INSTRUCTIONS

GEK-86110

TYPE CS26C/CS27C

AM PROTECTIVE RELAYING CHANNEL

GENERAL ELECTRIC

TABLE OF CONTENTS

TYPE CS26C/CS27C

AM PROTECTIVE RELAYING CHANNEL

The diagrams included in this book may, in some cases, vary in minor detail from the equipment which is supplied. However, in all cases the approved diagrams will be supplied and identified with the particular requisition involved.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired, or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company, Power Line Carrier Products, Malvern, PA 19355.

Notice that the module instructions found in this manual sometimes include material on more than one group (G-number) of that module. For exact identification of equipment supplied, refer to the drawing number found on the module, e.g., PL-19D413627G-2. This number will be described in the detailed module instructions, identifying any differences between each group number of that particular module.

INTRODUCTION TO MANUAL

Type 4CS26C/4CS27C CARRIER EQUIPMENT

INTRODUCTION

This publication contains instructions for installing, operating and servicing the General Electric Equipment. These instructions are divided into four major sections as follows:

- General
- Installation
- Alignment/Maintenance
- Module Descriptions

The General Section contains information for using and applying Type 4CS26C/27C Carrier Equipment.

The Installation Section contains information pertaining to installing and connecting this equipment.

The Alignment/Maintenance Section describes the alignment procedure using functional diagrams, troubleshooting aids, safety and maintenance, repair and return information and parts list notes. This section also contains a listing of recommended test equipment.

Complete information on each plug-in module will be found under its respective tab in the Module Description section of this manual.

It should be noted that the individual module instructions may include descriptions and information on more than one "group" of that module. By use of the model number on the equipment nameplate and the nomenclature table found in this section of the manual, identification of the particular module group can be determined.

Production changes of equipment (if any), incorporated after the basic issue of this publication, are identified in the write-up, Production Changes, of each module of equipment.

The customer should also note that if an instruction has been revised, the revision letter following the LBI number on the first page will apply throughout that instruction.

A Customer System Section may be included if special drawings, non-standard equipment or modified equipment is required, or for other special considerations.

GENERAL INSTRUCTIONS

CS26C/27C BLOCKING RELAY CARRIER

EQUIPMENT SECTION

INTRODUCTION

The General Electric Type 4CS26C/27C Teleprotection Equipment provides "blocking-type" carrier channels for both line and equipment relaying protection systems. The 4CS26C is designed for high speed use with solid-state directional and phase comparison relays (1.5/2 ms, 4 kHz channel spacing). The 4CS27C is used with slower electro-mechanical directional comparison relays (3.0/5 ms, 2 kHz channel spacing) with attendant spectrum saving for other channels. A voice channel (for service use) is available on both equipments (4CS26C/27C) as a plug-in module, and is accommodated without change to the channel spacing requirements. Relaying functions always pre-empt voice service. While both are primarily designed for "blocking type" service, an optional plug-in module provides for alternate "unblocking" service. In this mode of operation (continuous carrier on), no voice channel for maintenance service is available.

The principal hardware differences between the CS26C and 27C are found in the transmitter keying priorities, and connections. Channel speed differences are accommodated by jumpers in both transmitter and receiver modules.

The equipment identification (model number) is found on the nameplate (located on the inside of the fold down front cover) and is de-coded by use of the Nomenclature Table found on the next page. Additionally, a full explanation of the various module jumper arrays (function & position) is provided on Fig. 5 located at the end of the Alignment & Maintenance section of this manual.

Physically, the equipment occupies 4 rack units of space in a standard 19" wide shelf. (See Fig. 1). Individual plug-in modules are accessed from the front with all wiring and customer connections on the rear panel (TB1) or on extension cable terminal boards (RA, RB). Fig. 1 also shows the location of the 100 watt amplifier when used in lieu of 10 watt plug-in module, and the 250V Keying Regulator for 250V operation.

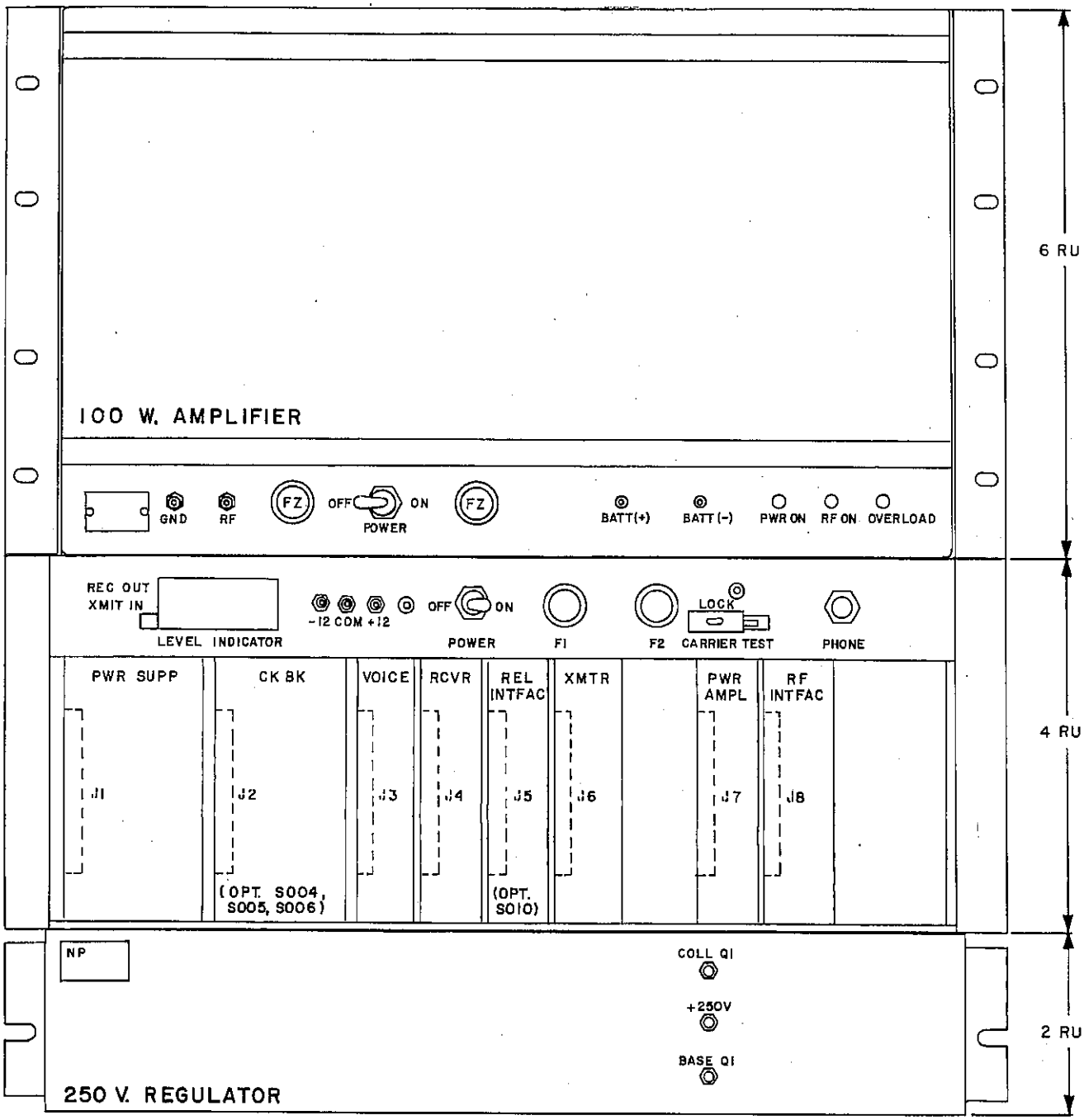


FIGURE 1
TYPICAL 4CS26C/4CS27C BLOCKING RELAY EQUIPMENT ASSEMBLY

Figure 1

TYPICAL 4CS26C/4CS27C
BLOCKING RELAY EQUIPMENT ASSEMBLY

(19C334225, Rev. 0)

NOMENCLATURE CHART

4CS26C 1 F 12 M 2 V A 0355 Option S004 ← Typical Type Number with Option

OPTIONS
S001 Sliding-link terminal boards instead of EB-25 boards*
S002 Negative Keying
S003 Reverse battery polarity
S004 Checkback: master unit without counter
S005 Checkback: master unit with counter
S006 Checkback: remote unit
S007 Two-frequency operation: specify transmit and receive frequencies
S008 Unblocking (not available with voice operation)
S009 Impedance-matching transformer for 100 watt transmitter: for 50/75/100/125/150 ohm output
S010 Relay interface module
S011 4-Wire RF interface (Less Skewed Hybrid)

OPERATING FREQUENCY
Operating frequency in even 0.5 kHz steps, starting at 30 kHz.
Example: state "0355" for operating frequency of 35.5 kHz.
For 2-frequency operation, specify "XXXX" here and order option S007.

ALARM
N Without alarm & indication package
A With alarm & indication package (2 alarm relays & level meter)

VOICE OPERATION
N No voice operation
V With voice operation

BANDWIDTH
1 Narrow band (2 kHz channel spacing) (Normally used with CS27C)
2 Wide band (4 kHz channel spacing) (Normally used with CS26C)

TRANSMITTER POWER OUTPUT
M 10 watts
H 100 watts (Not available for 250 VDC operation. Includes 100-watt power amplifier which requires 6 rack units of mtg space.)

POWER SUPPLY (Negative ground)

04 48-volt battery operation
12 125-volt battery operation
25 250-volt battery operation (includes 250 VDC keying regulator which requires 2 rack units of mounting space)

TYPE OF MOUNTING, WIRING HARNESS & TERMINAL BOARDS (ALSO SEE OPTION S001)
N For mtg. in fixed-rack cabinet or open rack, incl. std. terminal boards
F For mtg. in fixed-rack cabinet or open rack, incl. EB-25 terminal boards
S For mtg. in swing-rack cabinet, incl. wiring harness & EB-25 terminal boards
X Special harness: specify length of harness (includes EB-25 terminal boards)

KEYING AND RECEIVER OUTPUT
1 For CS26C: standard keying
1 For CS27C: standard keying with 30 ohm receiver relay
2 For CS27C: standard keying with 2000 ohm receiver relay

TYPE DESIGNATOR
4CS26C For use with static (solid-state) relays
4CS27C For use with electromechanical relays

* Type of mounting (F-X) must also be specified when requesting Option S001.

SYSTEM DESCRIPTION

The primary control circuit for the system is a crystal-controlled oscillator located in the receiver module. This oscillator determines frequency stability and provides the reference signals for both the transmitter and receiver synthesizers. Both the transmit and receive synthesizers are phase lock loop designs and are hand programmable from 31 kHz to 535 kHz. The transmitter is programmable in steps of 250 Hz and the receiver in steps of 500 Hz, which permits over 1000 channel combinations.

The frequency spectrum required has been greatly reduced (over earlier equipments) by using band-limited, amplitude-modulated relay carrier and single-sideband modulation for the voice option. The relaying function has two bandwidths, which determine channel speed: 2 kHz (narrowband) and 4 kHz (wideband). The transmitted relay carrier is band-limited so that the spectrum is restricted to the channel bandwidth. The voice option has a bandwidth of 2 kHz and is used with both narrow and wideband channels.

The unusual modulation-demodulation technique results in a demodulated "zero-output" signal if both the transmitter and receiver are on the same channel center frequency. Therefore, the receiver is always set at the channel center, and the transmitter is programmed (offset) for only one of the following: -250 Hz, +250 Hz, -500 Hz or +500 Hz from channel center frequency. When the transmitted carrier is demodulated at the receiver into one of the four tones (±250 Hz, +500 Hz), that tone is detected and used to operate the receiver output relay circuits.

EQUIPMENT

The basic CS26C/27C equipment consists of a shelf assembly with a control panel and equipped with four plug-in modules, namely (1) a Power Supply, (2) Transmitter, (3) Receiver and (4) RF Interface. Two output powers are available, namely, a 10 watt output module which plugs into the shelf or a 100 watt output which mounts external to the shelf in the same cabinet (normally just above). Other modules are (1) a Plug-in Voice Module, (2) a Plug-in Checkback Module (Master or Remote), (3) a Plug-in Relay Interface Module and (4) a Plug-in Unblocking Module.

TRANSMITTER

The Transmitter module consists of a programmable frequency synthesizer (PPL), modulator, keying control and driving circuits which power either the 10 watt Power Amplifier module or the external 100 watt Power Amplifier. An indication of relative output power can be displayed on an optional front panel meter.

There are four keyed inputs to the Transmitter: STOP, START, REDUCED POWER and SUPERVISION (CS26C only). Each input is sense reversable with a jumper.

The transmitter has a frequency range from 30 kHz to 535 kHz and is programmable in 250 Hz steps. The frequency is adjusted by a series of binary switches and jumpers. This synthesizer is slaved to a crystal oscillator located in the receiver. The output sidebands of the transmitter modulator are filtered by a bandpass filter, located on the RF Interface Module.

NOTE: No two transmitters in the same line section may be operated at the exact same frequency, otherwise carrier phase cancellation will be automatic (in the receiver) with resulting failure to block. If more than one transmitter (up to 4) is to be used, then each must be programmed to a different one of the following offset-frequencies:
F_c + 250 Hz, F_c - 250 Hz,
F_c + 500 Hz and F_c - 500 Hz.

RF INTERFACE

The RF interface module provides the many combinations needed for multiple application requirements. The module has movable plugs or straps that permit programming for 10 watt operation and 2 or 4 wire RF terminations. Two bandpass filters are located on this module, both having the same bandpass. The low power bandpass removes the multiple harmonics of the transmit modulator before power amplification and the high power filter provides harmonic clean-up before transmission to the line. There are ten bands of filters used to cover the RF spectrum from 31-535 kHz. Each band is designed to suppress the second harmonic of the lowest band frequency. Overlap is provided so no channels are lost.

In the 10 watt application the Power Amplifier drives a hybrid (HY1) and a filter (FL2) on the RF Interface Module. The hybrid provides a means of separating send and receive signals on a common line while maintaining sufficient isolation between local transmitter and receiver. The 10 watt filter contains gas and metal oxide varistor (MOV) devices to protect against line surges.

When the 100 watt Power Amplifier is used, power output is delivered to the external 50 ohm coaxial cable (to the line/switchyard equipment) at J90 on the rear of chassis. In this case, hybrid HY1 in the Interface module is deleted and local transmitter/receiver isolation is obtained from a hybrid (T80-T81) in the 100 watt Power Amplifier.

POWER AMPLIFIERS

The 10 watt Power Amplifier is a plug-in module with a heat sink and operates in the 30 kHz to 535 kHz range without tuning. The output stage is a Class B type push-pull and has a fixed gain of approximately 38 dB. Negative feedback is used to drive an output impedance of nominally 50 ohms. Overload protection is provided on a continuous basis for both current and voltage. RF on relay alarm is provided as an option. Mounted on the front of the unit are the LED indicators for RF on and overload.

The 100 watt Power Amplifier is driven directly from the Transmitter module and is located above the CS26C/27C shelf. It is a transistorized wideband class AB amplifier, powered directly from the station battery with a built-in DC-DC converter. For additional details, refer to Module section of this manual.

RECEIVER

The Receiver Module consists of (1) a Crystal Oscillator, (2) Synthesizer, (3) Demodulator, (4) IF Filter and (5) Detector. The receiver's synthesizer frequency is programmed for the center of the channel as opposed to the transmitter which is offset from the center by 250 Hz or 500 Hz above or below the channel center frequency. The balanced demodulator driven by 4 quadrature carriers at channel center frequency produce a tone output at (+) or (-) 250 Hz, or (+) or (-) 500 Hz. It is filtered by an active low pass filter providing the receiver selectivity.

The CS26C receiver output 5V at 20 mA) connects to the static relays through Jack 43 at rear of shelf. The CS27C output is transistor switched for both 30 ohm & 2000 ohm relay coils (either 48V or 125 VDC) at terminal boards on rear of the shelf.

Additionally, a reserve signal level output provides 1.0 mA DC fullscale as a reserve signal level monitor on a front panel meter. The receiver also provides the first demodulation step for voice reception.

VOICE OPTION

Single sideband transmission is used in the voice option, which utilizes phase cancellation techniques to generate the SSB. The unwanted sideband is attenuated and folded back in band with the wanted sideband. To demonstrate this technique, Fig. 2 presents the translation points encountered from transmit audio to receive audio, along with the spectrum generated at each point. Two-tone audio is used for demonstration, one tone at 500 Hz and the second at 1300 Hz. The relay modulation, explained above, functions essentially the same but uses single-stage mixing.

The transmit audio is shown as it appears before entering mixer 1 . The balanced mixer is a two section mixer driven by four quadrature 1 kHz carriers. Two outputs are derived from the mixer, 90° different in phase with a spectrum as shown at 2 . The 500 Hz translates to 500 Hz (and 1500 Hz, not shown) and the 1300 Hz to 300 Hz (and 2300 Hz, not shown). Each mixer output is filtered by an 800 Hz lowpass filter resulting in the spectrum shown at 2. The filtered signals are applied to another two-section balanced mixer 3 which translates the audio to the desired RF channel frequency. This is again modulated by four quadrature carriers at channel center frequency. The resulting transmitted spectrum is shown at 4 . The wanted tones are located at F_c -500 Hz and F_c +300 Hz while the suppressed sideband tones are located at F_c -300 Hz and F_c +500 Hz.

The receive de-modulation is the reverse of the transmitter. The balance mixer 5 generates two quadrature (F_c) outputs. The resulting audio signals are again filtered by two identical low pass active filters. The translated spectrum is as shown at 6. Note that the unwanted sideband is not visible at this point. The reason is that the wanted and suppressed sidebands fold on top of each other.

The quadrature signals are again fed into a balanced mixer 7 and combine with a four phase 1 kHz signal, resulting in an output audio shown at 8. The wanted audio is again at 500 Hz and 1300 Hz but now the suppressed sidebands show up at 700 Hz and 1500 Hz, along with the suppressed carrier at 1 kHz. The audio system described above has some fidelity limitations. (bandwidth approximately 1.6 kHz) but is entirely serviceable for maintenance applications. Signaling is effected by depressing the mike talk button which sends a 200 Hz signal to the receiver and actuates an annunciator. This is disconnected when the receive headset is plugged into the audio jack (Phone) on the front panel.

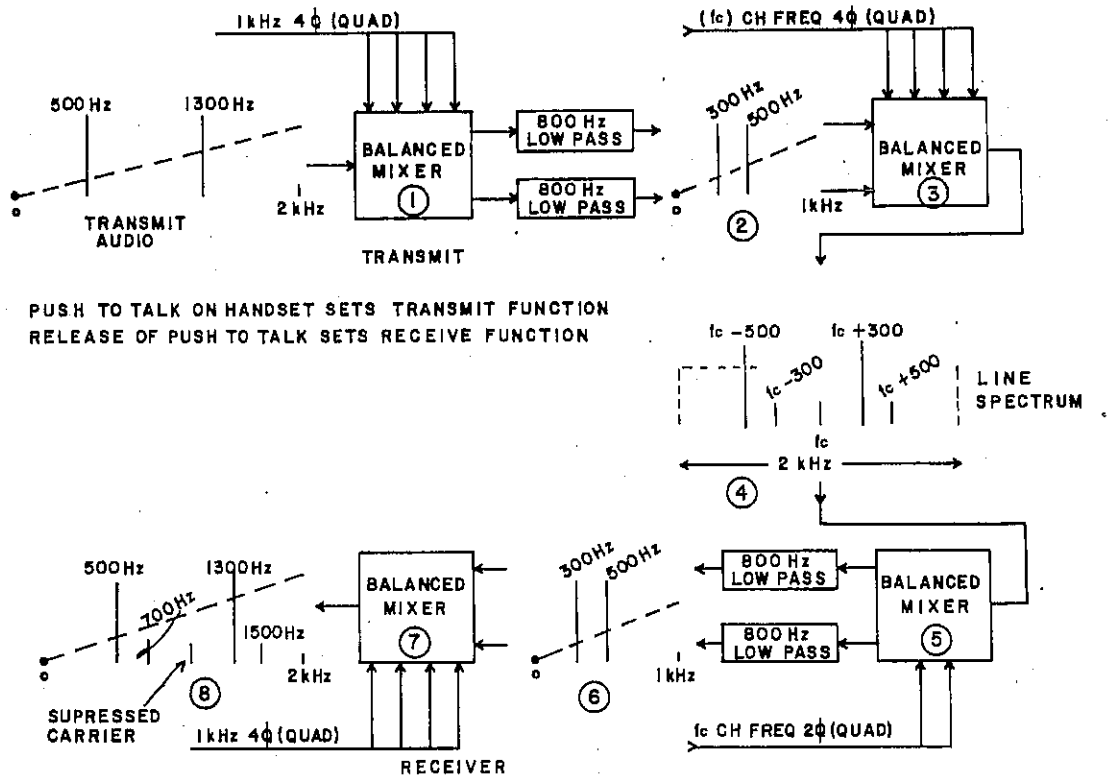


Figure 2

CS26C/27C SIMPLEX SSB VOICE OPTION
FUNCTIONAL BLOCK DIAGRAM
WITH SPECTRUM ANALYSIS

CHECKBACK

The Checkback Option consists of a Master Checkback module and up to three Remote Checkback modules. Either is assigned to slot J2 in the shelf.

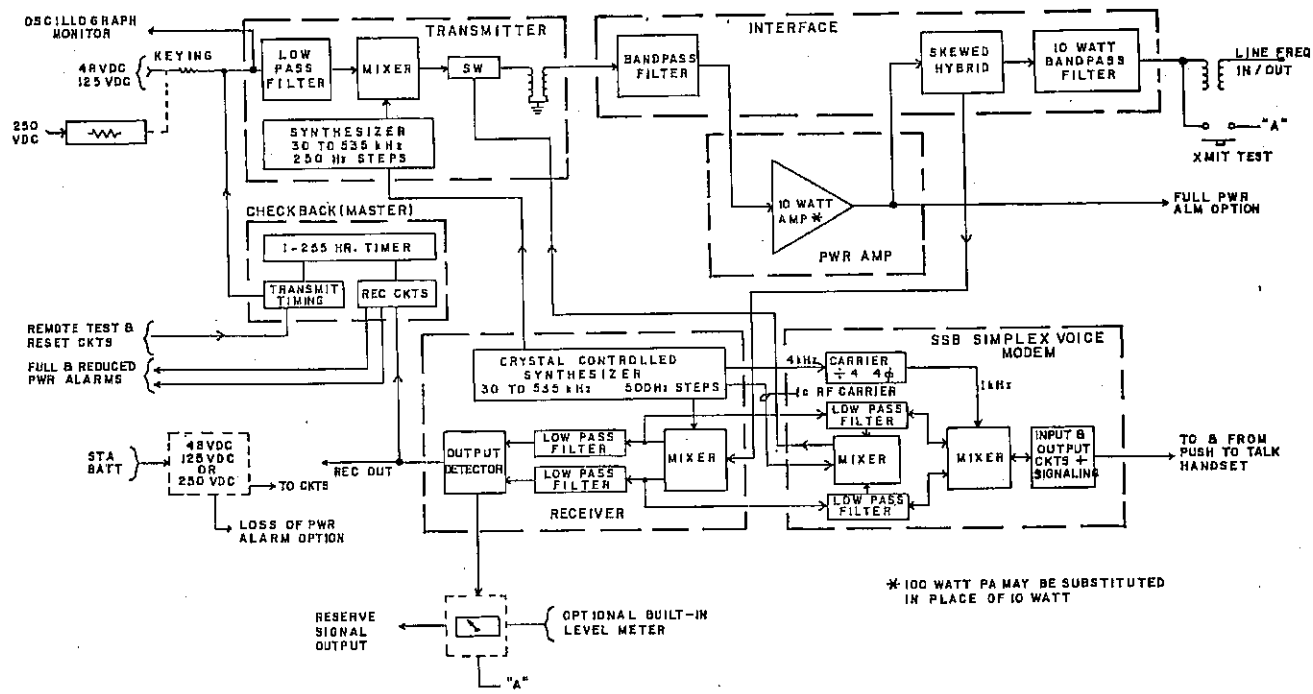
Automatic testing of a CS26C/27C system is provided by the timing and recording circuits of the Master Checkback module. The testing is programmable from 1 to 255 hours in one hour steps and the number of failed or good tests can be recorded by an optional counter located on the module.

Remote supervision of the master is also available for clock resetting, remote test initiation and remote clearing. This Remote module is also designed to check both full and reduced power operation. Both STOP and START blocking functions will override the Checkback function. Located on the front panel are six LED's on both the Master and Remote modules which indicate channel status for full and reduced power.

POWER SUPPLY

The CS26C/27C Power Supply module is of the DC to DC chopper/converter type and is available for 48, 125 and 250 volt station batteries. This converter, with battery surge and transient protection, provides ±12V at 1.5 amperes maximum for the operation of the several modules. An optional low voltage alarm relay is available. The Power Supply is equipped with short circuit protection.

For 250 volt DC operation a separate 2 RU regulator unit is required and mounted directly below the CS26C/27C shelf. It provides 125 VDC keying voltages.



CS26C/27C BLOCK DIAGRAM (WITH CHECKBACK AND VOICE OPTIONS)

NOMINAL OPERATING CHARACTERISTICS

SYSTEM

Frequency range
- Transmitter & receiver ..... Programmable in 0.5 kHz steps 31-535 kHz
- RF interface module ..... Available in 10 frequency bands

31-39.5 kHz	116-155.5 kHz
40-50 kHz	156-210.5 kHz
51-65.5 kHz	211-286.5 kHz
66-86.5 kHz	287-391.5 kHz
87-115.5 kHz	392-535 kHz

	CS-26C	CS-27C
Channel spacing	4 kHz (wide band)	2 kHz (narrow band)

Channel speed

Operate	1.5 milliseconds	3.0 milliseconds
Reset	2.0 milliseconds	5.0 milliseconds
Phase comparison	2.0 milliseconds	———

RF input/output impedance ..... 50 or 75 ohms nominal, unbalanced
Frequency stability ..... ±10 Hz
Output power ..... 10 watts (100 watts optional)
Harmonic distortion ..... −55 dBmO
Receive input level ..... 0.125 Vrms minimum, 7.0 Vrms maximum
Oscillograph monitor output ..... +10 Vdc into 4000 ohms when keyed

KEYING, NON-ISOLATED

CS-26C	Keying Voltage	Factory Programmed* To
Control (top priority)	5 V at 20 mA	Remove voltage to start carrier
Auxiliary stop	5 V at 20 mA	Apply voltage to stop aux functions (supv & reduced power)
Auxiliary keying		
Supervision	Station battery	Apply voltage to start carrier
Reduced power	Station battery	Apply voltage to start carrier at reduced power
CS-27C		
Start	Station battery	Remove voltage to start carrier
Stop (top priority)	Station battery	Apply voltage to stop carrier
Reduced power	Station battery	Apply voltage to reduce power

Manual keying ..... Spring-reset slide switch with lock position
Burden on external contacts ..... 20 mA max at battery voltage
*Keying circuits are factory programmed to co-ordinate with GE relay circuits, but can be field programmed to change the keying sense.

OUTPUTS, NON-ISOLATED

CS-26C
- Static relay receive ..... 5 V at 20 mA**
- Receive output ..... Station battery (100 mA nominal)
- Auxiliary output ..... Station battery (50 mA nominal)
- Reserve signal indication ..... 1 mA full-scale (adjustable) into external meter or optional built-in meter

CS-27C
- Receive output ..... Station battery (180 mA or 20 mA nominal)
- Auxiliary output ..... Station battery (50 mA nominal)
- Reserve signal indication ..... 1 mA full-scale (adjustable) into external meter or optional built-in meter

**Factory programmed to co-ordinate with GE static relay scheme, which delivers 5 V at 20 mA when no input signal is received. Can be field programmed to reverse this sense if application warrants.

VOICE OPERATION

Modulation ..... Single sideband
Transmission ..... Simplex (push-to-talk)
Signaling ..... Transmit button on handset keys transmitter at reduced power
Frequency response ..... 300 to 1600 Hz

100-WATT POWER AMP OPTION

Frequency range ..... 30-535 kHz
Permissible voltage variation
- 48-volt battery ..... 42-60 volts
- 125-volt battery ..... 103.2-141.9 volts

Harmonic distortion ..... −50 dBm0
Output power ..... 100 watts into 50 ohms
Output impedance
- Standard ..... 50 ohms, unbalanced
- With Option S009 ..... 50/75/100/125/150 ohms, unbalanced

CHECKBACK OPTION

Alarm relay (master only) ..... Form C contact, rated 100 VA
Counter (optional, master only) .. Electromechanical, counts to 999
Clock (master only) ..... Programmable from 1 to 255 hours in 1-hour steps. Crystal controlled to operate from dc supply.

ALARM & LEVEL INDICATION OPTION

Alarm contacts
- Loss of power ..... Form C contact, rated 100 VA
- RF on ..... Form A or B contact (field strappable) rated 100 VA, with 0.5-second dropout delay

Reserve signal meter
- Movement ..... 1.0 mA full scale
- Scale reading ..... +2 to −20 dB

ENVIRONMENTAL

Ambient temperature range ..... -20 to +60° C (air contacting equipment)
Relative humidity ..... Up to 95% at 40°C
Altitude ..... Up to 10,000 feet (3048 m) with 10° C reduction in max ambient temperature for each 5000 feet (1524 m) of elevation above 2500 feet (762 m).
Transient-withstand capability ..... All external user interfaces meet SWC specifications of ANSI C37.90-1978
- 1-minute withstand ..... 2500 Vdc from each terminal to ground (derated 100 Vdc for each 1000 feet or 305 m above 1000 feet altitude)
- Center conductor of coaxial cable to ground ..... 1500 Vdc impulse level

POWER REQUIREMENTS

Nominal Battery Voltage	Permissible Voltage Variation	RF Output Power			
		10 Watts		100 Watts	
		Standby	Keyed	Standby	Keyed
48 Vdc	42-60 V	450 mA	1.0 A	750 mA	4.9 A
125 Vdc	103.2-141.9 V	200 mA	0.5 A	500 mA	2.1 A
250 Vdc	210-280 V	100 mA	250 mA	NA	NA

WEIGHTS & DIMENSIONS

Equipment	Net Weight	Dimensions			Rack Space Req'd
		Height	Width	Depth	
•Transmitter-receiver shelf	31 lb 14.1 kg	7" 178 mm	19" 483 mm	13.5" 343 mm	4 RU*
•100-watt RF amplifier	20 lb 9.1 kg	10.5" 267 mm	19" 483 mm	13.0" 330 mm	7 RU**
•250-Vdc keying regulator	4 lb 1.8 kg	3.5" 89 mm	19" 483 mm	6.36" 162 mm	2 RU*

*1 rack unit = 1.75 inches (44.45 mm)

**Amplifier occupies 6 rack units. One additional rack unit is required for ventilation.

INSTALLATION INSTRUCTIONS

4CS26C/27C POWER LINE CARRIER EQUIPMENT

RECEIVING, HANDLING AND STORAGE

This equipment, when not included as part of a rack or cabinet, will be shipped in cartons designed to protect them against damage.

Immediately upon receipt of equipment, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Power Transmission and Distribution Sales Office.

Reasonable care should be exercised in unpacking the equipment in order that none of the parts are injured, lost, or the adjustment disturbed.

If the equipment is not to be installed immediately, it should be stored in their original cartons, racks, or cabinets in a place that is free from moisture, dust, or metallic chips. Foreign matter collected on the outside of the equipment may find its way inside and cause trouble in its operation.

INSTALLATION

Location

This equipment should always be installed in an indoor location, generally mounted in its own rack or cabinet with associated power amplifier units, test equipment or accessories. A number of factors should be considered in selecting a suitable location for this equipment:

- The location should be free from excessive humidity, dust and vibration.
- The equipment should not be installed in a battery room or where corrosive fumes are present.
- The equipment should be easily accessible for maintenance to both front and rear unless supplied in swing out cabinets.

An indoor installation is recommended, since it simplifies the installation and maintenance of the equipment and does not require the blowers, heaters and thermostatic controls usually necessary in outdoor installations.

Mounting

The Power Line Carrier equipment is supplied to the customer in two ways: (1) As un-mounted separate shelves (for open-rack installation) and, (2) As already mounted shelves in a cabinet (either a fixed-rack or a swing-rack cabinet).

The cabinet will be either a fixed-rack or a swing-rack type. Fasten indoor cabinets firmly to the floor with suitable bolts or lag-screws. This must be done before opening the rack if the cabinet is of the swing-rack type.

When open-rack mounting is to be used, or when the customer is planning to use his existing racks or cabinets, the equipment will be shipped separately. Each unit has a specific location in the rack and each unit must be correctly located for proper system operation. Reference should be made to either the typical installation arrangement diagrams or to special installation arrangement diagrams which are supplied.

In a multiple rack-up of CS26C/CS27C shelves, it is not necessary that an air space be provided between shelves.

Each shelf of equipment has holes for machine screws on the left and right mounting flanges designed to match standard 19" wide openings. An outline dimensioned diagram for the equipment will be found under the SHELF tab in the Module section of this manual.

Connections

Three categories of connections must be considered, and made, namely: (1) Equipment ground (chassis), (2) DC power and interconnections, and (3) Coaxial cable from equipment to the switchyard (or other cabinets of carrier equipment).

Chassis Ground

Equipment chassis grounds are generally made through the cabinet (or rack) mounting hardware. An additional electrical ground should be securely connected from the chassis to the earth ground connection at the cabinet location. AWG No. 12 wire with appropriately crimped terminals are recommended.

Power and Interconnections

Station battery power (48 VDC or 125 VDC) should be supplied to the carrier equipment and connected to the appropriate terminal boards supplied (TB1) as follows:

+ Battery to TB1-40

- Battery to TB1-39

+ Switched Battery to TB1-38

- Switched Battery to TB1-37

These boards (labeled TB1 on the rear of shelf, or RA, RB when wired on extension cables to the cabinet walls) provide all the termination points for customer power and interconnections. Connection diagrams are included in this section. Additional details of these connection points are found on the shelf wiring diagrams located in the module section of this manual under the SHELF tab. However, for special customer systems and hardware, more elaborate station cabinet wiring and interconnection diagrams are supplied with all required customer connections shown by dotted lines.

For the CS26C, a jack and plug connection (J43/P43) is provided for static relay applications. Standard transmitter keying connections as well as receiver outputs to relay coils and static relaying equipment are shown on both the shelf wiring and overall functional block diagrams found in the Alignment and Maintenance sections of this manual.

NOTE

This carrier equipment is wired to the station battery with the negative side (-48V or -125V) tied to the equipment COMMON bus, not to chassis ground. Therefore, all transmit keying circuit inputs should be supplied from +48 VDC or +125 VDC to the appropriate terminal on TB1 (or RA, RB).

Coaxial Cables

Power cable connections between the CS26C/27C shelf and the 100 watt amplifier are also included in this section of the manual.

The coaxial cable connection (J201) from the CS26C/27C to the switchyard (or other cabinets) is found at the top rear (right) of the shelf. Considerable care must be taken to assure proper cable termination is provided and that precautions are observed at installation time. Coaxial cables are used for the low-impedance circuit between line-tuning units and indoor mounted transmitter-receiver assemblies. The recommended coaxial cable is RG-8/U, (or equivalent) consisting of: Single-conductor, No. 12 AWG, 7 strands of No. 21 copper, polyethylene insulation, copper shielding braid, and black vinyl plastic jacket to a nominal outside diameter of 0.405 inch.

Specific installation details are as follows:

1. The usual practice in installing this coaxial cable is either to bury it directly in earth, or to install it in underground conduit or troughs, alone or with other cables. The cable should be run in the most direct manner to keep the total conductor length, and therefore the carrier loss, to a minimum.

2. If the coaxial cable is to be connected directly to the coupling capacitor, the cable (or cable and conduit) can enter the coupling capacitor base, either through the bottom which is open in some assemblies or through the opening in the side of the base which will accommodate standard conduit. Refer to the coupling-capacitor outline drawing for dimensions.

3. The copper braid which forms the outer conductor of the cable should be securely grounded at the carrier equipment end only. At the tuning unit end the braid should be connected to the ground (GND) terminal of the impedance-matching transformer or wide band filter without directly grounding this terminal at this point. It was previously our recommendation that both ends of this cable be grounded. However, it was found in certain cases that momentary ground fault currents flowing through the cable could cause saturation of the impedance matching transformer and subsequent failure of the carrier channel. This is especially important in the case of pilot relay channels since these must operate during a fault. The outer jacket of the cable should be cut back so that the braid is well insulated against high surge voltages that may be produced between ground and the braid during line faults. Install both ends so as to assure a permanently dry surface of two to three inches between the exposed copper braid and the inner central conductor.

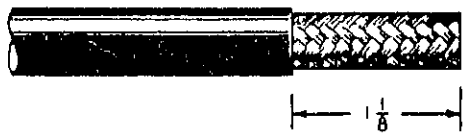
4. Minimum bending diameter is six times the diameter of the cable. Minimum bending temperature is 0° F.

5. The characteristic impedance of RG-8/U cable is 52 ohms. The capacitance is 29.5 picofarads per foot.

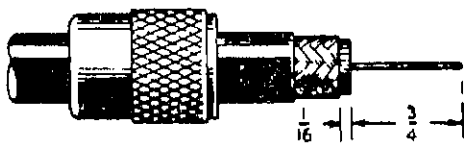
6. Cable Termination Diagram A-4032543, Figure 1, shows a method of attaching a connector to RG-8/U cable.

NOTICE

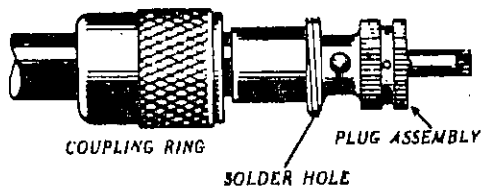
The carrier lead-in from the coupling capacitor should never be disconnected without first grounding the low potential end of the capacitor. Failure to keep a power-frequency ground on this end of the capacitor will allow dangerous static voltages to be built up at this point. Normally this ground is provided by a drainage coil located in the base of the coupling capacitor or in the cabinet housing the carrier equipment. To be safe, always close the grounding switch on the capacitor base, or ground the bottom terminal of the capacitor before disconnecting the lead-in conductor.



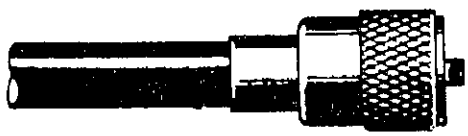
Cut end of cable even.
Remove vinyl jacket 1 ⅛"—*don't nick braid.*



Bare ¾" of center conductor—*don't nick conductor.*
Trim braided shield 1/16" and trim.
Slide coupling ring on cable.



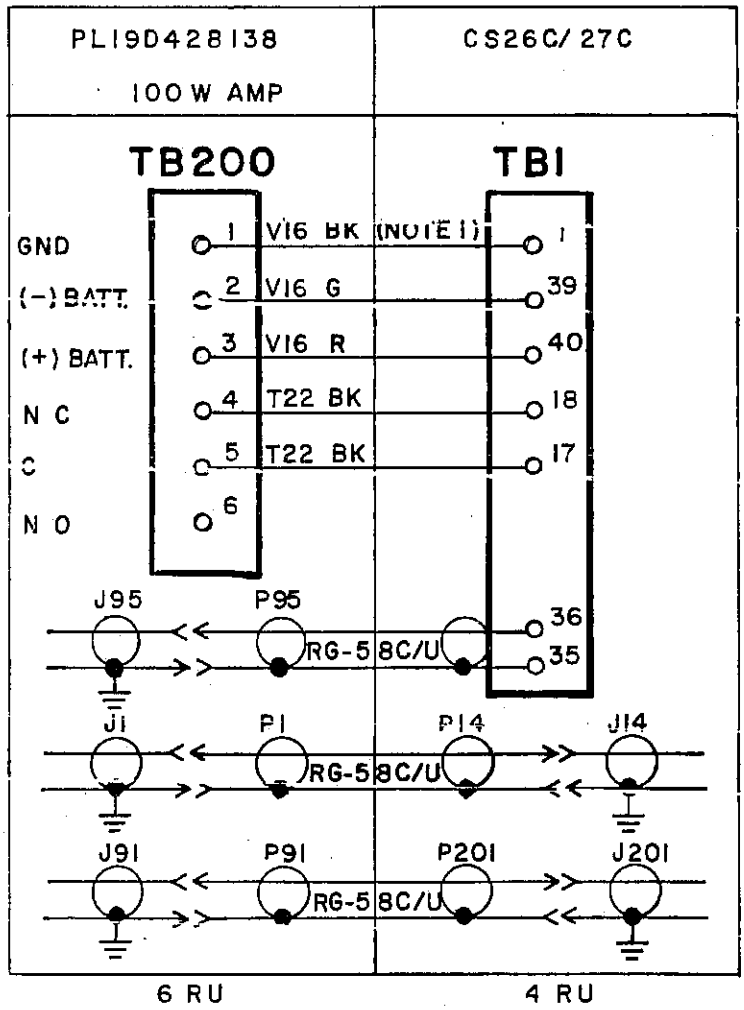
Screw the plug assembly on cable.
Solder assembly to braid thru solder holes.
Solder conductor to contact sleeve.



Screw coupling ring on assembly.

(A-4032543, Rev. 0)

Figure 1 - Installation Diagram RG 8/U Cable and Connector Assembly



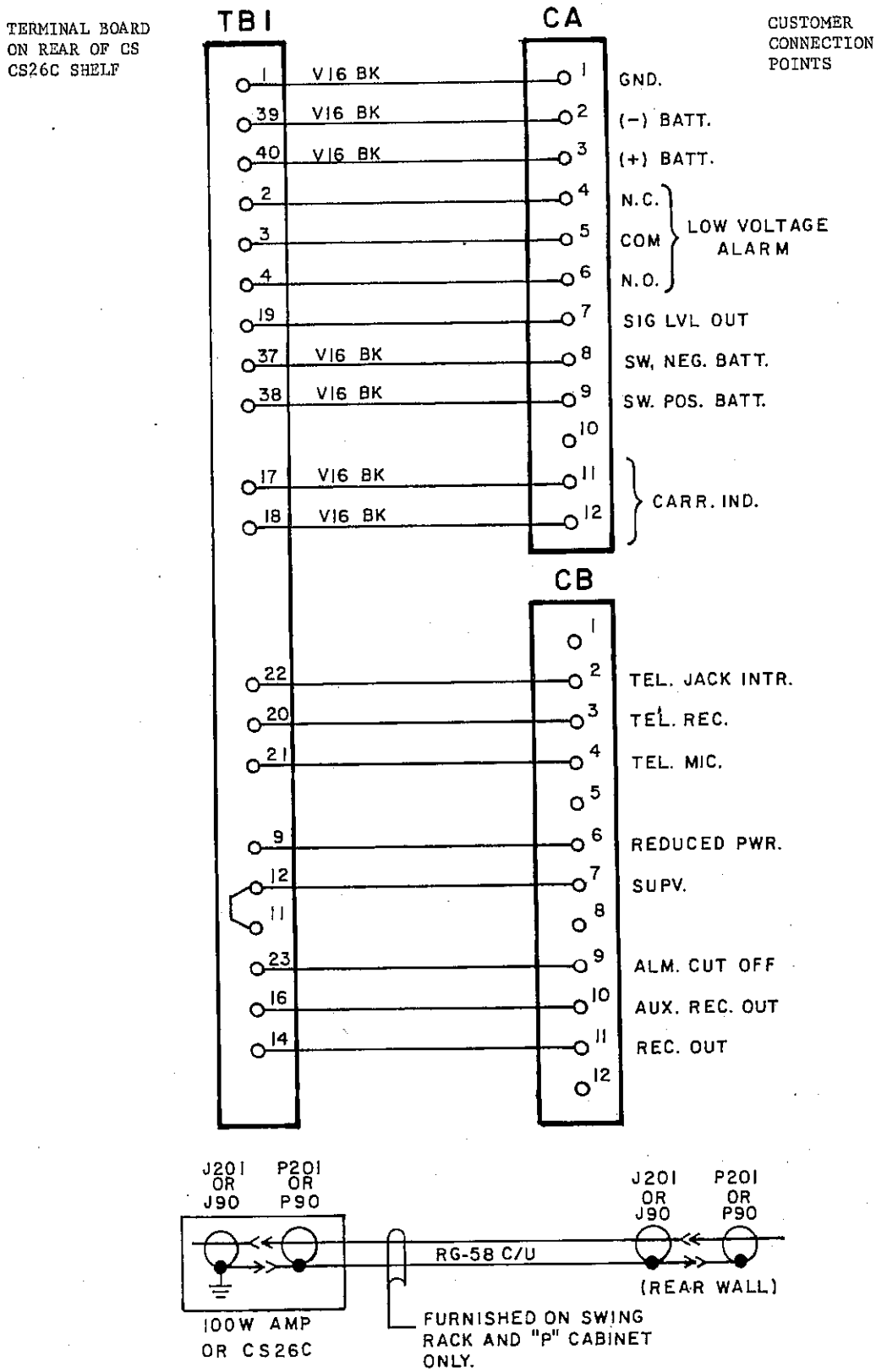
NOTES:
1. SLEEVED.

CABLE
19A133896G1

Interconnection Diagram

CABLE FOR 100 WATT POWER
AMPLIFIER CONNECTIONS

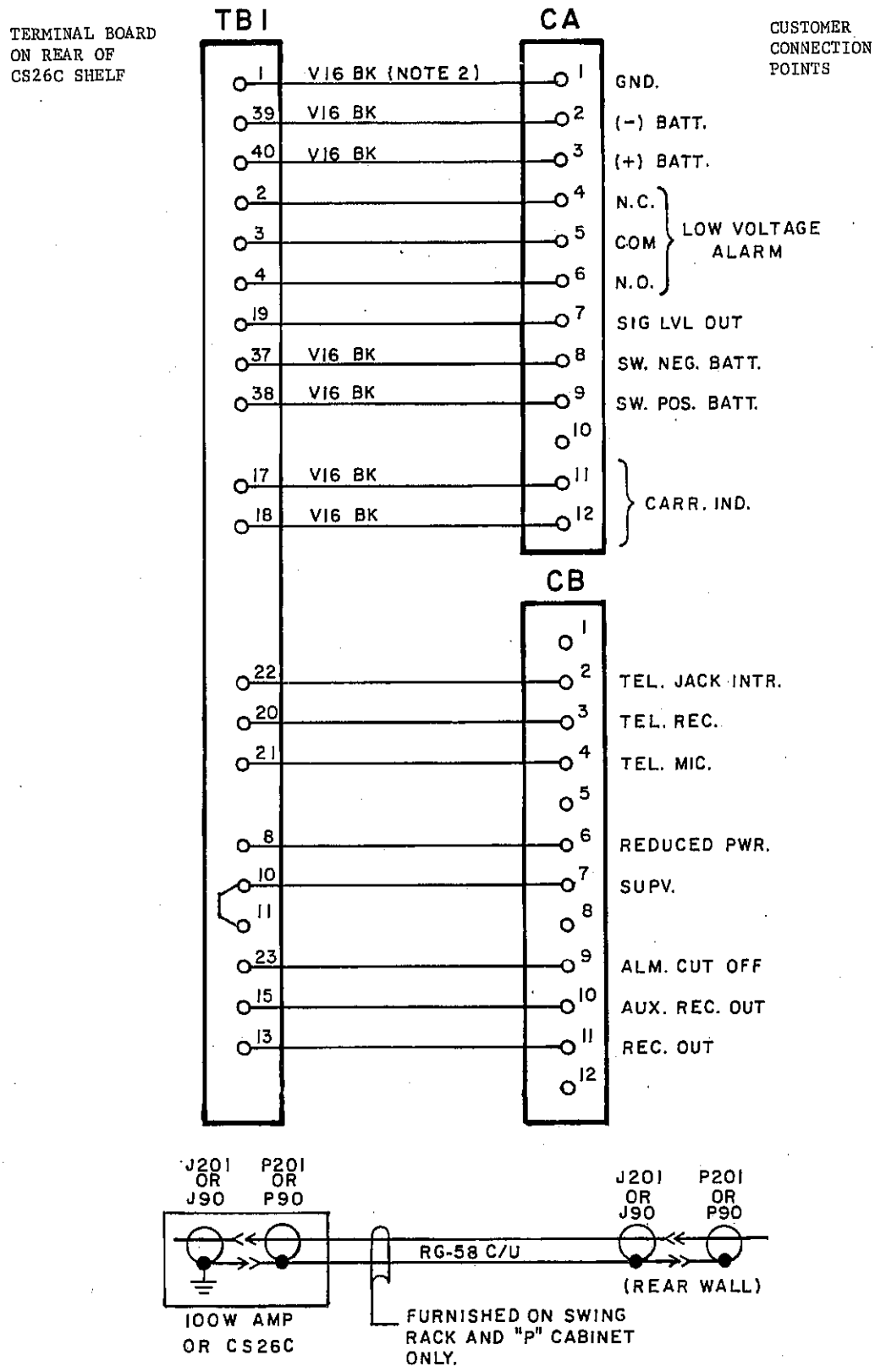
(19A133897, Rev. 1)



Interconnection Diagram

CABLE CONNECTIONS FOR CS26C, 48V
(FOR FIXED OR SWING RACK CABINET)

(19B229777, Rev. 0)

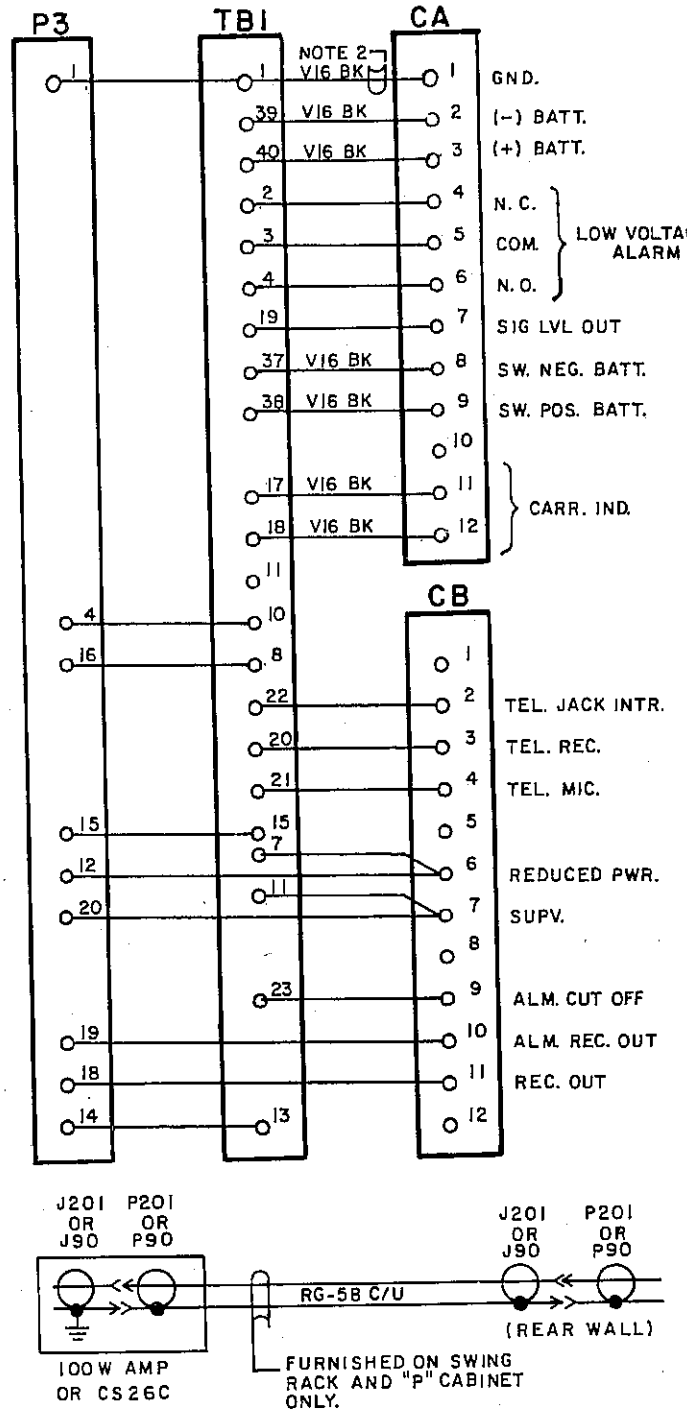


Interconnection Diagram

CABLE CONNECTIONS FOR CS26C, 125V
(FOR FIXED OR SWING RACK CABINET)

(19B229776, Rev. 0)

TERMINAL BOARD ON REAR OF CS26C SHELF



CUSTOMER CONNECTION POINTS

CS26C 250V

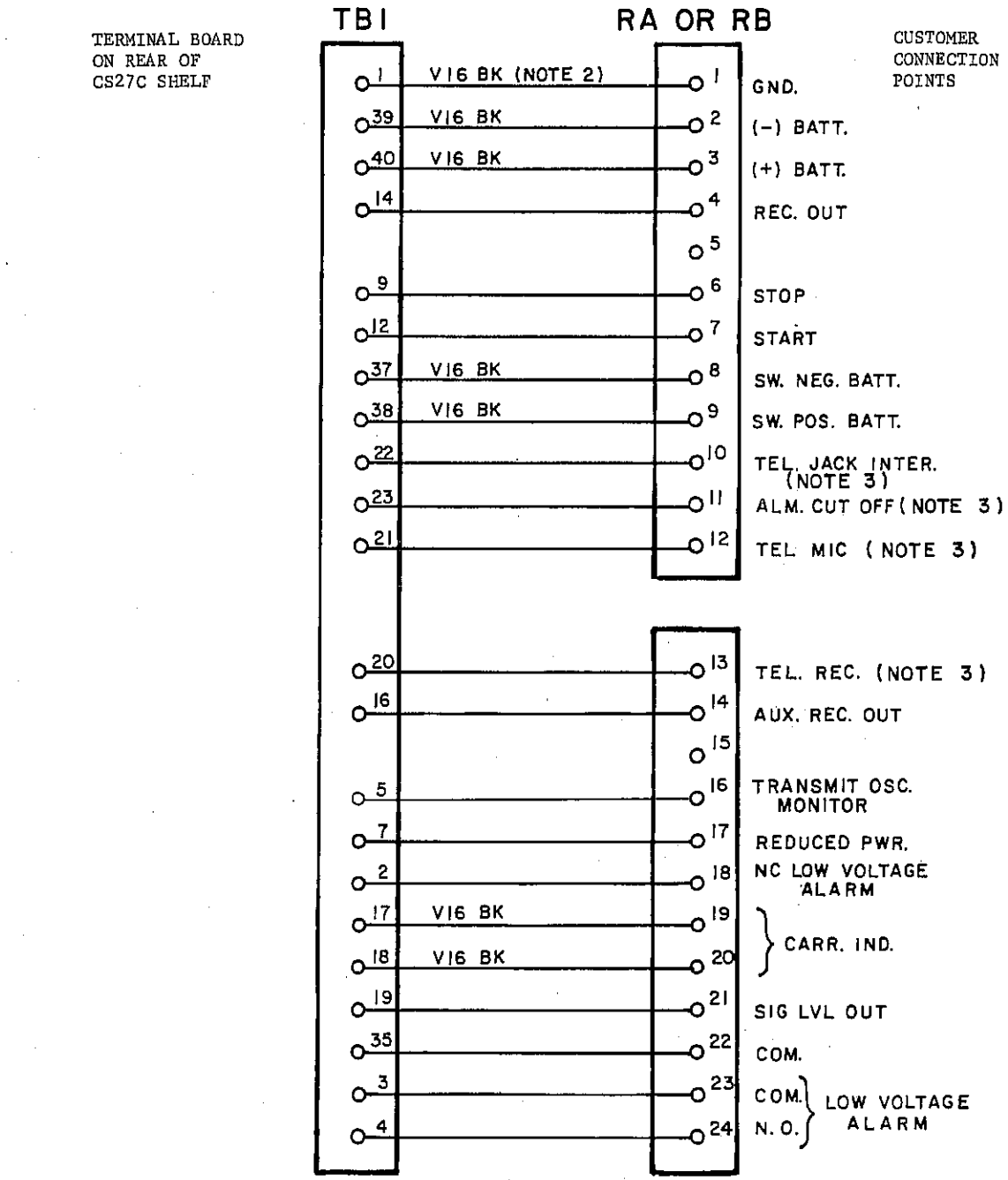
NOTES:
1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.

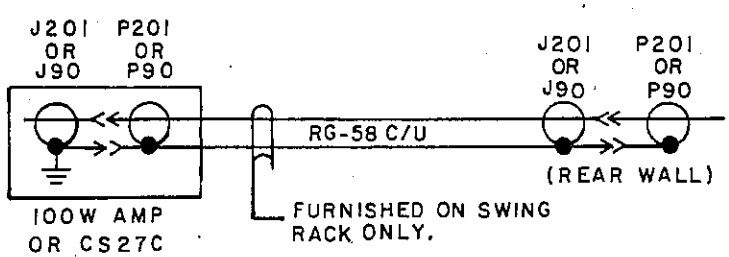
CABLE
19B229619G13, G15, G17
REV. A

Interconnection Diagram

CABLE CONNECTIONS FOR CS26C, 250V (FOR FIXED OR SWING RACK CABINET) PL-19B229619G13, -G15, -G17, REV. A

(19B229795, Rev. 1)





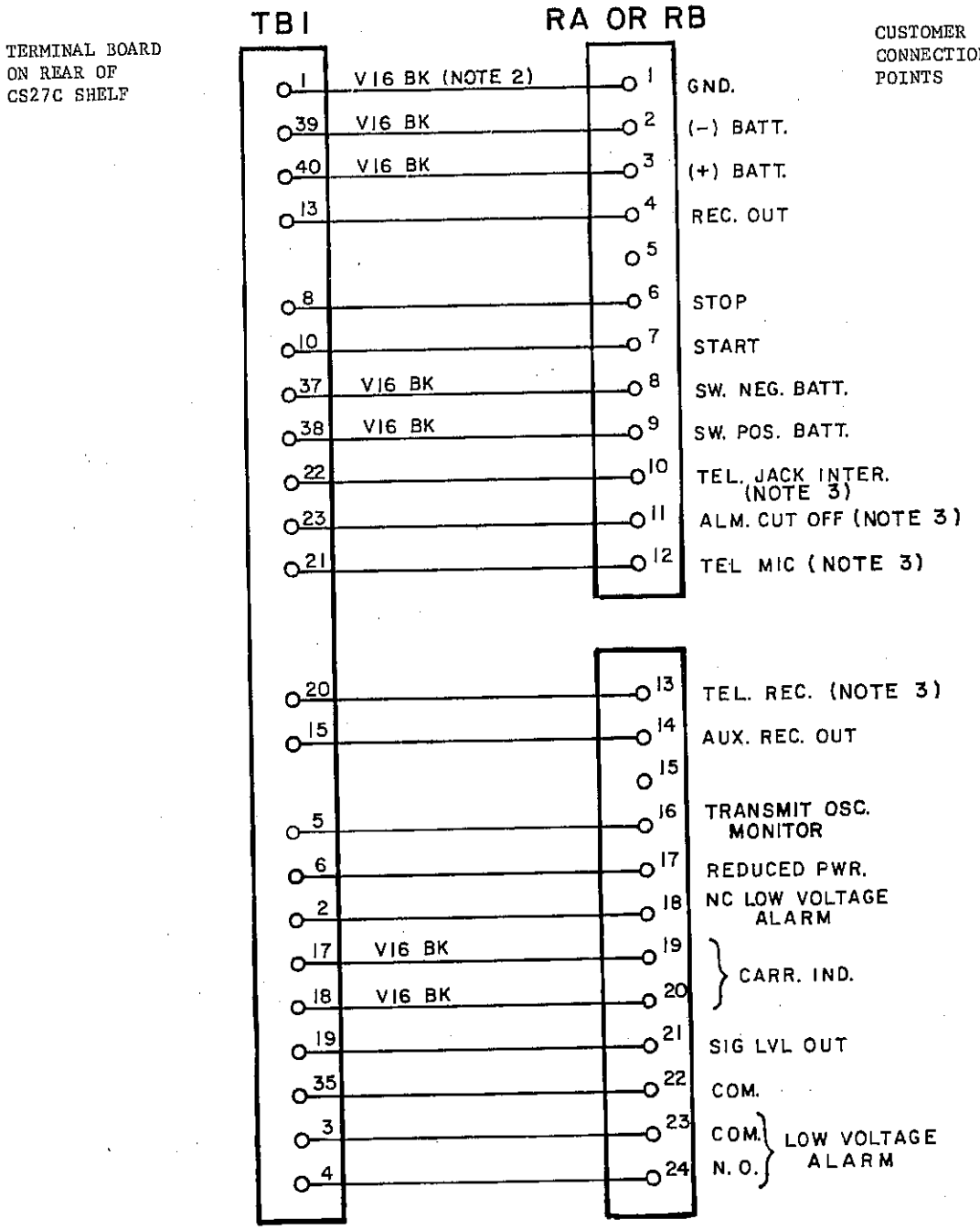
NOTES:
1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.
3. THESE CONNECTIONS ARE NOT USED WITH UNBLOCKING OPTIONS S008 AND S018.

CABLE 19B229619G4, G8

Interconnection Diagram

CABLE CONNECTIONS FOR CS27C, 48V
(FOR FIXED OR SWING RACK CABINET)

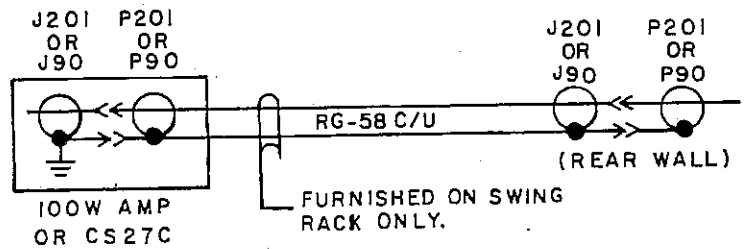
(19B229779, Rev. 2)



NOTES:

1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.
3. THESE CONNECTIONS ARE NOT USED WITH UNBLOCKING OPTIONS S008 AND S018.

CABLE
19B229619G3, G7

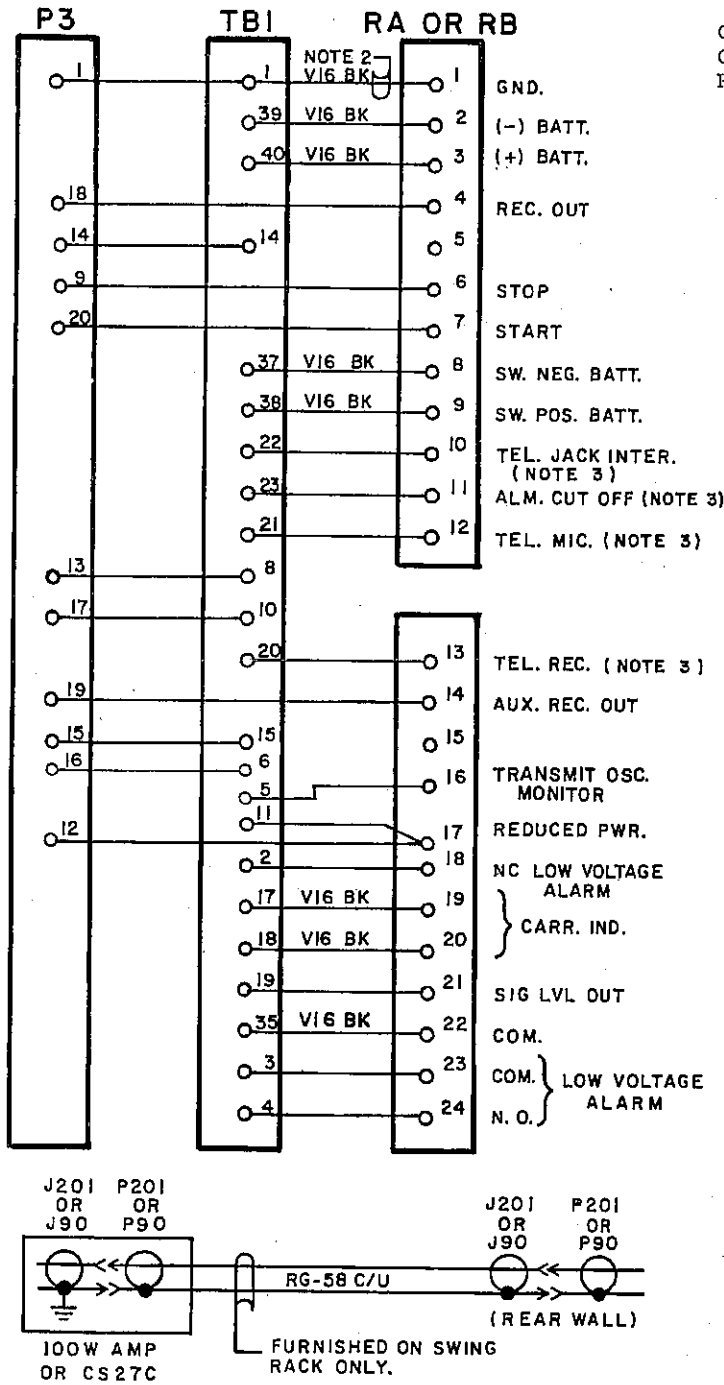


Interconnection Diagram

CABLE CONNECTIONS FOR CS27C, 125V (FOR FIXED OR SWING RACK CABINET)

(19B229778, Rev. 2)

TERMINAL BOARD ON REAR OF CS27 SHELF



CS27C 250V

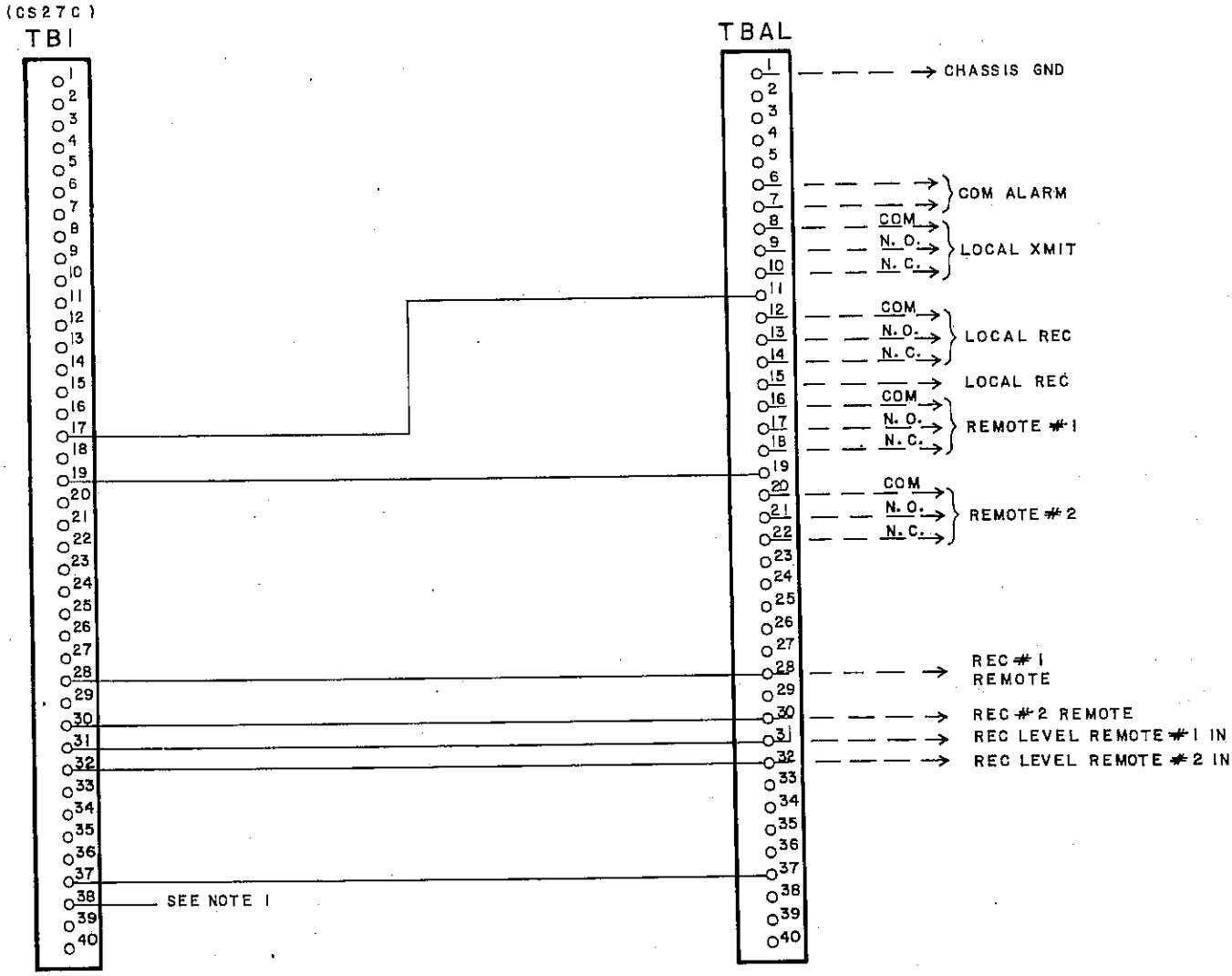
NOTES:
1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.
3. THESE CONNECTIONS ARE NOT USED WITH UNBLOCKING OPTIONS S008 AND S018.

CABLE
19B229619G14, G16
REV. B
19B229619G30, REV. A

Interconnection Diagram

CABLE CONNECTIONS FOR CS27C, 250V (FOR FIXED OR SWING RACK CABINET)

(19B229796, Rev. 5)



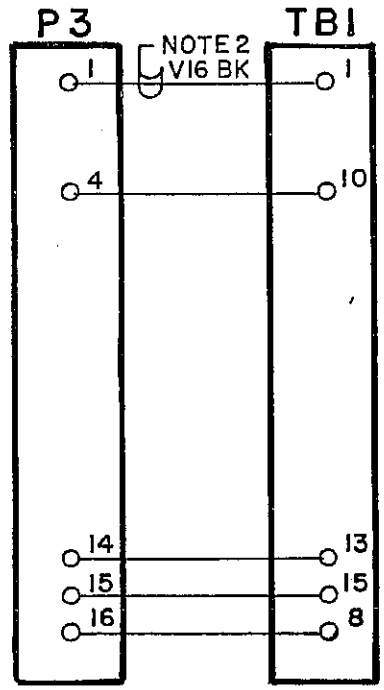
UNBLOCKING CS27C
19B229945G1

NOTE:
1. FOR 125V BATT CONNECT TO TBAL-38
   FOR 48V BATT CONNECT TO TBAL-39
   FOR 250V BATT CONNECT TO TBAL-40
2. ALL WIRES T22 BK

Interconnection Diagram

TYPE CS27C UNBLOCKING
PL-19B229945G1

(19C334460, Rev. 0)



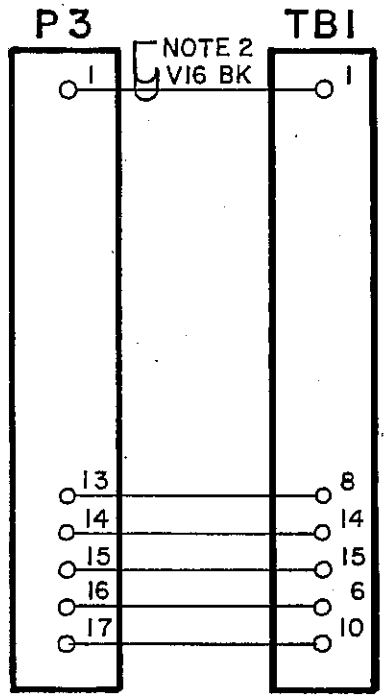
CABLE
19B229619G18,G20

CS26C 250V

NOTES:
1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.

(19A138780, Rev. 0)

Interconnection Diagram - Cable Connection for CS26C, 250 V
(For Cables Without EB-25 Terminal Boards)



CS27C 250V

CABLE
19B229619G19,G21
REV. A

NOTES:
1. ALL WIRE T22-BK EXCEPT AS NOTED.
2. SLEEVED.

(19A138781, Rev. 1)

Interconnection Diagram - Cable Connection for CS27C, 250 V
(For Cables Without EB-25 Terminal Boards)

INSTRUCTIONS

ALIGNMENT AND MAINTENANCE FOR TYPE CS26C/27C BLOCKING RELAY EQUIPMENT

RECOMMENDED TEST EQUIPMENT

The following test equipment (or equivalent) is recommended for initial adjustment, troubleshooting and maintenance of the CS26C/27C Blocking Relay Equipment.

1.	RMS Voltmeter-Wideband	HP3400A
2.	DC Voltmeter	Triplett 630
3.	Counter (electronic)	HP5381A
4.	Selective Voltmeter	RYCOM MODEL 6021 or 3135
5.	Module Extender	19D427767G1 (See diagram later in this section.)

The above items of test equipment are not supplied as part of the sytem equipment. This list is offered as an aid to the customer in determining what items of test equipment may be required.

FUNCTIONAL DIAGRAMS

Typical functional block diagrams are shown on subsequent pages. These include a CS26C system with 10 and 100 watt power outputs, and a CS27C with 10 and 100 watt power outputs. These diagrams are useful for testing and troubleshooting a system. Test points, wiring interfaces, keying, system adjustments and many strapping options are shown on the diagrams. Detailed descriptions, schematics and additional maintenance information will be found in the individual module instructions under the MODULE DESCRIPTION tab of this manual.

SAFETY CONSIDERATIONS

Since the use of high voltages, both transmission line voltages and AC and DC supply voltages, is necessary for the successful operation of much of the Carrier Current Equipment, certain reasonable precautions must be carefully observed by the operating personnel during the installation, operation and maintenance of the equipment.

Although practical safety measures have been incorporated in these equipments, the following general rule should be observed:

CAUTION

Under no circumstances should any person be permitted to handle any portion of the equipment that is supplied with high voltage, or to connect any external apparatus to the equipment, while the equipment is supplied with power, unless that person is thoroughly familiar with the hazards involved.

Individual unit or equipment instructions contain some safety references which should be followed - read the instructions completely before using a piece of equipment.

These safety references are in addition to the normal safety practices which have been established by the customer and should in no way be construed to modify or limit the customers safety procedures.

ALIGNMENT

Alignment of the CS26C/CS27C equipment consists of the following steps:

A. Verification of factory adjustments.
B. Adjustment of Line Tuning and Matching Equipment.
C. Adjustment of Transmitter output levels.
D. Adjustment of Receiver margin setting and received signal level indicator.

A. Verification of Factory Adjustments

The factory adjustments are described in a later section of this book. No attempt should be made to change a factory adjustment unless the specified test equipment is used.

B. Adjustment of Line Tuning and Matching Equipment

1. Refer to the instructions for the associated Line Tuning Equipment and perform the necessary adjustment.

2.* After the Line Tuning Equipment is properly aligned, key the Transmitter to Reduced Power by placing the externally connected test switch (TS, or sometimes CTS) in the RS (or TEST) position.

3.* With a selective voltmeter, measure the Transmitter signal level at TP3 (OUTPUT) of the Power Amplifier and at TP1 (RCV OUT) of the RF Interface. Record these levels.

4.* Unkey the Trasmitter and change the tap setting of transformer T1 at the rear of the Shelf. Key the Transmitter again to Reduced Power and repeat Step 3.

5.* Repeat Step 4 until a tap setting is found which results in the greatest difference in levels between TP3 and TP1. Leave the tap setting of T1 at this point.

* These steps apply only to the 10-watt equipment. No further matching is required for 100 watt equipment.

C. Adjustment of Transmitter Output Levels

1. Place the Transmitter module in an Extender plugged into J6 of the Shelf. Turn R90 (located near the rear of the Transmitter) full counter-clockwise.

2. With a selective voltmeter connected to TP4 (RF OUT) on the RF Interface module (10 watt equipment) or to TP RF on the Power Amplifier (100 watt equipment), key the TEST switch on the front of the Shelf to full power.

3. Adjust R90 (and, if necessary, jumper H) to produce an output level of 22 VRMS (10 Watt equipment) or 70.7 VRMS (100 watt equipment) as measured with the selective voltmeter. Release the TEST switch.

NOTE

If adjustment of R90 produces an overload condition in the Power Amplifier as evidenced by a lighted OVERLOAD LED, refer to the Power Amplifier instructions LBI-35773 found later in this manual.

4. Key the Transmitter to Reduced Power (see Step B-2 above). Adjust R63, located near the middle of the Transmitter module, to produce an output of 7 VRMS (10 watt equipment) or 22 VRMS (100 watt equipment) as measured with the selective voltmeter. Unkey the Transmitter. Remove the Extender and replace the Transmitter module into J6 of the Shelf.

NOTE

It is recommended that the Reduced Power output level be set at 10 dB below full output level. If the user's standard is otherwise, substitute the user's standard level for the level specified below.

D. Adjustment of Receive Margin Setting and Received Signal Level Indication

1. Key the remote Transmitter to Full Power in order to provide a normal received signal.

2. Variable resistor R7, jumper A, and the MARGIN and CARRIER ON/OFF LED's are located at the front of the Receiver module. Select jumper A position (0, 6, 12, 18 or 24 dB) such that the MARGIN LED is OFF when R7 is full counter-clockwise and ON when R7 is full clockwise.

3. Turn R7 full CCW; then adjust R7 in a CW direction until MARGIN LED just comes ON. The CARRIER ON/OFF LED will be ON and will be unaffected by the adjustment of R7.

NOTE

Step 3 adjusts the Receiver for 15 dB margin. If the user requires a margin setting other than 15 dB, the margin may be increased by adjusting jumper A and/or R7 to increase the level measured at TP2 of the Receiver module after completion of Step 3. An increase of 1 dB in level will increase the margin by 1 dB. By adjusting in this way, the MARGIN LED will remain ON until a decrease in received signal has reduced the margin to less than 15 dB. Similarly, the margin may be reduced (from 15 dB) by adjusting jumper A and/or R7 to decrease the level at TP2. Note however, that with margin settings of less than 15 dB, the MARGIN LED will not be ON. The MARGIN LED can be set for 15 dB margin only if the received signal level at the Shelf RF input connector J201 (10 watt equipment) or J90 (100 watt equipment) is 0.7 VRMS or greater. The CARRIER ON/OFF LED indicates a received relaying signal and is ON if the received signal margin is greater than or equal to zero dB.

4. The Receive Signal Level Meter is located on the front panel of the Shelf and should indicate zero dB when receiving a normal Full Power signal from the remote Transmitter. If adjustment is necessary, place the Receiver module in an Extender and adjust R95, located at the lower rear of the module, to provide a zero dB indication.

NOTE

In a system on a multi-terminal line (more than two terminals), the margin adjustment procedure of Section D should be performed using the weakest of the several received signals, as determined by the Receive Signal Level Meter indication or by measurement of the DC Voltage at Receiver TP 15.

ADDITIONAL MAINTENANCE INFORMATION
(by module)

Transmitter

The Transmitter frequency and jumper options are preset at the factory per customer's order. If a change is required, the programming procedure for the transmitter synthesizer is found later in this section. Option table Figure 5 lists the available jumper selections by function.

Transmitter keying is accomplished through current limiting resistors from the positive battery. The CS26C also has low voltage keying through J43. Battery keying voltage at the module connector should exceed +4 VDC.

The transmitter synthesizer operates from the receiver's 500 Hz reference signal and can be measured at TP1 (squarewave). TP2 is the output of the synthesizer which is twice the transmitter frequency (squarewave). TP16 and TP17 is the transmit carrier frequency (squarewave).

The synthesizer can be programmed for channel frequencies in 250 Hz steps from 30.5 kHz to 535.5 kHz.

The actual carrier output of the Transmitter module is at TP21. This signal is the unfiltered output of a mixer and contains all the odd harmonics of the fundamental.

TRANSMITTER SYNTHESIZER PROGRAMMING

CS26C/27C TRANSMITTER (line frequency):

NOTE

No two transmitters in the same line section may be operated at the exact same frequency, otherwise carrier phase cancellation will be automatic (in the receiver) with resulting failure to block. If more than one transmitter (up to 4) is to be used, then each must be programmed to a different one of the following offset-frequencies, F_c + 250 Hz, F_c - 250 Hz, F_c + 500 Hz and F_c - 500 Hz.

1. Listed below are the multiplying factors for the switch S1 and jumpers L and M:

S1-1	-	0.25
S1-2	-	0.5
S1-3	-	1.0
S1-4	-	2.0
S1-5	-	4.0
S1-6	-	8.0
S1-7	-	16.0
S1-8	-	32.0
S1-9	-	64.0
S1-10	-	128.0
L	-	256.0
M	-	512.0

2. Select the closest smaller multiplying factor to the desired line frequency and close that switch or jumper.

3. Subtract this factor from desired line frequency.

4. Select the closest smaller multiplying factor to the result in step 3 and close that switch.

5. Subtract this factor from results in step 3.

6. Repeat the procedures in steps 4 and 5 until result is zero.

7. Example:

   Desired Line Frequency - 300.5 kHz

   a. 300.5-256 = 44.5 Jumper L to 2-3
   b. 44.5-32 = 12.5 S1-8 Closed
   c. 12.5-8 = 4.5 S1-6 Closed
   d. 4.5-4 = 0.5 S1-4 Closed
   e. 0.5-0.5 = 0 S1-2 Closed

8. The jumpers J and K are used to change the capacitors in the PLL VCO circuit. The chart below shows the jumper positions for different frequency ranges:

FREQUENCY RANGE	JUMPER	
	J	K
30 kHz-100 kHz	1-2	1-2
101 kHz-300 kHz	1-2	2-3
301 kHz-535 kHz	2-3	2-3

The transmitter output level is measured at TP4 on the RF Interface module and is set using Jumper H and variable resistor R90 located on the rear of the Transmitter Module. An extender is necessary for this adjustment. Terminate the Power Amplifier into 50 ohms, key (START) the Transmitter and adjust the output voltage to read 22 VRMS at TP4 for 10 watts output. The level should not exceed 22 VRMS at TP4 on the Interface Module. The reduced power level is set 10 dB below the full power signal. This level is adjusted by using R63 in the Transmitter Module. The same procedure is followed as for full power except the reduced power function is keyed. (TB1-7 or 6)

The 10 watt equipment has a matching transformer located at the left rear of the shelf assembly. This transformer has taps for loads of 45, 50, 62, 75 and 82 ohms. The tap should be selected to present the closest impedance to 50 ohms at the transformer primary (10 watt filter output FL2 RF Interface). (See alignment section earlier.)

The 100 watt option uses the same adjustment except the output level is monitored at the RF output test point located on the lower left front of the 100 watt Power Amplifier. Terminate the Power Amplifier into 50 ohms and adjust the output voltage to read 70.7 VRMS.

The 100 watt Power Amplifier has an optional matching transformer (50, 75, 100, 125 and 150 ohms). It should also be adjusted to present 50 ohms to the Power Amplifier output.

Receiver

The Receiver carrier frequency is set on the channel frequency. The synthesizer can be programmed for channel frequencies in

500 Hz steps from 31.0 kHz to 535 kHz. The programming procedure is included in this section.

The Receiver has one normal adjustment, the receive signal margin. The MARGIN setting requires selecting Jumper A on the Receive Module for attenuation of 0, 6, 12, 18 or 24 dB, depending on receive signal strength. R7 located on the front of the Receiver Module is a trimmer between the 6 dB ranges. Jumper A and R7 are set so the MARGIN LED on the front of the module just energizes. This automatically establishes a margin of 15 dB.

The CARRIER ON/OFF LED indicates received relaying signal level and energizes if the receive signal equals or exceeds the minimum useable level at the RF receive connector (either J201 (10 watt) or J90 (100 watt). The sensitivity of the receiver is set at the factory, using R108. Also the margin detector threshold is set at the factory at 15 dB above the sensitivity threshold, using R142. In normal service R108 and R142 should not be adjusted. However, if required, the sensitivity can be re-established as shown on the Receiver Signal Level Diagram, 19B229890, Figure A.

The receive level meter indicator is located on the control panel and is factory adjusted for 0 dB scale reading for a normal 15 dB margin setting. If re-adjustment is necessary variable resistor R95 on the Receiver Module permits calibrating the indicator meter to 0 dB.

The receiver frequency synthesizer is programmed per ordering information. If a change is required, instructions provided later in this section should be followed. Jumper options are detailed in the Jumper Chart Figure 5 of this section.

CS26C/27C RECEIVER:

1. Listed below are the multiplying factors for the switch S1 and jumper H:

S1-1	-	0.5
S1-2	-	1.0
S1-3	-	2.0
S1-4	-	4.0
S1-5	-	8.0
S1-6	-	16.0
S1-7	-	32.0
S1-8	-	64.0
S1-9	-	128.0
S1-10	-	256.0
H	-	512.0

2. Select the closest <u>smaller</u> multiplying factor to the desired line frequency (F_C) and <u>close</u> that switch or jumper.

3. Subtract this factor from desired line frequency.

4. Select the closest smaller multiplying factor to the result in step 3 and close that switch.

5. Subtract this factor from result in step 3.

6. Repeat the procedures in step 4 and 5 until the result is zero.

7. <u>Example</u>:

   Desired Line Frequency - 215.5 kHz

a.	215.5-128 =	87.5	S1-9 Closed
b.	87.5-64 =	23.5	S1-8 Closed
c.	23.5-16 =	7.5	S1-6 Closed
d.	7.5-4 =	3.5	S1-4 Closed
e.	3.5-2 =	1.5	S1-3 Closed
f.	1.5-1 =	0.5	S1-2 Closed
g.	0.5-0.5 =	0	S1-1 Closed

8. The jumpers E and F are used to change the capacitors in the PLL VCO circuit. The chart below shows the jumper positions for different frequency ranges.

FREQUENCY RANGE	JUMPER	
	E	F
30 kHz-100 kHz	1-2	1-2
101 kHz-300 kHz	1-2	2-3
301 kHz-535 kHz	2-3	2-3

The receiver output Pin 7 is a transistor closure to common which is current limited from + battery by a resistor located on the back of the shelf. The output of Receiver is checked at TP16.

The receive signal can be monitored at TP4 and TP12. These signals are audio and should be equal in level and quadrature in phase. The rectified and combined signal is at TP14.

The CS26C has a 5V output located at Pin 12 for static relay applications.

Synthesizer checks:

TP9/10	Channel Frequency (squarewave)
TP17	Crystal Oscillator
TP18	Reference 1 kHz (squarewave)
TP19	Synthesizer Output (twice channel frequency squarewave)
Pin 5	Carrier to Voice (four times channel frequency narrow pulse)

RF INTERFACE

The RF Interface Module ties the Transmitter, Receiver, Power Amplifier and line together.

The receive test point TP1 contains the receive signal from the line after a band-pass filter and hybrid. The local transmit signal also appears at TP1 but with a much

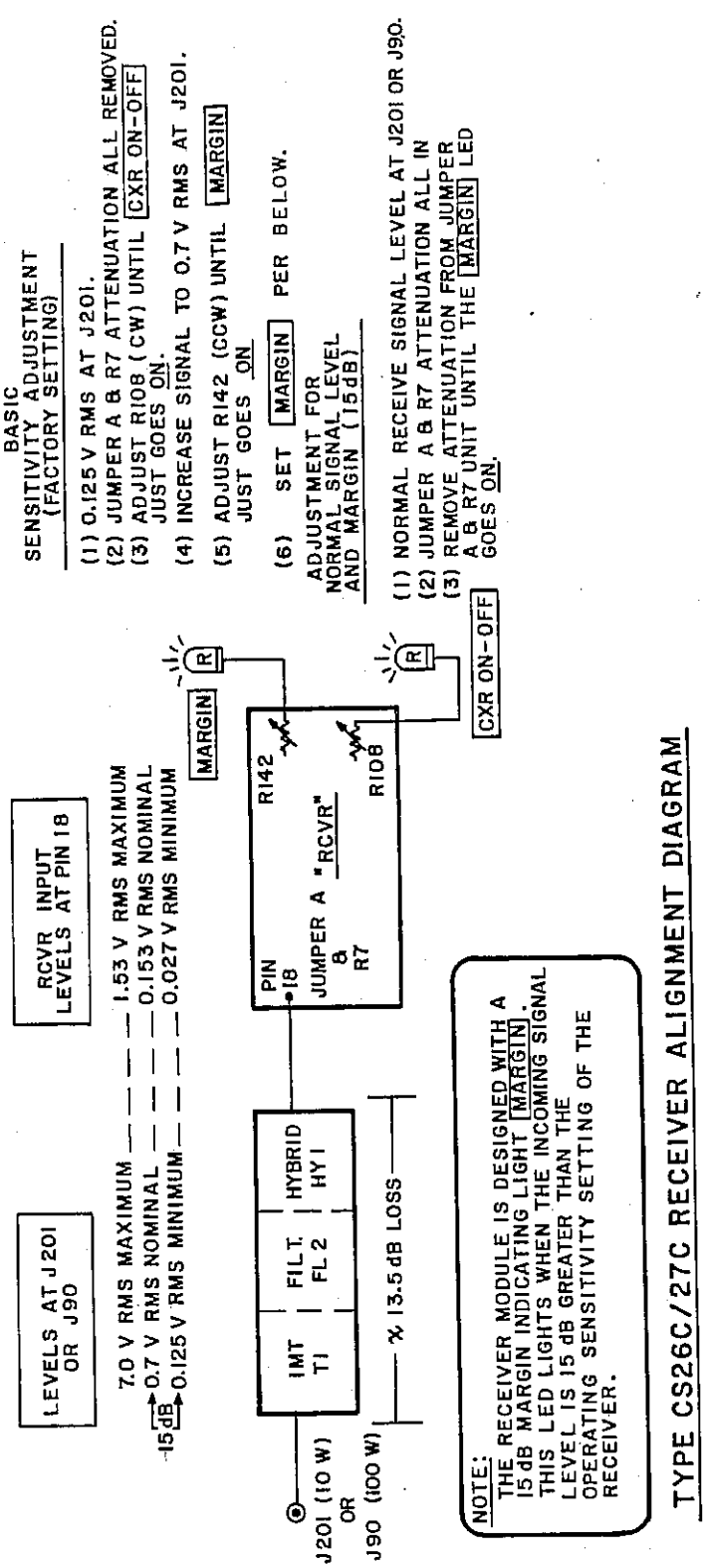


Figure A

RECEIVER ALIGNMENT DIAGRAM

(19B229890, Rev. 3)

higher harmonic content because of no filtering and mistermination of the hybrid at the harmonic frequencies.

The (10W OUT) test point TP4 is the output signal to the line through an isolation transformer (T1) located on the shelf. TP4 becomes a receive test point when the 100W option is applied. TP2 is the system common.

The bandpass filter in the RF Interface Module has 10 bands of frequencies (See Interface Module tab) and the Transmitter must be programmed for the installed band.

10 WATT POWER AMPLIFIER

The 10 Watt Power Amplifier has automatic protection which decreases the power consumption if an overload occurs. The output voltage at TP3 will pulse when in overload and the overload LED indicator will energize. Variable resistor R32 is factory set for the proper protection and full power indication. Refer to module instruction for additional information.

VOICE MODULE

The Voice Module is a simplex SSB system that uses phase cancellation for sideband rejection. The transmit output signal is at TP12. Signaling is done at 200 Hz which when modulated on the carrier results in a sideband 800 Hz from the carrier. A selective voltmeter is required to check the output signal.

The transmit carrier can be monitored at TP8-11 and the demodulation carrier at 1 kHz is at TP23-26. All modulation and demodulation mixers are suppressed carriers. Refer to the module instruction for detailed information.

The Voice Module has two adjustments, the send level adjust R6 and the receive level adjust R121. The send adjustment is preset at the factory. The receive level adjustment can be set for any desired level of voice from the handset. The audio signaling alert is disconnected when the handset is plugged into the audio jack on the control panel. The SSB voice is a simplex system requiring push-to-talk on the handset.

POWER SUPPLY

The Power Supply voltage is preset at the factory; however, if adjustment is necessary, the ±12 VDC (test point on control panel) can be set using R8 located in the Power Supply Module.

CHECKBACK (Option)

The Checkback has no adjustment except selecting the checkback automatic test interval. Switch S1 has 8 positions that selects a time from 1 hour (min.) to 255 hours (max.), for Master Checkback only. The switch positions are binary and count as follows:

TYPICAL TEST INTERVALS (Switch S1 Settings)

TEST INTERVAL	SWITCH POSITION 1 (1 Hr)	2 (2 Hr)	3 (4 Hr)	4 (8 Hr)	5 (16 Hr)	6 (32 Hr)	7 (64 Hr)	8 (128 Hr)
1 hour	C							
2 hours		C						
4 hours			C					
8 hours				C				
12 hours			C	C				
24 hours (1 day)				C	C			
48 hours (2 days)					C	C		
72 hours (3 days)				C			C	
168 hours (1 week)				C		C		C
240 hours (10 days)					C	C	C	C
255 hours (max.)	C	C	C	C	C	C	C	C

C = Switch closed with others open.

The Master Checkback clock is reset to zero by the push switch S2 (CLK RESET). The standard factory setting is for time slot #1 with the counter counting good test and the master not latching after a failed test. Reduced power is not included as a latching or count function.

For more than one Remote Checkback, refer to the jumper chart Fig. 5 of this section. Switch S3 (MANUAL TEST) initiates a test on the Master Checkback. S1 (MANUAL TEST) initiates a test from the Remote. Switch S4 (ALM RESET) resets the alarm on the Master. Switch S2 (ALM RESET) resets the Remote LED indicators. Refer to module instructions for additional information.

SERVICE HINTS FOR TRANSISTOR DIODE AND INTEGRATED CIRCUITS

Servicing solid state equipment requires some special techniques which can be easily acquired. The following hints are intended as a guide in developing these techniques.

The usual order for locating troubles is:

1. Use of symptoms discovered by eye and ear, simple realignment, and test jack readings to localize trouble.
2. Substitution of plug-in components in suspected stages.
3. Use of voltage readings, resistance readings, signal injection, realignment, sensitivity measurements, and gain measurements to further identify faulty components.
4. Replacement of suspected component.
5. Check out and adjustment of affected circuits.

Equipment using solid state components soldered directly to terminals require special treatment. Care must be taken to avoid overheating the devices while soldering; even others near the one being soldered can be damaged.

A heavy duty soldering iron should not be used. Make certain that the iron to be used does not have current leakage. An isolation transformer can be used to prevent current leakage. A low-wattage soldering iron must be used (consider 60 watts the absolute maximum).

Use a heat-sink (such as an alligator clip) on any transistor or diode lead being soldered.

Always check the circuit for defects which could damage the new device being placed into the circuit. Devices should never be removed or replaced while power is on, as a surge of current may damage them.

An easy way to remove molten solder from the holes in the board is to use a "solder-sucker". One type is called SOLDAPULLT and is made by EDYSN, INC. of Van Nuys, California, U.S.A.

A multi-lead component, such as an integrated circuit, should be removed from a printed circuit board by cutting all of its leads first, and then removing individually each piece of lead from its hole. This will prevent overheating of the board. In some cases, a broad-tip soldering iron can be used, if the number of leads is small - generally seven or less if closely spaced.

To replace transistors and diodes which are mounted on heat sinks, first remove the heat sink and bracket from the chassis by loosening the securing devices which hold them.

When replacing transistors using a heat sink, make certain that the transistor and the heat sink make firm and secure contact in order to provide good heat dissipation. A very light coating of DC4 (Dow-Corning 4 Compound Silicon Lubricant) is recommended for use with both transistors and diodes which use heat sinks.

SPECIAL PRECAUTIONS FOR METAL OXIDE SEMICONDUCTOR DEVICES (MOS)

Because of their high open circuit impedance, MOS devices are vulnerable to damage from static charges. Care must be taken in handling.

Even though protective devices are provided in most MOS device inputs, the protection is effective only against over voltage in the hundreds of volt range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the MOS circuits, decreasing the chance of damage.

To avoid damage to MOS devices, observe the following:

1. Momentarily touch both hands to bare metal earth grounded surface. This will discharge any static which may have accumulated on the person before the assembly. Due to static buildup from clothing, it may be necessary for the assembler to wear a ground strap during the assembly procedure.
2. Whenever possible avoid touching any electrically conductive parts of the circuit module with your hands.
3. When assembling a circuit module, avoid carpeted areas. Dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

4. All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the gound lead.

5. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through a resistance of approximately 100K.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

TEST EQUIPMENT PRECAUTIONS

Certain precautions are necessary to prevent damage to solid state components and circuits.

Signal generators, VTVM's and signal tracers should be of the transformer type which isolates the equipment from the power line. Use an isolation transformer whenever the test equipment uses a transformerless power supply.

Use a common ground between the transistor equipment and the chassis of the test equipment.

Use multimeters having a sensitivity of at least 20,000 ohms-per-volt. High currents from a meter of low sensitivity can damage solid state devices.

Take care when metering transistor circuits so as to avoid accidental short circuits which could cause damage. A base-to-collector short while a transistor is operating can ruin the transistor.

NOTE

Careful attention to the polarity of the meter leads should be given when testing transistors and diodes. In some meters, in the "OHMS" position, the internal battery is connected into the metering circuit so that its polarity is opposite to that indicated for voltage readings made with the meter leads. That is, with a meter of this sort, when measuring the forward resistance of a diode, instead of putting the positive lead on the anode and the negative lead on the cathode, the proper application would be to put the lead marked "negative" on the anode and the lead marked "positive" on the cathode. The GE Type 4CX5A and 4CX06A Meter Analyzer Unit is not of this type -- it has the same polarity in both voltage and resistance reading positions.

CAUTION

Inserting test prods into either the insulated holes of a connector plug or into the two-pronged blade terminals of a connector jack may cause damage.

To prevent damage to the connector terminals, a spare mating plug or jack should be inserted into the connector. Terminal numbers are now visible and test prods will not damage these (solder side) terminals.

REPAIR AND RETURN

The General Electric Company will repair and return faulty equipment modules. Contact the nearest GE Electric Utility Sales office for authorization instructions. If direct contact with the factory is urgent or necessary, call or write: Customer Service, Power Line Carrier Products Section, General Electric Company, Mountain View Road, Lynchburg, Virginia 24503, U.S.A.; Telephone 804*528-7190.

PARTS LIST NOTES

The Parts List for each unit or module includes all principal replacement parts. The symbol numbers used are the same as those appearing on schematics and other related diagrams.

The manufacturer's type numbers, when shown, are not necessarily direct replacements for the corresponding GE Part No.

When ordering a replacement part, please include description, symbol designation, and reference number of the part and ML- and PL-number of the unit or module. When reordering crystals and filters, also include the frequency. Orders may be sent to the nearest General Electric Company, Electric Utility Sales office or to General Electric Company, Power Line Carrier Products Section, Lynchburg, Virginia 24502.

The following is an explanation of the reference marks used in the parts lists:

Power Line Carrier equipment marked with a letter on or adjacent to the nameplate has had changes incorporated. The symbol * on the parts list indicates that this part or entry has been either added, deleted or changed according to production changes or alteration notices. The symbol ® on the parts list will indicate "Registered U.S. Patent Office".

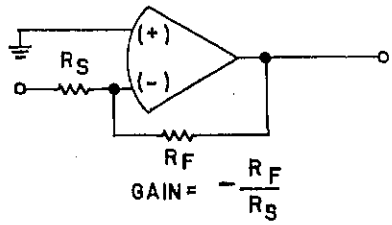
Table 1 - Relationship between Voltage Ratios and Decibel

DECIBEL DIFFERENCE IN VOLTAGE	VOLTAGE RATIOS	DECIBEL DIFFERENCE IN VOLTAGE	VOLTAGE RATIOS
0.0	1.00	17.5	7.5
0.5	1.06	18.0	7.94
1.0	1.12	18.5	8.41
1.5	1.19	19.0	8.91
2.0	1.26	19.5	9.45
2.5	1.33	20.0	10.0
3.0	1.41	20.5	10.6
3.5	1.49	21.0	11.2
4.0	1.58	21.5	11.9
4.5	1.68	22.0	12.6
5.0	1.78	22.5	13.3
5.5	1.88	23.0	14.1
6.0	1.99	23.5	14.9
6.5	2.11	24.0	15.8
7.0	2.24	24.5	16.8
7.5	2.37	25.0	17.8
8.0	2.51	25.5	18.8
8.5	2.66	26.0	19.9
9.0	2.81	26.5	21.1
9.5	2.99	27.0	22.4
10.0	3.16	27.5	23.7
10.5	3.35	28.0	25.1
11.0	3.55	28.5	26.6
11.5	3.76	29.0	28.2
12.0	3.98	29.5	29.9
12.5	4.22	30.0	31.6
13.0	4.46	30.5	33.5
13.5	4.73	31.0	35.5
14.0	5.01	31.5	37.6
14.5	5.31	32.0	39.8
15.0	5.62	32.5	42.2
15.5	5.96	33.0	44.6
16.0	6.3	33.5	47.3
16.5	6.68	34.0	50.1
17.0	7.08		

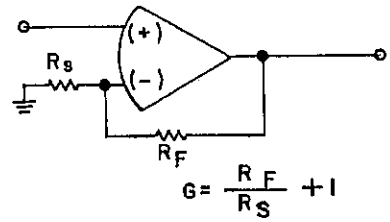
Table 2 - Conversion Table of Relative Values

(SCALE READING) dBsr	VOLTS RMS	POWER (dbm)		
		600 ohms	150 ohms	50 ohms
+40	77.5	+40	+46	+50.8
+30	24.5	+30	+36	+40.8
+20	7.75	+20	+26	+30.8
+10	2.45	+10	+16	+20.8
+ 6	1.55	+ 6	+12	+16.8
+ 3	1.10	+ 3	+ 9	+13.8
+ 2	0.975	+ 2	+ 8	+12.8
+ 1	0.869	+ 1	+ 7	+11.8
0	0.775	0	+ 6	+10.8
- 1	0.690	- 1	+ 5	+ 9.8
- 2	0.615	- 2	+ 4	+ 8.8
- 3	0.547	- 3	+ 3	+ 7.8
- 4	0.489	- 4	+ 2	+ 6.8
- 5	0.436	- 5	+ 1	+ 5.8
- 6	0.388	- 6	0	+ 4.8
- 7	0.346	- 7	- 1	+ 3.8
- 8	0.308	- 8	- 2	+ 2.8
- 9	0.275	- 9	- 3	+ 1.8
-10	0.245	-10	- 4	+ 0.8
-15	0.138	-15	- 9	- 4.2
-20	0.078	-20	-14	- 9.2
-25	0.044	-25	-19	-14.2
-30	0.025	-30	-24	-19.2
-35	0.014	-35	-29	-24.2
-40	0.008	-40	-34	-29.2

WHERE: dBm = dBsr + 10 log 600/R



AMPLIFIER



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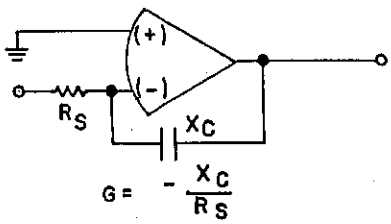
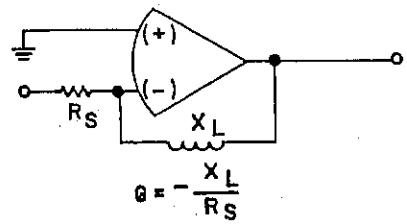
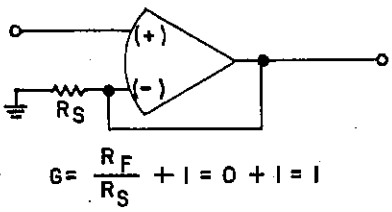


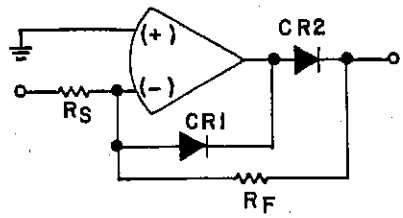
LOW PASS FILTER
OR
INTEGRATOR



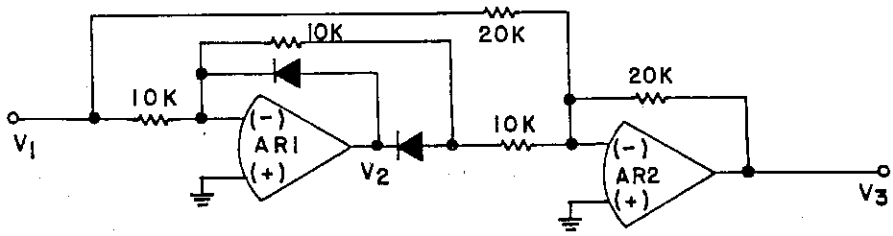
HIGH PASS FILTER
OR
DIFFERENTIATOR



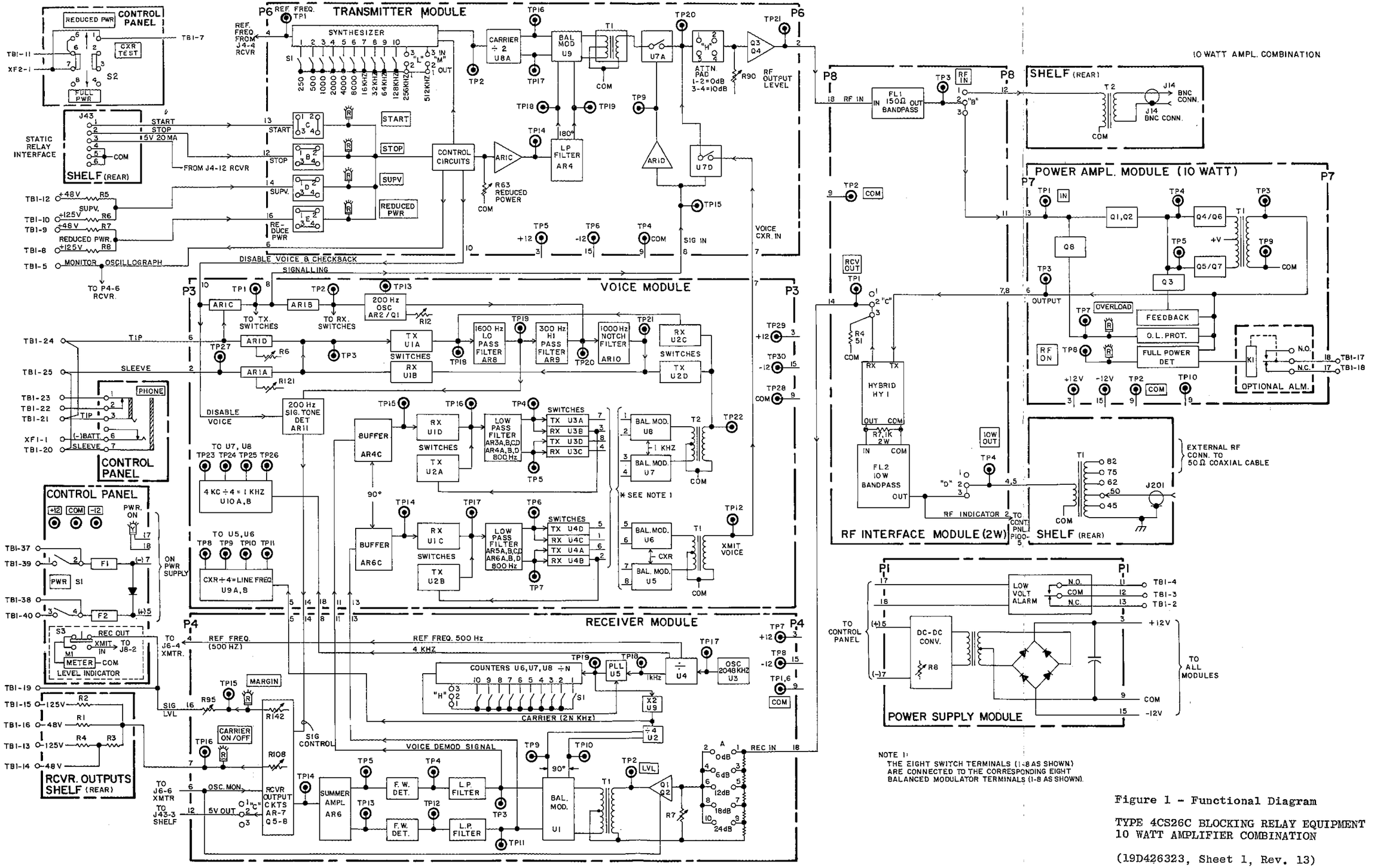
OP-AMP FOLLOWER



HALF WAVE RECTIFIER



FULL WAVE RECTIFIER

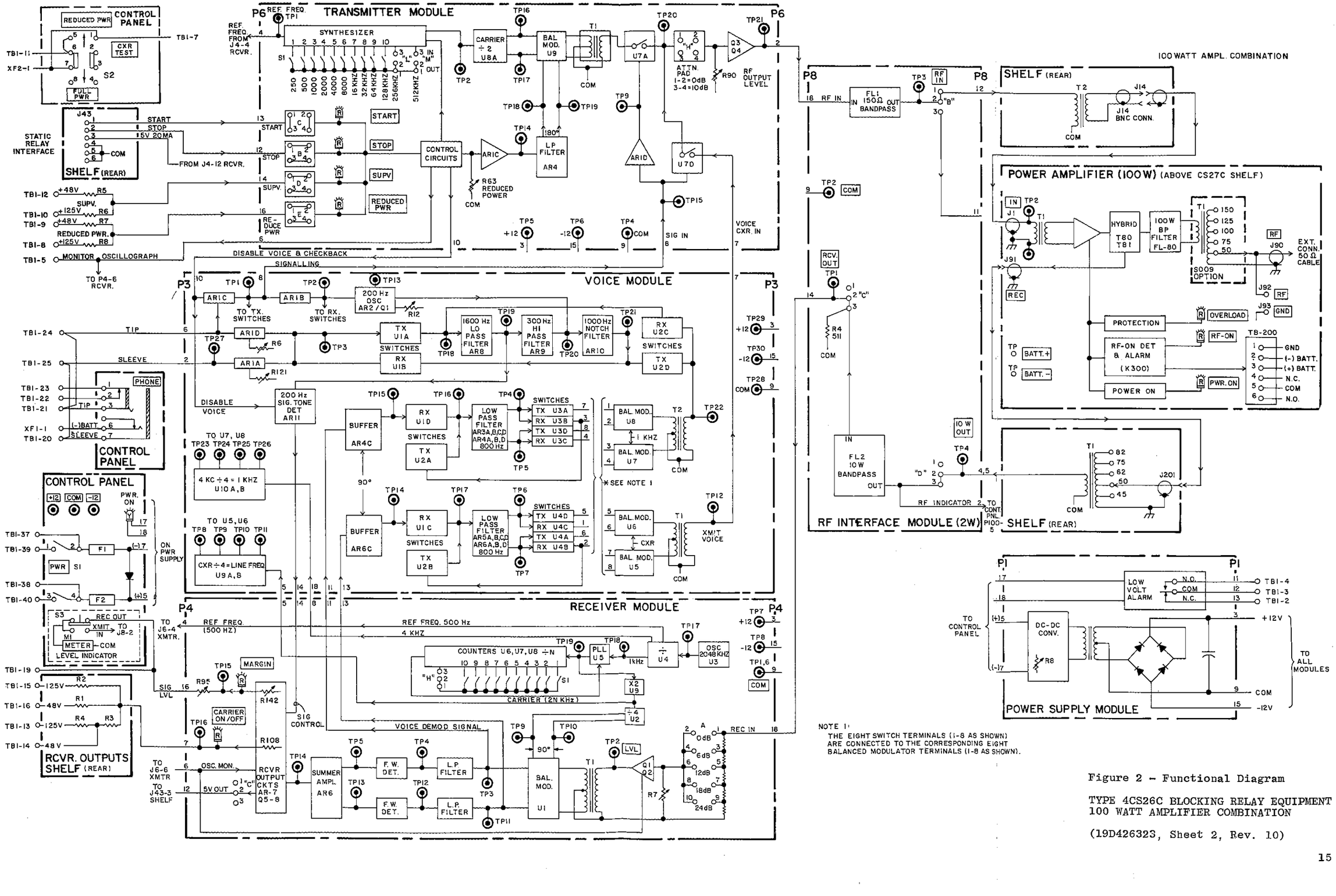


NOTE 1:
THE EIGHT SWITCH TERMINALS (1-8 AS SHOWN) ARE CONNECTED TO THE CORRESPONDING EIGHT BALANCED MODULATOR TERMINALS (1-8 AS SHOWN).

Figure 1 - Functional Diagram

TYPE 4CS26C BLOCKING RELAY EQUIPMENT
10 WATT AMPLIFIER COMBINATION

(19D426323, Sheet 1, Rev. 13)

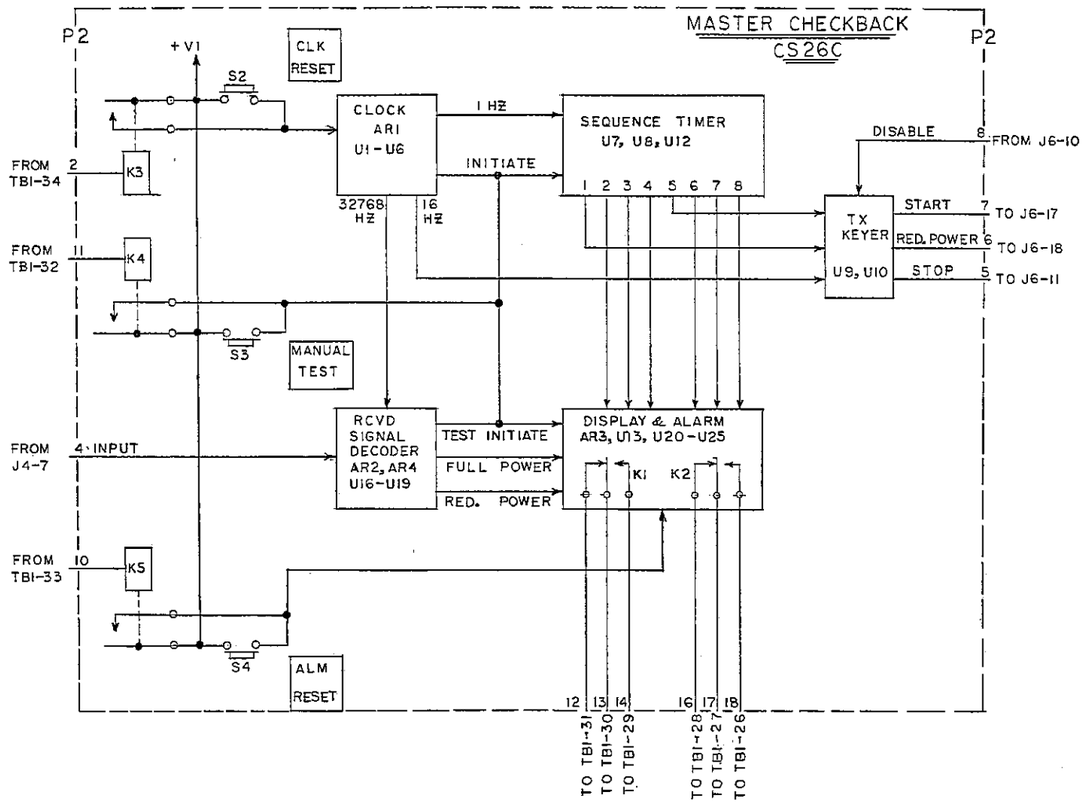


NOTE 1:
THE EIGHT SWITCH TERMINALS (1-8 AS SHOWN) ARE CONNECTED TO THE CORRESPONDING EIGHT BALANCED MODULATOR TERMINALS (1-8 AS SHOWN).

Figure 2 - Functional Diagram

TYPE 4CS26C BLOCKING RELAY EQUIPMENT
100 WATT AMPLIFIER COMBINATION

(19D426323, Sheet 2, Rev. 10)



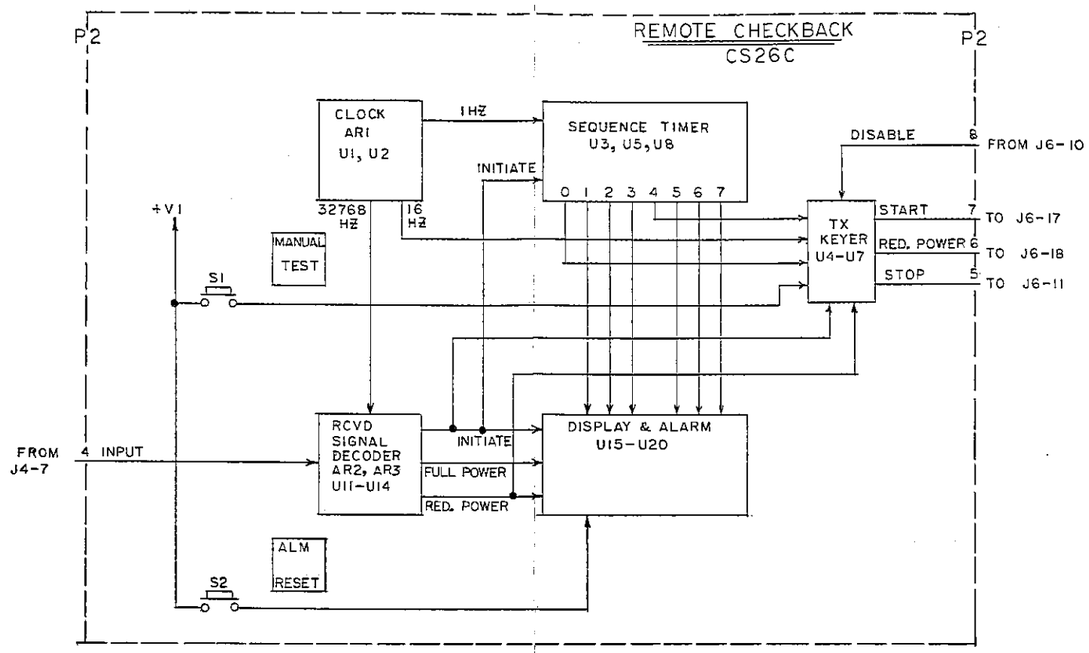


Fig. 2A - Functional Diagram

TYPE 4CS26C BLOCKING RELAY EQUIPMENT
MASTER/REMOTE CHECKBACK
(19D426323, Sheet 3, Rev. 0)

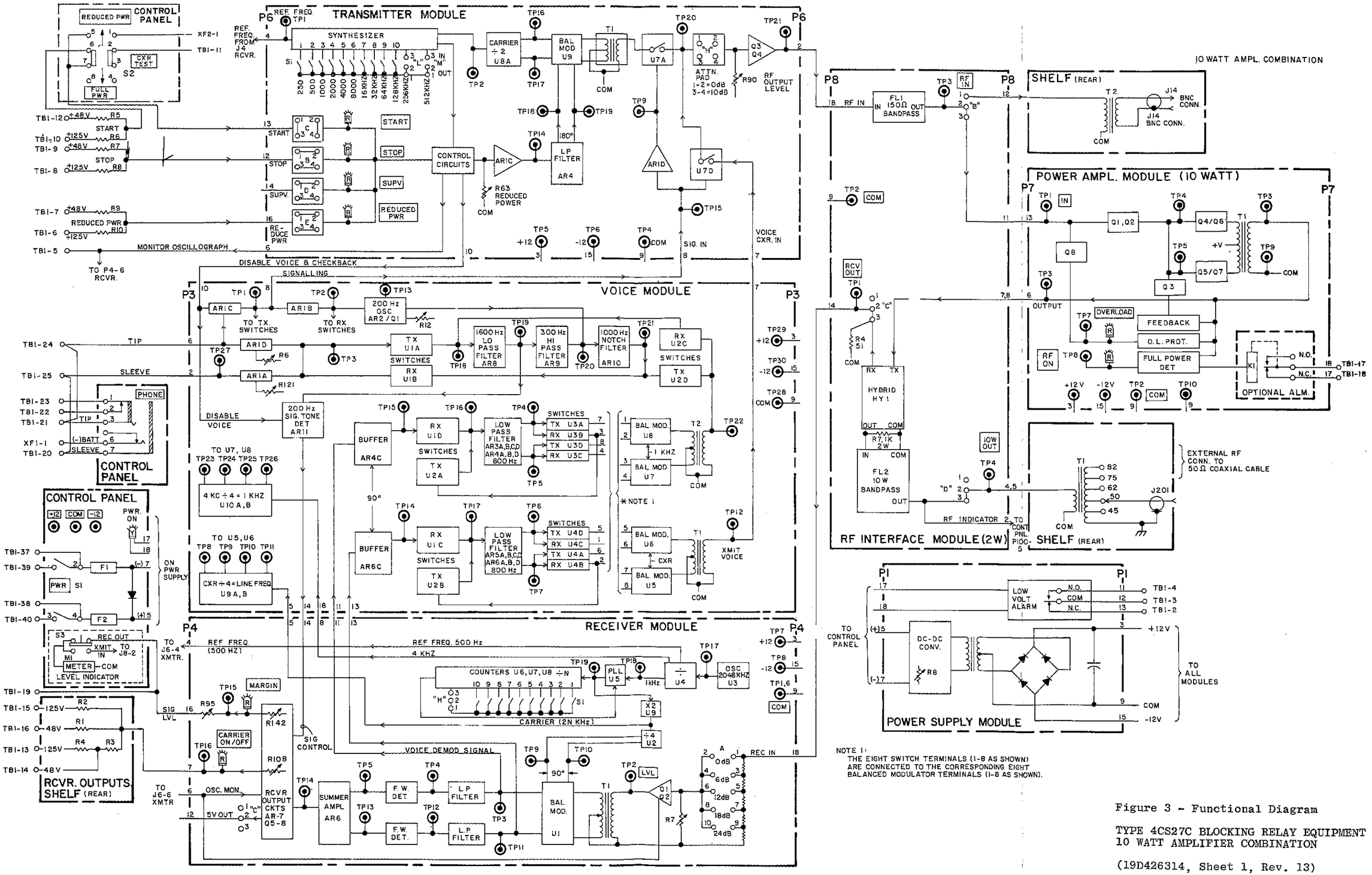
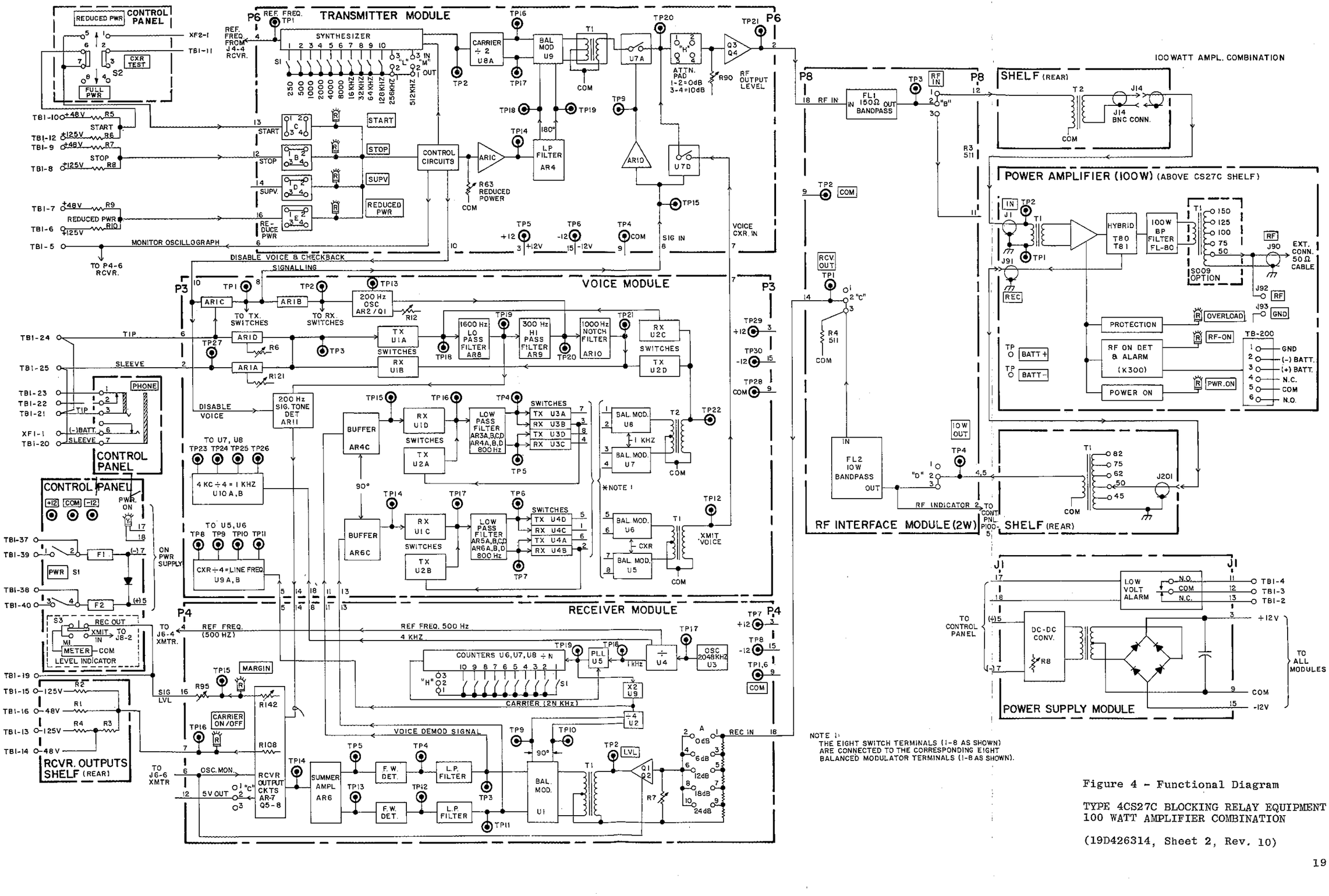


Figure 3 - Functional Diagram

TYPE 4CS27C BLOCKING RELAY EQUIPMENT
10 WATT AMPLIFIER COMBINATION

(19D426314, Sheet 1, Rev. 13)

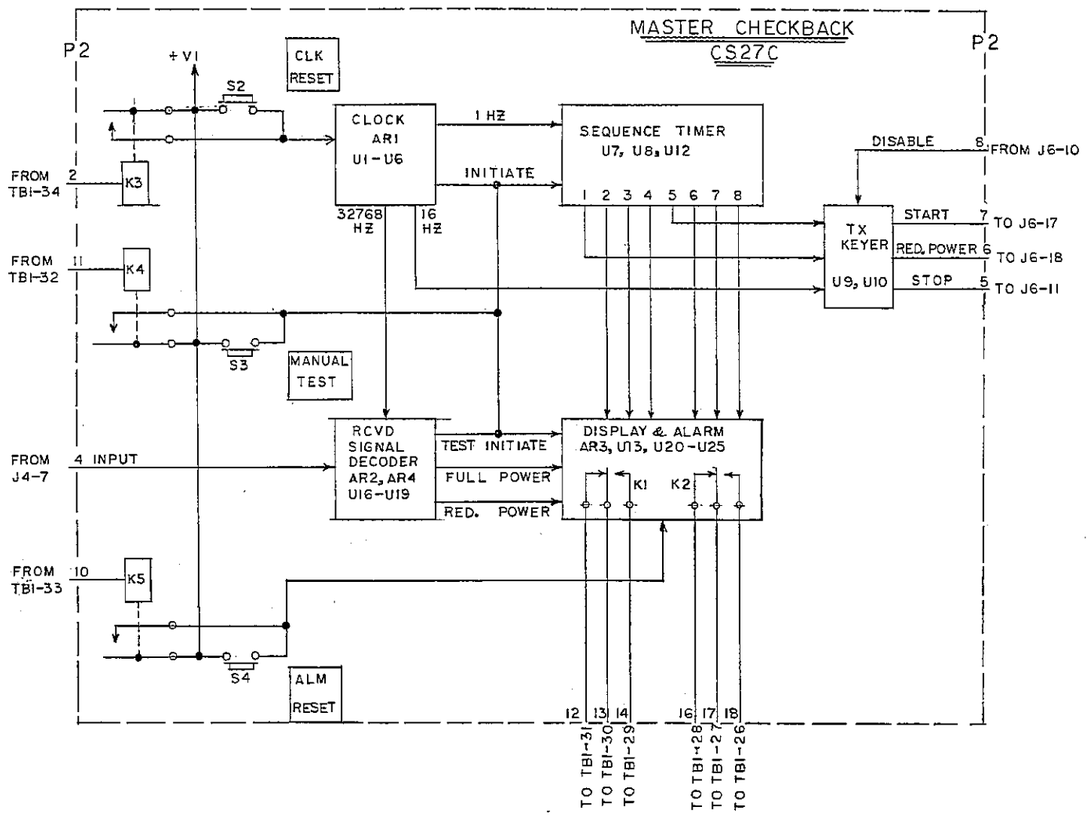


NOTE 1:
THE EIGHT SWITCH TERMINALS (1-8 AS SHOWN) ARE CONNECTED TO THE CORRESPONDING EIGHT BALANCED MODULATOR TERMINALS (1-8 AS SHOWN).

Figure 4 - Functional Diagram

TYPE 4CS27C BLOCKING RELAY EQUIPMENT
100 WATT AMPLIFIER COMBINATION

(19D426314, Sheet 2, Rev. 10)



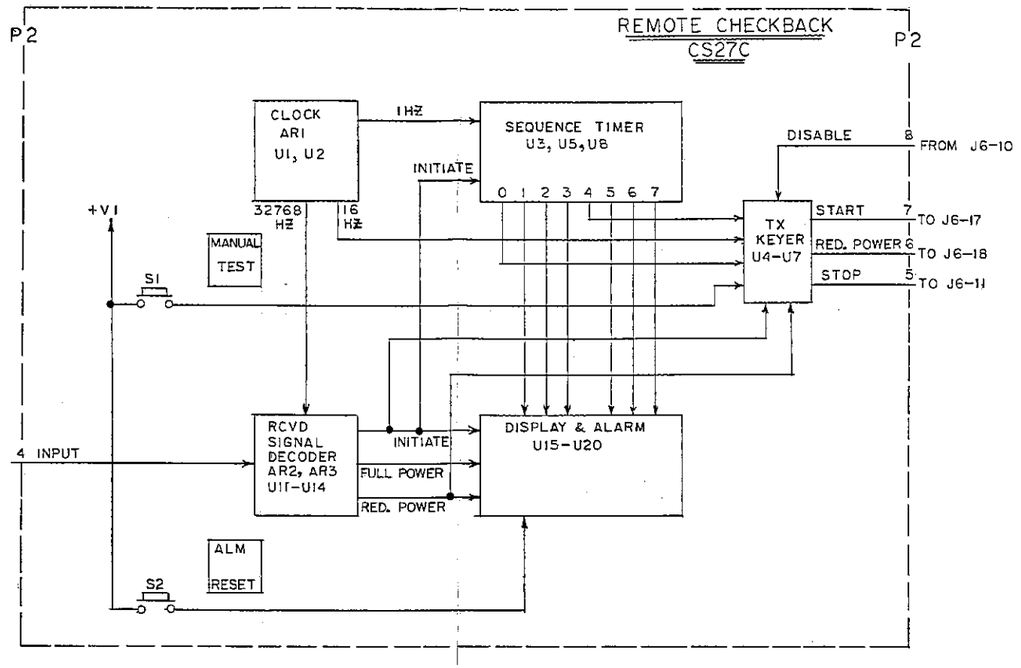


Fig. 4A - Functional Diagram

TYPE 4CS27C BLOCKING RELAY EQUIPMENT
MASTER/REMOTE CHECKBACK
(19D426314, Sheet 3, Rev. 0)

TRANSMITTER MODULE

JUMPER	POSITION	FUNCTION
A	1-2	COMMON TO NEG. BATT.
B	1-2 3-4	*STOP +VOLTAGE KEYED
	1-3 2-4	STOP 0 VOLTAGE KEYED
C	1-2 3-4	START + VOLTAGE KEYED
	1-3 2-4	*START 0 VOLTAGE KEYED
D	1-2 3-4	* SUPV. + VOLTAGE KEYED
	1-3 2-4	SUPV. 0 VOLTAGE KEYED
E	1-2 3-4	* REDUCED PWR. + VOLTAGE KEYED
	1-3 2-4	REDUCED PWR. 0 VOLTAGE KEYED
F	1-2 2-3	CS26C CS27C
G	1-2 2-3	CS26C CS27C
H	1-2 2-3	0 dB ATTENUATION 6 dB ATTENUATION
JUMPERS J-K-L-M SWITCH POSITION S1, 1-10 REFER TO ALIGNMENT AND MAINTANANCE SECT.		TRANSMITTER FREQUENCY PROGRAMING

* STANDARD

RF INTERFACE MODULE

JUMPER	POSITION	FUNCTION
A	2-3	* 10 WATT, 2 WIRE SYSTEM APPLICATION
B	2-3	
C	2-3	
D	2-3	
A	1-2	* 100 WATT, 2 WIRE SYSTEM APPLICATION
B	1-2	
C	2-3	
D	2-3	
A	2-3	10 WATT, 4 WIRE HIGH IMPEDANCE BRIDGING APPLICATION
B	2-3	
C	1-2	
D	2-3	
A	1-2	100 WATT, 4 WIRE HIGH IMPEDANCE BRIDGING APPLICATION
B	1-2	
C	1-2	
D	1-2	

* STANDARD

RECEIVER MODULE

JUMPER	POSITION	FUNCTION
A	1-2	0 dB ATTENUATION
	3-4	6 dB ATTENUATION
	5-6	12 dB ATTENUATION
	7-8	18 dB ATTENUATION
	9-10	24dB ATTENUATION
B	1-2	* 5V OUTPUT UPRIGHT SENSE
	2-3	5V OUTPUT REVERSE SENSE
C	1-2	* COMMON TO NEG. BATTERY
	2-3	COMMON TO POS. BATTERY
E F		SEE TEXT FOR FREQUENCY SETTING
G		NOT USED
H		SEE TEXT FOR FREQUENCY SETTING

* STANDARD

CHECKBACK (MASTER) MODULE

JUMPER	POSITION	FUNCTION
A	1-2	USED FOR FACTORY TEST
	2-3	* NORMAL SETTING
B	1-2	* COUNTER COUNTS GOOD TESTS
	2-3	COUNTER COUNTS FAILED TESTS
C	1-2	* NORMAL SETTING
	2-3	USED FOR FACTORY TEST
D	1-2	FULL PWR. REMOTE 1 DISABLE
	2-3	* FULL PWR. REMOTE 1 ENABLE
E	1-2	FULL PWR. REMOTE 2 DISABLE
	2-3	FULL PWR. REMOTE 2 ENABLE
F	1-2	FULL PWR. REMOTE 3 DISABLE
	2-3	FULL PWR. REMOTE 3 ENABLE
G	1-2	REDUCED PWR. REMOTE 1 DISABLE
	2-3	* REDUCED PWR. REMOTE 1 ENABLE
H	1-2	REDUCED PWR. REMOTE 2 DISABLE
	2-3	REDUCED PWR. REMOTE 2 ENABLE
J	1-2	REDUCED PWR. REMOTE 3 DISABLE
	2-3	REDUCED PWR. REMOTE 3 ENABLE
K	1-2	CS27C
	2-3	CS26C
L	1-2	* REDUCED PWR. TEST NOT INCLUDED IN CTR.
	2-3	REDUCED PWR. TEST INCLUDED IN CTR
M	1-2	CHECKBACK LATCH FOR FAILED TEST
	2-3	* CHECKBACK NOT LATCHED FOR FAILED TEST

* STANDARD

CHECKBACK (REMOTE) MODULE

JUMPER	POSITION	FUNCTION
A	1-2	NOT USED
	2-3	* CS26C & CS27C
B	1-2	* FULL POWER REPORT BACK REMOTE #1
	3-4	FULL POWER REPORT BACK REMOTE #2
	5-6	FULL POWER REPORT BACK REMOTE #3
C	1-2	* REDUCED POWER REPORT BACK REMOTE #1
	3-4	REDUCED POWER REPORT BACK REMOTE #2
	5-6	REDUCED POWER REPORT BACK REMOTE #3
** D	1-2	DISABLE REMOTE #1 FULL POWER
	2-3	ENABLE REMOTE #1 FULL POWER
** E	1-2	DISABLE REMOTE #2 FULL POWER
	2-3	ENABLE REMOTE #2 FULL POWER
** F	1-2	DISABLE REMOTE #3 FULL POWER
	2-3	ENABLE REMOTE #3 FULL POWER
** G	1-2	DISABLE REMOTE #1 REDUCED POWER
	2-3	ENABLE REMOTE #1 REDUCED POWER
** H	1-2	DISABLE REMOTE #2 REDUCED POWER
	2-3	ENABLE REMOTE #2 REDUCED POWER
** J	1-2	DISABLE REMOTE #3 REDUCED POWER
	2-3	ENABLE REMOTE #3 REDUCED POWER
K	1-2	NORMAL SETTING
	2-3	USED FOR FACTORY TEST

* STANDARD

**
NOTE:

1. ALL REMOTE LIGHTS ARE NORMALLY STRAPPED OUT (JUMPERS D,E,F,G,H,J). SYSTEM APPLICATION MAY REQUIRE REMOTE LIGHTS TO BE STRAPPED IN FOR REMOTE TIME SLOTS, EXCEPT THE LOCAL TIME SLOT. FOR EXAMPLE, A FOUR ENDED SYSTEM WOULD HAVE REMOTE LIGHTS 2 AND 3 STRAPPED IN FOR REMOTE 1, BUT SLOT 1 STRAPPED OUT.
   ALERT IF THE LOCAL TIME SLOT IS STRAPPED IN (FOR EXAMPLE, TIME SLOT 1 IN REMOTE 1), THEN THE FULL POWER LIGHT WILL FLASH WHEN REMOTE 1 RESPONDS AND THEN CLEAR. THE REDUCED POWER LIGHT MAY OR MAY NOT FLASH AND MAY NOT CLEAR. THE RECEIVED LOCAL SIGNAL IS A FUNCTION OF THE HYBRID TERMINATION. A GOOD HYBRID TERMINATION HAS HIGH ISOLATION, WHICH REDUCES THE LOCAL SIGNAL LEVEL; THEREFORE, A GOOD TERMINATION MAY RESULT IN INSUFFICIENT SIGNAL TO FLASH AND CLEAR THE REMOTE'S LIGHT. A POOR TERMINATION HAS LESS ISOLATION WHICH INCREASES THE RECEIVE SIGNAL LEVEL.

SYSTEM JUMPER CHART

Figure 5
System Jumper Option Chart

TYPE 4CS26C/4CS27C
BLOCKING RELAY EQUIPMENT

(19D426578, Rev. 3)

RECOMMENDED TEST EQUIPMENT

The proper installation, checkout and maintenance of power line carrier systems require that customer maintenance personnel be equipped with adequate test equipment. The purpose of this section is to assist in determining test equipment requirements.

ORDERING TEST EQUIPMENT

Test equipment can be purchased directly from the manufacturer or through the General Electric Company. The timely ordering of the required equipment is important, due to the long delivery cycle of some test equipment manufacturers.

RECOMMENDED TEST EQUIPMENT

The test equipment recommended for the adjustment, troubleshooting and maintenance of General Electric power line carrier systems is listed in the following table. Wherever possible, the same test equipment models have been recommended for the maintenance of all of the equipment covered.

Most customers will need only the "Reqd" (required) test equipment. This is the equipment necessary for placing the system in operation and troubleshooting to the unit or component level. Faulty units can be repaired locally or returned to General Electric for repair under the Repair & Return Program. Test equipment listed as "Opt" (optional) is not required, but will greatly facilitate troubleshooting the designated equipment. Since many customers already have some of the required test equipment, or equivalent, a customer's test equipment inventory should be checked before additional equipment is ordered.

POWER SOURCES

GE Test Set CX-06A is powered by the associated SSB rack. With the exception of the GE Type CX-06A, the Hewlett-Packard Type 1645A and the Triplett Model 630, all of the test equipment listed in the table will operate from 115/230-Vac, 50/60-Hz power or from self-contained battery packs.

Item	For Servicing (NOTE 1)				Recommended Test Equipment (or Equivalent)	Function
	Relaying Eq	SSB PLC	Telephone	Line Equip		
1	---	Opt NOTE 2	---	---	TEST PANEL: GE Type CX-06A. Test set can be used in other PLC racks if they are equipped with test shelf. Refer to Apparatus Handbook Section 6415 for ordering information.	• Audio oscillator: test tone source & service channel signaling source. • AC voltmeter: checking input and output levels and noise levels. • DC voltmeter: checking power supply and general maintenance. • Service channel: for communication between terminals during test and alignment over any SSB channel.
2	Reqd	Reqd	Reqd	Reqd	VOM: Triplett Model 630PL or METER-ANALYZER: GE Type CX-5A. Refer to Apparatus Handbook Section 6551 for ordering info.	General troubleshooting. GE meter-analyzer can be used in other racks if they are equipped with mounting frames. The meter-analyzer also measures rf milliamperes (250, 500 and 1000 mA ranges).
3	Opt	Reqd	Reqd	Opt	AC VOLTMETER: Hewlett-Packard Model 400EL with dB scale Option 001	Checking input and output levels and noise levels.
4	Opt	Reqd	Opt	Reqd	TEST OSCILLATOR: Hewlett-Packard Model 204C with Rechargeable Battery Pack Option 002	Test signal source.
5	Reqd	Reqd	Reqd	Reqd	FREQUENCY-SELECTIVE VOLTMETER (wave analyzer): Rycom Model 6021-50 with carrying case Model 3063	Checking all signal levels at audio, baseband and line frequencies (audio to 500 kHz with input power up to 100 watts). Carrying case recommended to protect the voltmeter.
6	Opt	Opt	Opt	Opt	FREQUENCY COUNTER: Hewlett-Packard • Main Frame Model 5300A • Counter Module 5304A • Rechargeable Battery Pack Model 5310A	Checking frequencies in the range of audio to 16 MHz. Since the Rycom 6021 contains a digital counter, the use of a separate frequency counter is optional.
7	Reqd	Reqd	---	Opt	NON-INDUCTIVE LOAD: Ohmite Model D101 (specify 52-ohm)	For loading transmitters.
8	Opt	Opt	Opt	---	CATHODE RAY OSCILLOSCOPE: Tektronix Type Numbers • Main Frame 5103N/D10 • Vertical Amp 5A15N • Time Base 5B10N • Blank Panel 016-0195-00 • 10X Probe P6006	Waveform analysis. The Tektronix package listed at left can be expanded to meet present or future requirements for a DC to 2-MHz device.

CONTINUED

INSTRUCTIONS

EXTENDER TEST BOARD
PL-19D427767G1, REV. A

DESCRIPTION

The Extender Test Board, PL-19D427767G1, provides extended connections for testing all Type 40 Tone, Type 45 MULTI-COM and Type 4CS26C/27C Blocking Carrier modules in the Shelf Unit thus, the module will be in the system electrically, yet be removed physically for troubleshooting or maintenance.

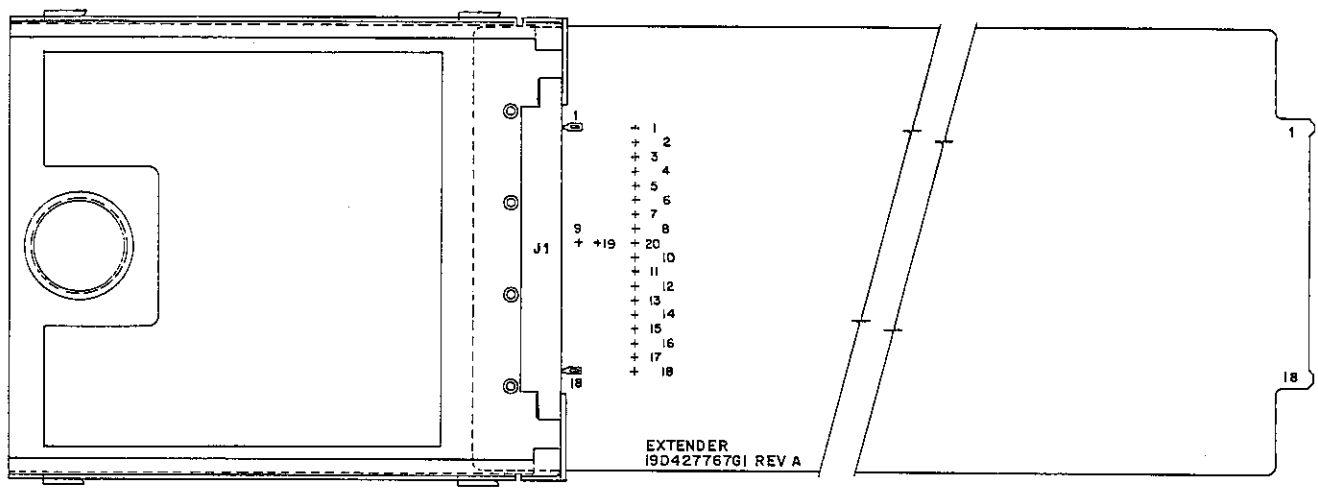
The Extender Test Board consists of a printed circuit card which will mate with the printed circuit-type connectors (18-contacts, one-part printed wiring; sim Elco Corp. Cat. No. 00-6007-015-940-002) mounted on the Shelf Unit.

Connector J1, mounted on the Extender Test Board, is also an 18-contact connector into which the modules to be tested will be inserted.

PARTS LIST

EXTENDER TEST BOARD
PL-19D427767G1

Symbol	GE Part No.	Description
		- - - - - - - - - CONNECTOR - - - - - - - - -
J1	19A116505P7	Printed wiring, one-part; 18-contacts; single wire hole; sim Elco 00-6007-018-940-002.



(19C326595, Rev. 2)

Figure 1 - Pictorial Diagram

PRODUCTION CHANGES

EXTENDER BOARD
PL-19D427767G1

The revisions listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D427767G1, Rev. A

Purpose: Standardization - To allow Extender Board to be used with Type 4CS26C and 4CS27C Blocking Relay Equipment in addition to the Type 40 Tone Equipment.

Part Changed	Was	Changed To
Support	19C326568P1	19C329797P1
- - - -	- - - - -	Add new pattern, GE Part No. 19A133852

RECOMMENDED TEST EQUIPMENT (Continued)

Item	For Servicing (note 1) Relaying Eq	SSB PLC	Telephone	Line Equip	Recommended Test Equipment (or Equivalent)	Function
9	---	Opt	Opt	---	PULSE SIGNALING TEST SET: Northeast Model TTS-26B	Sends pulses generated by built-in oscillator or external source. Measures % break and speed of pulses transmitted or received. % break of pulses transmitted can be varied over wide range, speed can be varied in 7 discrete steps.
10	Opt	Opt	---	Opt	DIRECTIONAL WATTMETER: Alltech Model 804A	Used for rf impedance matching.
11	Opt	---	Opt	---	DATA ANALYZER: Hewlett-Packard Model 1645A	Used with tone equipment only for analyzing data distortion and error rate.
12	Opt	Opt	Opt for ECS	---	MODULE EXTENDERS: refer to Apparatus Handbook for ordering information (1 per location)	Recommended for equipment which uses plug-in modules Used to extend modules for access to circuits while operating.
13	---	---	Req'd PLS-100 only	---	DIAGNOSTIC TEST MODULE: Option U001 for PLS-100 only (1 per location)	Plugs onto line processor for quickly checking operation of all PLS-100 circuits

NOTE 1: EXAMPLES OF EQUIPMENT

- Relaying Equipment: CS-26, CS-27 and Types 30, 40, 51, 61 and 71
- SSB PLC: CART Single-Sideband Power Line Carrier
- Telephone Equipment: PLS-100 Party Line Selector, ECS (Electronic Call Selector) phones and ringing sets
- Line Equipment: line traps, coupling capacitors, CCVTs and line tuners

NOTE 2: Test Panel Type CX-06A can be used in lieu of items 2, 3 and 4.

ADDRESSES OF VENDORS

Alltech Division of Cutler-Hammer
19535 East Walnut Drive
City of Industry, CA 91748

Hewlett-Packard Company
1501 Page Mill Road
Palo Alto, CA 94304

Northeast Electronics Corporation
P.O. Box 649
Airport Road
Concord, NH 03301

Ohmite Manufacturing Company
3601 Howard Street
Skokie, Illinois 60076

Rycom Instruments, Inc.
9351 East 59th Street
Raytown, Missouri 64133

Tektronix, Incorporated
14150 S.W. Karl Braun Drive
P. O. Box 500
Beaverton, Oregon 97005

Triplett Corporation
Bluffton, Ohio 45817

MODULE DESCRIPTION

GENERAL

This module description section of the instruction book contains complete information on each module used in a particular equipment model; namely, Description, Parts List, Production Change Sheet (if applicable), and a Parts Layout Diagram (see the nameplate on the equipment for exact model number). It should be noted that the individual module instructions may include descriptions and information on more than one group of that module. By use of the model number on the equipment nameplate and the nomenclature table found in the GENERAL DESCRIPTION section, identification of the particular module group can be determined.

Reference to the interconnection or arrangement diagrams will also identify the specific module group involved.

Note that the elementary diagrams are found with the module description text.

The module description text describes the electrical operation of that module and further contains a "Troubleshooting Aids" section for servicing the module, consisting of typical voltage readings and nominal operating characteristics.

REPAIR AND RETURN

The General Electric Company will repair and return a faulty module if the customer so desires. If so, contact the nearest General Electric Company Power Transmission and Distribution Sales Office for authorization.

PARTS LIST NOTES

The parts list for each unit or module includes all principal replacement parts. The symbol numbers used are the same as those appearing on elementary and other related diagrams.

The manufacturers' type numbers, when shown, are not necessarily direct replacements for the corresponding GE part number.

When ordering a replacement part, please include description, symbol designation, and reference number of the part and ML- and PL- number of the unit or module. When reordering crystals and filters, also include the frequency. Orders may be sent to the nearest General Electric Power Company Transmission and Distribution Sales Office.

The following is an explanation of the reference marks used in the parts lists:

Power Line Carrier equipment marked with a letter on or adjacent to the nameplate has had changes incorporated. The symbol, *, on the parts list indicates that this part or entry has either been added, deleted, or changed according to production changes or alteration notices. The symbol Ⓡ on the parts list will indicate "Registered U.S. Patent Office."

INSTRUCTIONS

TYPE CS26C/27C SHELF
PL-19D428833G1 and -G2, REV. A

GENERAL

The CS26C/27C Shelf Unit consists of a three rack unit (1 RU - 1.75") card holding chassis along with a 1 RU control panel section. Each shelf accepts eight plug-in modules with eighteen contacts which mate with keyed jacks at the rear of the shelf. The rear of the shelf has two 20 point, 15 ampere, #6 screw terminal boards for customer connections. Interconnecting cables are provided for a fixed rack or open rack application. For swing rack cabinet application customer terminal boards, RA, RB, are mounted on the cabinet and interconnected to the shelf with a cable.

The Nomenclature Chart found in the General Section will identify the factory shelf wiring for the customer ordered function per the model number stamped on the equipment nameplate found inside the shelf front door.

The control panel is the top section of the shelf and contains the operating functions of the equipment along with the keying resistors.

The two mounting rail positions are available, one for flush mounting, the other with the mounting rail located 6 13/16 inches (113.04 mm) from the shelf front. The shelf requires 12.75 inches (323.85 mm) deep, measured from the mounting surface.

The lower 3 RU of the shelf is accessed by a bottom hinged door equipped with two sliding fasteners.

The modules are of the printed wire, plug-in type, using redundant circuit connections which will mate with redundant bifurcated shelf connectors. The shelf connectors are keyed to prevent accidental insertion of the wrong modules.

DESCRIPTION

The CS26C and CS27C has three basic shelves, the CS26C (-G1) is shown on Schematic 19D428983, the CS27C (-G2) is shown on Schematic 19D428984 and the CS27C unblocking (-G3) is shown on Schematic 19D426950. The shelves are identical except the interface connections are different. Each shelf is wired as standard to accept the voice, checkback and unblocking options. Note: The voice and checkback options are not used with the unblocking option (-G3 shelf). Keying resistors are mounted inside the control panel and the receive output circuit current limiting resistors are mounted on the rear of the shelf.

NOTE

For 48 VDC and 125 VDC operation, the input keying connections for both the CS26C/CS27C are made directly to the appropriate TB1 terminal board connections (or to RA, RB on the cabinet wall).

For 250 VDC operation, an additional 250 VDC Regulator module must be used and is mounted directly below the CS26C/CS27C shelf. Refer to Schematic Diagram 19B229868 in LBI-7700 (CS27C) or to 19B229889 in LBI-18033 (CS26C) in this section for wiring connections.

The CS26C interfaces with static relays through J43, also located on the rear of the shelf. TB1 is the customer interface and contains 40 terminals.

The RF output connectors are found on the left rear of the shelf. Two coaxial connectors J201 (UHF) and J14 (BNC) interface either with the line or a 100 watt amplifier respectively. The output transformer T1, is a tapped isolation transformer that provides output matching impedances of nominally 50 and 75 ohms with trimmers of 82, 62 and 45 ohms. A moveable strap sets the impedance.

The control panel front contains the power ON-OFF switch with battery plus and minus fuses. The power supply ±12V power indicator (yellow LED) is mounted beside the ±12V test points. The voice handset jack is provided at the right of the control panel and is always wired. Also located on the front panel is an RF power switch S2, This is a three position, spring return to center switch. Operating the switch, to the right, applies full power to the output and reduced power to the output, when operated to the left. A metal locking tab is provided to lock the switch in the full or reduced power position. In the CS26C Shelf, full power position is wired into the supervisory circuit. In the CS27C Shelf it interrupts the start voltage. The Carrier Alarm Disable Switch, located on the front panel, interrupts the Audible Alarm Circuit when operated to the left.

NOTE

When Actuating Switch S2 (CXR TEST) for reduced power, make certain the Actuating Knob is pushed to its maximum travel position to avoid inadvertent full power keying.

ALARM/INDICATOR (Signal Level Monitor)

The INDICATOR part of this equipment contains a front panel meter with associated circuitry to provide relative indication of both receive and transmit signal levels. The meter is switched from receive level to transmit level by a spring loaded push button switch adjacent to the meter. Normal "out" position provides the receive level reading REC OUT.

The receive level is derived directly from the receiver output circuits as a DC current proportional to the receive signal level on -G1 and -G2. In -G3 (unblocking option), the receive level is derived from the alarm receivers. The transmit level is tapped off the transmitter output through a resistor divider in the power amplifier module.

The receive level is applied to the meter M1 through P100-4 and switch S3. Refer to Shelf Schematic & Interconnection diagram later in this section. The normal receive signal reading is adjusted to 0 dB using R95 on the receiver module and R64 on the alarm receiver. The XMIT signal at P100-5 is at 600 millivolts peak-to-peak for both the 10 watt and 100 watt power applications. It is amplified and rectified by op amp AR1. With S3 switch pushed in, XMIT-IN, the normal XMIT level is adjusted to 0 dB using R6 found on the meter circuit card behind the control panel. The removal of a screw on each side of this panel will allow the panel to slide forward and rest on the open shelf door. R6 is found on the left rear corner of the card.

The INDICATOR part of the kit consists of a printed board with a meter and switch. A cut out is provided in the left front of the control panel to accommodate this option Mounting instructions are included as part of the kit.

ENVIRONMENTAL CONDITIONS

1. Operating Temperature:

   -20°C to +60°C ambient air in contact with equipment.

2. Altitude:

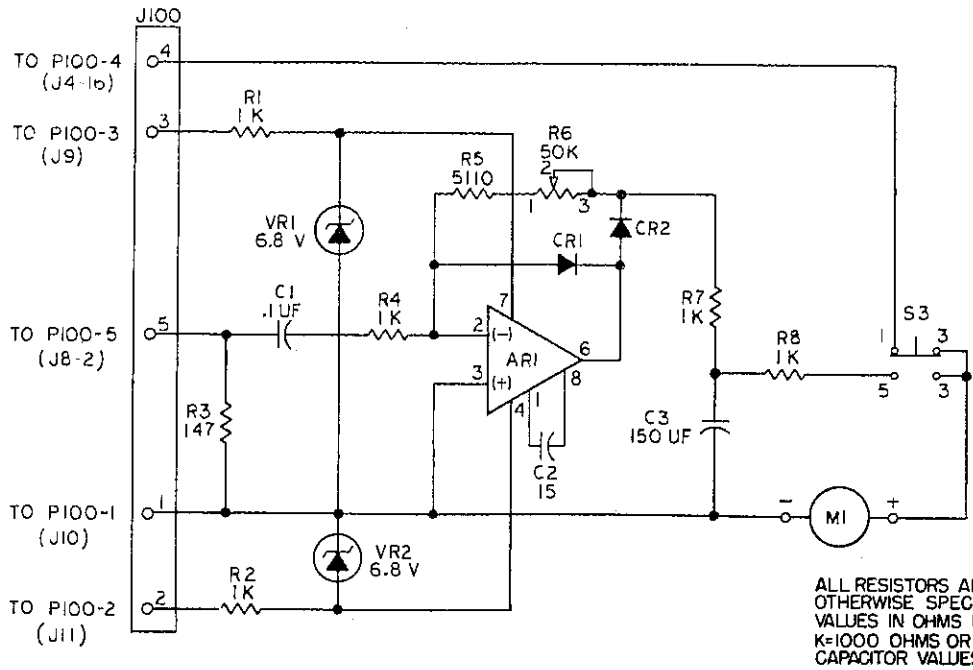
   Up to 10000 ft. (3048 m) with 10°C reduction in maximum ambient temperature for each 5000 ft. (1524 m) of elevation above 2500 ft. (762 m).

PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1* thru C10*	5490825P4	Ceramic; 6000 pF ±10%, 2000 VDCW C8 and C9 used in -G2 and -G3 only
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1	19A134354P2	Optoelectronic; yellow, wide angle; sim H-P5082-4555
CR3	4037822P1	Silicon, rectifier; sim 1N5060
		- - - - - - - - - - FUSES - - - - - - - - - -
F1, F2	1R16P1	Cartridge, quick blowing; 1/2 A; sim Littelfuse 312.500 or Bussmann AGC 1/2; used in 250 VDC equipment
F1, F2	1R16P3	Cartridge, quick blowing; 1 A; sim Littelfuse 312.001 or Bussmann AGC 1; used in 125 VDC equipment
F1, F2	1R16P5	Cartridge, quick blowing; 2 A; sim Littelfuse 312.002 or Bussmann AGC 2; used in 48 VDC equipment
		- - - - - - - CONNECTORS AND JACKS - - - - - -
J1 thru J8*	19A116505P7	Connector, printed wiring, one-part; 18 contacts; sim Elco 00-6007-018-940-002
J9	5490384P2	Jack tip; red; sim E.F. Johnson 105-252-1
J10	5490384P3	Jack tip; black; sim E.F. Johnson 105-253-1
J11	5490384P4	Jack tip; dark green; sim E.F. Johnson 105-254-1
J12	4029578P1	Telephone jack; sim Mallory #6; used in -G1 & -G2 only
J14*	19A115938P11	Connector, coaxial, receptacle; sim Amphenol 31-3377
J201	2R22P3	Connector; coaxial; sim Signal Corps. SO-239 or Amphenol 83-1R

Symbol	GE Part No.	Description
J43*	7775345P56	Connector; 8 contacts; sim Elco 01-1108-121-Gold-004-100; used in -G1 only
P43*	7775345P55	Connector; 8 contacts; sim Elco 01-3108-104-Gold-001103; used in -G1 only
P100*	19A700041P31	Connector; printed wiring; two-part; 5 circuits sim Molex 22-01-2055
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	2R14P31	Wirewound; 1K ohms ±5%, 25W
R2	2R14P36	Wirewound; 3.1K ohms ±5%, 25W
R3	2R14P27	Wirewound; 400 ohms ±5%, 25W; used in -G1 only
R3	2R14P24	Wirewound; 200 ohms ±5%, 25W; used in -G2 only
R4	2R14P30	Wirewound; 800 ohms 15%, 25W; used in -G1 only
R4	2R14P26	Wirewound; 310 ohms ±5%, 25W; used in -G2 & -G3 only
R5*, R7*, R9*	2R14P35	Wirewound; 2.5K ohms ±5%, 25W Note: R9 used in -G2 and -G3 only
R6, R8, R10	2R14P39	Wirewound; 6.3K ohms ±5%, 25W Note: R10 used in -G2 only
R12	19A116278P301	Metal film; 10 K ohms ±2%, 1/2 W
		- - - - - - - - - SWITCHES - - - - - - - - -
S1	19A116923P1	Toggle; DPST; sim Cutler-Hammer 8910K520
S2*	19B209261P12	Slide; 2 pole, 3 position; spring return to center both directions, 2 PTT, SR; sim Switchcraft 46313MDR
S4	19B209261P21	Slide; 2 pole, 2 position, DPDT; sim Switchcraft 11A-1433. Used in -G1 and -G2 only.
		- - - - - - - - - TRANSFORMER - - - - - - - - -
T1	PL-19B221755G1	Transformer
T2	PL-19B221775G1	Transformer
		- - - - - - - - - HOLDERS - - - - - - - - -
XF1, XF2	19B209005P1	Fuseholder; post type; sim Littelfuse 342012
	METER OPTION MOD. KIT PL-19C329995G1	
		- - - - - - - INTEGRATED CIRCUIT - - - - - - -
AR1	19A134379P1	Operational Amplifier; MOSFET input COS/MOS output; Linear; sim RCA CA3130T
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C2	19A700105P11	Mica; 15 pF ±5%, 500 VDCW
C3	5496267P3	Tantalum; 150 µF ±20%, 6 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1 & CR2	19A700028P1	Silicon, fast recovery; sim 1N4148
		- - - - - - - - - CONNECTOR - - - - - - - - -
J100*	19A134152P130	Printed wiring, two-part; 5-circuits; sim Molex 22-09-2051

Symbol	GE Part No.	Description
		- - - - - - - - - - - METER - - - - - - - - - - -
M1	19A143724P1	DC, special scale; sim GE Cat. No. #50-185111FAFA2JGD
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1, R2	19A701250P201	Metal film; 1K ohms ±1%, 1/4W
R3	19A701250P117	Metal film; 147 ohms ±1%, 1/4W
R4	19A701250P201	Metal film; 1K ohms ±1%, 1/4W
R5	19A701250P269	Metal film; 5.11K ohms ±1% 1/4W
R6	19A116559P124	Variable, cermet; 50 ohms to 50K ohms ±20%, 1-1/2W; 10% log taper
R7, R8	19A701250P201	Metal film; 1K ohms ±1%, 1/4W
		- - - - - - - - - - - SWITCH - - - - - - - - - - -
S3	19B209563P3	Push; 2 pole DT; momentary action; sim Switchcraft 145-3131A
		- - - - - - - - VOLTAGE REGULATOR - - - - - - -
VR1, VR2	19A700025P8	Silicon, Zener diode; sim Type BZX55-C6V8

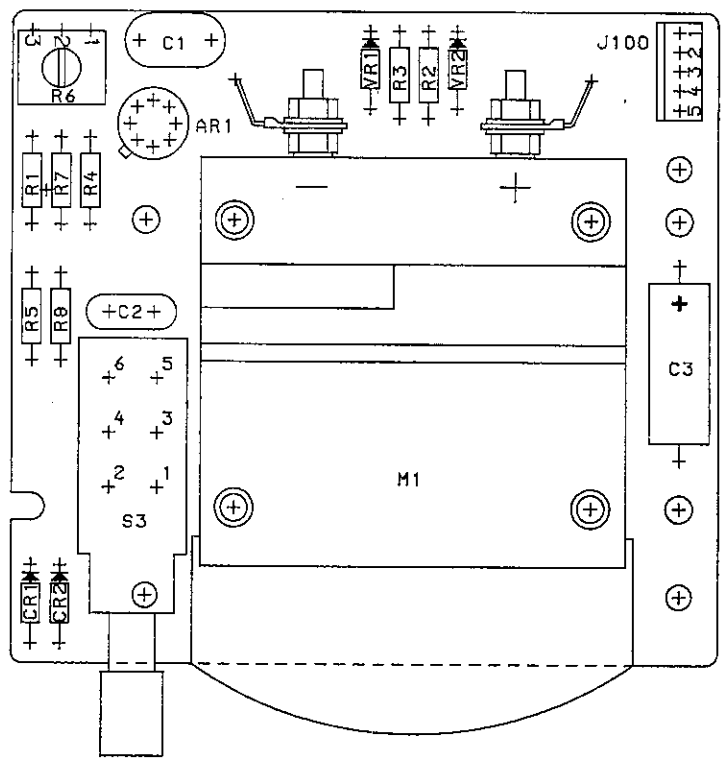


METER KIT OPTION

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

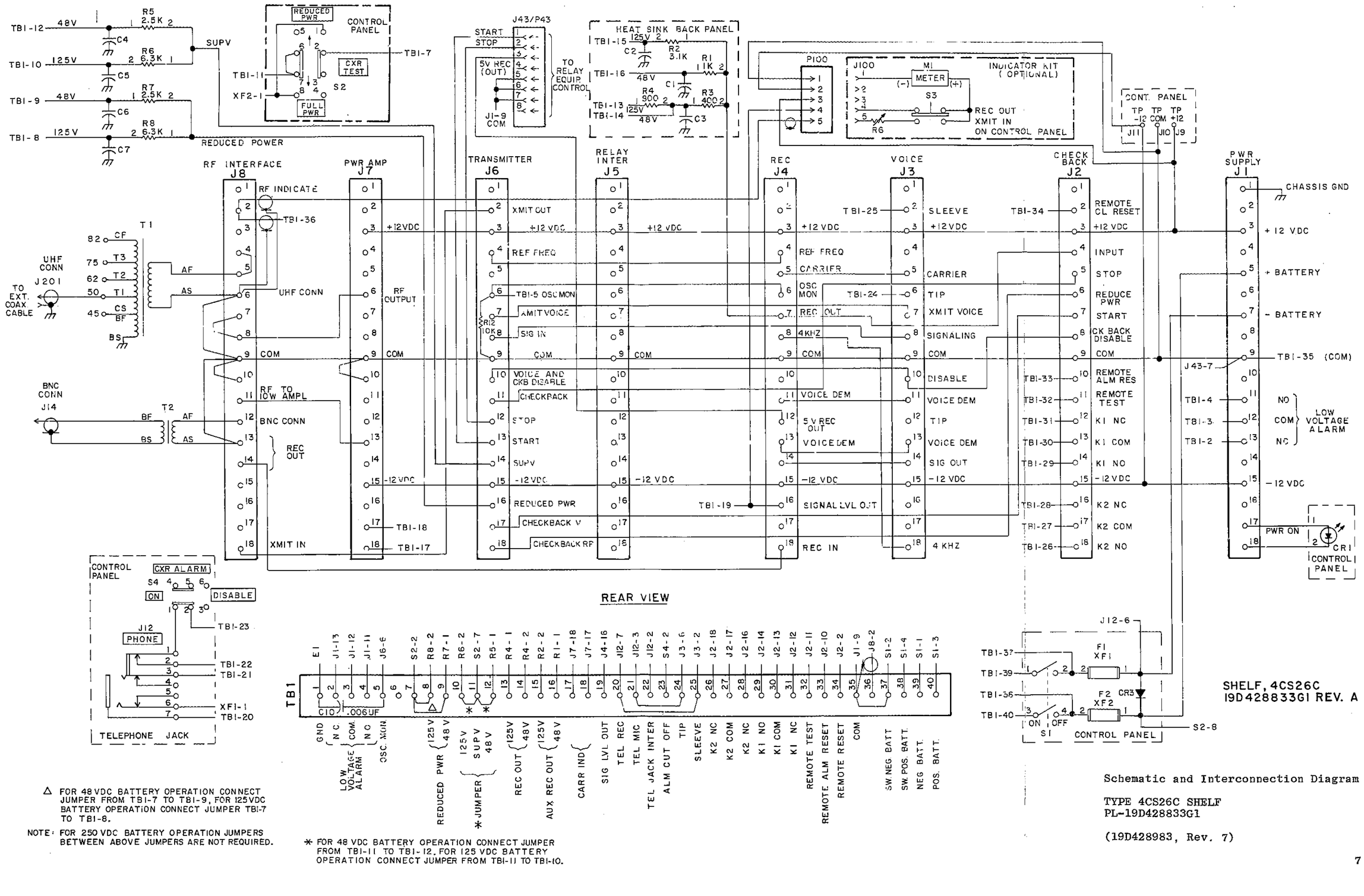
(19B229820, Rev. 0)

Schematic Diagram - Meter Option Mod. Kit/PL-19C329995G1



(19C329997, Rev. 1)

Pictorial Diagram - Meter Option Mod. Kit/PL-19C329995G1



△ FOR 48 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-7 TO TBI-9, FOR 125 VDC BATTERY OPERATION CONNECT JUMPER TBI-7 TO TBI-8.

NOTE: FOR 250 VDC BATTERY OPERATION JUMPERS BETWEEN ABOVE JUMPERS ARE NOT REQUIRED.

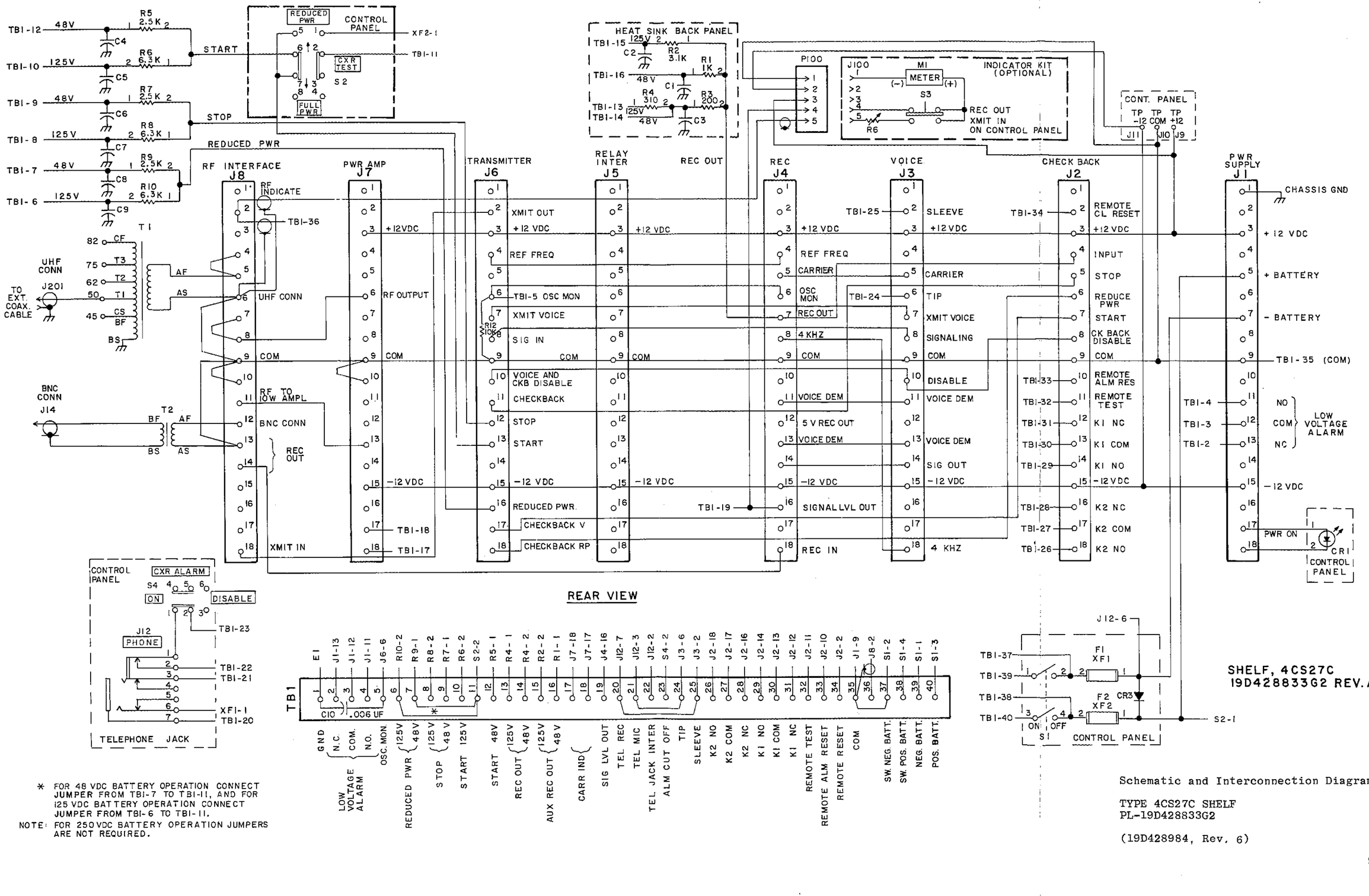
* FOR 48 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-11 TO TBI-12. FOR 125 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-11 TO TBI-10.

SHELF, 4CS26C
19D428833G1 REV. A

Schematic and Interconnection Diagram

TYPE 4CS26C SHELF
PL-19D428833G1

(19D428983, Rev. 7)



* FOR 48 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-7 TO TBI-11, AND FOR 125 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-6 TO TBI-11.

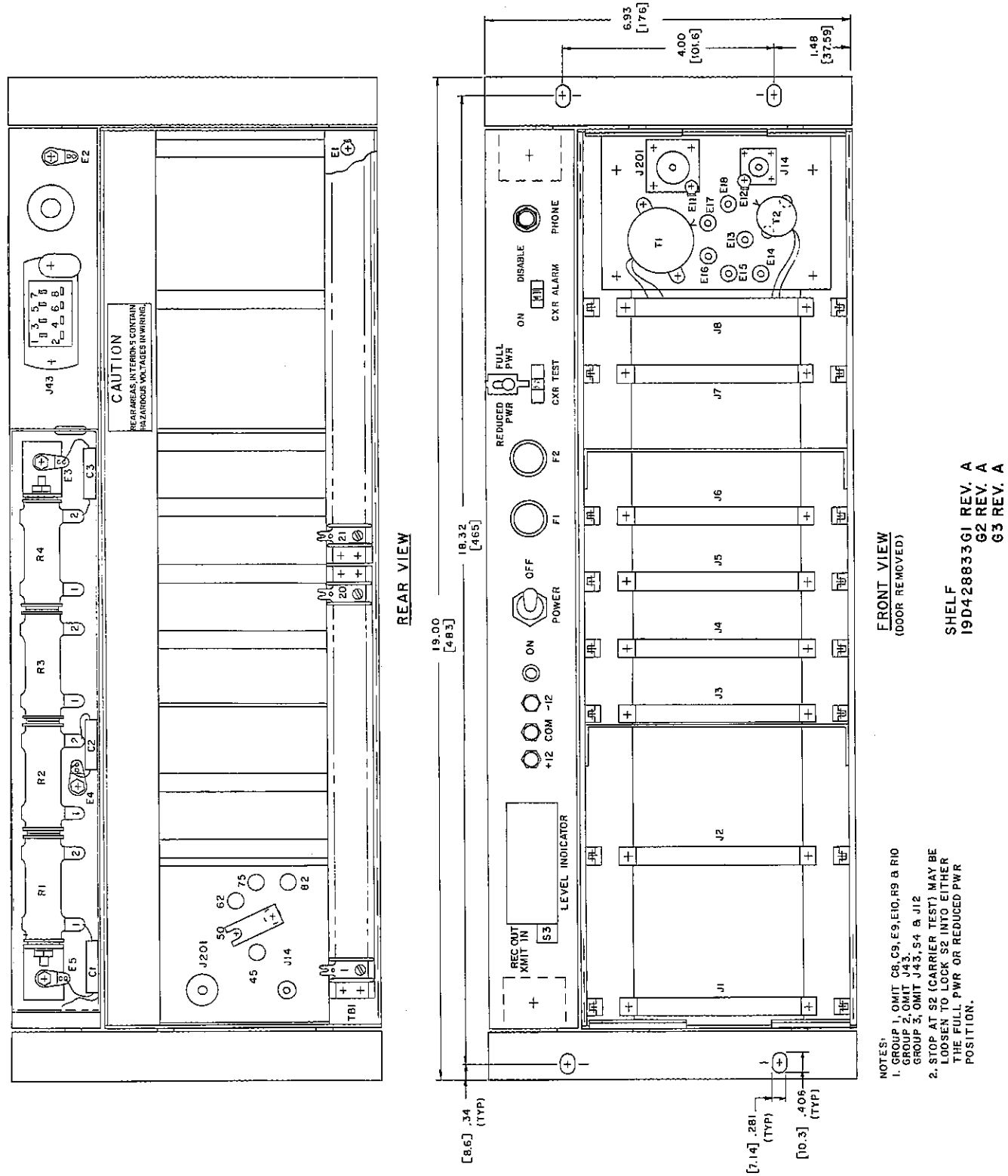
NOTE: FOR 250 VDC BATTERY OPERATION JUMPERS ARE NOT REQUIRED.

SHELF, 4CS27C
19D428833G2 REV.A

Schematic and Interconnection Diagram

TYPE 4CS27C SHELF
PL-19D428833G2

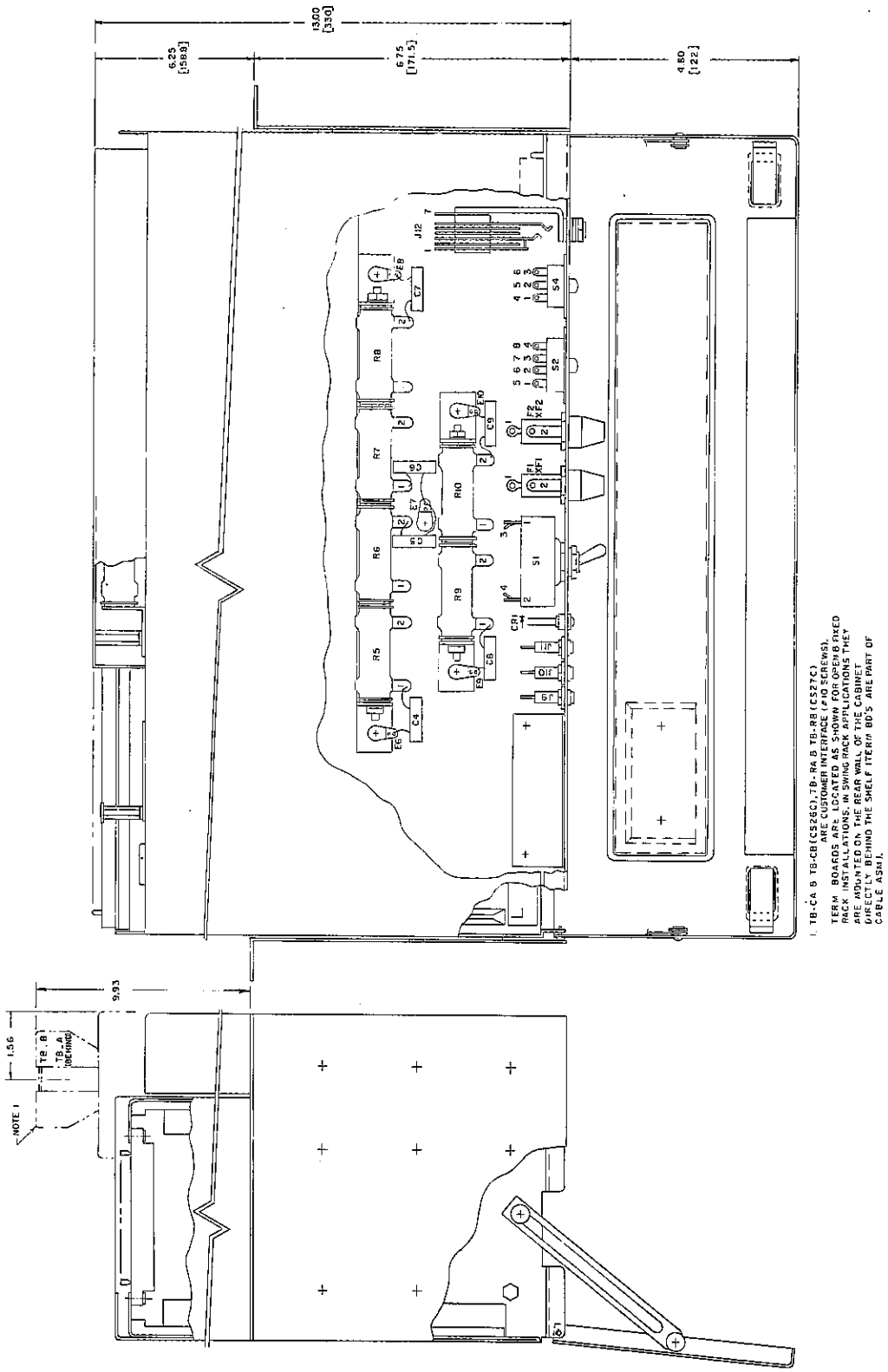
(19D428984, Rev. 6)



Pictorial/Outline Diagram

TYPE 4CS26C/4CS27C SHELF
PL-19D428833G1, -G2 and -G3

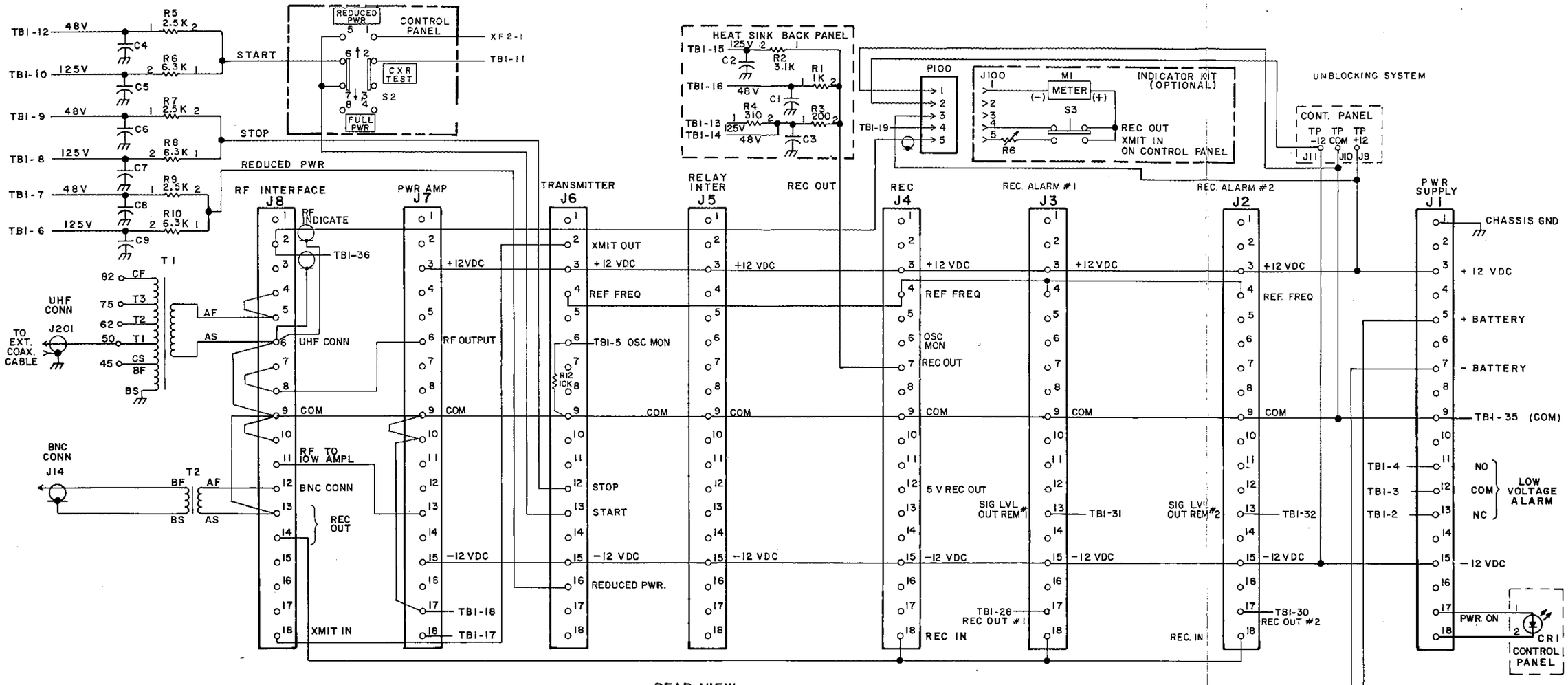
(19D426163, Sheet 1, Rev. 3)



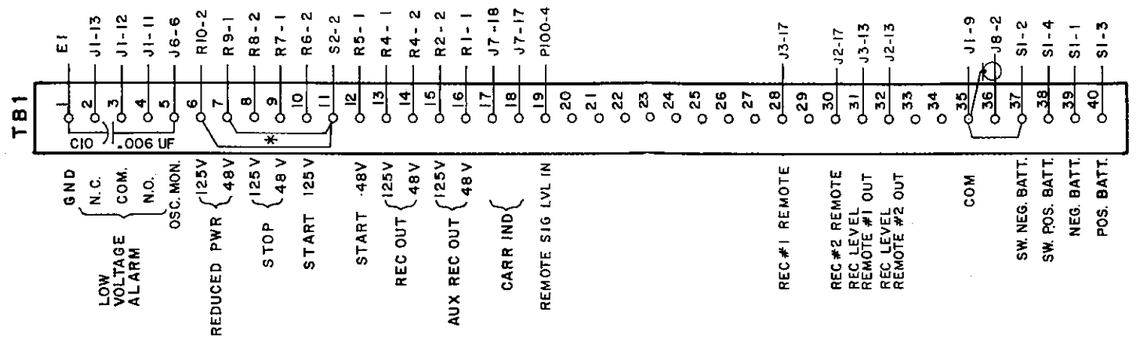
Pictorial/Outline Diagram

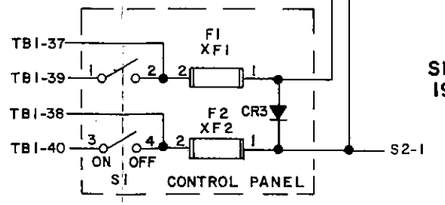
TYPE 4CS26C/4CS27C SHELF
PL-19D428833G1, -G2 and -G3

(19D426163, Sheet 2, Rev. 4)



REAR VIEW





SHELF, 4CS27C
19D42883G3 REV. A

* FOR 48 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-7 TO TBI-11, FOR 125 VDC BATTERY OPERATION CONNECT JUMPER FROM TBI-6 TO TBI-11.

NOTE: FOR 250VDC BATTERY OPERATION JUMPERS ARE NOT REQUIRED.

Schematic/Interconnection Diagram

TYPE 4CS27C SHELF UNBLOCKING
PL-19D428833G3

(19D426950, Rev. 1)

PRODUCTION CHANGES

PL-19D428833G1 thru -G3

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428833G1 thru -G3, Rev. A

Purpose: To permit front panel keying.

Part Changed	Was	Changed To
S4	- - -	Add S4, switch, slide; 2 pole, 2 position; sim Switchcraft 11A-1433
S2	19B209261P17	19B209261P12, slide; 2 pole, 3 position; spring return to center both directions 2 PTT, SR; sim Switchcraft 46313MDR

INSTRUCTIONS

250 VDC KEYING PANEL
PL-19C305822G6

INTRODUCTION

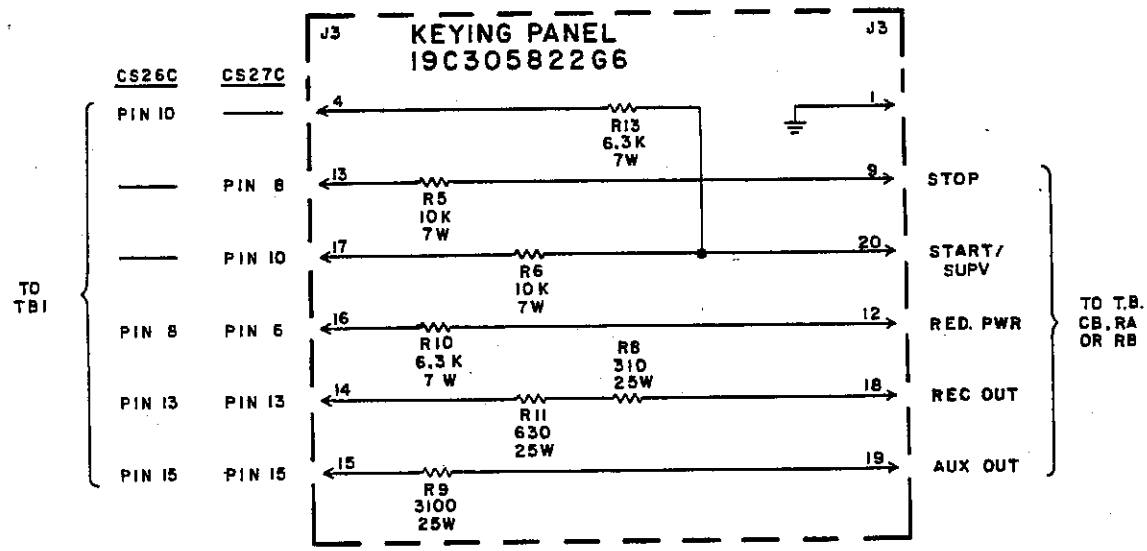
This Keying Panel is used in conjunction with a Type CS26C or Type CS27C Transmitter-Receiver Unit when the power source is a 250 Volt station battery.

This unit contains voltage dropping circuits (resistors R6, R10 and R13) for control and operation, and voltage dropping circuits (resistors R8, R9 and R11) for the auxiliary relays.

PARTS LIST

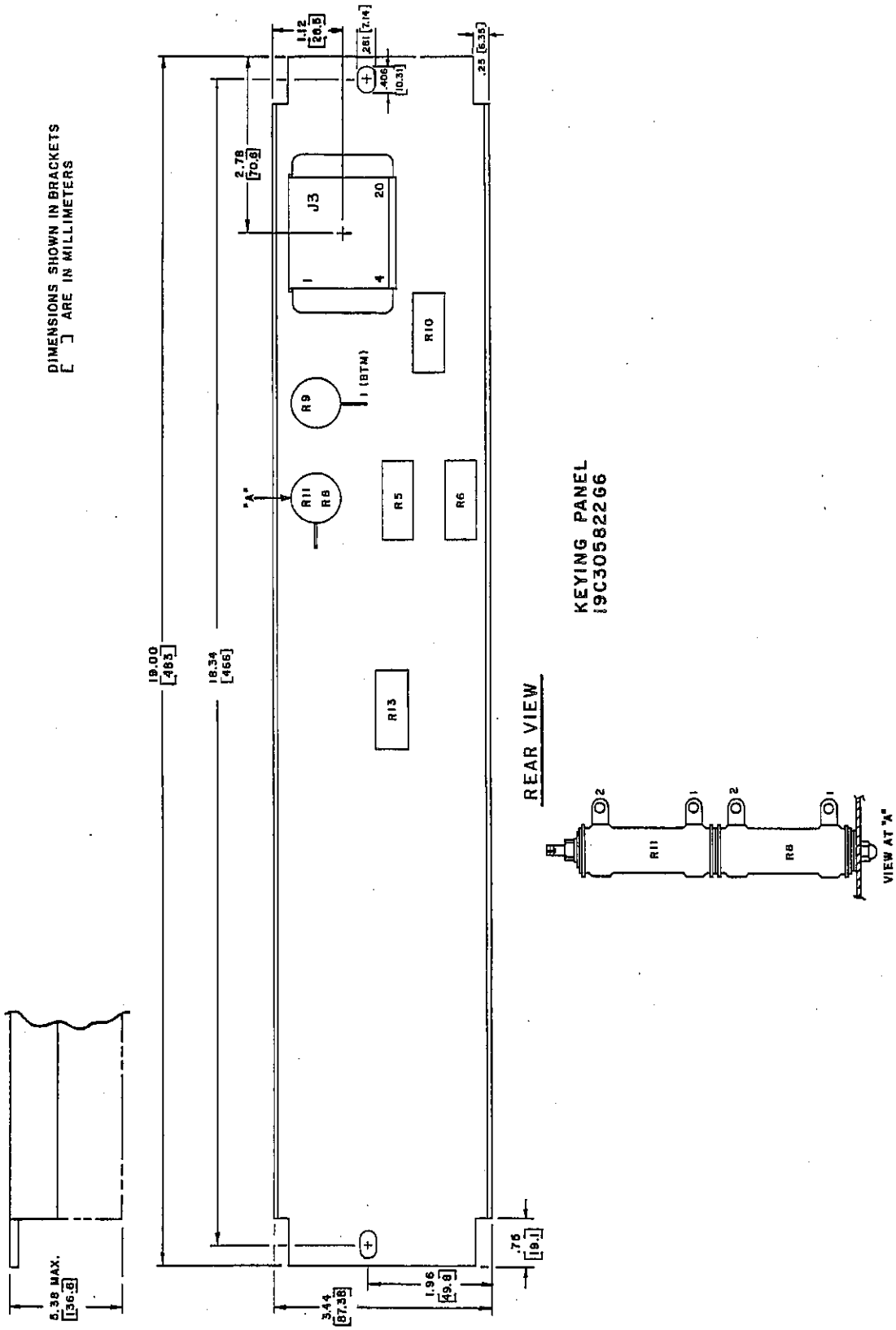
250 VOLT KEYING PANEL
PL-19C305822G6

Symbol	GE Part No.	Description
		- - - - - JACKS AND CONNECTORS - - - - -
J3	7775345P58	Connector; 20-contacts; sim to Elco Corp. Cat. No. 01-2220-121-gold-004-100
P3	7775345P23	Connector; 20-contacts; sim to Elco Corp. Cat. No. 01-4220-104-001-102
		- - - - - - - - RESISTORS - - - - - - - -
R5 & R6	7478711P41	Wirewound; 10,000 ohms ±5%, 7 W
R8	2R14P26	Wirewound; 310 ohms ±5%, 25 W
R9	2R14P36	Wirewound; 3100 ohms ±5%, 25 W
R10 & R13	7478711P39	Wirewound; 6300 ohms ±5%, 7 W



(19B230402, Rev. 0)

Schematic Diagram - 250 VDC Keying Panel/PL-19C305822G6



Outline Diagram

250 VDC KEYING PANEL
PL-19C305822G6

(19C335231, Rev. 0)

INSTRUCTIONS

TYPE CS26C/27C POWER SUPPLY
PL-19C329419G1 thru -G6, REV. A

DESCRIPTION

The Power Supply module provides the conversion from the DC battery voltage to the regulated ±12 VDC required by the CS26C/27C equipment. Groups 1 and 2 operate from a 48V battery, Groups 3 and 4 operate from 125V battery and Groups 5 and 6 operate from a 250V battery. Groups 2, 4 and 6 are equipped with a low voltage alarm relay.

OPERATION

Refer to Schematic Diagram 19D428905, and Pictorial Diagrams 19C329419, 19D428587 and 19C329294 which are included in this LBI instruction as well as Figure 1, a Functional Diagram 19D426749.

The input voltage is applied to the converter through a 2-pole switch located on the CS26C/27C shelf. Both positive and negative inputs are fused at the CS26C/27C shelf. An input filter (L3, C9 and C12) attenuates noise from the power source and vice versa.

The DC-DC converter (A1) is a fixed frequency (20 kHz), variable pulse width regulator. Integrated circuit AR3 generates a 20 kHz square-wave with a duty cycle of 90%. Flip-Flop U2 alternates the power pulse between power transistors Q6 and Q11. Transistors Q2 through Q5 and Q7 through Q10 are buffers to interface the CMOS gates U1-C and U1-D with the power transistors.

Secondary winding 9 and 10 of T1 provides the supply voltage for the control circuits plus the voltage control loop. These secondary voltage pulses are rectified by diodes CR4 and CR5 and integrated by resistor R47 and capacitor C3. Integrated circuit AR2 senses when this voltage has reached a predetermined level and switches the output pulse OFF.

Integrated circuit AR1 provides short circuit protection by sensing the emitter current of Q6 and Q11 through resistor R24, and switching the output pulse OFF when the emitter current exceeds a predetermined level. This circuit also limits the inrush current when the power supply is first turned ON.

Integrated circuit AR4 prevents gate U1-A from switching ON until the supply voltage for the control circuits reaches its normal level through resistor R31.

Secondary winding 4 and 5 of T1 provides the negative bias voltage to switch power transistors Q6 and Q11 OFF quickly.

Variable resistor R8 (±12 VDC level adj.) is used for adjusting the output to ±12 VDC. The ±12 VDC output is rectified by diodes CR9 through CR12 and filtered by inductors L1 and L2 and capacitors C14, C18 and C19.

Variable resistor R50 is used to balance the output pulses from Q6 and Q11. This adjustment is made by monitoring the current pulses at test point TP9 with an oscilloscrope, and if spikes are observed, adjust R50 to remove spikes. This is a factory adjustment and would be made in the field only when a component is changed.

The alarm circuit switches ON when the output voltage (3/C to 15/S) reaches ≥23 VDC and OFF if the output voltage drops to ≤17 VDC. Form C contacts are provided.

NOMINAL OPERATING CHARACTERISTICS

1. Input Voltage:
   a. Groups 1 and 2 42 VDC to 56 VDC
   b. Groups 3 and 4 103.2 VDC to 141.9 VDC
   c. Groups 5 and 6 210 VDC to 280 VDC
2. Output Voltage:
   a. +12 ±1 VDC
   b. -12 ±1 VDC
3. Low Voltage Alarm:
   Form C contacts, 100 µA
   a. Pick-up ≥23 VDC
   b. Drop-out ≤17 VDC

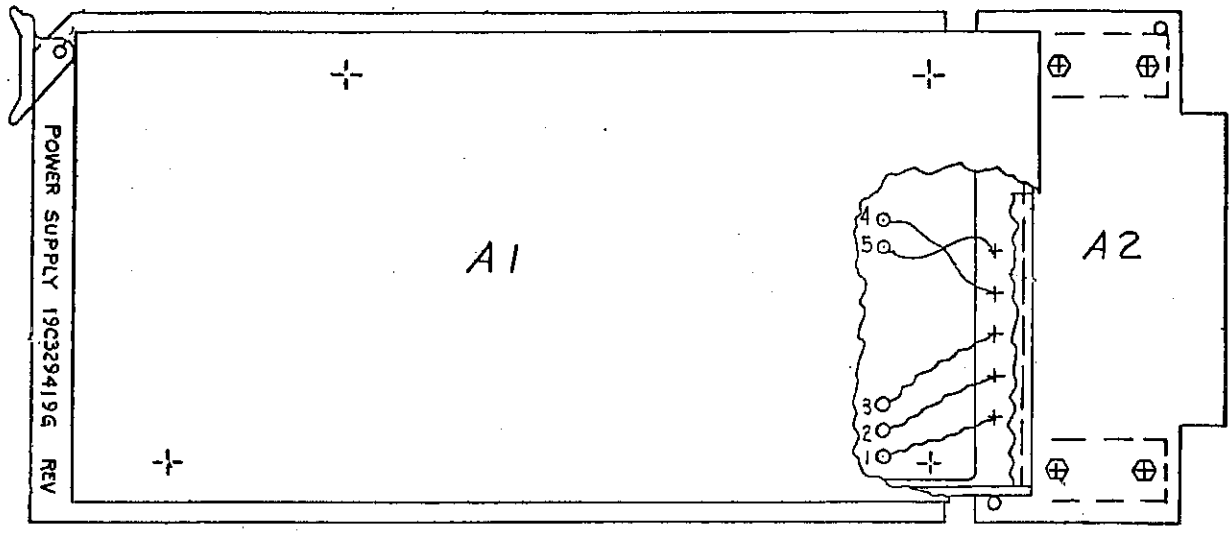
PARTS LIST

Symbol	GE Part No.	Description
A1	PL-19D428585G1	DC-DC Converter; used in -G1 and -G2 only
A1	PL-19D428585G2	DC-DC Converter; used in -G3 and -G4 only
A1	PL-19D428585G3	DC-DC Converter; used in -G5 and -G6 only
A2	PL-19C329292G1	Finger Board; used in -G1, -G3 and -G5 only
A2	PL-19C329292G2	Finger Board; used in -G2, -G4 and -G6 only
A1		DC-DC Converter PL-19D428585G1 thru -G3
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1, C5, C6	19A134202P16	Tantalum; 4.7 µF ±20%, 25 VDC
C2	549008P35	Mica; 220 pF ±5%, 500 VDCW
C3	5493367P8200J	Mica; 8200 pF ±5%, 100 VDCW
C4	5493366P1000F	Mica; 1000 pF ±1%, 100 VDCW
C7	19A134202P14	Tantalum; 1.0 µF ±20%, 35 VDCW
C9	5493132P12	Electrolytic; 50 µF -10, +50%, 250 VDCW; used in -G1 and -G2 only
C10 thru C12	19A115028P159	Polyester; 0.47 µF ±20%, 400 VDCW Note: C10 and C11 used in -G3 only
C13	5490008P33	Mica; 180 pF ±5%, 500 VDCW
C14	5493132P15	Electrolytic; 1000 µF -10, ±75%, 40 VDCW
C16, C17	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C18, C19	5496267P11	Tantalum; 68 µF ±20%, 15 VDCW
C20	4029003P8	Mica; 1000 pF ±5%, 500 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1 thru CR5, CR13 thru CR16	19A115250P1	Silicon, fast recovery; sim 1N4152
CR6 thru CR8	4037822P1	Silicon, rectifier; sim 1N5060
CR9 thru CR12	19A143814P1	Silicon, rectifier, fast recovery; sim GE A115F
		- - - - - - - - - - - - COIL - - - - - - - - - - - -
L1 thru L3	PL-19B218975G6	Coil
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1, Q2, Q7	19A116755P1	Silicon, NPN; sim 2N3947
Q3, Q5, Q8, Q10	19A115562P2	Silicon, PNP, switch; sim 2N2904A
Q4, Q9	19A115300P2	Silicon, NPN; sim 2N3053
Q6, Q11	19A115923P2	Silicon, NPN; sim 2N3902; used in -G1 and -G2 only
Q6, Q11	19A134690P1	Silicon, NPN; sim DTS 723; used in -G3 only
Q12*	19A134637P1	Silicon, NPN; sim 2N3440
Q12*	19A134637P2	Silicon, NPN; sim 2N3439
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1, R5	19A700106P63	Composition; 1 K ohms ±5%, 1/4 W
R2*	19A701250P340	Metal film; 25.5 K ohms ±1%, 1/4 W
R3, R4, R35	19C314256P21213	Metal film; 121 K ohms ±1%, 1/4 W
R6*, R15*, R17*, R42*, R47*	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W

Symbol	GE Part No.	Description
R8	19A116559P107	Variable, cermet; 25 ohms to 25 K ohms ±20%, 1/2 W; linear taper
R9*	19A701250P349	Metal film; 31.6 K ohms ±1%, 1/4 W
R11	3R152P622J	Composition; 6.2 K ohms ±5%, 1/4 W
R12, R20, R27, R43, R49	19A700106P87	Composition; 10 K ohms ±5%, 1/4 W
R13*	19A701250P217	Metal film; 6.19 K ohms ±1%, 1/4 W
R14*	19A701250P356	Metal film; 37.4 K ohms ±1%, 1/4 W
R16*	19A701250P254	Metal film; 3.57 K ohms ±1%, 1/4 W
R18, R25	19A700106P89	Composition; 12 K ohms ±5%, 1/4 W
R19, R26	3R152P513J	Composition; 51 K ohms ±5%, 1/4 W
R21, R28	3R152P512J	Composition; 5.1 K ohms ±5%, 1/4 W
R22, R29	19A700113P39	Composition; 100 ohms ±5%, 1/2 W
R23, R30	19A700113P46	Composition; 200 ohms ±5%, 1/2 W
R24	19B209022P1	Wirewound; 0.27 ohms ±5%, 2 W Used in -G1 only
R24	19B209022P12	Wirewound; 0.75 ohms ±5%, 2 W Used in -G2 only
R24	19B209022P18	Wirewound; 1.3 ohms ±5%, 2 W Used in -G3 only
R31*	19A116278P229	Metal film; 1.96 K ohms ±2%, 1/2 W Used in -G1 only
R31*	19A116278P269	Metal film; 5.11 K ohms ±2%, 1/2 W Used in -G2 only
R31*	19A116278P301	Metal film; 10 K ohms ±2%, 1/2 W Used in -G3 only
R32 thru R34	19C314256P21003	Metal film; 100 K ohms ±1%, 1/4 W
R35	19C314256P21213	Metal film; 121 K ohms ±1%, 1/4 W
R44, R45	19A116479P2121K	Metal film; 120 ohms ±10%, 2 W Used in -G1 only
R44, R45	19A116479P2301K	Metal film; 300 ohms ±10%, 2 W Used in -G2 only
R44, R45	19A116479P2621K	Metal film; 620 ohms ±10%, 2 W
R48*	19A701250P325	Metal film; 17.8 K ohms ±1%, 1/4 W
R50	19A116559P109	Variable, cermet; 100 ohms to 250 K ohms ±20%, 1/2 W
R56*	19A116278P373	Metal film; 56.2 K ohms ±2%, 1/2 W Used in -G1 only
R56*	19A116278P418	Metal film; 150 K ohms ±2%, 1/2 W Used in -G2 only
R56*	19A116278P447	Metal film; 300 K ohms ±2%, 1/2 W Used in -G3 only

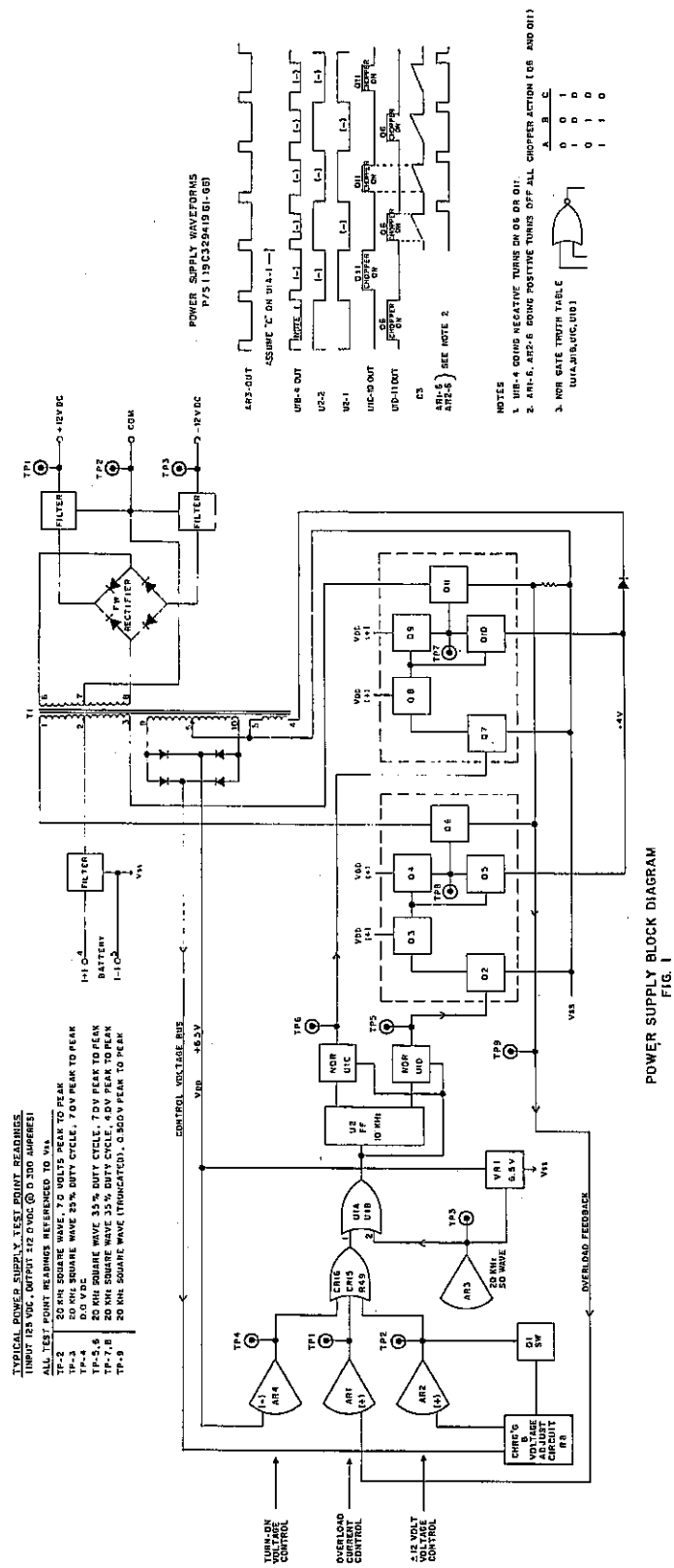
PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - TRANSFORMERS - - - - - - -
T1	PL-19B229227G6	Coil. Used in -G1 only
T2	PL-19B229227G7	Coil. Used in -G2 only
T1	PL-19B229227G8	Coil. Used in -G3 only
		- - - - - - VOLTAGE REGULATORS - - - - -
VR1*	4036887P6	Silicon, Zener Diode; 2.3 V sim 1N5234
VR2*	4036887P11	Silicon, Zener Diode; 10 V sim 1N5240B
		- - - - - INTEGRATED CIRCUITS - - - - - -
U1	19A134097P2	MOS, Digital (CMOS series); Quad 2 input NOR gate; sim 4001
U2	19A134097P23	MOS, Digital (CMOS series); Dual J-K Master-Slave flip-flop; sim 4027
AR1 thru AR4	19A134379P1	MOSFET input, COS/MOS output; linear; sim RCA CA3130T
A2		FINGER BOARD PL-19C329292G1 and -G2
		- - - - - - - - CAPACITORS - - - - - - -
C50	5490825P3	Ceramic; 10,000 pF -20 +100%, 2000 VDCW
C51	5490825P4	Ceramic; 6,000 pF ±10%, 2000 VDCW Used in -G2 only
		- - - - - - - - - DIODE - - - - - - - - -
CR52	19A115250P1	Silicon, fast recovery; sim 1N4152
		- - - - - - - - - RELAY - - - - - - - - -
K51	19B209598P1	Enclosed; 24 VDCW; coil, 600 ohms +10%, pull-in; 19.2 VDC max; 2 form C contacts; sim Guardian Elect. 1365PC-2C-24D Used in -G2 only
		- - - - - - - - TRANSISTORS - - - - - - -
Q51	19A115300P2	Silicon, NPN; sim 2N3053
		- - - - - - - - RESISTORS - - - - - - - -
R51	19A116479P2221K	Metal film; 220 ohms ±10%, 2 W
R52	3R78P131J	Composition; 130 ohms ±5%, 1 W
R53	19A700106P63	Composition; 1 K ohms ±5%, 1/4 W
R54*	19A701250P91	Metal film; 86.6 ohms ±1%, 1/4 W
R55	19A116479P2621K	Metal film; 620 ohms, ±10%, 2 W Used in -G1 only
		- - - - - - VOLTAGE REGULATOR - - - - - -
VR51	4036887P6	Silicon, Zener diode; sim 1N5234



(19C329419, Rev. 1)

Assembly Diagram - Power Supply/PL-19C329419G1 thru -G6

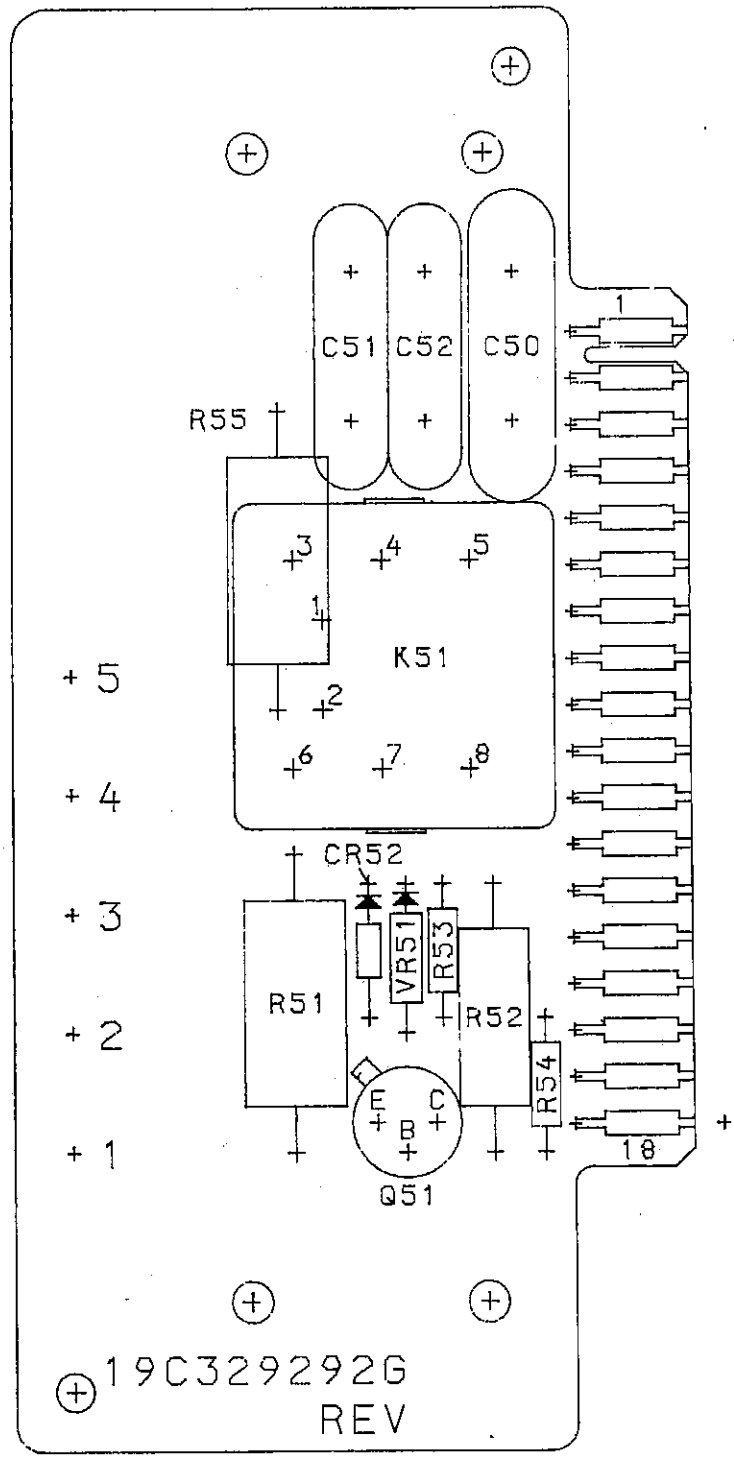


POWER SUPPLY BLOCK DIAGRAM
FIG. 1

Figure 1

FUNCTIONAL BLOCK DIAGRAM
OF THE POWER SUPPLY

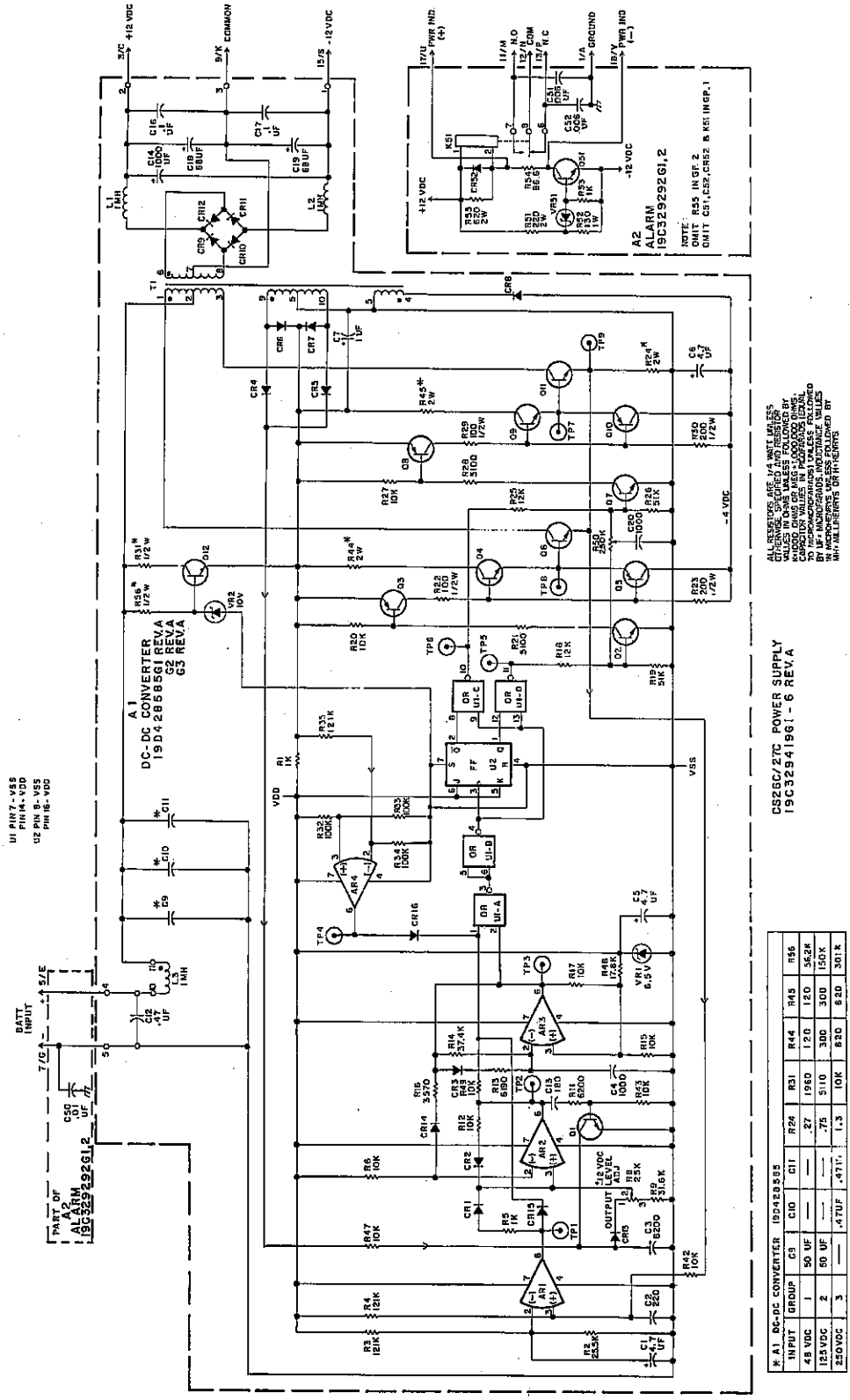
(19D426749, Rev. 2)



Pictorial Diagram

FINGER BOARD
PL-19C329292G1 and -G2

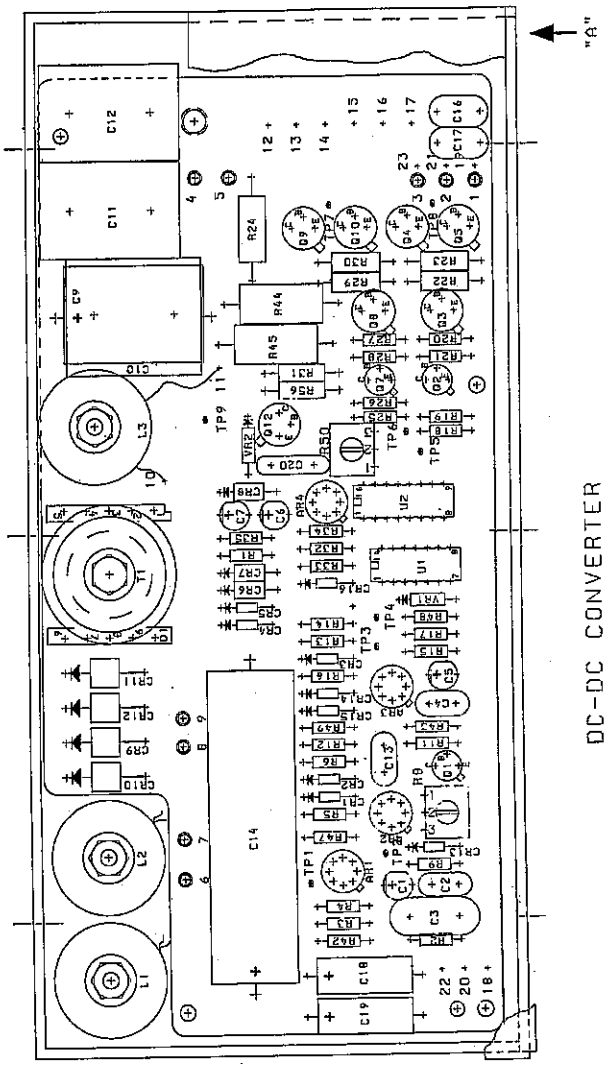
(19C329294, Rev. 0)

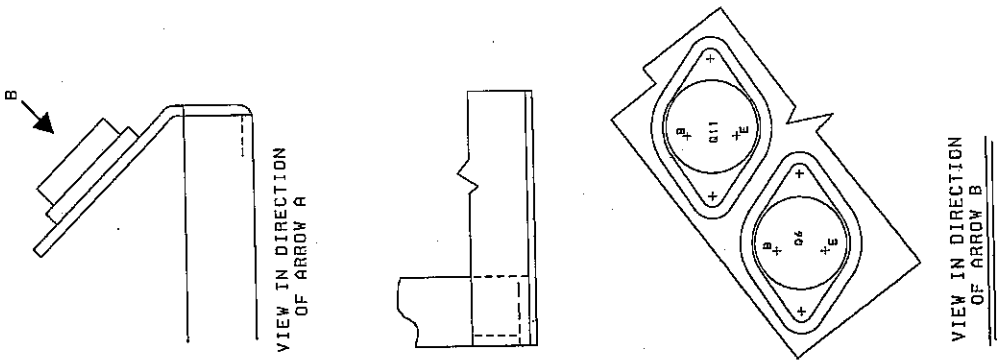


Schematic Diagram

POWER SUPPLY
PL-19C329419G1 thru -G6

(19D428905, Rev. 2)





Pictorial Diagram

DC-DC CONVERTER
PL-19D428585G1 thru -G3

(19D428587, Rev. 3)

PRODUCTION CHANGES

TYPE CS26C/27C POWER SUPPLY
PL-19C329419G1 thru -G6

The revisions listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19C329419G1 thru -G6, Rev. A

Purpose: To improve reliability of starting circuit.

Part Changed	Was	Changed To
DC-DC Converter	PL-19D428585G1	PL-19D428585G1, Rev. A
DC-DC Converter	PL-19D428585G2	PL-19D428585G2, Rev. A
DC-DC Converter	PL-19D428585G3	PL-19D428585G3, Rev. A
R31	19A116479P2512K (5.1 K ohms)	19A116278P229, Metal film; 1.96 K ohms ±2%, 1/2 W Used in -G1 only
R31	19A116479P2153K	19A116278P269, Metal film; 5.11 K ohms ±2%, 1/2 W Used in -G2 only
R31	19A116479P2303K	19A116278P301, Metal film; 10 K ohms ±2%, 1/2 W Used in -G3 only
Q12	------	Add Transistor, GE Part No. 19A134637P1; Silicon, NPN sim 2N3440. Used in -G1 and -G2 only
Q12	------	Add Transistor, GE Part No. 19A134637P2; Silicon, NPN sim 2N3439. Used in -G3 only
VR2	------	Add Voltage Regulator; GE Part No. 4036887P11; Silicon, Zener Diode; 10 V sim 1N5240B
R56	------	Add Resistor, GE Part No. 19A116278P373; Metal film; 56.2 K ohms ±2%, 1/2 W. Used in -G1 only
R56	------	Add Resistor, GE Part No. 19A116278P418; Metal film; 150 K ohms ±2%, 1/2 W. Used in -G2 only
R56	------	Add Resistor, GE Part No. 19A116278P447; Metal film; 300 K ohms ±2%, 1/2 W. Used in -G3 only

INSTRUCTIONS

TYPE CS26C/27C TRANSMITTER
PL-19D428610G1 and -G2, REV. A

DESCRIPTION

The CS26C/27C Transmitter is used for transmission of carrier current signals over high voltage power lines for solid state (CS26C) or electro-mechanical (CS27C) pilot relaying and supervisory control. The operating frequency of the transmitter is programmable from 30 kHz to 535 kHz in 250 Hz steps. The channel spacing is 2 kHz for Group 1 and 4 kHz for Group 2.

Input controls are the START, STOP, SUPERVISORY and REDUCED POWER.

Priorities for the CS26C controls are:

1. START ON switches the transmitter to full power.
2. STOP ON inhibits all inputs except START.
3. SUPERVISORY ON switches the transmitter to full power unless STOP is ON.
4. REDUCED POWER ON switches the transmitter to reduced power if STOP is not ON. If START or SUPERVISORY switches are ON the transmitter will be switched to full power.

Priorities for the CS27C controls are:

1. STOP ON inhibits all inputs.
2. START ON switches the transmitter to full power unless STOP is ON.
3. SUPERVISORY ON switches the transmitter to full power, unless STOP is ON.
4. REDUCED POWER ON switches the transmitter on to reduced power unless STOP is ON. If START or SUPERVISORY switches are ON the transmitter will be switched to full power.

OPERATION

Refer to Schematic Diagram 19D426313 and Pictorial Diagram 19D428612 which are included in this LBI.

Operating frequency of the transmitter is selected by the frequency synthesizer, which consists of phase-lock-loop (PLL) U2, and counters U3, U4 and U5. The transmitter operates above or below the channel frequency (center frequency) by ±250 Hz or ±500 Hz

The 500 Hz reference frequency from the receiver is connected to PLL Phase Comparator and the Voltage Controlled Oscillator (VCO) output of the PLL is connected to counters U3, U4 and U5. The output of the counters is connected to the Phase Comparator of the PLL. The output of Phase Comparator is filtered by network R5, R6, C1 and C2. This filtered output controls the frequency of the VCO. The PLL locks to the 500 Hz reference frequency and the VCO output frequency is equal to N times the 500 Hz reference frequency. N is determined by the programming switch S1 and jumpers L and M. The NOR gate U1A functions as a lock detector and inhibits counter U8 if PLL U1 fails to lock.

The switch AR2A and gate U7B applies a voltage to the modulator U9 through low pass filter AR4 when the transmitter is keyed ON. AR1B and AR1C are buffer amplifier for the low pass filter and AR1A is an inverting amplifier producing a signal 180° out-of-phase.

The carriers are applied to the modulator U9 by counter U8 when the transmitter is keyed ON. The output of the modulator is coupled to the output level pads by transformer T1 and gate U7A. U7A and U7D are controlled by the signalling circuit in the voice module. U7A is closed when signalling is OFF and U7D is open. When signalling is ON U7A is open and U7D is closed, switching voice into the output pads. The jumper H provides a fixed 6 dB attenuation to the output amplifier (Q3, Q4). Potentiometer R90 provides a variable attenuation of approximately 6 dB.

AR2A is controlled by the input signals START, STOP, SUPERVISORY and REDUCED POWER with priorities listed previously. Reduced power circuit AR2C and U7C is turned ON by the reduced power input. The START and SUPERVISORY input has priority control over this circuit. Variable resistor R63 sets the reduced power level.

Input interface circuits AR3A, B, C & D are identical. The input signals to these circuits are 0 VDC and +5 VDC referenced to common. Reversing the jumpers B, C, D, & E determines which input (0 or 5V) will switch the circuits ON (+). Light emitting diodes (LED) CR7, 8, 9 and 10 indicate if the circuit is ON. If any of the STOP, START, or SUPERVISORY circuits are ON, an output signal is produced at the voice and checkback disable output (Pin 10) by AR2B, D or AR3C.

Transistors Q1 and Q2 provide an oscillograph output from the START circuit. Jumpers F and G set up the keying priorities for the CS26C and CS27C. Jumper A is used to switch common from -BATTERY to +BATTERY.

PROGRAMMING LINE FREQUENCY

Listed below are the multiplying factors for the switch (S1) and jumper positions:

CAUTION

No two transmitters in the same line section may be operated at the exact same frequency, otherwise carrier phase cancellation will be automatic (in the receiver) with resulting failure to block. If more than one transmitter (up to 4) is to be used, then each must be programmed to a different one of the following offset frequencies, F_c + 250 Hz, F_c - 250 Hz, F_c + 500 Hz and F_c - 500 Hz.

S1-1	-	.25
S1-2	-	.5
S1-3	-	1.0
S1-4	-	2.0
S1-5	-	4.0
S1-6	-	8.0
S1-7	-	16.0
S1-8	-	32.0
S1-9	-	64.0
S1-10	-	128.0
L	-	256.0
M	-	512.0

1. Select the closest smaller multiplying factor to the desired line frequency and close that switch or jumper.
2. Subtract this factor from desired line frequency.
3. Select the closest smaller multiplying factor to the result in Step 2 and close that switch.
4. Subtract this factor from result in Step 2.
5. Repeat the procedures in Steps 3 and 4 until result is zero.

Example:

Desired line frequency = 300.5 kHz

1. 300.5 - 256 = 44.5 Jumper L to 2-3
2. 44.5 - 32 = 12.5 S1-8 —— Closed
3. 12.5 - 8 = 4.5 S1-6 —— Closed
4. 4.5 - 4 = 0.5 S1-4 —— Closed
5. 0.5 - 0.5 = 0.0 S1-2 —— Closed

The jumpers J and K are used to change the capacitors in the PLL VCO circuit. The chart below shows the jumper positions and frequency range.

FREQUENCY RANGE	JUMPER	
	J	K
30 kHz - 100 kHz	1-2	1-2
101 kHz - 300 kHz	1-2	2-3
301 kHz - 535 kHz	2-3	2-3

NOMINAL OPERATING CHARACTERISTICS

1. Power Requirements:

   +12 VDC, 100 mA
   -12 VDC, 100 mA

2. Inputs:

   a. STOP, SUPERVISORY, and REDUCED POWER:

      (1) ON +5 VDC
      (2) OFF 0 VDC

   b. START:

      (1) ON 0 VDC
      (2) OFF +5 VDC

   c. SIGNALING:

      (1) ON +6 VDC
      (2) OFF -6 VDC

3. Outputs:

   a. TRANSMITTER OUT:

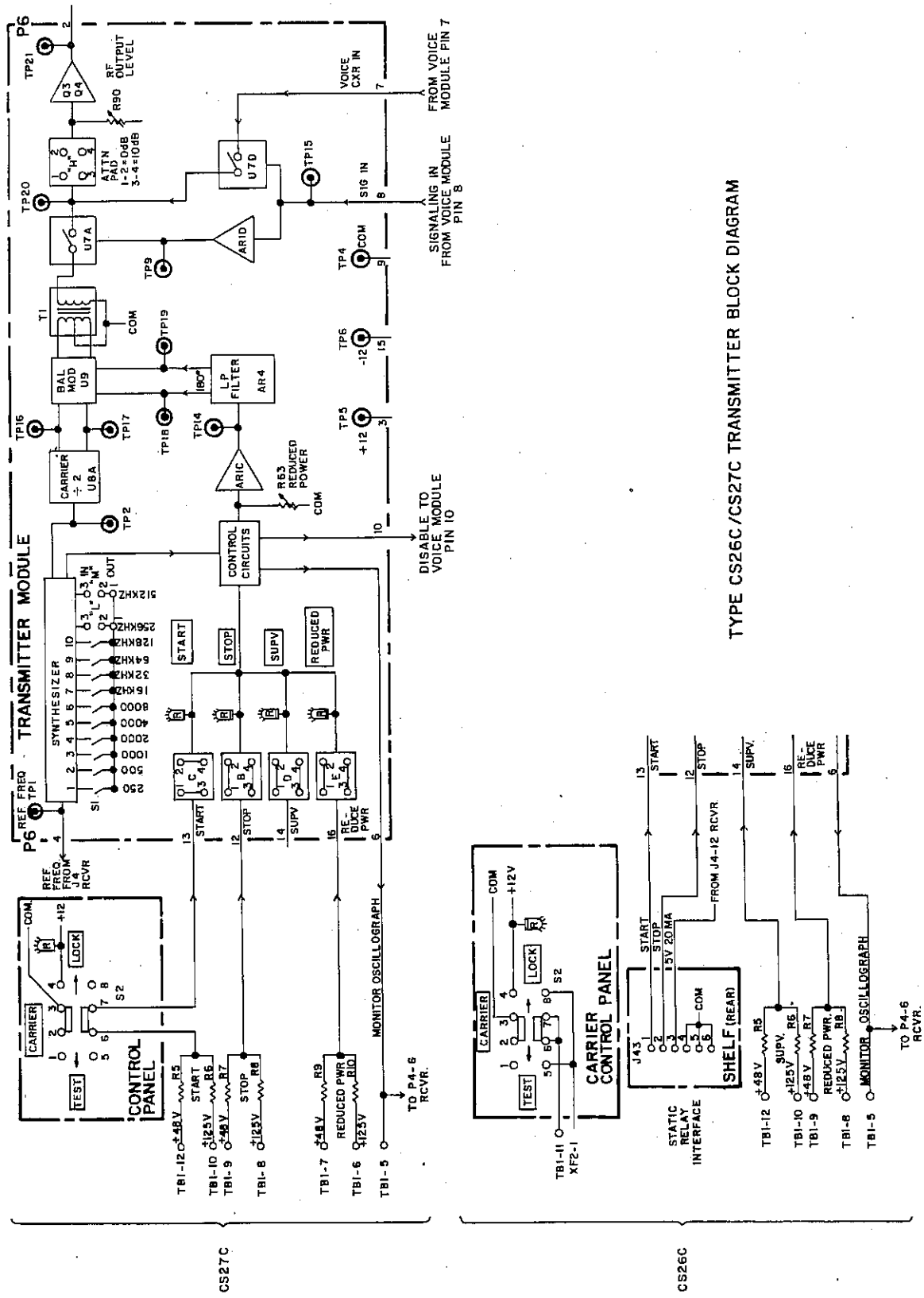
      LEVEL: Adjustable from +2 dBsr to -8 dBsr with 150 ohm load.

   b. Voice and CHECKBACK DISABLE:

      (1) ON +4 VDC
      (2) OFF 0 VDC

   c. OSCILLOGRAPH MONITOR:

      (1) ON 8 VDC with 4K ohm load
      (2) OFF 0 VDC



TYPE CS26C/CS27C
TRANSMITTER BLOCK DIAGRAM

(19C334231, Rev. 1)

PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P107	Polyester; 0.1 µF ±10%, 50 VDCW
C2	19A134202P115	Tantalum; 6.8 µF ±10%, 35 VDCW
C3	5490008P37	Mica; 270 pF ±5%, 500 VDCW
C4	5490008P27	Mica; 100 pF ±5%, 500 VDCW
C5	5490008P35	Mica; 220 pF ±5%, 500 VDCW
C6	5490008P43	Mica; 470 pF ±5%, 500 VDCW
C7, C15, C21 thru C23	19A116080P1	Polyester; 0.01 µF ±20%, 50 VDCW
C8	19A134202P6	Tantalum; 22 µF ±20%, 15 VDCW
C9, C10, C11, C12	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C13, C14	5496267P12	Tantalum; 150 µF ±20%, 15 VDCW
C16 thru C20	19C307114P1002G	Polystyrene; 10,000 pF ±2%, 100 VDCW
C24	19A116080P3	Polyester; 0.022 µF ±20%, 50 VDCW
		- - - - - - - - - DIODES - - - - - - - - - -
CR1 thru CR6, CR11 thru CR22	19A115250P1	Silicon, fast recovery; sim 1N4152
CR7 thru CR10	19A134354P1	Optoelectronic; red, wide angle; sim H-P 5082-4655
		- - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115779P1	Silicon, PNP; sim 2N3251
Q2, Q3	19A116755P1	Silicon, NPN; sim 2N3947
Q4	19A115300P2	Silicon, NPN; sim 2N3053
		- - - - - - - - - RESISTORS - - - - - - - - - -
R1, R67	19A701250P101	Metal film; 100 ohms ±1%, 1/4 W
R2, R4	19A700106P63	Composition; 1 K ohms ±5%, 1/4 W
R5	19A701250P347	Metal film; 30.1 K ohms ±1%, 1/4 W
R6, R43 thru R46	19A701250P218	Metal film; 1.5 K ohms ±1%, 1/4 W
R7, R78	19A701250P269	Metal film; 5.11 K ohms ±1%, 1/4 W Note: R78 used in -G1 only
R8 thru R19, R26, R49	19A700106P111	Composition; 100 K ohms ±5%, 1/4 W
R20, R22, R24, R25	19A116278P101	Metal film; 100 ohms ±2%, 1/2 W
R21, R23	19A701250P1	Metal film; 10 ohms ±1%, 1/4 W
R27, R32, R39, R93	19A701250P401	Metal film; 100 K ohms ±1%, 1/4 W
R28, R33, R36, R40	19A701250P139	Metal film; 249 ohms ±1%, 1/4 W
R29, R34, R37, R41, R55, R59, R65, R81, R82	19A701250P330	Metal film; 20 K ohms ±1%, 1/4 W
R30, R35, R38, R42, R50, R53, R56 thru R58, R60, R66, R70, R72, R75, R77, R80, R83, R88, R89	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W
R31,R64*,R86,R87	19A701250P201	Metal film; 1 K ohms ±1%, 1/4 W

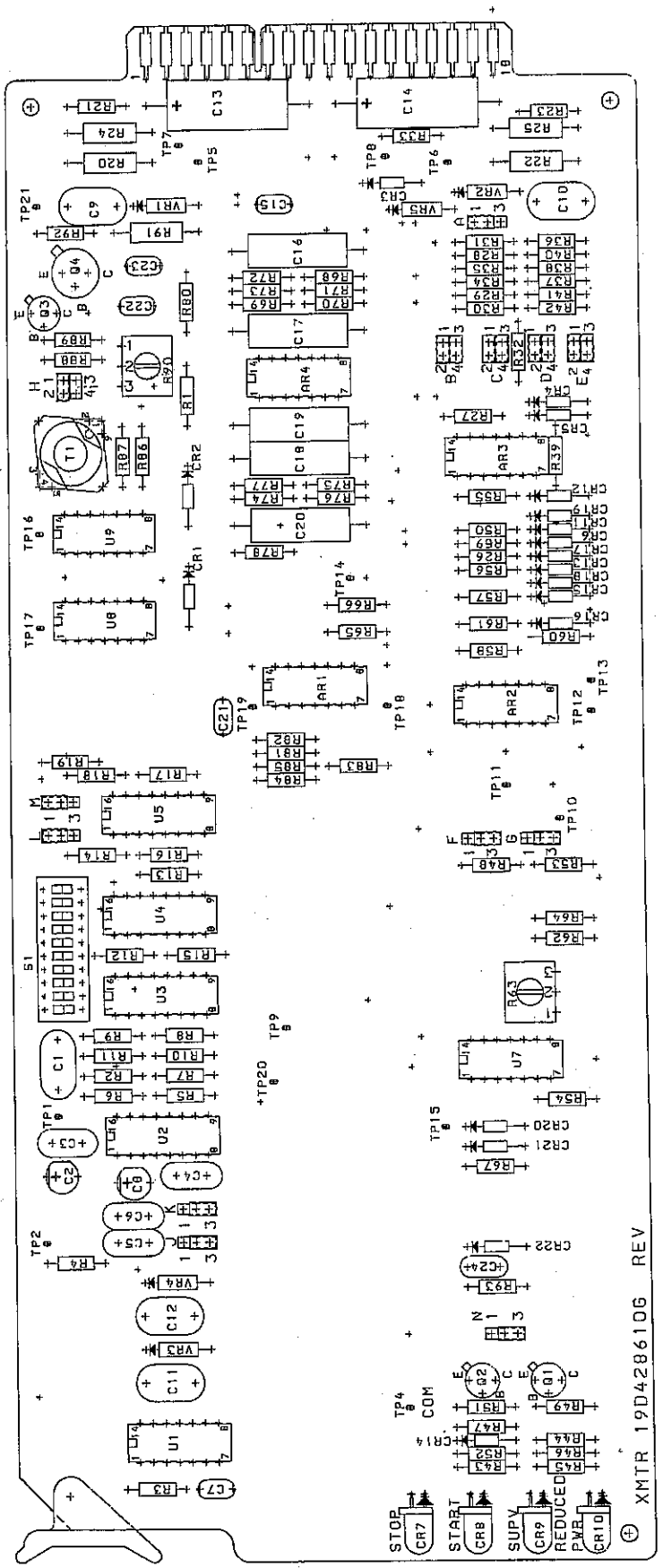
Symbol	GE Part No.	Description
R47	3R152P751J	Composition; 750 ohms ±5%, 1/4 W
R48	19A701250P285	Metal film; 7.5 K ohms ±1%, 1/4 W
R51 R52	19A700106P103	Composition; 47 K ohms ±5%, 1/4 W
R54	19A701250P310	Metal film; 12.4 K ohms ±1%, 1/4 W
R61	19A701250P288	Metal film; 8.06 K ohms ±1%, 1/4 W
R62	19A701250P327	Metal film; 18.7 K ohms ±1%, 1/4 W
R63	19A116559P118	Variably Cermet; 10 ohms to 5 K ohms ±20%, 1/4 W; 10% log taper
R68	19A701250P390	Metal film; 84.5 K ohms ±1%, 1/4 W Used in -G1 only
R68	19A701250P361	Metal film; 42.2 K ohms ±1%, 1/4 W Used in -G2 only
R69	19A701250P266	Metal film; 4.75 K ohms ±1%, 1/4 W Used in -G1 only
R69	19A701250P237	Metal film; 2.37 K ohms ±1%, 1/4 W Used in -G2 only
R71	19A701250P231	Metal film; 2.05 K ohms ±1%, 1/4 W Used in -G1 only
R71	19A701250P260	Metal film; 4.12 K ohms ±1%, 1/4 W Used in -G2 only
R73	19A701250P353	Metal film; 34.8 K ohms ±1%, 1/4 W Used in -G1 only
R73	19A701250P324	Metal film; 17.4 K ohms ±1%, 1/4 W Used in -G2 only
R74	19A701250P258	Metal film; 3.92 K ohms ±1%, 1/4 W Used in -G1 only
R74	19A701250P229	Metal film; 1.96 K ohms ±1%, 1/4 W Used in -G2 only
R76	19A701250P268	Metal film; 4.99 K ohms ±1%, 1/4 W; Used in -G1 only
R76	19A701250P296	Metal film; 9.76 K ohms ±1%, 1/4 W Used in -G2 only
R78	19A701250P240	Metal film; 2.55 K ohms ±1%, 1/4 W Used in -G2 only
R84, R85	19A701250P212	Metal film; 1.3 K ohms ±1%, 1/4 W
R90	19A116559P127	Variable, Cermet; 75 ohms to 100 K ohms ±20%, 1/4 W; 10% log taper
R91	19C314256P33830	Metal film; 383 ohms ±1%, 1/2 W
R92	19A701250P118	Metal film; 150 ohms ±1%, 1/4 W
		- - - - - - - - - SWITCH - - - - - - - - - -
S1	19B800010P1	Push; 10 stations (1-10); sim CTS 206-10
		- - - - - - - - TRANSFORMER - - - - - - - - -
T1	PL-19B221765G1	Transformer
		- - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A134097P2	Digital MOS; Quad 2-input NOR gate; sim 4001
U2	19A134097P38	Digital MOS; Micropower phase-locked loop; sim 4046
U3 thru U5	19A134097P217	Digital MOS; Programmable divide-by-N-4 bit counter (binary); sim 4526
U7, U9	19A134097P52	Digital MOS; Quad bi-lateral switch; sim 4066
U8	19A134097P11	Digital MOS; Dual "D" flip-flop with set/reset; sim 4013

PART LIST

Symbol	GE Part No.	Description
AR1, AR4	19A116297P5	Quad Operational Amplifier; sim LM248J
AR2, AR3	19A134511P1	Quad Operational Amplifier; sim NSCLM 224J or Motorola MLM 224L
		- - - - - - VOLTAGE REGULATOR - - - - - - - -
VR1 thru VR4	4036887P6	Silicon, Zener diode; sim 1N5234
VR5	4036887P5	Silicon, Zener diode; sim 1N5232B
		- - - - - - - - CONNECTORS - - - - - - - - -
---	19A134152P124	Printed wiring, two-part; 2 circuits; Gold; sim Molex 22-10-2021
---	19A134152P125	Printed wiring, two-part; 3 circuits; Gold; sim Molex 22-10-2031
---	19A134448P2	Dummy plug; 2 position shorting; Gold; sim Berg 65474-002

TYPICAL TRANSMITTER TEST POINT READINGS

TEST POINT	READING
TP1	500 Hz Square Wave 11.0 Volts, peak to peak
TP2	1000 Hz Square Wave 11.0 Volts, peak to peak
TP5, 7 TP6, 8	+6.5 VDC -6.5 VDC
TP9	200 Hz, Signaling ON, -6.1 VDC 200 Hz, Signaling OFF, +5.8 VDC
TP12	Carrier ON, +4.4 VDC Carrier OFF, -6.8 VDC
TP13	Reduced Power ON, +4.8 VDC Reduced Power OFF, -6.2 VDC
TP15	200 Hz, Signaling ON, -6.2 VDC 200 Hz, Signaling OFF, -4.6 VDC
TP16, 17	Carrier Frequency Square Wave, 12 Volts, peak to peak
TP20	Modulator Output Frequency, 7.0 Volts, peak to peak (Rounded Square Wave) 2.5 Volts RMS, approx.
TP21	Transmitter Line Frequency, 3.0 Volts, peak to peak (Rounded Square Wave), 1.0 Volts RMS, approx.

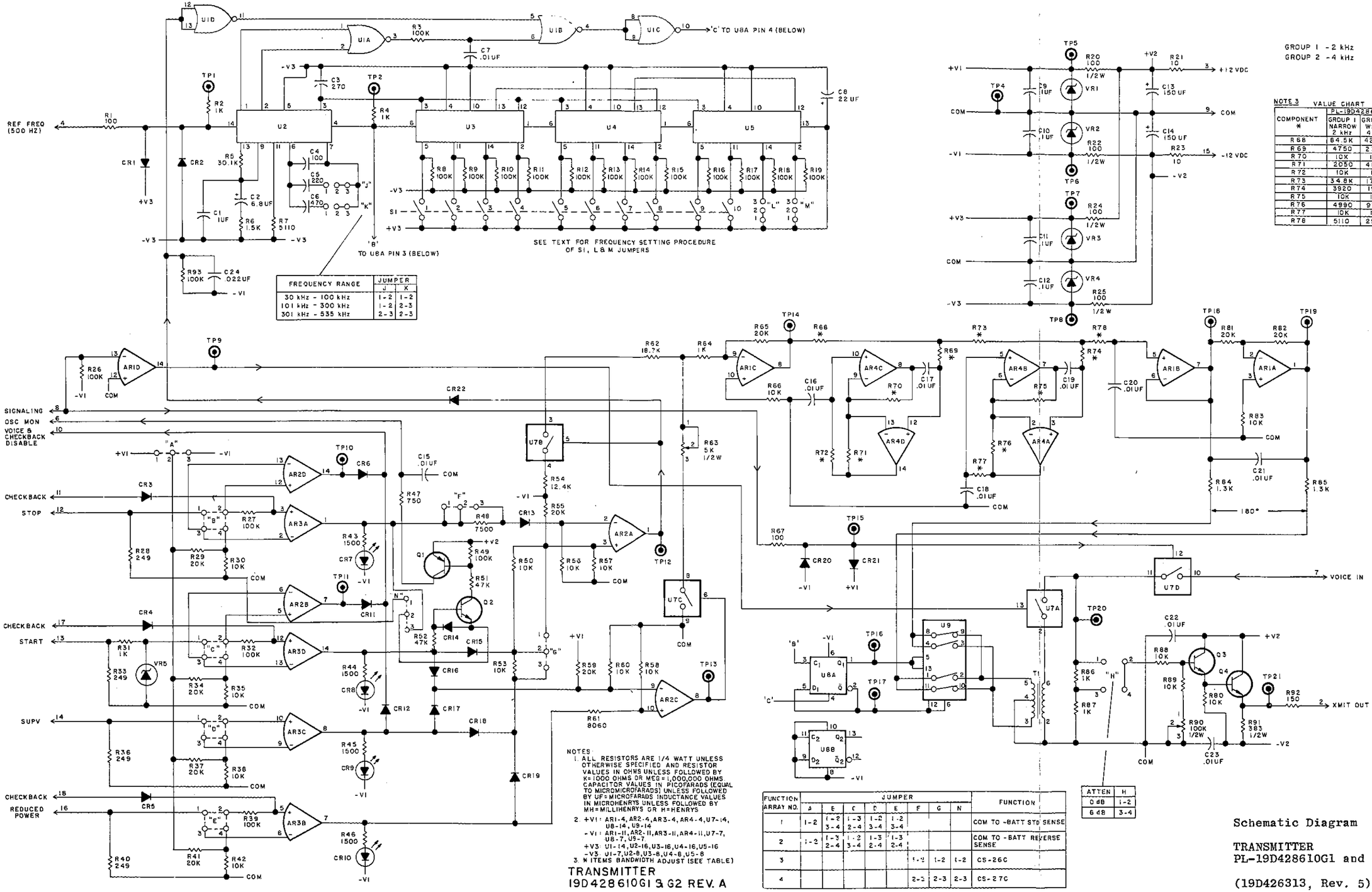


TRANSMITTER
19D428610G1 & G2 REV. A

Pictorial Diagram

TRANSMITTER
PL-19D428610G1 and -G2

(19D428612, Rev. 2)



Schematic Diagram

TRANSMITTER
PL-19D428610G1 and -G2

(19D426313, Rev. 5)

PRODUCTION CHANGES

TRANSMITTER
PL-19D428610G1 and -G2

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428610G1 and -G2, Rev. A

Purpose: To provide unblocking system function.

Part Changed	Was	Changed To
R62	19A701250P301 (10 K ohms)	19A701250P327 (18.7 K ohms)
R64	19A701250P301 (10 K ohms)	19A701250P201 (1 K ohms)

INSTRUCTIONS

TYPE CS-26C/27C 10 WATT POWER AMPLIFIER
PL-19D428607G1 and -G2, REV. B

GENERAL

The 10 watt power amplifier is a plug-in module that occupies the J7 position in the CS26C/27C shelf. The amplifier is driven from the RF Interface module and has an input impedance of 150 ohms. The maximum output is 10 watts into 50 ohms. The output level is set using the level adjustment (R90) located in the Transmitter module.

The Amplifier is equipped with overload protection, both voltage and current, along with an optional full power alarm relay (-G2 only). The relay contacts can be connected (with a soldered strap) for normally open or normally closed condition.

Located on the front of the module, the top LED indicates an overload condition and the lower LED indicates RF ON being transmitted. Also on the front, the RF Input test point (TP1) and circuit common test point (TP2), are located.

The frequency range of the amplifier is 30 kHz to 535 kHz. The output impedance is nominally 50 ohms. The ten watts output into 50 ohms is approximately 22 VRMS or 61 VPP. The amplifier output drives either a hybrid or a filter in the RF Interface Unit.

The output power transistors are mounted on a heat sink attached to the solder side of the printed board. The heat sink has two parts, the small thick plate and the long thinner plate. The long plate can be removed to allow access to the rear of the printed board without unsoldering the power transistors. The smaller heat sink is adequate for normal room ambient operation.

DESCRIPTION

The input to the power amplifier comes from the harmonic filter (FL1) located on the RF Interface module to Pin 13 of J7. The input level is adjusted for a system output of ten watts and is nominally 0.4 VRMS. The RF signal is amplified by the Q1 stage and fed into a differential amplifier Q4 and Q5 through Q2. Q3 is a current source for the differential amplifier. The collectors of Q4 and Q5 provide a low impedance drive source 180° out of phase for the output power transistors Q6 and Q7.

The output stages are Class B amplifiers operating between -12 VDC and +12 VDC into a center tapped transformer T1. The output transformer has a 3 to 1 step-up ratio with the output going to Pin 6 of J7. The TP3 is the output test point located near the output transformer.

Negative feedback is used in the amplifier design to establish an output impedance of 50 ohms. The feedback circuit consists of R25, L5, C10, R9, C3 and R20. The feedback is from the output back to the base of Q5.

There are two methods used to protect the amplifier against overload from a mis-terminated load or excessive drive. One method is monitoring the DC current in the output transistors. Since the power stages are Class B, the DC current supplied to the stages increases with drive. The current is sensed across R35 in the negative supply lead compared at the inputs of AR1-A. The DC current at full load condition is nominally one amp. If the voltage drop across R35 exceeds the diode voltage drop of CR5, the amplifier goes into protection.

The other protection used in conjunction with RF ON indication is sensing of the output voltage level with the circuit of R31, C16, R32, CR2, C17 and R33. This circuit is a half wave rectifier. The voltage at TP6 is compared with the voltage drop of VR1 (6.5V) at the input of AR1-B. If the voltage at TP6 exceeds the VR1 drop, the amplifier goes into protection. The threshold of this circuit is set to go into protection at an output voltage of about 28 V RMS.

The RF ON alarm compares the voltage at TP6 with a derived voltage from the divider R36 and R37 at the input of AR1-D. Components R26, R40, CR10 and C13 delay the RF ON alarm for about 20 ms. The output of AR1-D (TP8) switches positive with full power, energizing CR7 and (in -G2) turning ON Q9 which picks up K1. The RF ON indication is energized at about the 2 watt level.

The protection of the amplifier is accomplished by taking the positive output of either AR1-A or AR1-B and switching AR1-C positive which, in turn, turns ON Q8. Q8 shunts the incoming RF through R3 to common thus reducing the drive and the overload. C15 delays the resetting of AR1-C which has the effect of sampling RF output at a slow rate. When the cause of the overload is corrected, the amplifier will return to full power.

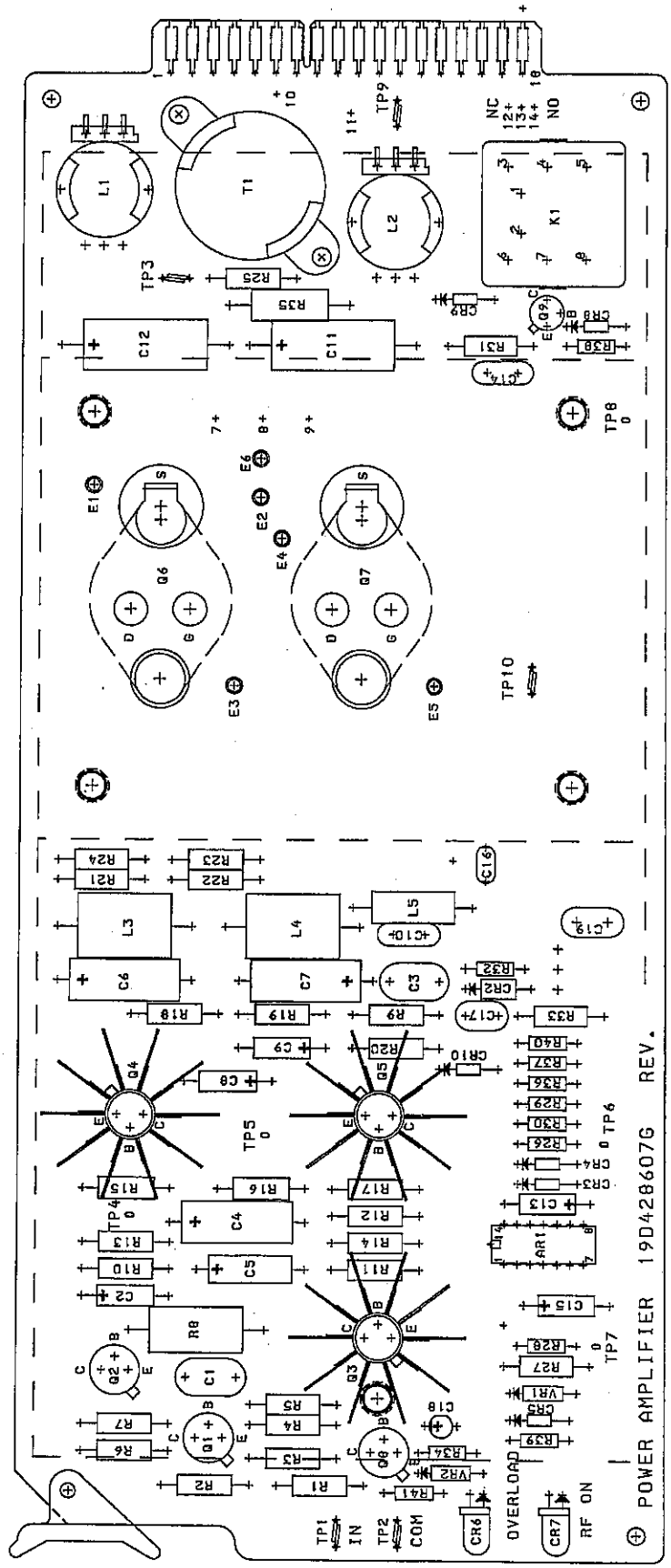
PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - - CAPACITORS - - - - - - -
C1, C3	19A116080P107	Polyester; 0.1 µF ±10%, 50 VDCW
C2, C8, C9, C13 C15	5496267P17	Tantalum; 1 µF ±20%, 35 VDCW
C4, C6, C7	5496267P15	Tantalum; 47 µF ±20%, 20 VDCW
C5	5496267P10	Tantalum; 22 µF ±20%, 15 VDCW
C11, C12	5496267P16	Tantalum; 100 µF ±20%, 20 VDCW
C14, C10*	5490008P119	Mica; 47 pF ±10%, 500 VDCW
C16	19A116080P14	Polyester; 0.0033 µF ±20%, 50 VDCW
C17	19A116080P5	Polyester; 0.047 µF ±20%, 50 VDCW
C18	19A134202P114	Tantalum; 1 µF ±10%, 35 VDCW
		- - - - - - - - - - - DIODES - - - - - - - - -
CR2	4037822P1	Silicon, rectifier; sim 1N5060
CR3 thru CR5, CR8 thru CR10	19A115250P1	Silicon, fast recovery; sim 1N4152 Note: CR8, CR9 used in -G2 only
CR6, CR7	19A134354P1	Optoelectronic; red, wide angle; sim HP 5082-4655
		- - - - - - - - - - - RELAY - - - - - - - - -
K1	19B209598P1	Enclosed; 24 VDC; coil, 600 ohms ±10%; pull-in, 19.2 VDC max; contacts, 2 form C; sim Guardian Elect. 1365 PC-2C-24D. Used in -G2 only
		- - - - - - - - - - - COILS - - - - - - - - -
L1, L2	PL-19B221763G1	Coil
L3, L4	7491382P105	RF Coil
L5	7488079P48	RF Coil
		- - - - - - - - - TRANSISTORS - - - - - - - -
Q1 thru Q5, Q8	19A115300P2	Silicon, NPN; sim 2N3053
Q6, Q7	19A143816P1	Field effect, type N; sim Hitachi 2SK135
Q9	19A116755P1	Silicon, NPN; sim 2N3947; Used in -G2 only
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A116278P117	Metal film; 147 ohms ±2%, 1/2 W
R2, R9, R12 R27	19A116278P201	Metal film; 1 K ohms ±2%, 1/2 W
R3	19A116278P129	Metal film; 196 ohms ±2%, 1/2 W
R4	19A116278P277	Metal film; 6.19 K ohms ±2%, 1/2 W
R5	19A116278P157	Metal film; 383 ohms ±2%, 1/2 W
R6	19A116278P329	Metal film; 19.6 K ohms ±2%, 1/2 W
R7	19A116278P169	Metal film; 511 ohms ±2%, 1/2 W
R8	19A116479P2102K	Metal film; 1 K ohms ±10%, 2W
R10	19A116278P245	Metal film; 2.87 K ohms ±2%, 1/2 W
R11, R31	19A116278P229	Metal film; 1.96 K ohms ±2%, 1/2 W
R13, R14	19A116278P133	Metal film; 215 ohms ±2%, 1/2 W

Symbol	GE Part No.	Desrciption
R15, R16	19A700113P7	Composition; 4.7 ohms ±5%, 1/2 W
R17	19A116278P53	Metal film; 34.8 ohms ±2%, 1/2 W
R18, R19	19A116278P101	Metal film; 100 ohms ±2%, 1/2 W
R20, R22, R23	19A116278P237	Metal film; 2.37 K ohms ±2%, 1/2 W
R21, R24	19A116278P393	Metal film; 90.9 K ohms ±2%, 1/2 W
R25	19A116278P261	Metal film; 4.22 K ohms ±2%, 1/2 W
R26, R29, R30	19C314256P22003	Metal film; 200 K ohms ±1%, 1/4 W
R28*, R39*	19A701250P261	Metal film; 4.22 K ohms ±1%, 1/4 W
R32*	19A701250P169	Metal film; 511 ohms ±1%, 1/4 W
R33	19A116278P381	Metal film; 68.1 K ohms ±2%, 1/2 W
R34*	19A701250P330	Metal film; 20 K ohms ±1%, 1/4 W
R35	19B209022P107	Wirewound; 0.47 ohms ±10%, 2W
R36*	19A701250P288	Metal film; 8.06 K ohms ±1%, 1/4 W
R37*	19A701250P213	Metal film; 1.33 K ohms ±1%, 1/4 W
R38*, R40*	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W Note: R38 used in -G2 only
R41*	19A701250P233	Metal film; 2.15 K ohms ±1%, 1/4 W
		- - - - - - - - TRANSFORMER - - - - - - - - -
T1	PL-19B221756G1	Output Transformer
		- - - - - - - VOLTAGE REGULATOR - - - - - - -
VR1	4036887P6	Silicon, Zener diode; sim 1N5234
VR2	4036887P1	Silicon, Zener diode; sim 1N5221B
		- - - - - - - INTEGRATED CIRCUIT - - - - - - -
AR1	19A134511P1	Quad Operational Amplifier; sim NSCLM 224J or Motorola MLM224L

TEST POINT READINGS	
TP1 to TP10 (Common)	Carrier Line Freq. sine wave; 0.530 volts rms
TP3 to TP10 (Common)	Carrier Line Freq. sine wave; 22.0 volts rms

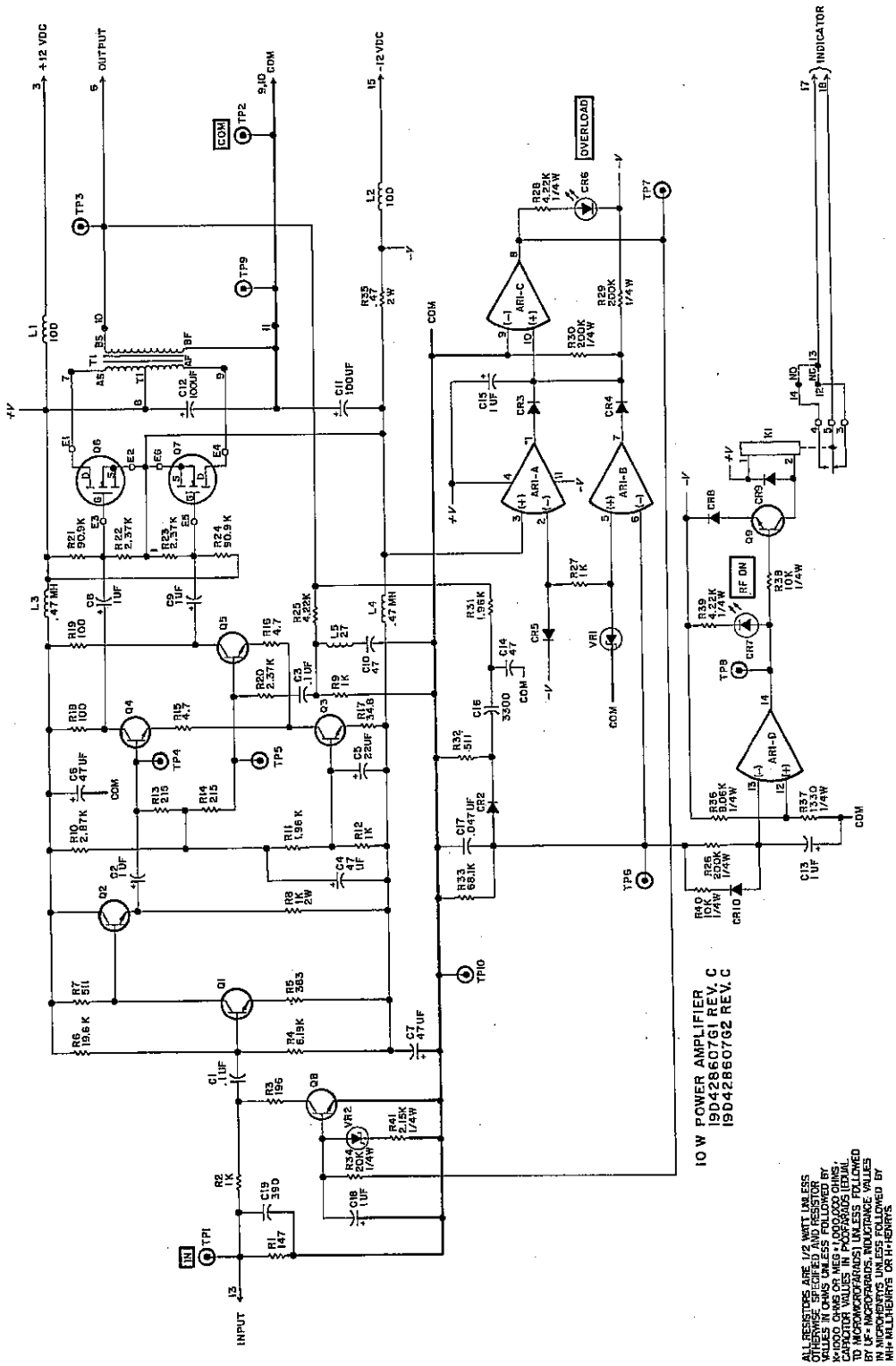
POWER AMPLIFIER
19D428607G1 REV.C
19D428607G2 REV.C



Pictorial Diagram

10 WATT POWER AMPLIFIER
PL-19D428607G1 and -G2

(19D428609, Rev. 4)



Schematic Diagram

10 WATT POWER AMPLIFIER
PL-19D428607G1 and -G2

(19D428665, Rev. 6)

PRODUCTION CHANGES

10 WATT POWER AMPLIFIER
PL-19D428607G1 and -G2

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428607G1 and -G2, Rev. A

Purpose: To provide unblocking system function.

Part Changed	Was	Changed To
R37	19A701250P259 (4.02 K ohms)	19A701250P221 (1.62 K ohms)

PL-19D428607G1 and -G2, Rev. B

Purpose: To provide fixed overload threshold.

Part Changed	Was	Changed To
R32	19A116559P104	19A701250P169; Metal Film, 511 ohms ±1%, 1/4 W
R37	19A701250P221 (1.62 K ohms)	19A701250P213 (1.33 K ohms)
C10	5490008P107 (12 pF)	5490008P119 (47 pF)

PL-19D428607G1 and -G2, Rev. C

Purpose: Improve stability.

Part Changed	Was	Changed To
C19		B7489162P41 to G2

INSTRUCTIONS

100 WATT AMPLIFIER
PL-19D426138G1, REV. F
PL-19D426138G2, REV. G

INTRODUCTION

The Power Amplifier PL-19D426138 is a fully transistorized, wideband, Class AB amplifier. It will deliver 100 W into a 50 ohm resistive load. The amplifier utilizes the latest technology by using power FET's (Field Effect Transistor) for the output stage. It is intended to boost the power of single function equipment such as CS26C/27C, CT51B/61A/71A etc. The amplifier can be powered directly from the station battery (48V G1 & 125V G2) without a converter. The overall frequency range is 30 kHz to 535 kHz, which is divided into 10 sub-ranges according to frequency of the output protection filter (FL80).

DESCRIPTION

The Power Amplifier is housed in a shelf that will fit a standard 19" (483 mm) rack and is 6 RU High (1 RU = 1.75") (44.5 mm). Two mounting rail positions are available: one for flush mounting and the other with rails recessed by 6.75" (171.5 mm).

At the lower front portion are the controls such as battery power switch, fuses, test points, battery voltage, RF output and indicator lights. At the lower rear portion are all the connectors (Input, RF, meter and receive) and the terminal board for battery power and the optional RF-ON relay contacts.

The actual power amplifier assembly contains a large printed circuit (PC) board with the four power transistors (and their heat sinks) as a integral part of the unit. It is mounted to the shelf from the rear, wired to the power supply and the controls within the shelf.

In the shelf are the power supply, protection filter and an optional impedance matching transformer. Access to the interior of the shelf is gained by detaching a perforated front cover.

G1 is used with a 48 VDC Station (Source) Battery Voltage*

G2 is used with 125 Station (Source) Battery Voltage

NOTE: For 250 VDC operation, a converter is required.

Available Optional Features Include:

Alarm/Indicator: Contains a plug-in RF-ON indication relay and circuitry.

Impedance Matching Transformer: (Option S009 for CS26C/27C only) contains an impedance matching transformer for matching the output to 50, 75, 100, 125 or 150 ohms.

* Floating or either polarity grounded

OPERATION

A. Power Supply

The POWER switch in the lower front of the shelf supplies the amplifier with battery power. The fuses protect the amplifier from short circuits and the PWR-ON indicator (yellow light emitting diode, LED) gives a positive indication of the presence of battery power. Two test points permit measurement of the exact value of the battery voltage. Filtering (L/C 210/211) will prevent transients on the battery lines from reaching the amplifier as well as RF from the amplifier leaking to the battery lines.

A "STEP" regulator on the power supply board lowers the supply voltage to the amplifier when the battery voltage exceeds the nominal value. This will lower the power dissipation in the output transistor at high battery voltages (equalizing of battery cells).

The operational amplifier AR230 serves as a threshold switch. At low to nominal battery voltage the output of AR230 is high. This turns Q230, Q231 and Q232 on thus shunting out the resistors between input and output of the power supply. The current demanded by the amplifier determines the voltage drops at the output (refer to nominal operating characteristics included in this instruction for values).

In G2 Power Supply (125 VDC) Q225 protects Q231 from excessive power dissipation in case of a DC short circuit in the amplifier.

Diodes CR210/211 protect the amplifier from applied incorrect polarity of the battery voltage, by blowing the fuses.

B. Amplifier

The connector J1, IN (rear of amplifier) accepts the signal from the single function equipment. When low level input equipment is used, the input attenuator is bypassed (Jumper F & G from 1 to 2). When high level input equipment is used the attenuator is inserted (Jumper F & G from 2 to 3). See nomimal operation characteristics for specifications. Transformer T1 provides HI-POT isolation between the ground referenced input and battery referenced amplifier circuitry.

Q1 and Q2 forms a pre-amplifier that provides isolation and impedance matching between the input and the driver. Q20 through Q23 forms the phase inverters and drivers for the output stage. Actually it

is two individual driver stages (Q20/21 and Q22/23) that are connected in series, DC wise, to conserve current drain. Both the preamplifier and driver are supplied from a voltage regulator which compensates for the voltage variation across the permissible battery voltage range (Refer to nominal operating characteristics included in this instruction for values).

In -G1, Q40 through Q43 form a Class AB push-pull output stage with R48 controlling the DC bias.

In -G2, Q40 through Q43 form a Class AB bridge amplifier output stage with R66, Q60 and Q70 providing the necessary DC biasing (center voltage and current control).

Transformers T80 and T81 form a skewed hybrid at the output of the amplifier and also provide HI-POT isolation. The protection filter FL80 limits the noise and transients from the power line that reach the amplifier. There are 10 different filters to cover the frequency range of 30 to 535 kHz. The gas protector E90, eliminates transients from the RF line.

The protection circuit (AR130) protects the amplifier from abnormal conditions such as a direct open or short circuited or excessive input level (overdrive) by squelching the input signal.

NOTE

Opening or shorting the RF output beyond the RF Bandpass Filter (or optional T1 Matching Transformer), may not trigger the overload protection. Sufficient impedance may exist due to the interposing circuitry such that this external open/short condition is not detectable. This impedance however will protect the amplifier against the abnormal condition.

The voltage threshold switch AR130A, switches from low to high, when the output voltage on transformer T80 exceeds approximately 85 VRMS. This can be due to an open RF line or excessive input level. The high output at AR130A will switch AR130D to high which will turn on Q155. The Q155 will short circuit the input of Q1 and Q2, thus eliminating the over voltage condition. The squelch will last for approximately 50 ms and then sample again. It will sample and squelch (pulsating) until the over voltage condition clears.

The current threshold switch ARC130C does essentially the same for the DC current which will be indicated by a Red LED in the lower front of the shelf.

The AR130B is a voltage threshold switch (similar to AR130A) that will go high, when the line frequency output voltage is approximately 22 VRMS (10 W @ 50 ohms). This means that the line frequency is ON which is indicated by a Red LED in the lower front of the amplifier shelf. NOTE: The threshold can be adjusted to switch at a different level (e.g. between 5 to 50W) by changing the setting of R125. On certain models, an auxiliary board can be plugged into the amplifier board, which will give a C contact action for the customer's use.

Since this amplifier has been designed for a 50 ohm output impedance, an optional impedance matching transformer can be used to match the desired line impedance (Refer to nominal operating characteristics included in this instruction for rating).

ADJUSTMENT

All necessary adjustments for normal operation of the amplifier have been made by the manufacturer. However for routine maintenance, or realignment after changing components, the following maintenance steps are provided.

MAINTENANCE

With No input signal (standby condition) measure DC current: approximately 300 mA; however, if no ampere meter is available, the voltage from TP40 to TP170 can be measured. For G1: 0.02 VDC; for G2: 0.06 VDC.

At nominal battery voltage (50 VDC for G1 and 130 VDC for G2) TP20 should read 41 VDC for G1 and 46 VDC for G2 with TP40 as reference.

The voltage drop (standby) across the power supply (Q231 C to E) should be less than 1V for G1 and 5V for G2 (Q231 is off).

At full power (71 VRMS @ 50 ohm load) the voltage drop across the power supply (Q231 C to E) should be less than 7.5V for G1 and 25V for G2. Also check the input level from TP2 to TP1 (Ground). It should be between 0.4 VRMS and 0.6 VRMS (See Table 1).

TABLE 1

FREQUENCY	INPUT VOLTAGE RMS (APPROX.)
30 kHz	.4
100 kHz	.42
200 kHz	.45
300 kHz	.48
400 kHz	.51
500 kHz	.57
550 kHz	.61

REALIGNMENT

Should it be necessary to replace components, particularly one of the output transistors, it may become necessary to readjust the amplifier for the best performance.

First, all the maintenance chesks should be performed (described previously). Second, the harmonics should be measured. If they are not adequate the following steps can be taken.

a. Check whether the frequency used falls within the range indicated on the protection filter (FL80).

b. Apply full power (71 VRMS @ 50 ohm load).

c. With selective voltmeter or spectrum analyzer read the harmonics. They should be 50 dB down (.24 VRMS at 50 ohm load) but not more than 55 dB.

d. If the second harmonic is higher than that, select jumpers B through E (one at a time) on the amplifier board and adjust R34 for lowest harmonic level. It may require one or more jumpers to be moved with readjustment of R34 each time.

e. If a transistor is defective in the driver or the output stage, the second harmonic will be down only 20 or 30 dB. This cannot be corrected with above procedure.

TABLE 2

TEST POINT READINGS	
TP2 to TP1	Between 0.4 VRMS and 0.6 VRMS (See Table 1 in Text)
TP20 to TP40 (COM)	G1 (48V) = 40V nominal G2 (125V) = 46V nominal } Adjusted by Jumper A
"TP170-TP40"	No signal in G1 = 0.020 VDC / G2 = 0.060 VDC

TABLE 3

JUMPER ARRAY TABLE FOR AMPLIFIER BOARD		
Jumper	Position	Function
A	1,2,3 or 4	Used to adjust TP20 nominal DC voltage level. (See Test Point Chart)
B,C,D,E	1-2 or 2-3	Used for second harmonic adjustment. (See text)
F & G (Both)	1-2	For use with low level input equipment.
	2-3	For use with high level input equipment.

NOMINAL OPERATING CHARACTERISTICS

1. DC Input

		G1	G2
* Station Battery Voltage	Range	42 to 56 VDC	103 to 142 VDC
	Nominal	50 VDC	130 VDC
Current Drain	Standby	0.3 A	0.3 A
	Full Power	3.8 A	1.6 A
Step Regulator in Power Supply: Resistor switched IN (Q231 OFF)		>49 VDC	129 VDC
OUT (Q231 ON)		<48.8 VDC	128 VDC

* Battery can be floated or either polarity can be grounded.

2. RF Input

	Low Level	High Level
Input Impedance	150 ohms	50 ohms
Attenuator:	W/O	W
Input Level Maximum (At J1, IN)	.6 VRMS (+4 dBm)	16 VRMS (+37 dBm)
Nominal Input Level (At TP1 & TP2)	See Table 1	

3. RF Output

Impedance	50 ohms
Output Power (Into 50 ohm resistive)	100 W (71 VRMS)
Frequency Range	30 kHz to 535 kHz
Receive Port of Hybrid:	
Impedance	50 ohms
Insertion Loss	14 dB
Transhybrid Loss (at 50 ohm resistive)	30 dB min.

4. Options

a. RF-ON Alarm/Indicator

Form C - Contact Rating	100 VA

b. Impedance Matching Transformer

Input Impedance	50 ohms
Input Power	100 W max.
Output Impedance (Strappable)	50, 75, 100, 125, 150 ohms

PARTS LIST

FRONT PANEL

Symbol	GE Part No.	Description
		- - - - - - - - - - - - FUSES - - - - - - - - - - -
F200, F201	7102673P6	Cartridge; 32V, quick blowing; sim Littelfuse 311006 or Bussman, AGC6. Used in -G1 only.
F200, F201	1R16P6	Cartridge; 250V, quick blowing; sim Littelfuse, 312003 or Bussman AGC 3. Used in -G2 only.
		- - - - - - - - - - - FILTER - - - - - - - - - - -
FL80	PL-19C304999	Selected filter
		- - - - - - - - - - - - SWITCH - - - - - - - - - -
S200	19A116923P1	Toggle; DPST; sim Cutler-Hammer 8910K520
		- - - - - - - - CONNECTORS AND JACKS - - - - - -
J92	5490384P1	Jack tip; white; sim E.F. Johnson 105-251-1
J93	5490384P3	Jack tip; black; sim E.F. Johnson 105-253-1
		- - - - - - - - - - - - HOLDER - - - - - - - - - -
XF200, XF201	19B209005P1	Fuseholder; sim Littelfuse 342012
		AMPLIFIER BOARD
A1	PL-19D428939G1	100 Watt Amplifier Board, used in -G1 only.
A1	PL-19D428939G2	100 Watt Amplifier Board, used in -G2 only.
		POWER SUPPLY
A2	PL-19D428973G1	Power Supply, used in -G1 only.
A2	PL-19D428973G2	Power Supply, used in -G2 only.
		CONNECTOR PANEL
A3*	PL-19B230395G1	Connector Panel
		100 WATT AMPLIFIER BOARD (A1) PL-19D428939G1, REV. E PL-19D428939G2, REV. E
		- - - - - - - - INTEGRATED CIRCUIT - - - - - - - -
AR130	19A134511P1	Quad Operational Amplifier; linear; sim NSCLM224J or Motorola MLM224L

Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1, C2, C20 C24, C126, C155	19A116080P9	Polyester; 0.22 µF ±20%, 50 VDCW
C3, C4, C21, C25	5496267P19	Tantalum; 22 µF ±20%, 35 VDCW
C5	5491871P820G	Mica; 820 pF ±2%, 300 VDCW
C22, C26	5496267P10	Tantalum; 22 µF ±20%, 15 VDCW
C23*	5490008P144	Mica; 510 pF ±10%, 300 VDCW
C40 thru C43, C63	19A115028P16	Polyester; 0.22 µF ±20%, 200 VDCW Note: C63 used in -G2 only
C45	19A116080P11	Polyester; 0.47 µF ±20%, 50 VDCW
C49, C54	19A115028P12	Polyester; 0.068 µF ±20%, 200 VDCW Used in -G2 only
C50 thru C53	5490008P131	Mica; 150 pF ±10%, 500 VDCW
C60, C64	5491656P44	Polyester; 212 µF ±20% -0%, 200 VDCW
C81	4029003P101	Mica; 510 pF ±10%, 500 VDCW
C85	19A700105P6	Mica; 10 pF ±5%, 500 VDCW. Used in -G1 only.
C86, C120	5490825P3	Ceramic; 10,000 pF +100%, -10%; 2000 VDCW
C121	19A116080P1	Polyester; 0.01 µF ±20%, 50 VDCW
C143	5496267P9	Tantalum; 3.3 µF ±20%, 15 VDCW
C150	5496267P1	Tantalum; 6.8 µF ±20%, 6 VDCW
C160	5496267P15	Tantalum; 47 µF ±20%, 20 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR21 thru CR25, CR70 thru CR73, CR121, CR130, CR140	19A115250P1	Silicon, fast recovery; sim 1N4152 Note: CR70 thru CR73 used in -G2 only.
CR100	4037822P1	Silicon, rectifier; sim 1N5060
		- - - - - - - - - PROTECTOR - - - - - - - - -
E90	19A115751P1	Telephone; 230 VDC, 25 A; sim Siemens B1-A230
		- - - - - - - CONNECTORS AND JACKS - - - - - -
J1*,J91*,J95*	19A115938P11	Receptacle, coaxial; BNC series; sim Amphenol 31-3377
J90	2R22P3	Plug, receptacle, coaxial; sim Signal Corps SO-239 or Amphenol 83-1R
J300*, J301*	19A116659P150	Printed wiring, two-part; 10-contacts; sim Molex 09-80-1102
- - -	19A134152P125	Printed wiring; two-part; 3 circuits; sim Molex 22-10-2031
- - -	19A134152P126	Printed wiring; two-part; 4 circuits; sim Molex 22-10-2041
- - -	19A134448P2	Dummy plug; 2 shorted positions; sim Berg 65474-001
		- - - - - - - - - - - - COIL - - - - - - - - - - - -
L28, L30, L31, L33	7491382P109	RF

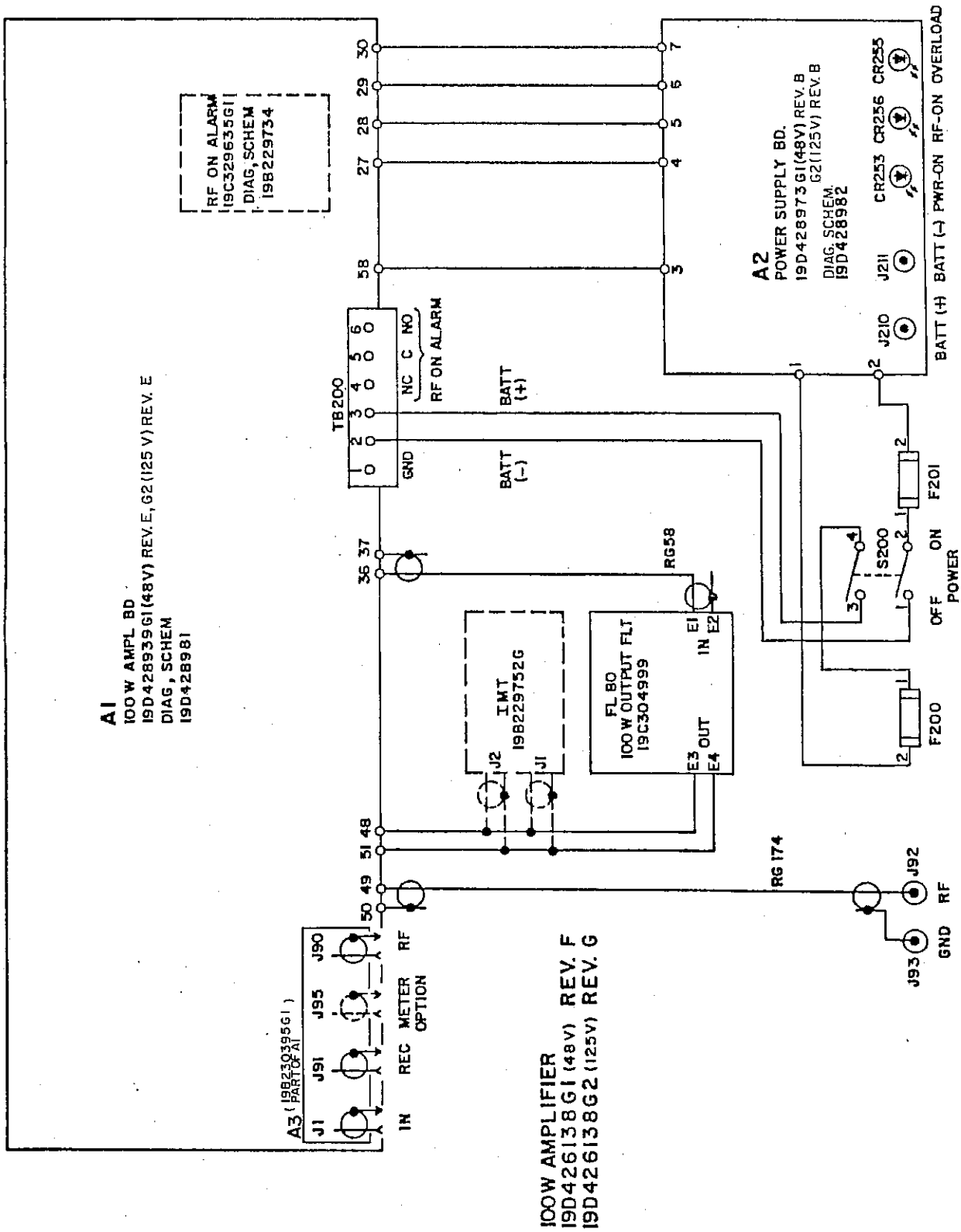
Symbol	GE Part No.	Description
		- - - - - - - - - TRANSISTORS - - - - - - - -
Q1, Q21, Q23 Q100	19A115562P2	Silicon, PNP, switch; sim 2N2904A Note: Q21 and Q100 used in -G1 only
Q20, Q22	19A115300P4	Silicon, NPN; sim 2N3053
Q21, Q100	19A134691P1	Silicon, PNP; switch; sim 2N5416 Used in -G2 only
Q40, Q41 Q42, Q43	19A143816P1	Field effect, N type; sim Hitachi 2SK135 Note: Q41 and Q42 used in -G1 only
Q41, Q42	19A143817P1	Field effect, P type; sim Hitachi 2SJ50 Used in -G2 only
Q60	19A116865P1	Silicon; NPN; sim 2N3712. Used in -G2 only
Q70	19A116330P1	Silicon, PNP, switch; sim 2N3636 Used in -G2 only
Q155	19A116755P1	Silicon; NPN; sim 2N3947
		- - - - - - - - - RESISTORS - - - - - - - - -
R2, R28, R33	19A701250P133	Metal film; 215 ohms ±1%, 1/4W
R3*, R7*	19A701250P217	Metal film; 1.47K ohms ±1%, 1/4W
R4*,R6*,R154*	19A701250P247	Metal film; 3.01K ohms ±1%, 1/4W
R5*,R61*,R71* R142*, R153*	19A701250P201	Metal film; 1K ohms ±1%, 1/4W Note: R61, R71 used in -G2 only
R8*, R9*	19A701250P112	Metal film; 130 ohms ±1%, 1/4W Used in -G1 only
R8*, R9*	19A701250P117	Metal film; 147 ohms ±1%, 1/4W Used is -G2 only
R12	2R14P18	Wirewound; 50 ohms ±5%, 25W
R13	19A116278P229	Metal film; 1.96K ohms ±2%, 1/2W
R14	19A701250P118	Metal film; 150 ohms ±1%, 1/4W
R15, R60 R108, R156	19A701250P1	Metal film; 10 ohms ±1%, 1/4W Note: R60 used in -G2 only; R108 used in -G1 only
R20*,R22*,R23*,R25* R28*, R33*	19A701250P233	Metal film; 2.15K ohms ±1%, 1/4W
R21*, R24*	19A701250P139	Metal film; 249 ohms ±1%, 1/4W Used in -G1 only
R21*, R24*	19A701250P147	Metal film; 301 ohms ±1%, 1/4W Used in -G2 only
R29*, R32*	19A701250P42	Metal film; 26.7 ohms ±1%, 1/4W Used in -G1 only
R29, R32	19A701250P50	Metal film; 32.4 ohms ±1%, 1/4W Used in -G2 only
R30*, R31*	19A701250P122	Metal film; 165 ohms ±1%, 1/4W
R34	19A116559P115	Variable, cermet; 7 ohms to 100 ohms ±20%, 1/2W, linear taper
R40 thru R45	19A116278P301	Metal film; 10K ohms ±2%, 1/2W Note: R41, R42 used in -G1 only; R44, R45 used in -G2 only
R46*	19A701250P333	Metal film; 21.5K ohms ±1%, 1/4W Used in -G1 only
R47*	19A701250P245	Metal film; 2.87K ohms ±1%, 1/4W Used in -G1 only
R48, R125*	19A116559P104	Variable, cermet; 10 ohms to 2.5K ohms ±20%, 1/2W, linear taper; R48 used in -G1 only

Symbol	GE Part No.	Description
R49*, R54*	19A701250P301	Metal film; 10K ohms ±1%, 1/4W Used in -G2 only
R50* thru R53*	19A701250P130	Metal film; 200 ohms ±1%, 1/4W
R61*, R71* R142*, R153*	19A701250P201	Metal film; 1K ohms ±1%, 1/4W Note: R61, R71 used in -G2 only
R62, R72	19A116278P201	Metal film; 1K ohms ±2%, 1/2W Used in -G2 only
R63, R73	19A116278P345	Metal film; 28.7K ohms ±2%, 1/2W Used in -G2 only
R64, R74 R75	19A116278P285	Metal film; 7.5K ohms ±2%, 1/2W Used in -G2 only
R65, R103, R105	19A116278P281	Metal film; 6.81K ohms ±2%, 1/2W Note: R65, R103, R105 used in -G2 only
R66	19A116559P102	Variable, cermet; 10 ohms to 5K ohms ±20%, 1/2W; linear taper. Used in -G2 only
R80	19A116363P102	Wirewound; 50 ohms ±5%, 50W
R81	19A116479P2300K	Metal film; 33 ohms ±10%, 2W
R85	19A116278P301	Metal film; 10K ohms ±2%, 1/2W Used in -G1 only
R85	19A116278P317	Metal film; 14.7K ohms ±2%, 1/2W Used in -G2 only
R86	19A116278P309	Metal film; 12.1K ohms ±2%, 1/2W Used in -G2 only
R86	19A116278P293	Metal film; 9.09K ohms ±2%, 1/2W Used in -G1 only
R95*, R96*	19A116278P277	Metal film; 6.19K ohms ±2%, 1/2W
R97*	19A701250P85	Metal film; 75 ohms ±1%, 1/4W
R100, R101 R112	19A116267P169	Metal film; 511 ohms ±2%, 1/2W Note: R100, R101 used in -G1 only
R102	2R12P27	Wirewound; 400 ohms ±5%, 10W Used in -G2 only
R103, R104	19A116278P261	Metal film; 4.22K ohms ±2%, 1/2W Used in -G1 only
R106	19A116278P1	Metal film; 10 ohms ±2%, 1/2W Used in -G1 only
R107	2R12P33	Wirewound; 1.6K ohms ±5%, 10W Used in -G2 only
R109	2R12P36	Wirewound; 3.1K ohms ±5%, 10W Used in -G2 only
R110	19A116278P141	Metal film; 261 ohms ±2%, 1/2W
R111	19A116278P69	Metal film; 51.1 ohms ±2%, 1/2W Used in -G1 only
R111	19A116278P77	Metal film; 61.9 ohms ±2%, 1/2W Used in -G2 only
R120	19A116278P365	Metal film; 46.4K ohms ±2%, 1/2W
R121	19A116278P205	Metal film; 1.1K ohms ±2%, 1/2W
R122	19C314256P23013	Metal film; 301K ohms ±1%, 1/4W
R123*,R124*,R130* R131*,R141*,R143* R151*,R155*	19A701250P330	Metal film; 20K ohms ±1%, 1/4W
R126*	19A701250P169	Metal film; 511 ohms ±1%, 1/4W
R132*	19A701250P269	Metal film; 5.11K ohms ±1%, 1/4W
R140*	19A701250P221	Metal film; 1.62 K ohms ±1%, 1/4W Used in -G1 only
R140*	19A701250P223	Metal film; 1.69 K ohms ±1%, 1/4W Used in -G2 only

Symbol	GE Part No.	Description
R144*	19A701250P447	Metal film; 301K ohms ±1%, 1/4W
R150	19C314256P22373	Metal film; 237K ohms ±1%, 1/4W
R152*	19A701250P247	Metal film; 3.01K ohms ±1%, 1/4W
R160	19A116278P157	Metal film; 383 ohms ±2%, 1/2W
R170 thru R172	549303P516	Wirewound; 0.2 ohms ±10%, 5W Note: R171 and R172 used in -G1 only
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	PL-19B221438G3	Transformer, isolation 1:1 ratio
T80	PL-19B221770G1	Transformer. Used in -G1 only
T80	PL-19B221770G2	Transformer. Used in -G2 only
T81	PL-19B221770G3	Transformer
T95*	PL-19B230359G1	Transformer, isolation
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1, VR2	4036887P1	Silicon, Zener diode; sim 1N5221B
VR40 thru VR43, VR50 thru VR53	4036887P6	Silicon, Zener diode; sim 1N5234 Note: VR41 thru VR43 used in -G2 only VR50 thru VR53 used in -G2 only
VR48, VR66 VR160, VR161	4036887P5	Silicon, Zener diode; sim 1N5232B Note: VR48 used in -G1 only; VR66 used in -G2 only
VR100	4036887P3	Silicon, Zener diode; sim 1N5228B

POWER SUPPLY (A2)
PL-19D428973G1 and -G2, REV. B

		- - - - - - - - INTEGRATED CIRCUIT - - - - - -
AR230	19A134511P1	Quad Operational Amplifier; linear; sim NSCLM224J or Motorola MLM224L
		- - - - - - - - - CAPACITORS - - - - - - - - -
C210, C211	19A134605P1	Paper-Liquid; 0.25 µF ±10%, 1500 VDCW
C230, C231	5496267P4	Tantalum; 330 µF ±20%, 6 VDCW
C237	19A116080P9	Polyester; 0.22 µF ±20%, 50 VDCW
C250	5493132P12	Electrolytic; 50 µF -10%, +50%, 250 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR210	5495922P1	Silicon, rectifier; sim 1N1200A Used in -G1 only
CR211, CR212 CR230, CR231	4037822P1	Silicon, rectifier; sim 1N5060 Note: CR211 and CR212 used in -G2 only
CR253	19A134354P2	Optoelectronic; yellow; wide angle; sim H-P 5082-4555
CR255, CR256	19A134354P1	Optoelectronic; red; wide angle; sim H-P 5082-4655
		- - - - - - - - - - JACKS - - - - - - - - - -
J210	19A116066P1	Jack tip; red; sim E.F. Johnson 105-0752-011
J211	19A116066P3	Jack tip; dark green; sim E.F. Johnson 105-0754-011



Schematic Diagram

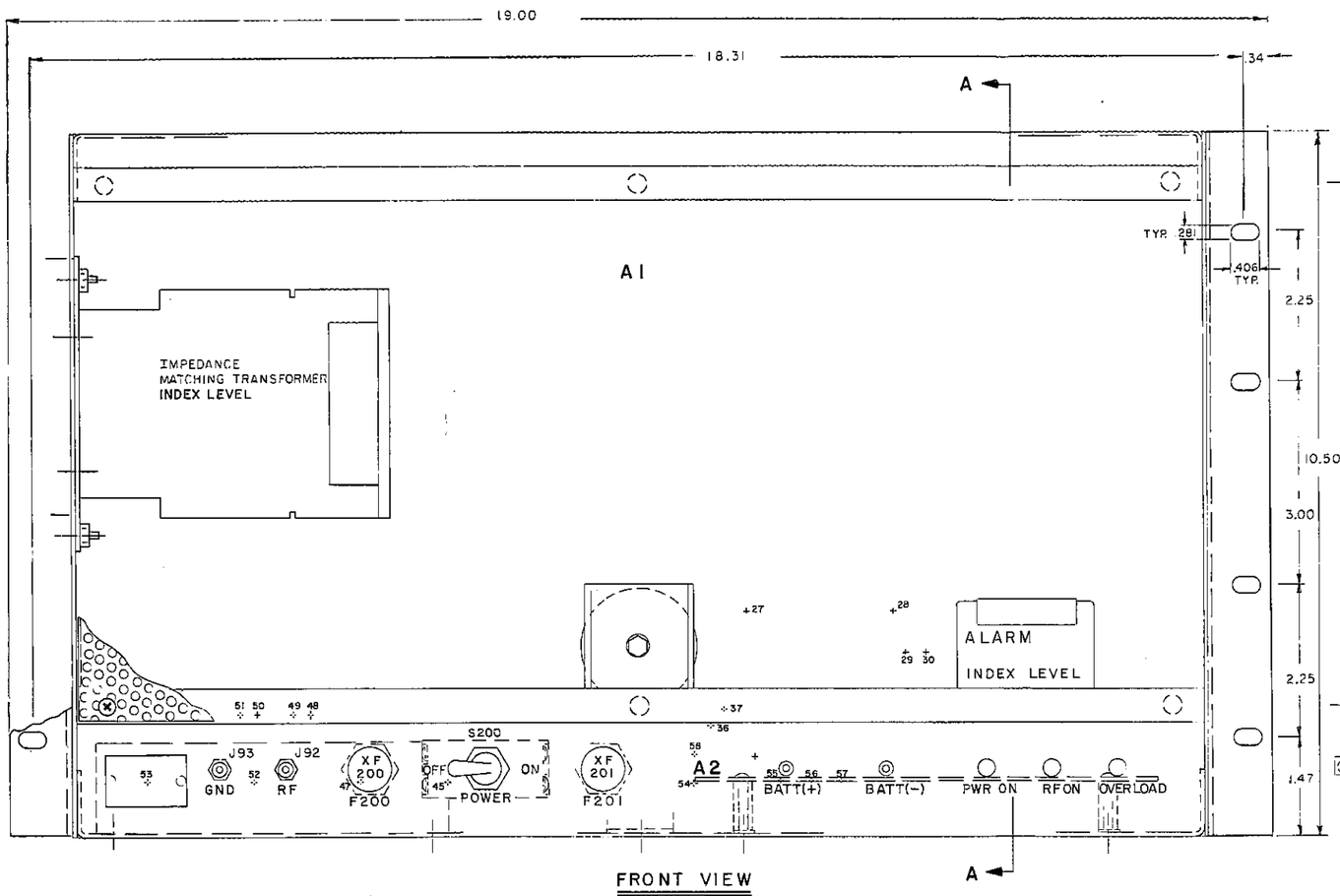
100 WATT AMPLIFIER
PL-19D426138G1 and -G2

(19D426279, Rev. 10)

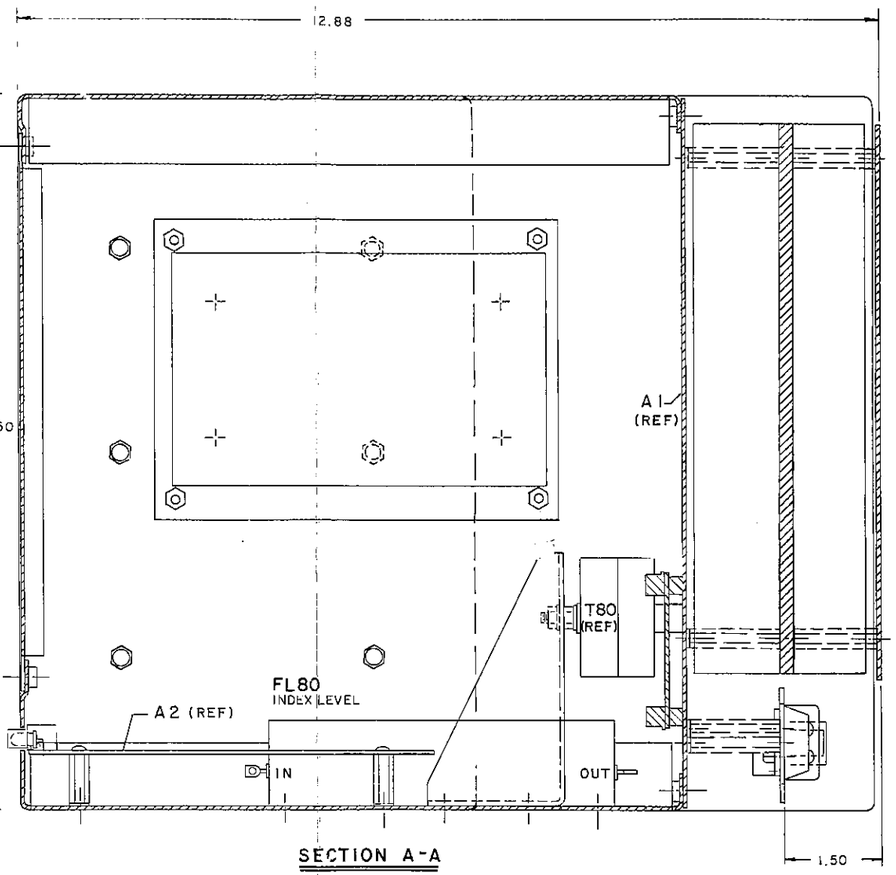
Symbol	GE Part No.	Description
		- - - - - - - - - - COILS - - - - - - - - - -
L210, L211	19A115392P1	RF
		- - - - - - - - - TRANSISTORS - - - - - - - -
Q225, Q230	19A134691P1	Silicon, PNP; switch; sim 2N5416 Used in -G2 only
Q230	19A115562P1	Silicon, PNP, switch; sim 2N2904A Used in -G1 only
Q231	19A116753P1	Silicon, NPN; sim 2N5302; Used in -G1 only
Q231	19A116757P1	Silicon, NPN; sim 2N5631; Used in -G2 only
Q232	19A115300P4	Silicon; NPN; sim 2N3053: Used in -G1 only
Q232	19A134637P1	Silicon; NPN, switch; sim 2N3440 Used in -G2 only
		- - - - - - - - - - RESISTORS - - - - - - - -
R210, R211, R231	19A116278P301	Metal film; 10K ohms ±2%, 1/2W Note: R231 used in -G1 only
R225*, R230*	19A701250P269	Metal film; 5.11K ohms ±1%, 1/4W Note: R225 used in -G2 only
R226	19A116278P257	Metal film; 3.83K ohms ±1%, 1/2W Used in -G2 only
R227	19A116278P201	Metal film; 1K ohms ±2%, 1/2W
R229*	19A701250P147	Metal film; 301 ohms ±1%, 1/4W
R231, R234, R235	19A116278P377	Metal film; 61.9K ohms ±2%, 1/2W Note: Used in -G2 only
R232*	19A116278P1	Metal film; 10 ohms ±2%, 1/2W
R233*	19A701250P317	Metal film; 14.7K ohms ±1%, 1/4W
R235	19A116278P285	Metal film; 7.5K ohms ±2%, 1/2W Used in -G1 only
R236*	19A116278P293	Metal film; 9.09K ohms ±2%, 1/2W Used in -G1 only
R236*, R244*	19A116278P369	Metal film; 51.1K ohms ±2%, 1/2W Used in -G2 only
R237	19A701250P271	Metal film; 5.36K ohms ±1%, 1/4W Used in -G2 only
R238*	19A701250P362	Metal film; 43.2K ohms ±1%, 1/4W Used in -G1 only
R238, R239	19C314256P22553	Metal film; 255K ohms ±1% 1/4W Used in -G2 only
R240*, R241*	19A701250P201	Metal film; 1.00K ohms ±1%, 1/4W Used in -G1 only
R240*, R241*	19A701250P249	Metal film; 3.16K ohms ±1%, 1/4W Used in -G2 only
R242*	19A701250P361	Metal film; 42.2K ohms ±1%, 1/4W
R243*	19A701250P230	Metal film; 2K ohms ±1%, 1/4W
R245, R246	2R14P9	Wirewound; 6.3 ohms ±5%, 25W Used in -G1 only
R245 thru R247	2R14P8	Wirewound, 5 ohms ±5%, 25W Note: R45, R46 used in -G2 only
R250 thru R252	19A116479P2511K	Metal film; 510 ohms ±10%, 2W Used in -G1 only
R250 thru R252	19A116479P2152K	Metal film; 1.5K ohms ±10%, 2W Used in -G2 only
R253	19A116278P165	Metal film; 464 ohms ±2%, 1/2W
R256*	19A701250P169	Metal film; 511 ohms ±1%, 1/4W

Symbol	GE Part No.	Description
		- - - - - - - VOLTAGE REGULATORS - - - - - - -
VR225	19A115528P13	Silicon, Zener diode; sim 1N3032A Used in -G2 only
VR235, VR236 VR253, VR254	4036887P5	Silicon, Zener diode; sim 1N5232B
VR237	4036887P51	Silicon, Zener diode; sim 1N5231B
		- - - - - - - - - CONNECTORS - - - - - - - -
---	19A134152P126	Printed wiring; two-part; 4 circuits; sim Molex 22-10-2041
---	19A134448P2	Dummy plug; 2 shorted positions; sim Berg 65474-001
		- - - - - - - - - - - LENS - - - - - - - - - -
---	19A134521P1	Panel light; red; sim Visual Comm. CLF-280-RTP
---	19A134521P4	Panel light; yellow; sim Visual Comm. CLF-280-YTP
---	19A134521P6	Lens Holder; sim Visual Comm. PCR-740
	RF ALARM BOARD PL-19C329635G1	
		- - - - - - - - - CAPACITORS - - - - - - - - -
C300	5496267P18	Tantalum; 6.8 µF ±20%, 35 VDCW
C301 thru C303	5490825P3	Ceramic; 10,000 pF ±100%, -20%, 2000 VDCW
		- - - - - - - - - - DIODE - - - - - - - - - -
CR300	4037822P1	Silicon, rectifier; sim 1N5060
		- - - - - - - - - - RELAY - - - - - - - - - -
K300	19B209439P1	Reed, mercury-welted; 48 VDC; 1.75W; Coil, 6.1K ohms ±10%; pull-in, 20.1 VDC max; dropout, 3.15 VDC min; 1 form C contact; sim CP Clare HGSR51211V01
		- - - - - - - - - TRANSISTOR - - - - - - - - -
Q300	19A134637P1	Silicon; NPN; switch; sim 2N3440
		- - - - - - - - - RESISTORS - - - - - - - -
R300, R301	19A116278P269	Metal film; 5.11K ohms ±2%, 1/2W
R310	19A116278P289	Metal film; 8 5K ohms ±2%, 1/2W
R311	19A116278P285	Metal film; 7.5K ohms ±2%, 1/2W
R312	19A116278P273	Metal film; 5.62K ohms ±2%, 1/2W
		- - - - - - - - - CONNECTORS - - - - - - - - -
P300. P301	19A116659P146	Printed wiring, two-part; 10-contacts; sim Molex 09-62-3102
---	19A134152P125	Printed wiring, two-part; 3-circuits; sim Molex 22-10-2031
---	19A134448P2	Dummy plug; 2 shorted positions; sim Berg 65474-001
		- - - - -OPTION S009 (For CS26C/27C Only) - - - See LBI-37284
IMT	PL-19B229752	Impedance Matching Transformer; (4CL14MC; PL-19B229752G1) Input impedance, 50ohms, 100W Output impedance. 50,75,100,125,150 ohms

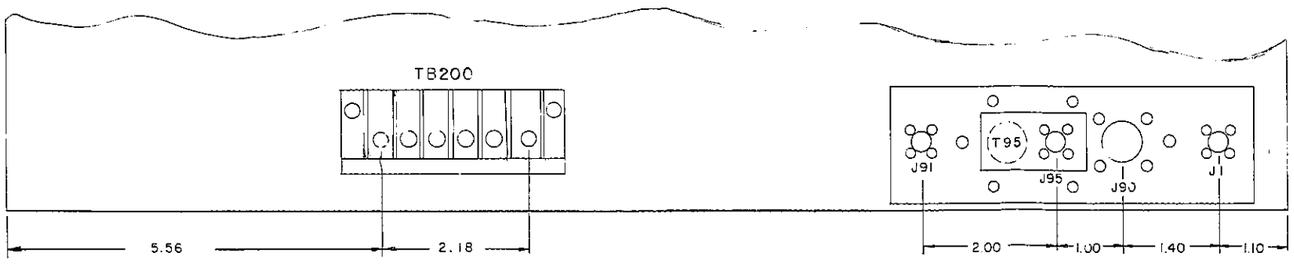
PARTS LIST ISSUED



FRONT VIEW



SECTION A-A



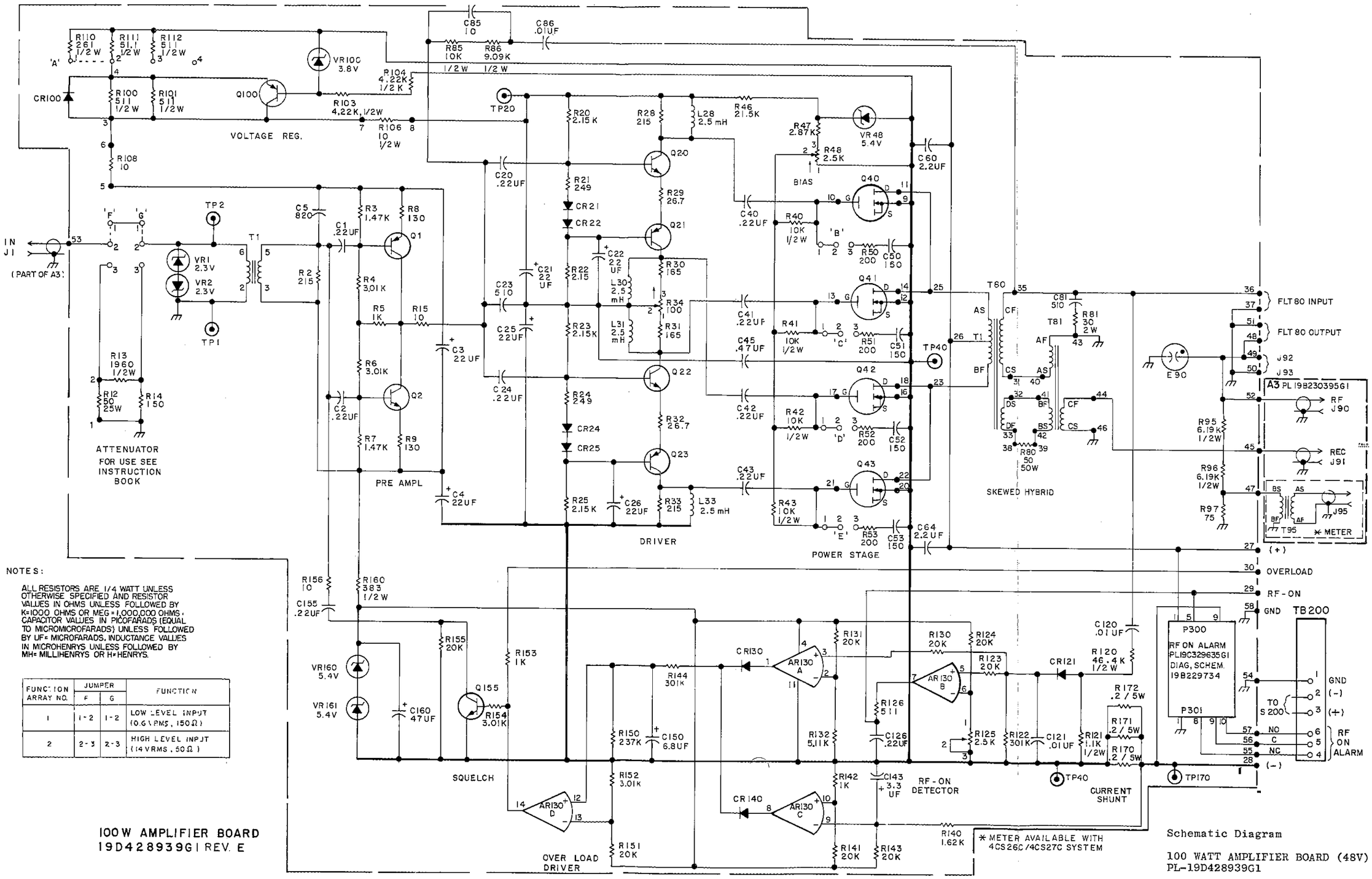
REAR VIEW

100 WATT AMPLIFIER
19D426138G1 REV. F
19D426138G2 REV. G

Pictorial Diagram

100 WATT AMPLIFIER
PL-19D426138G1 and -G2

(19D426207, Rev. 10)



NOTES:

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

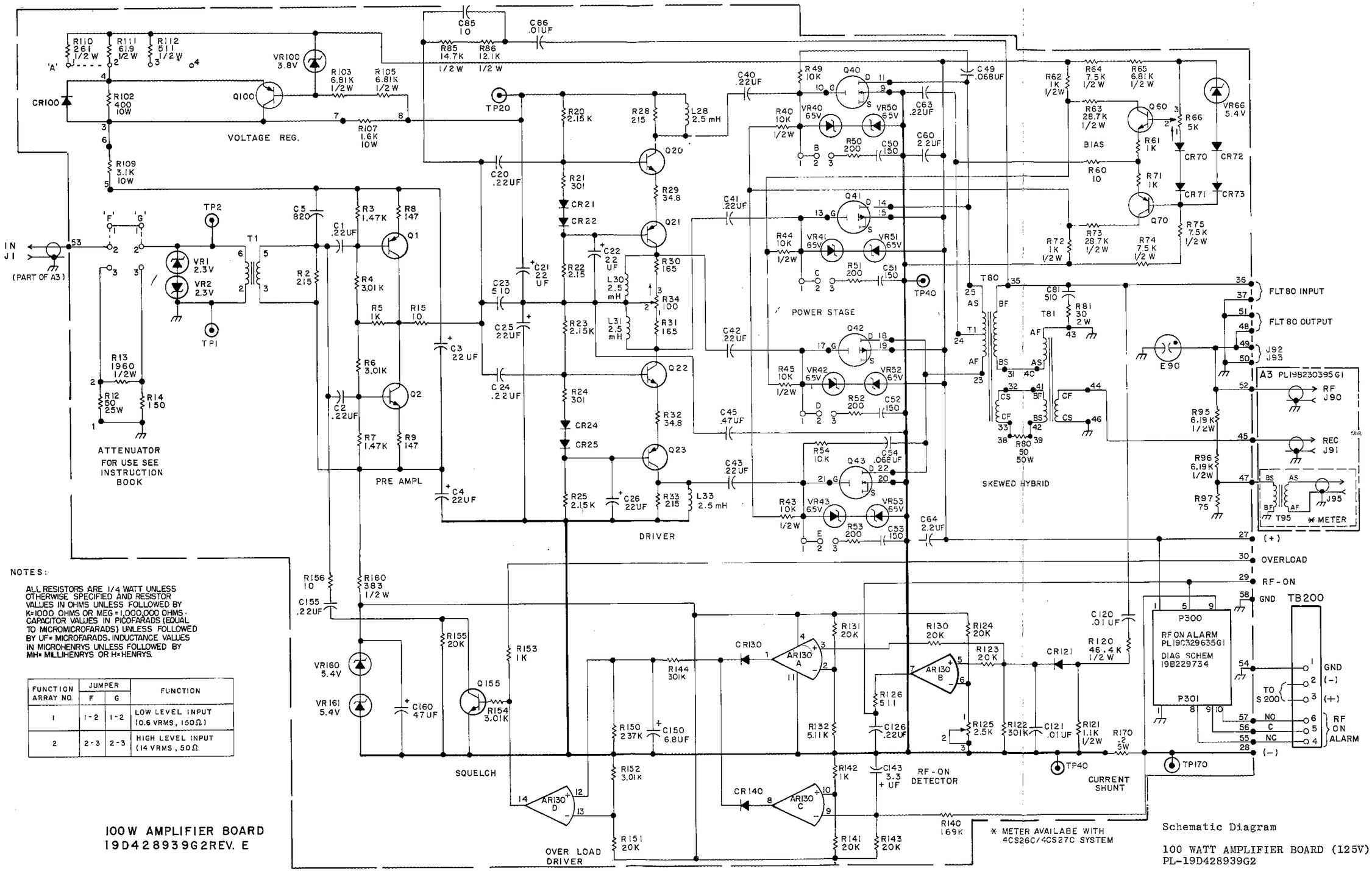
FUNCTION ARRAY NO.	JUMPER F	JUMPER G	FUNCTION
1	1-2	1-2	LOW LEVEL INPUT (0.6 VRMS, 150Ω)
2	2-3	2-3	HIGH LEVEL INPUT (114 VRMS, 50Ω)

100W AMPLIFIER BOARD
19D428939G1 REV. E

Schematic Diagram

100 WATT AMPLIFIER BOARD (48V)
PL-19D428939G1

(19D428981, Sheet 1, Rev. 9)



NOTES:

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

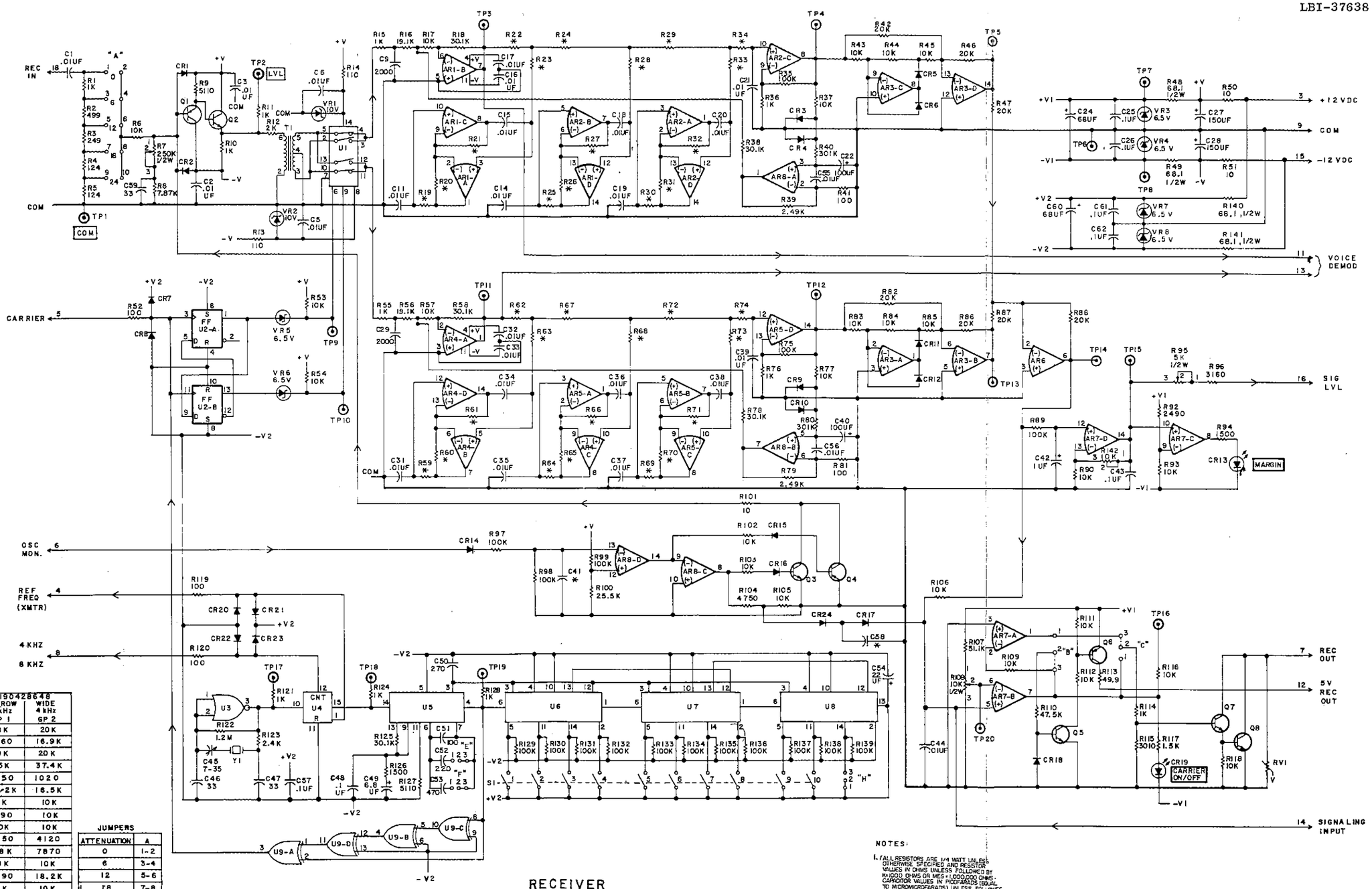
FUNCTION ARRAY NO.	JUMPER F	JUMPER G	FUNCTION
1	1-2	1-2	LOW LEVEL INPUT (0.6 VRMS, 150Ω)
2	2-3	2-3	HIGH LEVEL INPUT (14 VRMS, 50Ω

100W AMPLIFIER BOARD
19D428939G2REV. E

Schematic Diagram

100 WATT AMPLIFIER BOARD (125V)
PL-19D428939G2

(19D428981, Sheet 2, Rev. 9)



COMPONENT	PL-19D428648 NARROW 2 kHz GP 1	WIDE 4 kHz GP 2
R19, R59	20K	20K
R20, R60	8660	16.9K
R21, R61	20K	20K
R22, R62	75K	37.4K
R23, R63	2050	1020
R24, R67	33.2K	16.5K
R25, R64	10K	10K
R26, R65	4990	10K
R27, R66	10K	10K
R28, R68	8250	4120
R29, R72	15.8K	7870
R30, R69	10K	10K
R31, R70	9090	18.2K
R32, R71	10K	10K
R33, R73	3010	1500
R34, R74	1910	976
C41	.022UF	.01UF
C58	.047UF	.022UF

JUMPERS ATTENUATION	A
0	1-2
6	3-4
12	5-6
18	7-8
24	9-10
5V OUTPUT	8
UPRIGHT SENSE	1-2
REVERSE SENSE	2-3

JUMPERS RCVR OUTPUT	C
COM TO - BATT	1-2
COM TO + BATT	2-3

NOTE: FOR COM TO +BATT TRANSISTORS Q7 & Q8 MUST BE CHANGED TO PNP TYPE.

RECEIVER
19D428648G3 REV.
19D428648G4 REV.

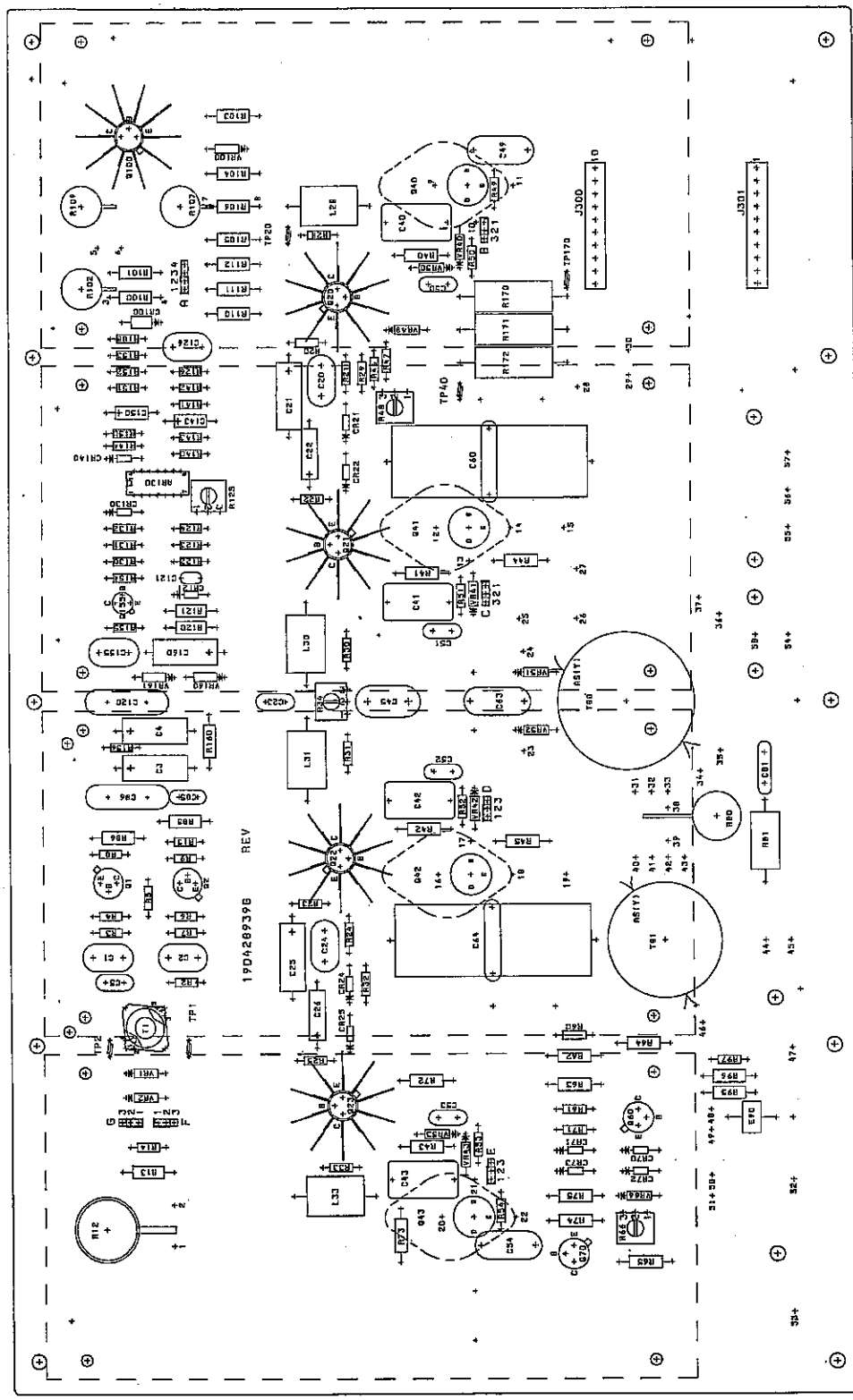
NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG =1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. +V AR1, AR2, AR4, AR5 (4)
   -V AR1, AR2, AR4, AR5 (11)
   +V1 AR3 (4), AR6 (7), AR7, AR8 (4)
   -V1 AR3 (11), AR6 (4), AR7, AR8 (11)
   +V2 U2, U3, U9 (14) & U4-U8 (16)
   -V2 U2, U3, U9 (7), & U4-U8 (8)

Schematic Diagram

RECEIVER
PL-19D428648G3 and -G4

(19D434715, Rev. 1)

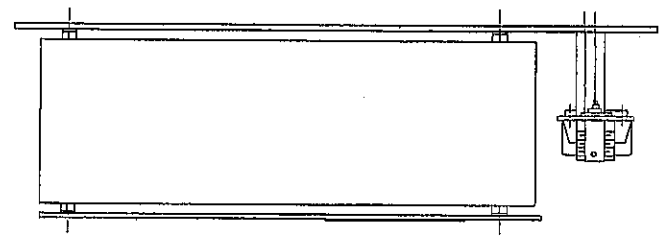


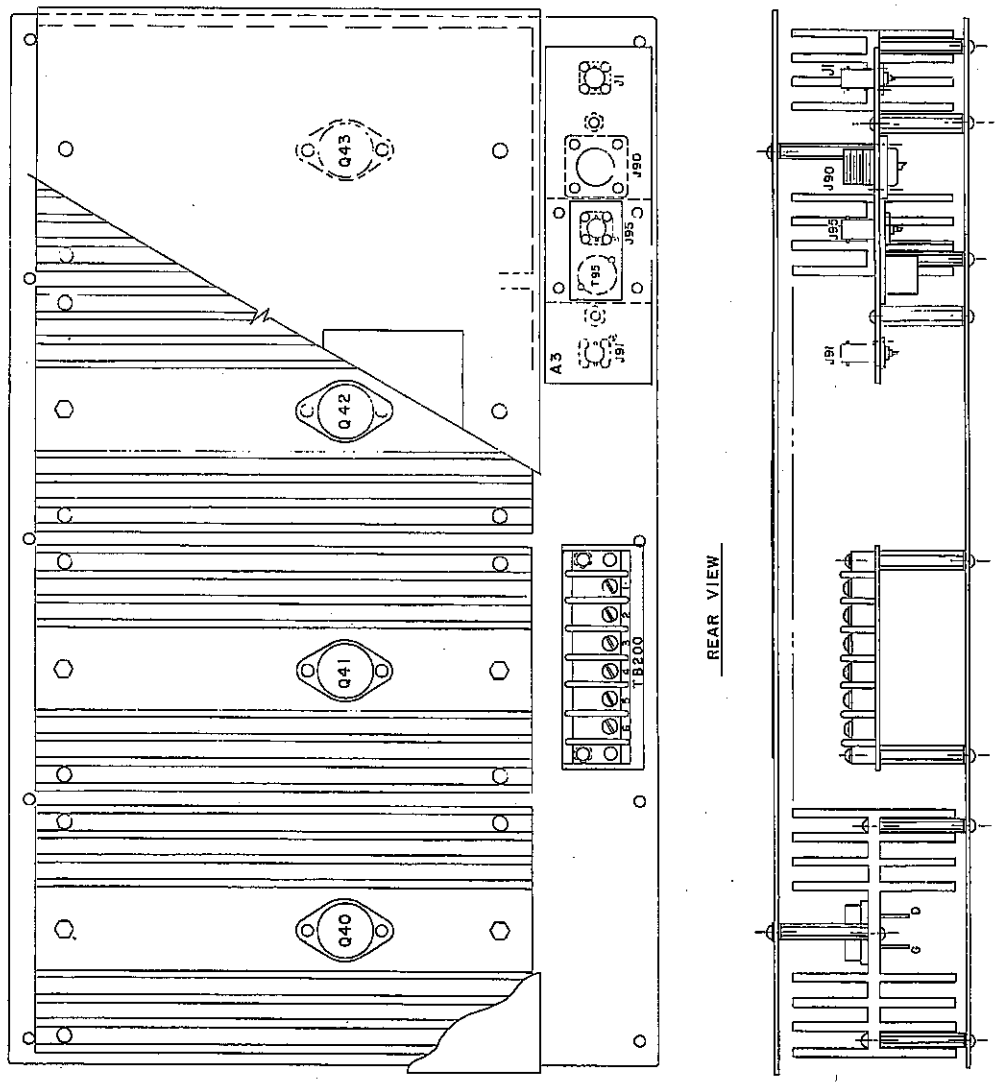
100W AMPL BD
19D428939G1 REV.E
19D428939G2 REV.E

Pictorial Diagram

100 WATT AMPLIFIER BOARD
PL-19D428939G1 and -G2

(19D428941, Sheet 1, Rev. 9)

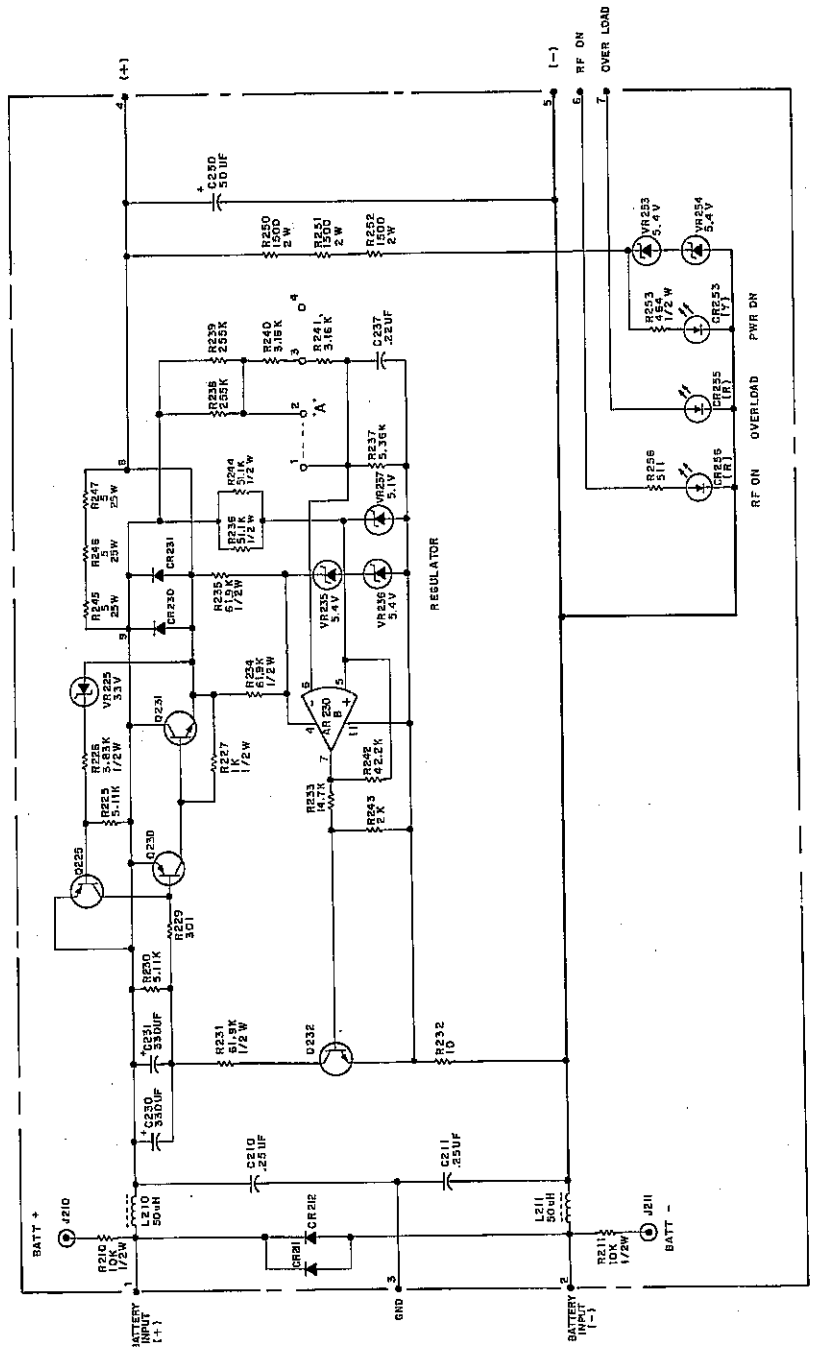




Pictorial Diagram

100 WATT AMPLIFIER BOARD
PL-19D428939G1 and -G2

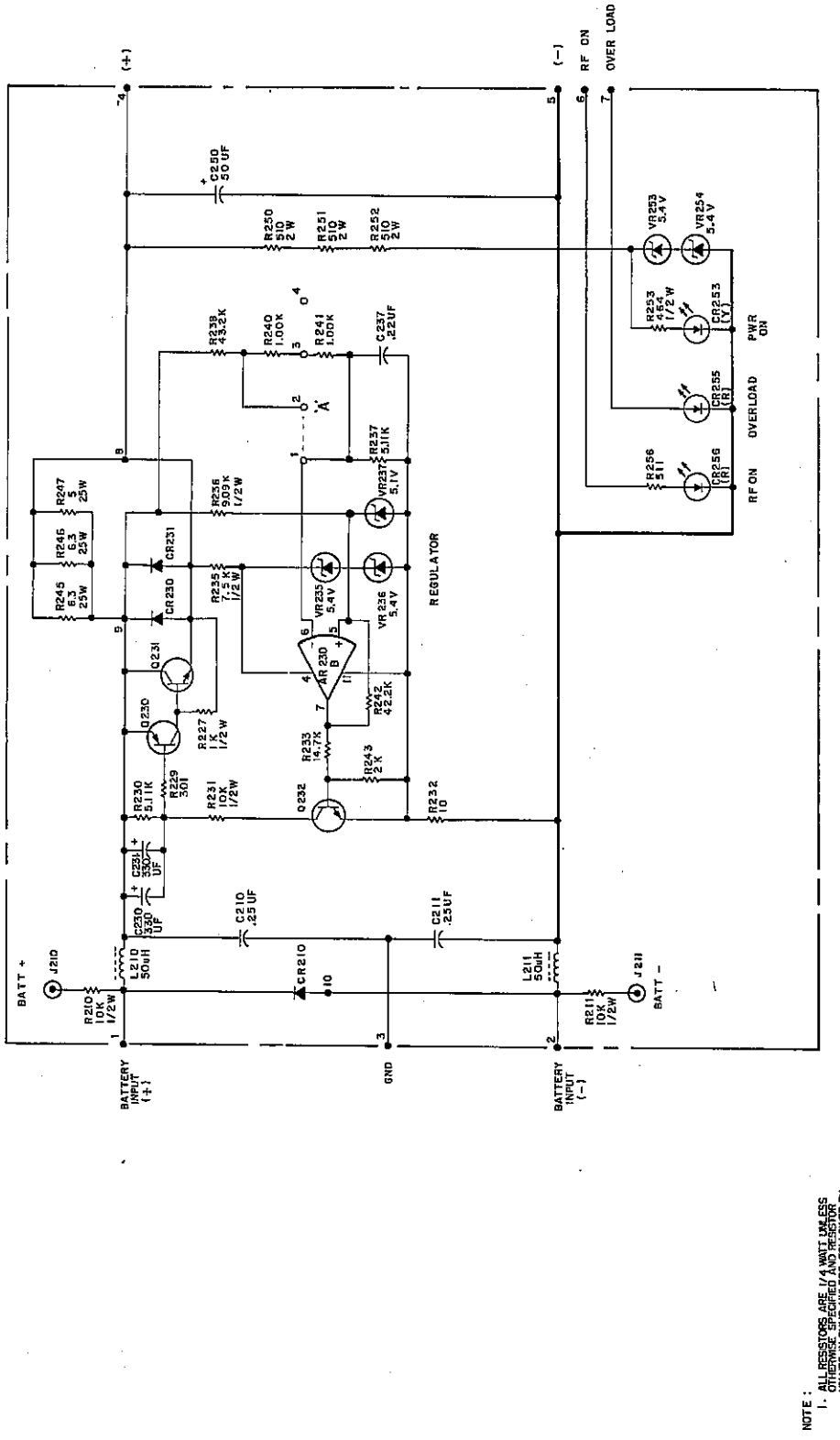
(19D428941, Sheet 2, Rev. 1)



Schematic Diagram

POWER SUPPLY (48V)
PL-19D428973G1

(19D428982, Sheet 1, Rev. 2)



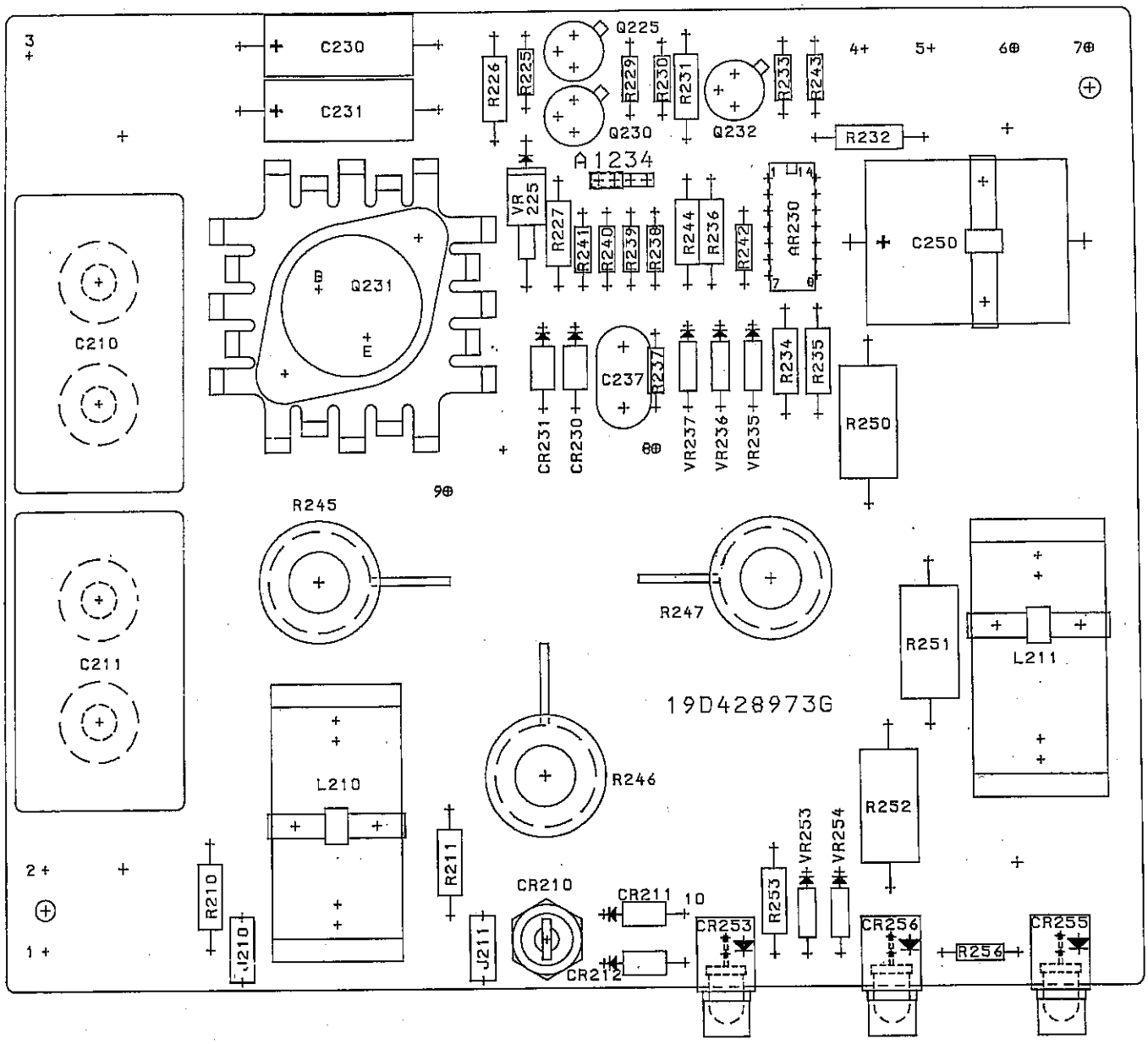
POWER SUPPLY
19D428973G1, REV. B

NOTE:
1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR M=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (PF) UNLESS FOLLOWED BY MF= MICROFARADS (UF) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

Schematic Diagram

POWER SUPPLY (125V)
PL-19D428973G2

(19D428982, Sheet 2, Rev. 2)

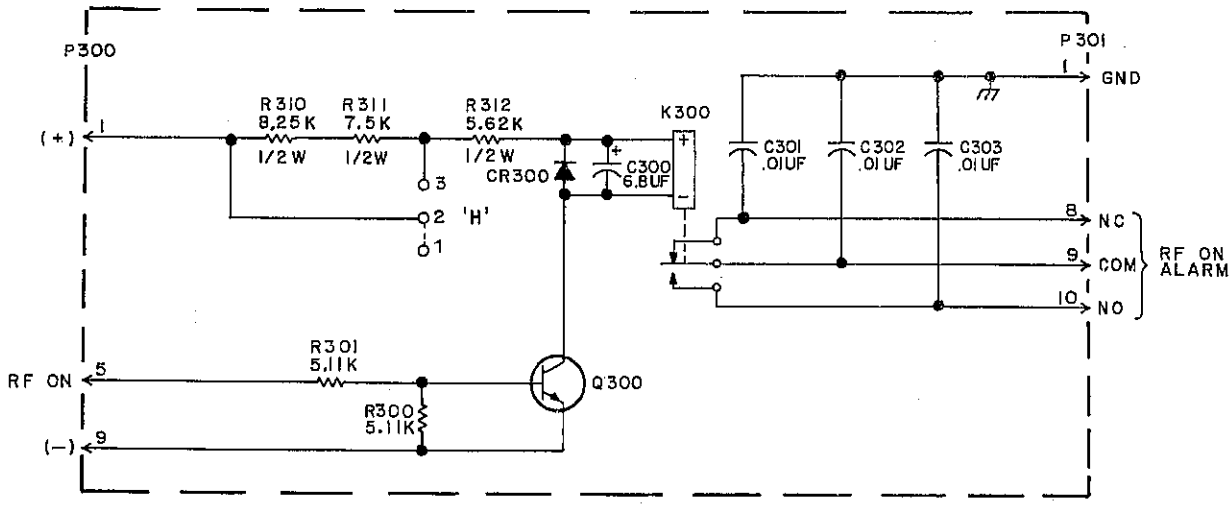


POWER SUPPLY
19D428973G1-2 REV. B

Pictorial Diagram

POWER SUPPLY (48 V and 125 V)
PL-19D428973G1 and -G2

(19C329622, Rev. 3)



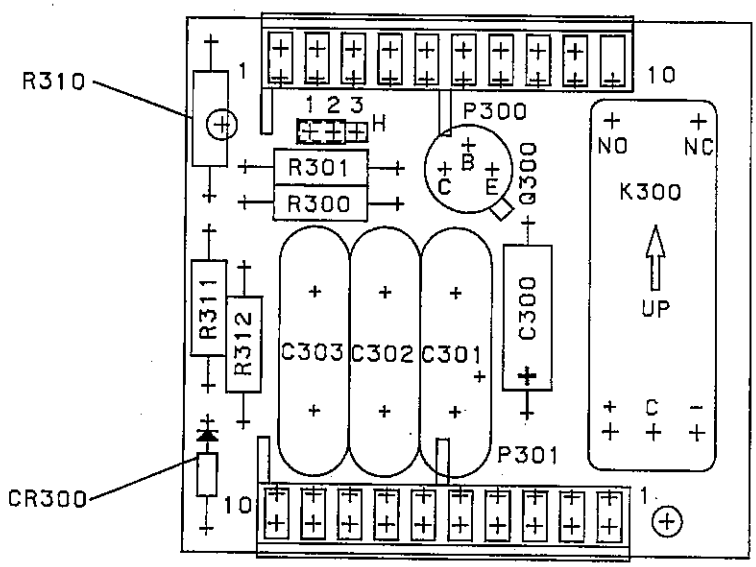
JUMPER 'H' ARRAY

ARRAY NO.	FUNCTION	POSITION
1	48 V	2 - 3
2	125V	1 - 2

RF ON ALARM
19C329635G1

(19B229734, Rev. 2)

Schematic Diagram - RF-ON Alarm Board/PL-19C329635G1



(19C329637, Rev. 0)

Pictorial Diagram - RF-ON Alarm Board/PL-19C329635G1

PRODUCTION CHANGES

100 WATT AMPLIFIER
PL-19D426138G1 AND -G2

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D426138G1 and -G2, Rev. A

Purpose: Add Option S002 wiring.

Part Changed	Was	Changed To
- - - -	- - -	Add J95, Connector 7776570P7 Receptacle, coaxial; BNC series; sim MIL No. UG-290A/U
A1	PL-19D428939G1 & -G2	PL-19D428939G1 & -G2, Rev. A

PL-19D426138G1 and -G2, Rev. B

Purpose: Improve system performance. Changed protection circuit attack time to 300 ms.

Part Changed	Was	Changed To
R144	19C314256P21003 (100K ±1%, 1/4W Metal Film)	19A701250P447 (301K ±1%, 1/4W Metal Film)
R152	19A701250P230 (2K ±1%, 1/4W Metal Film)	19A701250P247 (3.01K ±1%, 1/4W, Metal Film)
A1	PL-19D428939G1 & -G2, Rev. A	PL-19D428939G1 & -G2, Rev. B

PL-19D426138G1, Rev. B

Purpose: To provide unblocking system function.

Part Changed	Was	Changed To
R125	19A701250P233 (2.15K ohms ±1%, 1/4 W Metal Film)	19A701250P191 (866 ohms, ±1%, 1/4 W)
A1	PL-19D428939G1, Rev. B	PL-19D428939G1, Rev. C

PL-19D426138G1 and -G2, Rev. C

Purpose: To adjust line frequency alarm threshold level from 5 to 50 Watts.

Part Changed	Was	Changed To
R125	19A701250P191 (866 ohms ±1%, 1/4 W)	19A116559P104; Variable, cermet, 10 ohms to 2.5K ohms ±20%, 1/2 W
R140	19A701250P224 (1.74 K ohms, ±1%, 1/4 W)	19A701250P221 (1.62K ohms, ±1%, 1/4 W)
A1	PL-19D428939G1, Rev. C	PL-19D428939G1, Rev. D
A1	PL-19D428939G2, Rev. B	PL-19D428939G2, Rev. C

PL-19D426138G1 and -G2, Rev. D

Purpose: Adjust Power Supply Switching Threshold.

Part Changed	Was	Changed To
R236 Used in -G2	19A116278P393 (90.9 K ohms)	19A116278P369 (51.1 K ohms)
R244	- - - -	Add resistor, 19A116278P369, Metal Film; 51.1 K ohms ±20%, 1/2 W. Used in -G2 only.
A2	PL-19D428973G1 and -G2	PL-19D428973G1 and -G2, Rev. A
R236 Used in -G1	19A116278P321 (16.2 K ohms)	19A116278P293 (9.09 K ohms)

PL-19D426138G2, Rev. E

Purpose: To adjust overload threshold.

Part Changed	Was	Changed To
R140	19A701250P221 (1.62 K ohms ±1%, 1/4 W)	19A701250P223 (1.69 K ohms ±1%, 1/4 W)
A1	PL-19D428939G2, Rev. C	PL-19D428939G2, Rev. D

PL-19D426138G1, Rev. E
PL-19D426138G2, Rev. F

Purpose: To center power supply switching threshold.

Part Changed	Was	Changed To
R237 (-G2 only)	19A701250P269 (5.11 K ohms, ±1%, 1/4 W)	19A701250P271 (5.36 K ohms ±1%, 1/4 W)
R240, R241 (-G1 only)	19A701250P233 (2.15 K ohms ±1%, 1/4 W)	19A701250P201 (1.00 K ohms ±1%, 1/4 W)
A2	PL-19D428973G1 & -G2, Rev. A	PL-19D428973G1 & -G2, Rev. B

PL-19D426138G1, Rev. F
PL-19D426138G2, Rev. G

Purpose: To provide DC isolation of RF metering output.

Part Changed	Was	Changed To
T95	- - -	Add Isolation Transformer, PL-19B230359G1
A3	- - -	Add Connector Panel, PL-19B230395G1
A1	PL-19D428939G1 & -G2, Rev. D	PL-19D428939G1 & -G2, Rev. E

INSTRUCTIONS

TYPE CS26C/27C RF INTERFACE
PL-19D428798G1, REV. A

GENERAL

The RF Interface plug-in module provides the system interface between the line and the transmitter, power amplifier and receiver. The interface covers a frequency range of 30 kHz to 535 kHz in ten frequency bands, shown in Figure 1. Each band provides harmonic filtering and line protection.

The module occupies the J8 position in the shelf and contains a complement of filters and a hybrid as shown in Schematic Diagram, 19C334926.

The line protection is provided through use of gas tubes and Metal Oxide Varistor (MOV) devices. Four test points are located on the front of the module for system alignment and test.

The two primary functions are to provide interfaces for a CS26C/27C 2 wire system and a 100 watt, 2 wire system. The 10 and 100 watt, 4 wire systems also can be accommodated.

DESCRIPTION

Refer to Schematic Diagram 19C334926 and Pictorial Diagram 19D428800 which are included in this instruction.

In every application a low powered bandpass filter, FL1, is used to filter the transmitter output. This output is derived from a mixer and, therefore, contains all the odd harmonics of the carrier frequency which must be removed before power amplification. The bandpass filter is designed to partially attenuate the channel second harmonic and greatly attenuate the third and above. Since the operating frequency range is from 30 kHz to 535 kHz, ten groups of bandpass filters are required. The same frequency bands apply to FL1, FL2 and FL3.

The RF input to the Interface module is on Pin J8-18 and is filtered by FL1 and the output (TP3) applied to the "B" jumper (Pin 2). The TP3 test point RF IN is used to check the transmitter output for a clean sine wave display. In a 10 watt system the B jumper goes 2 to 3 and routes the RF signal to the 10 watt amplifier through Pin J8-11. In a 100 watt system the B jumper goes 1-2 and the RF signal is routed to the BNC connector (J14) on the back of the shelf through Pin J8-12 and transformer T2 on the shelf.

The amplified RF signal from the 10 watt amplifier returns to the Interface module on Pins 7 and 8 and goes through HY1 and FL2 to the output D jumper. With the D jumper in the 2-3 position, the signal is routed to the UHF coaxial connector J201 on the back of the shelf through Pins J8-4/5 and an impedance matching transformer T1. The test point 4 (TP4), (10W OUT), is located at the front of the board and is used to set output level of 10 watts (22 VRMS at 50 ohms).

In the 10 watt 2 wire application, both the local transmitted signal and the received remote signal come through the skewed hybrid to the receive out C jumper. The hybrid is terminated with 50 ohms (R4) and has a fixed attenuation of approximately 12 dB. The local transmitter signal is further attenuated up to approximately 35 dB depending on the line termination match. The receive output goes to the receiver through Pin J8-14 with the C jumper 2-3.

In the 100 watt 2-wire application, the hybrid is not used in the RF Interface module, and R4 terminates FL2. The 100 watt amplifier contains a skewed hybrid, and its receive output (J91) is connected via J201 (UHF) and IMT (T1) to Pins J8-4/5, then through FL2 to the R4 termination. TP1 and TP4 both become receive test points; TP1 has both the local and remote signals filtered.

The 4 wire application requires the use of FL3 which is a high impedance bandpass filter intended for bridging on an externally terminated received source, such as a receive hybrid. The bridging impedance is nominally 1000 ohms. (A 500 ohm filter plus a 500 ohm resistance.)

In a 10 watt 4 wire application jumper B is again 2-3 as is the output jumper D 2-3. The hybrid, HY1, is not used. The BNC coaxial connector J14 becomes the receiver input and jumper A is set 2-3 allowing the receive signal thru R3 and FL3 to be terminated by R1. Jumper C is set 1-2 connecting the receive signal to the receiver.

In the 100 watt 4 wire application the power amplifier is driven from the BNC connector, J14 with jumper B set to 1-2, and the UHF connector J201 becomes the receive input. Jumper D is set 1-2 routing the receive signal thru R2 to jumper A, which is set 1-2 allowing the signal to be terminated through FL3 into R1. The receive output is connected thru jumper C 1-2 to the receiver.

FIGURE 1

BAND	FREQ. RANGE	BAND	FREQ. RANGE
1	32- 39.5 kHz	6	116-155.5 kHz
2	40- 50.5 kHz	7	156-210.5 kHz
3	51- 65.5 kHz	8	211-286.5 kHz
4	66- 86.5 kHz	9	287-391.5 kHz
5	87-115.5 kHz	10	392-535.5 kHz

PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - - PROTECTOR - - - - - - - - - -
E1	19A115751P2	Telephone type; sim Siemens B1-F90
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1, FL3	19C304995	Filter
FL2	19C304998	Filter
		- - - - - - - - - - HYBRID - - - - - - - - - -
HY1	19B221767	Hybrid
		- - - - - - - - - RESISTORS - - - - - - - - -
R1, R3	19A116278P169	Metal film; 511 ohms ±2%, 1/2 W
R2*	19A116479P2511K	Metal film; 510 ohms ±10%, 2 W
R4, R8	19A116479P251OK	Metal film; 51 ohms ±10%, 2 W
R5	19A116278P285	Metal film; 7.5 K ohms ±2%, 1/2 W
R6	19A116278P117	Metal film; 147 ohms ±2%, 1/2 W
R7*	19A116479P2102K	Metal film; 1 K ohms ±10%, 2 W
		- - - - - - - - - CONNECTORS - - - - - - - - -
---	19A134152P125	Printed wiring; two-part; 3 circuits; Gold; sim Molex 22-10-2031
---	19A134448P2	Dummy plug; 2 position shorting; Gold; sim Berg 65474-001

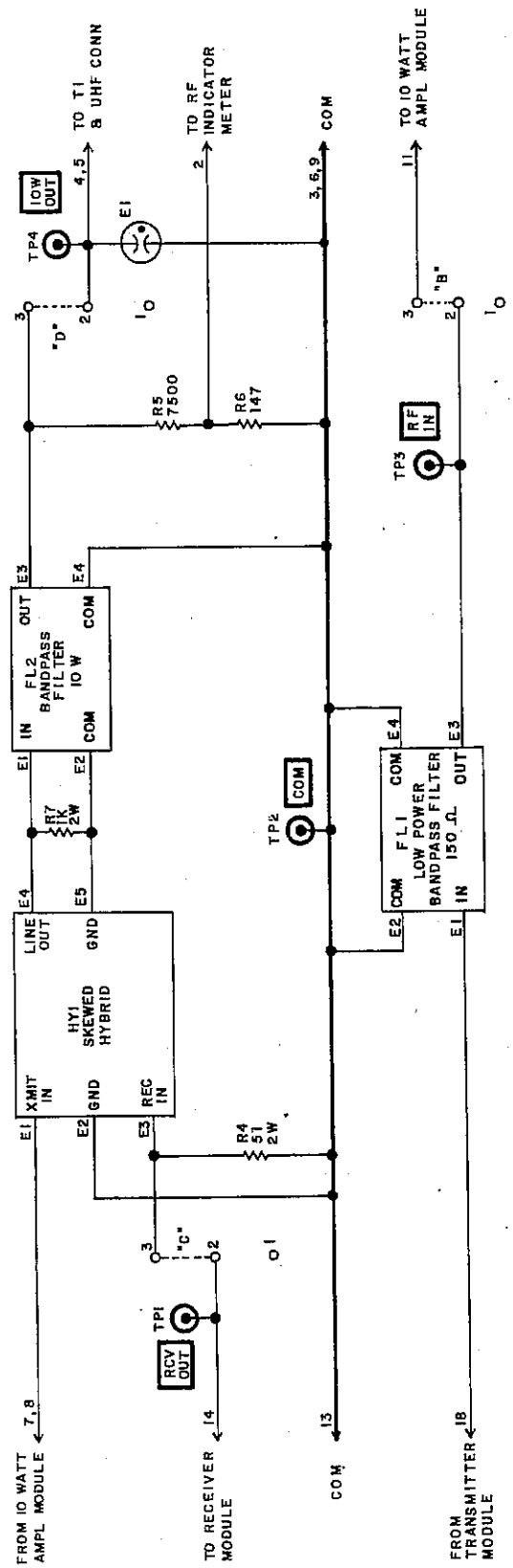
Typical RF Interface Test Point Readings

Conditions: TP3 or TP4 at 10 watts output and TP1 receiving from "far end."

TP1 Receive Line Frequency (from "far end")
Sine wave, 0.5 VRMS

TP3 Transmit Line Frequency (local)
Sine wave, 1.25 VRMS

TP4 Output Power (at transmitter freq)
Sine wave, 22.0 VRMS



NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. JUMPER "A"; R1-R3 & FL3 NOT USED.
3. FUNCTION ARRAY NO. 1.

RF INTERFACE
19D428798G1 REV. A
(AS USED WITH 10 WATT POWER AMPLIFIER)

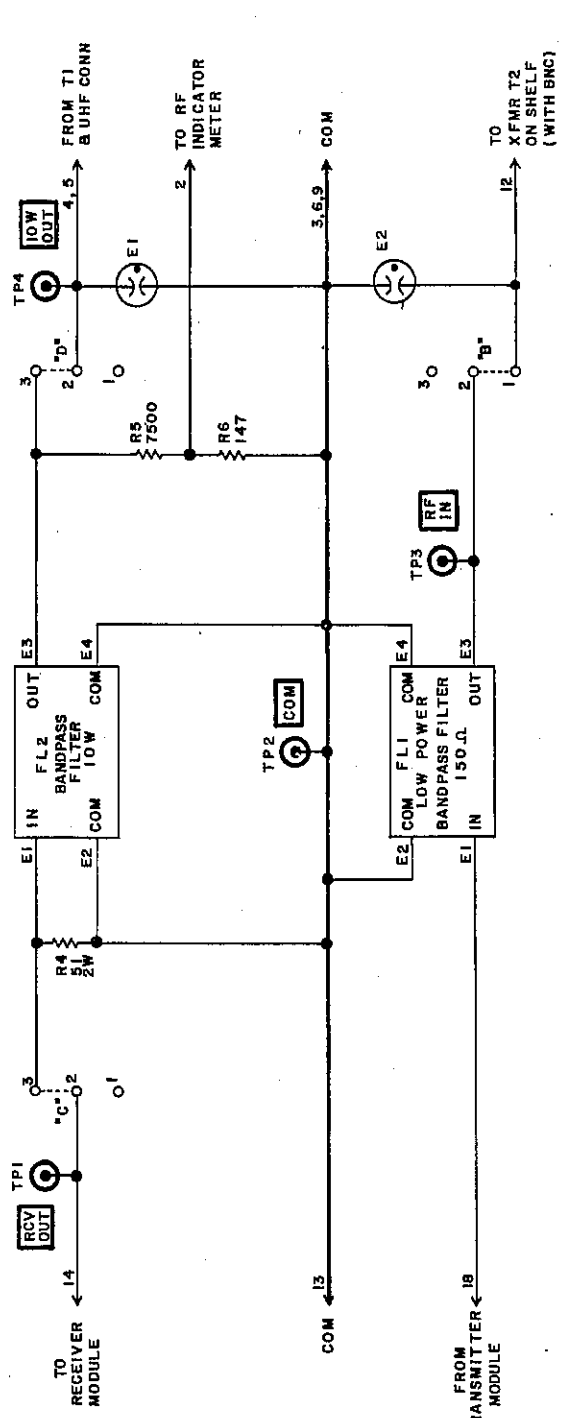
FUNCTION ARRAY TABLE

FUNC ARRAY NO.	JUMPERS A	B	C	D	FUNCTION
1	2-3	2-3	2-3	2-3	10 WATTS
2	1-2	1-2	2-3	2-3	100 WATTS

Schematic Diagram

RF INTERFACE
(Used With 10 Watt Amplifier)
PL-19D428798G1

(19C334926, Sheet 1, Rev. 2)



FUNCTION ARRAY TABLE

FUNC. ARRAY NO.	JUMPERS A	B	C	D	FUNCTION
1	2-3	2-3	2-3	2-3	10 WATTS
2	1-2	1-2	2-3	2-3	100 WATTS

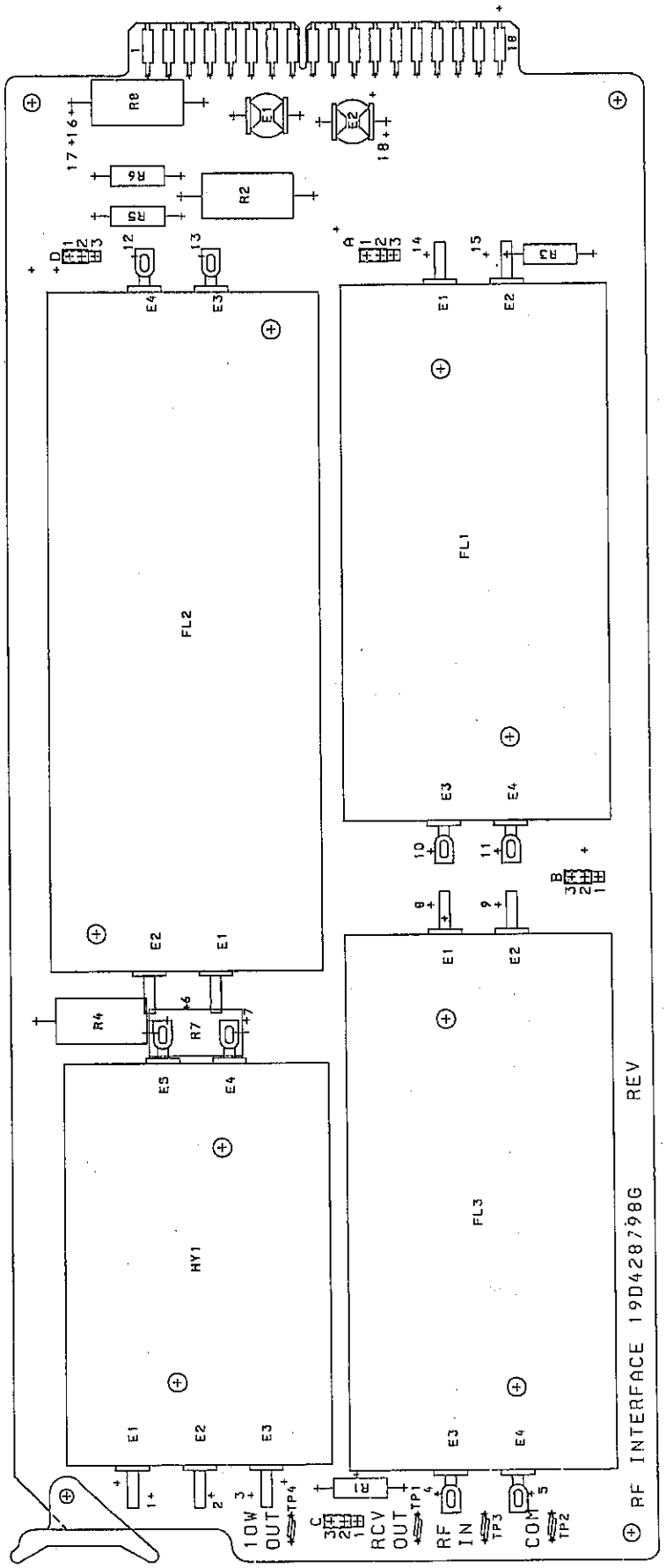
RF INTERFACE
19D428798G1 REV. A
(AS USED WITH 100WATT POWER AMPLIFIER)

NOTES:
1. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS; CAPACITOR VALUES IN MMFDARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. JUMPER "A"; R1-R3, R7, FL3, & HY1 NOT USED.
3. FUNCTION ARRAY NO. 2.

Schematic Diagram

RF INTERFACE
(Used With 100 Watt Amplifier)
PL-19D428798G1

(19C334926, Sheet 2, Rev. 3)



RF INTERFACE
19D428798G1 REV A

Pictorial Diagram

RF INTERFACE
PL-19D428798G1

(19D428800, Rev. 3)

PRODUCTION CHANGES

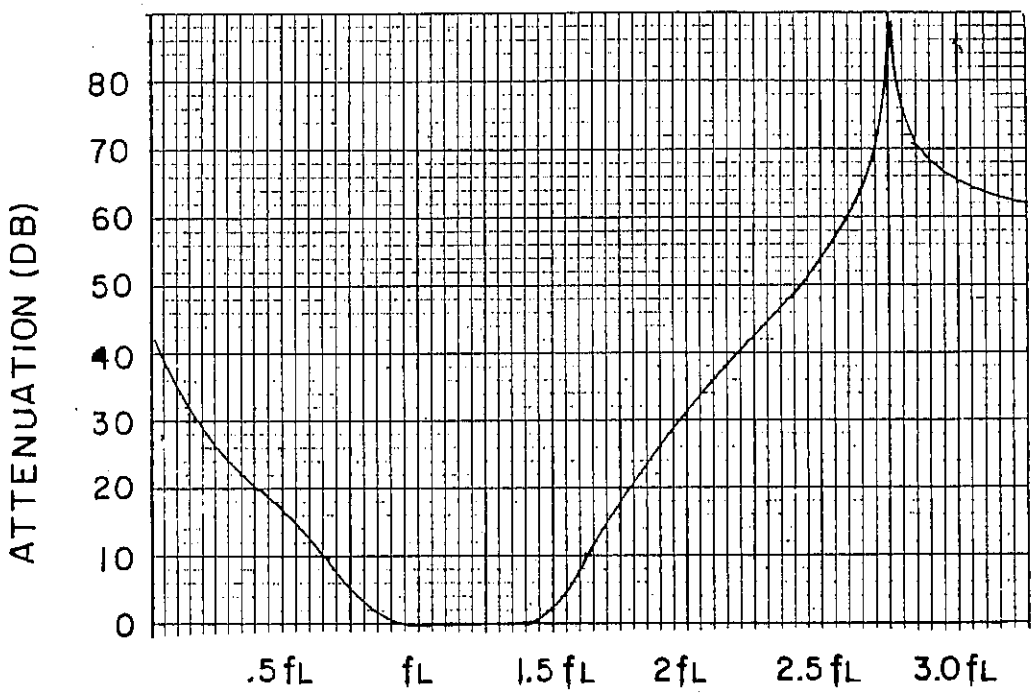
TYPE CS26C/27C RF INTERFACE
PL-19D428798G1

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428798G1, Rev. A

Purpose: Improve design.

Part Changed	Was	Changed To
R2	19A116278P169 511 ohms	19A116279P2511K Metal Film; 510 ohms ±10%, 2W
R8	- - -	Add resistor R8, GE Part No. 19A116479P2510K



GROUP	f_L (KHZ)	PASSBAND RANGE (KHZ)	CHANNEL DESIGNATION (KHZ)
1 & 11	30	30 - 41.5	32 - 39.5
2 & 12	38	38 - 52.5	40 - 50.5
3 & 13	49	49 - 67.5	51 - 65.5
4 & 14	64	64 - 88.5	66 - 86.5
5 & 15	85	85 - 117.5	87 - 115.5
6 & 16	114	114 - 157.5	116 - 155.5
7 & 17	154	154 - 212.5	156 - 210.5
8 & 18	209	209 - 288.5	211 - 286.5
9 & 19	285	285 - 393.5	287 - 391.5
10 & 20	390	390 - 537.5	392 - 535

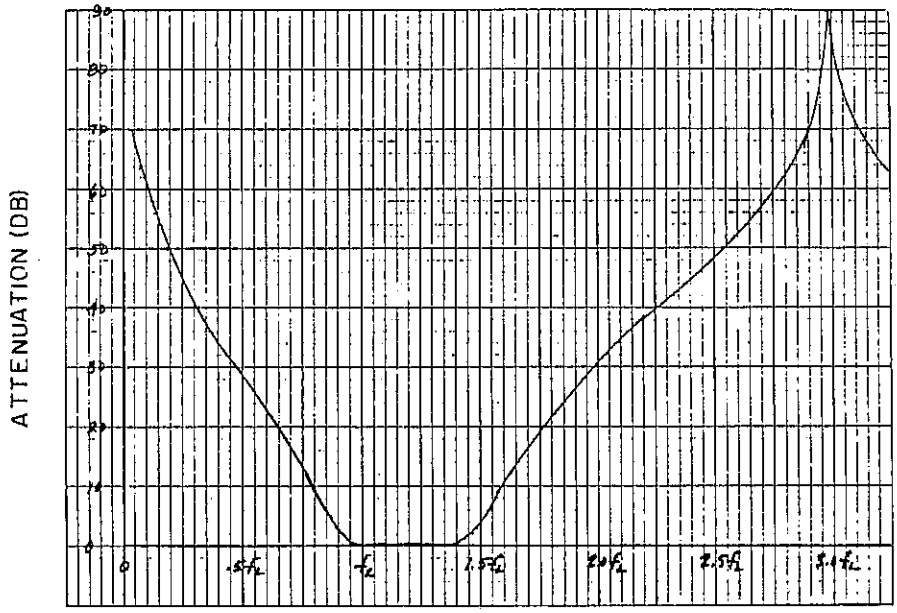
ELECTRICAL REQUIREMENTS

G1 – G10	G11 – G20
Z IN = Z OUT = 150 OHMS	Z IN = Z OUT = 500 OHMS

ALL GROUPS:
- INSERTION LOSS: $\leq$ 0.3 DB
- PASSBAND RIPPLE: $\leq$ 0.2 DB
- OPERATING TEMPERATURE RANGE: −20° C TO + 60°C
- E1 - INPUT
- E3 - OUTPUT
- E2 & E4 - GND

RF INTERFACE FILTERS
FL1 and FL3

19C304995



GROUP	f_L (KHZ)	PASSBAND RANGE (KHZ)	CHANNEL DESIGNATION (KHZ)
1	30	30 - 41.5	32 - 39.5
2	38	38 - 52.5	40 - 50.5
3	49	49 - 67.5	51 - 65.5
4	64	64 - 88.5	66 - 86.5
5	85	85 - 117.5	87 - 115.5
6	114	114 - 157.5	116 - 155.5
7	154	154 - 212.5	156 - 210.5
8	209	209 - 288.5	211 - 286.5
9	285	285 - 393.5	287 - 391.5
10	390	390 - 537.5	392 - 535

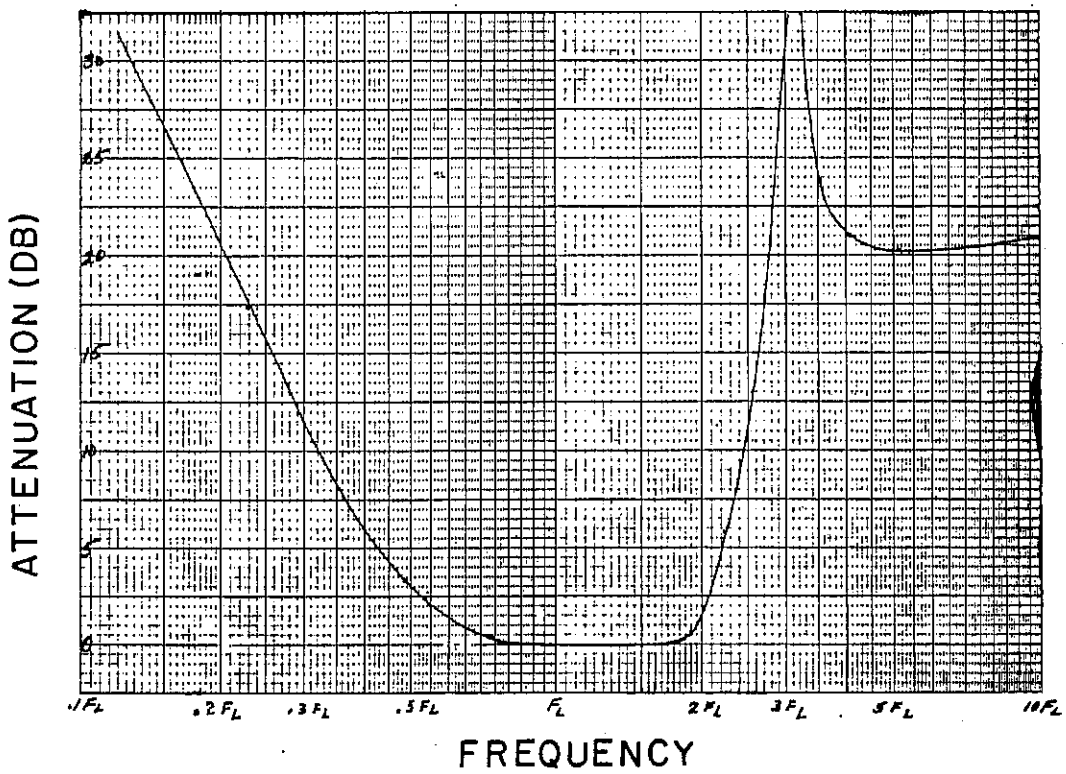
ELECTRICAL REQUIREMENTS

Z IN = Z OUT = 50 OHMS UNBALANCED

INPUT LEVEL: 10 WATTS RMS
PASSBAND RIPPLE: < 0.2DB
OPERATING TEMPERATURE RANGE:
- 20° C TO + 60°C

RF INTERFACE FILTERS
FL2

19C304998



GROUP	f_L (KHZ)	PASSBAND RANGE (KHZ)	CHANNEL DESIGNATION (KHZ)
1	30	30 - 41.5	32 - 39.5
2	38	38 - 52.5	40 - 50.5
3	49	49 - 67.5	51 - 65.5
4	64	64 - 88.5	66 - 86.5
5	85	85 - 117.5	87 - 115.5
6	114	114 - 157.5	116 - 155.5
7	154	154 - 212.5	156 - 210.5
8	209	209 - 288.5	211 - 286.5
9	285	285 - 393.5	287 - 391.5
10	390	390 - 537.5	392 - 535

ELECTRICAL REQUIREMENTS

Z IN = Z OUT = 50 OHMS (UNBALANCED)

INSERTION LOSS $\leq$ 0.3 DB

PASSBAND RIPPLE $\leq$ 0.2 DB

OPERATING TEMPERATURE RANGE 20°C TO 60° C

E1 - INPUT; E3 - OUTPUT; E2 & E4 GND.

100W OUTPUT FILTER
FL80

19C304999

INSTRUCTIONS

TYPE CS26C/27C RECEIVER
PL-19D428648G3
PL-19D428648G4

DESCRIPTION

The CS26C/27C receiver is used for reception of carrier current signals over high voltage power lines for solid state (CS26C) or Electro-Mechanical (CS27C) Pilot Relaying and Supervisory Control. Operating frequency of the receiver is determined by the local carrier frequency. This programmable frequency comes from the frequency synthesizer circuit located on the receiver module. Operating frequency is 30 kHz to 535 kHz in 500 Hz steps. Channel spacing is 2 kHz for Group 3 and 4 kHz for Group 4.

The relaying tone is detected, rectified and used to switch ON the output circuits. A signal level circuit provides an output drive to external meter on front panel.

OPERATION

Refer to Schematic Diagram 19D434715, and Pictorial Diagram 19D434716 which are included in this LBI.

The receive signal is coupled into the receiver through a capacitor and adjustable pad (Jumper A & R7). Buffer amplifier (Q1, Q2) provides isolation between input and balanced modulator U1. Counter U2 divides the receive carrier by four and produces two quadrature carriers to switch modulator U1. The two quadrature outputs of U1 are filtered by two active low-pass filters (AR1, 2 & AR4, 5). Outputs of the low-pass filters are connected to the inputs of the full-wave rectifiers AR3A & B and AR3C & D. Output of the two rectifiers are summed by amplifier AR6, and this output is detected by comparator AR7B. Inverting amplifier AR7A is connected to the comparator output. Transistors Q5 and Q6 provide a 5V, 20 mA output. Jumper B provides sense inverting for the 5V output. Transistors Q7 and Q8 provide a high voltage relay driver output. Jumper C is used to switch common from -BATTERY to +BATTERY. This would also require transistors Q7 and Q8 be changed from Type NPN to PNP transistors. Light emitting diode (LED) CR19 turns ON when carrier is detected.

Amplifier AR7D provides an output to the signal level meter and the 15 dB margin detector AR7C. LED, CR13 turns ON when the signal level reaches or exceeds 15 dB above threshold.

The DC feedback amplifier AR8A and AR8B sets the DC operating point of the low-pass filter. The AR8C & D squelch the receiver input when the local transmitter is keyed ON. It also switches the receiver ON.

The frequency synthesizer consists of oscillator circuit U3, counter U4, phase-lock-loop (PLL) U5, programmable counters U6-U8 and exclusive OR gate U9. Counter U4 divides the oscillator down from 2048 kHz to 1 kHz. This 1 kHz reference frequency is connected to the comparator circuit of the PLL. Output of the phase comparator is filtered by network R125, R126, C48 and C49. This filtered output controls the frequency of the voltage control oscillator (VCO). The PLL locks to the 1 kHz reference frequency and the VCO output frequency is equal to N times the 1 kHz reference frequency. N is determined by the programming switch S1 and Jumper H.

Exclusive OR gate U9 doubles the output frequency of the VCO. Counter U4 also provides the 500 Hz reference frequency to the local transmitter frequency synthesizer.

PROGRAMMING LINE FREQUENCY

Listed below are the multiplying factors for the switch S1 and Jumper H:

S1-1	-	0.5
S1-2	-	1 0
S1-3	-	2.0
S1-4	-	4.0
S1-5	-	8.0
S1-6	-	16.0
S1-7	-	32.0
S1-8	-	64.0
S1-9	-	128.0
S1-10	-	256.0
H	-	512.0

1. Select the closest smaller multiplying factor to the desired line frequency and close that switch or jumper.
2. Subtract this factor from desired line frequency.
3. Select the closest smaller multiplying factor to the result in Step 2 and close that switch.
4. Subtract this factor from result in Step 2.
5. Repeat the procedures in Steps 3 and 4 until the result is zero.

Example:

Desired line frequency = 215.5 kHz

1.	215.5 - 128 =	87.5	S1-9	Closed
2.	87.5 - 64 =	23.5	S1-8	Closed
3.	23.5 - 16 =	7.5	S1-6	Closed
4.	7.5 - 4 =	3.5	S1-4	Closed
5.	3.5 - 2 =	1.5	S1-3	Closed
6.	1.5 - 1 =	.5	S1-2	Closed
7.	.5 - .5 =	.0	S1-1	Closed

The jumpers E and F are used to change the capacitors in the PLL VCO circuit. The chart below shows the jumper positions and frequency range.

Frequency Range	Jumper	
	E	F
30 kHz - 100 kHz	1-2	1-2
101 kHz - 300 kHz	1-2	2-3
301 kHz - 535 kHz	2-3	2-3

RECEIVER SENSITIVITY ADJUSTMENT

Receiver sensitivity has been adjusted at the factory to 125 mV for a signal 250 Hz above or below the channel frequency. Because of the roll-off of the receiver's internal filter characteristic, the receiver will be less sensitive at frequency offsets greater than 250 Hz. The customer can re-adjust the sensitivity to 125 mV at the greater offset; but it is recommended that this not be done, because the increased sensitivity will increase the susceptibility of the receiver to produce false outputs due to noise on the transmission line.

To check the factory sensitivity adjustment and/or re-adjust the sensitivity, the following procedure may be used:

1. Connect a 50-ohm signal source to J201 of the Shelf (with 10-watt transmitter) or to J90 of the Power Amplifier (with 100-watt transmitter).
2. Place the Receiver on an Extender, and replace the Extender in the Receiver position in the Shelf. Place Jumper "A" in position 1-2 ("0") and turn R7 full clockwise.
3. Adjust frequency of signal source to 250 Hz above or below the channel frequency, and increase the level to 125 mV.
4. As the input signal level approaches 125 mV, the CXR ON/OFF LED should turn ON. If it does not, adjust R108 slowly clockwise until the CXR ON/OFF LED just turns on solidly (only on occasional flicker).

MARGIN THRESHOLD ADJUSTMENT

The margin threshold has been adjusted at the factory such that the MARGIN LED will turn ON when the level of the received signal is 15 dB or more above the level which will just turn ON the CXR ON/OFF LED. That is, the MARGIN LED indicates that the received signal has 15 dB or more margin. (The margin adjustment is unaffected by the amount of received signal frequency offset from the channel frequency.)

The margin threshold can be re-adjusted to indicate a margin other than 15 dB by the following procedure:

1. Complete the four steps RECEIVER SENSITIVITY ADJUSTMENT procedure (above).
2. Increase the input signal level by "X" dB, where "X" dB is equal to the desired margin.
3. Turn R142 fully clockwise; then, turn R142 slowly counter-clockwise until the MARGIN LED just turns ON.

NOMINAL OPERATING CHARACTERISTICS

1. Power Requirements:

   +12 VDC, 85 mA
   -12 VDC, 75 mA

2. Inputs

   a. Signal

      (1) Level: 0.153 VRMS for 15 dB margin
      (2) Frequency Range: 30 kHz to 535 kHz

   b. Oscillator Monitor:

      (1) OFF 0 VDC
      (2) ON +12 VDC

   c. Signaling:

      (1) OFF 0 VDC
      (2) ON +6 VDC

3. Outputs:

   a. Receive Out (Pin 12): 5 VDC, 20 mA

   b. Receive Out (Pin 7): Relay Driver

   c. Carrier (Pin 5): 12 VPP, 120 kHz to 2140 kHz

   d. Reference Frequency (XMTR) 12 VPP, 500 Hz

   e. 4kHz: 12 VPP

   f. Voice Demodulator: Quadrature Outputs to Voice Module

   g. Signal Level: 1 mA Output to Signal Level Meter

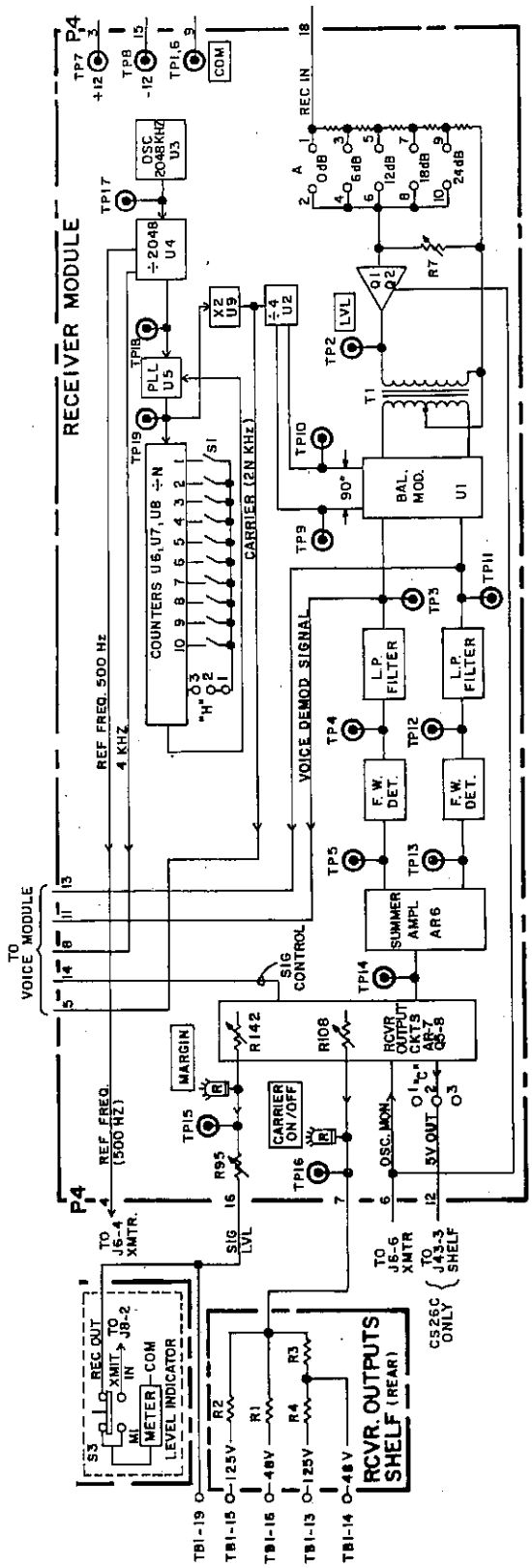
PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1 thru C3 C5, C6, C16, C17, C32, C33 C44, C55, C56	19A116080P1	Polyester; 0.01 µF ±20%, 50 VDCW
C9, C29	19C307114P2001G	Polystyrene; 2000 pF ±2%, 100 VDCW
C11, C14, C15, C18 thru C21 C31, C34, C35 thru C39	19C307114P1002G	Polystyrene; 10,000 pF ±2%, 100 VDCW
C22, C40	5496267P7	Tantalum; 100 µF ±20%, 10 VDCW
C24, C60	5496267P11	Tantalum; 68 µF ±20%, 15 VDCW
C25, C26, C43, C57 C61, C62	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C27, C28	5496267P12	Tantalum; 150 µF ±20%, 35 VDCW
C41	19A116080P103	Polyester; 0.022 µF ±10%, 50 VDCW Used in -G3 only
C41	19A116080P101	Polyester; 0.01 µF ±10%, 50 VDCW Used in -G4 only
C42	19A134202P14	Tantalum; 1 µF ±20%, 35 VDCW
C45	19A116867P5	Variable, ceramic; 7 to 35 pF, +10-100% to -10+70%, 160 VDCW
C46, C47	5490008P15	Mica; 33 pF ±5%, 500 VDCW
C48	19A116080P107	Polyester; 0.1 µF ±10%, 50 VDCW
C49	19A134202P115	Tantalum; 6.8 µF ±10%, 35 VDCW
C50	5490008P37	Mica; 270 pF ±5%, 500 VDCW
C51	5490008P27	Mica; 100 pF ±5%, 500 VDCW
C52	5490008P35	Mica; 220 pF ±5%, 500 VDCW
C53	5490008P43	Mica; 470 pF ±5%, 300 VDCW
C54	19A134202P6	Tantalum; 22 µF ±20%, 15 VDCW
C58	19A116080P105	Polyester; 0.47 µF ±10%, 50 VDCW Used in -G3 only.
C58	19A116080P103	Polyester; 0.022 µF ±10%, 50 VDCW Used in -G4 only.
C59	7489162P15	Mica; 33 pF ±5% 500 VDCW
		- - - - - - - - - DIODE - - - - - - - - - -
CR1 thru CR12, CR14 thru CR18, CR20 thru CR24	19A115250P1	Silicon, fast recovery; sim IN4152
CR13, CR19	19A134354P1	Optoelectronic; red, wide angle; sim H-P 5082-4655
		- - - - - - - TRANSISTORS - - - - - - - -
Q1, Q4	19A115779P1	Silicon, PNP; sim 2N3251
Q2	19A115300P2	Silicon, NPN; sim 2N3053
Q3, Q5	19A116755P1	Silicon, NPN; sim 2N3947
Q6	19A115562P2	Silicon, PNP, switch; sim 2N2904A
Q7	19A134637P1	Silicon, NPN switch; sim 2N3440
Q8	19A115924P1	Silicon, NPN; sim 2N3902

Symbol	GE Part No.	Description
		- - - - - - - - - RESISTORS - - - - - - - - - -
R1,R10,R15 ,R36,R55 , R76,R114,R121,R124, R128	19A701250P201	Metal film; 1 K ohms ±1%, 1/4 W
R2	19A701250P168	Metal film; 499 ohms ±1%, 1/4 W
R3	19A701250P139	Metal film; 249 ohms ±1%, 1/4 W
R4, R5	19A701250P110	Metal film; 124 ohms ±1%, 1/4 W
R6,R17,R25,R26,R27, R30,R32,R37,R43 thru R45,R53,R54,R57,R64 thru R66,R69,R71,R77, R83 thru R85,R90, R93,R102,R103,R105, R106,R109,R111,R112, R116,R118	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W Note: R26, R65, used in -G4 only.
R7	19A116559P225	Variable, Cermet; 100 ohms to 250 K ohms ±20%, 1/4 W, 10% log taper
R8	19A701250P287	Metal film; 7.87 K ohms ±10%, 1/4 W
R9, R127	19A701250P269	Metal film; 5.11 K ohms ±1%, 1/4 W
R11	19A700106P63	Composition; 1 K ohms ±5%, 1/4 W
R12	19A701250P230	Metal film; 2 K ohms ±1%, 1/4 W
R13, R14	19A701250P105	Metal film; 110 ohms ±1%, 1/4 W
R20	19A701250P323	Metal film; 16.9 K ohms ±1%, 1/4 W Used in -G4 only
R18,R38,R58, R78,R125	19A701250P347	Metal film; 30.1 K ohms ±1%, 1/4 W
R19,R21,R42,R46, R47,R59,R61,R82, R86 thru R88	19A701250P330	Metal film; 20 K ohms ±1%, 1/4 W
R20,R60	19A701250P291	Metal film; 8.66 K ohms ±1%, 1/4 W Used in -G3 only.
R16, R56	19A701250P328	Metal Film; 19.1 K ohms ±1%, 1/4 W
R22, R62	19A701250P385	Metal film; 75 K ohms ±1%, 1/4 W Used in -G3 only
R22, R62	19A701250P356	Metal film; 37.4 K ohms ±1%, 1/4 W Used in -G4 only
R23, R63	19A701250P231	Metal film; 2.05 K ohms ±1%, 1/4 W Used in -G3 only
R23, R63	19A701250P202	Metal film; 1.02 K ohms ±1%, 1/4 W Used in -G4 only
R24, R67	19A701250P351	Metal film; 33.2 K ohms ±1%, 1/4 W Used in -G3 only
R24, R67	19A701250P322	Metal film; 16.5 K ohms ±1%, 1/4 W Used in -G4 only
R26, R65	19A701250P268	Metal film; 4.99 K ohms ±1%, 1/4 W Used in -G3 only
R28, R68	19A701250P289	Metal film; 8.25 K ohms ±1%, 1/4 W Used in -G3 only
R28, R68	19A701250P260	Metal film; 4.12 K ohms ±1%, 1/4 W Used in -G4 only
R29, R72	19A701250P320	Metal film; 15.8 K ohms ±1%, 1/4 W Used in -G3 only
R29, R72	19A701250P287	Metal film; 7.87 K ohms ±1%, 1/4 W Used in -G4 only

Symbol	GE Part No.	Description
R31, R70	19A701250P293	Metal film; 9.09 K ohms ±1%, 1/4 W Used in -G3 only
R31, R70	19A701250P326	Metal film; 18.2 K ohms ±1%, 1/4 W Used in -G4 only
R33, R73, R115	19A701250P247	Metal film; 3.01 K ohms ±1%, 1/4 W Note: R33, R73 used in -G3 only
R33, R73, R94, R117, R126	19A701250P218	Metal film; 1.5 K ohms ±1%, 1/4 W Note: R33, R73 used in -G4 only
R34, R74	19A701250P228	Metal film; 1.91 K ohms ±1%, 1/4 W Used in -G3 only
R34, R74	19A701250P196	Metal film; 976 ohms ±1%, 1/4 W. Used in -G4 only
R35, R75	19A701250P408	Metal film; 118 K ohms ±1%, 1/4 W
R89, R97 thru R99, R129 thru R139	19A701250P401	Metal film; 100 K ohms ±1%, 1/4 W
R39, R79, R92	19A701250P239	Metal film; 2.49 K ohms ±1%, 1/4 W
R40, R80	19A701250P447	Metal film; 301 K ohms ±1%, 1/4 W
R41, R52, R81, R119, R120	19A701250P101	Metal film; 100 ohms ±1%, 1/4 W
R48,R49,R140,R141	19A116278P81	Metal film; 68.1 ohms ±1%, 1/2 W
R95*	19A116559P118	Variable, cermet; 10 ohms to 5 K ohms ±20%, 1/2 W; 10% log taper
R96	19A701250P249	Metal film; 3.16 K ohms ±1%, 1/4 W
R100	19A701250P340	Metal film; 25.5 K ohms ±1%, 1/4 W
R104	19A701250P266	Metal film; 4.75 K ohms ±1%, 1/4 W
R107	19A701250P369	Metal film; 51.1 K ohms ±1%, 1/4 W
R108, R142	19A700109P5	Variable, Cermet; 25 ohms to 10 K ohms ±20%, 1/2 W; linear taper
R110	19A701250P366	Metal film; 47.5 K ohms ±1%, 1/4 W
R113	19A701250P68	Metal film; 49.9 ohms ±1%, 1/4 W
R122	3R152P125	Composition; 1.2 megaohm ±5%, 1/4 W
R123	3R152P242	Composition; 2.4 K ohms ±5%, 1/4 W
		- - - - - - - - ARRESTOR - - - - - - - - - -
RV1	19A701783P2	Electrical surge; varistor; sim V275LA20
		- - - - - - - TRANSFORMER - - - - - - - - -
T1	PL-19B221765G1	Transformer
		- - - - - - - - - SWITCH - - - - - - - - - -
S1	19B800010P1	Push; 10 stations, 1-10; sim CTS 206-10
		- - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A143678P1	CMOS, dual SPDT analog switch; sim Siliconix DG307BK
U2	19A134097P11	Digital MOS: Dual "D" flip-flop with set/ reset; sim 4013
U3	19A134097P2	Digital MOS; Quad 2-input NOR gate; sim 4001
U4	19A134097P33	Digital MOS; 12-stage binary ripple counter; sim 4040

Symbol	GE Part No.	Description
U5	19A134097P38	Digital MOS; Micropower phase locked loop; sim 4046
U6 thru U8	19A134097P217	Digital MOS; Programmable divide-by-N-4 bit counter (binary); sim 4526
U9	19A134097P26	Digital MOS; Quad exclusive-OR gate; sim 4030
AR1, AR2, AR4, AR5	19A116297P5	Quad Operational Amplifier; linear; sim LM 248 J
AR3, AR7 AR8	19A134511P1	Quad Operational Amplifier, linear; sim NSCLM 224 J or Motorola MLM 224 L
AR6	19A116297P2	Operational Amplifier, linear; sim µA 741 C
		- - - - - - VOLTAGE REGULATORS - - - - - - -
VR1, VR2	4036887P11	Silicon, Zener diode; sim 1N5240 B
VR3 thru VR8	4036887P6	Silicon, Zener diode; sim 1N5234
VR3, VR4	19A115008P8	Silicon, Zener diode; sim 1N3829A
		- - - - - - - - -CRYSTAL - - - - - - - - - -
Y1	19B213427P15	2048 kHz
		- - - - - - - - CONNECTORS - - - - - - - - -
---	19A134152P125	Printed wiring, two-part; 3 circuits; Gold; sim Molex 22-10-2031
---	19A134448P2	Dummy plug; 2 position shorting; Gold; sim Berg 65474-001



TYPE CS26C/27C RECEIVER BLOCK DIAGRAM

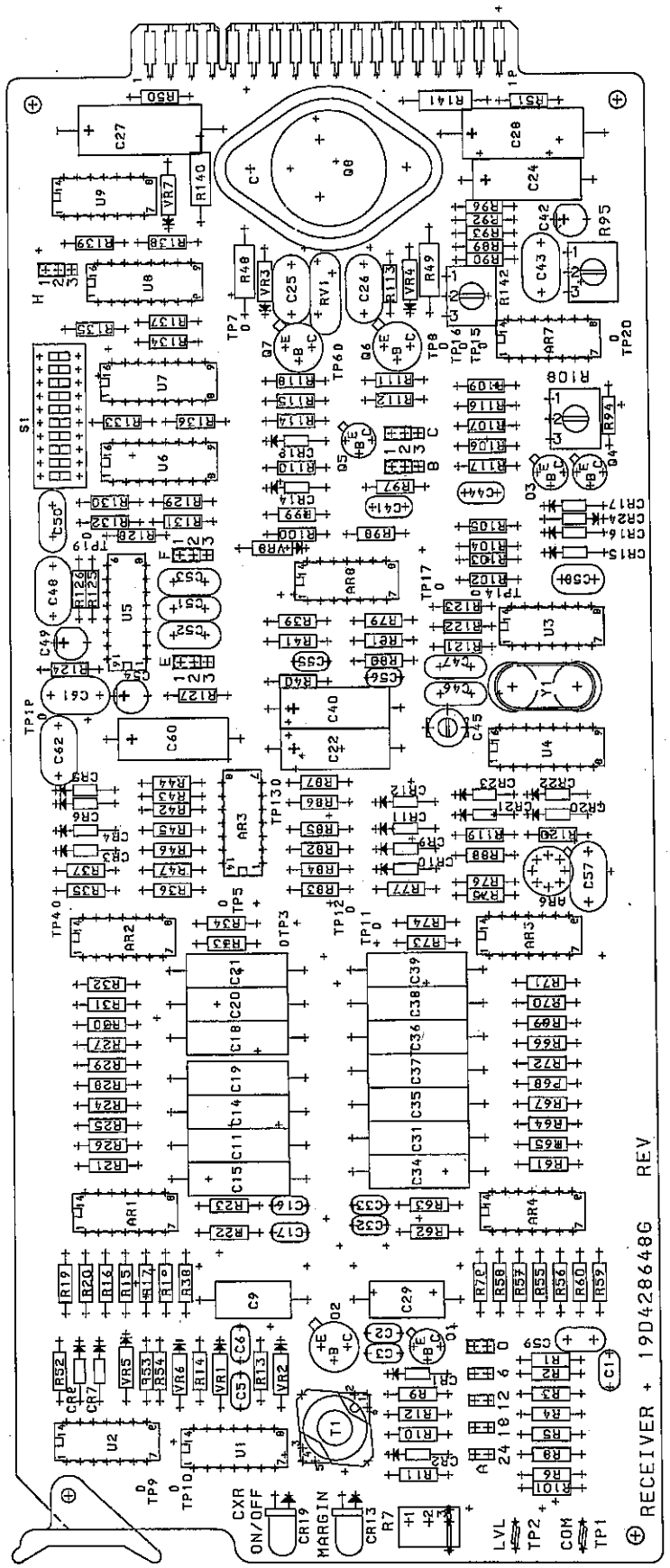
TYPICAL RECEIVER TEST POINT READINGS	
TEST POINT	READINGS
TP-2	CARRIER SINE WAVE (LINE FREQUENCY) APPROX. 125mV RMS (-18 dBm)
TP-7	+6.5 VDC
TP-8	-6.5 VDC
TP-4, 12	SINE WAVE 250 Hz (OR 500 Hz) AMPLITUDE 2 VRMS (+8.5 dBm)
TP-9, 10	SQUARE WAVES @ CARRIER FREQUENCY AMPLITUDE APPROX. 10V PEAK TO PEAK
TP-15	CARRIER ON: +4.2 VDC CARRIER OFF: -5.8 VDC
TP-16	CARRIER ON: +4.8 VDC CARRIER OFF: -5.8 VDC
TP-17	SQUARE WAVE 2048 kHz AMPLITUDE 14V PEAK TO PEAK
TP-18	SQUARE WAVE 1 kHz AMPLITUDE 14V PEAK TO PEAK
TP-19	SQUARE WAVE N TIMES FREQUENCY AT TP-18 AMPLITUDE APPROX. 14V PEAK TO PEAK

Functional Diagram

RECEIVER BLOCK DIAGRAM

(19C334234, Rev. 2)

RECEIVER
19D428648G3 REV.0
19D428648G4 REV.0



Pictorial Diagram

RECEIVER
PL-19D428648G3 and -G4

(19D434716, Rev. 0)

INSTRUCTIONS

TYPE CS26C/27C VOICE MODULE
PL-19D428670G1

DESCRIPTION

The Voice Module contains a simplex single-sideband (SSB) voice modulator/demodulator. In the send path all circuits are on the voice module except the RF output amplifier located on the Transmitter Module. In the receive path, the input RF amplifier and first modulator are located on the Receiver Module. Audio filters and second modulators are common to the send and receiver paths with transmission gates switching between send and receive modes. The send and receive circuits are terminated in a Push-to-Talk telephone handset. An audio tone generator is used for signaling.

OPERATION

Refer to Schematic Diagram 19D426337, Voice Signal Flow Diagram 19C334282 and Pictorial Diagram 19D428668 which are included in this section of the manual.

In the send mode, the Push-to-Talk switch on the telephone handset connects the TIP (Pin 6) to common through the carbon mike, this switches AR1C to +6 VDC and AR1B to -6 VDC. These two switches (AR1C & AR1B) control the transmission gates (U1-U4) that switch the voice module from the receive mode to the send mode. The voice signal from the carbon mike is coupled to amplifier AR1D by capacitor C2. Variable resistor R6 is used to adjust voice send level. Transmission gate U1A connects output of AR1D to low-pass filter AR8 and buffer amplifier AR9A couples output of AR8 to high-pass filter AR9. Buffer amplifier AR10A couples output of AR9 to notch filter AR10C & D. Transmission gate U2D connects the output of notch filter to transformer T2. The high-pass filter has a cut-off frequency of 300 Hz and the low-pass filter has a cut-off frequency of 1600 Hz. The notch filter is tuned to 1 kHz.

Transformer T2 is connected to balanced modulators U7 and U8. Counter U10 provides 1 kHz quadrature carriers to modulators U7 and U8. Transmission gates U2A and U2B connect the quadrature outputs from the modulators (U7 & U8) to low-pass filters AR3-AR4 and AR5-AR6. These filters have a cut-off frequency of 800 Hz. Amplifier AR7 provides output signals from the low-pass filters which are 180° out-of-phase. Transmission gates U3A, U3D, U4A and U4D connect these outputs to balanced modulators U5 and U6. Counter U9 provides line frequency quadrature carriers to modulators U5 and U6. Output of 200 Hz oscillator, AR2 is coupled into amplifier, AR10A when transistor, Q1 is switched OFF by AR1B.

The output signals from the balanced modulators (U5, U6) are summed and coupled to the send output by transformer T1. At this point one sideband from the modulators cancels and the other adds.

In the receive mode, quadrature audio inputs from the receiver module are connected to Pin 11 and 13. Transmission gates U1C and U1D connect the outputs of these filters to low-pass filters AR3-AR4 and AR5-AR6. The outputs of the low-pass filters are connected to balanced modulators U7 and U8 by transmission gates U3B, U3C, U4B and U4C. Outputs from the balanced modulators are summed by transformer T2 where one sideband is cancelled and the other is added.

Output of T2 is connected to the low-pass filter AR8 by transmission gate U2C. The signal is then passed through high-pass filter AR9 and notch filter AR10. Transmission gate U1B connects the output of the notch filter to the receive output stage AR1A. Receive output level is set by variable resistor R121. Resistor R92 sets the sidetone level to the telephone handset.

Output of high-pass filter, AR8, is also coupled through AR9A to a 200 Hz band-pass filter AR11B, and rectified by AR11A & D and detected by comparator AR11C. This circuit detects the 200 Hz signaling tone and turns ON the receiver output via pin 14.

NOMINAL OPERATING CHARACTERISTICS

1. Power Requirements:

   +12 VDC, 75 mA
   -12 VDC, 50 mA

2. Inputs:

   a. Tip: Voice send from handset mike

   b. Disable: ON - +6 VDC
      OFF - -6 VDC

   c. Voice Demod: Quadrature voice Signals from receiver

   d. Carrier: 12 VPP, 30-535 kHz

   e. 4 kHz: 12 VPP

3. Outputs:

   a. Signaling: ON - +6 VDC
      OFF - -6 VDC

   b. Sleeve: Voice out to handset

   c. Signaling: ON - +6 VDC
      OFF - -0 VDC

   d. XMIT Voice: RF voice out

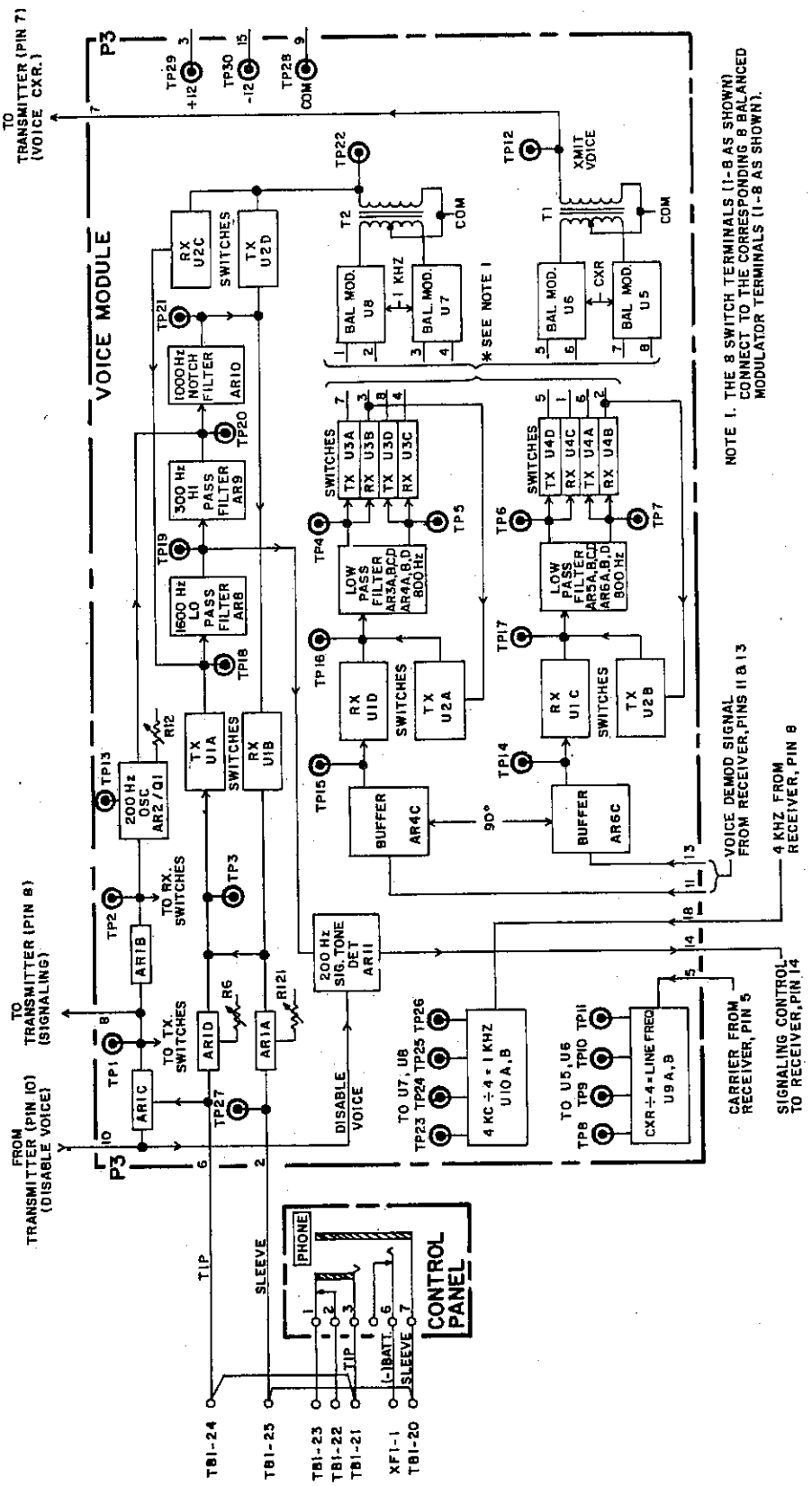
PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496267P12	Tantalum; 150 µF ±20%, 15 VDCW
C2, C47, C48, C55	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C3, C4, C53	19C300075P10001G	Polyester; 10,000 pF ±2%, 100 VDCW
C5 thru C18, C33 thru C37	19C307114P1002G	Polystyrene; 10,000 pF ±2%, 100 VDCW
C19, C20, C23	19A116080P8	Polyester; 0.15 µF ±20%, 50 VDCW
C21, C22, C45	19C300075P10002G	Polyester; 100,000 pF ±2%, 100 VDCW
C38	19C300075P56001G	Polyester; 56,000 pF ±2%, 100 VDCW
C39, C40 C44, C51	19C300075P47001G	Polyester; 47,000 pF ±2%, 100 VDCW
C41, C43	19C300075P22001G	Polyester; 22,000 pF ±2%, 100 VDCW
C42	19C300075P27001G	Polyester; 27,000 pF ±2%, 100 VDCW
C46	19A134202P14	Tantalum; 1.0 µF ±20%, 35 VDCW
C52	19C300075P12001G	Polyester; 12,000 pF ±2%, 100 VDCW
C54	5490008P15	Mica; 33 pF ±5%, 500 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1 thru CR16*	19A115250P1	Silicon, fast recovery; sim 1N4152
		- - - - - - - - - TRANSISTOR - - - - - - - - -
Q1	19A116755P1	Silicon, NPN; sim 2N3947
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	19A701250P1	Metal film; 100 ohms ±1%, 1/4 W
R2	3R78P431J	Composition; 430 ohms ±5%, 1 W
R3, R4, R15, R48, R50, R60, R80, R123, R124	19A701250P401	Metal film; 100 K ohms ±1%, 1/4 W
R5, R7, R49, R51, R54, R57, R62, R67, R74 thru R76, R82, R84, R89, R91, R95, R98, R100, R101, R116, R117, R122	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W
R6, R121	19A700109P3	Variable, Cermet; 22 K or 25 K ohms ±20%, 1/4 W 10% log taper; min 25 ohms
R8, R13, R14, R78, R127	19A701250P201	Metal film; 1 K ohms ±1%, 1/4 W
R9, R10	19A701250P388	Metal film; 80.6 K ohms ±1%, 1/4 W
R11	19A701250P195	Metal film; 953 ohms ±1%, 1/4 W
R12	19A116559P115	Variable, Cermet; 7 ohms to 100 ohms ±20%, 1/2 W; linear taper
R16, R32	19A701250P341	Metal film; 26.1 K ohms ±1%, 1/4 W
R17, R33,	19A701250P263	Metal film; 4.42 K ohms ±1%, 1/4 W
R18,R20,R23,R25,R28 R30,R34,R36,R39,R41, R44,R46,R102,R111,R112	19A701250P329	Metal film; 19.6 K ohms ±1%, 1/4 W
R19, R35, R93	19A701250P314	Metal film; 13.7 K ohms ±1%, 1/4 W
R21, R37*	19A701250P344	Metal film; 28 K ohms ±1%, 1/4 W
R22, R38	19A701250P284	Metal film; 7.32 K ohms ±1%, 1/4 W

Symbol	GE Part No.	Description
R24, R40, R79	19A701250P321	Metal film; 16.2 K ohms ±1%, 1/4 W
R26, R42	19A701250P342	Metal film; 26.7 K ohms ±1%, 1/4 W
R27, R43	19A701250P225	
R29,R45,R72, R107 thru R110	19A701250P320	Metal film; 15.8 K ohms ±1%, 1/4 W
R31, R47	19A701250P307	Metal film; 11.5 K ohms ±1%, 1/4 W
R33	19A701250P263	Metal film; 4.42 K ohms ±1%, 1/4 W
R52,R53,R56,R58, R61,R63,R65,R66	19A701250P330	Metal film; 20 K ohms ±1%, 1/4 W
R55,R59,R64,R68	19A701250P212	Metal film; 1.3 K ohms ±1%, 1/4 W
R69, R120	19A701250P101	Metal film; 100 ohms ±1%, 1/4 W
R70*	19A701250P277	Metal film; 6.19 K ohms ±1%, 1/4 W
R71	19A701250P287	Metal film; 7.87 K ohms ±1%, 1/4 W
R73	19A701250P328	Metal film; 19.1 K ohms ±1%, 1/4 W
R77*	19A701250P335	Metal film; 22.6 K ohms ±1%, 1/4 W
R85, R86, R128	19A701250P230	Metal film; 2 K ohms ±1%, 1/4 W
R78*	19A701250P306	Metal film; 11.3 K ohms ±1%, 1/4 W
R127	19A701250P201	Metal film; 1 K ohms ±1%, 1/4 W
R81*	19A701250P405	Metal film; 110 K ohms ±1%, 1/4 W
R83	19A701250P266	Metal film, 4.75 K ohms ±1%, 1/4 W
R87	19A701250P309	Metal film; 12.1 K ohms ±1%, 1/4 W
R88	19A701250P256	Metal film; 3.74 K ohms ±1%, 1/4 W
R90	19A701250P291	Metal film; 8.66 K ohms ±1%, 1/4 W
R92	19A701250P423	Metal film; 169 K ohms ±1%, 1/4 W
R94	19A701250P222	Metal film; 1.65 K ohms ±1%, 1/4 W
R96	19A701250P290	Metal film; 8.45 K ohms ±1%, 1/4 W
R99	19A701250P274	Metal film; 5.76 K ohms ±1%, 1/4 W
R103 thru R106	19A701250P322	Metal film; 16.5 K ohms ±1%, 1/4 W
R113	19A701250P359	Metal film; 40.2 K ohms ±1%, 1/4 W
R114	19A701250P293	Metal film; 9.09 K ohms ±1%, 1/4 W
R115	19A701250P420	Metal film; 158 K ohms ±1%, 1/4 W
R118	19A701250P358	Metal film; 39.2 K ohms ±1%, 1/4 W
R119	19A116559P102	Variable, Cermet; 10 ohms to 5 K ohms ±20%, 1/2 W; linear taper
R125, R126	19C314256P31100	Metal film; 110 ohms ±1%, 1/4 W
R129*	19A701250P205	Metal film; 1.1 K ohms ±1%, 1/4 W
		- - - - - - - TRANSFORMER - - - - - - - - -
T1	PL-19B221765G1	Transformer
T2	19B221609G1	Transformer
		- - - - - INTEGRATED CIRCUITS - - - - - - - -
U1 thru U8	19A134097P52	MOS, Digital (CMOS series); Quad Bilateral switch (improved CD4016AE); sim 4066
U9, U10	19A134097P11	MOS, Digital (CMOS series); Dual "D" Flip-Flop with set/reset; sim 4013
AR1, AR3 thru AR11	19A116297P5	Quad Operational Amplifier linear; 14 pin dual-in-line; sim LM 248J
AR2	19A134379P1	MOSFET input, COS/MOS output; linear; sim RCA CA3130T
		- - - - - VOLTAGE REGULATORS - - - - - - - -
VR1, VR2	4036887P1	Silicon, Zener diode; sim IN5221B
VR3, VR4	4036887P6	Silicon, Zener diode; sim IN5234

TYPICAL VOICE MODULE TEST POINT READINGS	
(SEND: -16 dBm input @ 800 Hz, TIP = Pin 6)	
Test Point	Reading
TP-1	Send +6.2 VDC Receive -4.8 VDC
TP-2	Send -4.8 VDC Receive +6.3 VDC
TP-3	800 Hz @ 280 mVrms
TP-13	200 Hz @ 4.2 Vrms
TP-18	800 Hz @ 280 mVrms
TP-19	200 Hz @ 530 mVrms
TP-29	+6.5 VDC
TP-30	-6.5 VDC

TYPICAL VOICE MODULE TEST POINT READINGS	
(RECEIVE: Receiving 800 Hz Signal @ -16 dBsr at Pins 11 & 13	
Test Point	Readings
TP-4, 5 TP-6, 7	Sine Waves, 800 Hz Amplitude 70 mVrms
TP-8,9,10,11	Square Waves @ Carrier Frequency Amplitude approx. 16 Volts peak to peak
TP-14,15, 16,17	Sine Waves @ Carrier Frequency Amplitude approx. 20 mVrms
TP-18,22	Modulated Sine Wave @ 200 Hz Amplitude approx. 70 mVrms
TP-19	Modulated Sine Wave @ 200 Hz Amplitude approx. 100 mVrms
TP-20,21	Sine Wave @ 800 Hz Amplitude approx. 20 mVrms
TP-23,24,25 26	Square Wave @ 1000 Hz Amplitude approx. 16 Volts peak to peak
TP-27	Sine Wave @ 800 Hz Amplitude approx. 35 mVrms
TP-29 TP-30	+6.5 VDC -6.5 VDC

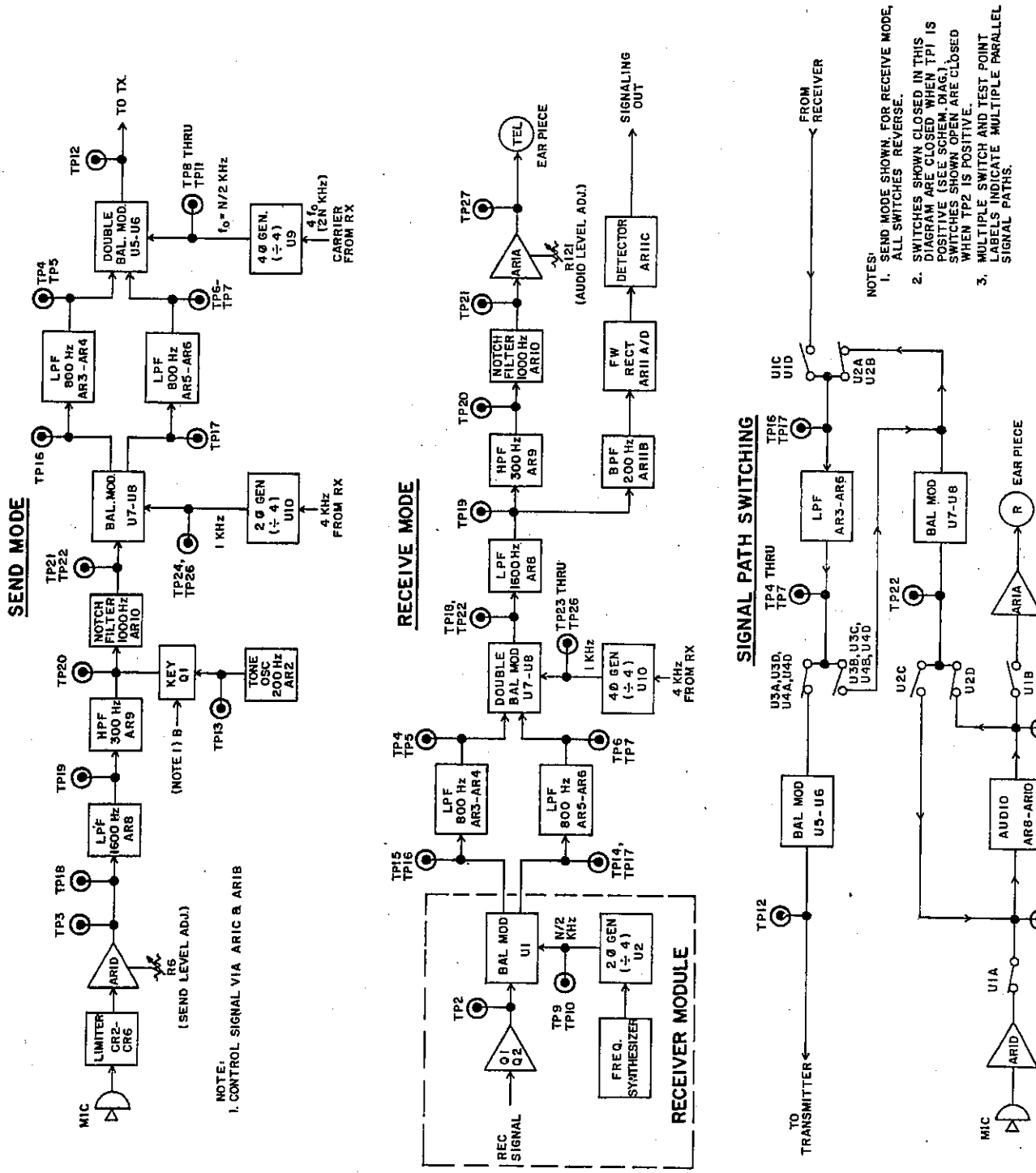


OVERALL VOICE MODULE BLOCK DIAGRAM

Block Diagram

OVERALL VOICE MODULE

(19C334232, Rev. 1)

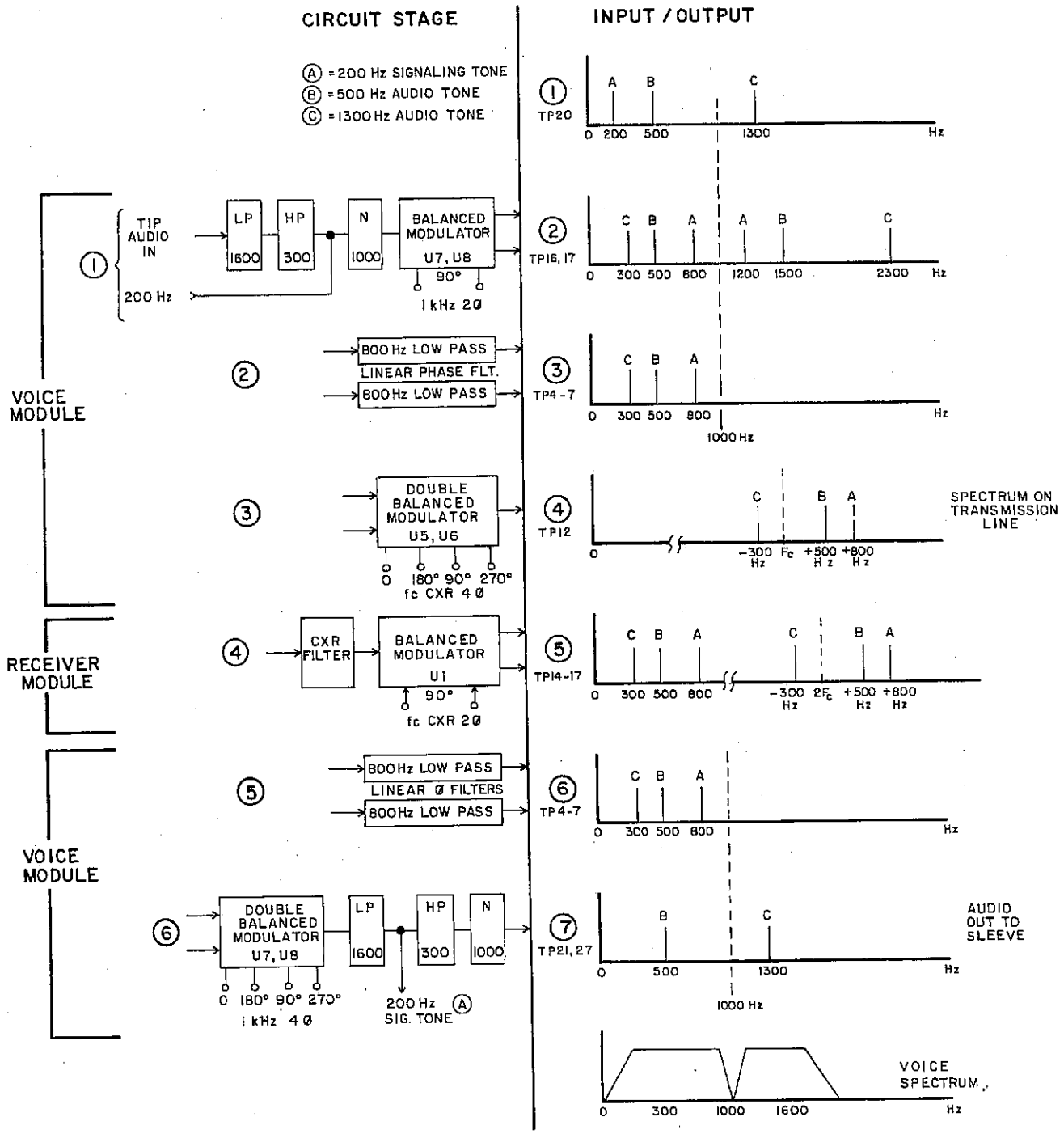


Block Diagram

SIGNAL FLOW

(19C334189, Rev. 2)

4CS26C/27C VOICE SSB MOD-DEMOD SYSTEM

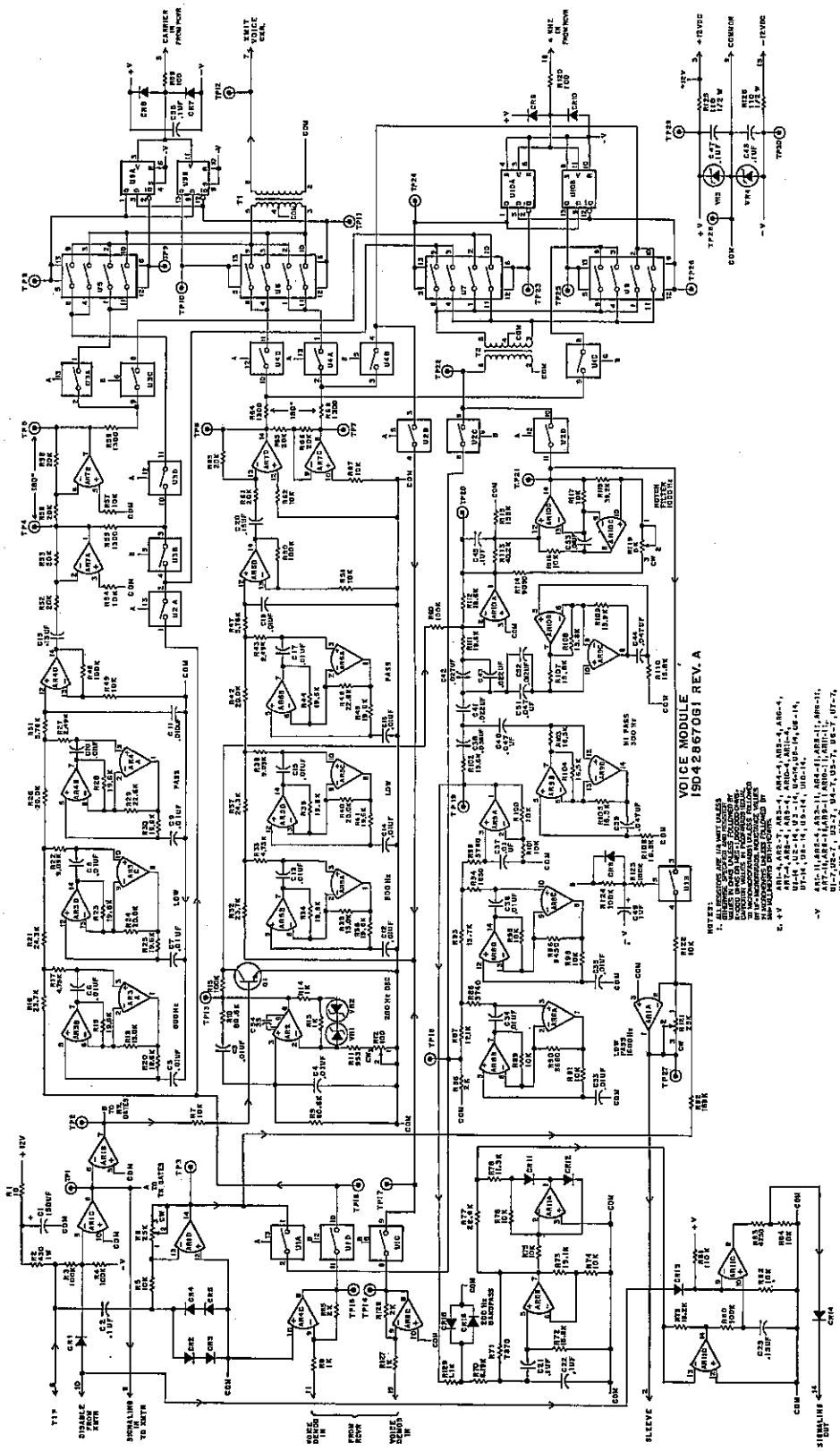


TEST POINTS REFERRED TO ABOVE ARE LOCATED IN VOICE MODULE.

Block Diagram

VOICE SSB MOD-DEMOD SYSTEM

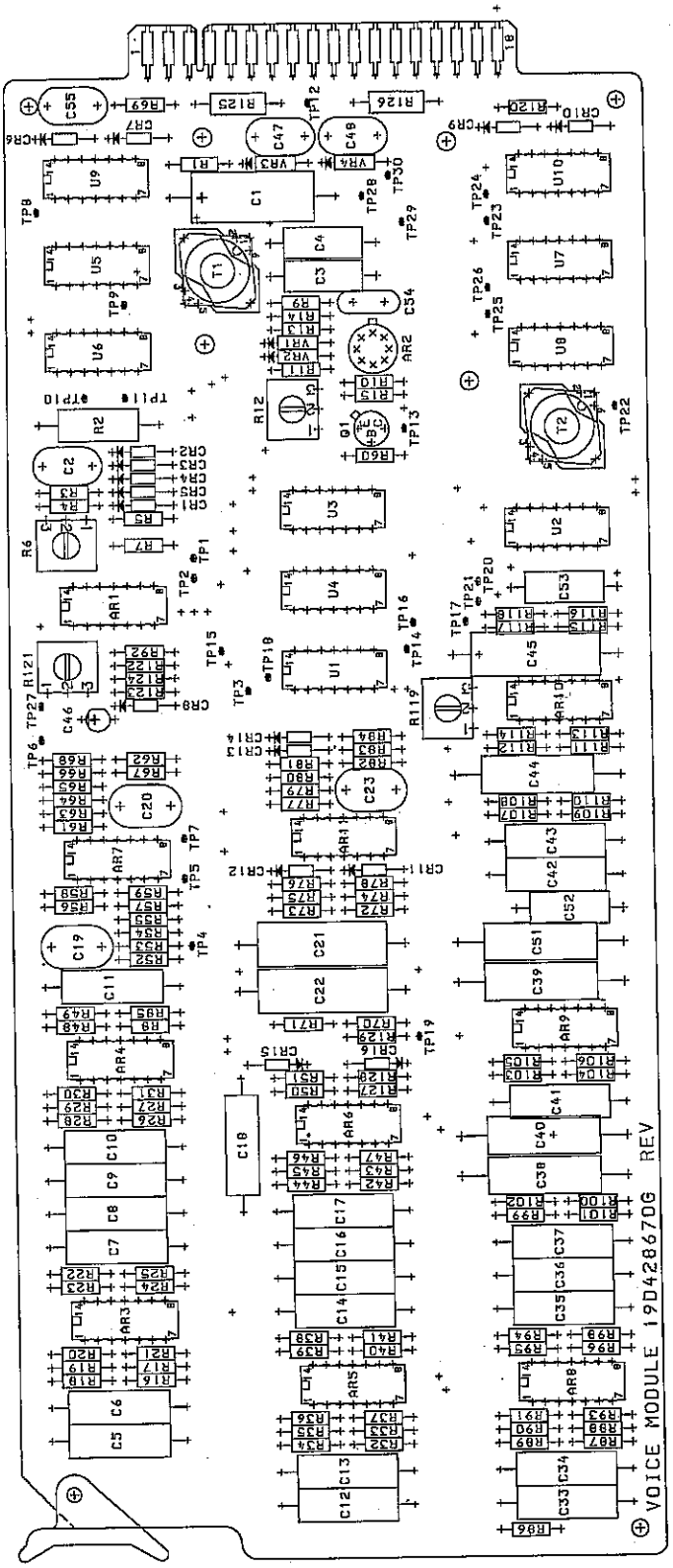
(19C334282, Rev. 1)



Schematic Diagram

VOICE MODULE
PL-19D428670G1

(19D426337, Rev. 4)



VOICE MODULE
19D428670G1 REV.A

Pictorial Diagram

VOICE MODULE
PL-19D428670G1

(19D428668, Rev. 2)

PRODUCTION CHANGES

TYPE CS26C/27C VOICE MODULATOR
PL-19D428670G1

The revisions listed below can be identified by revision letter appearing on the equipment nameplate.

PL-19D428670G1, Rev. A

Purpose: To improve sideband suppression.

Part Changed	Was	Changed To
R16 & R32	19A701250P341	19A701250P337
R17 & R33	19A701250P263	19A701250P266
R19 & R35	19A701250P314	19A701250P318
R21 & R37	19A701250P344	19A701250P338
R22 & R38	19A701250P284	19A701250P293
R24 & R40	19A701250P321	19A701250P330
R26 & R42	19A701250P342	19A701250P330
R27 & R43	19A701250P225	19A701250P239
R29 & R45	19A701250P320	19A701250P335
R31 & R47	19A701250P307	19A701250P274

INSTRUCTIONS

TYPE CS26C/27C CHECKBACK (MASTER)
PL-19D428677G1, REV. A
PL-19D428677G2, REV. B

DESCRIPTION

The Master Checkback module G1 (or G2 with read-out counter) produces the keying pulses, timing sequences, display lights and alarms to check and monitor a CS26C/27C carrier system, either manually or automatically. Up to three "remotes" may be checked for full or reduced power by the Master module. The optional counter (S005, G2 only) can be strapped to count the number of good tests or the number of tests failed. The counter may also be strapped to count only (1) full power or (2) full power and reduced power tests. Automatic checkback cycles are programmable from 1 hour to 255 hours in 1 hour intervals.

A full power alarm relay and a reduced power alarm relay is provided with Form "C" contacts. Alarm lights on the front panel of the module identify which remote failed and whether it was a full or reduced power failure. Provision is made (by built-in relays) for remotely (1) initiating a test, (2) resetting alarms and (3) resetting the program clock.

Also, a checkback test may be manually initiated at any remote location (up to 3), but only when the Master module is not in the test mode (interrogating the remotes).

OPERATION

Refer first to checkback Sequence Diagram found in this section. The entire interrogation and response sequence takes place in a nine (9) second interval and is then repeated. A master clock divides the total interval into nine (9) individual one second periods as shown on the diagram, with the first period for master interrogation (8 pulses @ 16 Hz in 1/2 sec.) of entire system. Then it "listens" during periods 2, 3 and 4 for each remote's respective response on full power. It interrogates again in period 5 (different code; 4 pulses @ 16 Hz in 1/4 sec.) and similarly waits for the sequential response of each remote in periods 6, 7 and 8 on reduced power. During clock period 9, the clock and alarms are reset and the entire interrogation/response sequence is ready to repeat as programmed by "dip" switch S1 on the module.

Refer now to Schematic Diagram 19E503535 and Pictorial Diagram 19D428679 for discussion of operation. The 32,768 Hz frequency at the output of the crystal oscillator AR1 is divided down to 16 Hz at Pin 15 of counter U1 and down to 1 Hz at Pin 6 of counter U2. At Pin 3 of counter U4 the frequency has been counted down to 1 Hz per hour. Programmable counters U5 and U6 set the automatic test output at Pin 3 of U6 in 1 hour steps from 1 to 255 hours. Switch S1 is used to program the counters in straight binary. Examples are given in next Table.

TYPICAL TEST INTERVALS (Switch S1 settings)

TEST INTERVAL	SWITCH POSITION 1 (1 Hr)	2 (2 Hr)	3 (4 Hr)	4 (8 Hr)	5 (16 Hr)	6 (32 Hr)	7 (64 Hr)	8 (128 Hr)
1 hour	C							
2 hours		C						
4 hours			C					
8 hours				C				
12 hours			C	C				
24 hours (1 day)				C	C			
48 hours (2 days)					C	C		
72 hours (3 days)				C			C	
168 hours (1 week)				C		C		C
240 hours (10 days)					C	C	C	C
255 hours (max.)	C	C	C	C	C	C	C	C

C = Switch closed with others open.

The checkback test sequence may be initiated in several ways, namely:

- Automatically, by the local master programmed clock (U6).
- Manually, by depressing the Manual Test Switch on front panel at either the master or remote location.
- By energizing the remote test relay coil (K4) at the master station.

When U7B sets, Pin 13 switches positive, applies a 1 to the Data Input of Flip-Flop U7A and switches AR3-A positive. This inhibits AR3-B, C & D, on the next positive edge of the 1 Hz clock. Flip-Flop, U7A sets and Pin 2 of U7A switches to 0 and applies a 0 to NOR gate U8D, Pin 13. This allows a 1 Hz clock signal to be applied to counter U12, Pin 14 through inverter U8A and NOR gate U8D. On the first count U12, Pin 2 switches to 1. This sets Flip-Flop U10A and Pin 1 of U10A switches to 1. NOR gate U9A switches to 0 allowing the 16 Hz clock to gated through NOR gate U9B to the STOP output. On Type CS27C, with jumper K in the 1-2 position, the START output is switched ON through inverters U9B & C by Flip-Flop U10A. On Type CS26C, with jumper K in the 2-3 position, the START output is switched ON each time the STOP is switched OFF. Counter U11 counts the output pulses (16 Hz) at the STOP output. When counter reaches 8, Flip-lop U10 is reset by a 1 output from U11, Pin 11. Counter U11 is also reset by NOR gate U9A.

These 8 pulses at 16 Hz rate from the Master Checkback Module are recognized at the remote Checkback Modules, as a command to switch to the test mode. Flip-Flop U21A is set on the second 1 Hz clock period and U12 switches to a 1 on Pin 4. Then the full power alarm light is turned ON for remote #1 and switches a 1 on Pin 1 of NAND gate, U20A. Remote #1 must send back 8 pulses at 16 Hz rate during this clock period. These input pulses switch AR2. The output of AR2 is connected to bandpass filter AR4-A and transistor switch Q5. As the pulses are received, Q5, causes the alarm lights to flash at a 16 Hz rate.

The 16 Hz pulses are detected by AR4-D and applied to the clock input of counter U16 through inverter AR4-B. Timing circuit AR4-C is switched LOW by the first pulse and allows U16 to count the pulses. If a pulse is delayed or missing AR4-C will switch positive resetting counter U16. This prevents random pulses from counting up to the desired number. When counter U16 reaches 8, Pin 9 switches to a 1, setting Flip-Flop U17-B. This starts counter U19 and when it reaches its predetermined count, Pin 1 momentarily switches to a 1 and this switches NAND gate U20-A to 0 and inverter U20-B to a 1, resetting Flip-Flop U21A and turning OFF alarm light #1.

If an additional pulse had been received, AR4-D would have reset U17A which in turn would have reset U18, before an output was produced. If the 8 pulses are not received within the second period of the 1 Hz clock, Flip-Flop U21A is left set and full power alarm light #1 is left ON.

The sequence described above is repeated for remotes 2 and 3, in the 3rd. and 4th 1 Hz clock periods. At the start of 1 Hz clock period 5, Pin 1 of U12 switches to a 1, setting Flip-Flop U10B. NOR gate U9A switches to 0 allowing the 16 Hz clock to be gated through NOR gate U9B to the STOP output. When U11 counts up to 4, Pin 1 switches to a 1, resetting Flip-Flop U10B. REDUCED POWER was switched ON when U10B was set and the START output was held OFF by U10A. The 4 pulses from the Master, commands the remotes to switch to reduced power and return 4 pulses in their respective time slots.

At the start of 1 Hz clock period 6, Pin 5 of U12 switches to a 1 and sets Flip-Flop U25A, turning ON reduced power alarm light for remote #1 and switches a 1 to Pin 1 of NAND gate U24A. During this clock period remote #1 must send back 4 pulses at 16 Hz rate. The four input pulses are detected as explained above for the eight pulses except counter U16 sets Flip-Flop U17A and counter U18 is started and outputs a pulse when its count is reached, setting Flip-Flop U25A. This turns ON reduced power alarm light #1 and switches a 1 on Pin 1 of NAND gate U24A. The circuits for the reduced power alarms are identical to the full power alarm circuits.

The sequence described above is repeated for remotes 2 and 3, in the 7th and 8th, 1 Hz clock periods. If any of the remotes (1, 2, or 3) do not exist, jumpers, D and G for remote #1 or E and H for remote #2 or F and J for remote #3, may be moved to position 1-2 to prevent an alarm.

During 1 Hz clock period 9, Pin 11 of U12 switches to a 1, resetting Flip-Flop U7B and preventing Flip-Flop U7A from resetting. U7B switches AR3-A OFF, turning the test light OFF and removing the inhibit from AR3-B & D. If any of the alarms are ON at the end of the test, AR3-D (for full power) or AR3-C (for reduced power) are switched OFF, closing the alarm contacts. If either AR3-C or AR3-D are switched OFF (Jumper L to 2-3), NAND gate U13C switches to a 1, which applies a reset to Flip-Flop U7A & B (Jumper M connected to 1-2), preventing the unit from going into the test mode until the alarms have been cleared. Under normal conditions Flip-Flop U7A is reset at the beginning of the 1 Hz clock period 10.

If the counter (M1) is strapped to count good tests (Jumper B to 1-2) NAND gate

U13B remains at 0 during period 9 (if no alarms are ON) and the 1 output from Pin 11 of U12 is switched through to the counter. An alarm causes U13B to switch to a 1 during period 11 and this blocks the pulse at U13D. Connecting the jumper B to 2-3 permits each failed test to be counted since each time U13B switches to a 1 the counter is advanced one count. If jumper L is connected to 1-2, the reduced power tests are also included in the count. Jumper M connected to 1-2, latches the checkback in a "no-test" mode until the alarms are reset.

The automatic timing sequence is started by operating CLOCK RESET switch S2. When this switch is operated, a test is started and the test will automatically be repeated in the number of hours programmed into the clock by switch S1.

A test may be manually initiated at any time, without affecting the automatic timing, by operating MANUAL TEST switch S3. When a test is not in progress, the Master Checkback will recognize the 4 pulses at 16 Hz as a command to switch into the test mode. The output of the 4 pulse detector U18, Pin 1, is OR connected by diode CR33 into the test start circuit.

A positive voltage applied to the checkback disables the input, therefore, stops any test in progress and resets all circuits. It also prevents the unit from switching to the test mode.

NOMINAL OPERATING CHARACTERISTICS

1. Power Requirements:

   +12 VDC, 95 mA
   -12 VDC, 95 mA

2. Outputs: Stop, Start and Reduced Power

   a) OFF: -6 VDC
   b) ON: +6 VDC

3. Inputs:

   a) Checkback Disable:

      (1) OFF: -6 VDC
      (2) ON: +6 VDC

   b) Input:

      (1) OFF: > 3.5 VDC
      (2) ON: < 0.5 VDC

4. Remote Controls: Clock Reset, Test and Alarm Reset

   a) ON: +6 VDC
   b) OFF: 0 VDC

5. Oscillator Frequency (TP1): 32,768 Hz

6. Pulse Frequency (TP2-During Test): 16 Hz

7. Time Slots: 1 sec.

CHECKBACK MASTER TEST POINT READINGS

TP1	Square wave Amplitude approx.	32.768 Hz 15. V pk. to pk.
TP2	Square wave Amplitude approx.	16 Hz 15. V pk. to pk.
TP3	Square wave Amplitude approx.	1 Hz 15. V pk. to pk.
TP4, 5, 6, 7	See Timing & Sequence Diagram shown on Figure 1.	

PARTS LIST

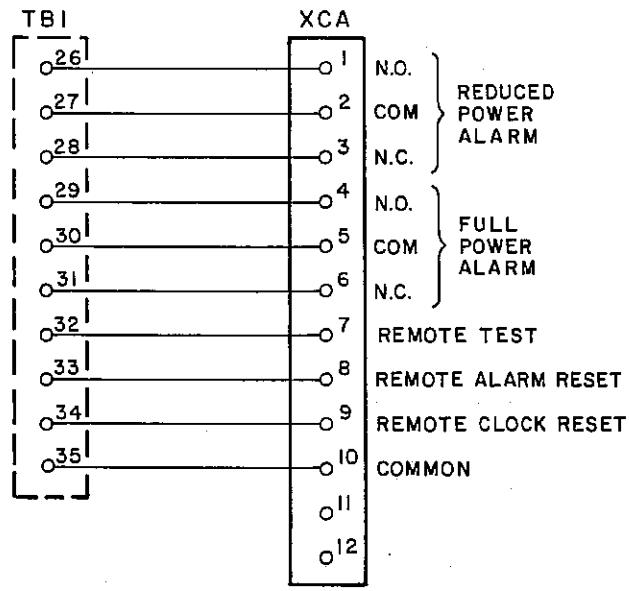
Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P1	Polyester; 0.01 µF ±20%, 50 VDCW
C11*	19A116080P14	Polyester; .0033 µF ±20%, 50 VDCW
C2 & C3 C8 thru C10 C12 thru C14 C16	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C4 & C17	19A134202P14	Tantalum; 1.0 µF ±20%, 35 VDCW
C5	19A115680P6	Electrolytic; 50 µF-10, + 150%, 50 VDCW
C6 & C15	19C300075P68001G	Polyester; 68000 pF ±2%, 100 VDCW
C7	19A134202P15	Tantalum; 6.8 µF ±20%, 35 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1 thru CR9, CR11 thru CR16, CR18, CR19, CR21, CR22, CR24, CR25, CR27, CR28, CR30, CR31, CR33 thru CR39	19A115250P1	Silicon, fast recovery; sim 1N4152
CR42 thru CR44	19A115250P1	Silicon, fast recovery; sim 1N4152
CR10, CR17, CR20, CR23, CR26, CR29, CR32	19A134354P1	Optoelectronic; red, wide angle; sim H-P 5082-4655
CR40, CR41	4037822P1	Silicon, rectifier; sim 1N5060
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1, K2	19B209439P3	Reed, mercury wetted; 24 VDC; 1.75 W; coil, 1.75 K ohms ±10%; pull-in 12.1 V max; drop-out, 1.85 V min; 1 form C contact, break before make; sim CP Clare HGJM51111R01
K3 thru K5	19A143774P1	Dry reed; coil, 125 ohms ±10%, operate, 6 V; pick-up, 3.8 VDC; max; drop-out, 0.5 VDC, min; 1 form A contact; sim Electrical Cat. No. RA30811061
		- - - - - - - - - - COUNTER - - - - - - - - - -
M1	19A144612P1	Electrical, with reset button; 24 VDC; sim Kessler-Ellis MK13.21. Used in -G2 only.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1, Q3, Q4, Q12	19A116755P1	Silicon, NPN; sim 2N3947
Q2, Q5	19A115300P2	Silicon, NPN; sim 2N3053
Q6 thru Q11, Q13	19A115779P1	Silicon, PNP; sim 2N3251
		- - - - - - - - - RESISTORS - - - - - - - - -
R1, R2, R58, R76	19C314256P23013	Metal film; 301 K ohms ±1%, 1/4 W

Symbol	GE Part No.	Description
R3*,R4*,R13* thru R20*,R29*,R31*,R32*, R55*,R56*,R59*,R60*, R62*,R63*,R65*,R66*, R68*,R69*,R71*,R72*, R89*,R91*	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W
R21, R43, R54	19A700106P87	Composition; 10 K ohms ±5%, 1/4 W
R22	19A700106P111	Composition; 100 K ohms ±5%, 1/4 W
R23, R44	19A700113P63	Composition; 1 K ohms ±5%, 1/2 W
R24*	19A701250P372	Metal film; 54.9 K ohms ±1%, 1/4 W
R25, R27, R33 thru R36, R38, R40, R41, R47 thru R52, R78, R84	19C314256P21003	Metal film; 100 K ohms ±1%, 1/4 W
R28*	19A701250P269	Metal film; 5.11 K ohms ±1%, 1/4 W
R30, R82	19C314256P21473	Metal film; 147 K ohms ±1%, 1/4 W
R37*,R57*,R61*, R64*,R67*,R70* R73*	19A701250P228	Metal film; 1.9 K ohms ±1%, 1/4 W
R42, R53	19A700106P103	Composition; 47 K ohms ±5%, 1/4 W
R45*, R92*	19A701250P369	Metal film; 51.1 K ohms ±1%, 1/4 W
R46, R50	19C314256P22003	Metal film; 200 K ohms ±1%, 1/4 W
R74, R75	19A116479P2560K	Metal film; 56 ohms ±10%, 2 W
R77*	19A701250P330	Metal film; 20 K ohms ±1%, 1/4 W
R79*	19A701250P218	Metal film; 1.5 K ohms ±1%, 1/4 W
R80*,R81*,R87*, R88*,R94*	19A701250P201	Metal film; 1 K ohms ±1%, 1/4 W
R83	19C314256P22943	Metal film; 294 K ohms ±1%, 1/4 W
R85	19C314256P21743	Metal film; 174 K ohms ±1%, 1/4 W
R86	19A701250P137	Metal film; 237 ohms ±1%, 1/4 W
R90	19C314256P21503	Metal film; 150 K ohms ±1%, 1/4 W
R93*	19A701250P275	Metal film; 5.9 K ohms ±1%, 1/4 W
		- - - - - - - - - SWITCHES - - - - - - - - - -
S1	19B800010P2	Push; 8 stations (1-8); sim CTS 206-8
S2 thru S4	7481654P6	Push; SP, normally open; red; sim Grayhill 30-1
		- - - - - - INTEGRATED CIRCUITS - - - - - - -
U1, U2, U18, U19	19A134097P33	MOS, Digital (CMOS series); 12 stage binary ripple counter; sim 4040
U3 thru U6	19A134097P217	MOS, Digital (CMOS series); programmable divide-by-N-4 bit counter (BCD); sim 4526
U7, U10, U17, U21, U23, U25	19A134097P11	MOS, Digital (CMOS series); Dual "D" Flip-Flop with set/reset; sim 4013
U8, U9	19A134097P2	MOS, Digital (CMOS series); Quad 2-Input NOR gate; sim 4001
U11, U12, U16	19A134097P15	MOS, Digital (CMOS series); Decode counter divider; sim 4017
U13, U20, U22, U24	19A134097P9	MOS, Digital (CMOS series); Quad 2-Input NAND gate; sim 4011
AR1	19A134379P1	MOSFET input, COS/MOS output; linear; sim RCA CA3130T

Symbol	GE Part No.	Description
AR2	19A116297P2	Operational Amplifier; linear; sim µA 741C
AR3	19A134511P1	Quad Operational Amplifier; linear; sim NSCLM 224J or Motorola MLM 224 L.
AR4	19A116297P5	Quad Operational Amplifier; linear; 14-pin dual-in-line; sim LM248J
		- - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1, VR2	4036887P6	Silicon, Zener diode; sim 1N5234
		- - - - - - - - - CRYSTAL - - - - - - - - -
Y1*	19A701383P1	Quartz crystal unit (tuning fork); 32.768 ±0.1% kHz; sim Motorola MTF 32-30A
		- - - - - - - - - CONNECTORS - - - - - - - - -
---	19A134152P125	Printed wiring, two-part; 3 circuits; sim Molex 22-10-2031; Gold
---	19A134448P2	Dummy plug; 2-position shorting; sim Berg 65474-001; Gold

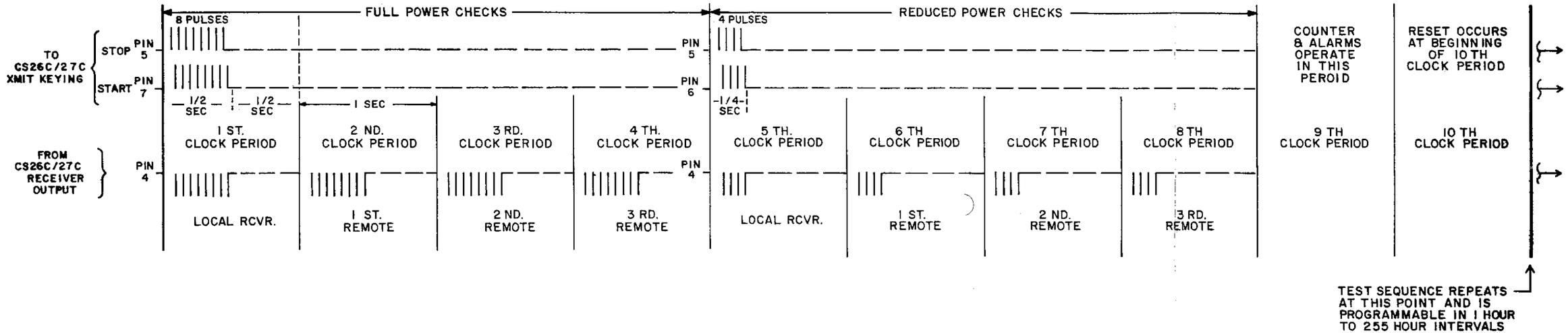
CUSTOMER CONNECTIONS
CHECKBACK
OPTIONS S004 AND S005 MASTER
OPTION S006 REMOTE

THE CONNECTIONS SHOWN BELOW ARE FOR THE ABOVE CHECKBACK, OPTIONS S004 AND S005. CHECKBACK OPTION S006 IS FOR THE REMOTE AND NO CUSTOMER CONNECTION IS REQUIRED.



(19A138743, Sheet 17, Rev. 0)

Interconnection Diagram - Checkback Cable - Option S004 and S005

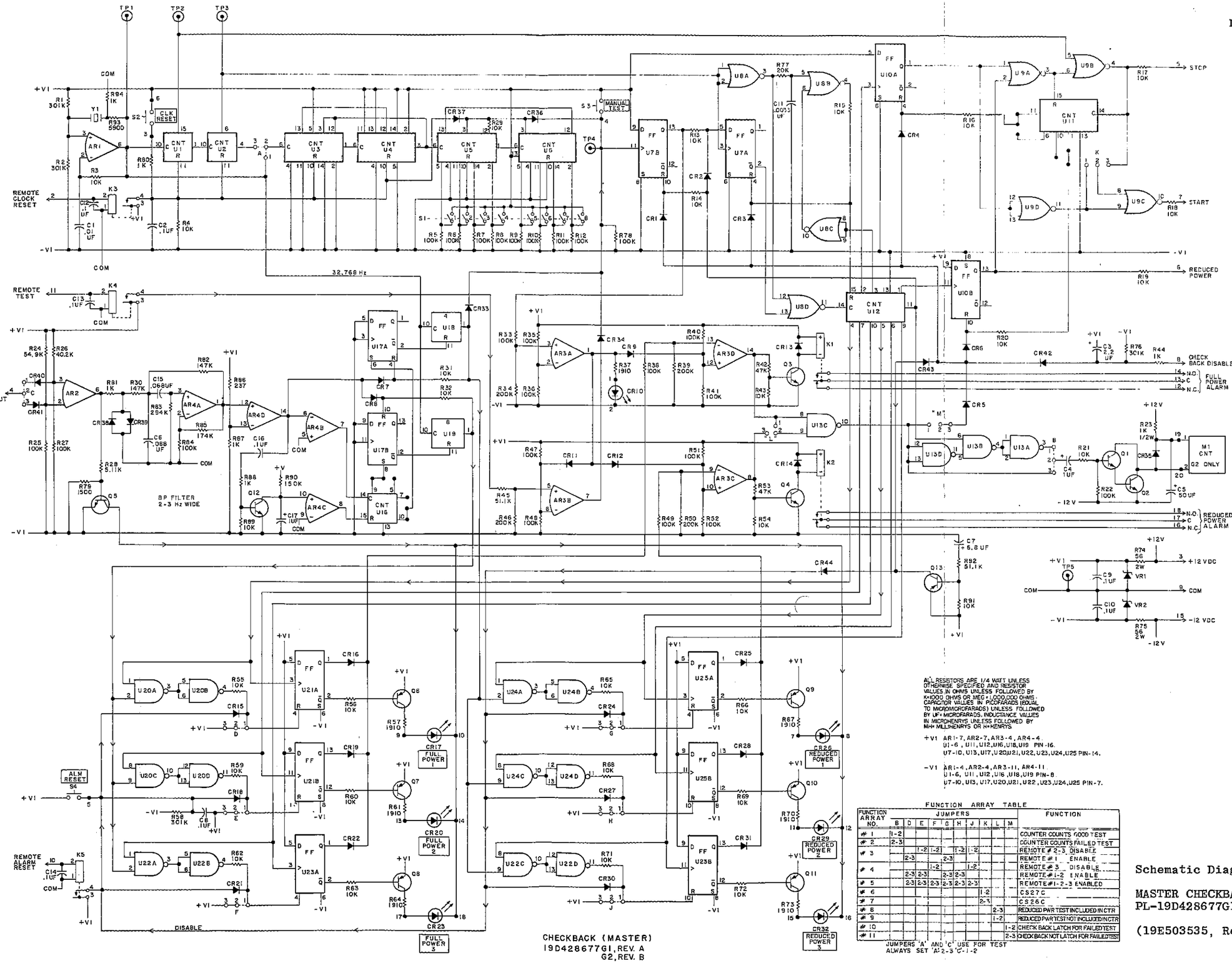


4CS26C/27C CHECKBACK SEQUENCE DIAGRAM

Figure 1 - Block Diagram

TYPE 4CS26C/27C CHECKBACK TUNING AND SEQUENCE DIAGRAM

(19D426755, Rev. 1)



CHECKBACK (MASTER)
19D428677G1, REV. A
G2, REV. B

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

+V1 AR1-7, AR2-7, AR3-4, AR4-4
U1-6, U11, U12, U16, U18, U19 PIN-16.
U7-10, U13, U17, U20, U21, U22, U23, U24, U25 PIN-14.

-V1 AR1-4, AR2-4, AR3-11, AR4-11
U1-6, U11, U12, U16, U18, U19 PIN-8.
U7-10, U13, U17, U20, U21, U22, U23, U24, U25 PIN-7.

FUNCTION ARRAY TABLE

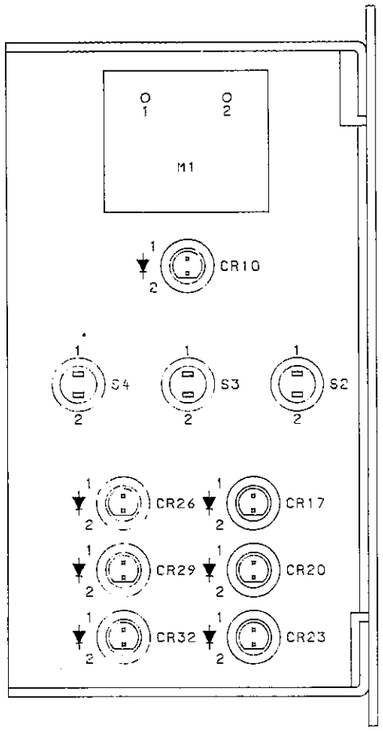
FUNCTION ARRAY NO.	JUMPERS B	D	E	F	G	H	J	K	L	M	FUNCTION
# 1	1-2										COUNTER COUNTS GOOD TEST
# 2	2-3										COUNTER COUNTS FAILED TEST
# 3		1-2	1-2			1-2	1-2				REMOTE # 2-3 DISABLE
		2-3			2-3						REMOTE # 1 ENABLE
# 4			1-2				1-2				REMOTE # 3 DISABLE
		2-3	2-3		2-3	2-3					REMOTE # 1-2 ENABLE
# 5		2-3	2-3	2-3	2-3	2-3	2-3				REMOTE # 1-2-3 ENABLED
# 6								1-2			CS27C
# 7								2-3			CS26C
# 8									2-3		REDUCED PWR TEST INCLUDED IN CTR
# 9									1-2		REDUCED PWR TEST NOT INCLUDED IN CTR
# 10										1-2	CHECK BACK LATCH FOR FAILED TEST
# 11										2-3	CHECK BACK NOT LATCH FOR FAILED TEST

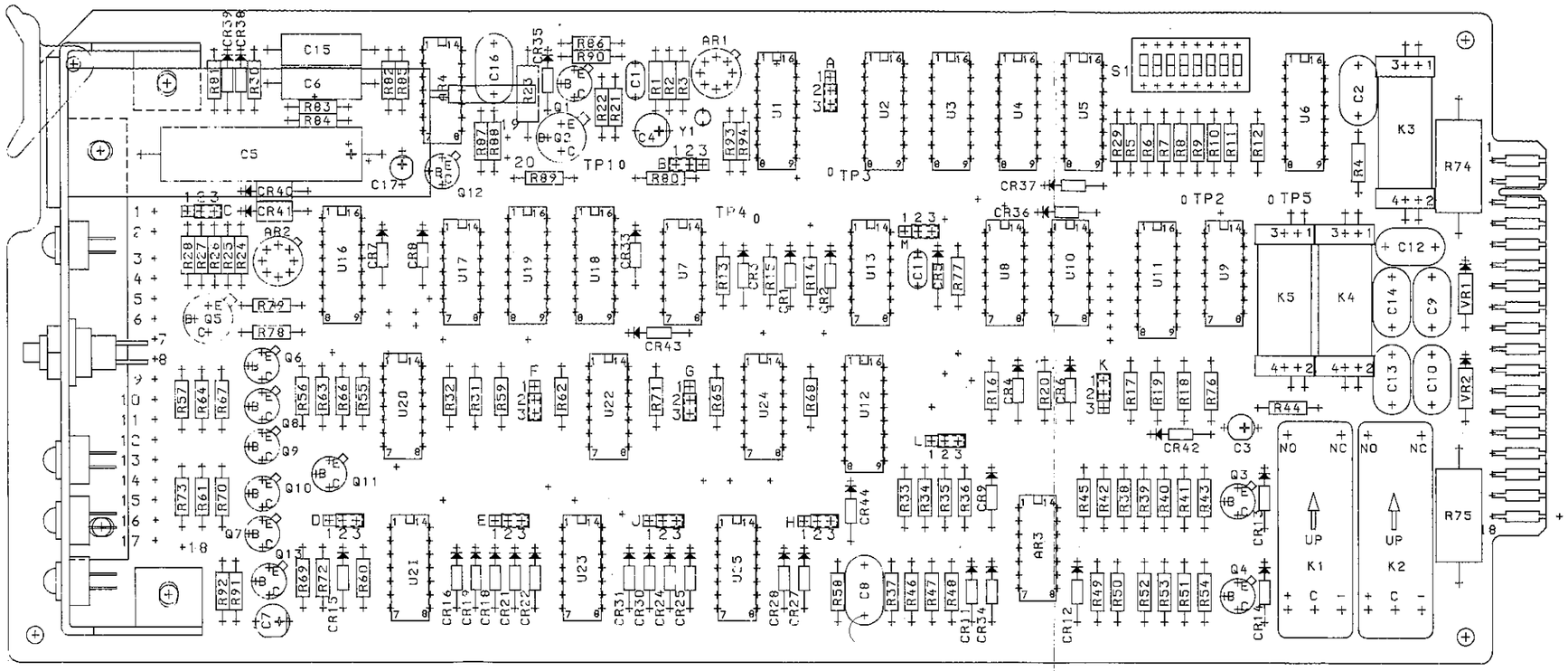
JUMPERS 'A' AND 'C' USE FOR TEST ALWAYS SET 'A' 2-3 'C' 1-2

Schematic Diagram

MASTER CHECKBACK
PL-19D428677G1 and -G2

(19E503535, Rev. 3)





CHECKBACK, MASTER
19D428677G1, REV. A
19D428677G2, REV. B

Pictorial Diagram

MASTER CHECKBACK
PL-19D428677G1 and -G2

(19D428679, Rev. 3)

PRODUCTION CHANGES

TYPE CS26C/27C CHECKBACK (MASTER)
PL-19D428677G1 and -G2

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428677G2, Rev. A

Purpose: To permit use of more readily available counter.

Part Changed	Was	Changed To
M1	19B209592P4	19A144612P1 - counter; electrical, with reset button; 24 VDC; sim K Kessler-Ellis MK13.21

PL-19D428677G1, Rev. A
PL-19D428677G2, Rev. B

Purpose: To reduce sequencer reset time.

Part Changed	Was	Changed To
C11	19A116080P1 (0.01 μF)	19A116080P14 (.0033 μF)

INSTRUCTIONS

TYPE CS26C/27C CHECKBACK (REMOTE)
PL-19D428721G1, REV. A

DESCRIPTION

The Remote Checkback Module responds to the signal sent by the Master Checkback by sending a signal to the Master Unit during its preassigned time slot. All the timing signals are controlled by a crystal oscillator. When the signal from the Master Checkback is detected, the clock is started.

Reserved for each remote, are two time slots, one for a full power test and the other for a reduced power test. Three remotes maybe tested by the Master Checkback. Each segment of the test is in one second intervals.

A manual test switch on the remote unit will generate a signal to the master unit that is recognized as a command to switch to the test mode. This allows a checkback test to be manually initiated at any of the remote sites.

Full and reduced power alarm lights allow the checkback test to be observed at any remote site. A checkback disable input stops any test in progress and resets all circuits.

OPERATION

Refer to Schematic Diagram 19D435387 and Pictorial Diagram 19D428723 which are included in this LBI.

The 32,768 Hz frequency at the output of crystal oscillator AR1 is divided down to 16 Hz at Pin 15 of U1 and down to 1 Hz at Pin 6 of U2. Counters U1 and U2 are inhibited from counting by NOR gate U3-D until a test signal is detected from the Master Checkback.

Input pulses from the CS26C/27C Receiver will switch AR2. The output of AR2 is connected to Bandpass Filter AR3-A and Transistor Switch Q7. As the pulses are received, Q7, causes the alarm lights to flash at a 16 Hz rate.

The 16 Hz pulses are detected by AR3-B and applied to clock input of counter U11 through inverter AR3-C. Timing circuit AR3-D is switched LOW by the first pulse and allows U11 to count the pulses. If a pulse is delayed or missing AR3-D will switch positive and reset counter U11. This prevents random pulses from counting up to the desired number. When counter U11 reaches 8, Pin 9 switches to a 1, setting Flip-Flop U12-B. This starts counter U14 and when it reaches its predetermined count Pin 1 momentarily switches to a 1 and this sets Flip-Flop U4-A. Flip-Flop U4-A switches a 1 to Pin 5 of NAND gate U6-B and Pin 12 of NOR gate U3-D. It also applies a 1 to Flip-Flop U5-A and this Flip-Flop is set on the next clock pulse. U3-D switches to a 0 and clock U1 and U2 is started. The 1 Hz clock signal is applied to counter U8 through inverter U3-A and NOR gate U3-B. Jumper B selects the time slot that the remote reports back in at full power and Jumper C selects the time slot that the remote reports back in at reduced power. Pin 2 of counter U8 switches to a 1 during the first period of the 1 Hz clock. When Jumper B is in the 1-2 position, NAND gate U6-B is switched 0 and this gates the 16 Hz pulses through NOR gate U3-C to the STOP output. The output pulses are counted by U7 and when they reach 8, Pin 11 of U7 switches to a 1, resetting Flip-Flop U4-A. Since Flip-Flop U5-A is set, U3-D remains at 0 and the clock continues to run.

At the start of the first time period, Pin 2 of U8, will also set Flip-Flop U16-A, unless jumper D is in the 1-2 position. With jumper D in the 2-3 position, the incoming pulses will flash full power alarm light #1 and will be switched OFF by the 8 pulse detector output U14, Pin 1 through NAND gate U15-A and inverter U15-B.

During the second 1 Hz clock period, remote #2 will report back and the full power alarm light #2 will be flashed by the 8 incoming pulses and will be switched OFF by the 8 pulse detector through NAND gate U15-C and inverter U15-D.

The above sequence is repeated by remote #3, except with full power alarm light #3, during the third 1 Hz clock period.

At the start of the fourth 1 Hz clock period, the Master Checkback sends 4 pulses at 16 Hz and Pin 10 of counter U8 releases the inhibit on Flip-Flop U4-B. The four pulses are detected by U3-B and when counter U11 reaches 4, Pin 10 switches to a 1 setting Flip-Flop U12-A. Flip-Flop U12-A releases counter U13 and when it reaches its predetermined count, Pin 1 switches to a 1, setting Flip-Flop U4-B. Flip-Flop U4-B switches to a 1 at Pin 1 of NAND gate U6-A.

When jumper C is connected to position 1-2, at the start of the fifth 1 Hz clock period, Pin 1 of U8 switches U6-A to 0 and this gates the 16 Hz pulses to the STOP output through NOR gate U3. When counter U7

reaches 4, Pin 1 of U7 switches to a 1 and resets U4-B. At the start of the period U6-A also switches REDUCED POWER, ON, through inverter U6-C. Reduced power is switched off when U4-B resets.

When jumper G is in the 1-2 position, the 4 incoming pulses will flash Reduced Power Alarm Light #1 and then it will be switched OFF by the 4 pulse detector output U13, Pin 1 through NAND gate U19-A.

During the sixth 1 Hz clock period, remote #2 will report back and the reduced power alarm light #2 will be flashed by the 4 incoming pulses and will be switched OFF by the 4 pulse detector through NAND gate, U19-C and inverter U19-D.

The above sequence is repeated by remote #3, except with the reduced power alarm light #3, during the seventh 1 Hz clock period.

At the start of the eighth 1 Hz clock period, Pin 9 of U8 switches to a 1, which resets all circuits, except the alarm light circuits, ending the test.

NOMINAL OPERATING CHARACTERISTICS

1. Power Requirements:

   +12 VDC, 65 mA
   -12 VDC, 65 mA

2. Oscillator Frequency (TP1): 32,768 Hz

3. Outputs: Stop, Start and Reduced Power

   a) OFF: -6 VDC
   b) ON: +6 VDC

4. Inputs:

   a) Checkback Disable:

      1. OFF: -6 VDC
      2. ON: +6 VDC

   b) Input:

      1. OFF: >3.5 VDC
      2. ON: <0.5 VDC

5. Pulse Frequency (TP-2-During Test): 16 Hz

6. Time Slots: 1 sec.

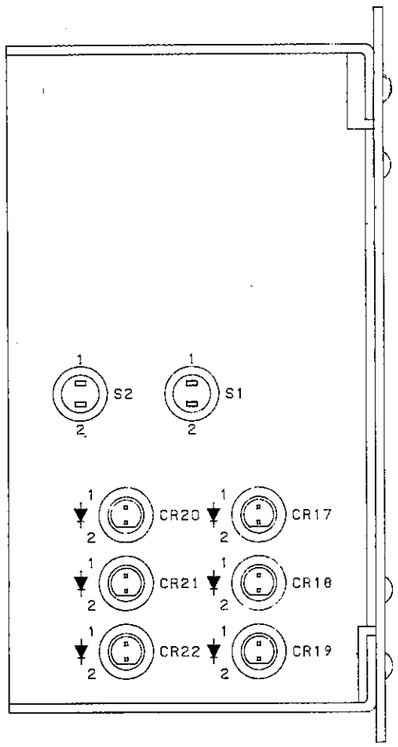
PARTS LIST

Symbol	GE Part No.	Description
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P1	Polyester; 0.01 µF ±20%, 50 VDCW
C2, C5 thru C7, C9	19A116080P7	Polyester; 0.1 µF ±20%, 50 VDCW
C3, C8	19C300075P68001G	Polyester; 68000 pF ±2%, 100 VDCW
C4	19A134202P15	Tantalum; 6.8 µF ±20%, 35 VDCW
C10	19A134202P14	Tantalum; 1.0 µF ±20%, 35 VDCW
C11*	5490008P43	Mica; 470 pF ±5%, 500 VDCW
C12	19A116080P8	Polyester; 0.15 µF ±20%, 50 VDCW
C13	5490008P43	Mica; 470 pF ±5%, 300 VDCW
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1 thru CR16, CR23 thru CR27, CR30 thru CR32	19A115250P1	Silicon, fast recovery; sim 1N4152
CR17 thru CR22	19A134354P1	Optoelectronic; red, wide angle; sim H-P 5082-4655
CR28, CR29	4037822P1	Silicon, rectifier; sim 1N5060
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 thru Q6, Q9	19A115779P1	Silicon, PNP; sim 2N3251
Q7	19A115300P2	Silicon, NPN; sim 2N3053
Q8	19A116755P1	Silicon, NPN; sim 2N3947
		- - - - - - - - - RESISTORS - - - - - - - - -
R1*, R2*	19A701250P447	Metal film; 301 K ohms ±1%, 1/4

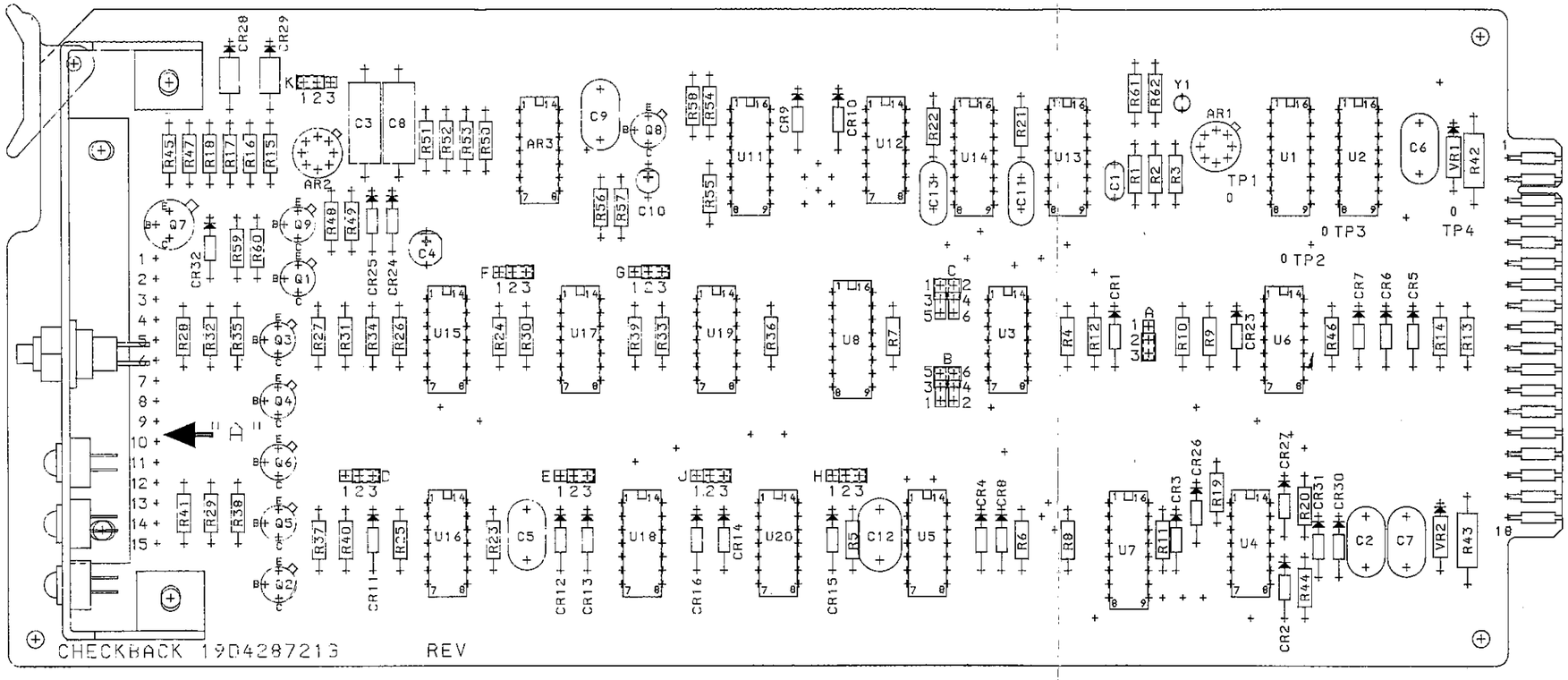
Symbol	GE Part No.	Description
R3*, R19*, R20* R57*, R59*	19A701250P301	Metal film; 10 K ohms ±1%, 1/4 W
R4 thru R14, R21, R22, R24 thru R27	19A700106P87	Composition; 10 K ohms ±5%, 1/4 W
R15*	19A701250P372	Metal film; 54.9 K ohms ±1%, 1/4 W
R16*,R18*,R52*	19A701250P401	Metal film; 100 K ohms ±1%, 1/4 W
R17*	19A701250P359	Metal film; 40.2 K ohms ±1%, 1/4 W
R23, R44	19A700106P111	Composition; 100 K ohms ±5%, 1/4 W
R28*, R29*, R32*, R35*, R38*, R41*	19A701250P228	Metal film; 1.91 K ohms ±1%, 1/4 W
R42*, R43*	19A116278P85	Metal film; 75 ohms ±2%, 1/2 W
R45*	19A701250P269	Metal film; 5.11 K ohms ±1%, 1/4 W
R47*	19A701250P218	Metal film; 1.5 K ohms ±1%, 1/4 W
R48*, R55*, R56*, R62*	19A701250P201	Metal film; 1.0 K ohms ±1%, 1/4 W
R49*, R50*	19A701250P417	Metal film; 147 K ohms ±1%, 1/4 W
R51*	19A701250P446	Metal film; 294 K ohms ±1%, 1/4 W
R53*	19A701250P424	Metal film; 174 K ohms ±1%, 1/4 W
R54	19A701250P137	Metal film; 237 ohms ±1%, 1/4 W
R58*	19A701250P418	Metal film; 150 K ohms ±1%, 1/4 W
R60*	19A701250P361	Metal film; 51.1 K ohms ±1%, 1/4 W
R61*	19A701250P275	Metal film; 5.9 K ohms ±1%, 1/4 W
		- - - - - - - - - SWITCHES - - - - - - - - -
S1, S2	7481654P6	Push; SP; normally open; red; sim Graybill 30-1
		- - - - - - INTEGRATED CIRCUITS - - - - - - -
U1, U2, U13, U14	19A134097P33	MOS, Digital (CMOS series); 12-stage binary ripple counter; sim 4040
U3	19A134097P2	MOS, Digital (CMOS series); Quad 2-input NOR gate; sim 4001
U4, U5, U12, U16, U18, U20	19A134097P11	MOS, Digital (CMOS series); Dual "D" Flip-Flop with set/reset; sim 4013
U6, U15, U17, U19	19A134097P9	MOS, Digital (CMOS series); Quad 2-input NAND gate; sim 4011
U7, U8, U11	19A134097P15	MOS, Digital (CMOS series); Decode counter divider; sim 4017
AR1	19A134279P1	MOSFET input, COS/MOS output; linear; sim RCA CA3130T
AR2	19A116297P2	Operational amplifier; linear; sim µA 741C
AR3	19A116297P5	Quad Operational Amplifier; linear; 14-pin dual-in-line; sim LM 248J
		- - - - - - VOLTAGE REGULATORS - - - - - -
VR1, VR2	4036887P6	Silicon, Zener diode; sim 1N5234
		- - - - - - - - - CRYSTAL - - - - - - - - -
Y1*	19A701383P1	Quartz crystal unit (tuning fork); 32.768 ±0.1% kHz; sim Motorola MTF 32-30A

Symbol	GE Part No.	Description
		- - - - - - - - - - CONNECTORS - - - - - - - - - -
---	19A134152P125	Printed wiring, two-part; 3 circuits; Gold; sim Molex 22-10-2031
---	19A134448P2	Dummy plug; 2-position shorting; Gold; sim Berg 65 474-001

TYPICAL CHECKBACK (REMOTE) TEST POINT READINGS	
(Receiving Normal Input Signal Level from Master)	
TEST POINT	READINGS
TP-1	Square Wave @ 32.768 Hz Amplitude approx. 15 Volts peak to peak
TP-2	Square Wave @ 16 Hz Amplitude approx. 15 Volts peak to peak
TP-3	Square Wave @ 1 Hz Amplitude approx. 15 Volts peak to peak
	FULL POWER TEST
Pin 4 (Input)	8 Negative Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
Pin 5 (Stop)	8 Positive Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
Pin 6 (Red. Pwr)	No Signal
Pin 7 (Start)	8 Positive Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
	REDUCED POWER TEST
Pin 4 (Input)	4 Negative Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
Pin 5 (Stop)	4 Positive Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
Pin 6 (Red. Pwr)	4 Positive Pulses @ 16 Hz rate Approx. 15 Volts peak to peak
Pin 7 (Start)	No Signal



VIEW AT "A"

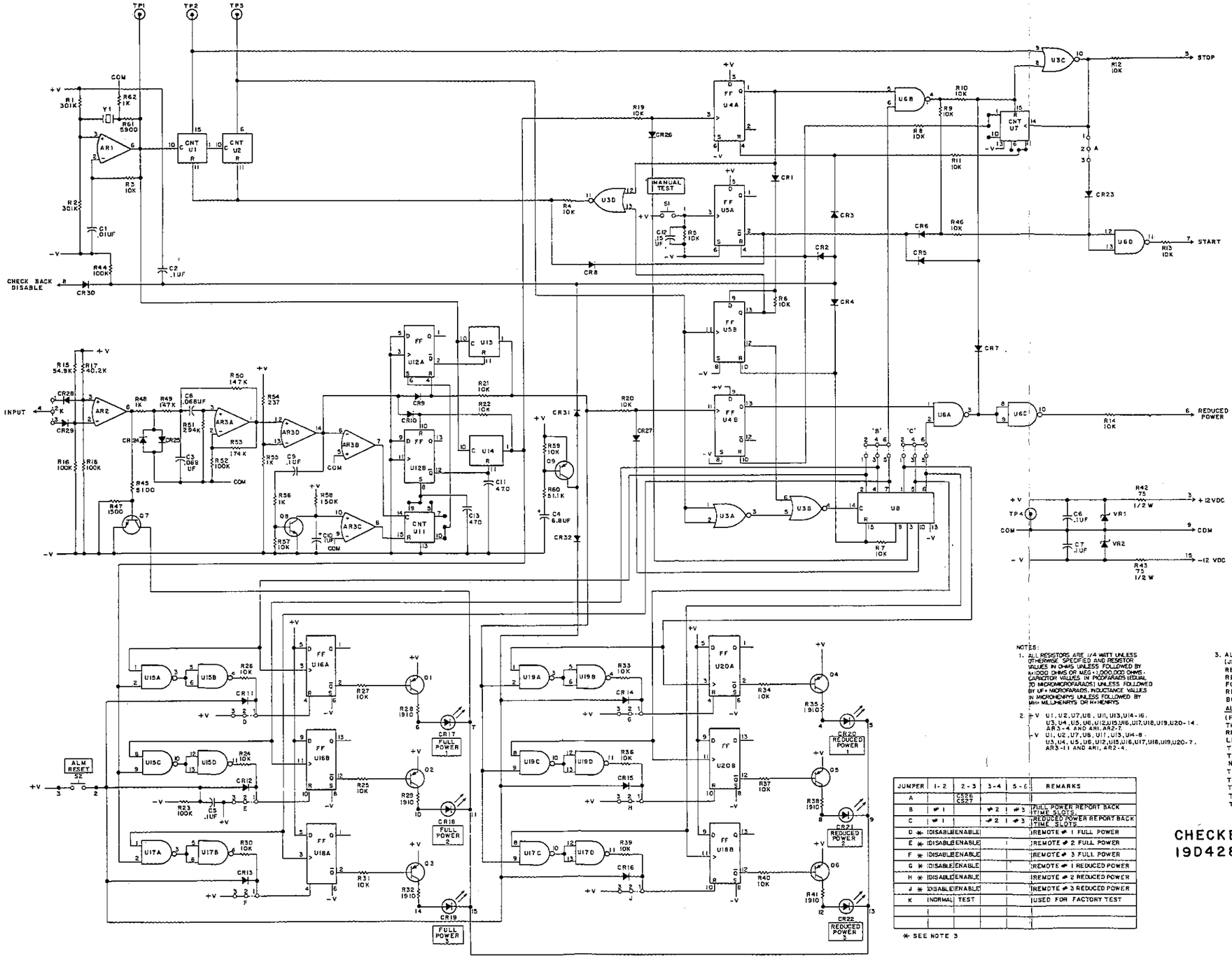


CHECKBACK, REMOTE
19D428721G1 REV. A

Pictorial Diagram

REMOTE CHECKBACK
PL-19D428721G1

(19D428723, Rev. 1)



NOTES:

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1,000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (DECIMAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.
2. +V U1, U2, U7, U8, U11, U13, U14-16, U3, U4, U5, U6, U12, U15, U16, U17, U18, U19, U20-14. AR3-4 AND 4A1, AR2-7.
   -V U1, U2, U7, U8, U11, U13, U14-8. U3, U4, U5, U6, U12, U15, U16, U17, U18, U19, U20-7. AR3-11 AND AR1, AR2-4.
3. ALL REMOTE LIGHTS ARE NORMALLY STRAPPED OUT (JUMPERS D,E,F,G,H J1. SYSTEM APPLICATION MAY REQUIRE REMOTE LIGHTS TO BE STRAPPED IN FOR REMOTE TIME SLOTS, EXCEPT THE LOCAL TIME SLOT. FOR EXAMPLE, A FOUR ENDED SYSTEM WOULD HAVE REMOTE LIGHTS 2 AND 3 STRAPPED IN FOR REMOTE 1, BUT TIME SLOT 1 STRAPPED OUT.

   ALERT IF THE LOCAL TIME SLOT IS STRAPPED IN, (FOR EXAMPLE, TIME SLOT 1 IN REMOTE 1), THEN THE FULL POWER LIGHT WILL FLASH WHEN REMOTE 1 RESPONDS AND THEN CLEAR. THE REDUCED POWER LIGHT MAY OR MAY NOT FLASH AND MAY NOT CLEAR. THE RECEIVED LOCAL SIGNAL IS A FUNCTION OF THE HYBRID TERMINATION. A GOOD HYBRID TERMINATION HAS HIGH ISOLATION, WHICH REDUCES THE LOCAL SIGNAL LEVEL; THEREFORE, A GOOD TERMINATION MAY RESULT IN INSUFFICIENT SIGNAL TO FLASH AND CLEAR THE REMOTE'S LIGHT. A POOR TERMINATION HAS LESS ISOLATION WHICH INCREASES THE RECEIVE SIGNAL LEVEL.

JUMPER	1-2	2-3	3-4	5-6	REMARKS
A		CS26 CS27			
B	⇌1		⇌2	⇌3	FULL POWER REPORT BACK TIME SLOTS
C	⇌1		⇌2	⇌3	REDUCED POWER REPORT BACK TIME SLOTS
D *	DISABLE	ENABLE			REMOTE ⇌ 1 FULL POWER
E *	DISABLE	ENABLE			REMOTE ⇌ 2 FULL POWER
F *	DISABLE	ENABLE			REMOTE ⇌ 3 FULL POWER
G *	DISABLE	ENABLE			REMOTE ⇌ 1 REDUCED POWER
H *	DISABLE	ENABLE			REMOTE ⇌ 2 REDUCED POWER
J *	DISABLE	ENABLE			REMOTE ⇌ 3 REDUCED POWER
K	NORMAL	TEST			USED FOR FACTORY TEST

* SEE NOTE 3

CHECKBACK (REMOTE)
19D428721G1 REV. A

Schematic Diagram

REMOTE CHECKBACK
PL-19D428721G1

(19D435387, Rev. 1)

PRODUCTION CHANGES

TYPE CS26C/27C CHECKBACK (REMOTE)
PL-19D428721G1

The revision listed below can be identified by the revision letter appearing on the equipment nameplate.

PL-19D428721G1, Rev. A

Purpose: To improve triggering stability.

Part Changed	Was	Changed To
C11	5490008P33 (180 pF)	5490008P43 (470 pF)

GENERAL ELECTRIC COMPANY
POWER SYSTEMS MANAGEMENT BUSINESS DEPT.
MALVERN, PA 19355

GENERAL ELECTRIC

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