TECHNICAL DATA PACKAGE

TDP3506 / O/N 9300-3506-00
Second Edition / October 1989

MODEL WMS300

WALL MOUNT

SPEAKER

USER STATION

TW INTERCOM SYSTEM

RTS SYSTEMS
1100 West Chestnut Street / Burbank, CA 91506 / Phone (818) 566-6700 / FSCM: 60572

PROPRIETARY NOTICE

COPYRIGHT NOTICE

PATENT NOTICE

The Model WMS300 contains and uses a design embodied in United States Patent No. 4,358,644: "BILATERAL CURRENT SOURCE FOR A MULTI-TERMINAL INTERCOM". This design employs a bilateral current source operated as a two-wire to four-wire converter.

TECHNICAL DATA PACKAGE, TDP 3506
Model WMS300 TW Intercom System Wall Mount Speaker User Station

Printing History:
First Edition: September 1983
Second Edition: October 1988
Thrid Edition: August 1989
Fourth Edition: October 1989

Published by the Engineering Department of RTS Systems, orporated, which is responsible for its contents.

Written by: Stan Hubler
Lianne Sterling Swanson

Edited by: Sheryl D. Thompson

Address all communication regarding this publication to:

Director of Engineering
RTS Systems
1100 West Chestnut Street
Burbank, CA 91506 U.S.A.

UNPACKING INFORMATION **AND** INSPECTION

Immediately upon receipt of the equipment, inspect the shipping container and the contents carefully for any discrepancies or damage. Should there be any, notify the freight company and the dealer at once.

The Model WMS300 shipping container should contain the following components:

Ordering Number 9000-5105-00

Qty	RTS Systems Part Number	Description
1	9010-5105-00	Model WMS300
1	9300-3504-00	Technical Data Package

NOTE: Detailed information concerning Theory of Operation, Maintenance, Spare Parts and System Interconnection is available in "The TW Intercom System Technical Manual", which may be obtained through an RTS Systems Dealer or directly from RTS Systems.

QUICK TABLE **OF** CONTENTS

RTS SYSTEMS' LIMITED WARRANTY

The products of RTS Systems are warranted to be free from defects in materials and workmanship for a period of one year from the date of sale.

RTS Systems's sole obligation during the warranty period is to provide, without charge, parts and labor necessary to remedy covered defects appearing in products returned prepaid to RTS Systems **1100** W. Chestnut Street, Burbank, California, **91506,** U.S.A.. This warranty does not cover any defect, malfunction or failure caused beyond the control of RTS Systems, luding unreasonable **or** negligent operation, abuse, accident, failure to follow instructions in the Technical Manual or the Owner's Manual, defective or improper associated equipment, attempts at modification and repair not authorized by RTS Systems, ., and shipping damage. Products with their serial numbers removed or effaced are not covered by this warranty.

To obtain warranty service, follow the procedures entitled "PROCEDURE FOR RETURNS" and "SHIPPING **TO** MANUFACTURER FOR REPAIR OR ADJUSTMENT" listed below.

This warranty is the sole and exclusive express warranty given with respect to RTS Systems products. It **is** the responsibility of the user to determine before purchase that this product is suitable for the user's intended purpose.

***ANY* AND ALL IMPLIED WARRANTIES, LUDING THE IMPLIED WARRANTY OF MERCHANTABILITY *ARE* LIMITED TO THE DURATION OF THIS EXPRESS LIMITED WARRANTY.**

NEITHER RTS SYSTEMS NOR THE DEALER WHO SELLS RTS SYSTEMS' PRODUCTS IS LIABLE FOR IDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND.

RETURN SHIPPING INSTRUCTIONS

Procedure For Returns:

If a repair is necessary, contact the dealer where this unit was purchased.

If repair through the dealer is not possible, phone the RTS Systems Customer Service Department, located at the factory, as directed below. They will issue a **Return Authorization Number.**

DO NOT RETURN *ANY* EQUIPMENT TO THE FACTORY WITHOUT FIRST OBTAINING A RETURN AUTHORIZATION NUMBER.

Be prepared to provide your company name, address, phone number, a person to contact regarding the repair, the type and quantity of equipment, a description of the problem and the serial number(s).

Questions regarding returns for repair should be directed to:

Customer Service
RTS Systems
1100 **W.** Chestnut St.
Burbank CA 91506 USA
Telephone: (818) 566-6700
Telex: 194855
Telefax: (818) 843-7953

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of RTS Systems equipment should be prepaid via United Parcel Service or the best available shipper. The equipment should be shipped in the original packing carton; if that is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the equipment should be wrapped in paper and surrounded with at least four hes of excelsior or similar shock-absorbing material. All shipments should be directed to the attention of the Order Service Department and must lude the Return Authorization Number.

Upon completion of any repair the equipment will be returned collect via United Parcel Service or specified shipper.

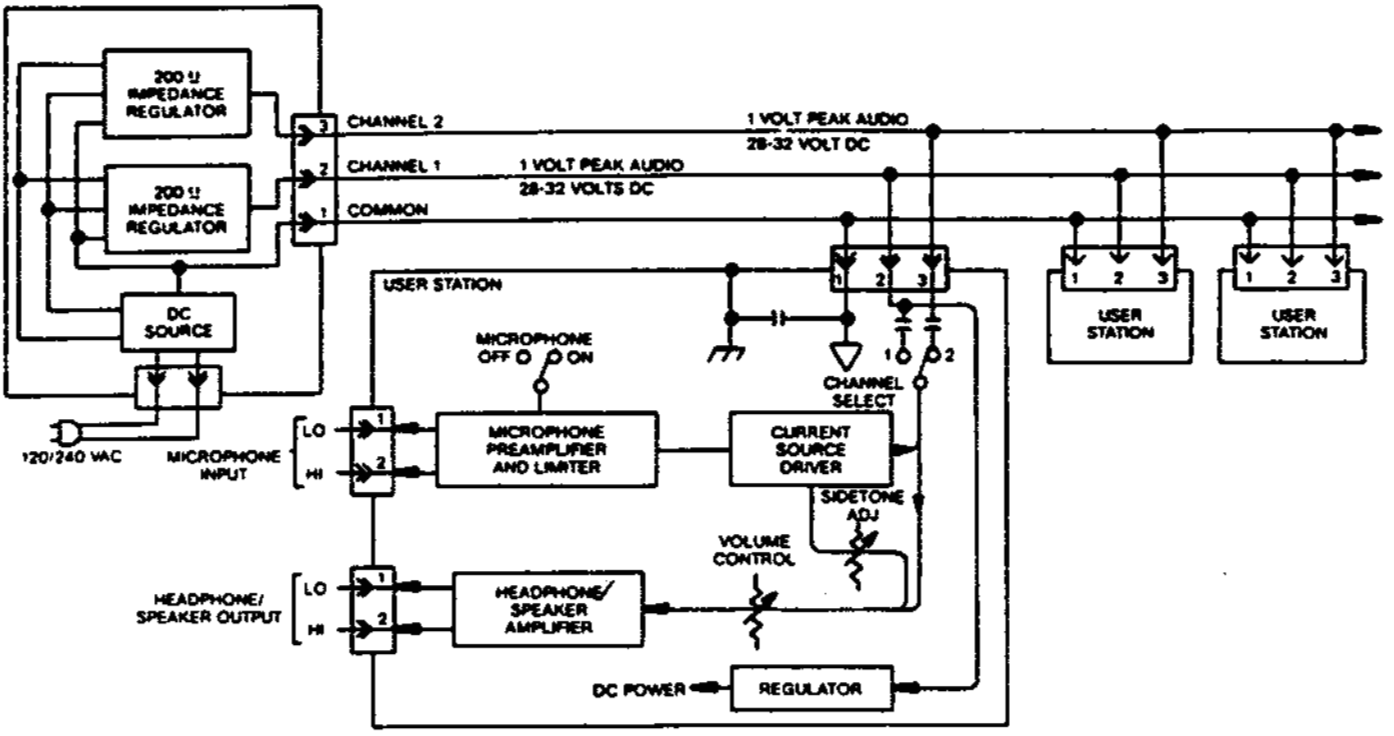


Figure 1-1
TW System Concept Block Diagram

SECTION 1: DESCRIPTION & SPECIFICATIONS

1.1 DESCRIPTION

The Model WMS300, a Wall Mount Speaker User Station, is a component used in the TW INTERCOM SYSTEM. Each User Station is a communications unit along a multi-unit conference bus. The System Concept Block Diagram, Figure 1-1, shows User Station interconnection, and User Station connection to the system power supply.

User Station interconnection can be:

1) centrally wired, with each cable coming from a central point, or
2) distributed, where all the user stations are looped together from one to another, or
3) a combination of both. The centrally wired interconnection not only reduces interchannel crosstalk, but also allows for easier expansion into an assignable channel, multi-channel system.

The WMS300 Block Diagram, Figure 1-2, shows user station functional components, input/output connections, and controls. The WMS300 User Station has the following functional components:

1) a microphone preamplifier with limiter
2) a latching action microphone on/off switch
3) a momentary action microphone on/off switch
4) a "bilateral current source" line driver
5) a listen volume control
6) a headphone/speaker amplifier
7) a speaker switch
8) a channel selector switch

The microphone preamplifier/limiter converts the small microphone signal to a strong line level signal, conditions the signal strength so that loud and soft talkers sound almost the same, and sends the signal to the line via the microphone switch and a "bilateral current source". The bilateral current source adds signal via the channel select switch to the line without affecting any signals already on the line. The bilateral current source also extracts the listen signal from the line and sends it to the headphone amplifier via the volume control. Some of the user's own voice signal ("sidetone") is also fed to the headphone amplifier.

The Channel Selector Switch selects the channel on which the user will talk and listen. The headphone amplifier output drives the user's headphones speaker and the speaker through the on/off switch.

The Volume Control adjusts Listen Level of the headphones and speaker. Note: The headphones are always "on"..

The user station voltage regulator takes power from channel 1, regardless of the channel selector switch setting (exception: local power option units). The regulator not only supplies regulated power to the user station, but also prevents unwanted interaction between the user station and that intercom line which is supplying the power. Because the regulator takes power from channel 1, channel 2 can be expanded into many channels by using a switch and, for each channel, a separate wire and a termination network consisting of a 200 ohm resistor and a 10 microfarad capacitor in series. (See the Application Diagrams in the TW Intercom Systems Technical Manual). A TW System Power Supply terminates each channel line with 200 ohms.

1.12 Operational Controls

The WMS300 User Station has the following controls, described and shown in Section 3.1:

1) Channel Select Switch
2) Latching-action MICrophone ON-OFF toggle switch.
3) Momentary-action MICrophone ON-OFF pushbutton switch (not standard with the call-light option).
4) A speaker/headphone VOLUME control (May be a dual control for the Dual Listen (DL) Option or the Program (E) Option
5) CALL LIGHT switch/indicator (Call Light Option (-L)
6) SPeaKeR ON/OFF switch
7) SIDETONE Adjustment

1.13 Connection, Inputs and Outputs

The WMS300 User Station has two input/output connectors described in Section 2.4:

1) DYNamic MICrophone type HeaDSeT or handset
2) Line INPUT (ties the station to the intercom line)

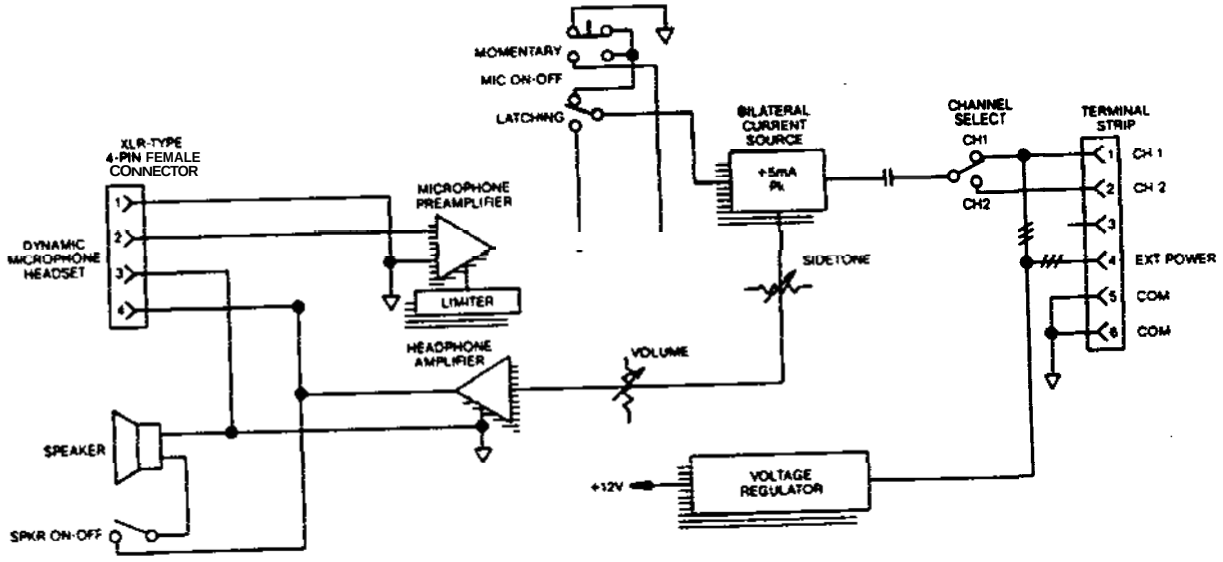


Figure 1-2
WMS300 Block Diagram

1.2 MODEL WMS300 SPECIFICATIONS

OVERALL SYSTEM SPECIFICATIONS

Audio Line Voltage, Nominal	1 volt, peak (0 dBm voltage-equivalent)
Average Speech Level Range	-20 dBV to -10 dBV
Absolute Maximum Speech Level	3 volts, peak (linear limit)
Audio Line Impedance, Nominal	200 - 50 ohms, 75 Hz to 20kHz System will continue to operate from 50 ohms to 300 ohms

System DC Line Voltage

Nominal	32 volts DC
Operational Range	18 to 35 volts DC
Steady state without damage	-1.5 volts to 36 volts DC
Transient	200 volts, 8 milliseconds or less (after this time, power supply and user station fuses will open)

System DC Current

Quiescent (per station)	10 to 40 milliamps
Dynamic (per station)	50 milliamps (w/25 ohm headphones) 70 milliamps (w/25 ohm headphones and lights) 100 milliamps (w/8 ohm speaker)
Start-Up Current	1.25 amperes, 50 units, all kinds
Fault Current	4.0 amperes, power supply at voltage > 12 volts 1.0 amperes, power supply at voltage < 12 volts

Operating Distances

Maximum DC limit	5,000 ft. distance along cable, power supply to single station #22 gauge wire -DC voltage drop limitation
Maximum AC limit	10,000 ft. *dry* pair, power supply at each end, #22 gauge wire
System Capacitance	0.3 microfarads (cumulative effect of 10,000 ft. of Maximum cable at 30 picofarads/foot)

USER STATION SPECIFICATIONS

Input DC voltage:	20 to 35 volts DC, operating from -200 to +36 volts DC without damage
DC Current	
Quiescent	10 to 40 milliamps
Operating	50 milliamps, typical (w/25 ohm headphones) 75 milliamps, typical (w/25 ohm headphones t light) 100 milliamps, typical(w/8 ohm speaker)
Impedance across line:	10,000 ohms typical; 2,000 ohms worst case dynamic operation
Ambient Temperature Range	Operating: 0 C to 60 C Storage: -55 C to 125 C
Noise contribution to 200 ohm line:	One Unit: -75 dBu Ten Unit: -67 dBu

Microphone Preamplifier

Input impedance*	470 ohms
Source Impedance*	200 ohms, nominal
Maximum Input Level*	150 millivolts
Voltage gain:	54 dB
Frequency Response	100 Hz to 10,000 Hz, 3dB
Limiter range	50 dB
Carbon Mic Excitation Current	10 milliamps, nominal (when optioned for Carbon Mic)

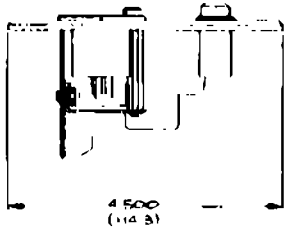
*Dynamic Microphone Input

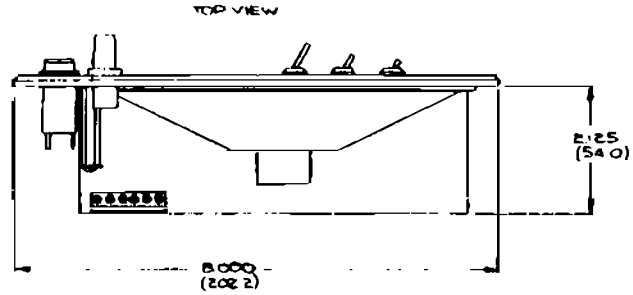
Current Source

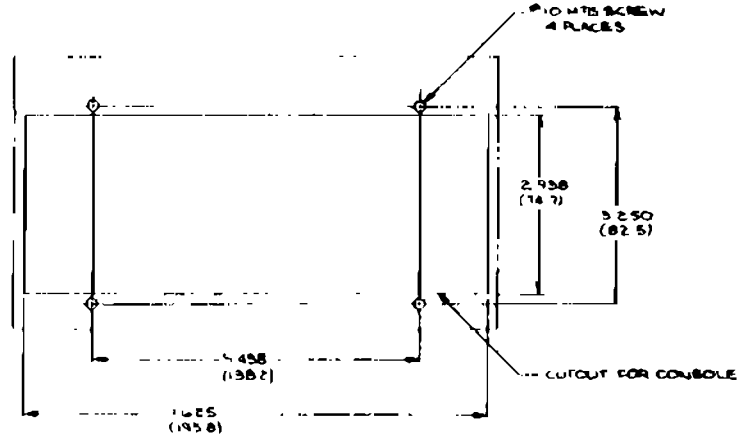
Transfer ratio:	5 milliamps/1.5 volts
output:	5 milliamps into 200 ohms

Headphone Amplifier

Overall voltage gain	24 dB
Overall voltage gain	9 volts peak-to-peak into 25 ohms
Output power:	Headset station: 1/2 watt into 25 ohms Speaker Station: 2 watts into 8 ohms
Frequency Response	150 Hz to 8,000 Hz, 3 dB
Headphone Impedance Range	25 to 600 ohms
Sidetone Adjustment Range	20 dB to full on
Call Light:	Signaling Frequency 20,000 kHz 3 dB Flashing Rate 5 Hz 2 Hz
Dimensions	4.5 H x 8.0 W x 1.75" D 114.3 x 44.5 x 203.2 mm







WEIGHT: 6 LBS (2.7 kg)

RTS SYSTEMS
INSTALLATION DRAWING
WMS-300-SPEAKER
STATION
ID3211

For permanent installations it is recommended that each channel should have individually shielded twisted pair of at least #22 gauge wire, such as Belden #8723 for 2 channels. Connect the shield to system common **but do not tie the shield to chassis, earth or connector shell ground.**

2 2 3 Crosstalk Control

In the TW Intercom System all channels share a common circuit ground return. Crosstalk due to common ground resistance *can* be lowered by reducing the common ground resistance. Reduction of ground resistance *can* occur as a side benefit of using shielded cable, since the shield drains can be tied together and electrically parallel the circuit ground. Another way of lowering resistive crosstalk is to "homerun" all interconnecting cables to a central or "home" location. In this configuration, the ground path is short and the corresponding ground resistance is small. Crosstalk due to mutual capacitance occurs when the signal on one wire of a twisted pair couples into the other wire. Separating the two conductors with a shield greatly reduces the capacitive crosstalk.

To reduce both capacitive and resistive crosstalk and to afford a degree of **RF** and electrostatic shielding, use a cable which has a shielded twisted pair for each channel. Each pair consists of a conductor for the channel, a conductor for circuit ground return and a shield around the two conductors. The shield is accessed via a **drain** conductor. This drain conductor and the shield *can* augment the circuit **grounds** and thus lower the ground resistance.

Routing the TW Intercom System cables along the same ductways and pathways **as** power cabling *can* increase the noise and hum levels.

22.4 Moisture / Contamination Protection

When using equipment in the rain, always protect the equipment with plastic covers----also, make sure all cable connectors are lifted out of the mud or snow and protected with plastic bags. Water, mud and snow in connectors *can* cause considerable audible noise.

2 2 5 Hum Prevention

Prevent inducing hum into the system by not locating user stations near hum sources such as power transformers, electrical switch panels, lamp dimmers or TV cameras. When the microphone switch is turned on, the dynamic microphone acts as a sensitive antenna for hum sources.

2.4 USER STATION CONNECTIONS

Dynamic Microphone headset connector:
AXR-4-31 type receptacle (J1)
Input level: *-55* dbu nominal
Output level to headphone: 10 volts peak-to-peak open circuit.

Pin 1 - Microphone low
Pin 2 - Microphone high
Pin 3 - Headphone low
Pin 4 - Headphone high

Line input connectors: (TB1)

Terminal # 1 - Channel 1
Terminal #2 - Channel 2
Terminal #3 - Channel 3 (3CH option)
Terminal #4 - Ext Power In (LP option)
Terminal #5 - Common (low side of line)
Terminal #6 - Common (low side of line)

USM option:

Terminal #4 - USM High
Terminal #5 - USM Low

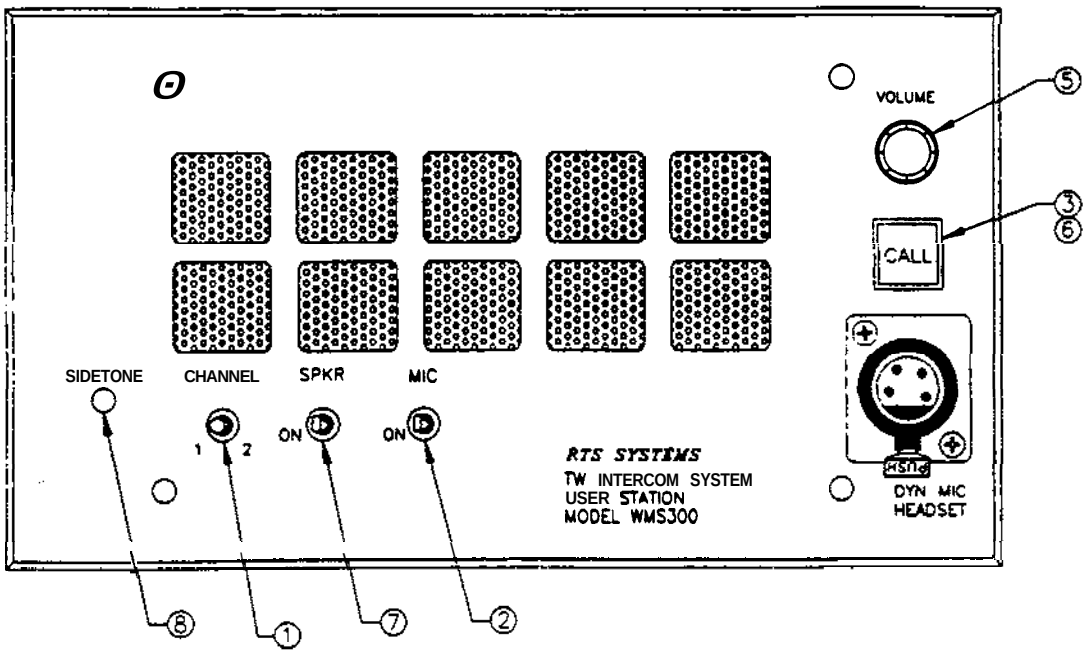


Figure 3-1
Model WMS300 Front Panel

SECTION 3: OPERATION

3.1 Operating Controls (See Figure 3-1)

Table 3-1 lists the Model WMS300 operating controls, with reference numbers corresponding to Figure 3-1.

Table 3-1

Ref No.	Name	Description
1	**Channel Select Switch**	Selects one of two channels (standard) or one of three channels (optional). The Call Light Option transmitter and receiver operate on the channel selected by this switch. The CHannel Select Switch is omitted in the Single Channel (SC) option.
2	**MIC ON-OFF Toggle**	A latching-action switch.
3	**MIC ON-OFF Pushbutton**	A momentary-action pushbutton switch. Not standard with the Call Light Option. Turning on the microphone here also slightly "dims" or attenuates the speaker.
4	**MIC SWITCH**	A momentary MIC switch is located on the optional push-to-talk microphone and requires that 2) above is ON. The push-to-talk microphone schematic is included in the speaker station schematic.
5	**VOLUME**	A speaker/headphone volume control. May be a dual control for the Dual Listen (DL) or Program (E) Option.

CAUTION ALWAYS TURN THIS CONTROL ALL THE WAY COUNTERCLOCKWISE (TO THE LEFT) BEFORE PLUGGING IN THE HEADSET.

6	**CALL Light Switch Indicator**	This switch/indicator appears only on the user stations with the "Call Light" option. When the CALL Switch is depressed, a 20 kilohertz signal is added to the TW intercom line on the same channel that the CHannel Select Switch has been set. This signal activates the Call Light receiver on all user stations which are switched to the same channel.
7	**SPeaKeR ON/OFF**	This switch turns on the speaker.
8	**SIDETONE**	The screwdriver-adjusted SIDETONE control sets the "sidetone" level during headset operation and sets the "balance" nulling during speaker/panel microphone operation.

SECTION **3:** OPERATION

3.1 Operating Controls (See Figure **3-1)** (continued)

To adjust the SIDETONE control for speaker operation:

1) turn **ON** the SPeaKeR switch,
2) turn ON the MICrophone switch,
3) set the VOLUME control to about 50%,
4) plug in a microphone
5) hum into the microphone and adjust SIDETONE for minimum sound through the loudspeaker.

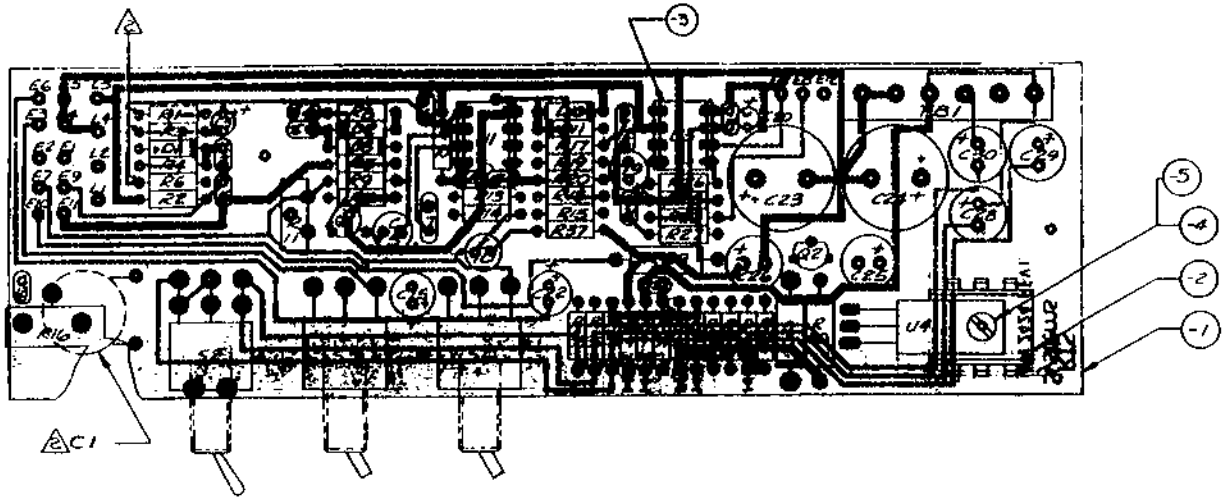
To adjust the SIDETONE control for headset operation:

1) turn **OFF** the SPeaKeR switch,
2) turn ON the MICrophoone switch, and
3) plug **in** a headset,
4) set the VOLUME **control** to about 50%,
5) turn the **SIDETONE** control **fully** counterclockwise, the adjust it clockwise for a comfortable level of your **own voice** while talking into the headset microphone.

SECTION 4 DRAWINGS

Model WMS300

REVISIONS				
	N	REVISED & REDRAWN	2-22-89	



4. PARTS NOT TO BE INSTALLED AT THIS ASSEMBLY LEVEL
3. R29 IS AN OPTIONAL PART.
2. INSTALL C1,R1,R3,R6 FROM CIRCUIT SIDE.

NOTES:
1. FOR SCHEMATIC SEE SD2387.

PL 2447	WMS300
PL 2445	WMS 300L
APPLICATION	

UNLESS OTHERWISE SPECIFIED

CONTRACT NO

APPROVED — DATE

DRAWN R. MERSON 2-22-89

CHECKED

ISSUED

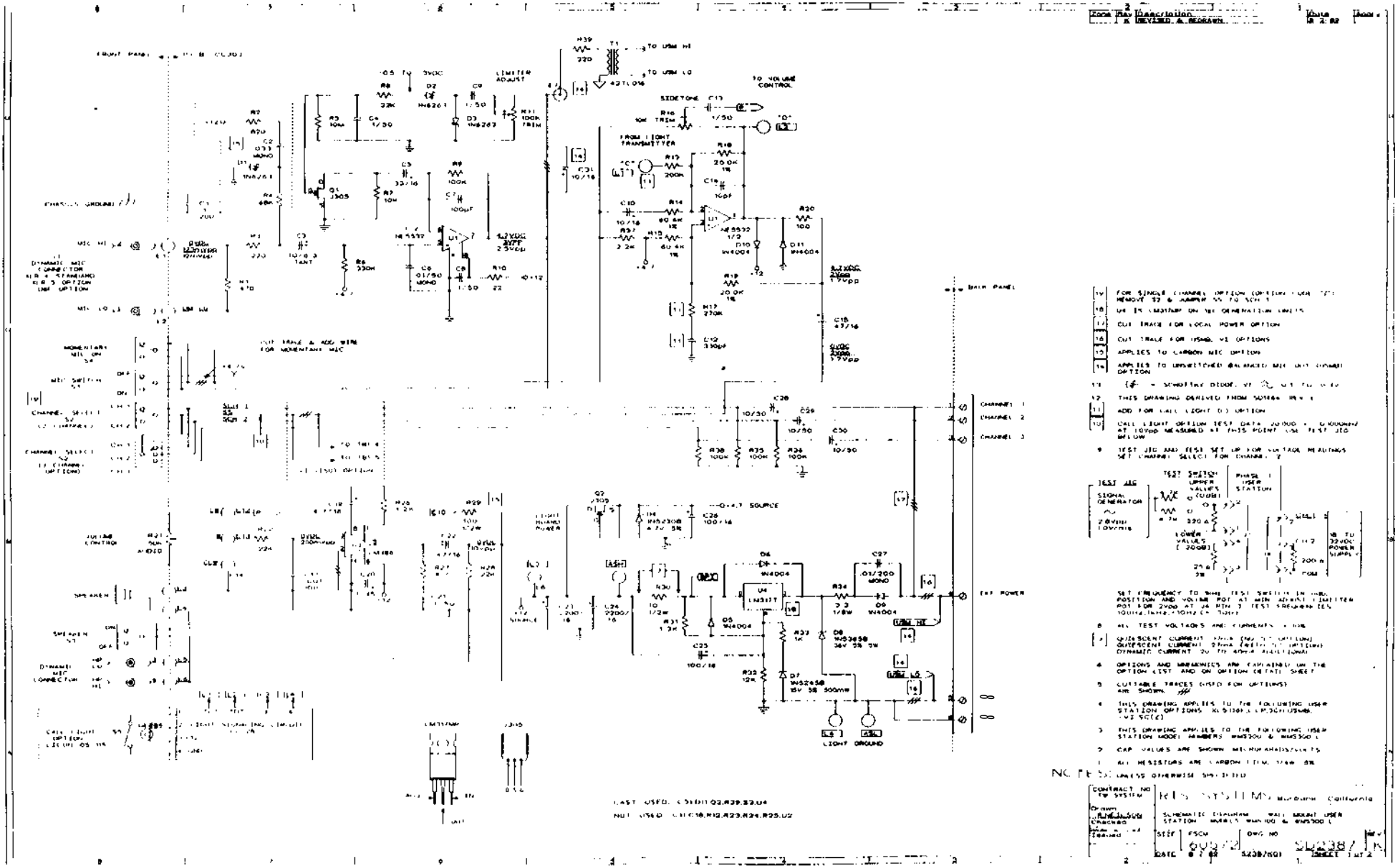
DO NOT SCALE DRAWING

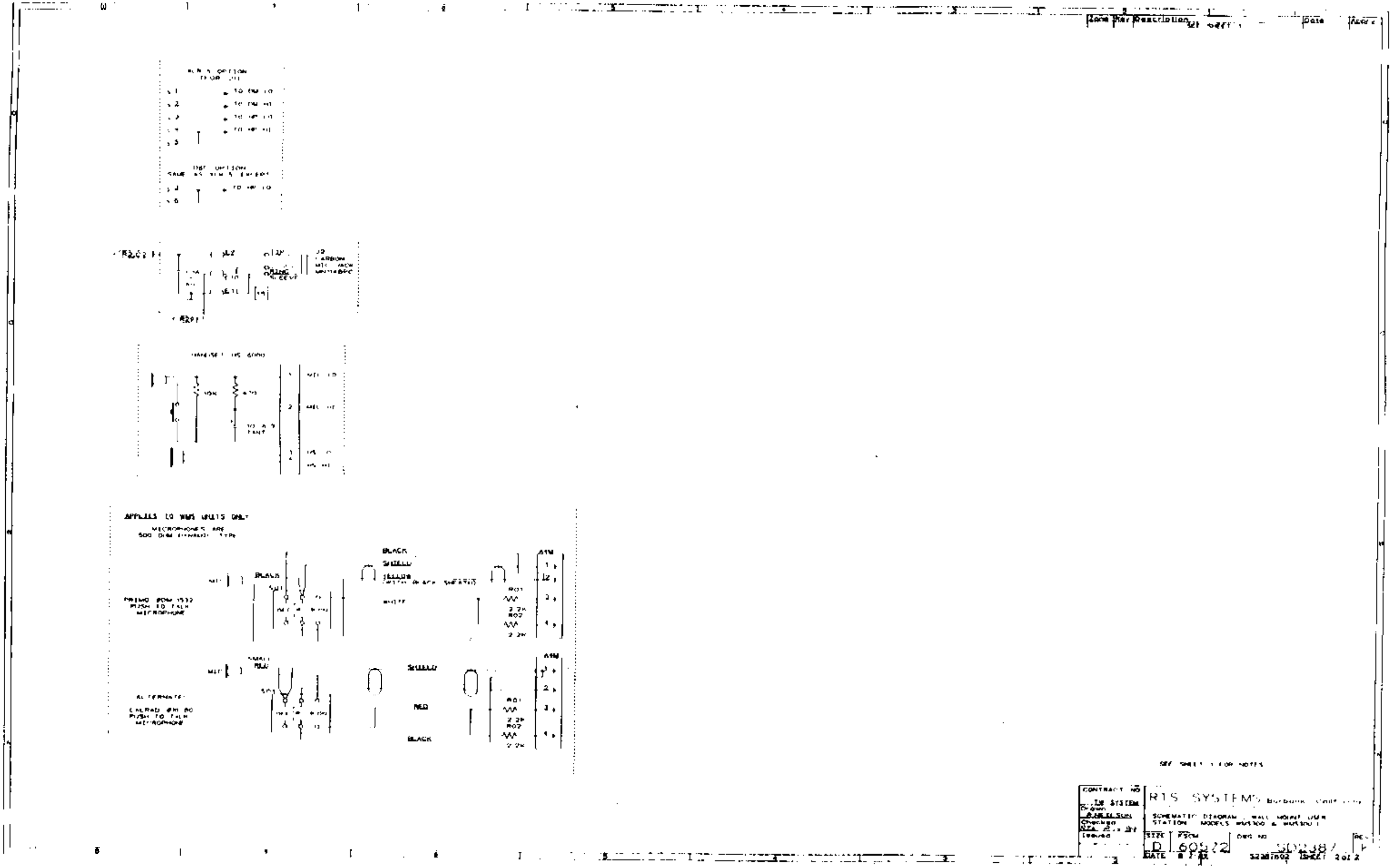
RTS SYSTEMS BURBANK CALIFORNIA

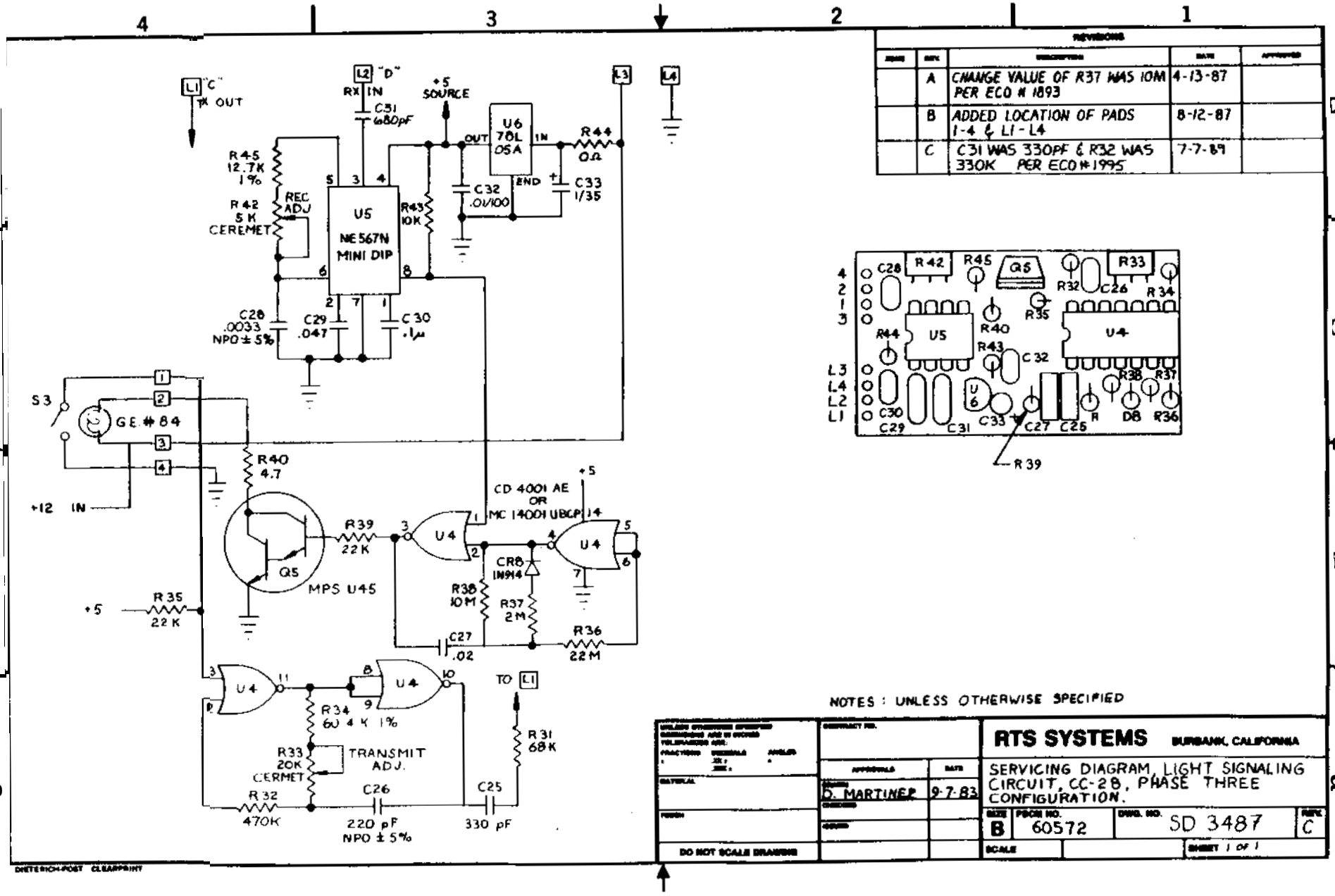
ASSEMBLY - PC B., CC-303,
MODELS WMS-300 & WMS-300L

SIZE	FSCM NO	DWG NO	REV
B	60572	AS 2424	N

SCALE 2/1 SHEET 1 OF 1




APPLIES TO WMS UNITS ONLY
BLACK
SHIELD
YELLOW
WHITE
RED
BLACK
CONTRACT NO
Drawn
Checked
RTS SYSTEMS
SCHEMATIC DIAGRAM
STATION
SIZE
D
FSCM
DWG NO
DATE
SHEET 2 of 2

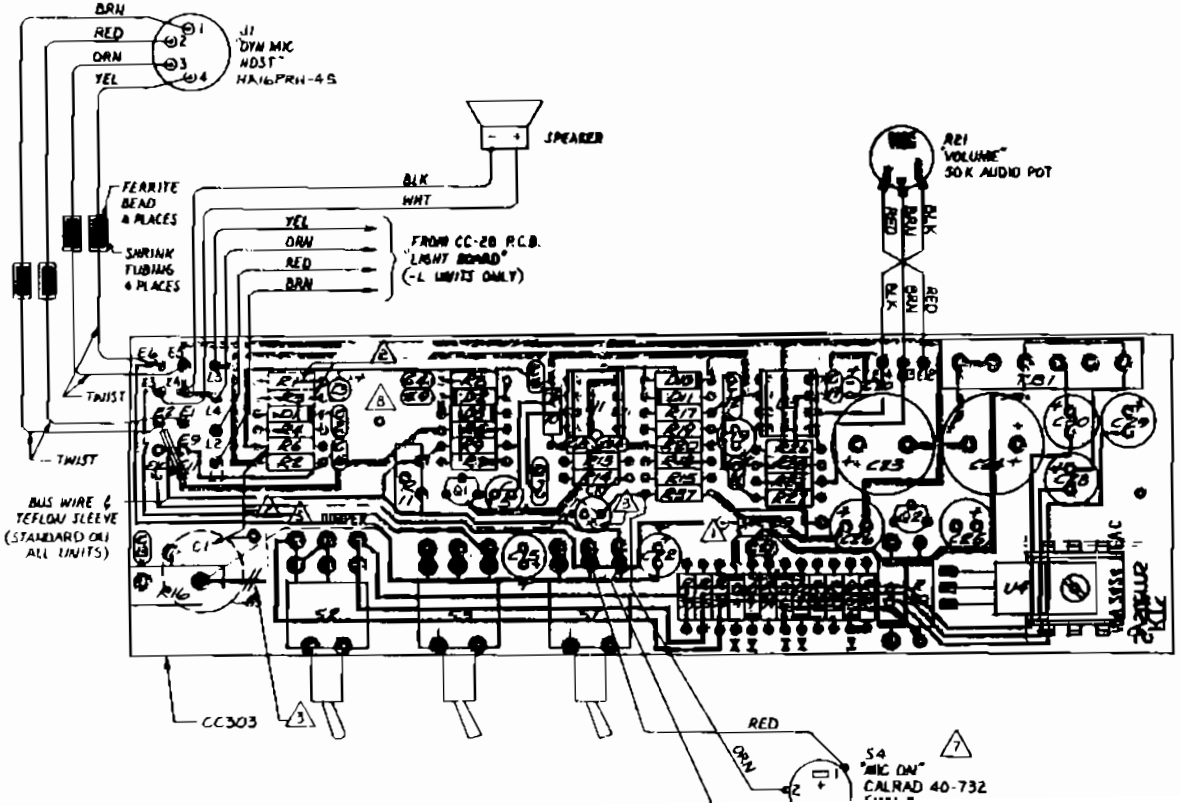


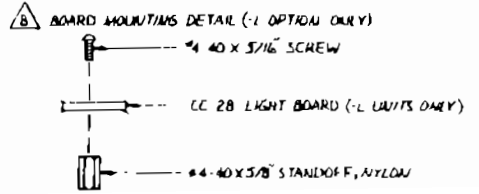
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	CHANGE VALUE OF R37 WAS 10M PER ECO # 1893	4-13-87	
	B	ADDED LOCATION OF PADS 1-4 & L1-L4	8-12-87	
	C	C31 WAS 330PF & R32 WAS 330K PER ECO #1995	7-7-89	

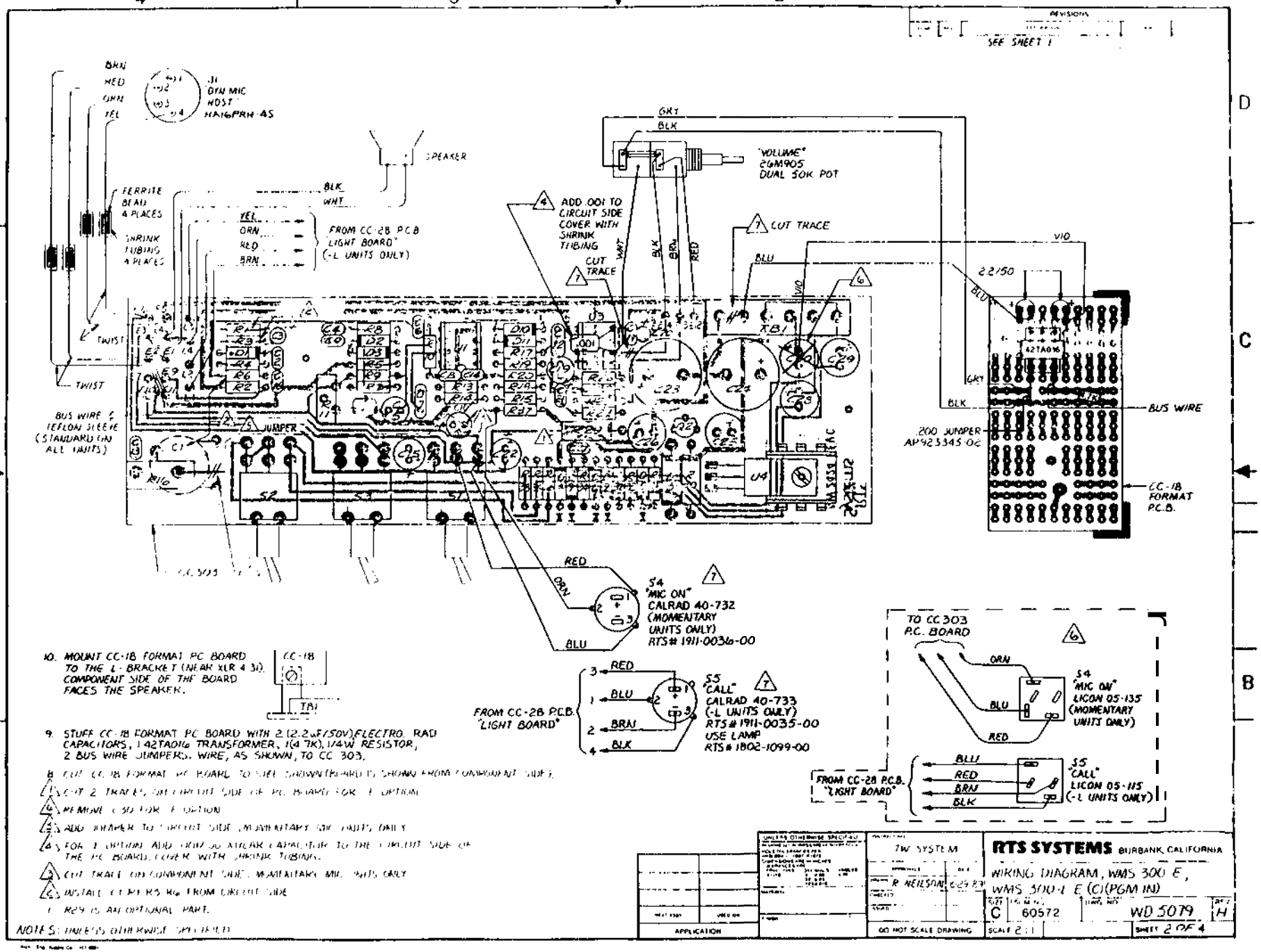
NOTES : UNLESS OTHERWISE SPECIFIED

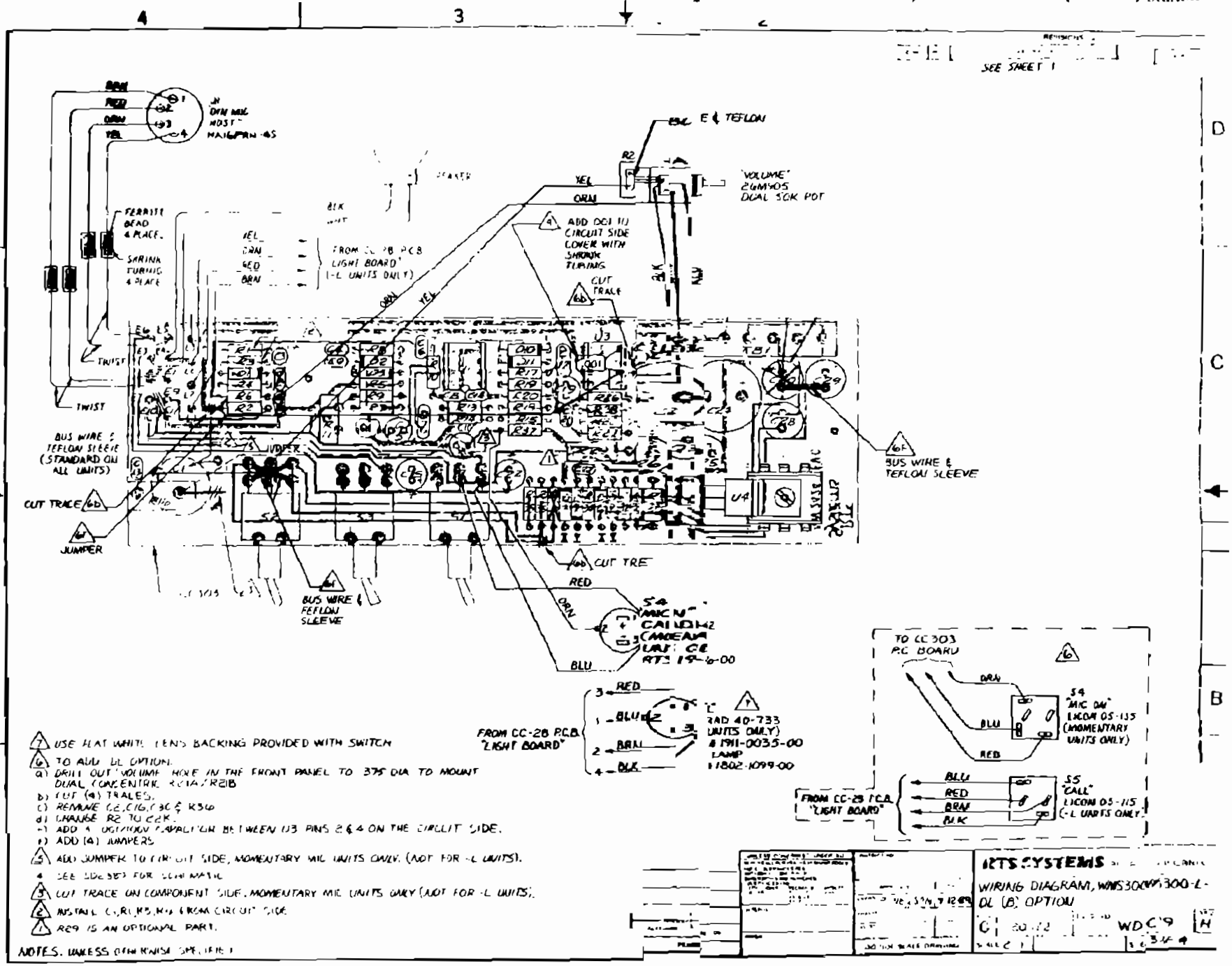
DO NOT SCALE DRAWING	APPROVALS: D. MARTINEZ 9-7-83	RTS SYSTEMS BURBANK, CALIFORNIA
		SERVICING DIAGRAM, LIGHT SIGNALING CIRCUIT, CC-28, PHASE THREE CONFIGURATION.
		SIZE B · FSCM NO. 60572 · DWG. NO. SD 3487 · REV. C
		SCALE · SHEET 1 OF 1

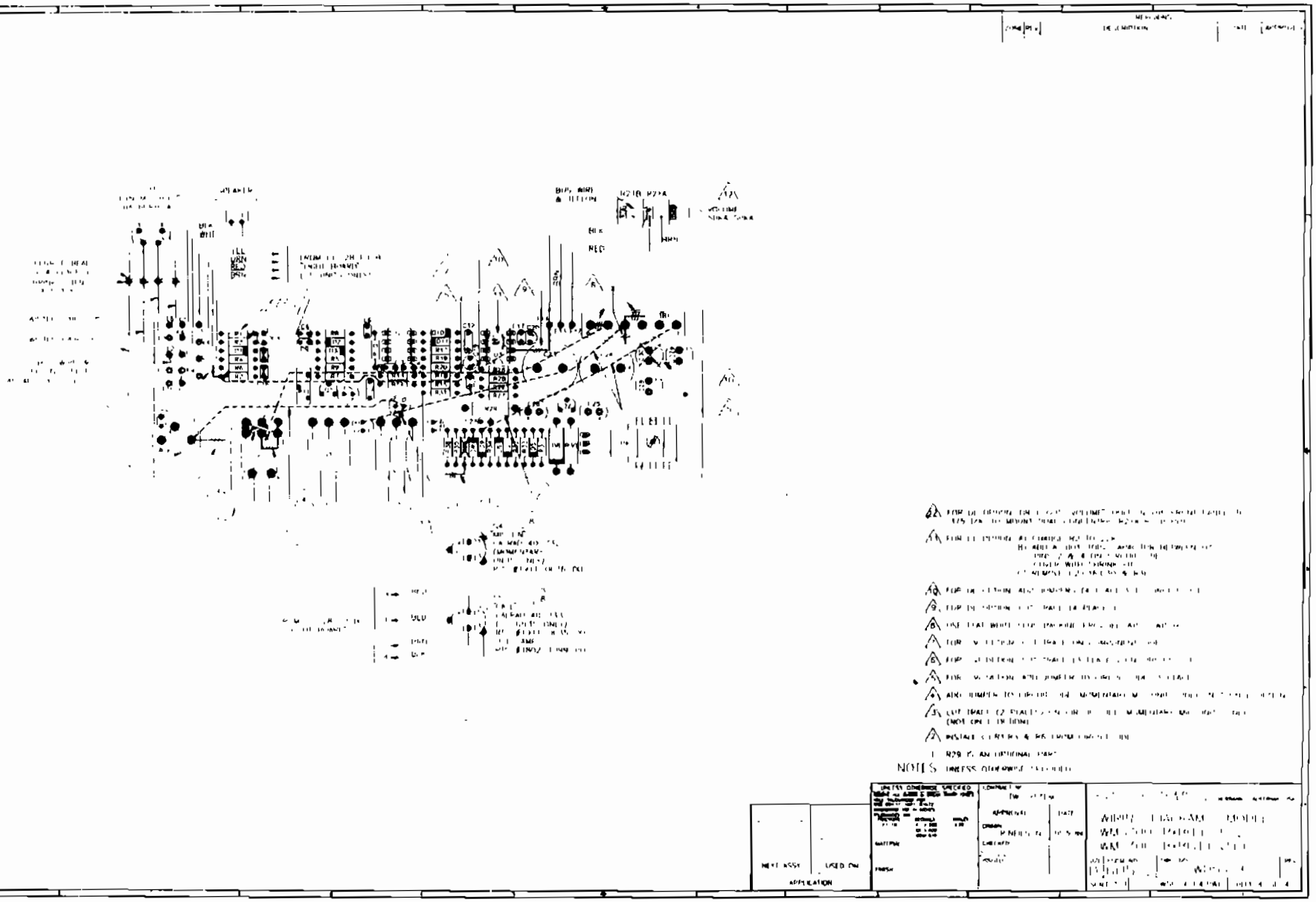
	A	REVERSED BRN & RED WIRES FROM J1 ECO 2076 RH	11-20-87	
	B	ADDED WIRES W/ ECO# 2369	12-16-88	
	C	R21 - REVERSED WIRES PER ECO # 2387	1-6-89	
	D	REVISED PER ECO# 2404	2-17-89	
	E	ADDED NOTE 8 PER ECO# 2540	7-7-89	RDK 7/1/89
	F	REVISED PER ECO # 2579	8/10/89	
	G	REVISED PER ECO# 2587	8/15/89	RDK 9/28/89
	H	REVISED PER ECO# 2670	9/28/89	RDK 9/28/89






SEE SHEET 1
J1 DYN MIC HOST HA16PRH-4S
SPEAKER
FERRITE BEAD 4 PLACES
SHRINK TUBING 4 PLACES
TWIST
BUS WIRE & TEFLON SLEEVE (STANDARD ON ALL UNITS)
FROM CC-28 P.C.B. "LIGHT BOARD" (-L UNITS ONLY)
"VOLUME" 26M905 DUAL 50K POT
ADD .001 TO CIRCUIT SIDE COVER WITH SHRINK TUBING
CUT TRACE
JUMPER
.200 JUMPER AP9253345-06
BUS WIRE
CC-18 FORMAT P.C.B.
S4 "MIC ON" CALRAD 40-732 (MOMENTARY UNITS ONLY) RTS# 1911-0036-00
S5 "CALL" CALRAD 40-733 (-L UNITS ONLY) RTS# 1911-0035-00 USE LAMP RTS# 1802-1099-00
FROM CC-28 P.C.B. "LIGHT BOARD"
TO CC303 P.C. BOARD
S4 "MIC ON" LICON 05-135 (MOMENTARY UNITS ONLY)
S5 "CALL" LICON 05-115 (-L UNITS ONLY)
10. MOUNT CC-18 FORMAT PC BOARD TO THE L-BRACKET (NEAR XLR 4 3). COMPONENT SIDE OF THE BOARD FACES THE SPEAKER.
9. STUFF CC-18 FORMAT PC BOARD WITH 2 (2.2uF/50V) ELECTRO. RAD CAPACITORS, 1 42TA016 TRANSFORMER, 1 (4.7K), 1/4W RESISTOR, 2 BUS WIRE JUMPERS. WIRE, AS SHOWN, TO CC 303.
8. CUT CC-18 FORMAT PC BOARD TO SIZE SHOWN (BOARD IS SHOWN FROM COMPONENT SIDE).
7. CUT 2 TRACES ON CIRCUIT SIDE OF PC BOARD FOR -L OPTION.
6. REMOVE C30 FOR -L OPTION.
5. ADD JUMPER TO CIRCUIT SIDE (MOMENTARY MIC UNITS ONLY).
4. FOR -L OPTION ADD .001 DISC CERAMIC CAPACITOR TO THE CIRCUIT SIDE OF THE PC BOARD. COVER WITH SHRINK TUBING.
3. CUT TRACE ON COMPONENT SIDE (MOMENTARY MIC UNITS ONLY).
2. INSTALL JUMPERS R26 FROM CIRCUIT SIDE.
1. R29 IS AN OPTIONAL PART.
NOTES: UNLESS OTHERWISE SPECIFIED
RTS SYSTEMS BURBANK, CALIFORNIA
WIRING DIAGRAM, WMS 300 E, WMS 300-L E (C)(PGM IN)
C 60572 WD 5079 H
SCALE 2:1 SHEET 2 OF 4
DO NOT SCALE DRAWING
APPLICATION
TW SYSTEM


SEE SHEET 1
FERRITE BEAD 4 PLACE.
SHRINK TUBING 4 PLACE
TWIST
BUS WIRE & TEFLON SLEEVE (STANDARD ON ALL UNITS)
CUT TRACE
JUMPER
BUS WIRE & TEFLON SLEEVE
CUT TRACE
CUT TRACE
BUS WIRE & TEFLON SLEEVE
"VOLUME" 26M505 DUAL 50K POT
ADD DC1 TO CIRCUIT SIDE COVER WITH SHRINK TUBING
FROM CC-28 PCB "LIGHT BOARD" (-L UNITS ONLY)
S4 "MIC ON" LICOM 42 (MOMENTARY UNITS ONLY) RTS 19-6-00
S5 "CALL" LICOM 42 (-L UNITS ONLY)
RAD 40-733 (-L UNITS ONLY) # 1911-0035-00 LAMP # 1802-1099-00
FROM CC-28 P.C.B. "LIGHT BOARD"
TO CC303 P.C. BOARD
S4 "MIC ON" LICOM 05-135 (MOMENTARY UNITS ONLY)
S5 "CALL" LICOM 05-115 (-L UNITS ONLY)
FROM CC-28 P.C.B. "LIGHT BOARD"
USE FLAT WHITE LENS BACKING PROVIDED WITH SWITCH
TO ADD DL OPTION:
a) DRILL OUT "VOLUME" HOLE IN THE FRONT PANEL TO .375 DIA TO MOUNT DUAL CONCENTRIC R26A/R26B
b) CUT (4) TRACES.
c) REMOVE C6,C16,C36 & R36
d) CHANGE R2 TO 50K.
e) ADD A JUMPER WIRE BETWEEN U3 PINS 2 & 4 ON THE CIRCUIT SIDE.
f) ADD (4) JUMPERS
ADD JUMPER TO CIRCUIT SIDE, MOMENTARY MIC UNITS ONLY. (NOT FOR -L UNITS).
SEE SHEET 3 FOR SCHEMATIC
CUT TRACE ON COMPONENT SIDE, MOMENTARY MIC UNITS ONLY (NOT FOR -L UNITS).
INSTALL C1,R1,R3,R4 FROM CIRCUIT SIDE
R29 IS AN OPTIONAL PART.
NOTES. UNLESS OTHERWISE SPECIFIED
RTS SYSTEMS
WIRING DIAGRAM, WMS300 & 300-L-DL (B) OPTION
WDC9



APPENDIX A

INSTALLATION LOCAL POWER OPTION WMS300

The WMS300 can be powered from an external (local) power supply of between 18 to 33 volts DC. The local power option, as supplied by RTS Systems uses a 117 VAC 60 Hz in, 24 VDC 400mA out supply. The external supply is wired across terminal block, TB1 pins 4 (external power t) and 5 (common). When using an external supply, the circuit board trace running between TB1 pins 1 (channel 1) and 4 must be cut.