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TECHNICAL MANUAL

Model CLD-2500
Composite Line Driver and Receiver System

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FIRST THINGS

HERE IS YOUR MODULATION SCIENCES CLD-2500 COMPOSITE LINE DRIVER/RECEIVER SYSTEM. PLEASE FOLLOW THE UNPACKING INSTRUCTIONS BELOW:

- UNPACK THE UNIT AND SAVE ALL PACKAGING MATERIALS. YOU MAY NEED THEM LATER TO SHIP OR MOVE THE CLD-2500.
- INSPECT THE UNIT(S) FOR ANY SIGN OF DAMAGE.
- IF YOU FIND ANY DAMAGE, REPORT IT IMMEDIATELY TO BOTH THE CARRIER AND TO MODULATION SCIENCES.
- IF THE CLD-2500 IS UNDAMAGED, FILL OUT THE REGISTRATION CARD THAT WAS PACKED INSIDE THE FRONT COVER OF THIS MANUAL AND RETURN IT TO MODULATION SCIENCES.

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1 OVERVIEW

1.1 Introduction

The Modulation Sciences CLD-2500 composite line driver system will transmit stereo composite baseband (including SCA channels) up to two miles (3.2 km) over readily available cable without degrading signal quality.

The system consists of a driver (CLD-2501), a receiver (CLD-2502), and up to 2500 feet (762 m) of Belden No. 9463 cable or up to 4000 feet (1219.2 m) of Belden No. 9172 cable. Cable runs up to 10,000 feet (3048 m) can be achieved with factory modification of the receiver. One driver can handle two separate runs of different lengths, each with its own receiver.

The CLD-2504, available separately from Modulation Sciences, can stand alone as a composite distribution amplifier to drive four separate coaxial lines of up to 100 feet (30.48 m), provided that no substantial ground potential difference exists between the driver and the equipment to which it connects.

With the CLD-2500, you can:

- Move stereo generators and composite processors from dangerous, inaccessible locations into the studio where they belong.
- Replace existing overly long coaxial lines to improve stereo separation and signal-to-noise ratio.
- Place STL transmitters and receivers near their antennas, eliminating the need for long runs of expensive semi-rigid foam coax.
- Distribute composite signal to testing and processing equipment within the studio or transmitter plant.

1.2 Background

FM composite baseband is a complex signal with a bandwidth greater than audio, yet requiring signal-to-noise figures considerably better than video. As a result, transmission over distances greater than six feet is difficult. Low capacitance cable such as RG-62 extends the maximum transmission line length to about twelve feet, but this is often inadequate.

Fiber optics, video distribution amplifiers, and new stereo generators with low output impedance have all been tried as composite line drivers, but none of these solutions have proven to be entirely satisfactory. With fiber optics, the drivers and receivers degrade signal quality. Video DAs offer fine high frequency response, but their low frequency roll-off causes poor separation and they are usually too susceptible to 60 Hz hum and RF interference.

Although the low output impedance of some new stereo generators may extend the maximum coaxial transmission line length, output impedance is not the only limiting factor for a composite line driver. To drive a long line at high frequencies, an amplifier must have both a high slew rate and sufficient output current to charge and discharge the capacitance of the entire length of cable. The longer the transmission line, the greater the required output current.

Ground loops present another problem in composite transmission. Ground potential differences between ends of an unbalanced coaxial line can produce substantial hum. For this reason, the CLD-2500 is balanced and it was designed to provide exceptional immunity to shield current related noise. A few stereo generators and exciters provide "floating" inputs or outputs, which does help somewhat, but leaving the shield ungrounded at one end can create severe RF interference problems, especially from AM broadcast energy. Here too, the longer the transmission line, the greater the problems.

1.3 Operation

The CLD-2500 features a high-current, balanced, impedance-matched driver coupled to Twinax line. At the receiver end, the cable is terminated and an active circuit translates the balanced Twinax circuit to a coaxial drive suitable for the short run to the exciter. (For further details on the Twinax cable, please see the section CABLE SELECTION.) Isolated, single-ended test outputs are provided on the front panel of both the receiver and the driver.

In order to ensure that the CLD-2500 system will never be the weak link in the air chain, it was designed to provide phase and frequency linearity sufficient to support stereo performance well in excess of that achievable by the best existing equipment. Distortion and noise figures are likewise superior to those of the most advanced systems.

2 SPECIFICATIONS

CLD-2500 System Specifications

SYSTEM CONFIGURATION:	One CLD 2501 composite line driver with one or two CLD 2502 line receivers.
MAXIMUM LINE LENGTH:	Belden No. 9463 (78 Ω): 2,500 feet (762 m) Belden No. 9182 (150 Ω): 4,000 feet (1219.2 m) ¹ With modified receiver: 10,000 feet (3048 m)
OVERALL SYSTEM GAIN:	Adjustable from zero to -20 dB

Test Conditions for all Following System Specifications:

INPUT LEVEL:	4 V P-P
GAIN:	Unity

Two-Tone IM Distortion:

ANY 2 FREQUENCIES 50 Hz TO 53 kHz,
1:1 at 4 V PP: TOTAL: -70 dB

ANY FREQUENCY 50 Hz TO 53 kHz WITH ANY
FREQUENCY 53 kHz to 100 kHz,
10:1 at 4 V P-P: TOTAL: -70 dB

BROADBAND NOISE (20 Hz to 100 kHz)	85 dB below 4 V P-P
60 Hz COMMON MODE REJECTION	95 dB nominal 70 dB at temperature extremes
60Hz SHIELD CURRENT NOISE REJECTION: (with 500 feet / 152.4 m) of BELDEN NO 9463) ²	Shield current: 0.5 A

Note 1: Termination resistors in both driver and receiver must be changed in order to use No. 9182 cable.

Note 2: This is an extreme figure. Normally, shield currents of only a few mA would be expected, in which case output noise resulting from shield current would be virtually impossible to detect.

Cable Length	NONE	1,000 Feet¹ (304.8 m)	2,500 Feet¹ (762 m)
Frequency Response (DC to 53 kHz)	±0.01 dB	±0.02 dB	±0.03 dB
Differential Time Delay Relative to 38 kHz at:			
1 kHz	-40 nsec	+10 nsec	+20 nsec
10 kHz	-10 nsec	+30 nsec	+20 nsec
19 kHz	-5 nsec	+10 nsec	-15 nsec
53 kHz	+5 nsec	+10 nsec	-40 nsec
Stereo Separation² at:			
1 kHz	> 60 dB	> 60 dB	55 dB
15 kHz	> 60 dB	55 dB	45 dB

Note 1: All specifications relating to system with cable were measured with HF compensation control adjusted.

Note 2: Separation figures were calculated from measured amplitude and delay response, assuming an ideal stereo composite input signal.

CLD-2501 COMPOSITE LINE DRIVER SPECIFICATIONS

SIZE:	1 3/4" x 19" (44.45 mm x 482.6 mm) rack panel 1 3/4" H x 12" W x 5 3/4" D rear housing (44.45 mm H x 304.8 mm W x 146.05 mm D)
POWER:	95 to 130 VAC, 10 W max. 190 to 260 V option available
TEMPERATURE RANGE:	0° to 50° C
RF PROTECTION:	All inputs and outputs RF suppressed, power supply RF suppressed and shielded from main circuitry
GAIN:	Unity to all outputs
POWER INDICATOR:	Green LED
CONNECTORS INPUT:	Floating BNC connector 1 to 10 V P-P 15 k Ω
TEST OUTPUT:	BNC connector 1 to 10 V P-P 200 Ω
MAIN OUTPUTS:	Two D3M (XLR type male) 1 to 10 V P-P (balanced) Impedance matched to cable type: No. 9463 (standard): 78 Ω No. 9182 (special order): 150 Ω

CLD-2502 COMPOSITE LINE RECEIVER SPECIFICATIONS

SIZE:	1 3/4" X 19" (44.45 mm x 482.6 mm) rack panel with 1 3/4" H x 12" W x 5 3/4" D rear housing (44.45 mm H x 304.8 mm W x 146.05 mm D)
POWER:	95 to 130 VAC, 10 W maximum 190 to 260 V option available
TEMPERATURE RANGE:	0° to 50° C.
RF PROTECTION:	All inputs and outputs from 0 to -20 dB
GAIN CONTROL:	20-turn trimpot Adjusts both main and test outputs from 0 to -20 dB
HF COMPENSATION:	1-turn trimpot Adjusts high frequency response for cable length
POWER INDICATOR:	Green LED
INPUT CONNECTOR:	D3F (XLR type female)
LEVELS:	1 to 10 V P-P (balanced)
IMPEDANCES:	Impedance matched to cable type: No. 9463 (standard): 78 Ω No. 9182 (special order): 150 Ω
TEST OUTPUT:	(BNC connector) 1 to 10 V P-P Source Impedance: 1 kΩ Load Impedance > 100 kΩ
MAIN OUTPUT ¹ :	(BNC connector) 1 to 10 V P-P Source Impedance: 180 Ω Load Impedance > 2 kΩ

Note 1: For less than 2 kΩ, use the CLD-2503, which is designed to drive loads as low as 75 Ω.

3 INSTALLATION AND SETUP

3.1 Cable Selection

Although Twinax cable is not common in broadcasting, the type chosen here is widely used in computer data communications. Readily available and reasonably priced, it consists of a balanced twisted pair surrounded by a shielded jacket. This description may make it sound like ordinary shielded audio cable, but its characteristic impedance is much more tightly controlled, it is better shielded, and it is relatively free of periodic discontinuities. Only Twinax can provide the high degree of balance needed to reject induced magnetic interference as well as the shielding needed to reject electrical interference such as RFI.

Only two types of cable are specified as suitable for use with the CLD-2500 system. The first (the standard type) is Belden No. 9463.

Unless otherwise specified, all units come equipped with the correct impedance-matching resistors for Belden No. 9463.

With 9463, transmission lines of up to 2,500 feet (762 m) may be driven. The second choice is Belden No. 9182, which is heavier, more expensive, and of higher impedance, but which can accommodate runs of up to 4,000 feet (1219.2 m). Cable lengths greater than this require factory modification of the receiver. (Available on request).

Other manufacturers make similar cable, but, since the operation of the system depends upon the loss versus frequency and impedance versus frequency curves of the particular type of cable employed (both of which may vary widely between two cable types of identical nominal impedance), **no other type of cable should be substituted**, even if it is described as "interchangeable" with one of the specified types.

If you feel you must use a type of cable other than those specified above, consult the factory.

3.2 Cable Wiring

The Twinax cable is handled very much like shielded audio cable. After the outer jacket is removed, the braided shield and the drain wire should be combined and the foil shield should be removed. The shield/drain wire goes to pin 1 of the Switchcraft XLR connector and the two inner conductors go to pins 2 and 3.

Important: Make sure that the wire color and pin numbers agree on both ends of the cable. In general, the shell of the connector should not be tied to the shield unless connectors are installed in the middle of the cable run. If this is the case, the shell may be tied to the shield as long as the outside of the shell cannot come into contact with ground.

3.3 Level and HF Compensation Adjustment

The input level to the Composite Line Driver should be as high as possible up to a maximum of 6 V peak-to-peak. This generally means that the output level control on the signal source should be turned all the way up. The driver unit has unity gain both to the test output on the front panel and to the Twinax cable. The output level control on the receiver unit should be used to reduce this level to match the input requirements of your exciter.

Note: If you are using less than 100 feet (30.48 m) of cable, set the HF COMP pot to the fully counterclockwise position and ignore the remainder of this section.

The HF COMP control is an adjustable high frequency equalizer used to compensate for losses in the cable. The easiest way to set it is to observe the composite signal at the TEST jack on the driver unit. Connect an oscilloscope to the TEST jack and drive the stereo generator with a 10 kHz sine wave on the left channel only. Adjust the stereo generator for the best possible signal (flattest baseline) at this point. Then take the oscilloscope to the receiver unit and connect it to the test jack. Adjust the HF COMP control until the signal resembles as closely as possible the signal previously observed at the driver unit.

Warning:

Do not use a 10X probe on the scope when measuring separation. If the probe is not perfectly compensated, the separation measurement may be seriously in error. Connect the composite signal directly to the scope input with a short length of coaxial cable.

If you have equipment capable of measuring frequency response out to 53 kHz with an accuracy of at least ± 0.05 dB, an alternative to the above method is to adjust the HF COMP control for the flattest frequency response out to 53 kHz. When properly equalized, the Composite Line Driver system should have a frequency response within ± 0.05 dB from DC to 53 kHz. The frequency response beyond 53 kHz will be less flat, but more than adequate for SCA transmission. (Frequency response at 100 kHz = -1 dB, worst case).

Once you have adjusted the HF COMP control, any further adjustments necessary to optimize system performance should be made by observing the signal from your modulation monitor and adjusting the stereo generator in the normal fashion.

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4 MAINTENANCE

4.1 Monitoring Performance

The single-ended test output on the front of each unit provides a convenient means of observing performance. The driver's test jack is driven by a separate differential amplifier which directly monitors the balanced output, while the receiver's test output is driven by the main output amplifier. If you wish to take measurements directly from the balanced line, you must use test equipment capable of operating in a full differential mode. Most dual trace oscilloscopes have this capability. (See your scope's owner's manual.) Do not attempt to make measurements directly on the balanced line with a meter or any other test instrument that will ground one side of the line.

4.2 Factory Service

Each Composite Line Driver and Receiver is subjected to an extensive multi-stage test procedure, including a minimum 48-hour burn-in, before leaving the factory. Should any problems arise which cannot be corrected by simply replacing a defective op-amp (all of which are socketed for easy replacement), the unit should be returned to the factory for service after first determining that the problem is not in some other piece of equipment. If you have any doubt as to the cause of any problem that may be associated with the CLD-2500, the MSI engineering staff will be glad to respond to telephone inquiries at (732) 302-3090 or toll-free at (800) 826-2603.

When returning your unit for service, you must first obtain a return authorization number from the factory. In order to ensure proper handling, be sure to enclose a letter describing the nature of the malfunction, your company name, and shipping address.

In general, any failure due to defects in materials or workmanship during your first three years of ownership should be covered by warranty. For full details, see Modulation Sciences, Inc. Standard Warranty.

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5 FIELD REPAIR

MSI recommends that defective units be returned for factory service. If you must attempt field service, the following points should be kept in mind:

1. Some of the CLD-2500's components are specially tested and/or matched to extremely tight tolerances. Replacing any of these components by an untested equivalent may result in severely degraded performance. It is especially important that matched components be replaced in groups rather than singly. MSI will be happy to supply sets of matched components for a nominal cost, should you require them.
2. When replacing components, care should be taken not to overheat traces while de-soldering. For ease of removal, we suggest cutting component leads flush with the top of the board before attempting de-soldering from the bottom.
3. Replacing certain components in the CLD-2502 receiver may make it necessary to re-trim either the HF COMP control (front panel) or the internal trimpot which nulls the receiver's common mode rejection ratio.
4. The above information, and any other material relating to servicing, is provided as a courtesy to those who feel that they must do their own repairs. MSI assumes no liability for damage or other problems arising from attempts to service units in the field. Any attempt at user servicing will void the warranty on that unit, although MSI will, of course, continue to provide non-warranty service at prevailing rates.

The following sections provide information on the CLD-2500's operation. We will be glad to respond to phone inquiries for additional information relating to particular problems that may arise.

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6 PRINCIPLES OF OPERATION

6.1 Overall Description

The drive amplifiers are custom-designed hybrid amplifiers which drive the Twinax through precision impedance matching resistors. The CLD-2501 driver provides two independent outputs. Thus, one driver can feed two cables, each driving a different exciter. Each cable may be of any length up to 2,500 feet (762 m) and still maintain performance equal to that of the best stereo generator. With factory modification of the CLD-2502 receiver equalizer, as much as 10,000 feet (3048 m) of cable may be used. Locating system gain control and high frequency compensation in the receiver allows one driver to handle two dissimilar transmission lines.

The input to the driver is a floating BNC connector. A grounded, isolated BNC output is provided on the front panel for test purposes. A separate differential amplifier is used to drive this output so that the signal may be monitored after the balanced output amplifiers.

The connector chosen for the Twinax is a standard XLR connector. It is well shielded, has controlled grounding, is readily available, and costs a small fraction of what RF-type Twinax connectors do. Also, assembly is relatively easy.

The receiver terminates the Twinax, has an isolation amplifier, and provides a low impedance output on a grounded BNC connector. In addition, a grounded BNC connector on the front panel provides a separately isolated test output. The output level is adjustable by means of a 20-turn trimpot to provide a system gain of zero to -20 dB.

6.2 CLD-2501 Line Driver Circuit Description

Input jack J4 floats, its shell isolated from ground by resistor R4. RF bypassing is provided by capacitors C101 through C103. Input amplifiers U1 and U3 drive output amplifiers U2 and U4. Precision 0.1% matched resistors set the gains to both phases of the balanced outputs, J1 and J2. Test output amplifier U5 monitors the main output through resistors R19 and R20, providing an isolated, grounded output to the front test jack, J4. There are no trimpots, resistors selected on test, nor any other form of trimming in the driver.

Output impedance matching resistors R11 through R18 vary in value depending on which type of cable is used. For Belden No. 9463, all eight resistors are present, and each is 78.7 Ω . For Belden No. 9182, only one resistor is used in each output leg and its value is 75.0 Ω .

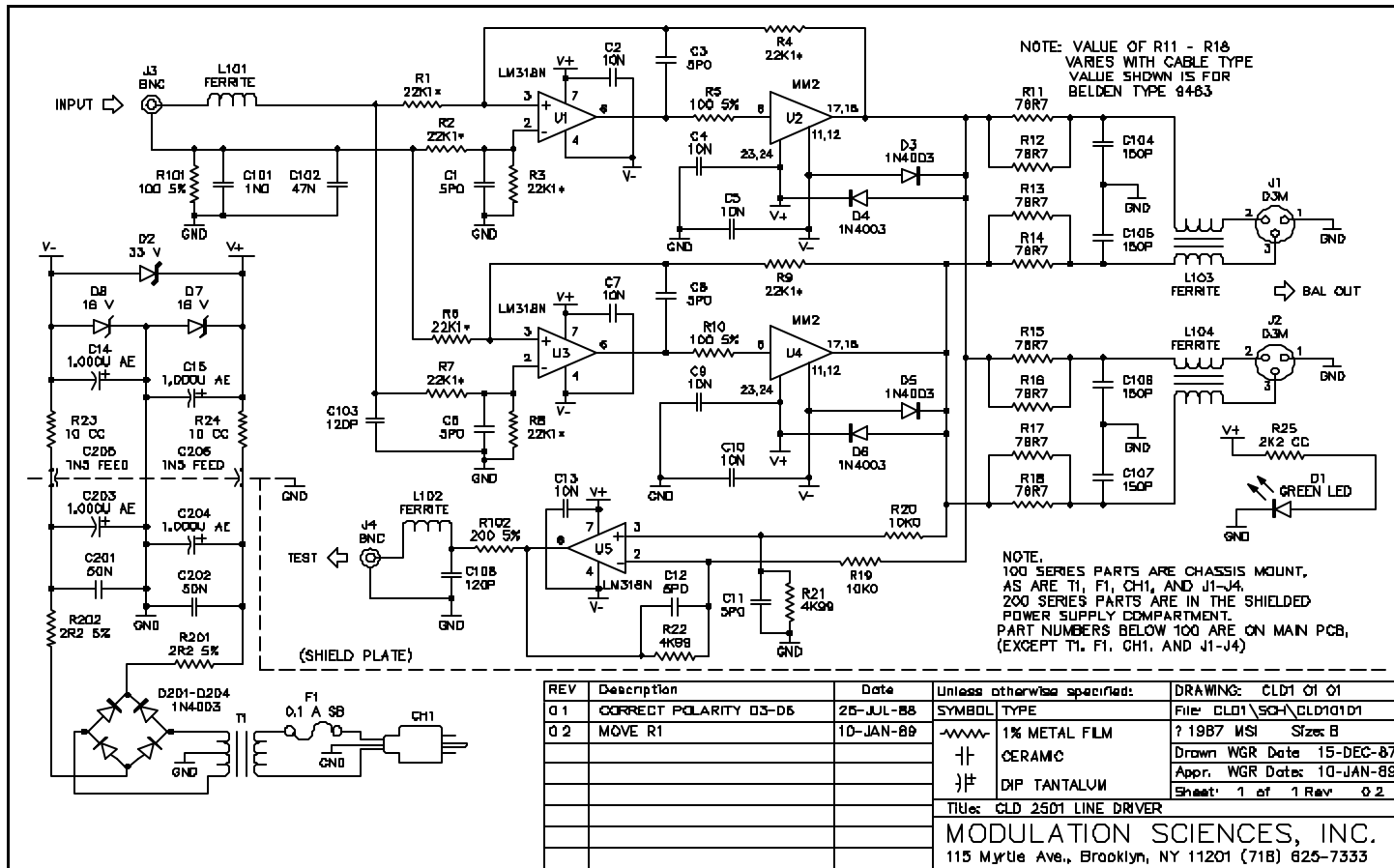
6.3 CLD-2502 Line Receiver Circuit Description

Input amplifier U1 changes the signal received through input jack J1 from balanced to unbalanced. Internal trimpot RV1 nulls the common mode gain of this differential input stage. Front panel 20-turn trimpot RV2 adjusts the overall gain. The network composed of R11, C5, R12, and front panel single-turn trimpot RV3 adjusts the high frequency response to compensate for cable losses. This portion of the circuit must be replaced by a more sophisticated equalizer when lines longer than 2,500 feet (762 m) are to be used.

Output amplifier U2 drives main output J2 and test output J3, which are resistively isolated.

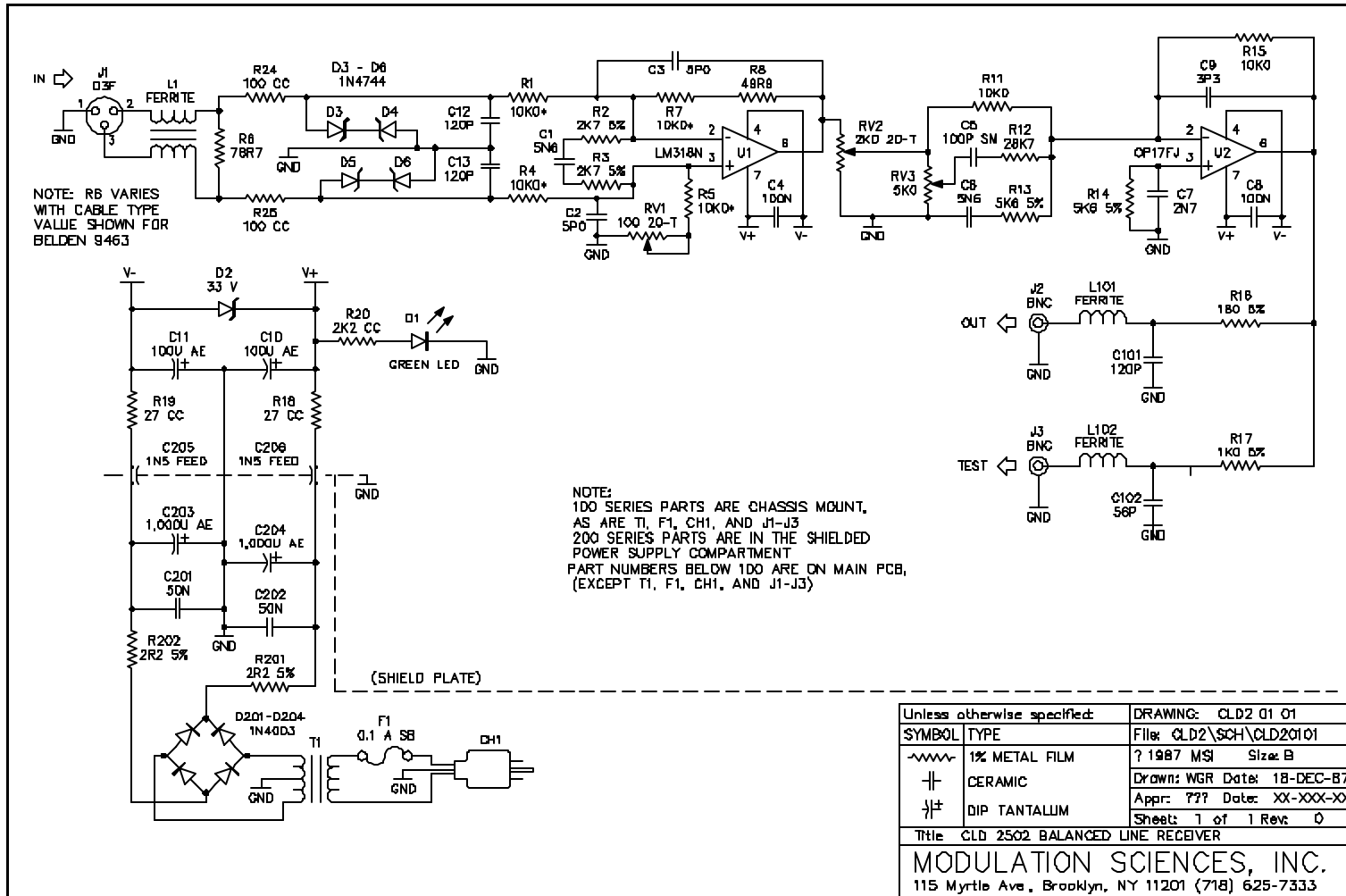
7 DIAGRAMS AND SUPPLEMENTARY INFORMATION

7.1 Schematic Diagram, CLD-2501 Line Driver



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7.2 Schematic Diagram, CLD-2502 Line Receiver



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8 WARRANTY

8.1 MSI Limited Warranty and Disclaimer

We warrant the equipment sold shall be free from defects in materials and workmanship under normal use and service for a period of three (3) years from the date of delivery when properly installed. Our sole obligation under this warranty shall be limited to repair or replacement, at Our option, of any such part or parts of the product which Our examination shall disclose to Our satisfaction to be defective.

If you wish to have warranty service performed at Our facilities, You shall obtain from Us, in advance, permission to return the equipment and shall ship it properly packed with transportation and insurance prepaid. Service performed at Our facilities under this warranty shall include parts plus labor. It is expressly agreed that Our obligation to repair or replace defective parts is Your sole and exclusive remedy.

The warranty to repair or replace defective parts is expressly in lieu of and hereby in disclaimer of all other express warranties, and is in lieu of and in disclaimer and exclusion of any implied warranties of merchantability, fitness for a particular purpose, as well as all other implied warranties, in law or in equity, and of all obligations or liability on our part. There are no warranties which extend beyond this description hereof.

Our liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside our factory, unless such work is authorized in writing by Us. Our obligation to repair or replace shall not apply to any equipment which shall have been repaired or altered outside Our factory in any way, subjected to negligence, misuse, unauthorized alteration or abuse, or damaged in transit.

OUR LIABILITY HEREUNDER SHALL NOT INCLUDE LOSSES OF ANTICIPATED PROFITS OR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES.

8.2 Summary of Modulation Sciences, Inc. Standard Warranty

Note: This is not the warranty. It is a summary of MSI's standard warranty and a description of how to obtain warranty service. The current, actual warranty is printed in its entirety on the preceding pages and supersedes warranty information which may be found elsewhere.

8.2.1 Who receives warranty protection?

Modulation Sciences' standard warranty protects the original end-user purchaser of record, but does not apply to subsequent owners.

8.2.2 What does the warranty cover?

Modulation Sciences agrees to repair or replace, at its expense, any unit which has a defect in materials or workmanship for a period of three (3) years after the date of sale to the original end-user purchaser. This warranty includes all parts, labor, calibration, and packing.

8.2.3 What doesn't the warranty cover?

MSI's warranty does not cover:

1. Freight and insurance charges paid by the purchaser in returning the unit for repair.
2. Defects which result from modifications or repairs to the unit not made by nor authorized in writing by Modulation Sciences, Inc.
3. Compensation for incidental or consequential damages resulting from any defect.
4. Trivial or cosmetic defects which do not affect the unit's ability to function normally.

8.2.4 How is the warranty period computed?

The warranty period begins on the date of delivery to the original end-user purchaser and is in effect for the next three years. The starting date is deemed to be the date on the invoice from Modulation Sciences, its agent, dealer, or distributor to the first end-user purchaser. Do not lose your invoice. It is your way of establishing that your warranty is still in force.

8.2.5 What if the unit cannot be repaired?

If Modulation Sciences decides not to repair or replace a given unit, Modulation Sciences agrees to refund to the first end-user purchaser its full purchase price. Payment of that amount will end MSI's responsibilities and Modulation Sciences may keep the unit.

8.2.6 How is warranty service obtained?

To claim your rights under this warranty:

1. Contact the dealer or distributor from whom this product was purchased. Describe the problem and ask if there is an easy solution.
2. If your dealer cannot help, contact Modulation Sciences' service department at (732) 302-3090 or (800) 826-2603 and explain the problem. If that unit requires factory service, you will be given a return authorization number.
3. When you have your return authorization number, you may return the unit. Pack it carefully for shipment, preferably using the original shipping carton and packing materials. **Assume that the box will be dropped several times during shipment. Use UPS or some other private carrier you know to be reliable. Do not use the Postal Service.** The risk of loss is yours. Modulation Sciences will not be responsible for damage or loss until the package is received by Modulation Sciences. **INSURE THE UNIT FOR ITS FULL REPLACEMENT VALUE. SHIP THE UNIT PREPAID TO THE ADDRESS SPECIFIED WHEN YOU RECEIVE YOUR RETURN AUTHORIZATION, AND BE SURE TO ENCLOSE A NOTE GIVING THE FOLLOWING INFORMATION:**
 - Your company name and shipping address (not a PO Box).
 - Your return authorization number.
 - A copy of your original invoice establishing the starting date of your warranty.
 - As full a description as possible of the problem(s).

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9 PARTS LISTS

9.1 Abbreviations of Manufacturers' Names

ALLENBRADL	Allen-Bradley
AMP	AMP
AMPHENOL	Amphenol Corporation
ARCO	Arcoelectric Corporation
BARRE	Barré Company
BELDEN	Belden Wire & Cable Company
BIVAR	Bivar, Inc.
BOURNS	Bourns, Inc.
BUSSMAN	Bussmann Division, Cooper Industries
CENTRALAB	Centralab
DALE	Vishay Dale
DIALIGHT	Dialight Corporation
FAIRRITEPR	Fair-Rite Products
HHSMITH	H. H. Smith, Inc.
JETPREC	Jet Precision
KEYSTONE	Keystone Electronics Corporation
KINGS	Kings Electronics Company, Inc.
LITTELFUSE	Littelfuse, Inc.
MAGNETCOIL	Magnetic Coils, Inc. (MCI Transformer Corporation)

MALLORY	Mallory Capacitor
OPTICALELE	Optical Electronics, Inc.
PANA	Panasonic
PRECMONOLI	Precision Monolithic
QUALITYCIR	Quality Circuits
SAMTEC	Samtec, Inc.
SIBLEYCOMP	Sibley Components
SPRAGUE	Sprague
SWITCHCRAF	Switchcraft, Inc.
TEXASINSTR	Texas Instruments
TUSONIX	Tusonix

9.2 Abbreviations Used in Parts Descriptions

ADJ	adjustable
AE	aluminum electrolytic capacitor
BH	binding head
BL	black
BUSH	bushing
CC	carbon composition resistor
CF	carbon film resistor
CM	cable mount
CONN'R	connector
DT	dipped tantalum capacitor
F (FEM)	female
FH	flat head
INT	internal
LH	left-hand
LW	lockwasher
M	male
MC	monolithic ceramic capacitor
MF	metal film resistor
MINI-BAY	mini-bayonet base lamp
MOM	momentary

MT	mount
MY	Mylar [®] capacitor
nF	nanofarads
OX	oxide coated
PC	printed circuit
pF	picofarads
PHIL	Phillips
PS	polystyrene capacitor
PY	polyester capacitor
REG	regulator
RH	round head, right-hand
RND	round
SB	slow-blow
SEG	segment
SF	stacked film capacitor
SM	silvered mica capacitor
SPAC	spacer
SS	solder socket
TS	terminal strip
uF	microfarads
WW	wire-wrap

9.3 Parts List, CLD-2501 Line Driver

NOTE: Some parts in the following lists are marked with an asterisk (*). When this symbol precedes a component, it means that the part has been tested by Modulation Sciences, Inc. and should not be replaced without consulting the factory.

CHASSIS PARTS

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUF. PART NUMBER
V02-CD1H					
A04-1004SCDG1	1	1 nF 10% DISC	C101	CENTRALAB	CE102
A04-1203UCBG1	2	120 pF DISC	C103,C108	ARCO	CCD 121
A04-1503UCBG1	4	150 pF DISC	C104-C107	SPRAGUE	10TST15
A04-1504XHNI1	2	1.5 nF FEEDTHROUGH	C205,C206	TUSONIX	357-001-X5U0-152M
A04-4705JMCH1	1	0.047 uF 100 V MC	C102	CENTRALAB	CZ20A473M
A06-FBEAD0001	2	FERRITE BEAD	L101,L102	FAIRRITEPR	2743002111
A06-FBEAD0002	2	FERRITE BEAD	L103,L104	FAIRRITEPR	28730024020
A08-D60102001	1	20 V PWR XFMR DUAL 110/230 V	T1	MAGNETCOIL	4/7/4020
A09-S3AG10001	1	FUSE, SLOW BLOW, 0.1 AMP	F1	LITTELFUSE	313.1
G04-CD4O	1	CD4 OUTPUT CARD		QUALITYCIR	OPCD4O
G04-FMMI	1	INPUT PC		QUALITYCIR	FMMI
G04-GBU	1	PC BOARD	PCB3	QUALITYCIR	GBU
H02-002F00002	1	CONN'R, BNC FEM, UG-1094/U	J4	AMPHENOL	31-221
H02-002F00003	1	LONG BUSHING BNC CONN'R	J3	KINGS	KC79-46
H02-003M00001	2	3 PIN M PANEL MT XLR CONN'R	J1,J2	SWITCHCRAF	D3M
H04-PN0000001	1	FUSE HOLDER	FH1	BUSSMAN	HKP
H11-CRN160401	1	#6 CRIMP LUG	PWR CORD GND	KEYSTONE	8200
J07-P18000001	1	6 FOOT LINE CORD (1.8 m)	CH1	BELDEN	17237B
K99-000000001	1	NYLON FLAT WASHER		HHSMITH	2678
K99-000000002	1	NYLON SHOULDER WASHER		HHSMITH	2668
L03-CD1HCHA	1	CLD1 CHASSIS		JETPREC	CD1HCHA
L03-CLD2501FP	1	CLD DRIVER FRONT			
L03-CP803RMP1	1	RACK PNL, BLK ANOD, SCREENED		JETPREC	CP803RMP1
L03-CP8HCOV	1	CP803-CLD1,2,3,4 COV		JETPREC	CP8HCOV
L03-CP8HSP	1	CP803-CLD1,2,3,4 SHIELD PLATE		JETPREC	CP8HSP
O03-4/40E2501	21	4-40 x 1/4 SEMS,PHIL PAN HEAD		VARIOUS	NONE

O03-4/40M2502	8	4-40 x 1/4 BH		VARIOUS	NONE
O03-4/40M3801	2	4-40 x 3/8 PHIL PAN HEAD		VARIOUS	NONE
O03-4/40N0001	2	4-40 HEX NUT, STEEL ZINC		VARIOUS	NONE
O03-NO.6I0001	4	#6 INT. LOCK WASH,STEEL ZINC		VARIOUS	NONE
V03-UPSA	1	PWB ASSY, POWER SUPPLY	POWER PWBA		
Z01-203	1	200 OHM 1/4 W 5% CF	R102	VARIOUS	1/4 W 5 % CF
Z07-103	1	100 OHM 5% 1/2 W CC EB TYPE	R101	ALLENBRADL	EB TYPE 1/2 W 5% CC

CIRCUIT BOARD PARTS

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUF. PART NUMBER
V01-CD1M					
A04-1005HMBG1	7	.01 uF 50 V 10% MC	C2,C4,C5,C7,C9,C10,C13	CENTRALAB	CW20C103K
A04-100AGANH1	2	1000 uF 35 V AE 20%	C14,C15	PANA	ECE-B1VGE102
A04-5001UCBG1	6	5 pF DISC	C1,C3,C6,C8,C11,C12	ARCO	CCD-050
B01-4003	4	RECTIFIER DIODE	D3-D6	VARIOUS	1N4003
B02-4752A	1	33 VOLT ZENER DIODE	D2	VARIOUS	1N4752A
C01-1B0000001	2	HYBRID OP AMP	U2,U4	OPTICALELE	OEI9911
C01-1F0000006	3	OP AMP, PLASTIC	U1*,U3*,U5*	TEXASINSTR	LM318P
E01-S50000001	1	GREEN LED	D1	DIALIGHT	521-9270
G04-CLD1	1	PC BOARD	PCB1	QUALITYCIR	CLD-1
H05-008000001	3	8-PIN EDGE GRIP SS	US1,US3,US5	AMP	2-640463-2
H05-024000002	2	24-PIN FACE GRIP SS	US2,US4	AMP	2-641266-20
Z01-000	2	0 OHM 1/4 W 5% CF	JUMPER	VARIOUS	
Z01-103	2	100 OHM 1/4 W 5% CF	R5,R10	VARIOUS	1/4 W 5 % CF
Z02-1005	2	10.0 K 1/4 W 1% MF	R19,R20	VARIOUS	1/4 W 1 % MF
Z02-4994	2	4.99 K 1/4 W 1% MF	R21,R22	VARIOUS	1/4 W 1 % MF
Z04-7872	8	78.7 OHM CMF-65 78.7 1% T-1 B14	R11-R18	DALE	RN65D78R7F
Z08-102	2	10 OHM EB TYPE 1/2 W 10% CC	R23-R24	ALLENBRADL	EB TYPE 1/2 W 10% CC
Z08-224	1	2.2 K 1/2 W 10% CC	R25	ALLENBRADL	EB TYPE 1/2 W 10% CC
Z14-2215	8	22.1 K RN55 0.1% 1/4 W 50PPM	R1*-R4*,R6*-R9*	RCD	MF55C - SORTED

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9.4 Parts List, CLD-2502 Line Receiver

NOTE: Some parts in the following lists are marked with an asterisk (*). When this symbol precedes a component, it means that the part has been tested by Modulation Sciences, Inc. and should not be replaced without consulting the factory.

CHASSIS PARTS

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUF. PART NUMBER
V02-CD2H					
A04-1203UCBG1	1	120 pF DISC	C101	ARCO	CCD 121
A04-1504XHNI1	2	1.5 nF FEEDTHROUGH	C205-C206	TUSONIX	357-001-X5U0-152M
A04-5602HCAF1	1	56 pF 5 % COG DISC	C102	MALLORY	CEC560J
A06-FBEAD0001	2	FERRITE BEAD	L101-L102	FAIRRITEPR	2743002111
A08-D60102001	1	20 V PWR XFMR DUAL 110/230 V	T1	MAGNETCOIL	4/7/4020
A09-S3AG10001	1	FUSE, SLOW BLOW, 0.1 AMP	F1	LITTELFUSE	313.1
G04-GBU	2	PC BOARD	PCB3,PCB4	QUALITYCIR	GBU
H02-002F00002	2	CONN'R, BNC FEMALE, UG-1094/U	J2,J3	AMPHENOL	31-221
H02-003F00001	1	3 PIN F PANEL MT XLR	J1	SWITCHCRAF	D3F
H04-PN0000001	1	FUSE HOLDER	FH1	BUSSMAN	HKP
H11-CRN160401	1	#6 CRIMP LUG, 22-18 AWG			
J07-P18000001	1	6 FOOT LINE CORD (1.8 M)	CH1	BELDEN	17237B
L03-CD3HCHA	1	CLD2,3 CHASSIS REV A	H1	BARRE	CLD3-BX
L03-CLD2502FP	1	CLD RECEIVER FRONT			
L03-CP803RMP1	1	RACK PNL, BLK ANOD, SCREENED			
L03-CP8HSP	1	CP803-CLD1,2,3,4 SHIELD PLATE			
O03-4/40E2501	22	4-40 x 1/4 SEMS, PHIL PAN HEAD		VARIOUS	NONE
O03-4/40M2502	8	4-40 X 1/4 BH		VARIOUS	NONE
O03-4/40M3801	2	4-40 X 3/8 PHIL PAN HEAD		VARIOUS	NONE
O03-4/40N0001	2	4-40 HEX NUT, STEEL ZINC		VARIOUS	NONE
O03-NO.4I0001	6	NO. 4 INT LOCK WASH, STEEL ZINC		VARIOUS	NONE
O05-000000001	1	STRAIN RELIEF, 5N-4 BLACK			
V03-UPSA	1	PWB ASSY, POWER SUPPLY			
Z01-203	1	200 OHM 1/4W 5% CF			

CIRCUIT BOARD PARTS

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUF. PART NUMBER
V01-CD2M					
A02-M103FS001	1	TRIMPOT, 20T 100R FS SIDE	RV1	BOURNS	3006P1-101
A02-M204FS001	1	2K 20-T TRIMPOT	RV2	BOURNS	3006P1-202
A02-S504US001	1	5K UPRIGHT TRIMPOT	RV3	BOURNS	3386W1-502
A04-1003RSNF1	1	100 pF 5% SM	C5	VARIOUS	DM15FD101J03
A04-1006HMCH1	2	0.1 uF 50 V 20% MC	C4,C8	MALLORY	C20C104M5UICA
A04-1009FANI1	2	100 uF 25 V AE		PANA	ECE-B1EU101Y
A04-1203UCBG1	2	120 pF DISC	C12,C13	ARCO	CCD 121
A04-2704MCFG1	1	2.7 nF 100V DISC, Y5P, 10%	C7	MALLORY	SM272K
A04-3301UCBG1	1	3.3 pF DISC	C9	CENTRALAB	DD3R3
A04-5001UCBG1	2	5 pF DISC	C2,C3	ARCO	CCD-050
A04-5604JMEG1	2	5.6 nF 100 V 10% MC	C1,C6	CENTRALAB	CW15A562K
A06-FBEAD0001	2	FERRITE BEAD	L2,L3	FAIRRITEPR	2743002111
A06-FBEAD0002	1	FERRITE BEAD	L1	FAIRRITEPR	28730024020
B02-4752A	1	33 VOLT ZENER DIODE	D2	VARIOUS	1N4752A
C01-1F0000001	1	OP AMP	U2	PRECMONOLI	OP-17FJ
C01-1F0000006	1	OP AMP, PLASTIC	U1*	TEXASINSTR	LM318P
E01-S50000001	1	GREEN LED	D1	DIALIGHT	521-9270
G04-CLD3	1	PC BOARD	PCB1	SIBLEYCOMP	CLD3
H05-008000001	1	8 PIN EDGE GRIP SS	US1	AMP	2-640463-2
H05-008000003	1	8 PIN MACHINE PIN SS	US2	SAMTEC	ICO-308-SGT
H09-001ST0001	2	BIFURCATED STAKE-IN TERMINAL	BY R12 & C5	KEYSTONE	1526-2
K01-A02COV001	1	20-T TRIMPOT COVER	RVC2	BOURNS	H-83-P
K02-000000001	1	TO-99 TO DIP CONVERTER		BIVAR	808-187
K04-1450B	5	4-40 X 3/8" HEX SPAC		KEYSTONE	1450B
O03-4/40E2501	5	4-40 x 1/4 SEMS, PHIL PAN HEAD		VARIOUS	NONE
Z01-000	3	0 OHM 1/4 W 5% CF	JUMPER	VARIOUS	1/4W
Z01-104	1	1K 1/4 W 5% CF	R17	VARIOUS	1/4 W 5 % CF
Z01-183	1	180 OHM 1/4 W 5% CF	R16	VARIOUS	1/4 W 5 % CF
Z01-274	2	2.7 K 1/4 W 5% CF	R2,R3	VARIOUS	1/4 W 5 % CF
Z01-564	2	5.6K 1/4 W 5% CF	R13,R14	VARIOUS	1/4 W 5 % CF
Z02-1005	1	10.0 K 1/4 W 1% MF	R15	VARIOUS	1/4 W 1 % MF
Z02-2875	1	28.7 K 1/4 W 1% MF	R12	VARIOUS	1/4 W 1 % MF
Z02-4992	1	49.9 OHM 1/4 W 1% MF	R8	VARIOUS	1/4 W 1 % MF
Z03-1005	1	10.0 K RN55 1/4 W 1% 50 PPM	R11	MILITARY	RN55CF
Z03-1005	4	10.0 K RN55 1/4 W 1% 50 PPM	R1*,R4*,R5*,R7*	MILITARY	RN55CF
Z04-7872	1	CMF-65 78.7 OHM 1% T-1 B14	R6	MILITARY	RN65CF

Z08-224	1	2.2 K 1/2 W 10% CC	R20	ALLENBRADL	EB TYPE 1/2 W 10% CC
Z08-272	2	27 OHM 1/2 W 10% CC	R18,R19	ALLENBRADL	EB TYPE 1/2 W 10% CC