COMMERCIAL ELECTRIC PRODUCTS CORPORATION
Cleveland, Ohio U.S.A.
Telephone (216) 241-2886 Fax (216) 241-1734
www.commercialelectric.com

MODEL 3500

RESIDUAL RINGING PLANT
WITH AUTOMATIC, MANUAL, AND DIAL-IN TRANSFER

{1} SPECIFICATIONS | ISSUE 9 | DATE 01/03

Spec. No. 3500-112

Serial No._____

Customer Ref._____

Size: 23" relay rack x height as follows:
10.5" for basic unit.
3.5" additional for "X" option.
3.5" additional for "A" option.
3.5" additional for "FP" option.

Inputs: 42-56 VDC. Current draw is 2.5 amperes at 50W load or 3.4 amperes at 100W load with all options installed.
Dial-in transfer input terminal.

Outputs: As ordered per the following options:

3500-112 Basic 50 watt Residual Ringing Plant with:
-AC/DC AUD Continuous Ringing (20Hz+440Hz+480Hz)
CODE1 GEN Interrupted Ringing
Three Interrupted Ground Cadences

( ) **H** Boosts Basic Ring Plant to 100 watts

( ) **X** Isolation Transformer with taps for +/-105V & AC/DC Audible

( ) **B** +48V Bias Supply for +AC/DC Audible (If required)

( ) **TL** Redundant Low Tone

( ) **TH** Redundant High Tone

( ) **A** Aux. Alarm Panel

( ) **FP** Aux. Fuse Panel

( ) **TD** Redundant Dial Tone

( ) **TR** Redundant Ringback Tone

( ) **R** Aux. Mercury Relays

( ) **Z** No Superimposed RBT

( ) **M** Load Demand Meter / Aux. Alarms

( ) **E** Extended Temp. Range: -40C to +65C

( ) **U** Agency Approved Versions

{1} INDEX

- Not provided unless authorized.

ISSUE	1	1	2-8
DATE	01	01	02

MODEL 3500-112

Input D.C Volts	Nominal D.C Volts	Amps. (No Load)	Amps. (Full Load) 50W / 100W
42-56	50	0.5	2.3 / 3.2
Input Filter (Noise to battery 20dBrnc)			

RINGING GENERATOR OUTPUTS

Ringing A.C. Volts	Nominal A.C. Volts	Amps. (Full Load) 50W / 100W	Ringing Frequency Limits	Audible Tone Superimposed Frequency Limits
82-88	86	0.55 / 1.10	20Hz +/-0.5%	440+480 +/-0.5%

TONE OUTPUTS (OPTION *) 112T

Volts	Full Load Watts	Regulation (4 volt tap)	Harmonics Below Fundamentals	Tone Volt Tap Interval
0.7-11	1.0	+/- 1 dB	50 dB	3-6 dB *
* Precise Tone of your choice.				

ISOLATION TRANSFORMER (OPTIONAL) 112X

	Primary -AC/DC Audible	Secondary +AC/DC Audible	Secondary +/- 105 volts	Total Load
Taps	1-2	3-4	5-6	
Nominal	86	86	105	40 Volt Amps.
Limits	82-88	80-88	97-108	

NOMINAL RATINGS

Input D.C.		Ringing Output 50W / 100W		Tone (Optional)	
Volts	Amps.	Volts	Amps.	Volts	Power
50	0.5	88	0	Not Installed	
50	2.3/3.2	84	0.55/1.10	Not Installed	
50	0.5	88	0	4.0 *	0
50	2.4/3.3 **	84	0.55/1.10	3.6	1 Watt

* 1. Taps are provided to set tone output voltage to 0.7, 1.0, 2.0, 4.0, 8.0, 11 VAC.
** 2. These figures reflect with Tone Option installed.

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The System 35 Ring Generator family meets requirements of UL Standard 1459 and is listed under number COM11459.

The System 35 Ring Generator family meets requirements of Title 47 of the CFR, Part 15, Subpart B for class A digital devices. Report #EM1949.

The System 35 Ring Generator family was tested and meets a Zone 4 Earthquake Seismic Vibration Test. MET Report #ESL949.

{3} FUSE REQUIRMENTS

MODEL 3500-112 (50W) & 3500-112H (100W)

Label	Maximum Size
SYS 1	GMT 5 Amp
SYS 2	GMT 5 Amp
SUPV	GMT 1.3 Amp
TRIP	GMT 1.3 Amp

CAUTION - Fusing of the Ringing Generator Output should not exceed 0.5 Amp per branch circuit for 50W unit and 1.0 Amp per branch circuit for 100W unit.

MODEL 3500-112T (1W)

CAUTION - Fusing of the Tone Generator Output should not exceed 0.5 Amp per branch circuit (1W).

MODEL 3500-112R1

Label	Maximum Size
F101	GMT 1.3 Amp

ATTENTION

1. Never install telephone wiring during a lightning storm.
2. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
3. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
4. Use caution when installing or modifying telephone lines.

CAUTION - Plug-in circuit cards utilize C-MOS solid state components which can be degraded, damaged or destroyed by electrical static discharge. A wrist strap connected to frame ground is to be worn anytime unit requires servicing.

EQUIPMENT ARRANGEMENT

The unit is arranged for mounting on a 23" relay rack drilled for 1-3/4" mounting spaces. The Model 3500-112 basic unit requires 10.5" of vertical mounting space. It consists of a painted steel main frame 7.0" high, and a fuse panel 3.5" high. The frame contains electrical and electronic components, most of which are mounted on plug-in printed circuit cards. The fuse panel mounts directly above the main frame and contains four type GMT power input fuses and fifty type GMT output distribution fuses. The basic Model 3500-112 comes with ten fuses on the AC/DC AUD output and with ten fuses on the CODE 1 GEN output. Space is reserved on the fuse panel for additional groups of fuses for other optional outputs such as +AC/DC AUD (2), +/-105V (8) and TONE (10). A space is also provided for a group of 10 additional fuses or an optional Ringing Level Indicator. The manual transfer switch is also located on this panel.

The 3500-112X isolation transformer panel requires an additional 3.5" of vertical space and mounts below the basic unit if this "X" option is specified.

The 3500-112 fuse alarm panel requires an additional 3.5" of vertical space and mounts above the basic unit if this "FP" option is specified.

The 3500-112 multiple alarm relay panel requires an additional 3.5" of vertical space and mounts above the "FP" option or the basic unit if this "A" option is specified.

The other options do not require any additional space as they mount inside the frame of the basic unit.

Refer to the drawing in section {2} of this manual for outline dimensions.

LOCATION AND MOUNTING

This equipment is designed to operate in a location with an ambient temperature range of 0 to 50 degrees C. The free circulation of air in this temperature range must be permitted in the area surrounding the equipment.

Mount the unit to the relay rack using the thru holes provided in the mounting bars which hold the various sections of the unit together. Screws and washers for mounting are supplied with the unit.

After mounting, check the unit visually before completing the installation. Make sure that all shipping materials have been removed from the unit. Check for loose fasteners or other damage from shipping or handling. Make sure all circuit cards are fully seated in their sockets.

PRELIMINARY POWER CONNECTIONS AND TEST

It is recommended that the installer first complete the ground connection to the +POS terminal block and the battery feed connections to the –NEG terminal block as described in section {5} of this manual. At this time a preliminary test of the unit can be performed. This test will assure that there was no damage to the unit in shipment, and in addition, will give the mercury wetted interrupter relays a period of no-load operation, which will distribute the mercury properly to the contacts.

To perform the preliminary electrical test, remove the four fuses marked SYS 1, SYS 2, SUPV, and TRIP from the fuse panel. Insert the feeder fuses so that the -48 VDC from the office is delivered to the unit. Now insert the fuses marked SYS 1 and SUPV, which will only power up system 1 and the supervisory circuit. After operating a short time, the unit should indicate a MINOR ALARM (yellow LED). This is because only one of the ringing generators has power and the monitors detect the lack of ringing output on system 2. Now install the fuses marked SYS 2 and TRIP. Transfer the unit from one system to the other using the manual transfer switch located on the fuse panel. Push the switch from side to side a couple of times to clear all alarms. Verify that pushing the switch to the left forces system 1 on-line (LED marked SYS1 O.L. should be lit), and pushing the switch to the right forces system 2 on-line (LED marked SYS2 O.L. should be lit). Allow the unit to run a few minutes undisturbed and verify that both SYS1 NORM and SYS2 NORM (green LED's) remain lit. The MINOR ALARM (yellow LED) and MAJOR ALARM (red LED) should not light.

If both systems remain normal, proceed with the rest of the installation. If alarms keep appearing, read through this manual and call the factory for telephone support as required.

ELECTRICAL CONNECTIONS

The interconnections between the basic unit and the various optional panels have been made at the factory. The installer is to make all other electrical connections as required. Refer to the drawings in section {2} and the text is section {5} for details of connections to the basic unit' s ground bar, terminal blocks, and output distribution fuse holders located on the rear of the unit. Information needed to wire certain customer-specific optional equipment can be found on the option drawings in section {4}.

CAUTION - Wire size to be used should be adequate to carry the full rated load of each output. Refer to **Recommended Wire Sizes** in section {5} of this manual for a wiring guide.

INPUT FUSES

Four GMT type fuses are provided in the battery feed circuits to the basic Model 3500-112. Fuses SYS 1 and SYS 2 carry input current to the two redundant systems in this equipment. Fuse SUPV carries input current to the supervisory system. Fuse -TRIP is the trip battery fuse and supplies -48 VDC for the -AC/DC AUD and CODE 1 GEN ringing return circuit. The 3500-112A multiple alarm relay panel has a separate type GMT input fuse. Certain applications of the 3500-112R mercury relay option will also be equipped with a separate type GMT input fuse.

OUTPUT DISTRIBUTION FUSES

Output fuses are provided in-groups of ten type GMT fuses. Each group of ten fuses is connected to one of the ringing or tone outputs of this unit. These fuses allow the installer to divide the exchange loads into fused branch circuits as desired. The installer may wire more than one group of ten fuses to a given output if more distribution fuses are needed. Space is provided on the fuse panel for up to fifty output distribution fuses. An additional fuse panel can be ordered if more than fifty distribution fuses are required. The interrupted ground outputs are not normally fused.

The installer should mark the branch circuit I.D. on the marker strip provided above the GMT output fuses.

FUSE ALARM

If any one of the input or output distribution fuses should open, a fuse alarm condition will be established. This will cause battery voltage to appear at the FAO terminal. In addition, the FUSE ALARM red LED will light. If the input fuses to both systems should open, a major alarm will also be extended. Replace an input fuse with a Bussmann type GMT size as shown on the front of the unit.

CAUTION - Do not remove or replace circuit cards with power applied to the unit. First remove the input fuse and wait a few seconds for the power supply voltages to bleed off. Removing or replacing cards with power applied to the unit may damage solid state components.

CAUTION - Plug-in circuit cards utilize C-MOS solid state components, which can be damaged by electrical static discharge. If cards are removed from the unit for any reason, be sure to observe appropriate handling precautions.

RINGING FREQUENCY ADJUSTMENT

The ringing generator frequency is determined by a crystal-controlled clock circuit, which assures long-term frequency accuracy and stability. If a change of ringing frequency is required, only a jumper change is needed on the CEWT-UPR ringing generator card. Refer to Section {7} for instructions.

RINGING VOLTAGE ADJUSTMENT

The output voltage of each ringing generator is set at the factory to a nominal 86 volts. This setting will also assure the proper output from the secondary windings of the optional ringing isolation transformer of 86V and 105V. If field adjustment of the ringing voltage becomes necessary as a result of replacing one or more of the plug-in cards, use the following procedure to reset the ringing voltage. Remove the front cover of the unit. Attach a voltmeter, which is accurate at 20 Hz to one of the two pairs of ringing test jacks located on the left and right sides of the lowest section of the main frame. Each pair of jacks gives access to one of the two redundant ringing generators. Facing the unit from the front, the pair of jacks on the left is system #1 and the pair of jacks on the right is system #2. Transfer the load if necessary so that the system you wish to adjust is off-line. Adjust the ringing voltage to 86 volts using the voltage adjustment control R1 located on the front of the CEWT-UPR ringing generator card, which has been selected as off-line. Clockwise rotation of the control will increase the ringing voltage. Be sure to check the voltage on both of the redundant ringing generators. After adjustment of the ringing voltage, it is suggested that the ringing monitor adjustment be checked as well.

TONE LEVEL ADJUSTMENT (3500-112T "T" option only)

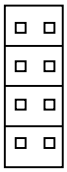
The output level of the tone generators (if provided) are adjustable in the field to match the requirements of a particular installation. Adjustment requires moving the white wire on each tone terminal block to select the desired tone voltage tap. The tone terminal blocks are located on the CETA plug-in tone amplifier cards located in the top most section of the main frame. Tone voltages from 0.7 volts RMS to 11 volts RMS are available and the voltages are marked next to the terminal blocks.

If you wish to change one of the tone output levels, remove power from one of the two redundant systems by removing the input fuse marked SYS 1 or SYS 2 (Not both at the same time!). Working on the powered-down system, remove the CETA card (see B-4096-C8 for card location). Locate the white tone adjust wire on the card. Move this wire to the terminal providing the desired tone voltage. Replace the card, replace the input fuse and transfer the load to the system you have adjusted, test the tone level. A fine adjustment can be made by pot R2 on the front of the CETA card.
Repeat this procedure on the redundant system.

FIELD INSTALLATION OR REMOVAL OF TONE OPTIONS

Space and wiring are provided in the 3500-112 basic unit to permit plugging in one (1) 3500-112T tone supply on an optional basis. Each 3500-112T tone supply consists of two sets of plug-in card type CE4T and CETA, which provide one of the following precise tones. DIAL TONE (350 Hz + 440 Hz), LOW TONE (480 Hz + 620 Hz), HIGH TONE (480 Hz), or audible RING TONE isolated from the 20 Hz ringing signal (440 Hz + 480 Hz). The particular tone output obtained from installing a 3500-115T tone option depends on the setting of jumper JB1 and JB2 on the Backplane (Ref: B-4096-B8).

Jumper both JB1 and JB2 as shown below:



(DT)	(1) 3500-112T in the DIAL TONE position.
(BSY, 60BSY, 120BSY)	(1) 3500-112T in the LOW TONE position.
(RBT, 1R RBT)	(1) 3500-112T in the RING TONE position.
(HT)	(1) 3500-112T in the HIGH TONE position.

To <u>install</u> the above option in the field, follow the procedure detailed below.
To <u>remove</u> above options in the field, study the procedure below and reverse the process.

INSTALL / REMOVE TONE

Ignore the alarms that will occur during this procedure. Preset the output voltage taps on the CETA card you wish to install to your best estimate of the tone voltage required. Refer to the above paragraph, TONE LEVEL ADJUSTMENT. After installation, measurements can be made and the tone output level can be changed if necessary.

Transfer the load to system 2 using the transfer switch. Remove input fuse SYS1 to power down system 1. Insert one of the CE4T cards in position 11 and one of the CETA cards in positions 12. (See B-4096-C8 for card location). Replace fuse SYS1.

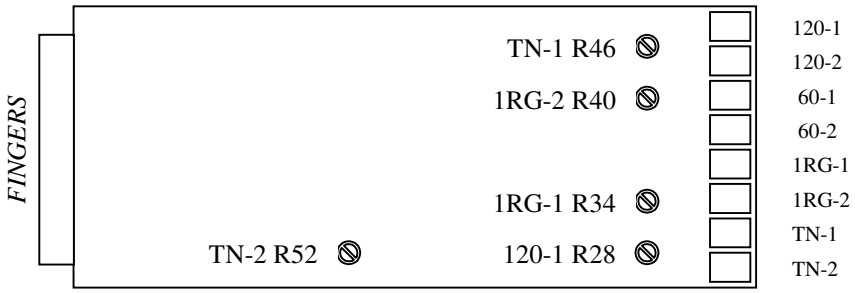
Transfer the load to system 1. Remove input fuse SYS2 to power down system 2. Insert the other CE4T card in position 14 and the other CETA card in position 15. Replace fuse SYS2.

Remove input fuse SUPV. Remove the CEPR processor card (third card from the left on the first shelf). Find the 8-pos rocker switch (J1) on this card. The rocker switch is numbered from "1" on the end closest to the gold fingers to "8" closest to the green LED's. Toggle switch "5" to close the circuit and thus enable the firmware code that monitors the continuous tone signal. Replace the card in the unit. Replace fuse SUPV.

RINGING AND TONE MONITOR CALIBRATION PROCEDURE

If a CEMO-U monitor card is replaced, or if any adjustment of the ringing or tone generator voltages is made, the monitors should be calibrated. Remove the supervisory system input fuse marked SUPV. Place the CEMO-U monitor card on a card extender. Replace the SUPV fuse and transfer the loads if necessary so that the particular LED's on the CEMO card you are adjusting is monitoring the off-line system.

Adjust the monitor level controls (R28, R34, R40, R46, R52) 1/2 turn CCW past the point where the associated monitor green LED (120-1, 1RG-1, 1RG-2, TN-1, TN-2) just attains full brightness. (First turn CW until the LED begins to flicker or dim, then turn CCW to full brightness, then turn 1/2 turn CCW further). Not all units will have tone installed. Ignore alarms and alarm LED's during the monitor adjustment process. Refer to the drawing below for adjustment locations on the CEMO-U monitor card.



{5} ELECTRICAL CONNECTIONS

ATTENTION

The input connections on this equipment are designed to meet requirements for power code "F". All power inputs require overcurrent protection from the equipment that provides power to this unit.

The output connections are rated for telecommunication code "X". All output connections are suitable for connection to exposed circuits requiring protection in accordance with Section 800-30 of the National Electrical Code, NFPA70.

(refer to drawings in section {2} of this manual.)

Ground connection to the ground terminal block
(located on the rear right-hand side of the fuse panel)

Symbol	Description of connecting circuit (+POS)
-48 A RTN	Ground (+48V) to system 1. Note 1.
-48 B RTN	Ground (+48V) to system 2. Note 1.

Battery feed connections to the power input terminal block.
(located on the rear right-hand side of the fuse panel)

Symbol	Description of connecting circuit (-NEG)
ABS	Auxiliary Battery Supply (-48V) to supervisory system thru fuse SUPV. Note 1.
-48 A	Battery (-48V) to system 1 thru fuse SYS 1. Note 1.
-48 B	Battery (-48V) to system 2 thru fuse SYS 2. Note 1.

A Ground Lug, located below the ground terminal block, is provided for chassis rounding.

Connections to the I/O terminal blocks (TB1, TB2 & TB3)
(located on the rear right-hand side of the main frame)

Symbol	Description of connecting circuit (TB1)
DIT	Dial-in transfer. Apply momentary ground for remote transfer. This feature allows system transfer and reset of alarms in an unattended location.
GENFA	This is a factory-wired connection to the ringing output distribution fuses. It connects the fuse alarm circuit to the ringing output fuses.

---See Connection Notes at the end of this section {5}.---

Symbol	Description of connecting circuit (TB1)
FAO	This fuse alarm output extension terminal outputs 500 ohm resistance battery when any input or output fuse opens. When the "A" option multiple alarm relay panel is specified, this FAO is factory-wired to the alarm coil on the "A" option.
TNFA	This is a factory-wired connection to the tone output distribution fuses when the "T" tone generator option is specified. It connects the fuse alarm circuit to the tone output fuses.
MNN	Minor alarm relay (NORMAL) contact. Note 2.
MNC	Minor alarm relay (COMMON) contact. Note 2.
MNA	Minor alarm relay (ALARM) contact. Note 2.
MJN	Major alarm relay (NORMAL) contact. Note 2.
MJC	Major alarm relay (COMMON) contact. Note 2.
MJA	Major alarm relay (ALARM) contact. Note 2.
SW1	Manual transfer to system 1. Factory wired to transfer switch.
SW2	Manual transfer to system 2. Factory wired to transfer switch.

Symbol	Description of connecting circuit (TB2)
RGEN	This is the ringing generator return lead connected to –TRIP thru a filter choke.
-**AC/DC**	Continuous ringing output. Factory wired to the output distribution fuses.
CD1GEN	Interrupted ringing output. Factory wired to the output distribution fuses.
+48 IN	Seldom used. See Note 4.
+AC/DC	Continuous 86V ringing output from the "X" option isolation transformer. Factory wired to the output distribution fuses.
+/-105	Factory wired to the output distribution fuses when "X" isolation transformer option is used.
10IPM	Ground pulse gate output. Ground is applied for 2 seconds on followed by 4 seconds off.
60IPM	Ground pulse gate output. Ground is applied for 0.5 second on followed by 0.5 second off.

---See Connection Notes at the end of this section {5}.---

Symbol	Description of connecting circuit (TB2)
120IPM	Ground pulse gate output. Ground is applied for 0.25 second on followed by 0.25 second off.
TONE	Factory wired to the output distribution fuses when the "T" tone generator option is used.
RTONE	This is the tone generator return lead. If the "T" tone generator option is used, the installer must jumper this to the ground bar in most cases. In the rare installation where the tone is to be returned to some other voltage than ground, wire this terminal to that other voltage. For example, busy tone is occasionally returned to the -48 volt battery.
SFA	This is a factory-wired connection to the input fuses. It connects the fuse alarm circuit to the SYS1, SYS2, and SUPV input fuses.

Symbol	Description of connecting circuit (TB3)
+G1	Ground to system 1. Factory wired to ground bar.
+G2	Ground to system 2. Factory wired to ground bar.
+G3	Ground to supervisory system. Factory wired to ground bar.
+G4	Ground to "X" option. Factory wired to ground bar.
-FB1	Fused Battery (-48V) to system 1. Factory wired to fuse SYS 1.
-FB2	Fused Battery (-48V) to system 2. Factory wired to fuse SYS 2.
-FB3	Fused Battery (-48V) to supervisory system. Factory wired to fuse SUPV.
-TRIP	Fused Battery. Factory wired to fuse –TRIP. See Note 3.

Connections to the output distribution fuse panel.

Ringing and tone outputs to the office loads are obtained by connecting directly to the fuseholder output terminals on the rear of the output distribution fuse panel. A group of 10 GMT fuses are normally provided for each specified output. The ringing or tone signal appearing on each group of 10 fuses is marked on the front of the fuse panel. The installer should wrap the load wire to the selected branch circuit fuseholder output pin. It is suggested that these connections be soldered. Where the load circuit consists of a load wire paired with a ground wire, the ground wire may be connected to the copper ground bar on the rear of the panel.

---See Connection Notes at the end of this section {5}.---

Field installation of optional equipment.

When options are ordered with the original purchase of a MODEL 3500-112, they are factory installed and wired to the basic unit. When options are ordered to be retrofitted to an existing MODEL 3500-112, they must be installed and wired in the field. Such field installation and wiring has been made quite simple, and instructions for installing and wiring each option are included with the optional equipment. Refer to section {4} of this manual for drawings to assist in wiring optional equipment.

Connection Notes:

Note 1. The installer should bring in two battery feed circuits each fused at 10 amperes to power this unit. This will assure ringing current to the office in the event that one of the feeds should be lost. Bring the first feed via #16 AWG wire (-NEG) to the terminal marked -48 A (T2). Bring the second feed via #16 AWG wire (-NEG) to the terminal marked -48 B (T5). If an Auxiliary Battery Supply is available, using a #22 AWG wire (-NEG), connect it to ABS (T1). This terminal is provided to keep the supervisory circuit operational in case both battery feeds fail.

A good ground is essential for the proper operation of this equipment and two #16 AWG ground wires must be provided. Bring the first ground via #16 AWG wire to the terminal marked -48 A RTN. Bring the second ground via #16 AWG wire to the terminal marked -48 B RTN. (+POS)

Note 2. The minor and major alarm relays have form C contacts to extend the alarms to the office. The installer may configure the alarm extension in any of the following ways:

(1) To extend ground in the event of an alarm, wire the COMMON contact to the ground bar and connect the ALARM contact to the office alarm circuit.

(2) To break ground in the event of an alarm (fail safe connection), wire the COMMON contact to the ground bar and connect the NORMAL contact to the office alarm circuit.

(3) To close a loop in the event of an alarm, wire the COMMON and ALARM contacts in series with the loop.

(4) To open a loop in the event of an alarm (fail safe connection), wire the COMMON and NORMAL contacts in series with the loop.

Note 3. This terminal gives the installer access to the fused trip battery ringing-return circuit. A possible use for this -TRIP connection is when using the "R" relay option to obtain additional interrupted ringing outputs such as a 2-RING code.

Note 4. This connection is only used when the "X" isolation transformer option is specified and the isolated 86 volt ringing output is to be used. If the +AC/DC AUD output is needed for a superimposed ringing system, an external source of +48 VDC must be wired to this +48 IN terminal. This should be protected by a 1-1/3 ampere alarm type fuse. If the isolated 86 volt ringing output is to be used as a source of ringing returned to ground, connect this +48 IN to the ground bar. If the “B” Option Bias Supply is installed do not connect this terminal to an outside supply.

Recommended Wire Sizes

Connection	Maximum Size	Minimum Size
Pos. Ground	12 AWG	16 AWG
Neg. Battery	12 AWG	16 AWG
Distribution	22 AWG	24 AWG
Alarm Outputs	22 AWG	24 AWG
Chassis Ground	08 AWG	14 AWG

GENERAL DESCRIPTION

The Model 3500-112 Residual Ringing Plant operates from -48 VDC and provides redundant 50 watts (0.55 ampere) of continuous and cadenced 20 Hz audible ringing current, ground pulse signaling cadences, and an optional tone supply. The output may be increased to redundant 100 watts (1.10 ampere) by ordering the 3500-112H option. The unit is designed to furnish those signals not supplied by the central office switch, yet needed for Private Line Circuits, Metallic Facility Terminal Circuits, Dial Long Line Circuits, Foreign Exchange Circuits, Test Desk Requirements, or other general purpose applications.

In addition to the optional tone supply, other options are available to add additional isolated ringing outputs, special interrupter cadences, additional mercury relays to interrupt ringing, tone, or battery, extra alarm relays, extra distribution fuses, etc.

OUTPUTS FURNISHED BY THE BASIC MODEL 3500-112

(-AC/DC AUD)
The basic Model 3500-112 provides continuous 20 Hz ringing current at 86 VAC. A precise ringback tone of 440 Hz + 480 Hz is superimposed on the ringing waveform to make the signal audible. The ringing output circuit is returned to the -48 VDC battery thru a trip battery fuse. This continuous ringing output is supplied to the load thru 10 GMT output distribution fuses.

(CODE 1 GEN)
The basic Model 3500-112 provides ringing current interrupted at 2 seconds on, 4 seconds off. During the 2-second ring period, the -AC/DC AUD signal is output. During the 4-second silent period, -48V trip battery is output. This interrupted ringing output is supplied to the load thru 10 GMT output distribution fuses.

(GROUND CADENCES)
The basic Model 3500-112 provides three interrupted ground outputs rated at 1.0 ampere each. The first ground pulse output is a 10 IPM cadence of 2 seconds on and 4 seconds off. This cadence is also used internally to operate the mercury relays, which provide the CODE 1 GEN interrupted ringing output. The second and third ground pulse outputs are a 60 IPM cadence and a 120 IPM cadence respectively. These cadences are also used internally to operate the mercury relays, which provide the 60BSY and 120BSY interrupted busy tone signals when this tone option is specified.

OUTPUTS FURNISHED BY THE 3500-112X ISOLATION TRANSFORMER OPTION

(+/-105V)
This signal is similar to the -AC/DC AUD signal except that the ringing voltage is 105 VAC and the ringing output circuit is returned to ground. This continuous ringing output is supplied to the load thru 8 GMT output distribution fuses.

(+AC/DC AUD)
This signal is similar to the -AC/DC AUD signal except that the ringing output circuit is returned to a source of +48 VDC instead of to the -48 VDC exchange battery. The customer must supply the +48 VDC bias source. This can be obtained from any convenient +48V source in the office and should be protected by a 1-1/3 ampere alarm type fuse. In locations where such a +48V supply is not available, a Commercial Electric DC-DC converter is recommended. A redundant DC-DC converter should be specified if the loss of the +AC/DC AUD output would adversely affect any critical loads. This continuous ringing output is supplied to the load thru 2 GMT output distribution fuses. If +AC/DC AUD is not required, this extra 86 volt ringing output may be returned to ground and used for auxiliary ground-returned ringing.

OUTPUT FURNISHED BY THE 3500-112T REDUNDANT TONE OPTION

(TONE)
Space and wiring are provided in the basic 3500-112 unit to permit plugging in a 1.0-watt redundant tone supply on an optional basis. Any one of the following precise tones may be selected: dial tone (350 Hz + 440 Hz), low tone (480 Hz + 620 Hz), high tone (480 Hz), or audible ringing tone isolated from the 20 Hz ringing signal (440 Hz + 480 Hz). The tone output level may be adjusted from 0.7 volts (rms) to 11.0 volts (rms) in 3-6 dB steps. This continuous tone output is supplied to the load thru 10 GMT output distribution fuses.

OUTPUTS FURNISHED BY THE 3500-112A MULTIPLE ALARM RELAY OPTION

This separate alarm relay panel expands the number of alarm contacts available beyond those provided in the basic 3500-112 unit. Three sets of form C "dry" contacts are provided for each of the following alarms: fuse alarm, minor alarm and major alarm. The three sets of contacts on each alarm relay may be used for audible alarm, visual alarm, scan alarm, etc. The relays are wired to the basic 3500-112 alarm circuits as slave alarm relays.

OUTPUTS FURNISHED BY THE 3500-112R MERCURY RELAY OPTION

This heavy-duty mercury relay option mounts on the output distribution fuse panel of the basic 3500-112 and can be use for a variety of purposes. One or more 3500-112R units can be installed on a basic 3500-112. The relay coil operates from the ground pulse cadences generated in the basic unit and the mercury-wetted form C contacts can be wired to interrupt ringing, tone, battery, etc. Examples of uses for this option would be: a 2-RING interrupted ringing output, a 60 IPM interrupted busy tone output, a 120 IPM interrupted congestion tone output, a 60 IPM interrupted battery output for lamp flash, etc.

SYSTEM ARRANGEMENT

The Model 3500-112 basic unit contains redundant ringing generators, each with its own 100VA mercury relay and capable of providing both continuous and interrupted ringing current. Maximum ringing power output can be increased from the 50 watts furnished as standard to 100 watts by specifying the 3500-112H option. Space is reserved in the basic unit for the optional 3500-112T redundant 1W tone supply, which consists of four additional plug-in cards. A connector is provided for plugging in the optional 3500-112X isolation transformer, which comes mounted on a separate panel. A single supervisory system is provided, which monitors both the on-line and off-line generators, controls transfer, provides visual indication of system status, and extends minor, major, and fuse alarms.

Both redundant systems operate at all times and are constantly monitored. Either system may be selected as "on-line" and carries the exchange load. If a fault is detected on the on-line system only, the load is automatically transferred and a minor alarm is extended. If a fault is detected on the off-line system only, a minor alarm is extended. In the event a failure occurs on the on- line system, and the off-line system is also detected as being faulty, the load will not be transferred and a major alarm will be extended.

Each of the two redundant ringing systems in the Model 3500-112 basic unit consists of a POWER SUPPLY CIRCUIT, a RINGING GENERATOR CIRCUIT, and a RINGING INTERRUPTER CIRCUIT.

The supervisory system consists of a POWER SUPPLY CIRCUIT, a PROCESSOR CONTROL CIRCUIT, SIGNAL MONITOR CIRCUITS, a manual TRANSFER SWITCH, an alarm RESET FEATURE, a REMOTE (DIAL-IN) TRANSFER feature, and a SYSTEM STATUS CIRCUIT to display system status and extend alarms.

The optional 3500-112T redundant tone supply consists of plug-in cards, which can easily be added in the field to the basic unit. Each of the two redundant tone generators consists of a TONE GENERATOR CIRCUIT. Tone generator circuit #1 operates from the same power supply circuit used with ringing generator #1. Tone generator circuit #2 operates from the same power supply circuit used with ringing generator #2.

The optional 3500-112X ringing isolation transformer mounts on a separate panel and plugs in to a connector on the main frame. The 86V transformer primary winding is wired to the -AC/DC AUD output of the redundant ringing generators. There are two secondary windings on this transformer. The 86V secondary provides the +AC/DC AUD output, while the 105V secondary provides the +/-105V output.

Each of the sub-systems listed above in CAPITAL LETTERS is described as follows:

POWER SUPPLY CIRCUIT

The 42-56 VDC input is passed thru an input fuse to protect the power wiring to the unit. It then passes thru an input LC filter to reduce noise back to the talking circuits in the telephone system. The filtered 48 VDC goes to the CEOP power supply card where a series regulator and zener diode produce system operating voltages of -6 VDC and -14 VDC. The power supply card also furnishes crystal controlled clock pulses needed by the redundant 10, 60 and 120 IPM ground pulse cadence circuits.

RINGING GENERATOR CIRCUIT

Ringing power is synthesized on the CEWT-UPR ringing generator card. The frequency and waveform generated is determined by 2-pin shorting blocks and a plug-in micro-controller. The micro-controller stores in digital code two different alternations of the ringing waveform, one with the audible ringback tone superimposed and the other as an ordinary sinewave. Off card components relating to the ringing generator circuit are a ringing output LC filter, a ringing voltage step-up transformer, and audio frequency and radio frequency filter capacitors as needed. The secondary winding of the ringing transformer is returned to the -48 VDC office battery thru a trip battery fuse. This causes the composite output of the ringing supply to be the sum of the -48 VDC battery, the 86 VAC 20 Hz output of the ringing generator, and the superimposed audible tone of 440 Hz + 480 Hz. This composite signal is the -AC/DC AUD output.

RINGING INTERRUPTER CIRCUIT

The interrupter functions are located on the CEME-U interrupter card. Counters and logic produce the timing cadences to control three one-ampere ground pulse gate circuits. The three gates operate at 10 IPM (2 seconds on and 4 seconds off), 60 IPM (0.5 second on and 0.5 second off), and 120 IPM (0.25 second on and 0.25 second off). These three interrupted ground signals are output to the office, the 10 IPM also used internally to operate mercury-wetted interrupter relay. The load voltage to be switched by the gates should not exceed 56 volts DC and the load current should not exceed 1 ampere DC. The gates are self-protecting against damage due to overloads and shorts. They are also designed to absorb the inductive voltage spike generated when opening an inductive load such as a relay coil.

A mercury-wetted relay is also mounted on this card and operates from the 10 IPM ground-pulse gate. The ringing signal is interrupted using this mercury relay operating at 10 IPM. The relay has form C contacts and outputs the -AC/DC AUD composite ringing signal when actuated and outputs the -48 VDC trip battery when released. This interrupted ringing signal is the CODE 1 GEN output.

TONE SYNTHESIZER CIRCUIT

All four of the precise call-progress tones are synthesized on the CE4T four-tone generator card. A micro-controller contains digital code to define the four desired tone waveforms. The output goes thru a D/A converter to an analog switch, which de-multiplexes the composite signal and outputs the four desired precise tones. The outputs of this card are low-level tone signals that need to be amplified before they are suitable for use in a telephone system.

TONE OUTPUT CIRCUIT

Circuitry to amplify one of the precise call-progress tones and provide output isolation and level adjustment is contained on the CETA tone amplifier and transformer card. The tone to be amplified is brought in to the card at a level of approximately 5.0 volts peak-to-peak. A gain control potentiometer sends a portion of this signal to a push-pull audio amplifier which drives the primary winding of the tone transformer. Six taps on the secondary winding of this transformer are brought out to a tap selection terminal strip on the card. These are used to adjust the tone output level in 3-6 db steps as required for a particular installation. A non-adjustable sample of the tone output voltage is used for tone generator monitoring.

PROCESSOR CONTROL CIRCUIT

A CEPR processor card uses a microprocessor to execute the instructions contained in it's memory. The card functions as a programmable controller, looping thru its instruction set, monitoring the status of inputs, and controlling outputs as required. The firmware supplied causes the Model 3500-112 to operate in the following manner: Both redundant systems operate at all times and all outputs on both systems are monitored. Either system may be selected as "on-line" with the manual transfer switch and will carry the load. If a fault is detected on the on-line system only, the load is automatically transferred after a short delay, and a minor alarm is extended. If a fault is detected on the off-line system only, a minor alarm is extended. In the event a failure occurs on the on-line system, and the off-line system is also detected as being faulty, the load will not be transferred and a major alarm will be extended. Also, if a fault is detected in the supervisory system itself, or if a fuse alarm is detected, a major alarm will be extended. A dip switch (J1) on the CEPR card is used to modify the program execution to accommodate changes in the installed options, etc.

SIGNAL MONITOR CIRCUIT

The on-line and off-line signal outputs are monitored for normal operation by the CEMO-U monitor card. If an abnormal signal is detected, and the signal remains abnormal for a few seconds, this information is communicated to the CEPR processor card where an alarm/transfer sequence will be initiated.

The ringing generators and the tone generators (if installed) are monitored for normal output level. If the ringing voltage or one of the tone voltages should fall below a preset threshold value and remain there for a short delay, this information is communicated to the CEPR processor card where an alarm/transfer sequence will be initiated. These continuous signal monitors are adjustable and are identified as TN-1 and TN-2.

In addition, the interrupted signals are monitored for normal interrupter function. If one of the interrupted signals should fail to appear, or should appear continuously, this information is communicated to the CEPR processor card where an alarm/transfer sequence will be initiated. In a unit without tone options installed, the interrupted signals monitored for both Systems 1 and 2 are the 1RG (interrupted ringing), the 60 IPM and 120 IPM (interrupted ground) signals.

TRANSFER SWITCH

A front panel toggle switch is provided to allow for manual transfer of loads to either of the two redundant systems when desired. Upon initial application of power, system #1 will become the on-line system and will take the load, while system #2 will operate as a hot standby. Once the unit is operating, either of the two systems can be selected as the on-line system by moving the transfer switch to the FORCE 1 or FORCE 2 position which will cause the load to be taken by the selected system. When released, the switch will return by spring action back to AUTOMATIC so that automatic transfer can occur in case of a failure.

RESET FEATURE

Once a fault has been detected, this fail condition will remain latched in until manually reset. The unit can be reset with the TRANSFER SWITCH by forcing the loads to the faulty system.

REMOTE (DIAL-IN) TRANSFER AND RESET

Application of a momentary ground to the DIT input pin will cause the loads to be transferred to the opposite system and will reset any alarm condition that may have existed on that system. By applying a second momentary ground to the transfer input pin, the loads will be transferred back to the system originally on-line and any alarms existing on that system will be reset.

SYSTEM STATUS CIRCUIT

LED's displays the status of the Model 3500-112 on certain of the plug-in cards. These visual indicators are visible thru the front cover of the main frame. In addition, system status is extended to the office by a set of form C "dry" contacts to indicate minor alarm and a set of form C "dry" contacts to indicate major alarm. The alarm relays are arranged such that loss of power to the alarm circuit will bring in the alarms.

VISUAL INDICATOR DESCRIPTION

The **CEAM** alarm card displays the following information:

FUSE ALARM - If one of the input or output fuses should open, this red LED will light and will extend a 500 ohm resistance battery fuse alarm signal to the office (if connected).

SYS 1 NORM - If system 1 is operating normally, this green LED will light. The LED will extinguish if a fault is detected on system 1 or a fuse alarm occurs.

SYS 2 NORM - If system 2 is operating normally, this green LED will light. The LED will extinguish if a fault is detected on system 2 or a fuse alarm occurs.

MINOR ALARM - If a fault is detected in either one but not both of the redundant systems, the appropriate green LED (SYS 1 NORM or SYS 2 NORM) will extinguish thus identifying the faulty system. In addition a minor alarm will be extended over form C contacts and this yellow LED will light.

MAJOR ALARM - If a fault is detected on both of the redundant systems, both green LED' s (SYS 1 NORM and SYS 2 NORM) will extinguish, a major alarm will be extended over form C contacts, and this red LED will light. A major alarm will also be extended if a fault is detected in the supervisory system or if an output distribution fuse alarm should occur.

The **CEPR** processor card displays the following information:

SYS1 O.L. - When lit, this green LED indicates that system 1 is on-line and is carrying the load.

SYS2 O.L. - When lit, this green LED indicates that system 2 is on-line and is carrying the load.

POWR ON - This green LED verifies that input power is reaching the unit, the supervisory system input fuse is O.K., and the micro-controller is scanning the memory and executing the stored program. In the event any of the above circuits develops a fault or power is removed from the unit, this LED will extinguish, and major alarm will be extended.

The **CEME-S3R1** interrupter card displays the following information:

120 - When this green LED is flashing at 120 IPM, it indicates that the 120 IPM interrupter relay coil is receiving the indicated cadence from the 120 IPM ground pulse gate.

60 - When this green LED is flashing at 60 IPM, it indicates that the 60 IPM interrupter relay coil is receiving the indicated cadence from the 60 IPM ground pulse gate.

10 - When this green LED is flashing at 10 IPM, it indicates that the 10 IPM interrupter relay coils are receiving the indicated cadence from the 10 IPM ground pulse gate.

The **CEMO-U** monitor card displays the following information:

120-1 - The green LED lights when voltage appears on the monitored interrupted (120 IPM) ground output from system 1. This would be the 120 IPM interrupted ground output. The red LED lights when the monitored 120 IPM signal fails. The fault could be due either to loss of output or to continuous output. The red LED remains lit even if the 120 IPM signal returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch.

120-2 - The green LED lights when voltage appears on the monitored interrupted (120 IPM) ground output from system 2. This would be the 120 IPM interrupted ground output. The red LED lights when the monitored 120 IPM signal fails. The fault could be due either to loss of output or to continuous output. The red LED remains lit even if the 120 IPM signal returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch.

60-1 - The green LED lights when voltage appears on the monitored interrupted (60 IPM) ground output from system 1. This would be the 60 IPM interrupted ground output. The red LED lights when the monitored 60 IPM signal fails. The fault could be due either to loss of output or to continuous output. The red LED remains lit even if the 60 IPM signal returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch.

60-2 - The green LED lights when voltage appears on the monitored interrupted (60 IPM) ground output from system 2. This would be the 60 IPM interrupted ground output. The red LED lights when the monitored 60 IPM signal fails. The fault could be due either to loss of output or to continuous output. The red LED remains lit even if the 60 IPM signal returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch.

1RG-1 - The green LED lights when ringing voltage appears on the interrupted ringing output (CODE 1 GEN) from system 1. It flashes at a 10 IPM rate (2 seconds on and 4 seconds off) when indicating normal operation of the interrupted ringing signal. The red LED is inoperative, but a fault in this signal due either to loss of ringing output or to continuous ringing output will light this red LED.

1RG-2 - The green LED lights when ringing voltage appears on the interrupted ringing output (CODE 1 GEN) from system 2. It flashes at a 10 IPM rate (2 seconds on and 4 seconds off) when indicating normal operation of the interrupted ringing signal. The red LED is inoperative, but a fault in this signal due either to loss of ringing output or to continuous ringing output will light this red LED.

TN-1 - The green LED lights when normal continuous tone voltage is present from system 1. The red LED lights when the tone voltage drops below a preset value and remains low for several seconds. The red LED remains lit even if the tone voltage returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch. If the low tone option is not installed, these LED's are inoperative.

TN-2 - The green LED lights when normal continuous tone voltage is present from system 2. The red LED lights when the tone voltage drops below a preset value and remains low for several seconds. The red LED remains lit even if the tone voltage returns to normal so as to indicate which signal caused the alarm. The red LED must be reset with the transfer switch. If the low tone option is not installed, these LED's are inoperative.

SUMMARY OF VISUAL INDICATORS

Label	Color	Description	Normal Status
LED's on the CEAM master alarm card:			
FUSE ALARM	RED	Lights to indicate an open fuse.	OFF
SYS1 NORM	GREEN	Lights to show system 1 is normal.	ON
SYS2 NORM	GREEN	Lights to show system 2 is normal.	ON
MINOR ALARM	YELLOW	Lights to show a minor alarm.	OFF
MAJOR ALARM	RED	Lights to show a major alarm.	OFF
LED's on the CEPR processor card:			
SYS1 O.L.	GREEN	Lights to show system 1 is on-line.	ON or OFF
SYS2 O.L.	GREEN	Lights to show system 2 is on-line.	OFF or ON
POWR ON	GREEN	Lights to show processor running.	ON
LED's on the CEME-S3R1 interrupter cards (one card for each system):			
120	GREEN	120 IPM interrupter indicator.	FLASHING
60	GREEN	60 IPM interrupter indicator.	FLASHING
10	GREEN	10 IPM interrupter indicator.	FLASHING

Label	Color	Description	Normal Status
		LED's on the CEMO-U monitor card:	
120-1	GREEN	120 IPM interrupter indicator. (SYS1)	FLASHING
	RED	120 IPM interrupter failure.	OFF
120-2	GREEN	120 IPM interrupter indicator. (SYS2)	FLASHING
	RED	120 IPM interrupter failure.	OFF
60-1	GREEN	60 IPM interrupter indicator. (SYS1)	FLASHING
	RED	60 IPM interrupter failure.	OFF
60-2	GREEN	60 IPM interrupter indicator. (SYS2)	FLASHING
	RED	60 IPM interrupter failure.	OFF
1RG-1	GREEN	Interrupted ringing indicator. (SYS1)	FLASHING
	RED	Inoperative.	OFF
1RG-2	GREEN	Interrupted ringing indicator. (SYS2)	FLASHING
	RED	Inoperative.	OFF
TN-1	GREEN	Tone generator indicator. (SYS1)	*
	RED	Tone generator failure.	OFF
TN-2	GREEN	Tone generator indicator. (SYS2)	*
	RED	Tone generator failure.	OFF

* These LED's are ON if tone option is installed, otherwise OFF.

FURTHER DETAILS

Section {7} in this manual gives further details on the major sub-assemblies used in this unit.

MODEL 4200 LOAD & VOLTAGE INDICATOR

The Model 4200 Ringing Level Indicator is a self-contained instrument capable of monitoring Ringing Generator voltage and current. The instrument is designed to be mounted on a model 3500-FP fuse panel for easy addition to new or existing Ring Plants.

OPERATION INSTRUCTIONS

"Amps/Volts" switch in the "Volts" position.

When the mode selector is in the "Side 1" position, the digital display shows the present ringing voltage level of generator 1 in the range of 0-199.9 VAC.

When the mode selector is in the "Side 2" position, the digital display shows the present ringing voltage level of generator 2 in the range of 0-199.9 VAC.

"Amps/Volts" switch in "Amps" position.

A set of four (4) Light Emitting Diodes indicate ringing current. These LEDS indicate 25%, 50%, 75% and 100% of generator capacity, respectively.

When the mode selector is in the "Track" position, the LED that is lit indicates the present ringing current level.

When the mode selector is in the "Latch" position, the LED that is lit indicates the highest ringing current level reached since the "Latch" mode has been last selected.

The digital display indicates present ringing current level in the range of 0-1.999 Amps.

MODEL 4200 ALARM OPTION OPERATION

The terminal strip on the 4200A circuit board provides the following connections.

Terminal	Designation	Function
8	LWA	Load warning alarm contact.
7	LWC	Load warning common contact.
6	LWN	Load warning normal contact.
5	LAA	Load alarm alarm contact.
4	LAC	Load alarm common contact.
3	LAN	Load alarm normal contact.
2	DIR	Dial in reset.
1		No connection.

Load warning contacts are in the normal (LWN & LWC in make position) until 75% of ring generator capacity is reached. At this time LWN & LWC open and LWC & LWA will make. Load alarm contacts are in the normal (LAN & LAC make position) until 100% of ringing generator capacity is reached. At this time LAN & LAC open and LAC LAA will make. ALL contacts are form "C" dry contacts rated at 1 AMP maximum at 60 VDC.

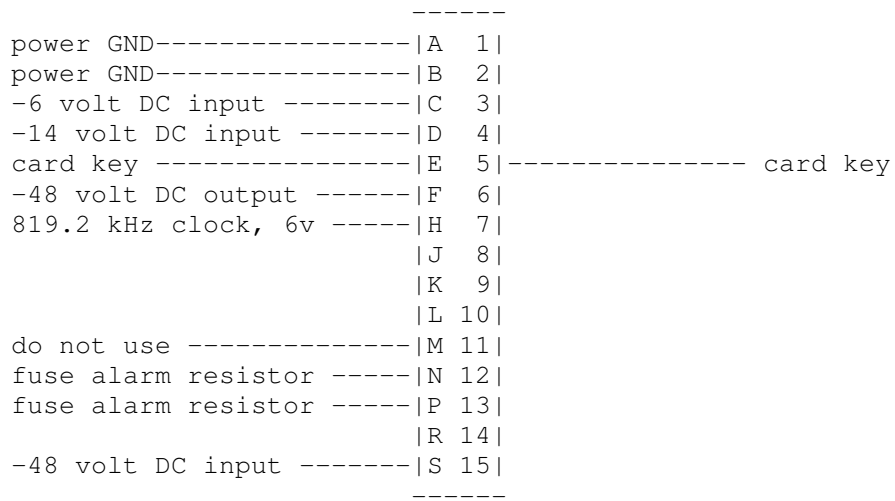
DIAL-IN RESET OPERATION

Dial-in reset will reset the alarm contacts to normal and also reset the latch mode on the 4200 LED display. Reset can be accomplished by applying a momentary ground to terminal 2.

{7} CEOP-U1 OSCILLATOR/POWER SUPPLY CARD

This card furnishes regulated -14 volts DC and -6 volts DC to operate the solid state devices used in the equipment. It also furnishes a filtered -48 volt DC supply to power -48 volt components as needed. In addition this card has a crystal oscillator and digital counters and buffers to furnish clock signals as needed by other cards in the system.

connections viewing rear of edge connector



sheet 7-OP-003 schematic W-

{7} CEPR PROCESSOR CARD

This card consists of a micro-controller with memory containing the software instruction set, a RAM memory for temporary data storage, a crystal-controlled clock circuit, and various counters, input and output interface devices, etc. The card functions as a programmable controller, looping thru its instruction set, monitoring the status of inputs, and controlling outputs as required.

This card normally interfaces with from one to seven I/O cards each of which supports several inputs, outputs, monitors, or other functions.

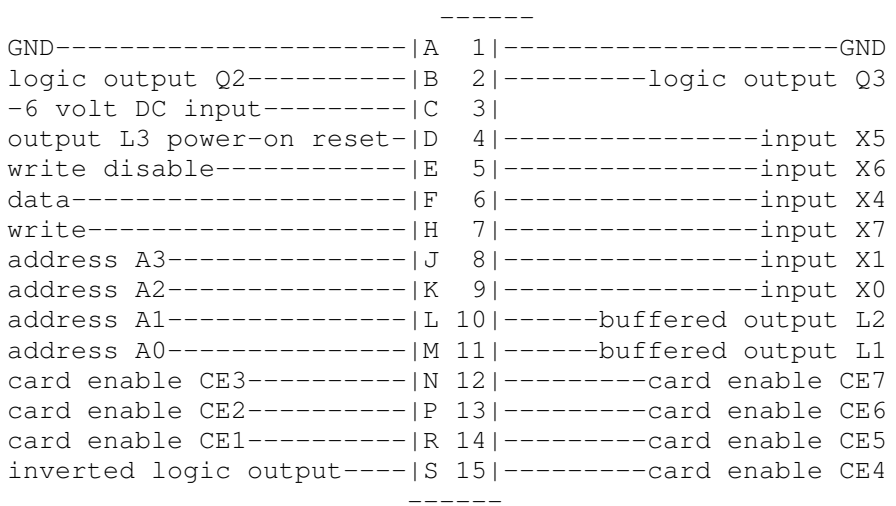
Three visual indicators have the following functions:

Upper LED D1 - When lit indicates that output L1 is low.
Middle LED D2 - When lit indicates that output L2 is low.
Bottom LED D3 - When lit indicates processor is running normally, and output L3 is low.

A pair of these cards can be used to control automatic transfer and alarm function in a fully redundant system. When so applied, inputs and outputs are typically assigned as follows: X0 is self on-line verify, X1 is LEAD/LAG input, X4 is opposite on-line verify, X5 is opposite normal verify, X6 is force OFF, X7 is force ON, L1 is not normal output, and L2 is not on-line output.

One of these cards can be used to control automatic transfer and alarm function in a fully redundant system. When so applied, inputs and outputs are typically assigned as follows: X0 is +48VDC monitor input, X4 is transfer verify, X5 is fuse alarm input, X6 is force to system 1, X7 is force to system 2, Q2 is system 2 normal output, Q3 is system 1 normal output, and L2 is transfer control output.

connections viewing rear of edge connector



{7} CEMO-U MONITOR CARD

This card contains eight monitor circuits. Five of these circuits (M2,M6,M7,M8,M9) are adjustable, and can monitor continuous signals for proper voltage level. The remaining three circuits (M3,M4,M5) are not adjustable, and can monitor the interruption of signals such as ground pulses or cadenced call progress signals. This card also contains two ground pulse gates (G1,G2).

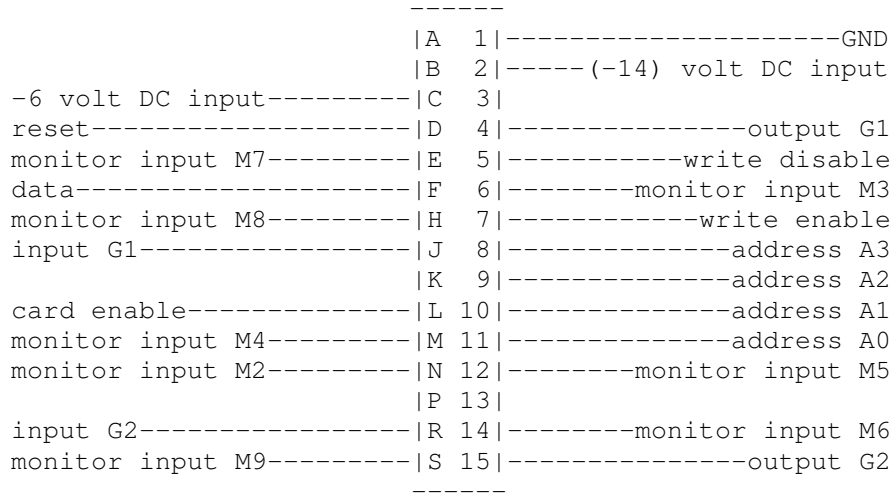
Each continuous signal to be monitored should be connected to an input thru a series capacitor (and series resistor if necessary) so as to obtain a voltage at the monitor input of approximately 1.4 volts AC (peak) with all DC blocked. The monitor level adjustments (R28 for M2, R34 for M6, R40 for M7, R46 for M8, R52 for M9) set the voltage threshold of each monitor. As long as the signal level is above this threshold, the circuit will light a green LED (M2 at top of card to M9 at bottom of card), and transmit this information to the associated processor card. Red LED's next to these green LED's are under control of the associated processor card and can be used to latch in and indicate an alarm.

Each interrupted signal to be monitored should be connected to an input thru a series capacitor/resistor/diode as needed to obtain a voltage at the monitor input of at least 1.0 volts (peak). The monitor circuit detects the presence or absence of the signal and lights a green LED (M2 at top of card to M9 at bottom of card), whenever the signal is present. This is transmitted to the associated processor card where software can verify the interruption of the signal. Monitors M3, M4, and M5 can monitor entirely different cadences.

- - - - Typical assignment of monitors and ground pulses - - -

M2	M3	M4	M5	M6	M7	M8	M9	G1	G2
120-1	120-2	60-1	60-2	1RG-1	1RG-2	TN-1	TN-2	S2NRM	XFER

connections viewing rear of edge connector



sheet 7-MO-002 schematic W-

{7} CEAM-FA ALARM AND REMOTE TRANSFER RELAY CARD

This card provides visual indication of the status of two redundant systems of equipment. In addition, minor alarm, major alarm, and fuse alarm are extended to the office. A relay is provided for remote transfer of the equipment when required.

FUSE ALARM - The fuse alarm circuit can respond to open fuses protecting the following different types of signals: exchange battery to the BATT FA IN pin, continuous or interrupted ringing signals to the RINGING FA IN pin, or ground-level continuous or interrupted tone signals to the TONE FA IN pin. Any of these fuse alarm conditions will cause red LED D1 (fuse alarm) to light and will extend ground and 500 ohm resistance battery fuse alarm signals on the appropriate output pins. A time delay circuit assures that interrupted signals extend a continuous fuse alarm.

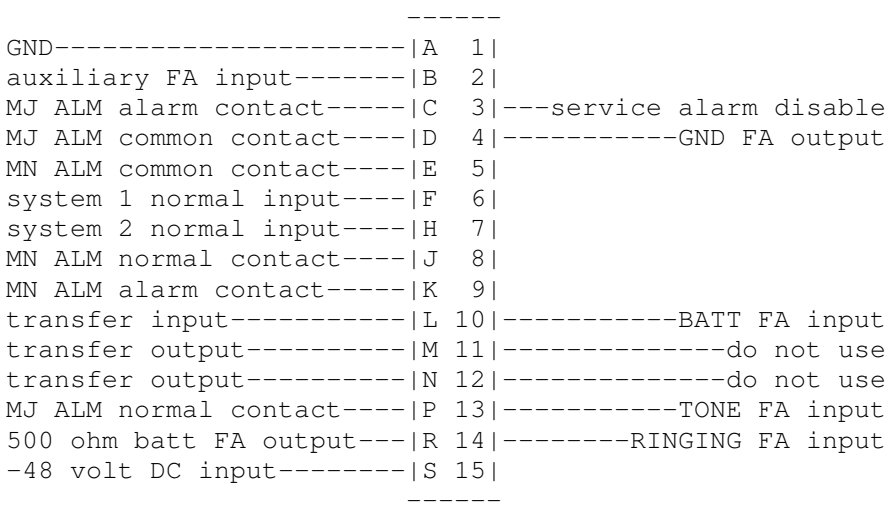
BOTH SYSTEMS NORMAL - If ground is applied to both the system 1 normal input pin and the system 2 normal input pin, then green LED D2 (system 1 normal) and green LED D3 (system 2 normal) will light. No alarms will be extended.

MINOR ALARM - Loss of ground on either but not both of the system normal input pins will cause the appropriate green LED (D2 or D3) to extinguish thus identifying the faulty system. In addition, a minor alarm will be extended over form C contacts and the yellow LED D4 (minor alarm) will light.

MAJOR ALARM - Loss of ground on both of the system normal input pins will cause both of the green LED' s (D2 and D3) to extinguish and a major alarm will be extended over form C contacts. Red LED D5 (major alarm) will light.

REMOTE TRANSFER - Application of a momentary ground to the transfer input pin will cause relay K3 to pick up momentarily and extend logic-level ground signals to both redundant systems on the two transfer output pins.

connections viewing rear of edge connector

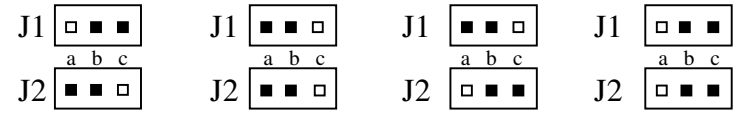


sheet 7-AM-002 schematic W-

{7} CEWT-UPR RINGING GENERATOR CARD
(MCR01-7)

This card contains circuitry to generate ringing power. The frequency and waveform generated is determined by 2-pin shorting blocks and a plug-in micro-controller. The memory stores in digital code two different alternations of the ringing waveform, one with the audible ringback tone superimposed and the other as an ordinary sinewave. A high frequency pulse train is generated with the width of the pulses proportional to the analog waveform. The pulses are fed to two pairs of push-pull operated power switching transistors. The outputs go to an L-C filter and ringing transformer. The filtering removes the high frequency components reconstructing the desired waveform.

Shorting blocks determine the frequency as follows:



A gain control potentiometer is provided to adjust the amplitude of the output. This control (R1) is mounted at the front edge of the card and may be accessed for adjustment thru the front cover of the unit. This control is set at the factory to provide the rated output level. If field adjustment is attempted, be sure not to exceed an output voltage to the primary of the ringing transformer of 64 volts peak-to-peak at no load. Otherwise, distortion of the output may result.

A current limit control (R2) is preset at the factory so that the full load output voltage is slightly less than the no load output voltage. I/R comp (R38) is also preset at the factory and should not require field adjustment.

connections viewing rear of edge connector

```
                                 ------
power GND-----------------|A  1|---------------power GND
power GND---------------- |B  2|---------------power GND
                          |C  3|
feedback jumper---------- |D  4|
remote shutdown----------|E  5|
                          |F  6|
                          |H  7|
                          |J  8|--------voltage feedback
                          |K  9|----------------AC output
                          |L 10|----------------AC output
                          |M 11|----------------AC output
                          |N 12|----------------AC output
                          |P 13|--------voltage feedback
                          |R 14|-----(-48) volt DC input
                          |S 15|-----(-48) volt DC input
                          ------
```

{7} CEME-S3R1 INTERRUPTER CARD

This card contains three one-ampere ground pulse gate circuits (G1,G2,G3). G1 interrupts ground at a 120 IPM rate. G2 interrupts ground at a 60 IPM rate. G3 interrupts ground to produce a one-ring pattern which is adjustable using eight DIP switches. An 819.2 KHZ clock is brought in to the card. Counters and logic produce the control signals to the three PNP transistor gates.

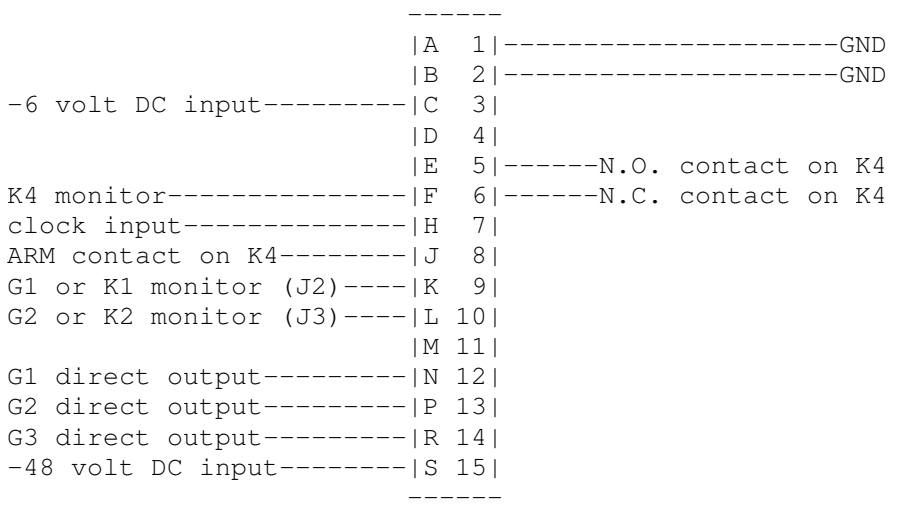
These ground pulse gates are intended to switch resistive or inductive DC loads. The load voltage should not exceed 56 volts DC and the load current should not exceed 1 ampere DC. The gates are self-protecting against damage due to overloads and shorts. They are also designed to absorb the inductive voltage spike generated when opening an inductive load such as a relay coil.

This card also contains a mercury-wetted relay (K4) with single form C contacts (break-before-make). Green LED's on the front of the card permit visual verification of normal operation. G1 operates at 120ipm and lights LED D8. G2 operates at 60ipm and lights LED D12. Relay K4 operates from the adjustable gate G3 and light LED D4.

The relay contacts should not switch loads in excess of 100 VA. Also the load voltage should not exceed 500 volts and the load current should not exceed 2 amperes. Adequate contact protection to be furnished by customer so that dI/dt does not exceed 25 amperes per microsecond when contacts close, and dV/dt does not exceed 5 volts per microsecond when contacts open.

Monitor connections are brought out from the gates thru jumpers J2 and J3. A monitor connection for relay K4 is brought out thu a coupling capacitor.

connections viewing rear of edge connector

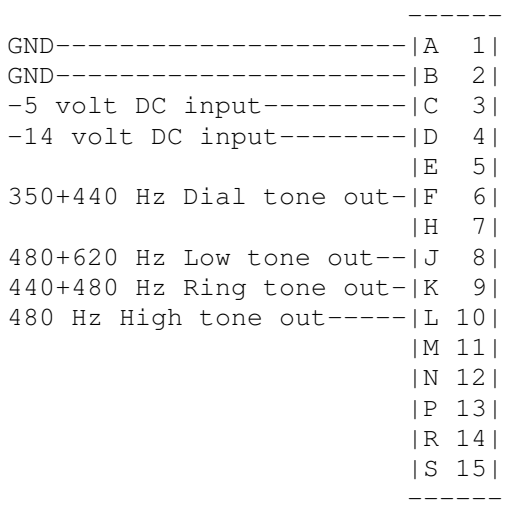


{7} CE4T-1 FOUR-TONE GENERATOR CARD

This card contains circuitry to synthesize all four of the precise call-progress tones. A micro-controller contains digital code to define the four desired tone waveforms. The output goes thru a D/A converter to an analog switch, which de-multiplexes the composite signal and outputs the four desired precise tones.

A gain control potentiometer is provided to adjust the amplitude of the output. This control (R2) is set at the factory to provide a voltage of 5.00 volts peak-to-peak on the 480 Hz output. This should not require adjustment in the field.

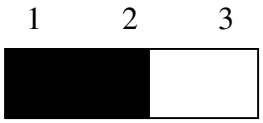
connections viewing rear of edge connector



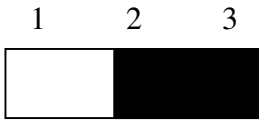
{7} CETA-2 TONE AMPLIFIER AND TRANSFORMER CARD

This card contains circuitry to amplify a tone signal and provide output level adjustment. The audio-frequency tone to be amplified is brought in to the card at a level of approximately 5.0 volts peak-to-peak. A gain control potentiometer sends a portion of this signal to a push-pull audio amplifier which drives the primary winding of the tone transformer.

The gain control potentiometer provides fine adjustment of the amplitude of the tone output. This control (R1) is mounted at the upper front edge of the card. This control is set at the factory to provide the rated tone output level. If field adjustment is attempted, be sure not to exceed an output voltage to the primary of the tone transformer of 62 volts peak-to-peak; otherwise distortion of the output tone may result.



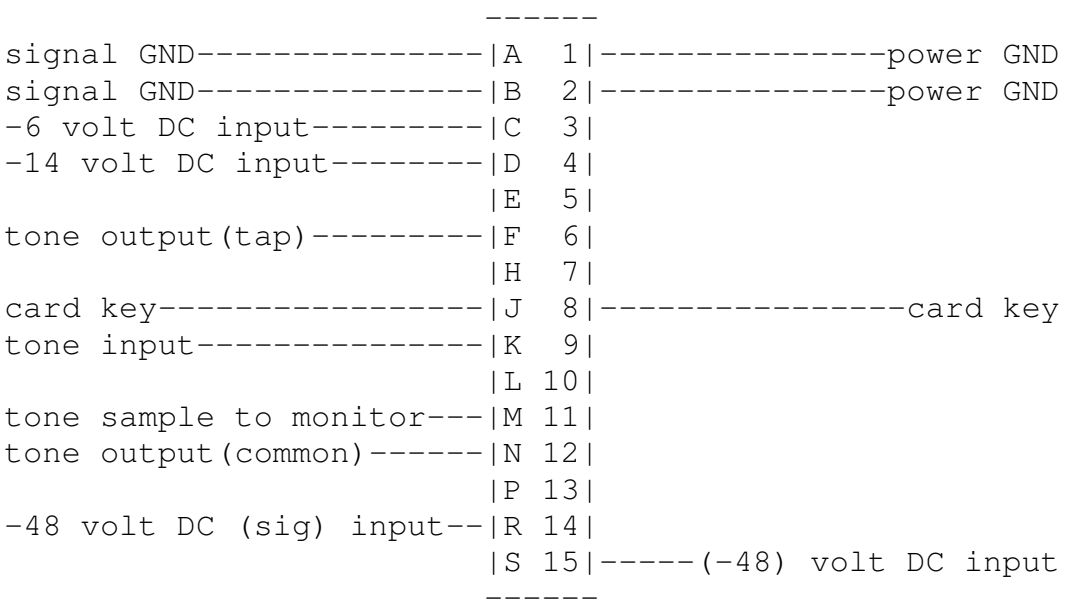
RBT, LT, DT



HT (only)

The tone transformer serves to isolate the tone output circuit and transform the amplified tone signal to the voltage level required by a particular telephone system. Six output voltages are provided by transformer taps which allow adjustment of the output voltage from 0.7 volts (rms) to 11.0 volts (rms). Jumper block J1 (shown above) is used to select the primary of the transformer for a single-frequency tone (positions 2/3) or for a double-frequency tone (positions 1/2). A fixed sample of the tone output is available for monitoring.

connections viewing rear of edge connector



sheet 7-TA-003 schematic W-

{7} CE1X7 TRANSFER RELAY CARD

This card contains four transfer relays (K1, K2, K3, K4). These relays all energize at the same time, transferring up to seven circuits, using form “C” contacts

connections viewing rear of edge connector

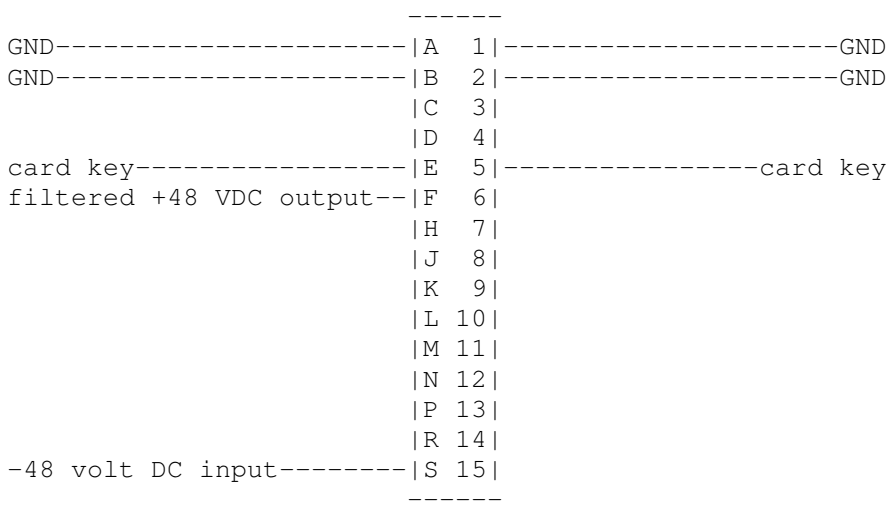
```
                          ------
N.O. contact K1a---------|A  1|
N.C. contact K1a---------|B  2|------COM contact K1a
N.O. contact K1b---------|C  3|
N.C. contact K1b---------|D  4|------COM contact K1b
N.O. contact K2a---------|E  5|
N.C. contact K2a---------|F  6|------COM contact K2a
N.O. contact K2b---------|H  7|
N.C. contact K2b---------|J  8|------COM contact K2b
N.O. contact K3a---------|K  9|
N.C. contact K3a---------|L 10|------COM contact K3a
N.O. contact K3b---------|M 11|
N.C. contact K3b---------|N 12|------COM contact K3b
N.O. contact K4a---------|P 13|
N.C. contact K4a---------|R 14|------COM contact K4a
-48 volt DC input--------|S 15|------grounding input
                          ------
```

{7} CEBS-10 +48V BIAS POWER SUPPLY CARD

This power supply card furnishes regulated +48 VDC @10 watts. A green LED, located on the edge of the card, lights when the +48V is normal.

This card is designed to operate over an input voltage range of -42 VDC to -58 VDC. The +48 VDC regulated output voltage will approximately match the input voltage supplied to the card.

connections viewing rear of edge connector



sheet 7-BS-001

{9} ELECTRICAL PARTS LIST

PARTS IN MODEL 3500-112 OR 3500-112H BASIC FRAME.

Part Number	Description	Quantity Per Unit	Qty. Spares Recommended
CEOP-U1	Power supply card	3	1
CEWT-UPR	Ringing card - MCR01	2	1
CEPR-3	Processor card - MCP01	1	1
CEMO-U	Monitor card	1	1
CEAM-FA	Alarm & annunciator card	1	1
CEME-S3R1	Interrupter card	2	1
CE4T-1	Tone synthesizer card - MCT01	2	1
CEBS-10	+48V bias supply card	1	1
CE1X7	Transfer relay card	1	1
CE112-U	Backplane card	1	0
CECE	Card extender	1	0
1506-105	Pin jack	4	0
50-30B-10	Edge connector	16	0
TS-PC-12L-45-U	Terminal block, 12-line	2	0
TS-PC-8L-45-U	Terminal block, 8-line	3	0
A-1537M	Choke	3	0
B-3849-31	Ringing transformer	2	0
A-4362-3	Capacitor, 1000 uf, 63 v.	2	0
230B1E105K	Capacitor, 1 uf, 400 v.	2	0
VC3D8200	Resistor, 8.2K, 3 watt	2	0
1N4005	Diode	2	0

PARTS IN MODEL 3500-112 OUTPUT DISTRIBUTION FUSE PANEL.

B-4142-1	Ground bar	1	0
H-AHAMF6-32X5/8	Aluminum standoff supports	11	0
F-7112	Fuseholder for 1 GMT	4	0
HAX10A	Fuseholder for 10 GMT	4	0
F-7117	Fuse, GMT 5 ampere	2	1
F-7113	Fuse, GMT 1-1/3 ampere	2	1
F-7136	Fuse, GMT 1/2 ampere	20	0
F-G-D	Fuse, Dummy AX1	40	0
A-3545	Transfer switch	1	0
1N4005	Diode	7	0

{9} continued

PARTS IN MODEL 3500-112A AUXILIARY ALARM RELAY PANEL OPTION.

Part Number	Description	Quantity Per Unit	Qty. Spares Recommended	
F-7113	Fuse, GMT 1-1/3 ampere	1	1	
F-7112	Fuseholder type HLT	1	0	
KL16/04PA	Terminal block, 4-line	1	0	
KL16/04Z	Marker strip	1	0	
A-4417-A	Fuse Alarm card	1	0	
A-4417-B	Minor and Major Alarm card	2	0	

PARTS IN MODEL 3500-112FP AUXILIARY FUSE PANEL OPTION.

B-4142-1	Ground bar	1	0	
H-AHAMF6-32X5/8	Aluminum standoff supports	11	0	
HAX10A	Fuseholder for 10 GMT	6	0	*
F-7136	Fuse, GMT 1/2 ampere	30	0	*
F-G-D	Fuse, Dummy AX1	60	0	*
1N4005	Diode	6	0	*

PARTS IN MODEL 3500-112R AUXILIARY MERCURY RELAY OPTION.

F-7113	Fuse, GMT 1-1/3 ampere	1	0
F-7112	Fuseholder type HLT	1	0
A-4136-2	CE112R-1 Assembly	1	0

PARTS IN MODEL 3500-112T REDUNDANT TONE OPTION.

CE4T-1	Four tone generator card	2	1
CETA	Tone amplifier card	2	1

PARTS IN MODEL 3500-112X ISOLATION TRANSFORMER OPTION.

B-3849-31	Isolation transformer	1	0
1375P	Molex 03-09-2151 Plug	1	0

* Maximum

{10} TROUBLESHOOTING PROCEDURE

The MODEL 3500 does not require routine maintenance. If trouble is experienced, the following guide may be of help in locating the defective component. A set of spare cards will be of help in quickly isolating a problem. Refer to sections {3} and {6} of this manual for background information.

CAUTION - Do not remove or replace circuit cards with power applied to the unit. First remove the input fuse and wait a few seconds for the power supply voltages to bleed off. Removing or replacing cards with power applied to the unit may damage solid state components.

CAUTION - Plug-in circuit cards utilize C-MOS solid state components which can be damaged by electrical static discharge. If cards are removed from the unit for any reason, be sure to observe appropriate handling precautions.

If trouble is experienced, observe the LED's visible thru the front cover of the unit and use the following guide to help identify and correct the problem. If you need help in diagnosing or correcting a problem, do not hesitate to contact the factory for technical support.

SYMPTOM - The green POWER ON LED is lit and the yellow MINOR ALARM LED is also lit. Either the SYS1 NORM or the SYS2 NORM green LED is extinguished thus identifying the system in trouble.

POSSIBLE CAUSE AND SOLUTION - The problem is most likely the result of a temporary overload, which has caused the unit to self-protect and indicates a fault. Try to reset the unit using the front panel TRANSFER SWITCH marked FORCE 1 FORCE 2 as described in section {6} of this manual under TRANSFER SWITCH and RESET FEATURE. If the unit will not remain reset but continues to go into minor alarm, check the red LED' s on the CEPM monitor cards for identification of the defective ringing or tone output.

If the faulty output is indicated to be a ringing generator, measure the ringing voltage directly using a voltmeter connected to the test jacks located behind the front cover on the left and the right sides of the lowest section of the main frame. These jacks are marked SYSTEM 1 RINGING GENERATOR, and SYSTEM 2 RINGING GENERATOR. If ringing voltage has been lost, replace the CEWT-UPR ringing generator card in the defective ringing system. If the ringing voltage appears to be normal, try replacing the CEME-S3R1 ringing interrupter mercury relay card.

If the unit keeps alarming out even though continuous and interrupted ringing outputs check normal, attempt to adjust the ringing monitor per the instructions in section {3} of this manual. If this does not cure the problem, replace the CEMO-U monitor card with a spare.

If the faulty output is indicated to be one of the precise tone supplies, determine if the tone has actually been lost by forcing the loads to the faulty system with the transfer switch and listening to the tone using a telephone. If the tone has been lost or sounds defective, replace the CE4T tone generator card or the CETA tone amplifier card with a spare. If the tone sounds normal, attempt to adjust the tone monitor per the instructions in section {3} of this manual. If this does not cure the problem, replace the CEMO-U monitor card with a spare.

SYMPTOM - The green POWER ON LED is lit and the red MAJOR ALARM LED is also lit. Both of the green SYS1 NORM and SYS2 NORM LED's are extinguished.

POSSIBLE CAUSE AND SOLUTION - The problem is most likely a shorted load or severe overload causing one of the output circuits to self-protect against damage and turn in a minor alarm. The unit then automatically transfers to the redundant system which sees the same short or overload and thus turns in a major alarm. One of the red LEDs on a CEMO monitor card should be lit. This identifies the defective load circuit. Attempt to reset the unit per the general operating instructions. If the unit continues to go into MAJOR ALARM, check the indicated load for overload or short circuit.

SYMPTOM - The green POWER ON LED is extinguished.

POSSIBLE CAUSE AND SOLUTION - Check for the presence of -6 volts DC on pin C of the CEPR processor card. If the -6 volts is O.K., replace the CEPR processor card. If the -6 volts is not O.K., remove the CEPR processor card and the CEMO-U monitor card and once again measure the -6 volts at the socket of the CEPR processor card, pin C. If the -6 volts is still not present, replace the CEOP-U1 power supply card in the supervisory system. If the -6 volts is now O.K., replace the removed cards one at a time and observe which card causes the -6 volt supply to be overloaded. Replace that card with a spare.

SYMPTOM - The red FUSE ALARM LED is lit.

POSSIBLE CAUSE AND SOLUTION - If one of the output distribution fuses has opened, the problem is in that particular branch circuit office load. Repair the load and replace the fuse. If input fuse SYS1 or SYS2 has opened, the CEWT-UPR ringing generator card may be shorted. Replace the card. In the unlikely event that this is not the problem, there may be a shorted input filter capacitor. If SYS1 is open, check C1. If SYS2 is open, check C2. C1 and C2 are located on the motherboard on the rear of the unit. If one of these has shorted, replace it with part number A-4263-3. If input fuse SUPV has opened, the supervisory system filter capacitor C4 located on the rear of the motherboard may be shorted. If so, replace it with part number A-4263-3. If the trip battery fuse TRIP has opened, the ringing output circuit has been grounded or overloaded. This should not blow fuse TRIP which is a 1-1/3 ampere fuse if the load distribution fuses are kept to 1/2 ampere or less. Check the values of the distribution fuses on the -AC/DC AUD output and the CODE 1 GEN output.

{11} WARRANTY

COMMERCIAL ELECTRIC PRODUCTS CORPORATION, the SELLER, warrants that this product shall be free from defects in material and workmanship during the first 90 days after the product is activated. During said period, SELLER will repair or replace any defective parts free of charge to BUYER, including any labor costs. In addition, SELLER shall repair or replace any defective parts, so discovered by BUYER to be defective within two years from the date of shipment of same, provided BUYER promptly so notifies SELLER. In no case shall SELLER' S liability under this warranty extend beyond two years from the date of shipment of said product. This warranty shall not apply if this product is misused, modified, repaired, or otherwise abused by BUYER or others. The repair or replacement of defective parts, or the refund of the invoice cost thereof, as shall be determined by SELLER in its sole discretion, shall be the limit of SELLER' S liability hereunder and shall be BUYER' S sole and exclusive remedy.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES. SELLER MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABLILITY OR FITNESS FOR ANY PARTICULAR PURPOSE WITH RESPECT TO ANY PRODUCTS EXCEPT AS HEREIN EXPRESSLY PROVIDED.

SYSTEMS AND EQUIPMENT NOT ECONOMICALLY RETURNABLE TO THE FACTORY

In the event that the product involved is a system or equipment which, in the judgment of SELLER, is not economically returnable to the factory or if SELLER has performed the installation, supervised the installation, or performed testing and turn-on, circuit components and SELLER' S repair labor are covered by this warranty for the first 90 days from date of turn-on and circuit components are warranted for two years from the date of shipment. Upon request, SELLER will send a service technician to the site to determine if the unit is defective in circuit components or workmanship, and will repair the equipment. If the failure is SELLER' S fault, no invoice for circuit components or repair labor will be issued if the complaint has been issued within the first 90 days from date of turn-on. If the complaint is issued more than 90 days from the date of turn-on but within two years from date of shipment, BUYER will be billed at the prevailing CUSTOMER SERVICE RATES but will not be billed for circuit components. If the problem occurs after two years from the date of shipment, circuit component and repair labor are billable. If the problem has been created by misuse or abuse of the equipment or by malfunction of associated equipment or by environmental conditions, at any time after shipment, BUYER will be billed for circuit components and labor.

GENERAL PROVISIONS

COMMERCIAL ELECTRIC PRODUCTS CORPORATION shall not be obligated to pay any costs or charges incurred by the customer or by any other party. In no event will COMMERCIAL ELECTRIC PRODUCTS CORPORATION be liable for consequential damages. No waiver, alteration, or modification of any of the provisions herein shall be binding on COMMERCIAL ELECTRIC PRODUCTS CORPORATION unless in writing and signed by an authorized official of COMMERCIAL ELECTRIC PRODUCTS CORPORATION. If, during any warranty period, the subject equipment has, in the opinion of COMMERCIAL ELECTRIC PRODUCTS CORPORATION, been modified or misrepaired, the warranty will be void unless the modifications or repairs have been made after consultation with COMMERCIAL ELECTRIC PRODUCTS CORPORATION and upon the recommendation of COMMERCIAL ELECTRIC PRODUCTS CORPORATION.

COMMERCIAL ELECTRIC PRODUCTS CORPORATION recommends that all shipments of equipment be inspected by the customer for hidden damage upon receipt from the carrier to insure that a timely claim be filed, if necessary, by the customer. COMMERCIAL ELECTRIC PRODUCTS CORPORATION will not pay claims for shipping damages.