

Effective: September 2002

Supersedes I.L. 40-220 dated March 1989

( | ) Denotes Change Since Previous Issue

## Type LCB II Relay Modules (with DIN Connectors)



Printed circuit modules should not be removed or inserted while the LCB is energized. Failure to observe this precaution can result in an undesired tripping output and/or component damage. In addition, modules should not be interchanged between relays without rechecking calibration.

These instructions contain a brief description, schematic, component location and bill of material for the following LCB Modules:

ALS-1	Analog Logic Power Supply
DTD	Demodulator/Time Delay
MD	Modulator/Demodulator
IFDT-1/2	Audio Dual Tone Interface
IFO-1/2	Fiber Optic Interface
RELAY	Relay Sensing Logic
DTT	Direct Transfer Trip
AXLM	Auxiliary Logic
ARTM-1/2	AR Trip Logic

All integrated circuits used on the modules are sensitive to and can be damaged by the discharge of static electricity. Electrostatic discharge precautions should be observed when handling modules or individual components.

### 1.0 CONSTRUCTION

The LCB modules are designed for insertions into a 3 rack unit LCB chassis. Module terminations are provided by means of a terminal connector.

Following a tabulation of the module widths and number of connector terminals.

Module Name	Module Location Widths	No. Connector Terminals
ALS-1	2	32
DTD	1	32
MD	1	32
IFDT-1/2	1	32
IFO-1/2	1	32
RELAY	1.75	32
DTT	1	32
AXLM	1	32
ARTM-1/2	3	32

NOTE: 1 module location width equals 1.2 inches.

### 2.0 MODULE APPLICATION/DESCRIPTION

#### 2.1 ALS-1 ANALOG LOGIC POWER SUPPLY

The ALS-1 power supply covered in other instructions provides  $\pm 15Vdc$  to power the LCB relay. Units are available for 48, 125 or 250Vdc station batteries. This module is covered by a separate I.L. 41-830.12.

#### 2.2 DTD – DEMODULATOR AND TIME DELAY

The DTD module is used only for 3 terminal line applications and contains a demodulator for the second channel and a channel delay equalization circuit (TD) to compensate for possible different delays in the two channels.

*All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Inc. representative should be contacted.*

### 2.3 MD – MODULATOR/DEMOMULATOR

The MD module contains both the modulator and demodulator for transmission and detection of the LCB communicated signal.

The modulator generates the 1.7 KHz carrier signal and contains the circuitry to provide the modulation of the carrier signal based on the sequence output voltage from the RELAY module. In turn, the modulated output connects to the channel interface for transmission to the remote terminal.

The demodulator receives its information for the respective channel interface (audio or optical) and reconstructs the remote LCB signal.

### 2.4 IFDT – AUDIO DUAL TONE INTERFACE

The IFDT module contains the circuitry to provide both the transmit and receive isolated interface with the user's audio tone equipment or equivalent.

The transmitter provides adjustable output for proper coordination with the communication medium.

In the receive portion, input level sensitivity is adjustable and stabilized with an AGC circuit. Detection circuits are employed for high and low level, excessive noise to signal levels, frequency translation and missing cycle periods.

For 3 terminal line applications, two channel interface modules are required.

### 2.5 IFO – OPTICAL INTERFACE

The IFO module contains the circuitry to provide both the transmit and receive interface to fiber optic cable.

The IFO has various versions depending on transmit power, optical wavelength (850 or 1300 nm) and optical connectors (SMA or ST).

The standard transmitter consists of a fiber optic LED emitter mounted on a bracket extending to the rear of the module.

The High Power Output Transmitter contains a Fiber Optic Edge Emitting LED mounted on the IFO module. The LED assembly has a "PIGTAIL" with the ST connector mating with the bulkhead connector mounted on a bracket.

For the receive portion, a bulkhead connector mounted on

the same bracket as the emitter provides a means for connection of the receive fiber optic cable. From this connector, a larger core fiber connects to a fiber optic PIN photodiode detector in a shielded receiver circuit. Following the detection, the receiver employs an AGC circuit, low level and missing cycle detection.

For 3 terminal line applications, two channel interface modules are required.

### 2.6 RELAY – RELAY SENSING

The RELAY module contains the circuitry to generate, compare and determine trip for the LCB current differential system relaying quantities. Included are: a sequence network with independent sensitivity selection for positive (P), negative (N) and zero (Z), adjustable system pickup setting (T DIAL), adjustable channel delay equalizer, comparison circuits for the local versus remote quantities, trip detection and channel monitoring functions.

### 2.7 DTT – DIRECT TRANSFER TRIP

The DTT module is used as an option to provide a direct transfer trip function utilizing the same channel as that employed for normal LCB relaying.

For tripping, the LCB system utilizes the ARTM-2 module, which provides 2 AR relays, with one dedicated for direct transfer trip.

### 2.8 AXLM – AUXILIARY LOGIC

The AXLM module is used to provide auxiliary logic, timing, indication and input/output features associated with the LCB relay system. such features include electrical target reset, trip desensitizing on breaker closing, overcurrent trip options on loss of channel(s), and sustained loss of channel monitoring and indication.

### 2.9 ARTM-1/2 – AR TRIP MODULE

The ARTM-1, single trip, or ARTM-2 double trip (for use with direct transfer trip option), module provides the final AR contact tripping output for the LCB relay system. Block of tripping and indication during the dc power up/down as well as provision for manual reset are also provided on this module.

### 3.0 MODULE REFERENCE INFORMATION (REFER TO IL 41-830.12)

#### ALS-1 Module – (Refer to I.L. 41-830.12)

Style 1615C51: G01 - 48Vdc  
G02 - 125 Vdc  
G03 - 250 Vdc

#### DTD Module – Style 1609C38G02

Internal Schematic: 1355D47  
Component Location: 1609C38  
Chassis Location: POS. C

#### MD Module – Style 1609C38G01

Internal Schematic: 1355D39  
Component Location: 1609C38  
Chassis Location: POS. D

#### IFDT Module – Style 1609C39G01

Internal Schematic: 1355D40  
Component Location: 1609C39  
Chassis Location: POS. F (Channel 1)  
POS. E (Channel 2)

#### IFO Module (Standard) –

Style 1609C40G01 (850NM/SMA)  
Style 1609C40G02 (1300NM/SMA)  
Style 1609C40G03 (850NM/ST)  
Style 1609C40G04 (1300NM/ST)  
Internal Schematic: 1355D41  
Component Location: 1499B44  
Chassis Location: POS. F (Channel 1)  
POS. E (Channel 2)

#### IFO Module (High Power) –

Style 1609C96G01 (1300NM/ST)  
Internal Schematic: 1355D70  
Component Location: 1609C96  
Chassis Location: POS. F (Channel 1)  
POS. E (Channel 2)

#### RELAY Module – Style 1609C41G01

Internal Schematic: 1355D42  
Component Location: 1609C41  
Chassis Location: POS. G

#### DTT Module – Style 1609C42G01 (2 Term.) Style 1609C42G02 (3 Term.)

Internal Schematic: 1355D43  
Component Location: 1609C42  
Chassis Location: POS. K

#### AXLM Module – Style 1609C43G01

Internal Schematic: 1355D44  
Component Location: 1609C43  
Chassis Location: POS. L

#### ARTM-1 Module – Style 1609C44G01

(No Transfer Trip)  
Internal Schematic: 1355D45  
Component Location: 1499B49  
Chassis Location: POS. M

#### ARTM-2 Module –

Style 1609C44G02 (Main assembly)  
Style 1581C27G01 (Sub-assembly)

(Transfer Trip)

Internal Schematic: 1355D45  
Component Location:  
1499B49 (Main assembly)  
1484B32 (Sub-assembly)  
Chassis Location: POS. M

### 4.0 RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable spare modules or components can be furnished to the customers who are equipped for doing repair work. When ordering parts (components, modules, etc.) always give the complete catalog number and appropriate ABB style number(s).

#### ATTACHMENTS

##### A. Internal Schematics

Figure	Module	Drawing
1	DTD	1355D47
2	MD	1355D39
3	IFDT	1355D40
4	IFO (Standard)	1355D41
5	IFO (High Power)	1355D70
6	RELAY	1355D42
7	DTT	1355D43
8	AXLM	1355D44
9	ARTM-1/2	1355D45

##### B. Component Locations

Figure	Module	Drawing
10	MD/DTD	1609C38
11	IFDT	1609C39
12	IFO (Standard)	1499B44
13	IFO (High Power)	1609C96
14	RELAY	1609C41
15	DTT	1609C42
16	AXLM	1609C43
17	ARTM-1 (main assembly)	1499B49
18	ARTM-2 (sub-assembly)	1484B32

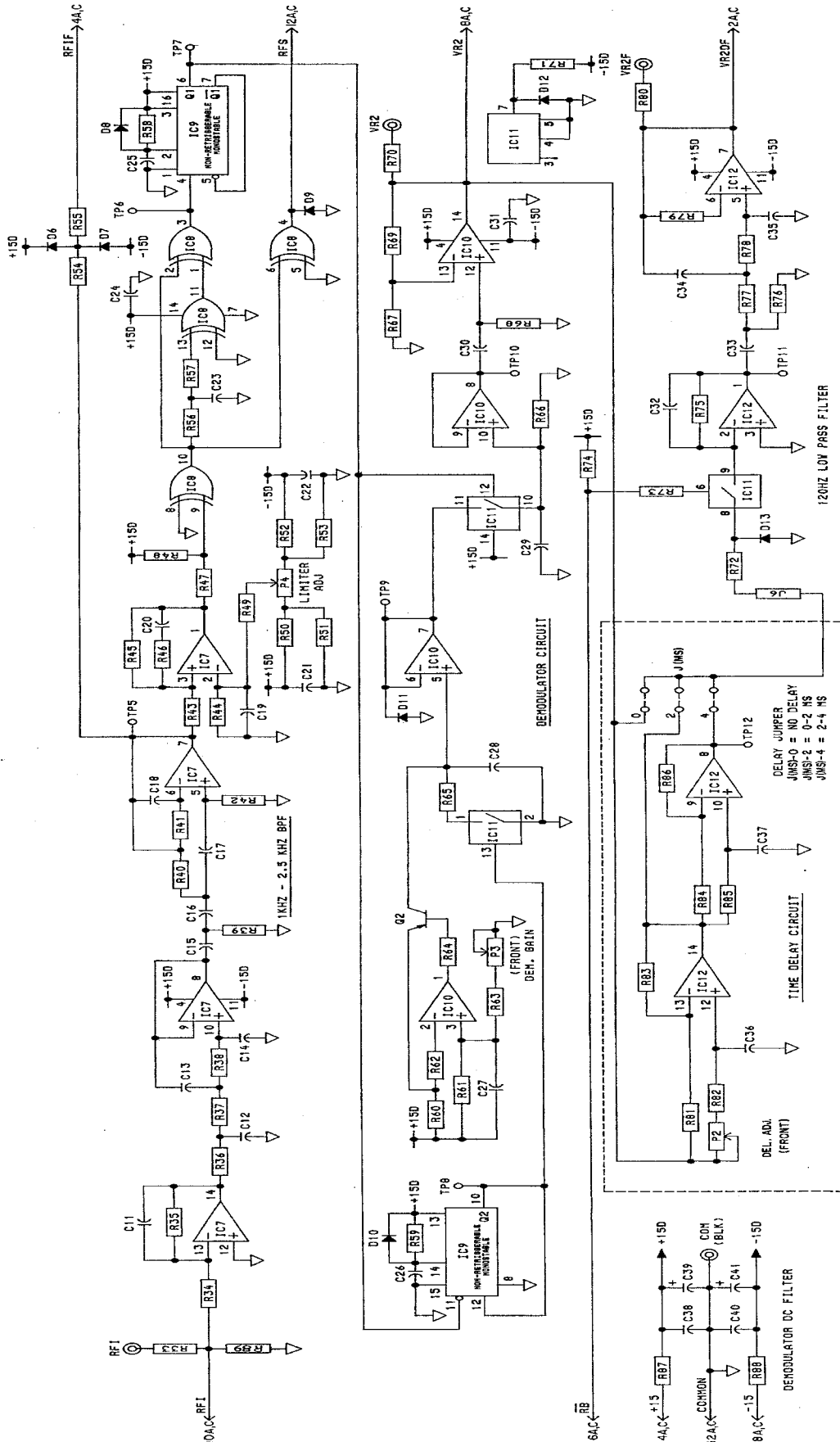


Figure 1: Internal Schematic DTD Module

Sub 3  
1355D47

CAPACITOR	RESISTOR	LINK	J (MS)	STYLE	STYLE
C11	0.01 MFD 200V +-5% MET-POLY CARB	R33	3.01K 1/8W 1% METAL FILM	353A428H47	
C12	0.05 MFD 200V +-2% MET-POLY CARB	R34	20K 1/8W 1% METAL FILM	353A543H30	
C13	0.01 MFD 200V +-5% MET-POLY CARB	R35	200K 1/8W 1% METAL FILM	353A543H30	
C14	270 PF 500V +-2% MICA	R36	121K 1/8W 1% METAL FILM	353A543H30	
C15	0.022 MFD 200V +-2% MET-POLY CARB	R37	121K 1/8W 1% METAL FILM	353A543H30	
C16	0.01 MFD 200V +-5% MET-POLY CARB	R38	121K 1/8W 1% METAL FILM	353A543H30	
C17	0.01 MFD 200V +-5% MET-POLY CARB	R39	8.25K 1/4W 1% METAL FILM	353A543H30	
C18	0.01 MFD 200V +-5% MET-POLY CARB	R40	82.5K 1/8W 1% METAL FILM	353A543H30	
C19	0.1 MFD 100V +-5% MICA	R41	301K 1/8W 1% METAL FILM	353A543H30	
C20	1.0 MFD 100V +-5% MICA	R42	301K 1/8W 1% METAL FILM	353A543H30	
C21	1. MFD 100V +-5% MET-POLY CARB	R43	10K 1/8W 1% METAL FILM	353A543H30	
C22	1. MFD 100V +-5% MET-POLY CARB	R44	10K 1/8W 1% METAL FILM	353A543H30	
C23	47 PF 500V +-2% MICA	R45	15M 5% CARB 1/2W	353A543H30	
C24	1. MFD 100V +-2% MICA	R46	100K 1/8W 1% METAL FILM	353A543H30	
C25	6.0 PF 500V +-2% MICA	R47	5.1K 1/8W 1% METAL FILM	353A543H30	
C26	1. MFD 200V +-5% MET-POLY CARB	R48	5.1K 1/8W 1% METAL FILM	353A543H30	
C27	1. MFD 100V +-2% MICA	R49	5.1K 1/8W 1% METAL FILM	353A543H30	
C28	100 PF 500V +-2% MICA	R50	15K 1/8W 1% METAL FILM	353A543H30	
C29	500 PF 500V +-2% MICA	R51	15K 1/8W 1% METAL FILM	353A543H30	
C30	0.47 MFD 100V +-5% MET-POLY CARB	R52	30.1 OHM 1/8W 1% METAL FILM	353A543H30	
C31	1. MFD 100V +-5% MET-POLY CARB	R53	30.1 OHM 1/8W 1% METAL FILM	353A543H30	
C32	0.1 MFD 200V +-2% MET-POLY CARB	R54	10K 1/8W 1% METAL FILM	353A543H30	
C33	1. MFD 100V +-5% MET-POLY CARB	R55	10K 1/8W 1% METAL FILM	353A543H30	
C34	0.47 MFD 100V +-5% MET-POLY CARB	R56	5.1K 1/8W 1% METAL FILM	353A543H30	
C35	0.1 MFD 200V +-2% MET-POLY CARB	R57	15K 1/8W 1% METAL FILM	353A543H30	
C36	0.12 MFD 200V +-5% MET-POLY CARB	R58	15K 1/8W 1% METAL FILM	353A543H30	
C37	0.1 MFD 200V +-5% MET-POLY CARB	R59	15K 1/8W 1% METAL FILM	353A543H30	
C38	0.1 MFD 100V +-5% MET-POLY CARB	R60	15K 1/8W 1% METAL FILM	353A543H30	
C39	1.0 MFD 35V +-20% TANTALUM	R61	30.1K 1/8W 1% METAL FILM	353A543H30	
C40	0.1 MFD 100V +-5% MET-POLY CARB	R62	15K 1/8W 1% METAL FILM	353A543H30	
C41	100 MFD 35V +-20% TANTALUM	R63	15K 1/8W 1% METAL FILM	353A543H30	

Figure 1a: Internal Schematic DTD Module

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I355D47

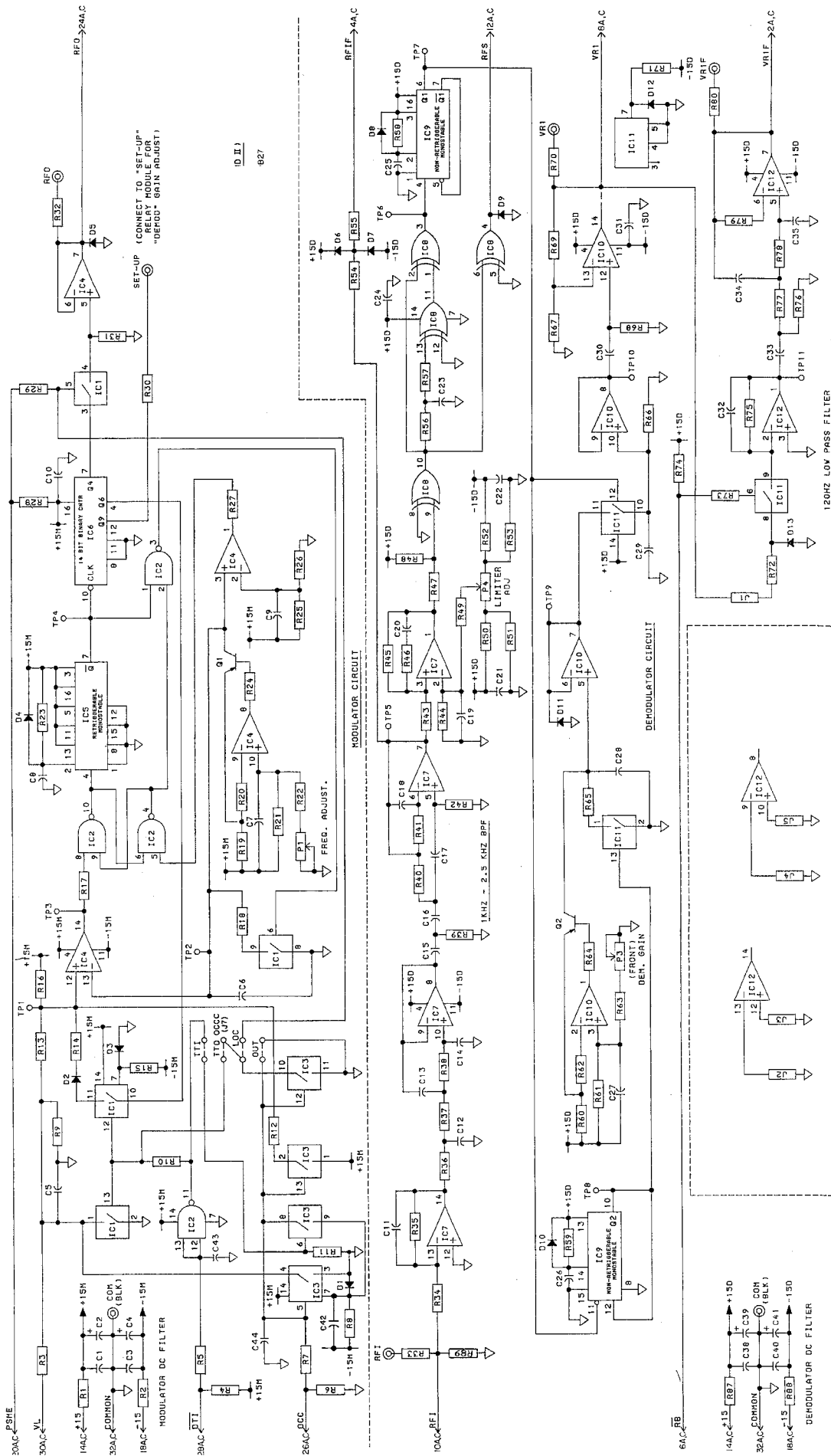
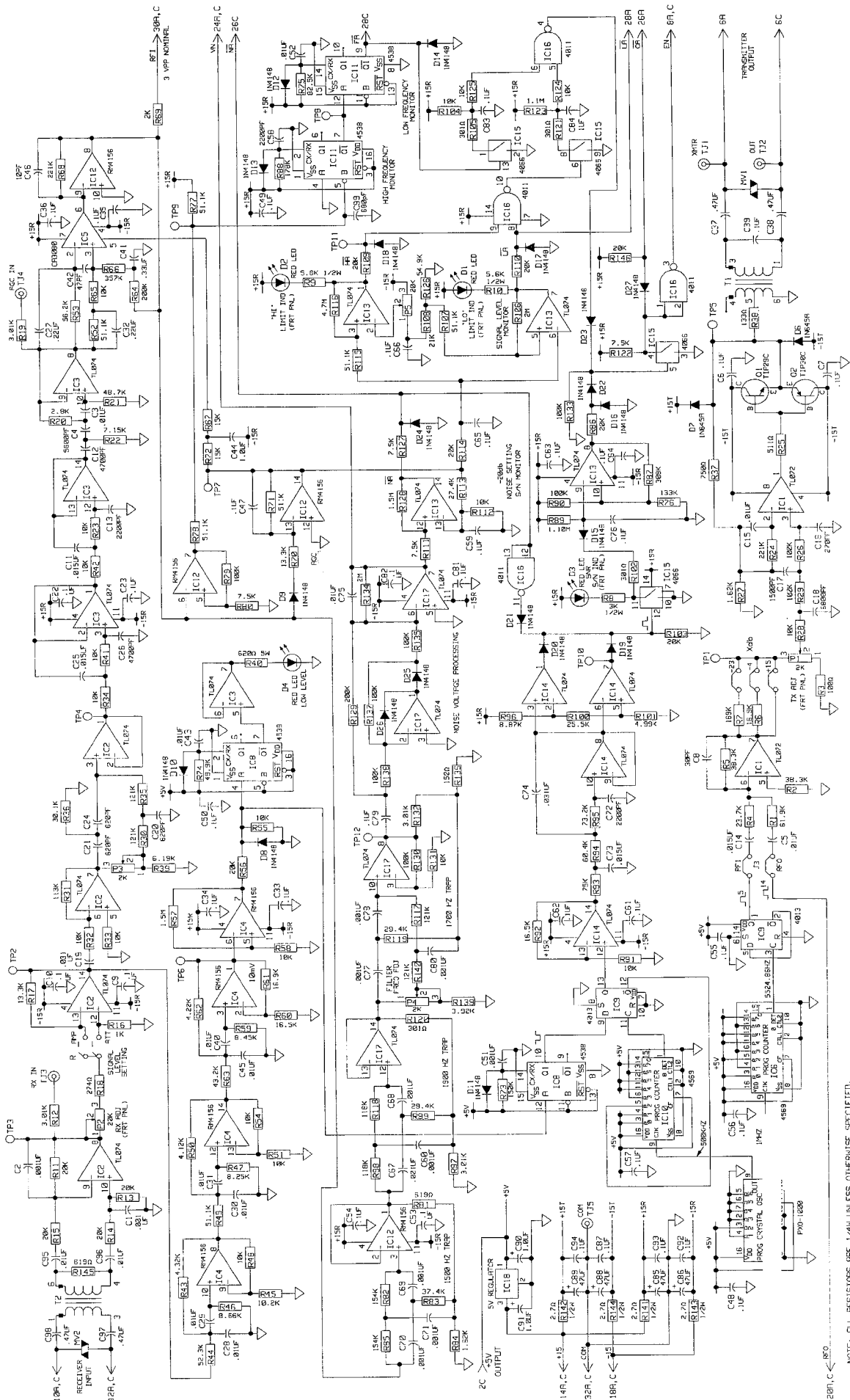


Figure 2: Internal Schematic MD Module

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1355D39





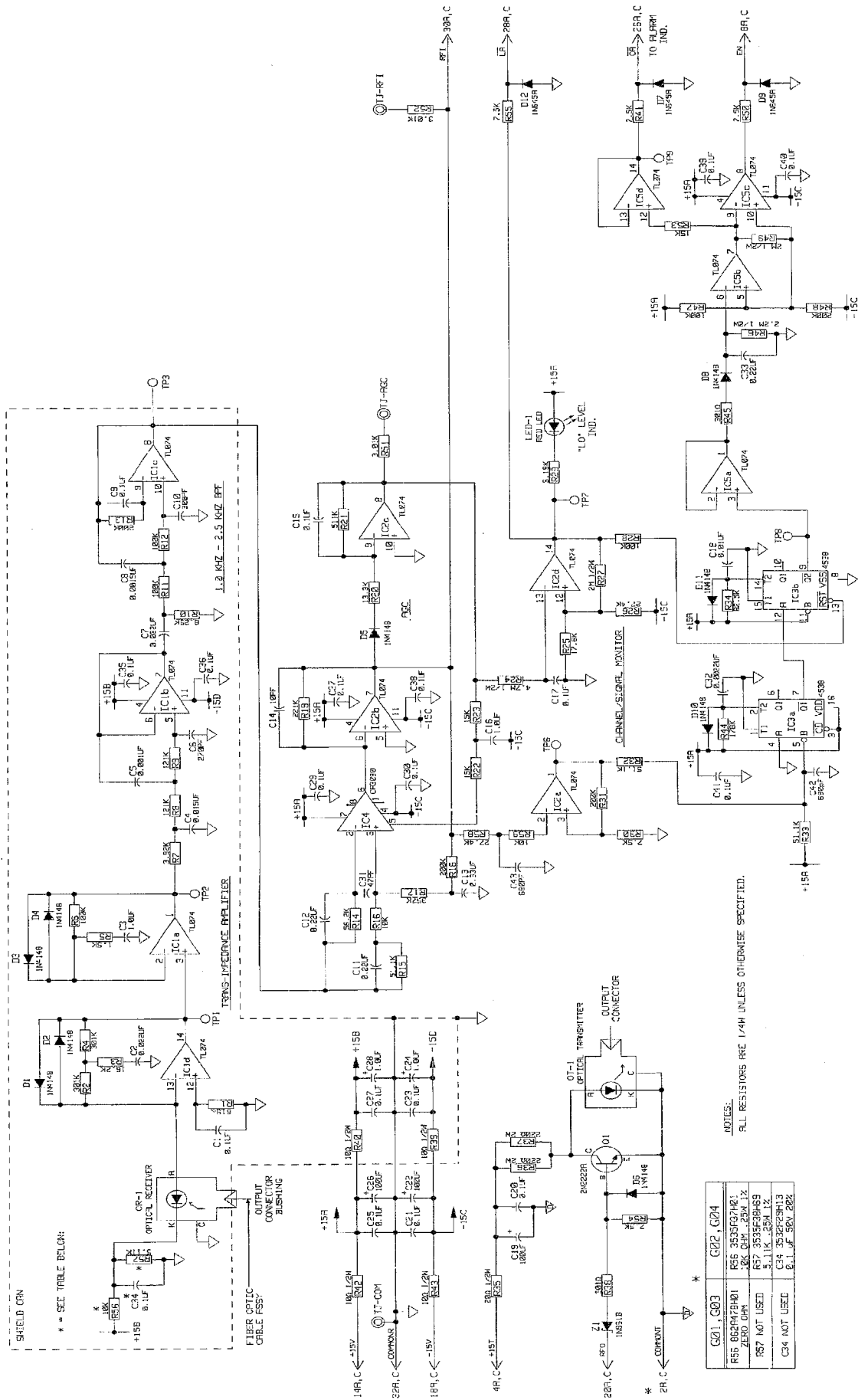
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1355D40

Figure 3: Internal Schematic IFDT Module

NOTE: ALL RESISTORS ARE 1/4W UNLESS OTHERWISE SPECIFIED.







Sub 3  
1355D41

Figure 4: Internal Schematic IFO Module (Standard)

COMP.LOC	DESCRIPTION	STYLE	GROUP
C1	1 MFD 100V +-5% MET-POLY CARB	3534A08H03	ALL
C2	.02 MFD 100V +-2% MET-POLY CARB	3534A03H01	ALL
C3	1.0UF 50V +-5% MET-POLY CARB	3534A06H11	ALL
C4	.015 MFD 200V +-2% MET-POLY CARB	3534A06H05	ALL
C5	.001 MFD 200V +-1% MET-POLY CARB	3534A06H01	ALL
C6	.720 PF 500V +-2% MICA	7202787H12	ALL
C7	.022 MFD 100V +-2% MET-POLY CARB	3533A05H01	ALL
C8	.0115 MFD 600V +-2% MET-POLY CARB	3533A05H06	ALL
C9	3533A05H01	3533A05H01	ALL
C10	300 PF 500V +-5% MET-POLY CARB	1877A58H09	ALL
C11	22 MFD 100V +-5% MET-POLY CARB	3534A08H10	ALL
C12	.38UF 50V +-5% MET-POLY CARB	863A168H16	ALL
C13	10 PF 500V +-5% MICA	763A209H03	ALL
C14	.1 MFD 100V +-5% MET-POLY CARB	3534A06H03	ALL
C15	1.0UF 50V +-5% MET-POLY CARB	3534A06H11	ALL
C16	.1 MFD 100V +-5% MET-POLY CARB	3534A06H08	ALL
C17	.01 MFD 200V +-2% MET-POLY CARB	3534A06H02	ALL
C18	1.0 MFD 100V +-5% MET-POLY CARB	3534A06H01	ALL
C19	100 MFD 35V +-20% TANTALUM	6534A06H06	ALL
C20	.1 MFD 100V +-5% MET-POLY CARB	860A068H16	ALL
C21	1.0 MFD 35V +-20% TANTALUM	860A068H10	ALL
C22	.1 MFD 100V +-5% MET-POLY CARB	817A241H15	ALL
C23	1 MFD 35V 10% TANTALUM	3534A06H06	ALL
C24	.1 MFD 100V +-5% MET-POLY CARB	890A068H01	ALL
C25	100 MFD 35V +-20% TANTALUM	3534A06H01	ALL
C26	.1 MFD 100V +-5% MET-POLY CARB	890A068H08	ALL
C27	1 MFD 35V 10% TANTALUM	763A209H15	ALL
C28	.1 MFD 100V +-5% MET-POLY CARB	3534A06H08	ALL
C29	1 MFD 100V +-5% MET-POLY CARB	3534A06H01	ALL
C30	.1 MFD 100V +-5% MET-POLY CARB	47 FF 500V +-2% MICA	ALL
C31	.022 UF 2% 400V MET-POLY CARB	3534A06H01	ALL
C32	22 MFD 100V +-5% MET-POLY CARB	3534A06H10	ALL
C33	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C34	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C35	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C36	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C37	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C38	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C39	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C40	1 MFD 50V 20% CERAMIC	3532A28H13	ALL
C41	800PF 500V +-2% DIPPED MICA	3532A28H13	ALL
C42	800PF 500V +-2% DIPPED MICA	3532A28H13	ALL
C43	800PF 500V +-2% DIPPED MICA	3532A28H13	ALL

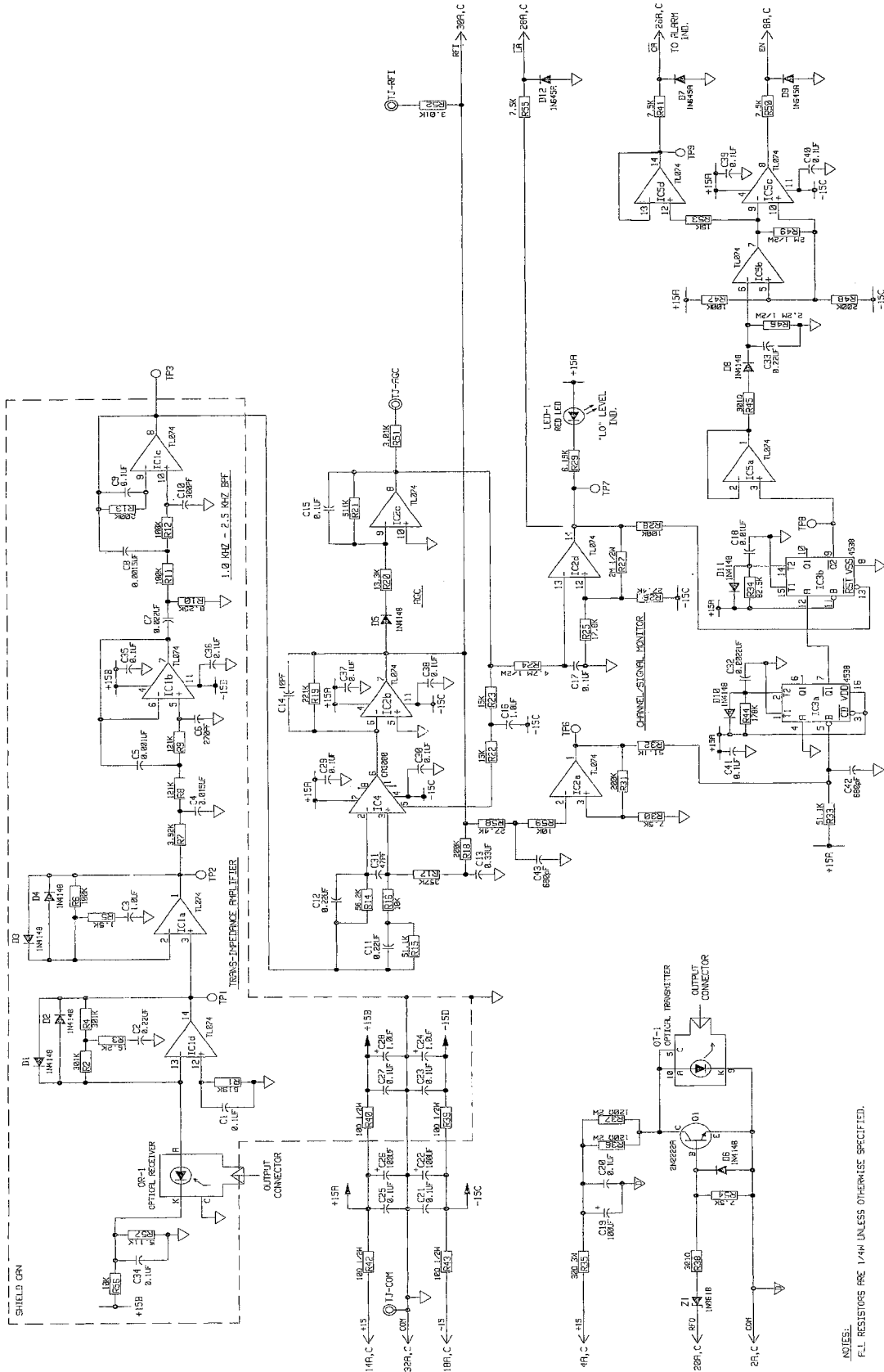
COMP.LOC	DESCRIPTION	STYLE	GROUP
IC1	TL074 UJ QUAD OP AMP	3528A09H01	ALL
IC2	TL074 UJ QUAD OP AMP	3528A09H01	ALL
IC3	MC1458BAL DUAL PREG MONO MULTVIB	3527A09H01	ALL
IC4	CA3090AS OP TRANSCOND AMP	3539A02H01	ALL
IC5	TL074 UJ QUAD OP AMP	3528A09H01	ALL

COMP.LOC	DESCRIPTION	STYLE	GROUP
R1	618K 25W 1% METAL FILM	3529A38H77	ALL
R2	301K 25W 1% METAL FILM	3529A38H47	ALL
R3	16.8K 25W 1% METAL FILM	3532A38H17	ALL
R4	301K 25W 1% METAL FILM	3532A38H17	ALL
R5	1.58K 25W 1% METAL FILM	3532A38H16	ALL
R6	100K 25W 1% METAL FILM	3532A38H01	ALL
R7	3.92K 25W 1% METAL FILM	3532A38H58	ALL
R8	121K 25W 1% METAL FILM	3532A38H09	ALL
R9	8.25K 25W 1% METAL FILM	3532A38H89	ALL
R10	100K 25W 1% METAL FILM	3532A38H01	ALL
R11	100K 25W 1% METAL FILM	3532A38H50	ALL
R12	200K 25W 1% METAL FILM	3532A38H50	ALL
R13	56.2K 25W 1% METAL FILM	3535A37H63	ALL
R14	61.1K 25W 1% METAL FILM	3535A37H69	ALL
R15	10K 25W 1% METAL FILM	3535A37H01	ALL
R16	357K 25W 1% METAL FILM	3532A38H54	ALL
R17	200K 25W 1% METAL FILM	3532A38H30	ALL
R18	200K 25W 1% METAL FILM	3532A38H34	ALL
R19	13.3K 25W 1% METAL FILM	3535A37H13	ALL
R20	51.1K 25W 1% METAL FILM	3532A38H69	ALL
R21	15K 25W 1% METAL FILM	3535A37H16	ALL
R22	15K 25W 1% METAL FILM	3535A37H16	ALL
R23	15K 25W 1% METAL FILM	3535A37H16	ALL
R24	4.7M 25W 5% CARBON FILM	3535A41H65	ALL
R25	27.4K 25W 1% METAL FILM	3535A37H25	ALL
R26	27.4K 25W 1% METAL FILM	3535A37H43	ALL
R27	200K 25W 1% METAL FILM	3532A38H30	ALL
R28	100K 25W 1% METAL FILM	3532A38H01	ALL
R29	618K 25W 1% METAL FILM	3535A38H65	ALL
R30	7.50K 25W 1% METAL FILM	3535A37H69	ALL
R31	200K 25W 1% METAL FILM	3535A37H69	ALL
R32	51.1K 25W 1% METAL FILM	3535A37H69	ALL
R33	82.5K 25W 1% METAL FILM	3535A37H69	ALL
R34	200K 25W 1% METAL FILM	3535A37H69	ALL
R35	200K 25W 1% METAL FILM	3535A37H69	ALL
R36	200K 25W 1% METAL FILM	3535A37H69	ALL
R37	200K 25W 1% METAL FILM	3535A37H69	ALL
R38	200K 25W 1% METAL FILM	3535A37H69	ALL
R39	200K 25W 1% METAL FILM	3535A37H69	ALL
R40	200K 25W 1% METAL FILM	3535A37H69	ALL
R41	200K 25W 1% METAL FILM	3535A37H69	ALL
R42	200K 25W 1% METAL FILM	3535A37H69	ALL
R43	200K 25W 1% METAL FILM	3535A37H69	ALL
R44	200K 25W 1% METAL FILM	3535A37H69	ALL
R45	200K 25W 1% METAL FILM	3535A37H69	ALL
R46	200K 25W 1% METAL FILM	3535A37H69	ALL
R47	200K 25W 1% METAL FILM	3535A37H69	ALL
R48	200K 25W 1% METAL FILM	3535A37H69	ALL
R49	200K 25W 1% METAL FILM	3535A37H69	ALL
R50	200K 25W 1% METAL FILM	3535A37H69	ALL
R51	200K 25W 1% METAL FILM	3535A37H69	ALL
R52	200K 25W 1% METAL FILM	3535A37H69	ALL
R53	200K 25W 1% METAL FILM	3535A37H69	ALL
R54	200K 25W 1% METAL FILM	3535A37H69	ALL
R55	200K 25W 1% METAL FILM	3535A37H69	ALL
R56	200K 25W 1% METAL FILM	3535A37H69	ALL
R57	200K 25W 1% METAL FILM	3535A37H69	ALL
R58	200K 25W 1% METAL FILM	3535A37H69	ALL
R59	200K 25W 1% METAL FILM	3535A37H69	ALL

COMP.LOC	DESCRIPTION	STYLE	GROUP
LED1	RED LED (EDGE MOUNT) 650-0406	3509A22H01	ALL
D1	1N4148	836A028H06	ALL
D2	1N4148	836A028H06	ALL
D3	1N4148	836A028H06	ALL
D4	1N4148	836A028H06	ALL
D5	1N4148	836A028H06	ALL
D6	1N4148	836A028H06	ALL
D7	1N4148	836A028H06	ALL
D8	1N4148	836A028H06	ALL
D9	1N4148	836A028H06	ALL
D10	1N4148	836A028H06	ALL
D11	1N4148	836A028H06	ALL
D12	1N4148	836A028H06	ALL

Sub 3  
1355D41

Figure 4a: Internal Schematic IFO Module (Standard)



UNLESS  
FEL. RESISTORS ARE 1/4W UNLESS OTHERWISE SPECIFIED.

Figure 5: Internal Schematic IFO Module (High Power)

Sub 1  
1355D70

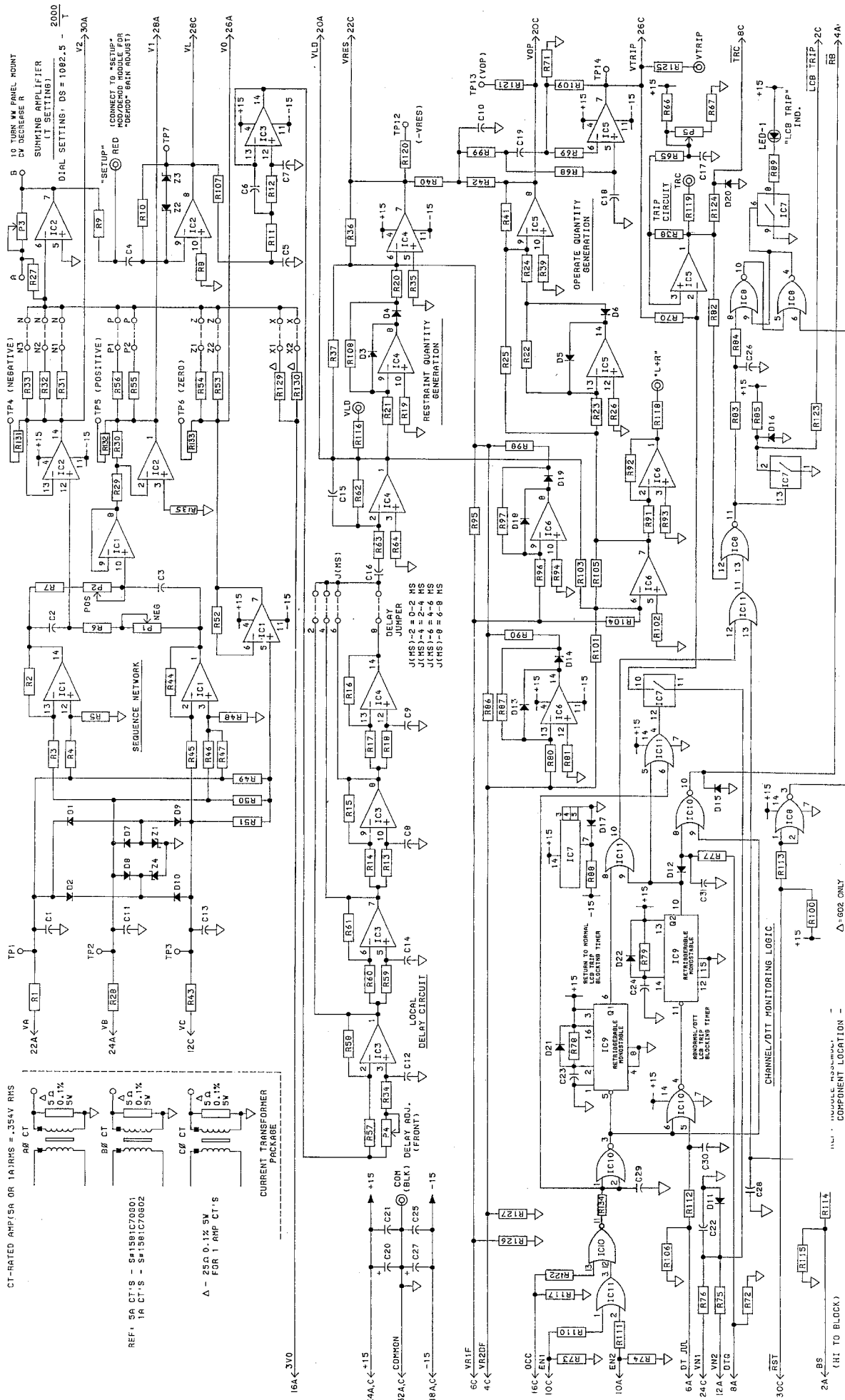
COMP LOC	CAPACITORS DESCRIPTION	STYLE	RESISTORS DESCRIPTION	STYLE
R1	.1 MFD 100V +-5% MET-POLY CARB	353468H08	6.19K .25W 1% METAL FILM	353468H07
R2	.022 MFD 100V +-2% MET-POLY CARB	3533953H09	10.1K .25W 1% METAL FILM	3533953H08
R3	.1 MFD 50V +-5% MET-POLY CARB	3533468H01	30.1K .25W 1% METAL FILM	3533468H07
R4	.015 MFD 200V +-2% MET-POLY CARB	3533468H05	1.50K .25W 1% METAL FILM	3533468H18
R5	.001 MFD 200V +-1% MET-POLY CARB	3533468H01	1.00K .25W 1% METAL FILM	3533468H01
R6	270 PF 500V +-2% MICA	762A757H12	3.92K .25W 1% METAL FILM	3533468H08
R7	.022 MFD 100V +-2% MET-POLY CARB	3533953H01	12.1K .25W 1% METAL FILM	3533468H09
R8	.0015 MFD 500V +-2% MET-POLY CARB	3533953H08	8.25K .25W 1% METAL FILM	3533468H09
R9	300 PF 500V +-5% MET-POLY CARB	3533468H08	1.00K .25W 1% METAL FILM	3533468H01
R10	.1 MFD 100V +-5% MET-POLY CARB	187A584H08	200K .25W 1% METAL FILM	3533468H30
R11	.22 MFD 100V +-5% MET-POLY CARB	353468H10	56.2K .25W 1% METAL FILM	3533468H72
R12	.22 MFD 100V +-5% MET-POLY CARB	353468H10	5.11K .25W 1% METAL FILM	3533468H69
R13	.33 MFD 50V +-5% MET-POLY CARB	663A166H16	19K .25W 1% METAL FILM	3533468H61
R14	.1 MFD 500V +-5% MICA	353468H08	300K .25W 1% METAL FILM	3533468H61
R15	.1 MFD 100V +-5% MET-POLY CARB	353468H08	300K .25W 1% METAL FILM	3533468H69
R16	.1 MFD 100V +-5% MET-POLY CARB	3533953H01	20.1K .25W 1% METAL FILM	3533468H34
R17	.1 MFD 100V +-5% MET-POLY CARB	660A363H01	20.1K .25W 1% METAL FILM	3533468H34
R18	.01 MFD 200V +-20% TANTALUM	3533468H08	15.3K .25W 1% METAL FILM	3533468H13
R19	.1 MFD 100V +-5% MET-POLY CARB	3533468H08	511K .25W 1% METAL FILM	3533468H69
R20	.1 MFD 100V +-5% MET-POLY CARB	880A363H01	15K .25W 1% METAL FILM	3533468H18
R21	.1 MFD 100V +-5% MET-POLY CARB	353468H08	15K .25W 1% METAL FILM	3533468H18
R22	.1 MFD 100V +-5% MET-POLY CARB	353468H08	4.7M .25W 5% CARBON FILM	3533468H71
R23	.1 MFD 100V +-5% MET-POLY CARB	353468H08	17.8K .25W 1% METAL FILM	3533468H25
R24	.1 MFD 100V +-5% MET-POLY CARB	353468H08	27.4K .25W 1% METAL FILM	3533468H43
R25	.1 MFD 100V +-5% MET-POLY CARB	353468H08	2M .25W 1% METAL FILM	3533468H30
R26	.1 MFD 100V +-5% MET-POLY CARB	353468H08	100K .25W 1% METAL FILM	3533468H01
R27	.1 MFD 100V +-5% MET-POLY CARB	353468H08	6.19K .25W 1% METAL FILM	3533468H77
R28	.1 MFD 100V +-5% MET-POLY CARB	353468H08	200K .25W 1% METAL FILM	3533468H65
R29	.1 MFD 100V +-5% MET-POLY CARB	353468H08	200K .25W 1% METAL FILM	3533468H30
R30	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.11K .25W 1% METAL FILM	3533468H69
R31	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.11K .25W 1% METAL FILM	3533468H69
R32	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20.1K .25W 1% METAL FILM	3533468H69
R33	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20.1K .25W 1% METAL FILM	3533468H69
R34	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1K .25W 1% METAL FILM	3533468H69
R35	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1K .25W 1% METAL FILM	3533468H69
R36	.1 MFD 100V +-5% MET-POLY CARB	353468H08	1.00 OHM 2W 5% MOLDED COMP	187A202H05
R37	.1 MFD 100V +-5% MET-POLY CARB	353468H08	1.00 OHM 2W 5% MOLDED COMP	187A202H05
R38	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM .25W 1% METAL FILM	3533468H47
R39	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	3533468H47
R40	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A202H01
R41	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3533468H65
R42	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A202H01
R43	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A202H01
R44	.1 MFD 100V +-5% MET-POLY CARB	353468H08	176K .25W 1% METAL FILM	3533468H25
R45	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM .25W 1% METAL FILM	3533468H01
R46	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.00K .25W 1% METAL FILM	3533468H01
R47	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20.1K .25W 1% METAL FILM	3533468H01
R48	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20.1K .25W 1% METAL FILM	3533468H01
R49	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20.1K .25W 1% METAL FILM	3533468H01
R50	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3533468H01
R51	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.01K .25W 1% METAL FILM	3533468H01
R52	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.01K .25W 1% METAL FILM	3533468H01
R53	.1 MFD 100V +-5% MET-POLY CARB	353468H08	15K .25W 1% METAL FILM	3533468H01
R54	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3533468H01
R55	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3533468H01
R56	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10K .25W 1% METAL FILM	3533468H01
R57	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.11K .25W 1% METAL FILM	3533468H01
R58	.1 MFD 100V +-5% MET-POLY CARB	353468H08	27.4K .25W 1% METAL FILM	3533468H01
R59	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10K .25W 1% METAL FILM	3533468H01

COMP LOC	CAPACITORS DESCRIPTION	STYLE	TRANSISTORS DESCRIPTION	STYLE
Q1	RED LED (EDGE MOUNT) 550-0406	3508A22H01	2N2222A NPN 40V 0.8A 0.4W	762A672H15
D1	LYTEL ST PIN PHOTO DIODE 0673-001	9647A37H08	ZENERS DESCRIPTION	186A797H07
D2	LASERTRON GLED 13005M-501	9647A35H04		
D3				
D4				
D5				
D6				
D7				
D8				
D9				
D10				
D11				
D12				

COMP LOC	CAPACITORS DESCRIPTION	STYLE	TRANSISTORS DESCRIPTION	STYLE
IC1	TL074IJ QUAD OP AMP	3588A90H01		
IC2	TL074IJ QUAD OP AMP	3528A90H01		
IC3	MC14538BAL DUAL PREC MONO MULTIVIB	3527A09H01		
IC4	CR200HS OP TRANSCOND AMP	3533A21H01		
IC5	TL074IJ QUAD OP AMP	3528A90H01		

Sub 1  
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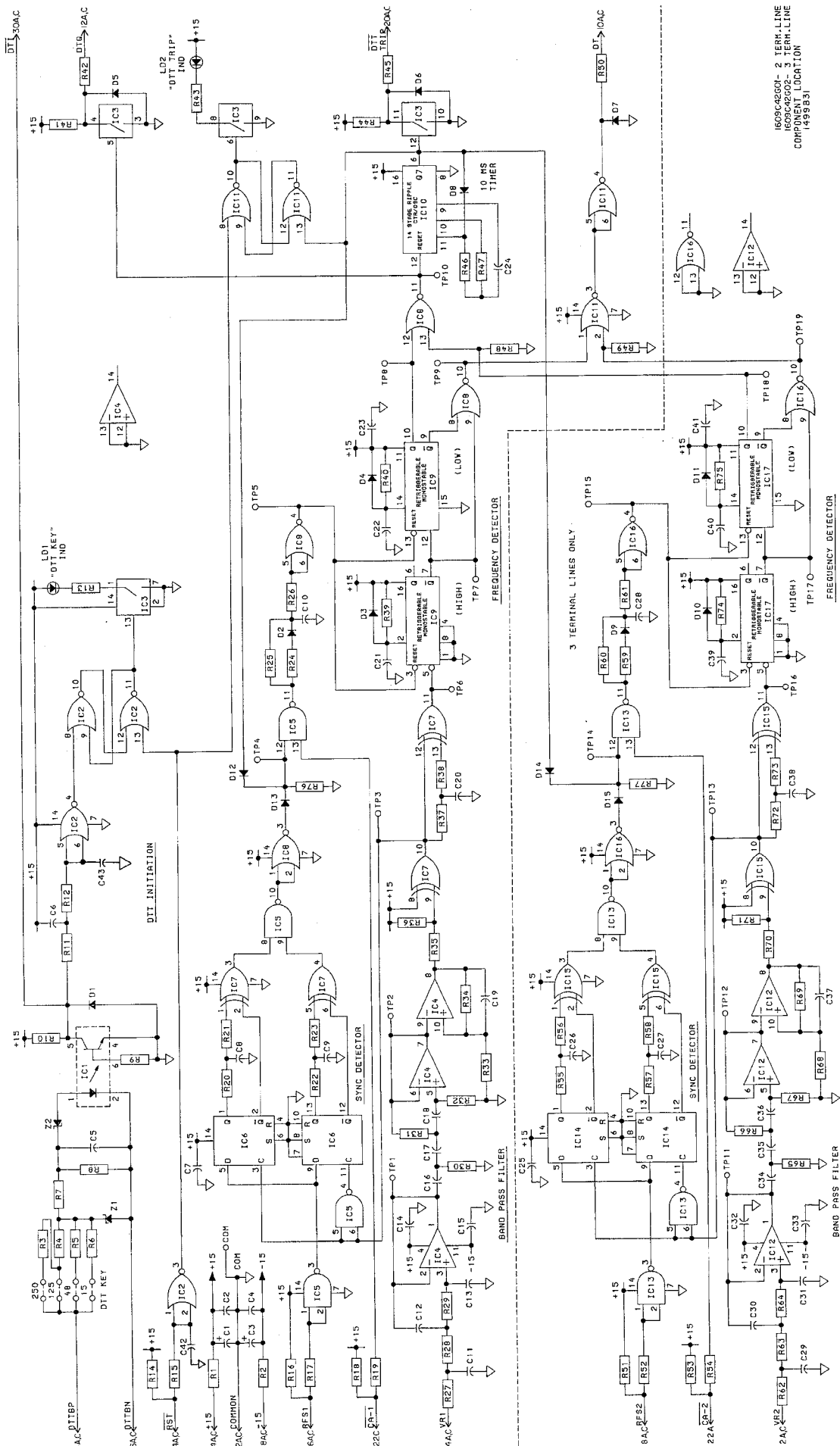
Figure 5a: Internal Schematic IFO Module (High Power)



Sub 7  
1355D42

Figure 6: Internal Schematic Relay Module





IC608C8001- 2 TERM. LINE  
 IC608C8002- 3 TERM. LINE  
 COMPONENT LOCATION  
 I499B31

Sub 2  
 I355D43

Figure 7: Internal Schematic DTT Module



CAPACITOR	GROUPS *		STYLE	DIODE	RESISTOR	STYLE	ZENER	STYLE	LINK	DITTY KEY	BLUE CLIP LINK	STYLE	11	11
	1	2												
C01	10 MFD 35V +-5% TANTALUM		82AS36H12	LD01	RED LED (EDGE MOUNT)	3508A22H01	Z01	1M4747A 20V 1W 5X				84PA43PH01		
C02	0.1 MFD 100V +-5% TANTALUM		82AS36H12	LD02	RED LED (EDGE MOUNT)	3508A22H01	Z02	1M752A 5.6V 400MU 5X				185A77H12		
C03	0.1 MFD 100V +-5% TANTALUM		82AS36H12											
C04	0.1 MFD 100V +-5% MET-POLYCARB		3534A6B00											
C05	0.47 MFD 100V +-5% MET-POLYCARB		3534A6B00											
C06	0.22 MFD 100V +-2% MET-POLYCARB		3532A3B01											
C07	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C08	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C09	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C10	0.22 MFD 100V +-2% MET-POLYCARB		3532A3B01											
C11	6690PF 50V +-2% POLYSTY		3537A23H65											
C12	1500 PF 500V +-2% MICA		187A564H05											
C13	1500 PF 500V +-2% MICA		762A75H03											
C14	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C15	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C16	6690PF 50V +-2% POLYSTY		3537A23H65											
C17	3000 PF 500V +-2% MICA		3532A31H54											
C18	3000 PF 500V +-2% MICA		3532A31H54											
C19	20 PF 300V +-5% MICA		3532A31H47											
C20	510 PF 500V +-2% MICA		3532A31H47											
C21	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C22	0.1 MFD 200V +-2% MET-POLYCARB		3534A6B00											
C23	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C24	0.001UF 200V +-5% MET-POLYCARB		3532A3B01											
C25	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C26	0.1 MFD 200V +-2% MET-POLYCARB		3534A6B00											
C27	0.1 MFD 200V +-2% MET-POLYCARB		3534A6B00											
C28	0.22 MFD 100V +-2% MET-POLYCARB		3532A3B01											
C29	66.900 PF 50V +-2% POLYSTY		3537A23H65											
C30	1500 PF 500V +-2% MICA		187A564H05											
C31	1500 PF 500V +-2% MICA		762A75H03											
C32	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C33	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C34	66.900 PF 50V +-2% POLYSTY		3537A23H65											
C35	3000 PF 500V +-2% MICA		3532A31H54											
C36	3000 PF 500V +-2% MICA		3532A31H54											
C37	20 PF 300V +-5% MICA		3532A31H47											
C38	510 PF 500V +-2% MICA		3532A31H47											
C39	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C40	0.1 MFD 200V +-2% MET-POLYCARB		3534A6B00											
C41	0.1 MFD 50V +-20% CERAMIC		3532A3B01											
C42	.05MFD 100V +-20% CERAMIC		184A663H02											
C43	.05MFD 100V +-20% CERAMIC		184A663H02											
D01	1N4148 75V		836A928H06											
D02	1N4148 75V		836A928H06											
D03	1N4148 75V		836A928H06											
D04	1N4148 75V		836A928H06											
D05	1N4148 75V		836A928H06											
D06	1N4148 75V		836A928H06											
D07	1N4148 75V		836A928H06											
D08	1N4148 75V		836A928H06											
D09	1N4148 75V		836A928H06											
D10	1N4148 75V		836A928H06											
D11	1N4148 75V		836A928H06											
D12	1N4148 75V		836A928H06											
D13	1N4148 75V		836A928H06											
D14	1N4148 75V		836A928H06											
D15	1N4148 75V		836A928H06											
INT CKT														
IC01	4N35 OPTICAL COUPLER		7748974H81											
IC02	ICL1401BAL QUAD 2-INPUT NOR		3533A17H01											
IC03	ICL1406BAL QUAD BILATERAL SWITCH		3527A09H06											
IC04	ICL0741L QUAD OR AND/NAND		3527A09H06											
IC05	ICL14013BAL DUAL 6 FLIP FLOP		3527A25H06											
IC06	ICL14013BAL DUAL 6 FLIP FLOP		3527A25H06											
IC07	ICL14013BAL QUAD EXCLUSIVE OR		3527A25H06											
IC08	ICL14001BAL QUAD 2-INPUT NOR		3533A17H01											
IC09	ICL14001BAL QUAD 2-INPUT NOR		3527A09H01											
IC10	ICL14001BAL QUAD 2-INPUT NOR		3527A09H01											
IC11	ICL14001BAL QUAD 2-INPUT NOR		3527A09H01											
IC12	ICL14013BAL QUAD 6 FLIP FLOP		3527A25H06											
IC13	ICL14013BAL QUAD 6 FLIP FLOP		3527A25H06											
IC14	ICL14013BAL QUAD 6 FLIP FLOP		3527A25H06											
IC15	ICL14013BAL QUAD 6 FLIP FLOP		3527A25H06											
IC16	ICL14001BAL QUAD 2-INPUT NOR		3533A17H01											
IC17	ICL14001BAL QUAD 2-INPUT NOR		3527A09H01											

Sub 2  
1355D43

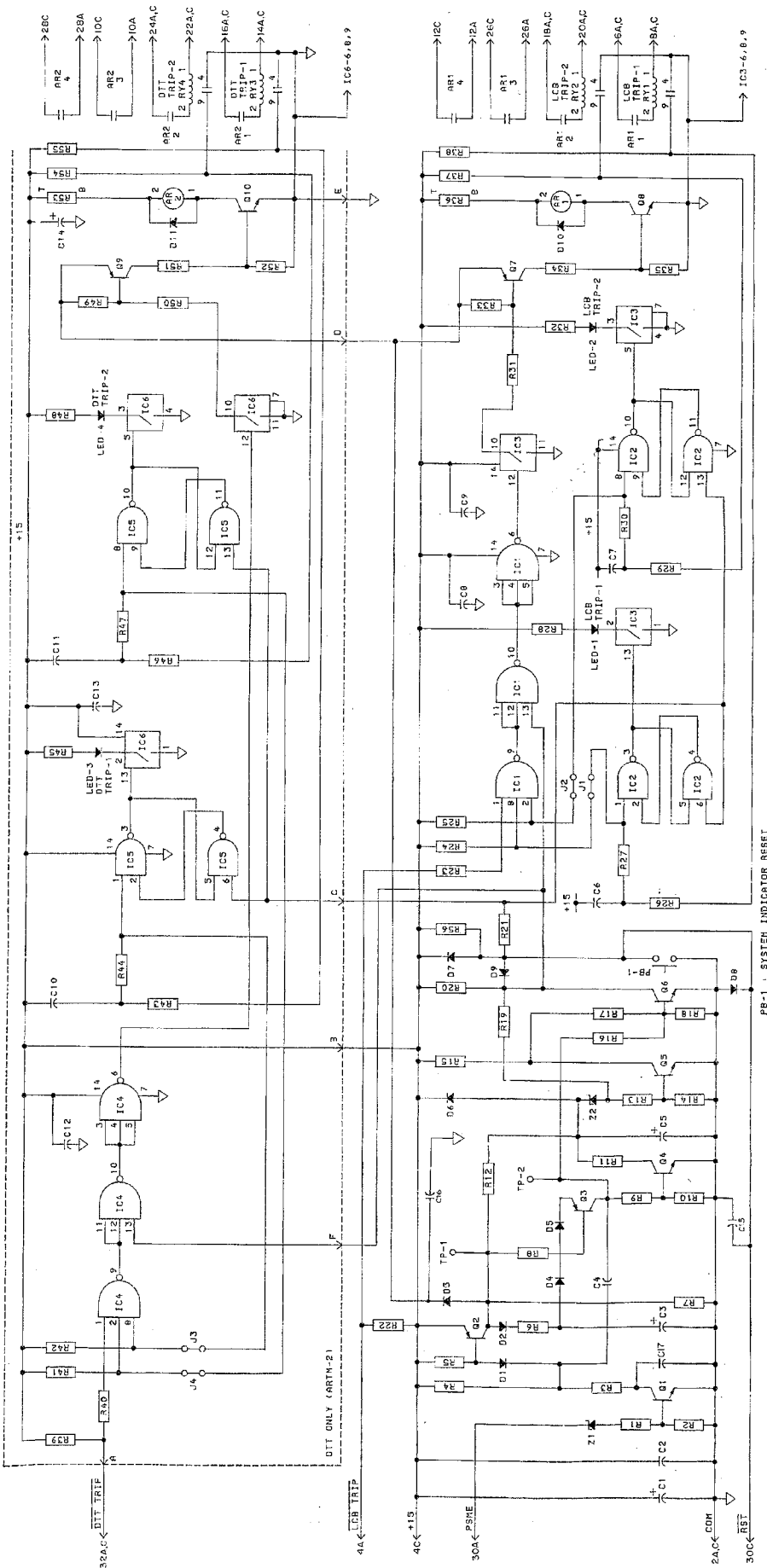
\* GROUP 1 IS 2 TERMINAL LINES  
\* GROUP 2 IS 3 TERMINAL LINES

Figure 7a: Internal Schematic DTT Module



Figure 8a: Internal Schematic AXLM Module

COMPONENT	VALUE	UNIT	DESCRIPTION	REF. DESIG.	QTY	UNIT PRICE	TOTAL PRICE	DATE	REVISION
OPC	10 MFD	35V	5% TANFILM	8625530H12	1	1.00	1.00	1987	1
C01	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C02	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C03	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C04	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C05	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C06	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C07	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C08	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C09	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C10	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C11	6.8 MFD	35V	5% TANFILM	1044651H21	1	1.00	1.00	1987	1
C12	6.8 MFD	35V	5% TANFILM	1044651H21	1	1.00	1.00	1987	1
C13	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C14	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C15	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C16	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C17	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C18	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C19	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C20	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C21	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C22	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C23	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C24	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
C25	1 MFD	100V	5% MET-POLY	3324659008	1	0.50	0.50	1987	1
D01	1N645A	25V		8726524H23	1	1.00	1.00	1987	1
D02	1N645A	25V		8726524H23	1	1.00	1.00	1987	1
D03	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D04	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D05	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D06	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D07	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D08	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D09	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D10	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D11	1N4148	75V		8626524H23	1	1.00	1.00	1987	1
D12	1N645D	25V		8626524H23	1	1.00	1.00	1987	1
D13	1N645D	25V		8626524H23	1	1.00	1.00	1987	1
D14	1N645D	25V		8626524H23	1	1.00	1.00	1987	1
D15	1N645A	25V		8626524H23	1	1.00	1.00	1987	1
INT CKT	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I001	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I002	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I003	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I004	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I005	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I006	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I007	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I008	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I009	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I010	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I011	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I012	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I013	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I014	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
I015	4N35 OPTICAL COUPLER			7748936H01	1	1.00	1.00	1987	1
LED 1	RED LED (EDGE MOUNT)			3508523H01	1	1.00	1.00	1987	1
LED 2	RED LED (EDGE MOUNT)			3508523H01	1	1.00	1.00	1987	1
LED 3	RED LED (EDGE MOUNT)			3508523H01	1	1.00	1.00	1987	1
POT	20K 3/4W 10% TRIMPOT			3527030H04	1	1.00	1.00	1987	1
P01	20K 3/4W 10% TRIMPOT			3527030H04	1	1.00	1.00	1987	1
P02	20K 3/4W 10% TRIMPOT			3527030H04	1	1.00	1.00	1987	1
P03	20K 3/4W 10% TRIMPOT			3527030H04	1	1.00	1.00	1987	1
P04	20K 3/4W 10% TRIMPOT			3527030H04	1	1.00	1.00	1987	1
TRANSISTOR	2N2329A, NPN			7658523H19	1	1.00	1.00	1987	1
Q01	2N2329A, NPN			7658523H19	1	1.00	1.00	1987	1
Q02	2N2329A, NPN			7658523H19	1	1.00	1.00	1987	1



Sub 3  
1355D45

Figure 9: Internal Schematic ARTM-1 and 2 Module



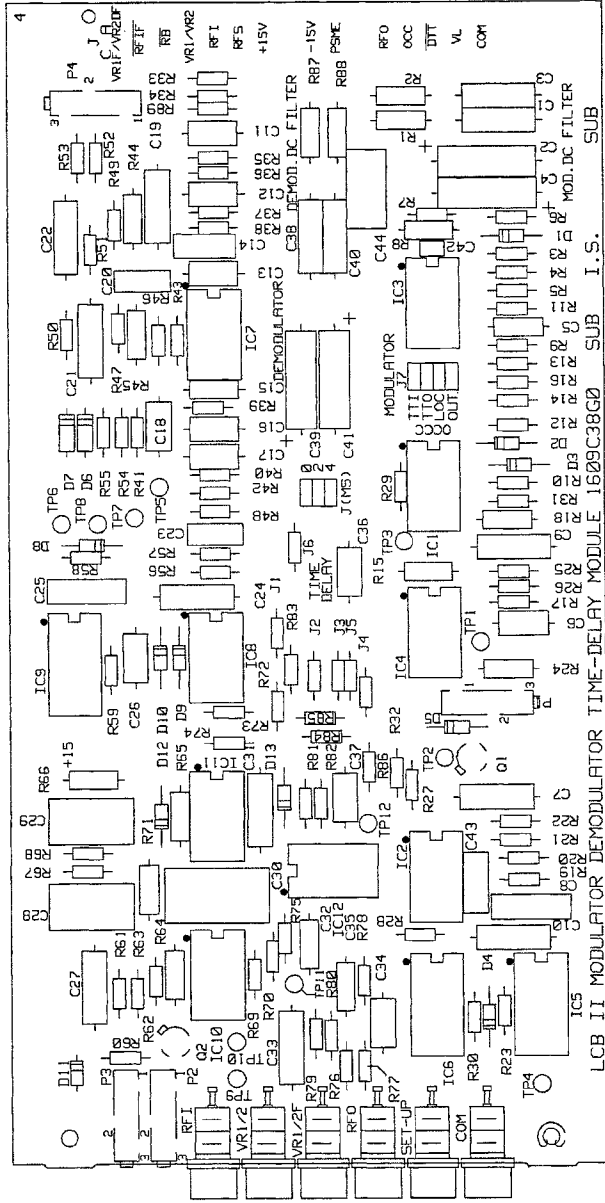
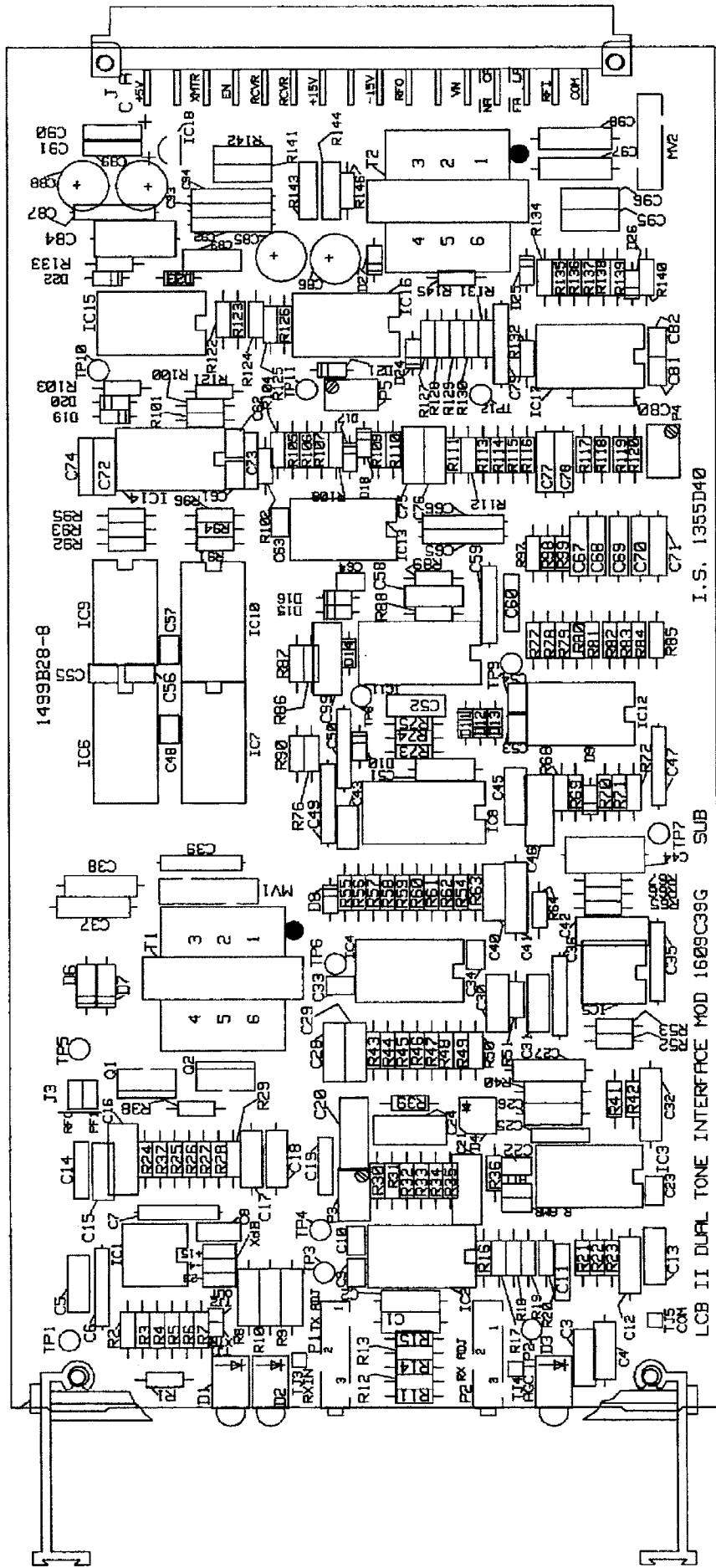
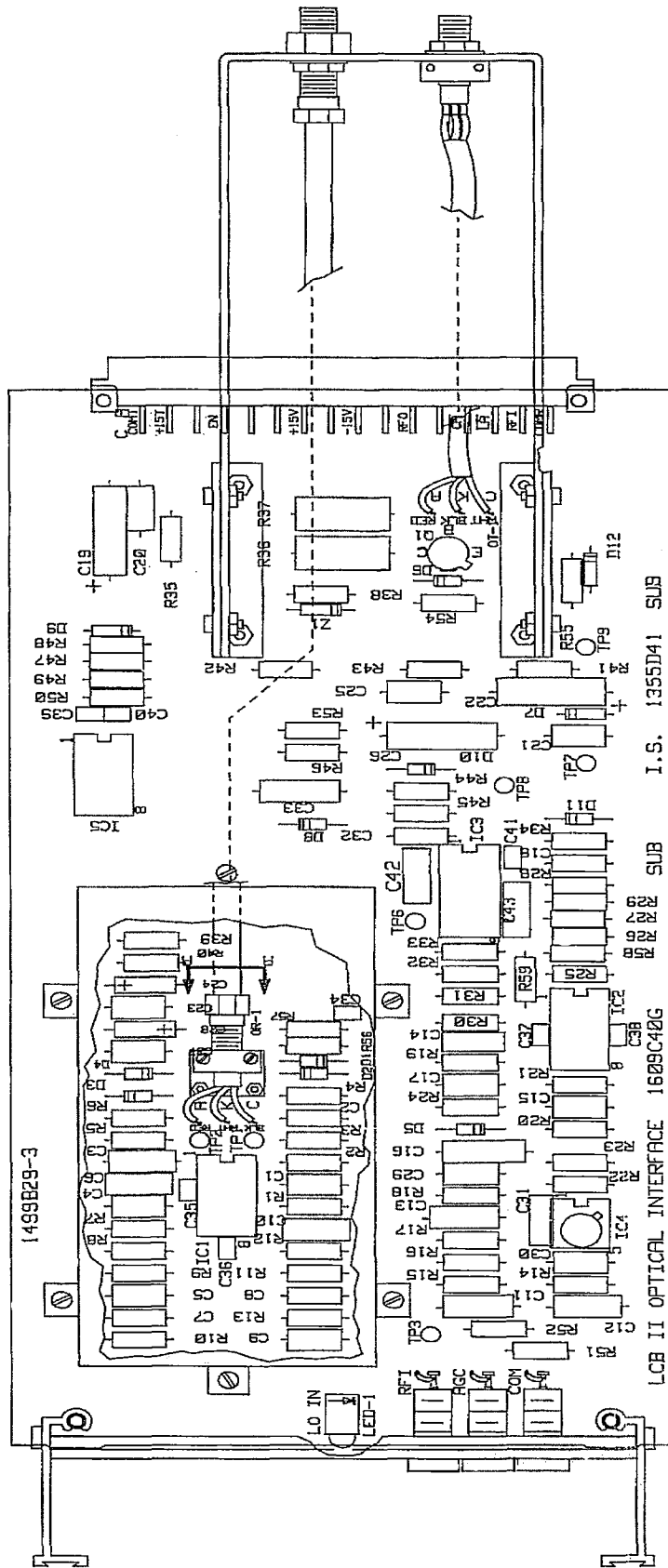


Figure 10: Component Location MD/DTD Module



Sub 9  
1609C39

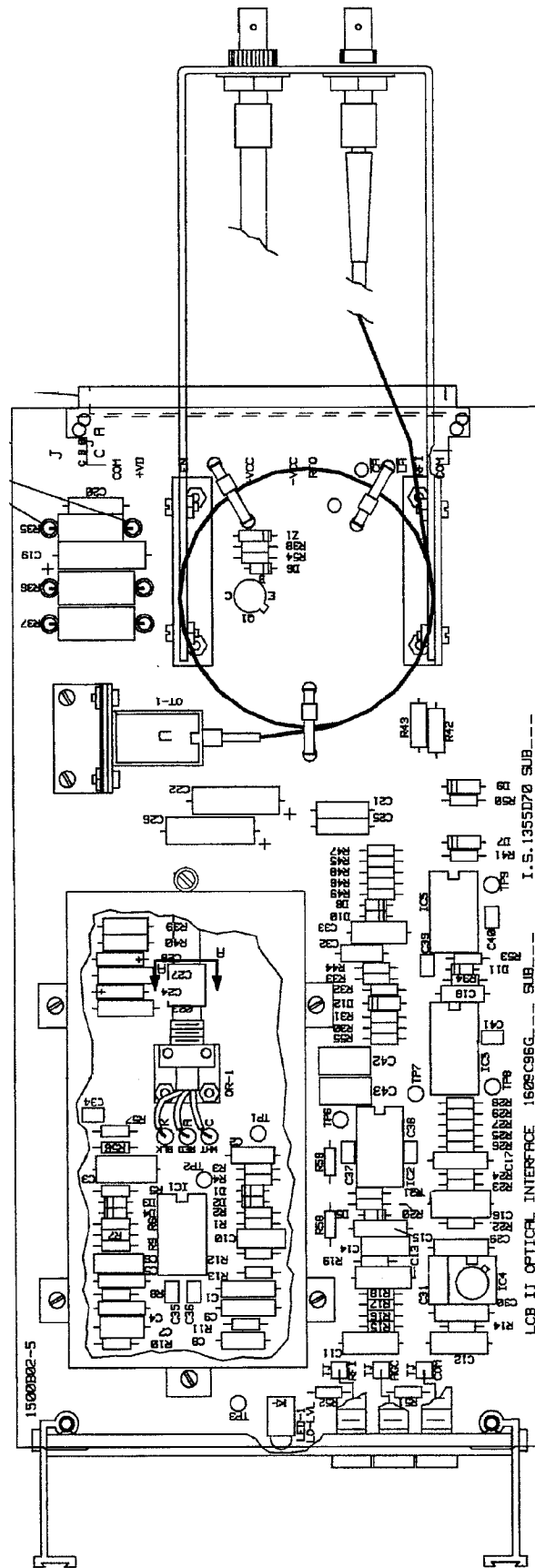
Figure 11: Component Location IFDT Module



Sub 2  
1499B44

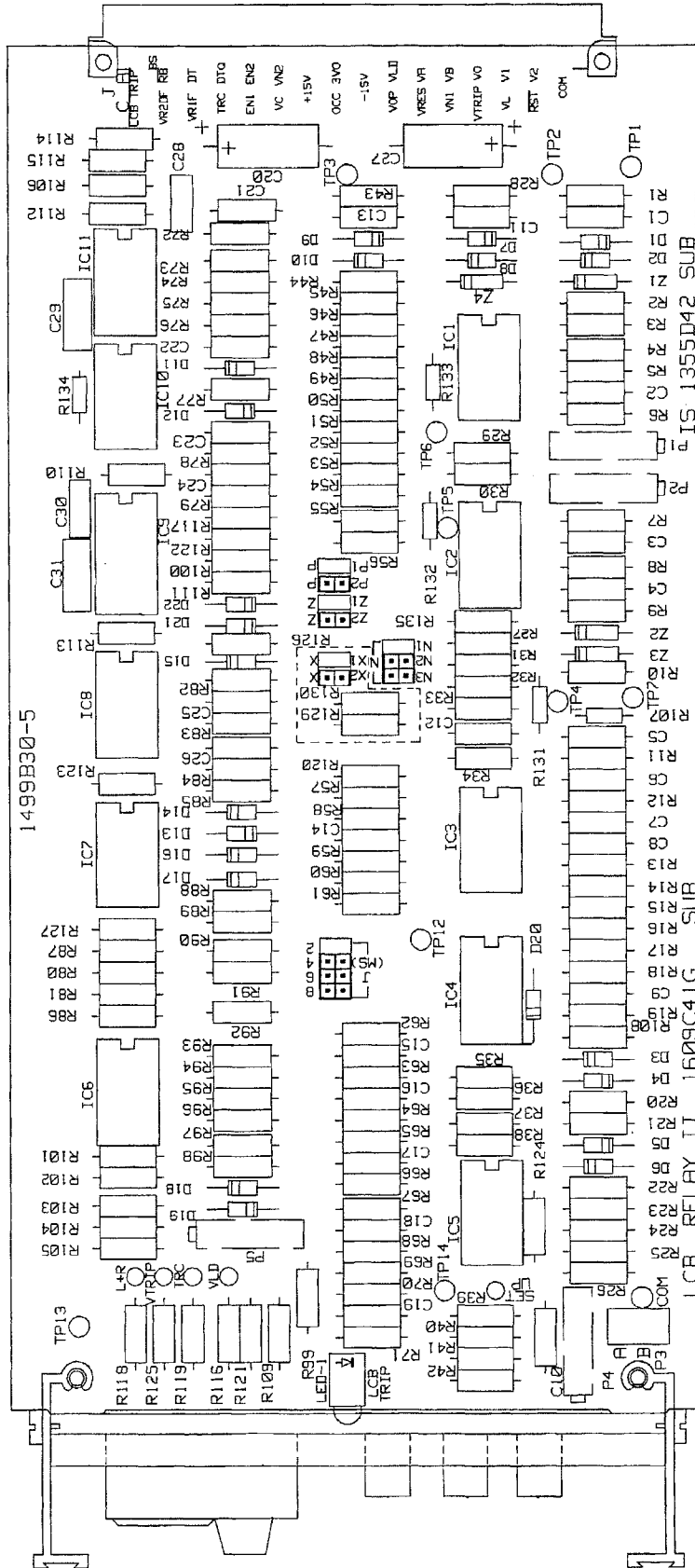
Figure 12: Component Location IFO (Standard) Module





\*Sub 12  
1609C96

Figure 13: Component Location IFO (High Power) Module



Sub 13  
1609C41

Figure 14: Component Location Relay Module

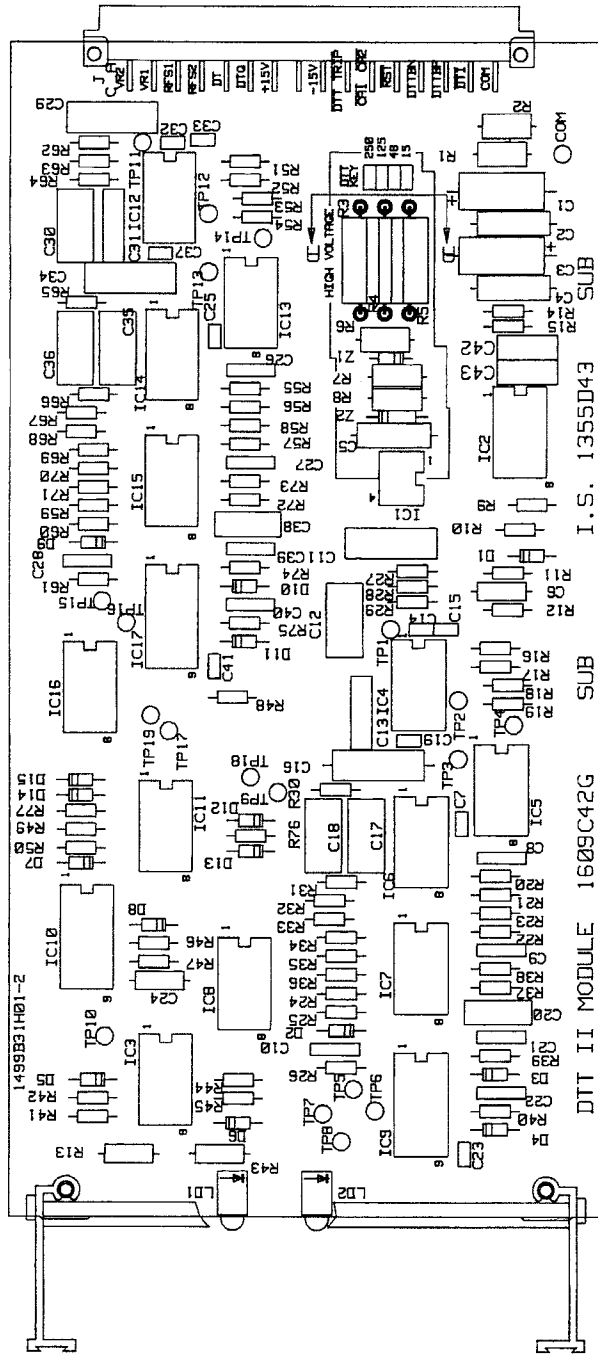


Figure 15: Component Location DTT Module

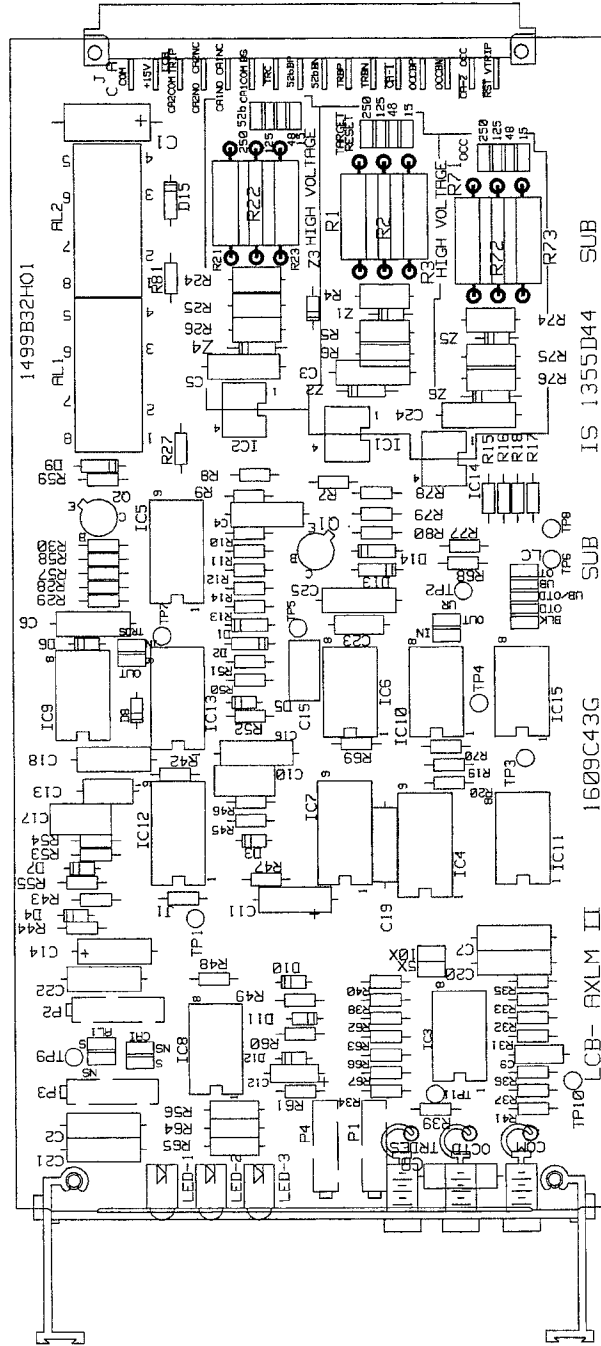


Figure 16: Component Location ALXM Module

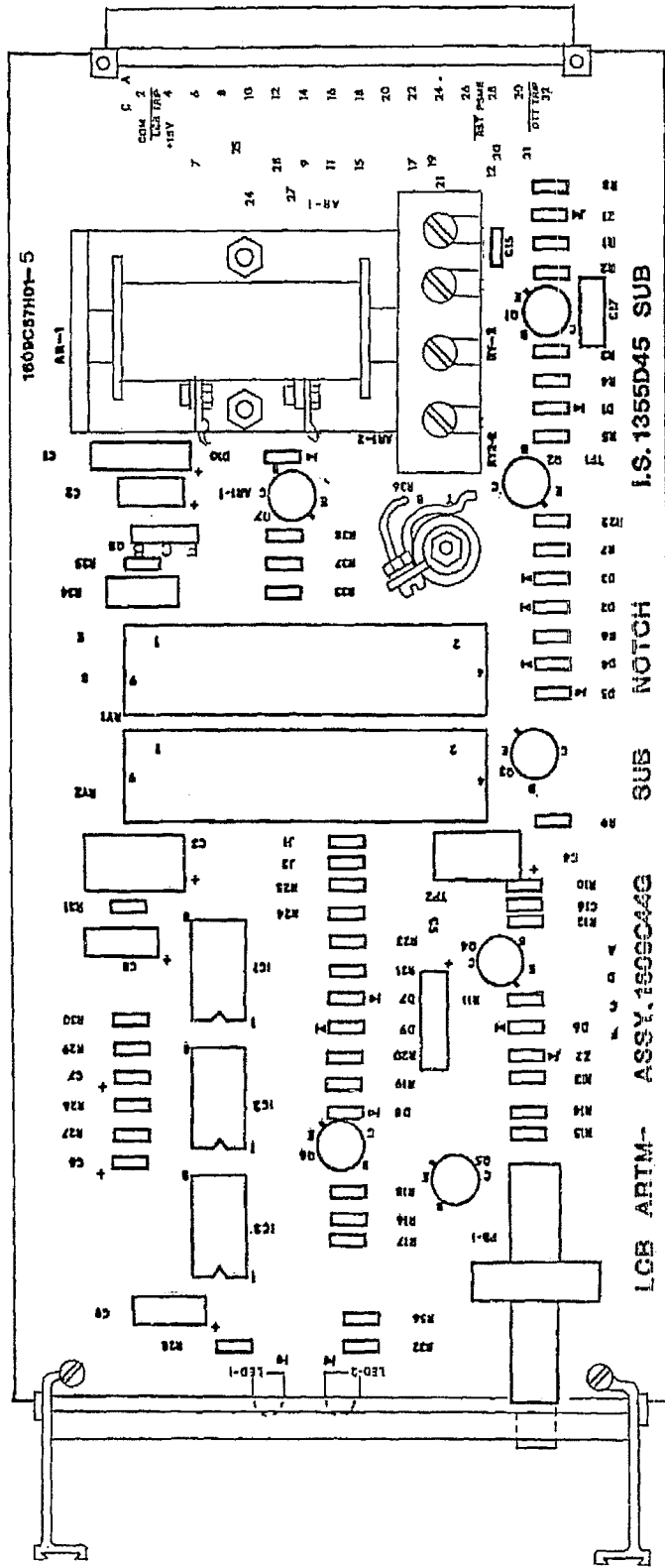


Figure 17: Component Location ARTM-1 Module

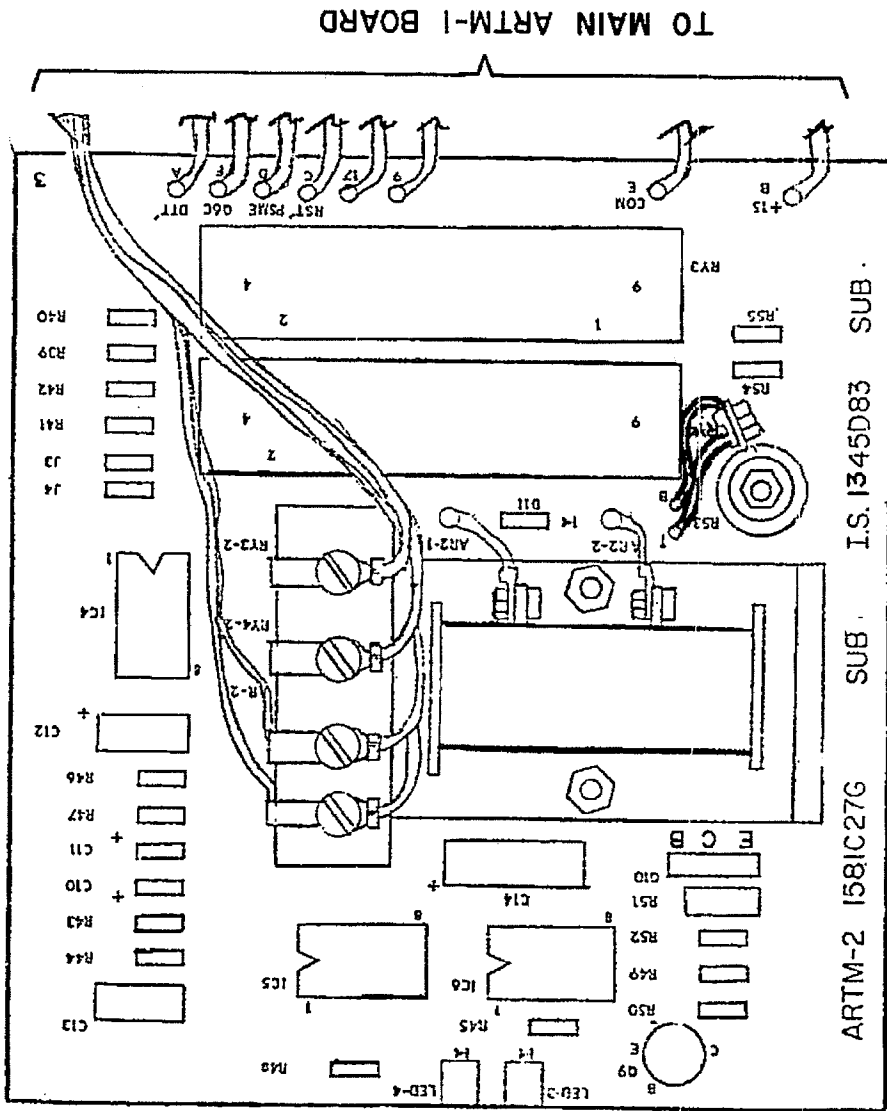


Figure 18: Component Location ARTM-2 Module

**NOTES**



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IL 40-220 - Revision A