR)



MANUFACTURING REFERENCES

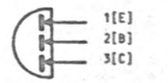
CODE	NO.
CIRCUIT PACK CODE	305A
CONNECTOR ON FRAME	905B
MANUFACTURING TESTING REQ	X-17995

SYMBOL

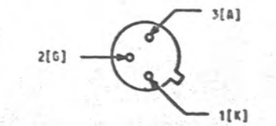


NOTES:

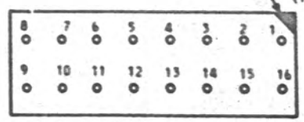
1. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PROCEDED BY A + (PLUS) OR - (MINUS) ARE IN VOLTS.
2. TERMINAL ARRANGEMENT OF THE 51F TRANSISTOR IS:



3. TERMINAL ARRANGEMENT OF THE 2N2324 THYRISTOR IS:



4. THIS RESISTOR IS EXTERNALLY MOUNTED ON THE CIRCUIT PACK. WHEN THE TONE AMPLIFIER IS USED FOR 1VA OUTPUT, IT IS A 100Ω, 20W TYPE KS-8512,L8A OR EQUIVALENT. WHEN THE TONE AMPLIFIER IS USED FOR 100 MVA OUTPUT IT IS A 309Ω, 10W TYPE KS-8512,L3C OR EQUIVALENT.
5. TERMINAL ASSIGNMENT OF THE INTEGRATED CIRCUIT IS AS FOLLOWS:



CPS 305A

ISSUE 2A

RINGING TONE AND SIGNALING CIRCUITS GENERAL USE CIRCUIT

SD-82156-01-JIA

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-JIA

PART OF CPS 305A
TONE AMPLIFIER

CIRCUIT DESCRIPTION

THE CIRCUIT SHOWN IN FIGURE 1 IS A 1 VOLT-AMPERE AMPLIFIER WHICH CONSISTS BASICALLY OF THREE PARTS. THE FIRST PART IS AN INPUT ISOLATION CIRCUIT AND SUMMING AMPLIFIER; THE SECOND PART CONSISTS OF REGULATED BIAS SUPPLIES; AND THE THIRD PART CONSISTS OF A PROTECTION CIRCUIT.

THE FIRST PART CONSISTS OF INTEGRATED CIRCUIT IC1 WITH TWO HIGH IMPEDANCE INPUTS PROVIDED FOR ADDING AUDIBLE SIGNALS IN THE RANGE OF 300 Hz TO 3000 Hz. THE OUTPUT OF IC1 HAS A LOW OUTPUT IMPEDANCE AND DRIVES A TRANSFORMER TO OBTAIN THE PROPER CURRENT AND VOLTAGE LEVELS THAT ARE REQUIRED FOR CALL PROGRESS TONES IN THE RINGING AND TONE POWER PLANTS.

THE ADDING OF THE TWO SIGNALS AND THE VOLTAGE AND POWER GAIN ARE PROVIDED BY IC1. THE PROPER OUTPUT VOLTAGE LEVEL IS OBTAINED BY CONNECTING THE APPROPRIATE TRANSFORMER WITH THE PROPER CHOICE OF TAPS AND BY ADJUSTMENT OF R3 AND R4.

CAPACITORS C5, C6 AND C7 WERE SELECTED IN ACCORDANCE WITH THE INSTRUCTIONS FOR IC1 USE. CAPACITOR C8 FILTERS MINUS 30-VOLT SUPPLY NOISE. DIODES CR4 AND CR5 ARE CONNECTED DIRECTLY ACROSS THE OUTPUT TRANSISTORS IN IC1 TO PREVENT REVERSE VOLTAGE TRANSIENTS FROM DAMAGING THE CHIP.

THE SECOND PART CONSISTS OF TWO SHUNT REGULATORS WHICH ARE POWERED FROM THE MINUS 48-VOLT CENTRAL OFFICE BATTERY. THE FIRST REGULATOR PROVIDES MINUS 30-VOLTS FOR IC1. IT CONSISTS OF RESISTOR R WHICH IS EXTERNAL TO THE AMPLIFIER, DIODES CR2 AND CR3, AND CAPACITOR C1. THE SECOND REGULATOR PROVIDES MINUS 15-VOLTS FOR THE (+) INPUT OF IC1. IT CONSISTS OF RESISTOR R5, DIODE CR1, AND CAPACITOR C4.

THE THIRD PART CONSISTS OF A PROTECTION CIRCUIT FOR IC1. IT IS MADE UP OF TRANSISTORS Q1, AND Q2, DIODES CR6, CR7 AND CR8, AND RESISTORS R8, R9, R10, R11 AND R12. A SYSTEM REQUIREMENT IS THAT THE LOW END OF THE SECONDARY WINDING OF THE OUTPUT TRANSFORMER BE CONNECTED TO THE MINUS 48-VOLT CENTRAL OFFICE BATTERY. THIS IS TO INSURE THAT THERE WILL BE SUFFICIENT CURRENT TO BLOW A DISTRIBUTION FUSE ALMOST INSTANTANEOUSLY WITHOUT AFFECTING OTHER CONNECTING CIRCUITS. NORMALLY THERE IS INSUFFICIENT CURRENT THROUGH THE PARALLEL COMBINATION OF R8 AND R9 TO TURN ON TRANSISTOR Q1. THE NORMAL MAXIMUM PEAK AC LOAD CURRENT IS APPROXIMATELY 0.6 AMPERE AT FULL LOAD. THIS RESULTS IN A PEAK VOLTAGE DROP OF APPROXIMATELY 0.3 VOLT ACROSS THESE RESISTORS.

WHEN A FUSE IS BLOWN IN THE SECONDARY OF THE OUTPUT TRANSFORMER, A LARGE INSTANTANEOUS AC CURRENT WILL FLOW FROM THE PRIMARY OF THE OUTPUT TRANSFORMER THROUGH COUPLING CAPACITOR C9, RESISTORS R8, R9 AND IC1.

WHEN THE VOLTAGE DROP ACROSS RESISTORS R8 AND R9 REACHES APPROXIMATELY 0.7 VOLT, TRANSISTOR Q1 TURNS ON; THIS IN TURN, PROVIDES GATE CURRENT TO TRIGGER Q2. Q2 TURNING ON WILL PROVIDE A SHORT CIRCUIT ACROSS THE PRIMARY OF THE OUTPUT TRANSFORMER WHICH WILL DIVERT THE TRANSIENT CURRENT FROM FLOWING INTO IC1. AFTER THE FUSE BLOWS, THE CURRENT WHICH WAS FLOWING INTO IC1 IS GREATLY REDUCED. THIS IN TURN SHUTS OFF TRANSISTOR Q1. Q2 TURNS OFF WHEN THE AC VOLTAGE AT THE ANODE BECOMES NEGATIVE WITH RESPECT TO ITS CATHODE. AFTER THIS HAPPENS, THE CIRCUIT RETURNS TO ITS NORMAL MODE OF OPERATION. ZENER DIODES CR7 AND CR8 CLAMP THE INSTANTANEOUS VOLTAGE REFLECTED BACK INTO THE PRIMARY OF THE TRANSFORMER WHEN A FUSE IS BLOWN, TO PLUS OR MINUS 27 VOLTS.

INPUT/OUTPUT INFORMATION

1. DC INPUT
   - A) VOLTAGE*:
     NORMAL: -48.00 TO -52.00
     EMERGENCY: -42.75 TO -53.50
     MAX TRANSIENT: -60.00
   - B) CURRENT (THE SUM OF THE CURRENTS ENTERING TERMINALS 12 AND 0).
     NORMAL: 200 MA MAX. (-48V TO -52V INPUT)
     EMERGENCY: 140 MA MAX. (-42.75V INPUT)
     EMERGENCY: 255 MA MAX. (-53.5V INPUT)

   *AN EXTERNAL RESISTOR IS REQUIRED. IT IS TO BE CONNECTED BETWEEN THE -48V BATTERY FEED AND TERMINAL 0 OF THE CIRCUIT PACK. SEE THE TONE AMPLIFIER SYMBOL AND NOTE 4 ON SHEET J11A.

2. SIGNAL INPUT
   - A) VOLTAGE:
     2.60V RMS ± 0.5dB APPLIED TO EITHER OF TERINALS 27 OR 9 OR BOTH.
   - B) SIGNAL FREQUENCY:
     300 Hz TO 3000 Hz
   - C) SIGNAL INPUT IMPEDANCE:

SIGNAL INPUT APPLIED BETWEEN AMPLIFIER TERMINALS	TYPICAL INPUT IMPEDANCE
21,22,23, AND 27	22.5KΩ
21,22,23 AND 9	22.5KΩ

   - D) NOISE:
     THE HARMONIC DISTORTION CONTENT OF EACH SIGNAL CONNECTED TO THE INPUT OF THE AMPLIFIER SHALL BE ≥ 57dB BELOW THE FUNDAMENTAL.

3. AMPLIFIER OUTPUT**
   - A) POWER OUTPUT:
     1 VOLT-AMPERE
   - B) OUTPUT IMPEDANCE CHARACTERISTICS:
     WHEN OPERATING INTO A 2213A TRANSFORMER WITH THE OUTPUT VOLTAGE OF THE AMPLIFIER SET AT 5.16 VOLTS RMS AND MAXIMUM OUTPUT CURRENT OF 230 MA RMS, THE OUTPUT IMPEDANCE IS TYPICALLY 1 OHM.
   - C) AC VOLTAGE REGULATION:
     5.16 VOLTS RMS ±0.5dB UNDER THE FOLLOWING CONDITIONS:
     DC INPUT -42.75V TO -53.50V
     LOAD 0 TO 1 VOLT-AMPERE
     TEMPERATURE 0°C TO 65°C
   - E) NOISE:
     WHEN A GIVEN SIGNAL - WHICH HAS A HARMONIC DISTORTION CONTENT ≥ 57dB BELOW THE FUNDAMENTAL - IS CONNECTED TO THE INPUT OF THE AMPLIFIER, THE SIGNAL MEASURED AT THE OUTPUT OF THE TRANSFORMER WILL HAVE A HARMONIC DISTORTION CONTENT ≥ 52dB BELOW THE FUNDAMENTAL UNDER CONDITIONS STATED IN (C).

   ** THE OUTPUT OF THE AMPLIFIER-TERMINAL 3 - IS CONNECTED TO A 2213A TRANSFORMER.

4. AMBIENT TEMPERATURE:
   THE AMPLIFIER IS DESIGNED TO OPERATE FROM 0°C TO 65°C.

CPS305A

ISSUE 2A

RINGING TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J11B

BELL TELEPHONE LABORATORIES INCORPORATED

6S

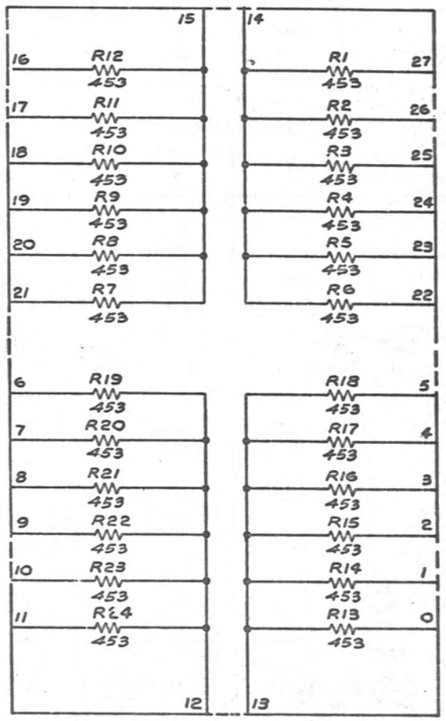
SD-82156-01-J11B

CPS A1110
TONE SPLITTING RESISTORS

COMPONENT LIST

RESISTOR

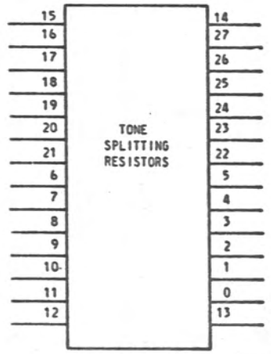
DESIG	CODE
[24] R1-R24	KS-20289,L6C,453



MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A1110
CONNECTOR ON FRAME	905B
MANUFACTURING TESTING REQ	X-17995

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS.

INPUT/OUTPUT INFORMATION

NONE REQUIRED

CIRCUIT DESCRIPTION

THIS CIRCUIT PACK (CP) COMPRISES FOUR SETS OF SIX RESISTORS IN EACH SET, ALL OF THE RESISTORS ARE CONNECTED TOGETHER AT ONE END AND THIS COMMON POINT IS BROUGHT OUT EXTERNALLY. THESE RESISTORS ARE INTENDED FOR USE AS TONE-SPLITTING RESISTORS IN RINGING AND TONE (R&T) PLANTS. THE INITIAL USE OF THIS CP IS IN THE R&T PLANT FOR NO. 3 ESS SYSTEM (SD-82255-01). FOR THE TYPICAL APPLICATION, A PAIR OF RESISTORS IS REQUIRED FOR EACH TONE OUTPUT PAIR THAT IS MULTIPLED FROM THE TONE TRANSFORMER SECONDARY WINDING (A RESISTOR IS PLACED IN SERIES WITH EACH OF THE "TIP" & "RING" LEADS). USUALLY, MULTIPLE OUTPUTS ARE REQUIRED FOR EACH TONE. THE OUTPUT TERMINALS ON THE CP ARE SUCH THAT 12 PAIRS OF RESISTORS MAY BE EMPLOYED FOR A PARTICULAR TONE OUTPUT. FOR EXAMPLE IF A SHORT IS PLACED BETWEEN TERMINALS 12 & 13 AND ANOTHER SHORT IS PLACED BETWEEN TERMINALS 14 & 15, THEN THE "TIP" AND "RING" PAIRS ARE R1 & R13, R12 & R24, ETC.

SD-82156-01-J12

CPSA1110

ISSUE 2A

RINGING TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J12

BELL TELEPHONE LABORATORIES INCORPORATED

6S

PART OF CPS A1111
TONE TRANSFORMERS

COMPONENT LIST

CAPACITOR

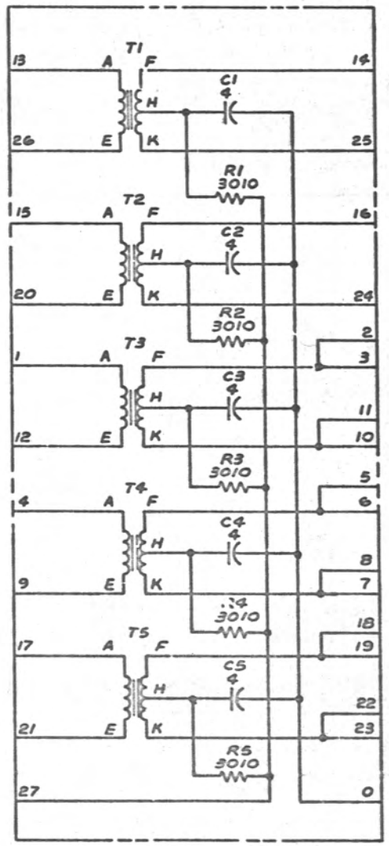
DESIG	CODE
C1	542G,4
C2	542G,4
C3	542G,4
C4	542G,4
C5	542G,4

RESISTOR

DESIG	CODE
R1	KS-20289,L6C,3010
R2	KS-20289,L6C,3010
R3	KS-20289,L6C,3010
R4	KS-20289,L6C,3010
R5	KS-20289,L6C,3010

TRANSFORMER

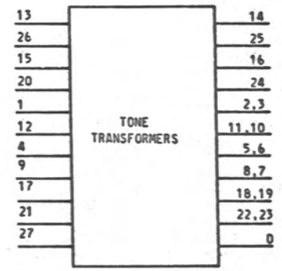
DESIG	CODE
T1	3000F
T2	3000K
T3	3000H
T4	3000J
T5	3000G



MANUFACTURING REFERENCES

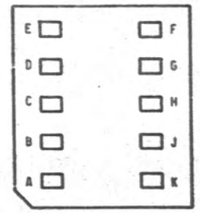
CATEGORY	NO.
CIRCUIT PACK CODE	A1111
CONNECTOR ON FRAME	905B
MANUFACTURING TESTING REQUIREMENTS	X-17995

SYMBOL



NOTES:

1. TERMINAL ASSIGNMENTS OF 3000F, 3000K, 3000H, 3000J, AND 3000G TRANSFORMERS ARE:



2. UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS,
CAPACITOR VALUES ARE IN MICROFARADS AND
VALUES PRECEDED BY +(PLUS) OR -(MINUS) ARE
IN VOLTS.

CPSA1111

ISSUE 2A

RINGING TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J13A

BELL TELEPHONE LABORATORIES
INCORPORATED

6S

PART OF CPS AIIII

TONE TRANSFORMERS

CIRCUIT DESCRIPTION

THIS CIRCUIT PACKAGE (CP) COMPRISES FIVE TRANSFORMERS, FIVE RESISTORS AND FIVE CAPACITORS. THE TRANSFORMERS ARE USED IN CONJUNCTION WITH TONE AMPLIFIERS IN RINGING & TONE PLANTS TO PROVIDE THE CALL-PROGRESS TONES TO THE SYSTEM. THE INITIAL APPLICATION OF THIS CP IS IN THE NO. 3 ESS SYSTEM. EACH TRANSFORMER HAS A CENTER-TAPPED SECONDARY WINDING, WITH A RESISTOR-CAPACITOR NETWORK CONNECTED TO EACH CENTER TAP. EACH CAPACITOR PROVIDES AN AC GROUND FOR THE BALANCED TONE OUTPUT. THE CAPACITORS ARE ALL CONNECTED TOGETHER AT ONE END WHICH IS THEN CONNECTED EXTERNALLY TO THE GROUND OF THE CKT. IN WHICH THIS CP IS USED. SIMILARLY, THE RESISTORS ARE ALL CONNECTED TOGETHER AT ONE END. IN THE APPLICATION FOR NO.3 ESS SYSTEM, THE COMMON POINT ON THE RESISTORS IS CONNECTED EXTERNALLY TO THE COIL OF A RELAY. THIS PROVIDES A CURRENT-PATH TO OPERATE THE RELAY IN THE EVENT THAT A LOW-IMPEDANCE-TO-GROUND SHOULD DEVELOP ON ANY OF THE EXTERNAL LEADS CONNECTED TO THE SECONDARY WINDING OF EACH TRANSFORMER.

INPUT/OUTPUT INFORMATION

1. AMBIENT TEMPERATURE/HUMIDITY

   THIS CIRCUIT PACK WILL OPERATE SATISFACTORY OVER THE AMBIENT TEMPERATURE LIMITS OF 0°C TO 65°C WITH A RELATIVE HUMIDITY OF 20 TO 80 PERCENT.

2. OUTPUT POWER CAPABILITY

   EACH TRANSFORMER IS CAPABLE OF DELIVERING 100 MILLIWATTS OF POWER AT FULL-LOAD CONDITIONS (LOAD REGULATION CHARACTERISTICS ARE DEFINED IN SECTION 3).

INPUT/OUTPUT INFORMATION (CONT)

3. TERMINAL VOLTAGE SPECIFICATIONS

   (A) THE VOLTAGE APPLIED TO THE PRIMARY WINDING OF EACH TRANSFORMER FOR THE INTENDED APPLICATION IS EITHER A SINGLE SINUSOID OR A COMBINED WAVEFORM WHICH CONSISTS OF TWO SINUSOIDAL VOLTAGES ADDED TOGETHER. IN ORDER TO OBTAIN THE REQUIRED SECONDARY VOLTAGES AS LISTED BELOW, THE RMS VALUE OF THE PRIMARY VOLTAGE FOR ANY TRANSFORMER WILL BETWEEN 4.35V AND 4.65V.

   THE OUTPUT VOLTAGE, FREQUENCY AND REGULATION CHARACTERISTICS FOR EACH TRANSFORMER ARE AS FOLLOWS:

TRANSFORMER NUMBER	FREQUENCY OF PRIMARY VOLTAGE (HERTZ)	*SECONDARY VOLTAGE(VRMS)		
		MAX @ N.L.	HALF-LOAD	MIN @ F.L
T1	350 & 440 COMBINED	1.272	1.200	1.128
T2	440	0.509	0.480	0.451
T3	440 & 480 COMBINED	0.382	0.360	0.338
T4	480	0.307	0.290	0.273
T5	480 & 620 COMBINED	0.212	0.200	0.188

*THE SECONDARY VOLTAGE IS INITIALLY SET AT HALF-LOAD BY AN ADJUSTMENT ON THE AMPLIFIER WHICH IS CONNECTED TO THE TRANSFORMER PRIMARY.

(B) THE MAXIMUM VOLTAGE RATING TO GROUND ON ANY WINDING IS 60V.

4. HARMONIC DISTORTION

FOR EACH TRANSFORMER, WHEN A PURE SINUSOIDAL VOLTAGE OF THE APPROPRIATE FREQUENCY CONTENT (AS PREVIOUSLY INDICATED) AND WITH A MAGNITUDE BETWEEN 4.35V RMS AND 4.65V RMS IS APPLIED TO THE PRIMARY WINDING, THE TOTAL HARMONIC VOLTAGE AT THE SECONDARY FOR ALL PRESCRIBED LOAD CONDITIONS WILL BE AT LEAST 55db BELOW THE FUNDAMENTAL SIGNAL LEVEL.

SD-82156-01-J138

CPSAIIII

ISSUE 2A

RINGING, TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J138

BELL TELEPHONE LABORATORIES INCORPORATED

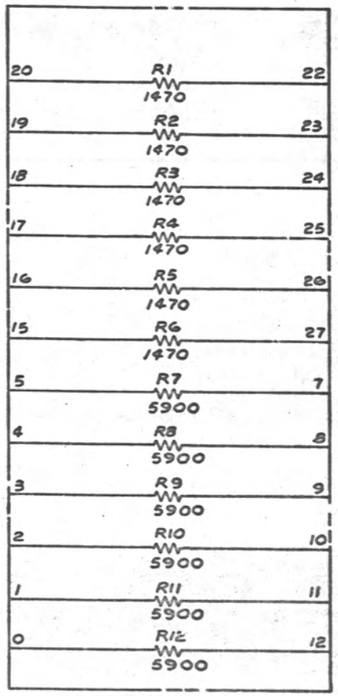
6S

CPS A1113
RESISTOR NETWORK

COMPONENT LIST

RESISTOR

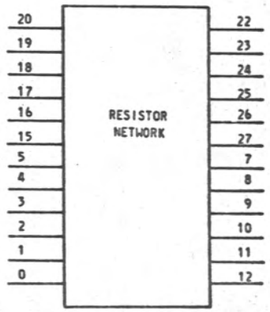
DESIG	CODE
[6] R1-R6	KS-20810,L1A,1470
[6] R7-R12	KS-20810,L1A,5900



MANUFACTURING REFERENCES

CATEGORY	NO.
CIRCUIT PACK CODE	A1113
CONNECTOR ON FRAME	905B
MANUFACTURING TESTING REQ	X-17995

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS.

INPUT/OUTPUT INFORMATION

NONE REQUIRED

CIRCUIT DESCRIPTION

THIS CIRCUIT PACK (CP) COMPRISES 12 ISOLATED RESISTORS WITH ALL LEADS EXTERNALLY AVAILABLE. EACH OF RESISTORS R1 THROUGH R6 IS USED IN SERIES WITH A TONE-MONITOR INPUT TO SIMULATE A 3dB DROP IN TONE OUTPUT VOLTAGE IN RINGING & TONE PLANT. EACH OF RESISTORS R7 THROUGH R12 IS USED TO LIMIT THE CURRENT IN A SCANNING-LOOP ON THE OUTPUT OF THE RINGING & TONE (R&T) PLANT. THE INITIAL USE OF THIS CP IS IN THE R&T PLANT FOR NO. 3 ESS SYSTEM.

CPSA1113

ISSUE 2A

RINGING TONE AND SIGNALING CIRCUITS
GENERAL USE CIRCUIT PACKS

SD-82156-01-J14

BELL TELEPHONE LABORATORIES INCORPORATED 6S

SD-82156-01-J14

PART OF CPS 305B
TONE AMPLIFIER

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	KS-19658,L9,1000
C2	KS-19774,L5,0.10
C3	KS-19774,L5,0.10
C4	KS-19658,L28,800
C5	KS-20676,L3, 220 PF
C6	KS-20676,L3, 470 PF
C7	KS- 20676,L3, 470
C8	KS- 20676,L7,0.015
C9	KS-19658,L67,450

DIODE

DESIG	CODE
CR2	485E
CR3	485E
CR4	426AC
CR5	426AC
CR7	426S
CR8	426S
CR9	446A
CR10	446A
CR11	446A
CR12	446A

INTEGRATED CIRCUIT

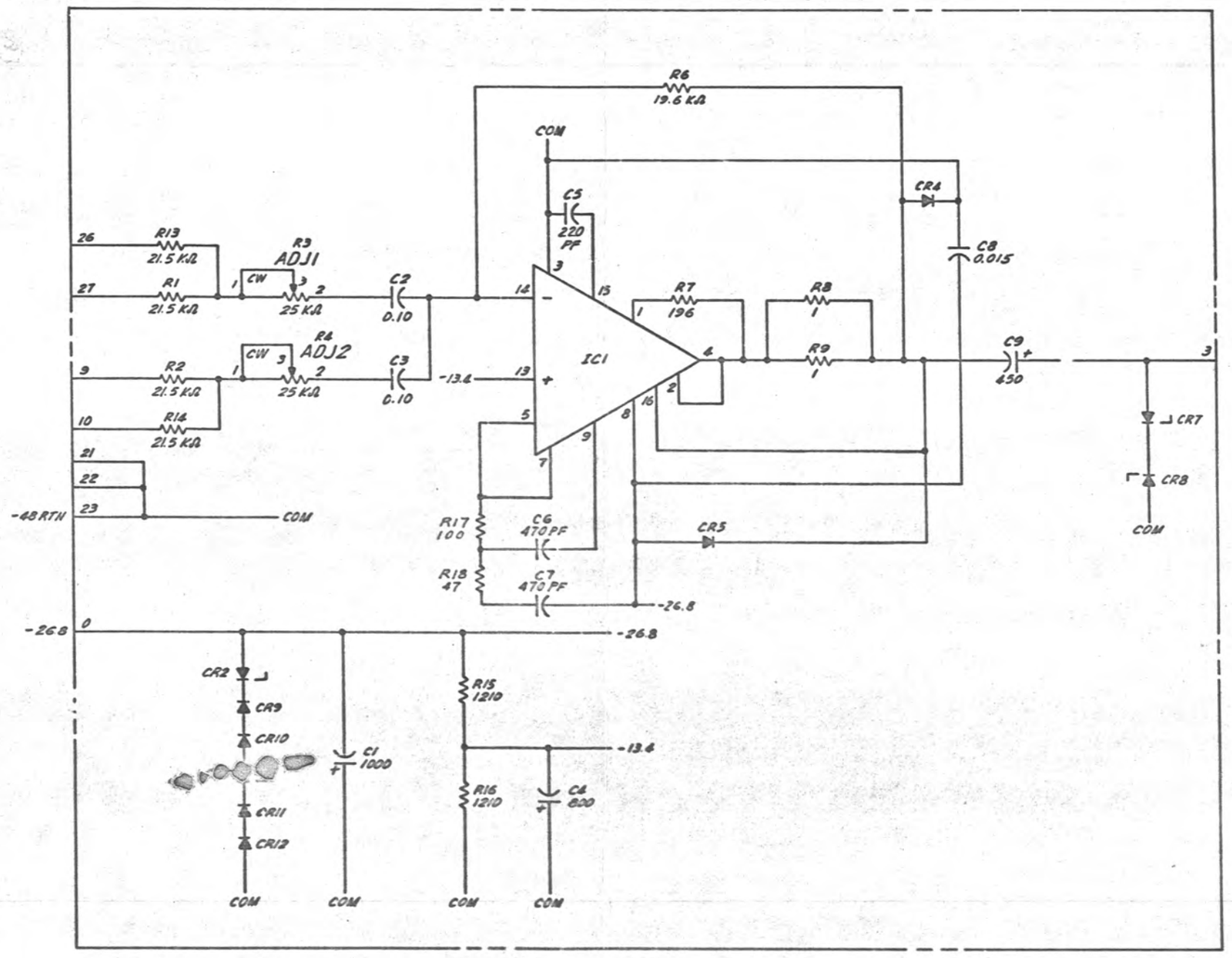
DESIG	CODE
IC1 (SEE NOTE 6)	535B

POTENTIOMETER

DESIG	CODE
R3	KS-19646,L3A,25KΩ
R4	KS-19646,L3A,25KΩ

RESISTOR

DESIG	CODE
R1	KS-20810,L1A,21.5KΩ
R2	KS-20810,L1A,21.5KΩ
R6	KS-20810,L1A,19.6KΩ
R7	KS-20616,L1A,196
R8	KS-14603,L3AD,1
R9	KS-14603,L3AD,1
R13	KS-20810,L1A,21.5KΩ
R14	KS-20810,L1A,21.5KΩ
R15	KS-20810,L1A,1210
R16	KS-20810,L1A,1210
R17	KS-20200,L1, 100
R18	KS-.0200,L1, 47

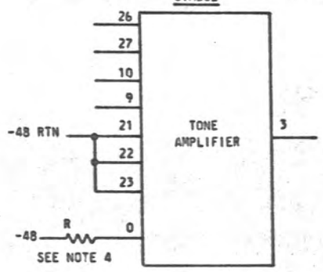


REF DESIG NOT USED		
	CR1 CR6	R5, R10 R11, R12

MANUFACTURING REFERENCES

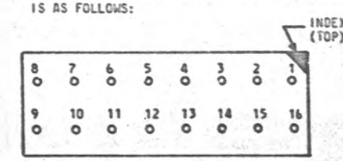
CODE	NO.
CIRCUIT PACK CODE	305B
CONNECTOR ON FRAME	905B
MANUFACTURING TESTING REQ	X-17995

SYMBOL



NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PROCEDED BY A +(PLUS) OR - (MINUS) ARE IN VOLTS.
2. THIS RESISTOR IS EXTERNALLY MOUNTED FROM THE CIRCUIT PACK, WHEN THE TONE AMPLIFIER IS USED FOR 1VA OUTPUT, IT IS A, 110Ω, 30W TYPE KS-8512, L10A OR EQUIVALENT. WHEN THE TONE AMPLIFIER IS USED FOR 100 MVA OUTPUT IT IS A 309Ω, 10W TYPE KS-8512,L3A OR EQUIVALENT.
3. TERMINAL ASSIGNMENT OF THE INTEGRATED CIRCUIT IS AS FOLLOWS:



4. 535B INTEGRATED CIRCUITS WITH WE DATE CODES OF 0476 AND EARLIER SHALL ONLY BE USED IF A RED DOT HAS BEEN STAMPED ON THE COPPER HEADER OF EACH UNIT BY WE,RD MANUFACTURING.
5. CAUTION: ON THE 535B DEVICE THE COPPER SUBSTRATE AND TERMINAL 8 ARE ELECTRICALLY COMMON. IN THE 305B CP THE VOLTAGE AT TERMINAL 8 IS -30VDC. SINCE THE HEAT SINK IS MOUNTED DIRECTLY TO THE SUBSTRATE THEN THE POTENTIAL ON THE HEAT SINK IS ALSO -30V. THEREFORE, WHILE POWER IS APPLIED TO THE CIRCUIT PACK ANY EXTERNAL CONTACT WITH THE HEAT SINK SHOULD BE AVOIDED IN ORDER TO PREVENT DAMAGE TO THE 535B IC.

CPS 305B

ISSUE 7A

RINGING TONE AND SIGNALING CIRCUITS GENERAL USE CIRCUIT

SD-82156-01-J15A

BELL TELEPHONE LABORATORIES INCORPORATED

DRG SIZE 6S

SD-82156-01-J15A

PART OF CPS 305B
TONE OF AMPLIFIER

CIRCUIT DESCRIPTION

THE CIRCUIT SHOWN IN FIGURE 1 IS A 1 VOLT-AMPERE AMPLIFIER WHICH CONSISTS BASICALLY OF TWO PARTS. THE FIRST PART IS AN INPUT ISOLATION CIRCUIT AND SUMMING AMPLIFIER; THE SECOND PART CONSISTS OF A REGULATED BIAS SUPPLY.

THE FIRST PART CONSISTS OF INTEGRATED CIRCUIT IC1 WITH TWO HIGH IMPEDANCE INPUTS PROVIDED FOR ADDING AUDIBLE SIGNALS IN THE RANGE OF 300 Hz TO 3000 Hz. THE OUTPUT OF IC1 HAS A LOW OUTPUT IMPEDANCE AND DRIVES A TRANSFORMER TO OBTAIN THE PROPER CURRENT AND VOLTAGE LEVELS THAT ARE REQUIRED FOR CALL PROGRESS TONES IN THE RINGING, TONE AND CADENCE SYSTEMS.

THE ADDING OF THE TWO SIGNALS AND THE VOLTAGE AND POWER GAIN ARE PROVIDED BY IC1. THE PROPER OUTPUT VOLTAGE LEVEL IS OBTAINED BY CONNECTING THE APPROPRIATE TRANSFORMER WITH THE PROPER CHOICE OF TAPS AND BY ADJUSTMENT OF R3 AND R4.

CAPACITORS C5, C6 AND C7 AND RESISTORS R17 AND R18 WERE SELECTED IN ACCORDANCE WITH THE INSTRUCTIONS FOR IC1 USE. CAPACITOR C8 FILTERS MINUS 26.8-VOLT SUPPLY NOISE. DIODES CR4 AND CR5 ARE CONNECTED DIRECTLY ACROSS THE OUTPUT TRANSISTORS IN IC1 TO PREVENT REVERSE VOLTAGE TRANSIENTS FROM DAMAGING THE CHIP.

THE SECOND PART CONSISTS OF A SHUNT REGULATOR WHICH IS POWERED FROM THE MINUS 48-VOLT CENTRAL OFFICE BATTERY. THE REGULATOR PROVIDES MINUS 26.8-VOLTS FOR IC1. IT CONSISTS OF RESISTOR R WHICH IS EXTERNAL TO THE AMPLIFIER, DIODES CR2, CR3,CR9,CR10,CR11 AND CR12, CAPACITORS C1 AND C4 AND RESISTORS R15 AND R16.

NOTE: IN THE APPLICATION OF THIS CP SPECIAL ATTENTION SHOULD BE PAID TO "CAUTION" WHICH IS SHOWN ON SHEET NOTE 5 OF SHEET J15A.

INPUT-OUTPUT INFORMATION

1. DC INPUT
   A) VOLTAGE*:
      NORMAL: -48.00 TO -52.50
      EMERGENCY: -42.75 TO -53.50
      MAX TRANSIENT: -60.00
   B) CURRENT (THE SUM OF THE CURRENTS ENTERING TERMINAL 0)
      NORMAL: 230 MA MAX. (-48V TO -52.5V INPUT)
      EMERGENCY: 145 MA MAX. (-42.75V INPUT)
      EMERGENCY: 240 MA MAX. (-53.5V INPUT)
      *AN EXTERNAL RESISTOR IS REQUIRED. IT IS TO BE CONNECTED BETWEEN THE -48V BATTERY FEED AND TERMINAL 0 OF THE CIRCUIT PACK. SEE THE TONE AMPLIFIER SYMBOL AND NOTE 4 ON SHEET J15A.
2. SIGNAL INPUT
   A) VOLTAGE:
      2.00V RMS ±0.5dB APPLIED TO EITHER OF TERMINALS 26 AND 27 CONNECTED TOGETHER OR 9 AND 10 CONNECTED TOGETHER OR BOTH. 4.50V RMS ±1.0dB APPLIED TO EITHER OF TERMINALS 27 OR 9 OR BOTH.
   B) SIGNAL FREQUENCY:
      300 Hz TO 3000 Hz
   C) SIGNAL INPUT IMPEDANCE:

SIGNAL INPUT APPLIED BETWEEN AMPLIFIER TERMINALS	TYPICAL INPUT IMPEDANCE
21,22,23, AND 27	32.5KΩ
21,22,23, AND 9	32.5KΩ
21,22,23, AND 26 CONNECTED TO 27	22.5KΩ
21,22,23, AND 9 CONNECTED TO 10	22.5KΩ

   D) NOISE:
      THE HARMONIC DISTORTION CONTENT OF EACH SIGNAL CONNECTED TO THE INPUT OF THE AMPLIFIER SHALL BE ≥56dB BELOW THE FUNDAMENTAL
3. AMPLIFIER OUTPUT**
   A) POWER OUTPUT:
      1 VOLT-AMPERE
   B) OUTPUT IMPEDANCE CHARACTERISTICS:
      WHEN OPERATING INTO A 2213A TRANSFORMER WITH THE OUTPUT VOLTAGE OF THE AMPLIFIER SET A 5.00 VOLTS RMS (MAXIMUM VOLTAGE SWING 20 VOLTS PEAK TO PEAK) AND MAXIMUM OUTPUT CURRENT OF 200 MA RMS.(MAXIMUM CURRENT SWING 2 AMPERES PEAK TO PEAK) THE OUTPUT IMPEDANCE IS TYPICALLY 1 OHM.
   C) AC VOLTAGE REGULATION:
      4.70 VOLTS RMS ±0.5dB (MAXIMUM VOLTAGE SWING 20 VOLTS PEAK TO PEAK) UNDER THE FOLLOWING CONDITIONS:
      DC INPUT -42.75V TO -53.50V
      LOAD 0 TO 1 VOLT-AMPERE
      TEMPERATURE 0°C TO 65°C
   E) NOISE:
      WHEN A GIVEN SIGNAL - WHICH HAS A HARMONIC DISTORTION CONTENT ≥56dB BELOW THE FUNDAMENTAL - IS CONNECTED TO THE INPUT OF THE AMPLIFIER, THE SIGNAL MEASURED AT THE OUTPUT OF THE TRANSFORMER WILL HAVE A HARMONIC DISTORTION CONTENT ≥50dB BELOW THE FUNDAMENTAL UNDER CONDITIONS STATED IN (C).

** THE OUTPUT OF THE AMPLIFIER-TERMINAL 3 - IS CONNECTED TO A 2213A TRANSFORMER TO OBTAIN THE ABOVE DATA.

4. AMBIENT TEMPERATURE:
   THE AMPLIFIER IS DESIGNED TO OPERATE FROM 0°C TO 65°C.