

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

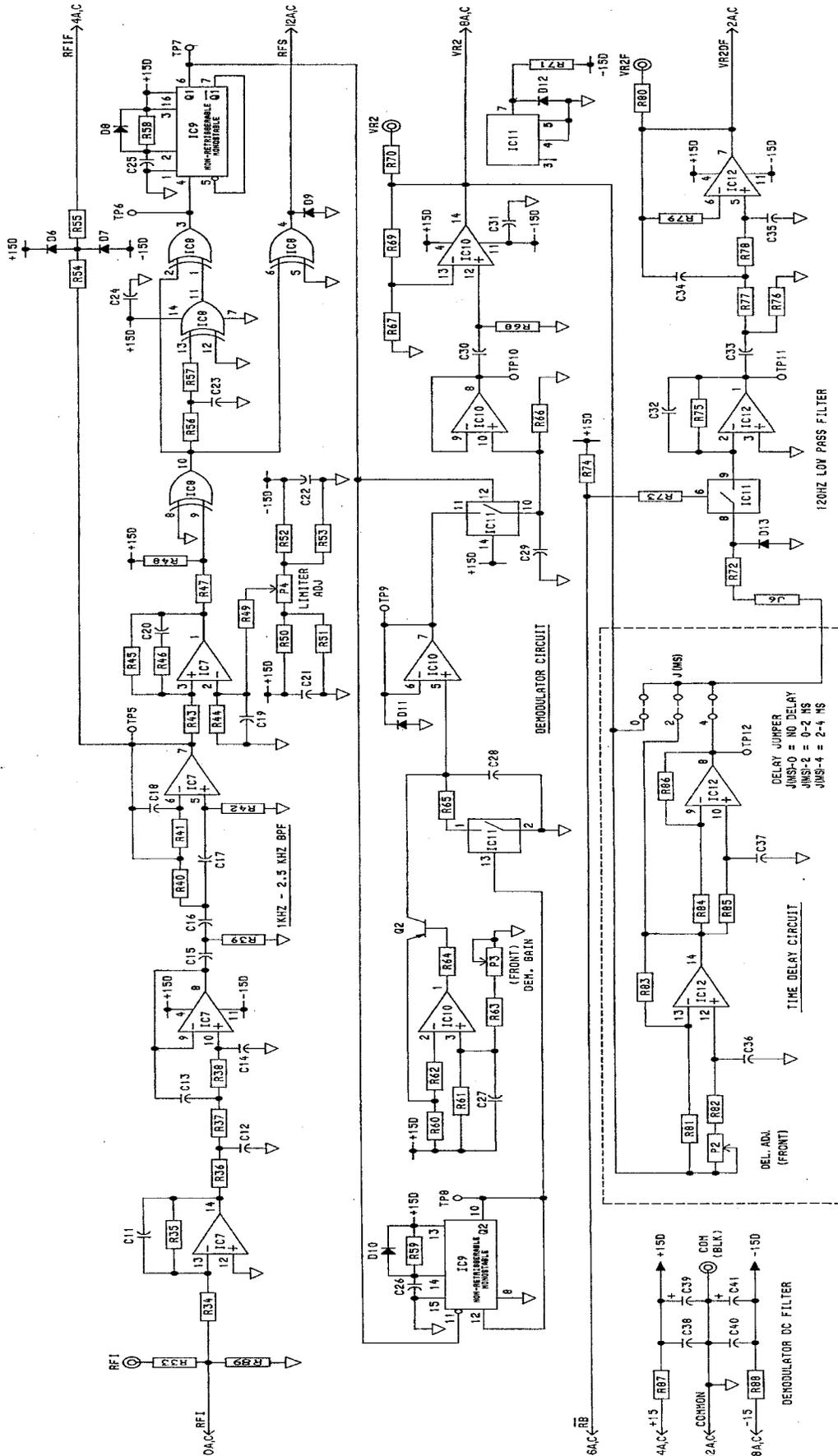


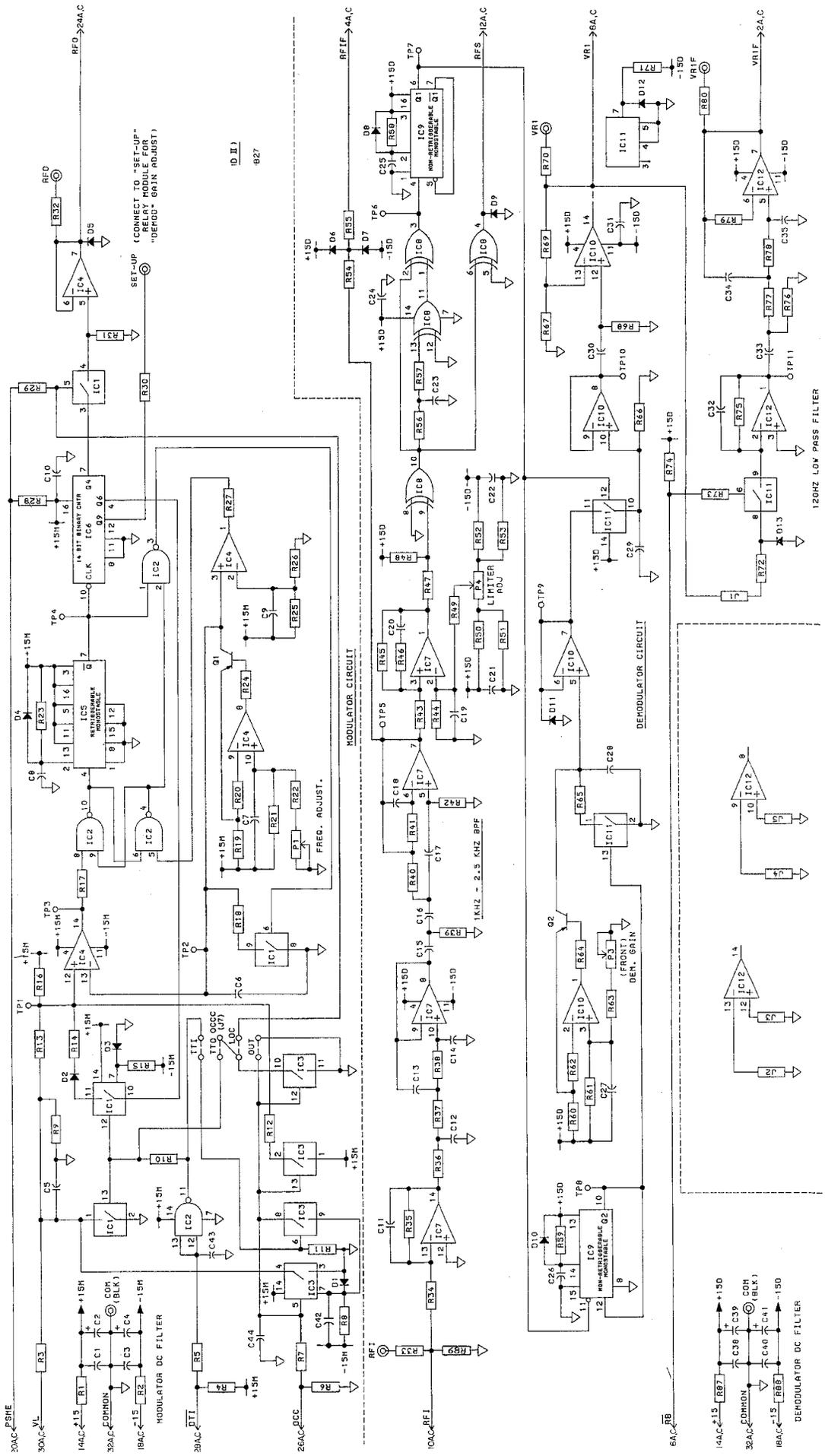
Figure 1: Internal Schematic DTD Module

Sub 3  
1355D47

CAPACITOR	STYLE	RESISTOR	STYLE
C11	0.01 MFD 200V +-5% MET-POLY CARB	R33	3.01K 1/8W 1% METAL FILM
C12	0.05 MFD 200V +-2% MET-POLY CARB	R34	20K 1/8W 1% METAL FILM
C13	0.01 MFD 200V +-5% MET-POLY CARB	R35	20K 1/8W 1% METAL FILM
C14	270 PF 500V +-2% MICA	R36	121K 1/8W 1% METAL FILM
C15	0.02 MFD 200V +-2% MET-POLY CARB	R37	121K 1/8W 1% METAL FILM
C16	0.01 MFD 200V +-5% MET-POLY CARB	R38	8.25K 1/4W 1% METAL FILM
C17	0.01 MFD 200V +-5% MET-POLY CARB	R39	8.25K 1/8W 1% METAL FILM
C18	0.1 MFD 200V +-5% MET-POLY CARB	R40	301K 1/8W 1% METAL FILM
C19	1 MFD 100V +-5% MICA	R41	301K 1/8W 1% METAL FILM
C20	1 MFD 100V +-5% MET-POLY CARB	R42	301K 1/8W 1% METAL FILM
C21	1 MFD 100V +-5% MET-POLY CARB	R43	10K 1/8W 1% METAL FILM
C22	47 PF 500V +-2% MICA	R44	15M 5% CARB 1/2W
C23	1 MFD 100V +-5% MET-POLY CARB	R45	100K 1/8W 1% METAL FILM
C24	0.1 MFD 100V +-2% MICA	R46	51.1K 1/8W 1% METAL FILM
C25	0.01 MFD 200V +-1% MET-POLY CARB	R47	51.1K 1/8W 1% METAL FILM
C26	0.01 MFD 200V +-2% MICA	R48	10K 1/8W 1% METAL FILM
C27	1 MFD 100V +-5% MET-POLY CARB	R49	15K 1/8W 1% METAL FILM
C28	5100 PF 500V +-2% MICA	R50	15K 1/8W 1% METAL FILM
C29	5100 PF 500V +-2% MICA	R51	30.1 OHM 1/8W 1% METAL FILM
C30	0.47 MFD 100V +-5% MET-POLY CARB	R52	30.1 OHM 1/8W 1% METAL FILM
C31	1 MFD 100V +-5% MET-POLY CARB	R53	10K 1/8W 1% METAL FILM
C32	1 MFD 100V +-2% MET-POLY CARB	R54	10K 1/8W 1% METAL FILM
C33	1 MFD 100V +-5% MET-POLY CARB	R55	10K 1/8W 1% METAL FILM
C34	0.47 MFD 100V +-5% MET-POLY CARB	R56	51.1K 1/8W 1% METAL FILM
C35	0.01 MFD 200V +-2% MET-POLY CARB	R57	51.1K 1/8W 1% METAL FILM
C36	0.12 MFD 200V +-5% MET-POLY CARB	R58	15K 1/8W 1% METAL FILM
C37	0.1 MFD 200V +-5% MET-POLY CARB	R59	100K 1/8W 1% METAL FILM
C38	0.1 MFD 100V +-5% MET-POLY CARB	R60	15K 1/8W 1% METAL FILM
C39	100 MFD 35V +-20% TANTALUM	R61	30.1K 1/8W 1% METAL FILM
C40	0.1 MFD 100V +-5% MET-POLY CARB	R62	15K 1/8W 1% METAL FILM
C41	100 MFD 35V +-20% TANTALUM	R63	566K 1/8W 1% METAL FILM
		R64	511 OHM 1/4W 1% METAL FILM
		R65	100 OHM 1/4W 1% METAL FILM
		R66	50M 1/4W 1% METAL OXIDE CERMET
		R67	133K 1/8W 1% METAL FILM
		R68	110K 1/8W 1% METAL FILM
		R69	750K 1/8W 1% METAL FILM
		R70	5.01K 1/8W 1% METAL FILM
		R71	3.01K 1/4W 1% METAL FILM
		R72	200K 1/8W 1% METAL FILM
		R73	200K 1/8W 1% METAL FILM
		R74	51.1K 1/8W 1% METAL FILM
		R75	100K 1/8W 1% METAL FILM
		R76	150K 1/8W 1% METAL FILM
		R77	75K 1/8W 1% METAL FILM
		R78	75K 1/8W 1% METAL FILM
		R79	501K 1/8W 1% METAL FILM
		R80	200K 1/8W 1% METAL FILM
		R81	200K 1/8W 1% METAL FILM
		R82	200K 1/8W 1% METAL FILM
		R83	200K 1/8W 1% METAL FILM
		R84	200K 1/8W 1% METAL FILM
		R85	200K 1/8W 1% METAL FILM
		R86	200K 1/8W 1% METAL FILM
		R87	2.7 OHM 1/2W 5% CARB
		R88	10K 1/8W 1% METAL FILM
		R89	10K 1/8W 1% METAL FILM
			RM10022FR19

Sub 3  
1355D47

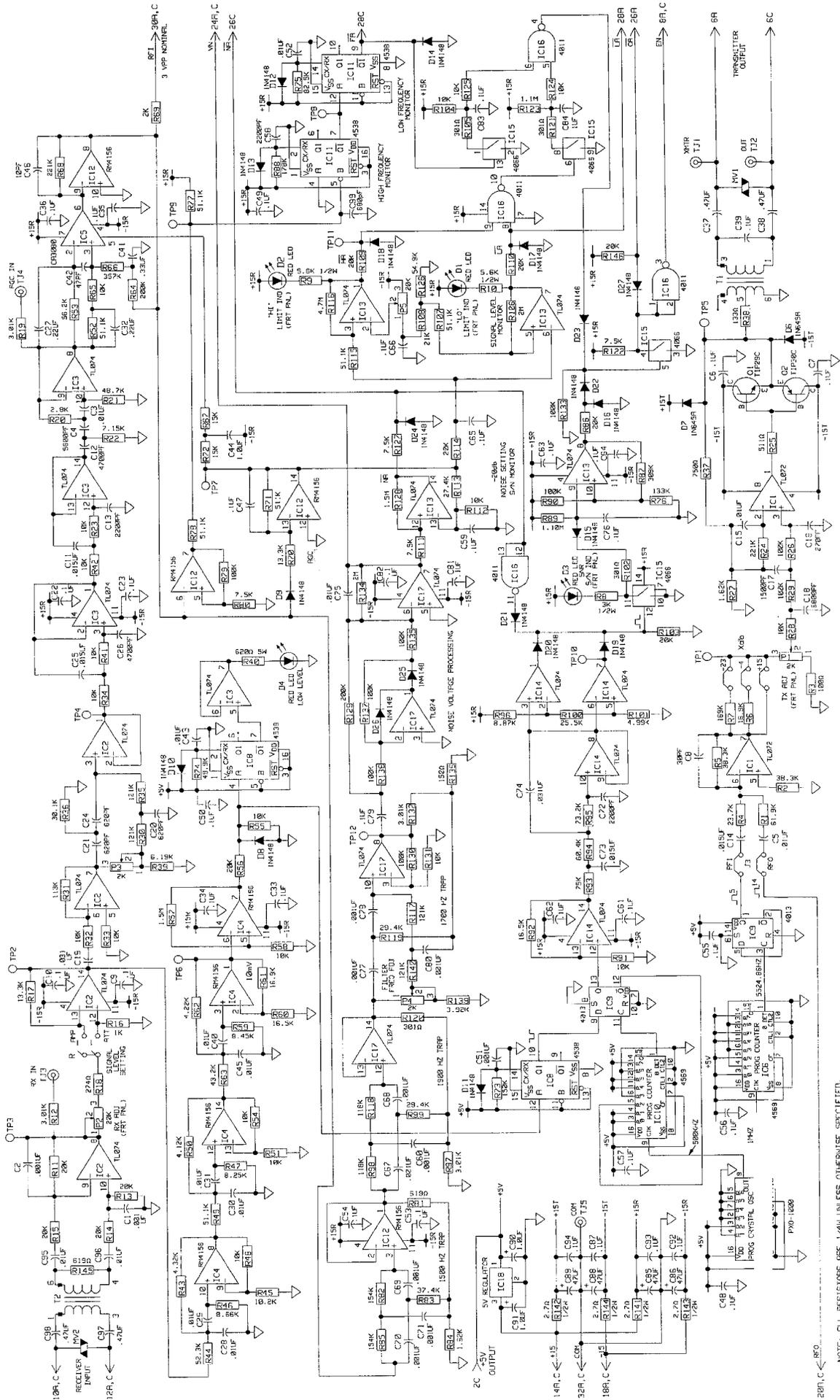
Figure 1a: Internal Schematic DTD Module



Sub 5  
1355D39

Figure 2: Internal Schematic MD Module





Sub 6  
1355D40

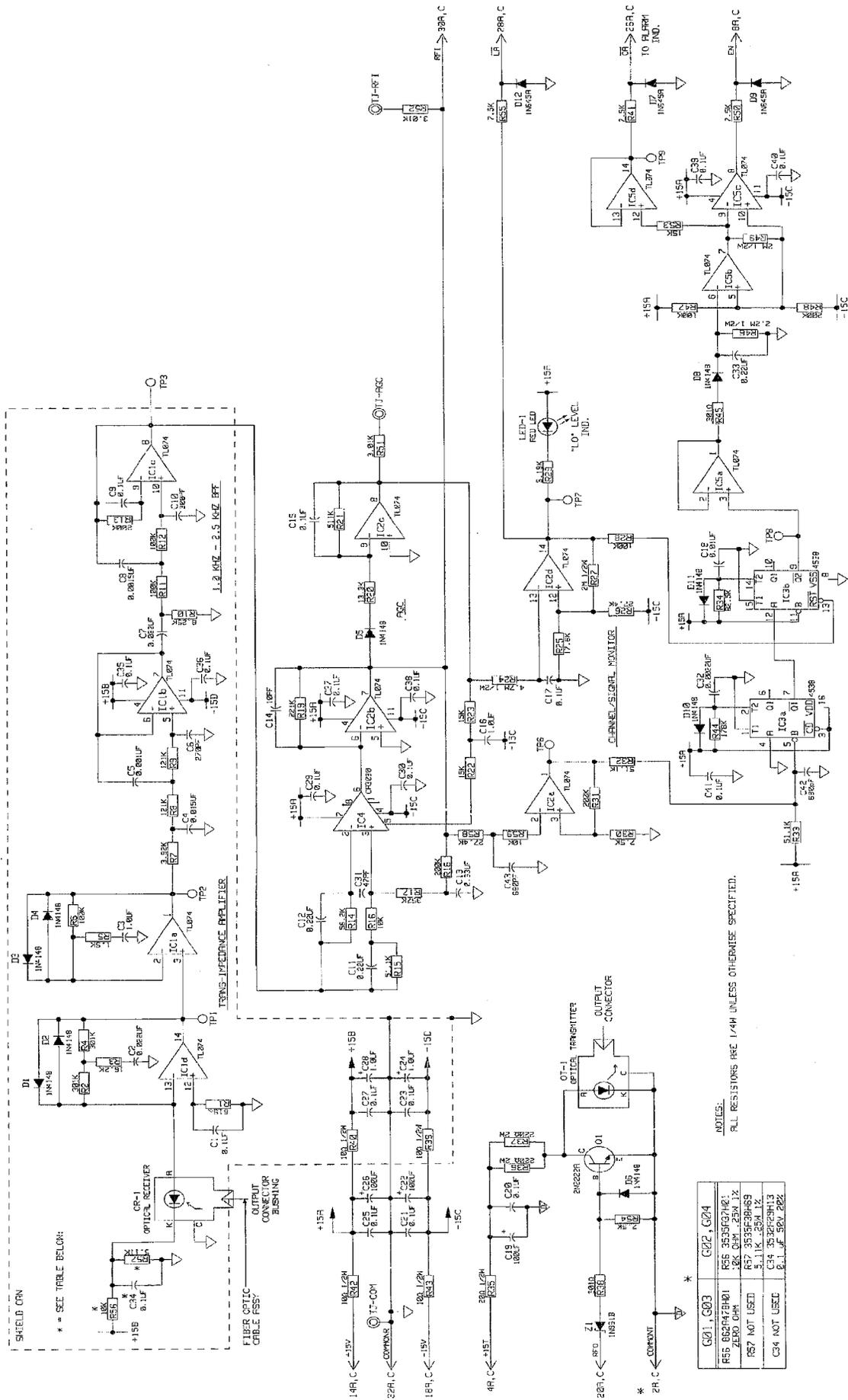
Figure 3: Internal Schematic IFDT Module

INSIDE ALL RESISTORS ARE 1/4W UNLESS OTHERWISE SPECIFIED.

Figure 3a: Internal Schematic IFDT Module

Table with columns for Component ID, Component Name, and Component Value. The table lists various electronic components such as capacitors (e.g., 0.02uF, 100uF), resistors (e.g., 100K, 100V), diodes, and transistors, along with their specific values and types.

Sub 6  
1355D40



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

G01, G03	G22, G24
R55 682A27H01	R56 3535E27H01
R57 3535E27H01	R58 3535E27H01
C32 3535E27H01	C33 3535E27H01
C34 3535E27H01	C35 3535E27H01

Sub 3  
1355D41

Figure 4: Internal Schematic IFO Module (Standard)

COMP.LOC.	CAPACITORS DESCRIPTION	STYLE	GROUP
C1	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C2	.02 MFD 100V +- 2% MET-POLY CARB	3534A83H01	ALL
C3	1.0UF 50V +- 5% MET-POLY CARB	3534A86H11	ALL
C4	.015 MFD 200V +- 2% MET-POLY CARB	3534A89H05	ALL
C5	.001 MFD 200V +- 1% MET-POLY CARB	3534A89H01	ALL
C6	.72 PF 500V +- 2% MICA	72P2787H12	ALL
C7	.022 MFD 100V +- 2% MET-POLY CARB	3533A53H01	ALL
C8	.0115 MFD 800V +- 2% MET-POLY CARB	3533A53H06	ALL
C9	.353 MFD 500V +- 2% MICA	187A584H09	ALL
C10	.22 MFD 100V +- 5% MET-POLY CARB	3534A89H10	ALL
C11	.22 MFD 100V +- 5% MET-POLY CARB	3534A89H10	ALL
C12	.353UF 50V +- 5% MET-POLY CARB	863A168H16	ALL
C13	.10 PF 500V +- 5% MICA	733A209H03	ALL
C14	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C15	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C16	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C17	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C18	.01 MFD 200V +- 2% MET-POLY CARB	3534A89H02	ALL
C19	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C20	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C21	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C22	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C23	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C24	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C25	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C26	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C27	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C28	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C29	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C30	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C31	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C32	.022 UF 2% 400V MET-POLY CARB	763A029H15	G02
C33	.22 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C34	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C35	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C36	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C37	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C38	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C39	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C40	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C41	.1 MFD 100V +- 5% MET-POLY CARB	3534A89H03	ALL
C42	.680UF 500V +- 2% DIPPED MICA	3532A31H57	ALL
C43	.680UF 500V +- 2% DIPPED MICA	3532A31H57	ALL

DIODES DESCRIPTION	STYLE	GROUP
LED1	RED LED EDGE MOUNT 650-0-006	ALL
D1	1N4148	ALL
D2	1N4148	ALL
D3	1N4148	ALL
D4	1N4148	ALL
D5	1N4148	ALL
D6	1N4148	ALL
D7	1N4148	ALL
D8	1N4148	ALL
D9	1N4148	ALL
D10	1N4148	ALL
D11	1N4148	ALL
D12	1N4148	ALL

COMP.LOC.	TRANSISTORS DESCRIPTION	STYLE	GROUP
C1	2N2222A NPN	762A572H14	ALL

COMP.LOC.	RESISTORS DESCRIPTION	STYLE	GROUP
R1	618K 25W 1% METAL FILM	352A38H77	ALL
R2	301K 25W 1% METAL FILM	352A38H47	ALL
R3	16.8K 25W 1% METAL FILM	3532A38H74	ALL
R4	301K 25W 1% METAL FILM	3532A38H74	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	2.25K 25W 1% METAL FILM	3532A38H09	ALL
R10	100K 25W 1% METAL FILM	3532A38H89	ALL
R11	100K 25W 1% METAL FILM	3532A38H01	ALL
R12	200K 25W 1% METAL FILM	3532A38H30	ALL
R13	56.2K 25W 1% METAL FILM	3532A38H50	ALL
R14	61.1K 25W 1% METAL FILM	3535A37H65	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	51K 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	3535A37H25	ALL
R25	27.4K 25W 1% METAL FILM	3535A37H43	ALL
R26	210K 25W 1% METAL FILM	3532A38H30	ALL
R27	210K 25W 1% METAL FILM	3532A38H01	ALL
R28	100K 25W 1% METAL FILM	3535A38H77	ALL
R29	618K 25W 1% METAL FILM	3535A38H65	ALL
R30	7.50K 25W 1% METAL FILM	3532A38H30	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	220-0HM 5W 5% MOLDED COMP	187A290H88	ALL
R35	220-0HM 2W 5% MOLDED COMP	187A290H11	ALL
R36	220-0HM 2W 5% MOLDED COMP	187A290H11	ALL
R37	301 01M 25W 1% METAL FILM	3532A38H47	ALL
R38	10-0HM 5W 5% FIXED COMP	187A290H01	ALL
R39	10-0HM 5W 5% FIXED COMP	187A290H01	ALL
R40	7.50K 25W 1% METAL FILM	3535A38H65	ALL
R41	10-0HM 5W 5% FIXED COMP	187A290H01	ALL
R42	10-0HM 5W 5% FIXED COMP	187A290H01	ALL
R43	178K 25W 1% METAL FILM	3532A38H25	ALL
R44	220-0HM 2W 5% METAL FILM	3535A38H47	ALL
R45	100K 25W 1% METAL FILM	3535A37H11	ALL
R46	2.2M 0HM 25W 5% C.F.	3535A37H11	ALL
R47	100K 25W 1% METAL FILM	3532A38H01	ALL
R48	200K 25W 1% METAL FILM	3532A38H10	ALL
R49	210K 25W 1% METAL FILM	3532A38H30	ALL
R50	7.50K 25W 1% METAL FILM	3535A38H65	ALL
R51	3.01K 25W 1% METAL FILM	3535A38H47	ALL
R52	3.01K 25W 1% METAL FILM	3535A38H47	ALL
R53	15K 25W 1% METAL FILM	3535A37H18	ALL
R54	7.50K 25W 1% METAL FILM	3535A38H65	ALL
R55	10K 25W 1% METAL FILM	3535A37H01	G02
R56	5.11K 25W 1% METAL FILM	3535A38H65	G02
R57	0 0HM	862A478H01	G01
R58	27.4K 25W 1% METAL FILM	3535A37H43	ALL
R59	10K 25W 1% METAL FILM	3535A37H01	ALL

COMP.LOC.	ZENERS DESCRIPTION	STYLE	GROUP
Z1	1N8961B 10V 5% 400MW	186A797H07	ALL

COMP.LOC.	OPTICAL COMPONENTS DESCRIPTION	STYLE	GROUP
O1	HFD 3943-002 HONEYWELL DETECTOR	9644A71H02	G01
O2	HFE 4807-013 HONEYWELL EMITTER	9644A71H06	G02
O3	LYTEL SMA DETECTOR 0668-001	9647A37H05	G02
O4	LYTEL SMA EMITTER 0668-000	9647A37H05	G02
O5	HFD 3854-007 HONEYWELL DETECTOR	9644A71H06	G03
O6	HFE 4834-017 HONEYWELL EMITTER	9644A71H06	G03
O7	LYTEL DETECTOR 0673-001	9647A37H07	G04
O8	LYTEL ST EMITTER 0670-000	9644A70H02	G04
O9	BUSHING (SMA)	9644A70H03	G01,2
O10	FIBER OPTIC CABLE 9" SMA 100/140	1604C71G01	G01,2
O11	FIBER OPTIC CABLE 9" ST 100/140	1604C71G01	G01,2
O12	FIBER OPTIC CABLE 9" ST 100/140	1604C71G14	G03,4

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Figure 4a: Internal Schematic IFO Module (Standard)

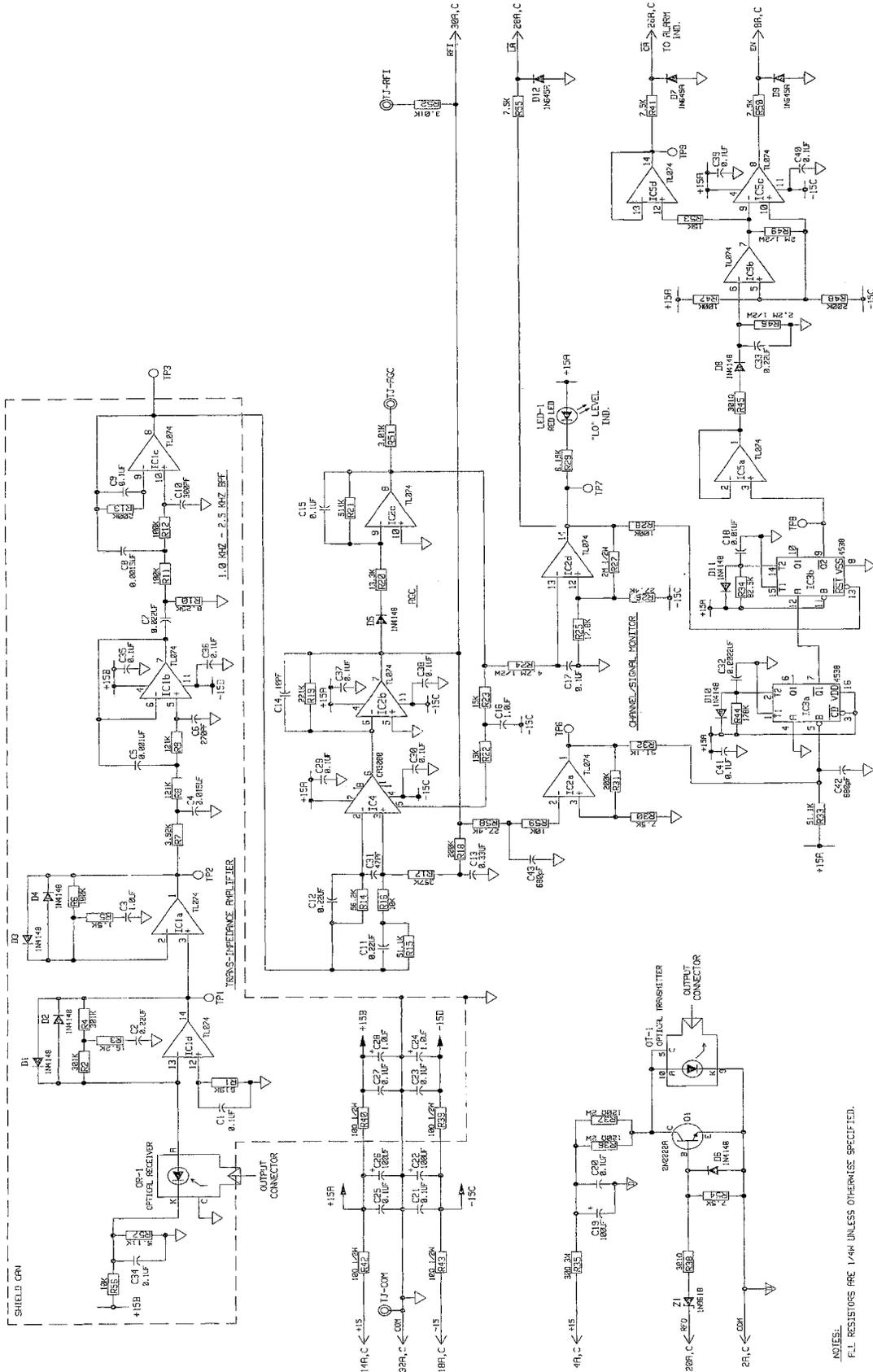


Figure 5: Internal Schematic IFO Module (High Power)

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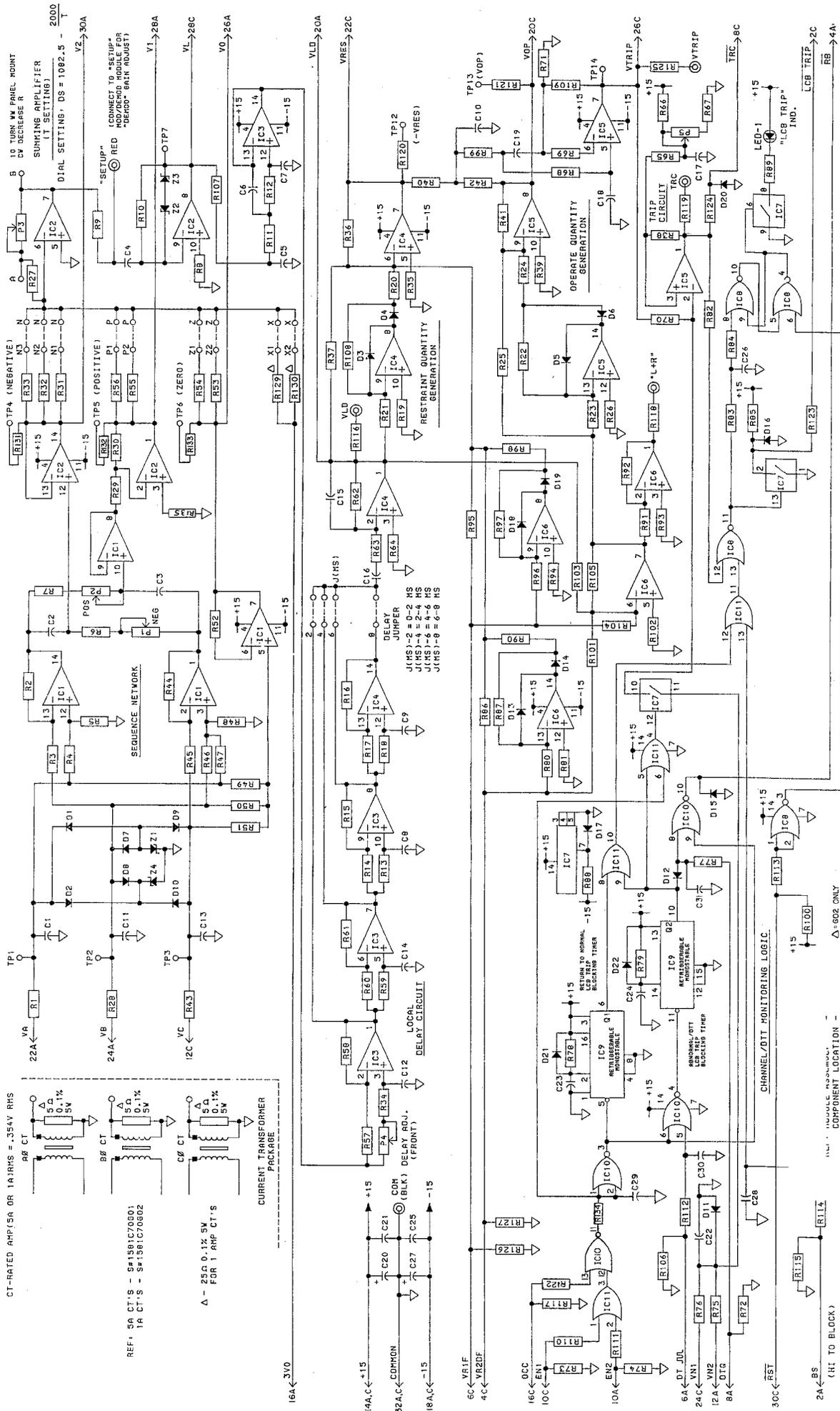
NOTES:  
1. ALL RESISTORS ARE 1/4W UNLESS OTHERWISE SPECIFIED.

COMP LOC	CAPACITORS DESCRIPTION	STYLE	RESISTORS DESCRIPTION	STYLE
R1	.1 MFD 100V +-5% MET-POLY CARB	353468H08	6.19K .25W 1% METAL FILM	353468H17
R2	.022 MFD 100V +-2% MET-POLY CARB	3533953H09	10.1K .25W 1% METAL FILM	3533953H21
R3	.1 MFD 50V +-5% MET-POLY CARB	3533468H11	30.1K .25W 1% METAL FILM	3533468H47
R4	.015 MFD 200V +-2% MET-POLY CARB	3533468H05	1.50K .25W 1% METAL FILM	3533468H18
R5	.001 MFD 200V +-1% MET-POLY CARB	3533468H20	1.00K .25W 1% METAL FILM	3533468H01
R6	270 PF 500V +-2% MICA	762A757H12	3.92K .25W 1% METAL FILM	3533468H58
R7	.022 MFD 100V +-2% MET-POLY CARB	3533953H01	12.1K .25W 1% METAL FILM	3533468H08
R8	.0015 MFD 500V +-2% MET-POLY CARB	3533953H08	12.1K .25W 1% METAL FILM	3533468H09
R9	300 PF 500V +-5% MET-POLY CARB	3533468H08	8.25K .25W 1% METAL FILM	3533468H01
R10	.1 MFD 100V +-5% MET-POLY CARB	187A584H08	1.00K .25W 1% METAL FILM	3532000H01
R11	.22 MFD 100V +-5% MET-POLY CARB	353468H10	100K .25W 1% METAL FILM	3532000H01
R12	.22 MFD 100V +-5% MET-POLY CARB	353468H10	56.2K .25W 1% METAL FILM	3532000H01
R13	.33 MFD 50V +-5% MET-POLY CARB	663A166H16	5.11K .25W 1% METAL FILM	3532000H01
R14	.1 MFD 500V +-5% MICA	763A620H03	19K .25W 1% METAL FILM	3532000H01
R15	.1 MFD 100V +-5% MET-POLY CARB	353468H08	300K .25W 1% METAL FILM	3532000H01
R16	.1 MFD 100V +-5% MET-POLY CARB	353468H08	300K .25W 1% METAL FILM	3532000H01
R17	.1 MFD 100V +-5% MET-POLY CARB	3533953H09	20.1K .25W 1% METAL FILM	3532000H01
R18	.01 MFD 200V +-2% MET-POLY CARB	660A763H01	20.1K .25W 1% METAL FILM	3532000H01
R19	.1 MFD 100V +-5% MET-POLY CARB	3533468H08	51.1K .25W 1% METAL FILM	3532000H01
R20	.1 MFD 100V +-5% MET-POLY CARB	3533468H08	15K .25W 1% METAL FILM	3532000H01
R21	.1 MFD 100V +-5% MET-POLY CARB	880A363H01	15K .25W 1% METAL FILM	3532000H01
R22	.1 MFD 100V +-5% MET-POLY CARB	353468H08	4.7M .25W 5% CARBON FILM	3535A41H65
R23	.1 MFD 100V +-5% MET-POLY CARB	837A241H15	17.8K .25W 1% METAL FILM	3535A41H65
R24	.1 MFD 100V +-5% MET-POLY CARB	353468H08	27.4K .25W 1% METAL FILM	3535A41H65
R25	.1 MFD 100V +-5% MET-POLY CARB	980A363H01	2M .25W 1% METAL FILM	3535A41H65
R26	.1 MFD 100V +-5% MET-POLY CARB	353468H08	100K .25W 1% METAL FILM	3535A41H65
R27	.1 MFD 100V +-5% MET-POLY CARB	837A241H15	6.19K .25W 1% METAL FILM	3535A41H65
R28	.1 MFD 100V +-5% MET-POLY CARB	353468H08	200K .25W 1% METAL FILM	3535A41H65
R29	.1 MFD 100V +-5% MET-POLY CARB	753A468H08	5.11K .25W 1% METAL FILM	3535A41H65
R30	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.11K .25W 1% METAL FILM	3535A41H65
R31	.1 MFD 100V +-5% MET-POLY CARB	353468H08	28.5K .25W 1% METAL FILM	3535A41H65
R32	.1 MFD 100V +-5% MET-POLY CARB	353468H08	90 OHM 3W 1% WIRE WOUND	3535A41H65
R33	.1 MFD 100V +-5% MET-POLY CARB	353468H08	1.00 OHM 2W 5% MOLDED COMP	3535A41H65
R34	.1 MFD 100V +-5% MET-POLY CARB	353468H08	1.00 OHM 2W 5% MOLDED COMP	3535A41H65
R35	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM 2W 5% METAL FILM	3535A41H65
R36	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM 2W 5% METAL FILM	3535A41H65
R37	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM 2W 5% METAL FILM	3535A41H65
R38	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM 2W 5% METAL FILM	3535A41H65
R39	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A290H01
R40	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A290H01
R41	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3535A41H65
R42	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A290H01
R43	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10 OHM .5W 5% FIXED COMP	187A290H01
R44	.1 MFD 100V +-5% MET-POLY CARB	353468H08	176K .25W 1% METAL FILM	3532A88H25
R45	.1 MFD 100V +-5% MET-POLY CARB	353468H08	30.1 OHM .25W 1% METAL FILM	3532A88H25
R46	.1 MFD 100V +-5% MET-POLY CARB	353468H08	500K .25W 1% METAL FILM	3532A88H25
R47	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20K .25W 1% METAL FILM	3532A88H25
R48	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20K .25W 1% METAL FILM	3532A88H25
R49	.1 MFD 100V +-5% MET-POLY CARB	353468H08	20K .25W 1% METAL FILM	3532A88H25
R50	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3532A88H25
R51	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.01K .25W 1% METAL FILM	3532A88H25
R52	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.01K .25W 1% METAL FILM	3532A88H25
R53	.1 MFD 100V +-5% MET-POLY CARB	353468H08	15K .25W 1% METAL FILM	3532A88H25
R54	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3532A88H25
R55	.1 MFD 100V +-5% MET-POLY CARB	353468H08	7.50K .25W 1% METAL FILM	3532A88H25
R56	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10K .25W 1% METAL FILM	3532A88H25
R57	.1 MFD 100V +-5% MET-POLY CARB	353468H08	5.11K .25W 1% METAL FILM	3532A88H25
R58	.1 MFD 100V +-5% MET-POLY CARB	353468H08	27.4K .25W 1% METAL FILM	3532A88H25
R59	.1 MFD 100V +-5% MET-POLY CARB	353468H08	10K .25W 1% METAL FILM	3532A88H25

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	ZENERS DESCRIPTION	186A797H07
D3	TL074IJ QUAD OP AMP	3588A90H01	ZENERS DESCRIPTION	186A797H07
D4	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D5	MC14538BAL DUAL PREC MONO MULTIVIB	3527A09H01	ZENERS DESCRIPTION	186A797H07
D6	CR200HS OP TRANSCOND AMP	3533A21H01	ZENERS DESCRIPTION	186A797H07
D7	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D8	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D9	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D10	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D11	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07
D12	TL074IJ QUAD OP AMP	3528A90H01	ZENERS DESCRIPTION	186A797H07

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



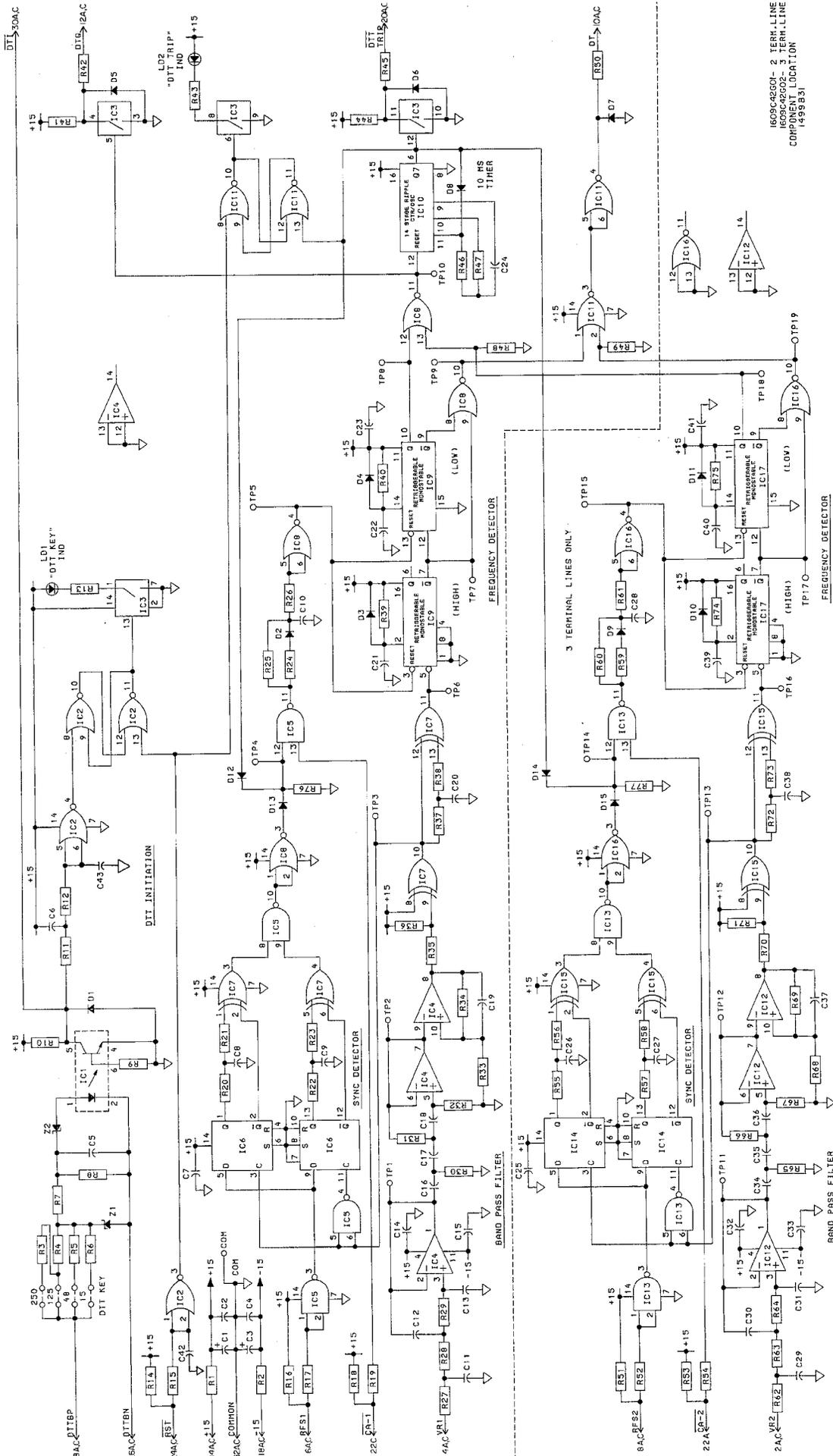
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Figure 6: Internal Schematic Relay Module

CAPACITOR		STYLE	RESISTOR	STYLE	LINK	STYLE
C01	1 MFD 100V ±5% MET-POLY CARB	333453H00	R001	300 OHM 5% 1/8W METAL GLAZE	R101	300K 1/8W 1% METAL FILM
C02	.022 MFD 200V ±2% MET-POLY CARB	333453H01	R002	301K 1/8W 1% METAL FILM	R102	75K 1/8W 1% METAL FILM
C03	.01 MFD 50V ±5% MET-POLY CARB	333453H02	R003	301K 1/8W 1% METAL FILM	R103	200K 1/8W 1% METAL FILM
C04	.047 MFD 100V ±5% MET-POLY CARB	333453H03	R004	301K 1/8W 1% METAL FILM	R104	200K 1/8W 1% METAL FILM
C05	.01 MFD 200V ±2% MET-POLY CARB	333453H04	R005	100K 1/8W 1% METAL FILM	R105	100K 1/8W 1% METAL FILM
C06	.01 MFD 200V ±2% MET-POLY CARB	333453H05	R006	100K 1/8W 1% METAL FILM	R106	100K 1/8W 1% METAL FILM
C07	.01 MFD 200V ±2% MET-POLY CARB	333453H06	R007	100K 1/8W 1% METAL FILM	R107	100K 1/8W 1% METAL FILM
C08	.01 MFD 200V ±2% MET-POLY CARB	333453H07	R008	100K 1/8W 1% METAL FILM	R108	100K 1/8W 1% METAL FILM
C09	.01 MFD 200V ±2% MET-POLY CARB	333453H08	R009	100K 1/8W 1% METAL FILM	R109	100K 1/8W 1% METAL FILM
C10	.01 MFD 200V ±2% MET-POLY CARB	333453H09	R010	100K 1/8W 1% METAL FILM	R110	100K 1/8W 1% METAL FILM
C11	.01 MFD 200V ±2% MET-POLY CARB	333453H10	R011	100K 1/8W 1% METAL FILM	R111	100K 1/8W 1% METAL FILM
C12	.01 MFD 200V ±2% MET-POLY CARB	333453H11	R012	100K 1/8W 1% METAL FILM	R112	100K 1/8W 1% METAL FILM
C13	.01 MFD 200V ±2% MET-POLY CARB	333453H12	R013	100K 1/8W 1% METAL FILM	R113	100K 1/8W 1% METAL FILM
C14	.01 MFD 200V ±2% MET-POLY CARB	333453H13	R014	100K 1/8W 1% METAL FILM	R114	100K 1/8W 1% METAL FILM
C15	.01 MFD 200V ±2% MET-POLY CARB	333453H14	R015	100K 1/8W 1% METAL FILM	R115	100K 1/8W 1% METAL FILM
C16	.01 MFD 200V ±2% MET-POLY CARB	333453H15	R016	100K 1/8W 1% METAL FILM	R116	100K 1/8W 1% METAL FILM
C17	.01 MFD 200V ±2% MET-POLY CARB	333453H16	R017	100K 1/8W 1% METAL FILM	R117	100K 1/8W 1% METAL FILM
C18	.01 MFD 200V ±2% MET-POLY CARB	333453H17	R018	100K 1/8W 1% METAL FILM	R118	100K 1/8W 1% METAL FILM
C19	.01 MFD 200V ±2% MET-POLY CARB	333453H18	R019	100K 1/8W 1% METAL FILM	R119	100K 1/8W 1% METAL FILM
C20	.01 MFD 200V ±2% MET-POLY CARB	333453H19	R020	100K 1/8W 1% METAL FILM	R120	100K 1/8W 1% METAL FILM
C21	.01 MFD 200V ±2% MET-POLY CARB	333453H20	R021	100K 1/8W 1% METAL FILM	R121	100K 1/8W 1% METAL FILM
C22	.01 MFD 200V ±2% MET-POLY CARB	333453H21	R022	100K 1/8W 1% METAL FILM	R122	100K 1/8W 1% METAL FILM
C23	.01 MFD 200V ±2% MET-POLY CARB	333453H22	R023	100K 1/8W 1% METAL FILM	R123	100K 1/8W 1% METAL FILM
C24	.01 MFD 200V ±2% MET-POLY CARB	333453H23	R024	100K 1/8W 1% METAL FILM	R124	100K 1/8W 1% METAL FILM
C25	.01 MFD 200V ±2% MET-POLY CARB	333453H24	R025	100K 1/8W 1% METAL FILM	R125	100K 1/8W 1% METAL FILM
C26	.01 MFD 200V ±2% MET-POLY CARB	333453H25	R026	100K 1/8W 1% METAL FILM	R126	100K 1/8W 1% METAL FILM
C27	.01 MFD 200V ±2% MET-POLY CARB	333453H26	R027	100K 1/8W 1% METAL FILM	R127	100K 1/8W 1% METAL FILM
C28	.01 MFD 200V ±2% MET-POLY CARB	333453H27	R028	100K 1/8W 1% METAL FILM	R128	100K 1/8W 1% METAL FILM
C29	.01 MFD 200V ±2% MET-POLY CARB	333453H28	R029	100K 1/8W 1% METAL FILM	R129	100K 1/8W 1% METAL FILM
C30	.01 MFD 200V ±2% MET-POLY CARB	333453H29	R030	100K 1/8W 1% METAL FILM	R130	100K 1/8W 1% METAL FILM
C31	1000PF 500V ±5% DURA MICA	333453H30	R031	100K 1/8W 1% METAL FILM	R131	100K 1/8W 1% METAL FILM
DIODE		STYLE				
D01	1N625A 250V	333453H31	R032	100K 1/8W 1% METAL FILM	R132	100K 1/8W 1% METAL FILM
D02	1N4148 75V	333453H32	R033	100K 1/8W 1% METAL FILM	R133	100K 1/8W 1% METAL FILM
D03	1N4148 75V	333453H33	R034	100K 1/8W 1% METAL FILM	R134	100K 1/8W 1% METAL FILM
D04	1N4148 75V	333453H34	R035	100K 1/8W 1% METAL FILM	R135	100K 1/8W 1% METAL FILM
D05	1N4148 75V	333453H35	R036	100K 1/8W 1% METAL FILM		
D06	1N4148 75V	333453H36	R037	100K 1/8W 1% METAL FILM		
D07	1N4148 75V	333453H37	R038	100K 1/8W 1% METAL FILM		
D08	1N4148 75V	333453H38	R039	100K 1/8W 1% METAL FILM		
D09	1N4148 75V	333453H39	R040	100K 1/8W 1% METAL FILM		
D10	1N4148 75V	333453H40	R041	100K 1/8W 1% METAL FILM		
D11	1N4148 75V	333453H41	R042	100K 1/8W 1% METAL FILM		
D12	1N4148 75V	333453H42	R043	100K 1/8W 1% METAL FILM		
D13	1N4148 75V	333453H43	R044	100K 1/8W 1% METAL FILM		
D14	1N4148 75V	333453H44	R045	100K 1/8W 1% METAL FILM		
D15	1N4148 75V	333453H45	R046	100K 1/8W 1% METAL FILM		
D16	1N4148 75V	333453H46	R047	100K 1/8W 1% METAL FILM		
D17	1N4148 75V	333453H47	R048	100K 1/8W 1% METAL FILM		
D18	1N4148 75V	333453H48	R049	100K 1/8W 1% METAL FILM		
D19	1N4148 75V	333453H49	R050	100K 1/8W 1% METAL FILM		
D20	1N4148 75V	333453H50	R051	100K 1/8W 1% METAL FILM		
D21	1N4148 75V	333453H51	R052	100K 1/8W 1% METAL FILM		
D22	1N4148 75V	333453H52	R053	100K 1/8W 1% METAL FILM		
DIGITAL DIAL		STYLE				
DIAL		3509A12H03				
INT CRT		STYLE				
IC01	TL07413 QUAD OP AMP	3509A12H04				
IC02	TL07413 QUAD OP AMP	3509A12H05				
IC03	TL07413 QUAD OP AMP	3509A12H06				
IC04	TL07413 QUAD OP AMP	3509A12H07				
IC05	TL07413 QUAD OP AMP	3509A12H08				
IC06	TL07413 QUAD OP AMP	3509A12H09				
IC07	TL07413 QUAD OP AMP	3509A12H10				
IC08	TL07413 QUAD OP AMP	3509A12H11				
IC09	TL07413 QUAD OP AMP	3509A12H12				
IC10	TL07413 QUAD OP AMP	3509A12H13				
IC11	TL07413 QUAD OP AMP	3509A12H14				
DIODE		STYLE				
LEN-1	RED LED (EDGE MOUNT)	3509A12H01				
POT		STYLE				
P01	100K 3/4W 10% TRIMPOT	3509A12H02				
P02	100K 3/4W 10% TRIMPOT	3509A12H03				
P03	100K 3/4W 10% TRIMPOT	3509A12H04				
P04	100K 3/4W 10% TRIMPOT	3509A12H05				
P05	100K 3/4W 10% TRIMPOT	3509A12H06				

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Figure 6a: Internal Schematic Relay Module



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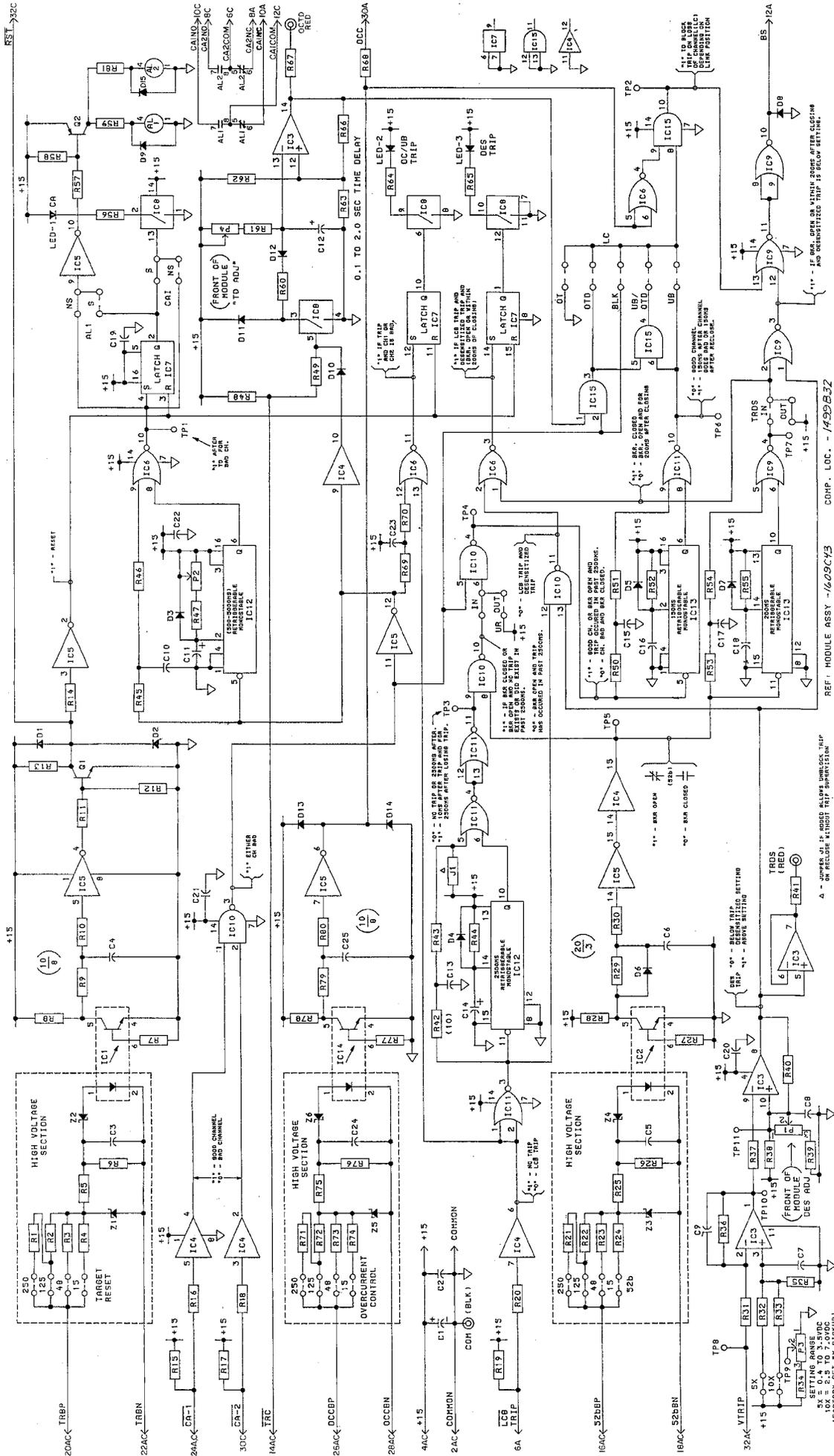
Figure 7: Internal Schematic DTT Module

CAPACITOR		GROUPS		DIODE		RESISTOR		GROUPS		ZENER		STYLE	
		1	2	1	2	1	2	1	2	1	2	1	2
C01	10 MFD 35V +-5% TANTALUM POLYCARB			LD01	RED LED (EDGE MOUNT)	R01	2.7 OHM 1/2W 5% CARBON	11	3508A22H01	Z01	1N4747A 20V 1W 5X		849A437H01
C02	0.1 MFD 100V +-5% TANTALUM POLYCARB			LD02	RED LED (EDGE MOUNT)	R02	10 OHM 1/2W 5% CARBON	11	3508A22H01	Z02	1N752A 5.6V 400MU 5X		186A777H12
C03	0.1 MFD 100V +-5% TANTALUM POLYCARB					R03	20K 2W 5% CARBON	11					
C04	0.1 MFD 100V +-5% MET-POLYCARB					R04	20K 2W 5% CARBON	11					
C05	0.47 MFD 100V +-5% MET-POLYCARB					R05	4.8K 2W 5% CARBON	11					
C06	0.22 MFD 100V +-2% MET-POLYCARB					R06	430 OHM 1/2W 2X METAL GLAZE	11					
C07	0.1 MFD 50V +-20% CERAMIC					R07	3.6K 1/2W 5% METAL GLAZE	11					
C08	0.1 MFD 50V +-20% CERAMIC					R08	10K 1/8W 1X METAL FILM	11					
C09	0.1 MFD 50V +-20% CERAMIC					R09	10K 1/8W 1X METAL FILM	11					
C10	0.22 MFD 100V +-2% MET-POLYCARB					R10	30.1K 1/8W 1X METAL FILM	11					
C11	6690PF 50V +-2% POLYSTY					R11	51.1K 1/8W 1X METAL FILM	11					
C12	1500 PF 500V +-2% NICA					R12	10K 1/8W 1X METAL FILM	11					
C13	1500 PF 500V +-2% NICA					R13	10K 1/8W 1X METAL FILM	11					
C14	0.1 MFD 50V +-20% CERAMIC					R14	10K 1/8W 1X METAL FILM	11					
C15	0.1 MFD 50V +-20% CERAMIC					R15	51.1K 1/8W 1X METAL FILM	11					
C16	6690PF 50V +-2% POLYSTY					R16	10K 1/8W 1X METAL FILM	11					
C17	3000 PF 500V +-2% NICA					R17	10K 1/8W 1X METAL FILM	11					
C18	3000 PF 500V +-2% NICA					R18	10K 1/8W 1X METAL FILM	11					
C19	20 PF 300V +-5% NICA					R19	10K 1/8W 1X METAL FILM	11					
C20	510 PF 500V +-2% NICA					R20	10K 1/8W 1X METAL FILM	11					
C21	0.1 MFD 50V +-20% CERAMIC					R21	10K 1/8W 1X METAL FILM	11					
C22	0.1 MFD 200V +-2% MET-POLYCARB					R22	10K 1/8W 1X METAL FILM	11					
C23	0.1 MFD 200V +-2% MET-POLYCARB					R23	10K 1/8W 1X METAL FILM	11					
C24	0.1 MFD 50V +-20% CERAMIC					R24	10K 1/8W 1X METAL FILM	11					
C25	0.001UF 200V +-5% MET-POLYCARB					R25	10K 1/8W 1X METAL FILM	11					
C26	0.1 MFD 50V +-20% CERAMIC					R26	10K 1/8W 1X METAL FILM	11					
C27	0.1 MFD 200V +-2% MET-POLYCARB					R27	10K 1/8W 1X METAL FILM	11					
C28	0.22 MFD 100V +-2% MET-POLYCARB					R28	10K 1/8W 1X METAL FILM	11					
C29	66.900 PF 50V +-2% POLYSTY					R29	10K 1/8W 1X METAL FILM	11					
C30	1500 PF 500V +-2% NICA					R30	10K 1/8W 1X METAL FILM	11					
C31	1500 PF 500V +-2% NICA					R31	10K 1/8W 1X METAL FILM	11					
C32	0.1 MFD 50V +-20% CERAMIC					R32	10K 1/8W 1X METAL FILM	11					
C33	0.1 MFD 50V +-20% CERAMIC					R33	10K 1/8W 1X METAL FILM	11					
C34	66.900 PF 50V +-2% POLYSTY					R34	10K 1/8W 1X METAL FILM	11					
C35	3000 PF 500V +-2% NICA					R35	10K 1/8W 1X METAL FILM	11					
C36	3000 PF 500V +-2% NICA					R36	10K 1/8W 1X METAL FILM	11					
C37	20 PF 300V +-5% NICA					R37	10K 1/8W 1X METAL FILM	11					
C38	510 PF 500V +-2% NICA					R38	10K 1/8W 1X METAL FILM	11					
C39	0.1 MFD 50V +-20% CERAMIC					R39	10K 1/8W 1X METAL FILM	11					
C40	0.1 MFD 200V +-2% MET-POLYCARB					R40	10K 1/8W 1X METAL FILM	11					
C41	0.1 MFD 200V +-2% MET-POLYCARB					R41	10K 1/8W 1X METAL FILM	11					
C42	0.1 MFD 50V +-20% CERAMIC					R42	10K 1/8W 1X METAL FILM	11					
C43	.05MFD 100V +-20% CERAMIC					R43	10K 1/8W 1X METAL FILM	11					
C44	.05MFD 100V +-20% CERAMIC					R44	10K 1/8W 1X METAL FILM	11					
D01	1N4148 75V			D01	836A928H06								
D02	1N4148 75V			D02	836A928H06								
D03	1N4148 75V			D03	836A928H06								
D04	1N4148 75V			D04	836A928H06								
D05	1N4148 75V			D05	836A928H06								
D06	1N4148 75V			D06	836A928H06								
D07	1N4148 75V			D07	836A928H06								
D08	1N4148 75V			D08	836A928H06								
D09	1N4148 75V			D09	836A928H06								
D10	1N4148 75V			D10	836A928H06								
D11	1N4148 75V			D11	836A928H06								
D12	1N4148 75V			D12	836A928H06								
D13	1N4148 75V			D13	836A928H06								
D14	1N4148 75V			D14	836A928H06								
D15	1N4148 75V			D15	836A928H06								
INT CKT													
IC01	4N35 OPTICAL COUPLER												
IC02	ICL4013BAL QUAD 2-INPUT NOR												
IC03	ICL4066BAL QUAD BILATERAL SWITCH												
IC04	ICL0741 QUAD OR AND-NOT NAND												
IC05	ICL4013BAL QUAD 2-INPUT NOR												
IC06	ICL4013BAL QUAD 2-INPUT NOR												
IC07	ICL4013BAL QUAD EXCLUSIVE OR												
IC08	ICL4001BAL QUAD 2-INPUT NOR												
IC09	ICL4001BAL QUAD 2-INPUT NOR												
IC10	ICL4001BAL QUAD 2-INPUT NOR												
IC11	ICL4001BAL QUAD 2-INPUT NOR												
IC12	ICL4001BAL QUAD 2-INPUT NOR												
IC13	ICL4013BAL QUAD 2-INPUT NAND												
IC14	ICL4013BAL QUAD 2-INPUT NOR												
IC15	ICL4013BAL QUAD EXCLUSIVE OR												
IC16	ICL4001BAL QUAD 2-INPUT NOR												
IC17	ICL4001BAL QUAD 2-INPUT NOR												

Sub 2  
1355D43

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

Figure 7a: Internal Schematic DTT Module



Sub 4  
1355D44

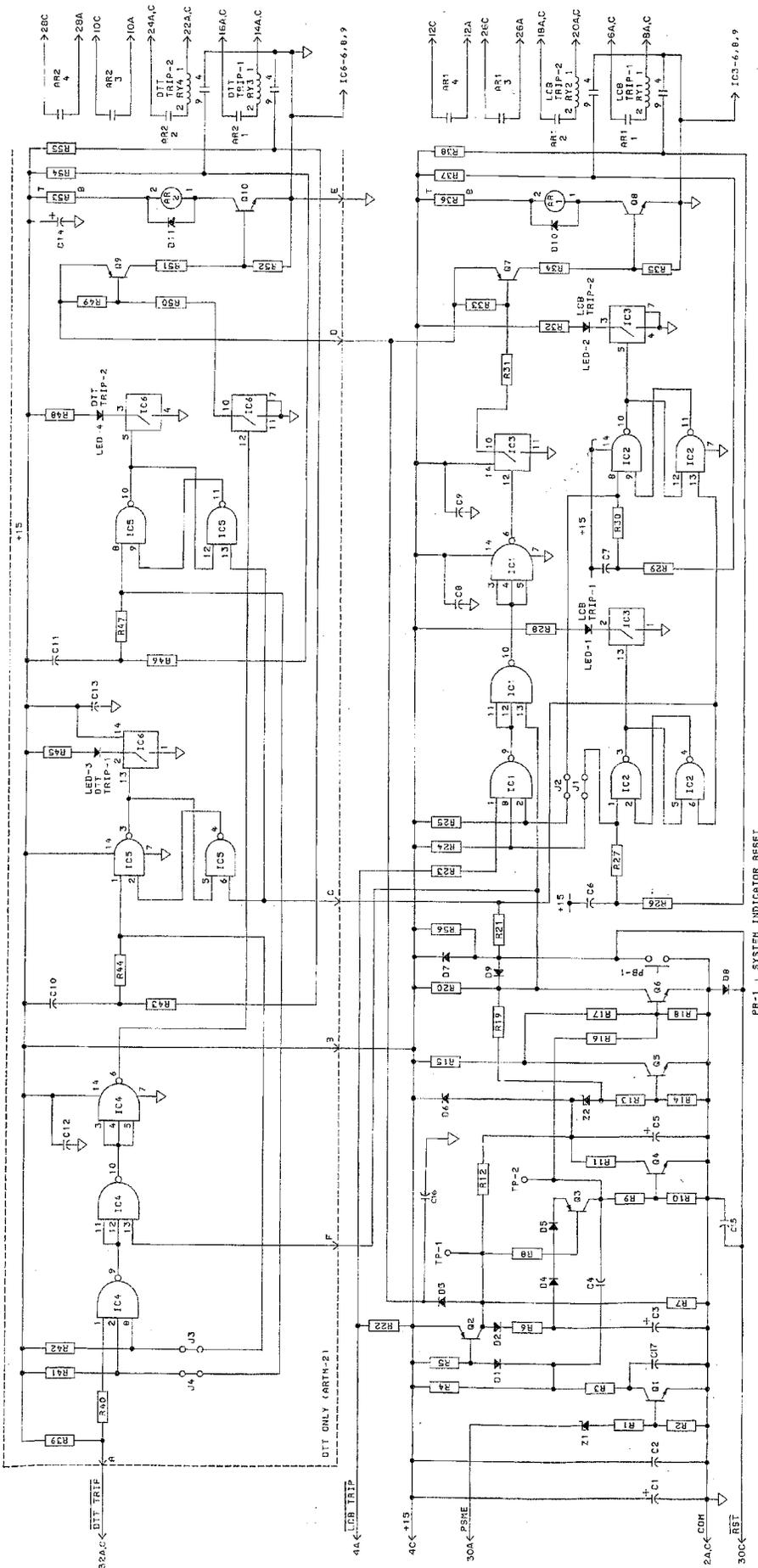
Figure 8: Internal Schematic AXLM Module

REF: MODULE ASSY - 1609C43 COMP. LOC. - 1492B32

A - UNLESS OTHERWISE SPECIFIED, ALL PARTS ARE TO BE USED AS SHOWN.

TP8 - VTRIP  
TP9 - TRIP  
TP10 - (FRONT OF MODULE) DES MOD.  
TP11 - (FRONT OF MODULE) DES MOD.  
TP12 - (FRONT OF MODULE) DES MOD.  
TP13 - (FRONT OF MODULE) DES MOD.  
TP14 - (FRONT OF MODULE) DES MOD.  
TP15 - (FRONT OF MODULE) DES MOD.  
TP16 - (FRONT OF MODULE) DES MOD.  
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TP26 - (FRONT OF MODULE) DES MOD.  
TP27 - (FRONT OF MODULE) DES MOD.  
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TP31 - (FRONT OF MODULE) DES MOD.  
TP32 - (FRONT OF MODULE) DES MOD.  
TP33 - (FRONT OF MODULE) DES MOD.  
TP34 - (FRONT OF MODULE) DES MOD.  
TP35 - (FRONT OF MODULE) DES MOD.  
TP36 - (FRONT OF MODULE) DES MOD.  
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TP61 - (FRONT OF MODULE) DES MOD.  
TP62 - (FRONT OF MODULE) DES MOD.  
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TP64 - (FRONT OF MODULE) DES MOD.  
TP65 - (FRONT OF MODULE) DES MOD.  
TP66 - (FRONT OF MODULE) DES MOD.  
TP67 - (FRONT OF MODULE) DES MOD.  
TP68 - (FRONT OF MODULE) DES MOD.  
TP69 - (FRONT OF MODULE) DES MOD.  
TP70 - (FRONT OF MODULE) DES MOD.  
TP71 - (FRONT OF MODULE) DES MOD.  
TP72 - (FRONT OF MODULE) DES MOD.  
TP73 - (FRONT OF MODULE) DES MOD.  
TP74 - (FRONT OF MODULE) DES MOD.  
TP75 - (FRONT OF MODULE) DES MOD.  
TP76 - (FRONT OF MODULE) DES MOD.  
TP77 - (FRONT OF MODULE) DES MOD.  
TP78 - (FRONT OF MODULE) DES MOD.  
TP79 - (FRONT OF MODULE) DES MOD.  
TP80 - (FRONT OF MODULE) DES MOD.  
TP81 - (FRONT OF MODULE) DES MOD.  
TP82 - (FRONT OF MODULE) DES MOD.  
TP83 - (FRONT OF MODULE) DES MOD.  
TP84 - (FRONT OF MODULE) DES MOD.  
TP85 - (FRONT OF MODULE) DES MOD.  
TP86 - (FRONT OF MODULE) DES MOD.  
TP87 - (FRONT OF MODULE) DES MOD.  
TP88 - (FRONT OF MODULE) DES MOD.  
TP89 - (FRONT OF MODULE) DES MOD.  
TP90 - (FRONT OF MODULE) DES MOD.  
TP91 - (FRONT OF MODULE) DES MOD.  
TP92 - (FRONT OF MODULE) DES MOD.  
TP93 - (FRONT OF MODULE) DES MOD.  
TP94 - (FRONT OF MODULE) DES MOD.  
TP95 - (FRONT OF MODULE) DES MOD.  
TP96 - (FRONT OF MODULE) DES MOD.  
TP97 - (FRONT OF MODULE) DES MOD.  
TP98 - (FRONT OF MODULE) DES MOD.  
TP99 - (FRONT OF MODULE) DES MOD.  
TP100 - (FRONT OF MODULE) DES MOD.





Sub 3  
1355D45

Figure 9: Internal Schematic ARTM-1 and 2 Module

1609C44G01 & 1609C44G02

1581C27G01

ITEM	PART NAME	DESCRIPTION	STYLE	ITEM	PART NAME	DESCRIPTION	STYLE
A1-1	RELAY	1-6 OHM COIL, 10W, 4A	406C645G44	AR2	AR UNIT	1-6 OHM COIL, 10W, 4A	406C645G44
C1	CAPACITOR	100 MFD, 35V, ±20% TANTALUM	80A333H03	C10	CAPACITOR	.033 MFD, 100V, ±5% MET-POLY CARB	3524A68H06
C2	CAPACITOR	.1 MFD 100V ±5% TANTALUM	372466H03	C11	CAPACITOR	.033 MFD 100V ±5% MET-POLY CARB	3524A68H06
C3	CAPACITOR	.1 MFD 100V ±5% TANTALUM	1884669H01	C12	CAPACITOR	.1 MFD 100V ±5% MET-POLY CARB	3524A68H06
C4	CAPACITOR	.1 MFD 100V ±5% TANTALUM	80A333H01	C13	CAPACITOR	.1 MFD 100V ±5% MET-POLY CARB	3524A68H06
C5	CAPACITOR	100 MFD, 35V, ±20% TANTALUM	3524A68H06	C14	CAPACITOR	100 MFD, 35V, ±20% TANTALUM	3524A68H06
C6	CAPACITOR	.033 MFD, 100V, ±5% MET-POLY CARB	3524A68H06	D11	DIODE	1N4188	188A342H06
C7	CAPACITOR	.1 MFD 100V ±5% MET-POLY CARB	3524A68H06	IC1	INT CKT	MC110338AL TRIPLE 3 INPUT NAND	3527A09H02
C8	CAPACITOR	.1 MFD 100V ±5% MET-POLY CARB	3524A68H06	IC2	INT CKT	MC110118AL QUAD-2 INPUT NAND	3527A09H06
C9	CAPACITOR	.1 MFD 100V ±5% MET-POLY CARB	3524A68H06	IC3	INT CKT	MC110668BAL QUAD BILATERAL SWITCH	862A478H01
C15	CAPACITOR	.022 MFD 500V ±5% DIPPED MICA	3532A31H01	J03	JUMPER	0 OHM	962A478H01
C17	CAPACITOR	.022 MFD 500V ±5% DIPPED MICA	3532A31H01	J04	JUMPER	0 OHM	962A478H01
D1	DIODE	1N454A	837A62H03	LED3	RED LED (EDGE MOUNT)	3508A22H01	3508A22H01
D2	DIODE	1N454A	837A62H03	LED4	RED LED (EDGE MOUNT)	3508A22H01	3508A22H01
D3	DIODE	1N454A	837A62H03	Q9	TRANSISTOR	2N2907A PNP	762A672H17
D5	DIODE	1N454A	837A62H03	Q10	TRANSISTOR	D444VHIO NPN	3532A45H19
D7	DIODE	1N454A	837A62H03	R30	RESISTOR	51-1K 1/4W 1% METAL FILM	848A821H18
D8	DIODE	1N454A	837A62H03	R31	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
D9	DIODE	1N454A	837A62H03	R32	RESISTOR	511K 1/4W 1% METAL FILM	848A822H11
D10	DIODE	1N454A	837A62H03	R33	RESISTOR	51-1K 1/4W 1% METAL FILM	848A822H11
IC1	INT CKT	MC110338AL TRIPLE 3 INPUT NAND	3527A09H02	R34	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
IC2	INT CKT	MC110118AL QUAD-2 INPUT NAND	3527A09H06	R35	RESISTOR	500K 1/4W 1% METAL FILM	848A822H11
IC3	INT CKT	MC110668BAL QUAD BILATERAL SWITCH	862A478H01	R36	RESISTOR	5.0K 1/4W 1% METAL FILM	848A822H11
J1	JUMPER	0 OHM	862A478H01	R37	RESISTOR	330 OHMS 1/4W 5% WIRE WOUND	862A478H01
J2	JUMPER	0 OHM	862A478H01	R38	RESISTOR	22-1/4 OHM 25W ±5% AWLCL	862A478H01
LED-1	RED LED (EDGE MOUNT)	3508A22H01	3508A22H01	R39	RESISTOR	15K 1/4W 1% METAL FILM	848A822H11
LED-2	RED LED (EDGE MOUNT)	3508A22H01	3508A22H01	R40	RESISTOR	15K 1/4W 1% METAL FILM	848A822H11
PG-1	SWITCH	PUSHBUTTON	1441C63H01	R41	RESISTOR	-5 AMP DC PICKUP, FORM A	1442C62G01
Q1	TRANSISTOR	2N2907A PNP	762A672H17	R42	RESISTOR	-5 AMP DC PICKUP, FORM A	1442C62G01
Q2	TRANSISTOR	2N2907A PNP	762A672H17	R43	REED RELAY	REED RELAY	1442C62G01
Q3	TRANSISTOR	2N2907A PNP	762A672H17	R44	REED RELAY	REED RELAY	1442C62G01
Q4	TRANSISTOR	2N2907A PNP	762A672H17	R45	REED RELAY	REED RELAY	1442C62G01
Q5	TRANSISTOR	2N2907A PNP	762A672H17	R46	REED RELAY	REED RELAY	1442C62G01
Q6	TRANSISTOR	2N2907A PNP	762A672H17	R47	REED RELAY	REED RELAY	1442C62G01
Q7	TRANSISTOR	2N2907A PNP	762A672H17	R48	REED RELAY	REED RELAY	1442C62G01
Q8	TRANSISTOR	D444VHIO NPN	3532A45H19	R49	REED RELAY	REED RELAY	1442C62G01
R1	RESISTOR	1K 1/4W 1% METAL FILM	848A822H11	R50	RESISTOR	1K 1/4W 1% METAL FILM	848A822H11
R2	RESISTOR	3-01K 1/4W 1% METAL FILM	848A822H11	R51	RESISTOR	3-01K 1/4W 1% METAL FILM	848A822H11
R3	RESISTOR	51-1K 1/4W 1% METAL FILM	848A822H11	R52	RESISTOR	51-1K 1/4W 1% METAL FILM	848A822H11
R4	RESISTOR	100-OHM 1/4W 1% METAL FILM	848A822H11	R53	RESISTOR	100-OHM 1/4W 1% METAL FILM	848A822H11
R5	RESISTOR	20K 1/4W 1% METAL FILM	848A822H11	R54	RESISTOR	20K 1/4W 1% METAL FILM	848A822H11
R6	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R55	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R7	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R56	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R8	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R57	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R9	RESISTOR	30 OHMS 1/4W 1% METAL FILM	848A822H11	R58	RESISTOR	30 OHMS 1/4W 1% METAL FILM	848A822H11
R10	RESISTOR	511K 1/4W 1% METAL FILM	848A822H11	R59	RESISTOR	511K 1/4W 1% METAL FILM	848A822H11
R11	RESISTOR	51-1K 1/4W 1% METAL FILM	848A822H11	R60	RESISTOR	51-1K 1/4W 1% METAL FILM	848A822H11
R12	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R61	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R13	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R62	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R14	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R63	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R15	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R64	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R16	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R65	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R17	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R66	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R18	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R67	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R19	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R68	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R20	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R69	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R21	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R70	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R22	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R71	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R23	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R72	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R24	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R73	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R25	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R74	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R26	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R75	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R27	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R76	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R28	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R77	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R29	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R78	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R30	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R79	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R31	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R80	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R32	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R81	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R33	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R82	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R34	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R83	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R35	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R84	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R36	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R85	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R37	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R86	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R38	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R87	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R39	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R88	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R40	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R89	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R41	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R90	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R42	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R91	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R43	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R92	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R44	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R93	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R45	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R94	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R46	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R95	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R47	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R96	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R48	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R97	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R49	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R98	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R50	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R99	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R51	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R100	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R52	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R101	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R53	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R102	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R54	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R103	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R55	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R104	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R56	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R105	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R57	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R106	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R58	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R107	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R59	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R108	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R60	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R109	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R61	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R110	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R62	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R111	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R63	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R112	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R64	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R113	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R65	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R114	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R66	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R115	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R67	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R116	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R68	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R117	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R69	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R118	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R70	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R119	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R71	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R120	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11
R72	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11	R121	RESISTOR	10K 1/4W 1% METAL FILM	848A822H11

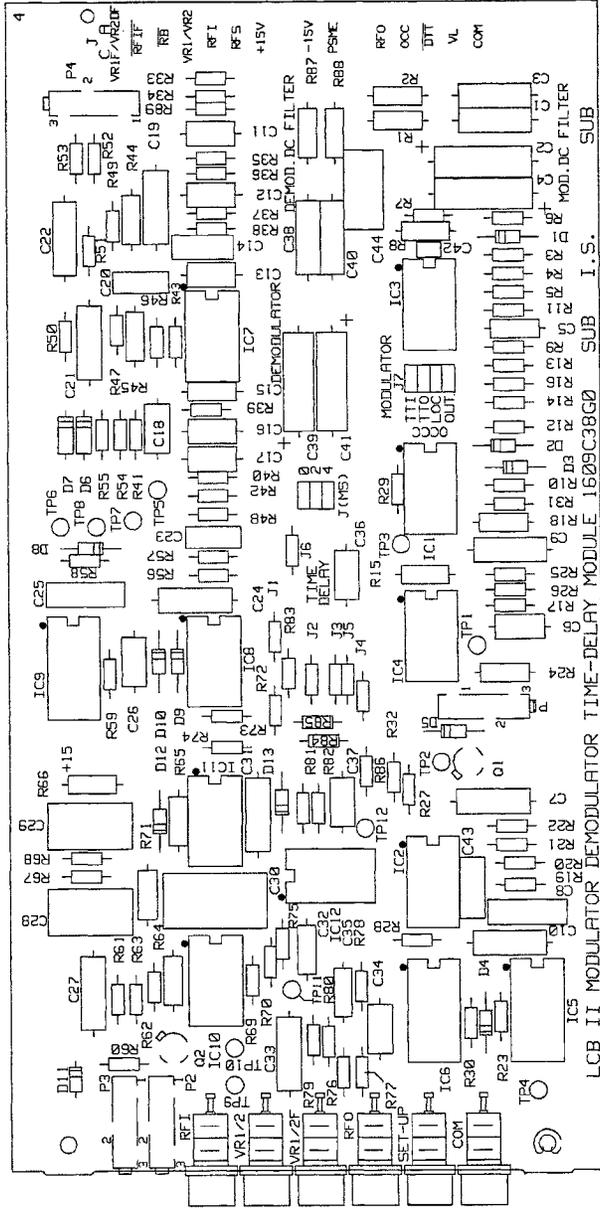
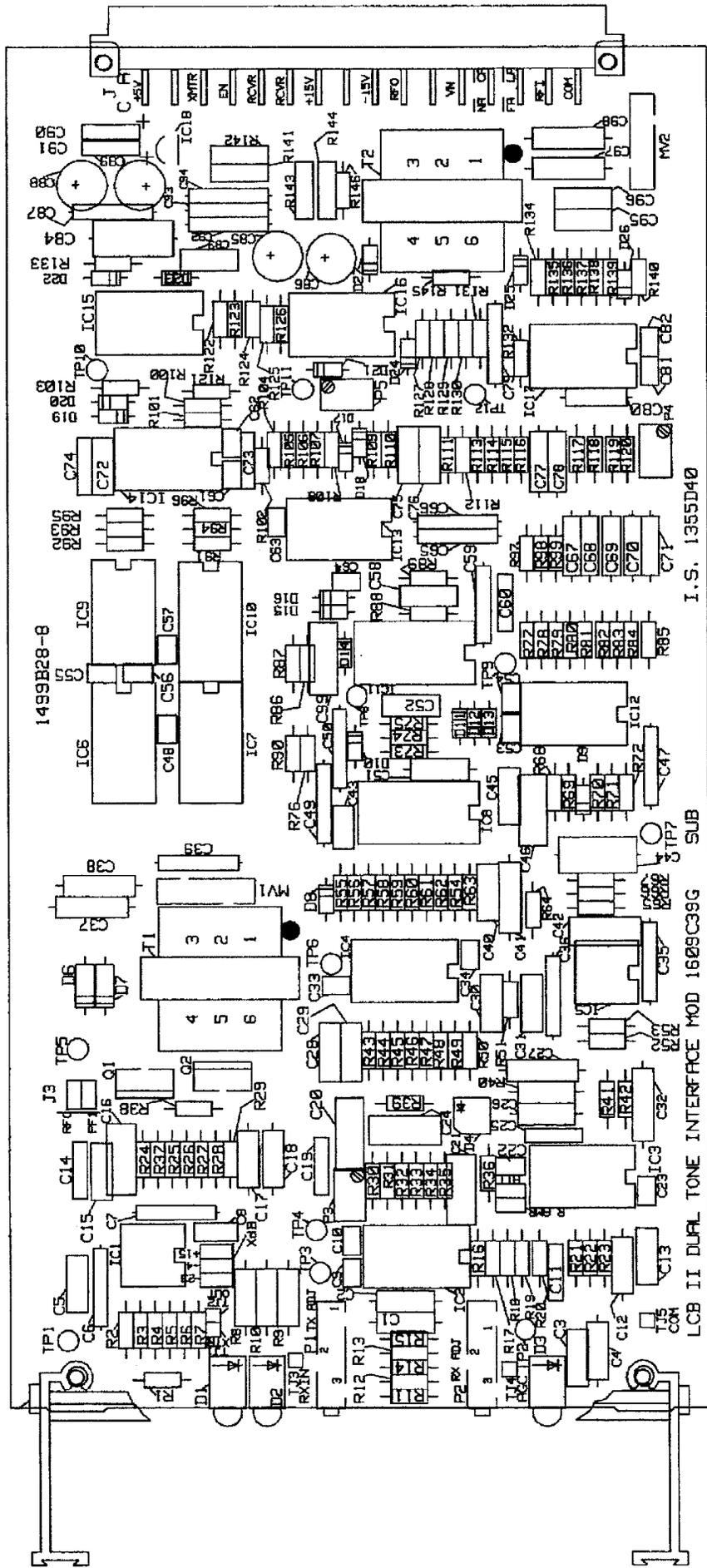
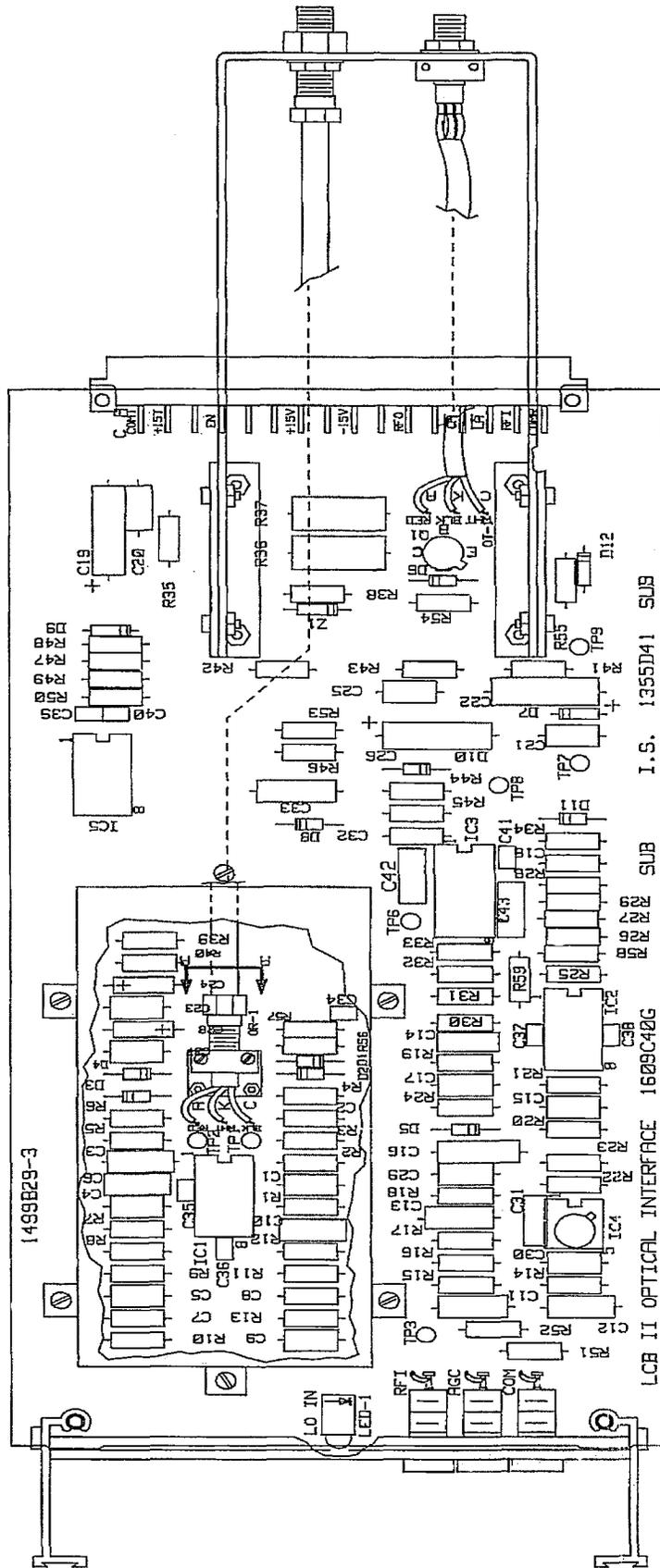


Figure 10: Component Location MD/DTD Module



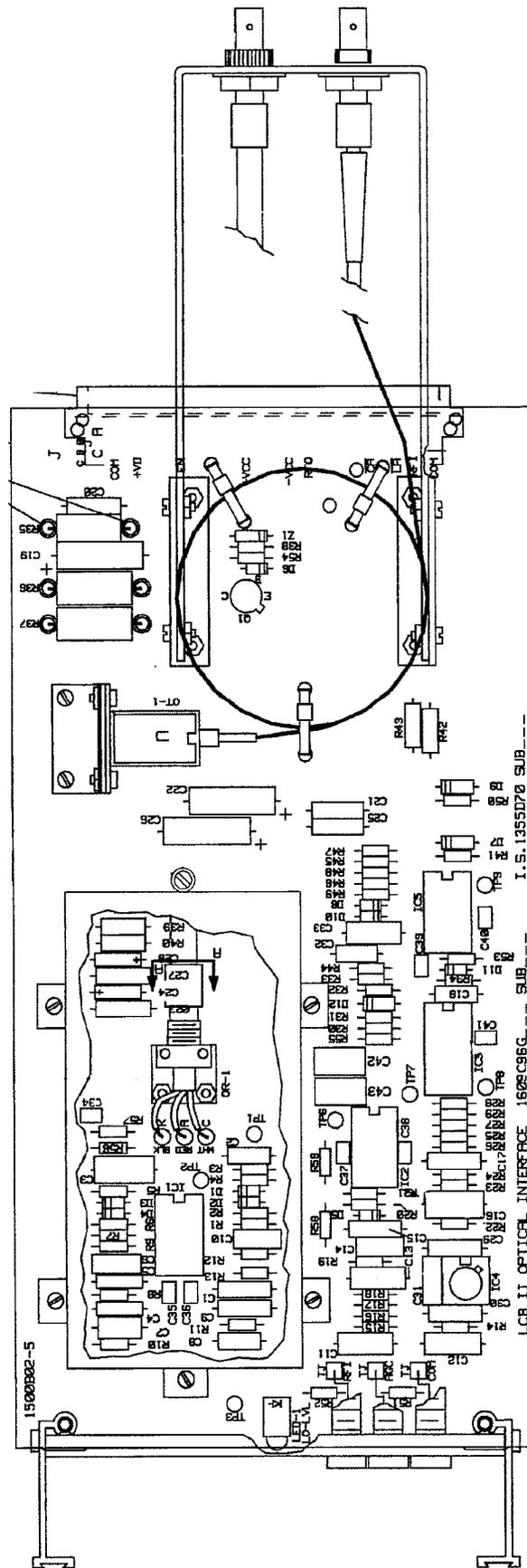
Sub 9  
1609C39

Figure 11: Component Location IFDT Module



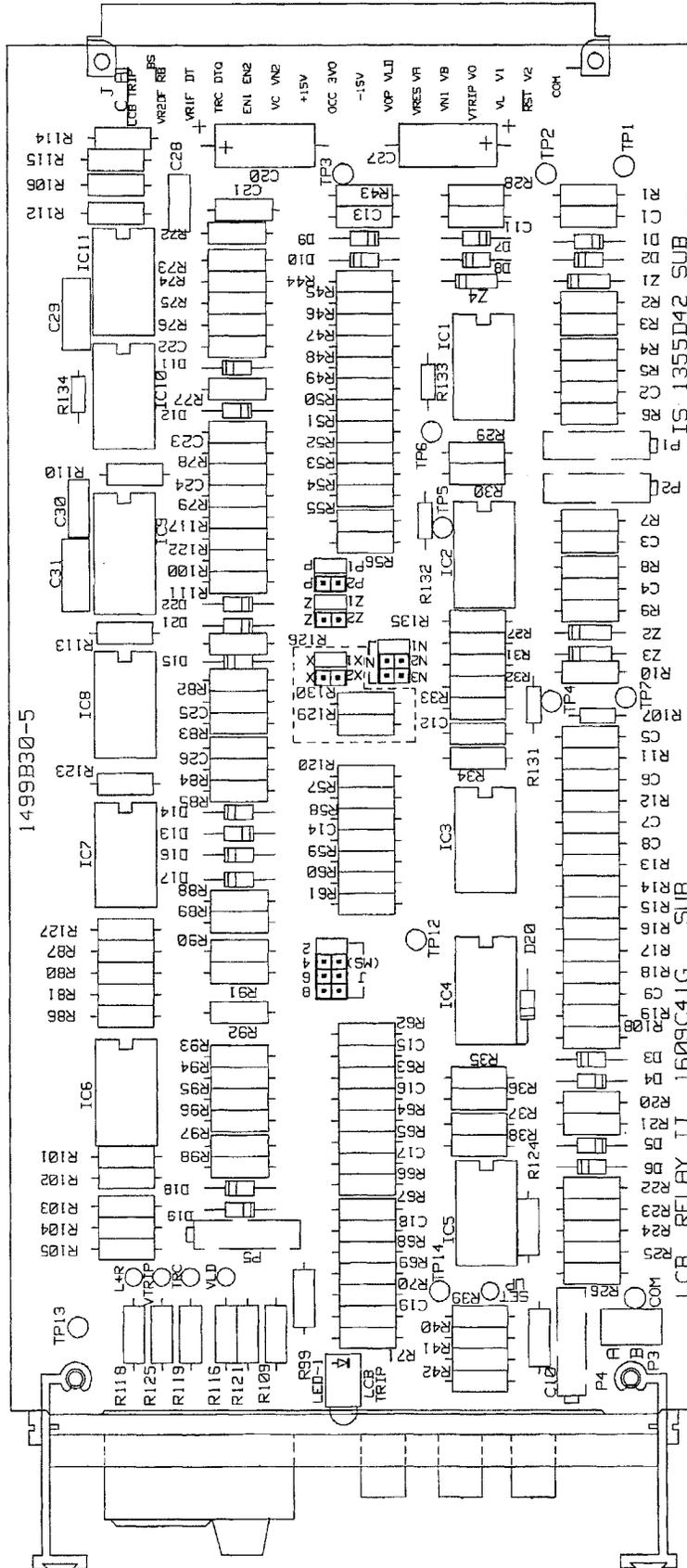
Sub 2  
1499B44

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

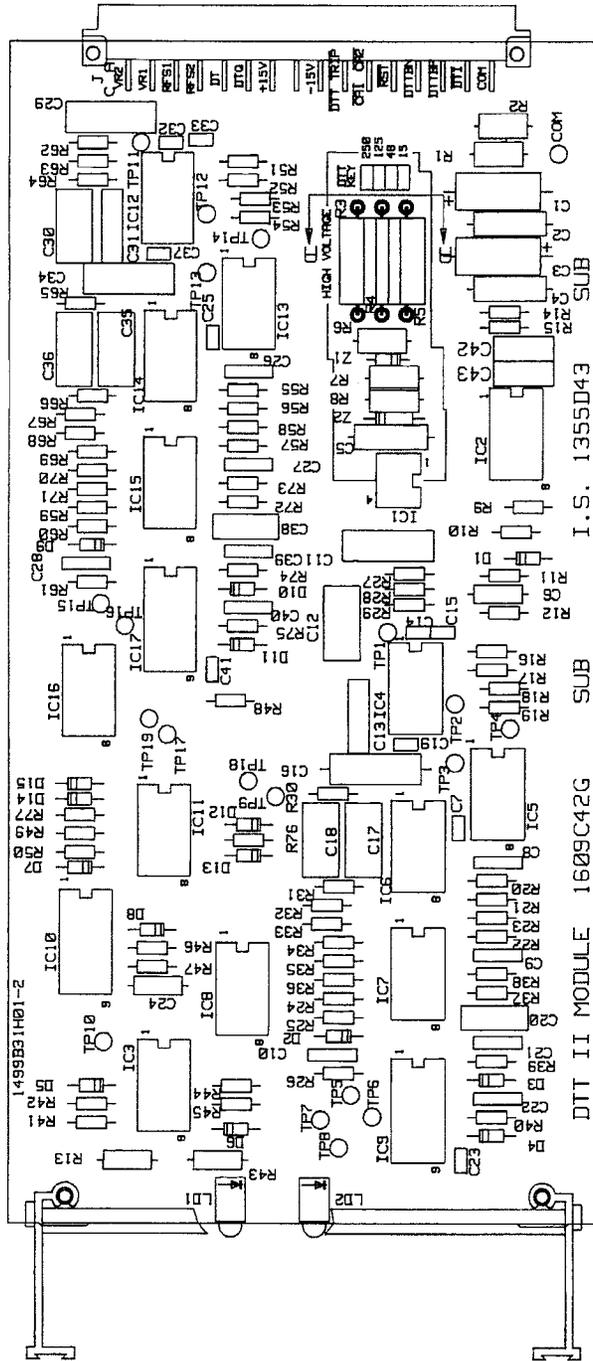


Figure 15: Component Location DTT Module

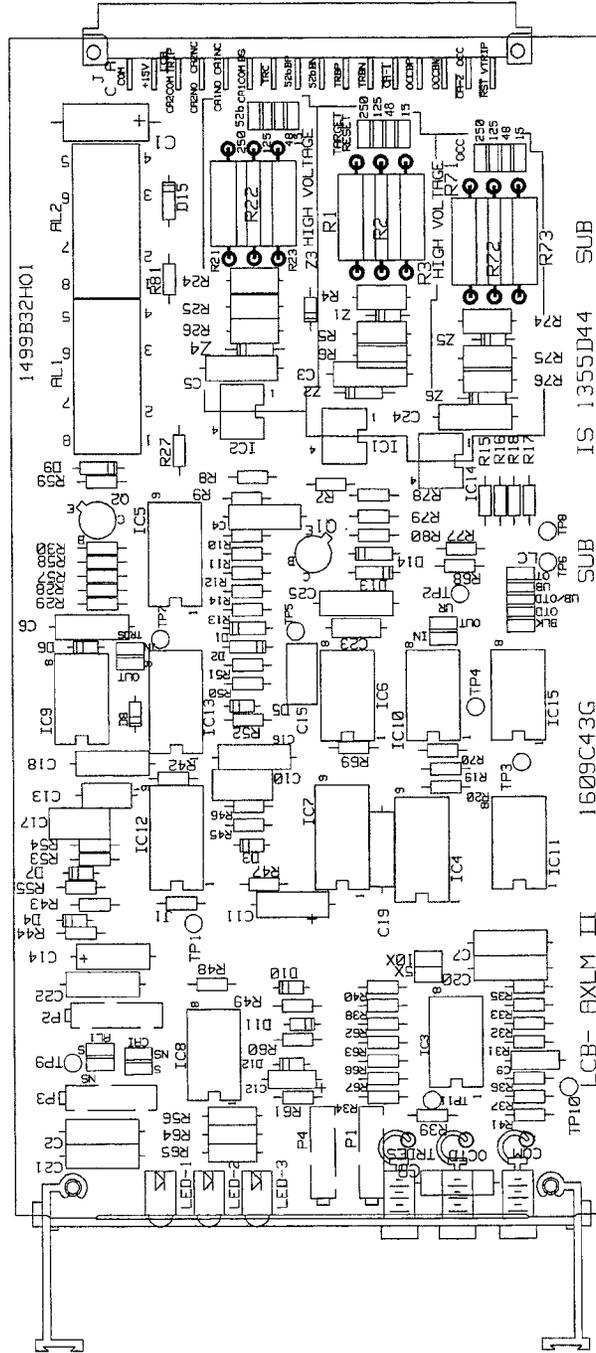


Figure 16: Component Location ALXM Module

Sub 6  
1609C43

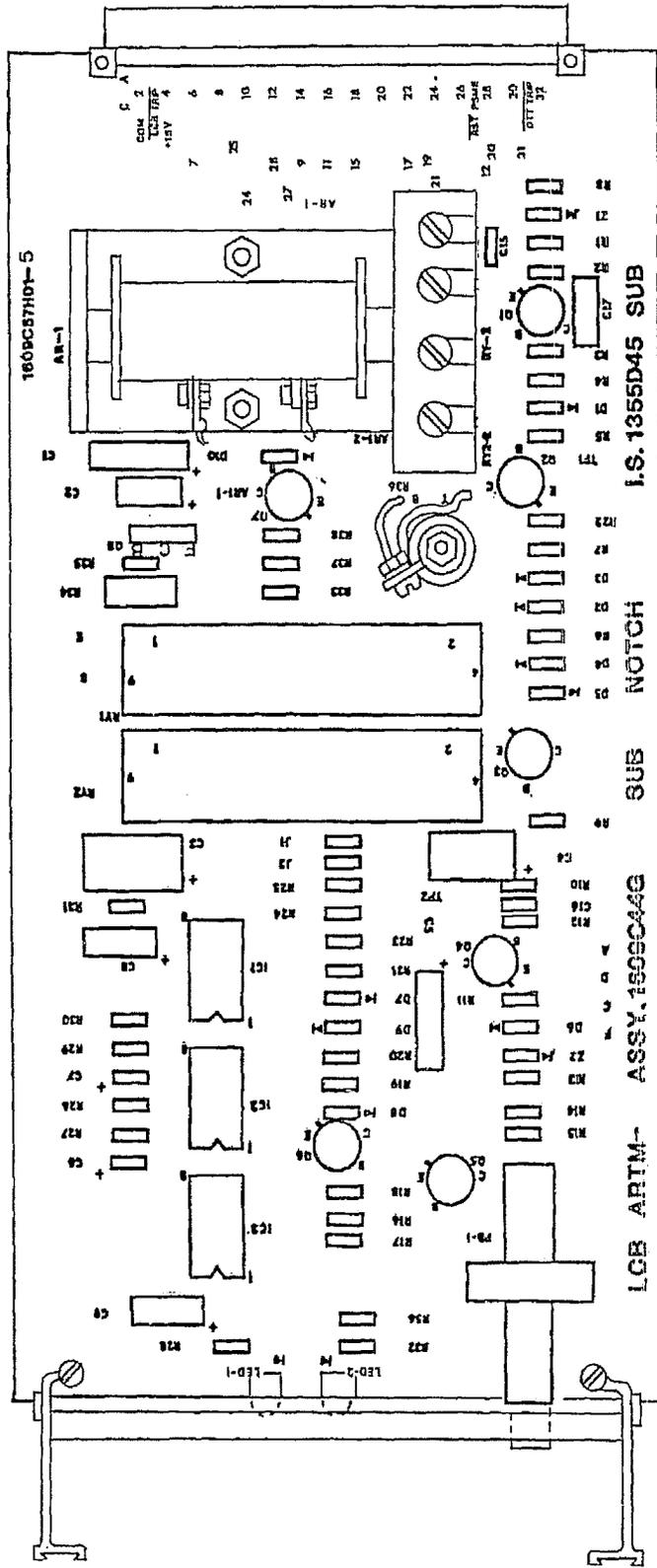


Figure 17: Component Location ARTM-1 Module

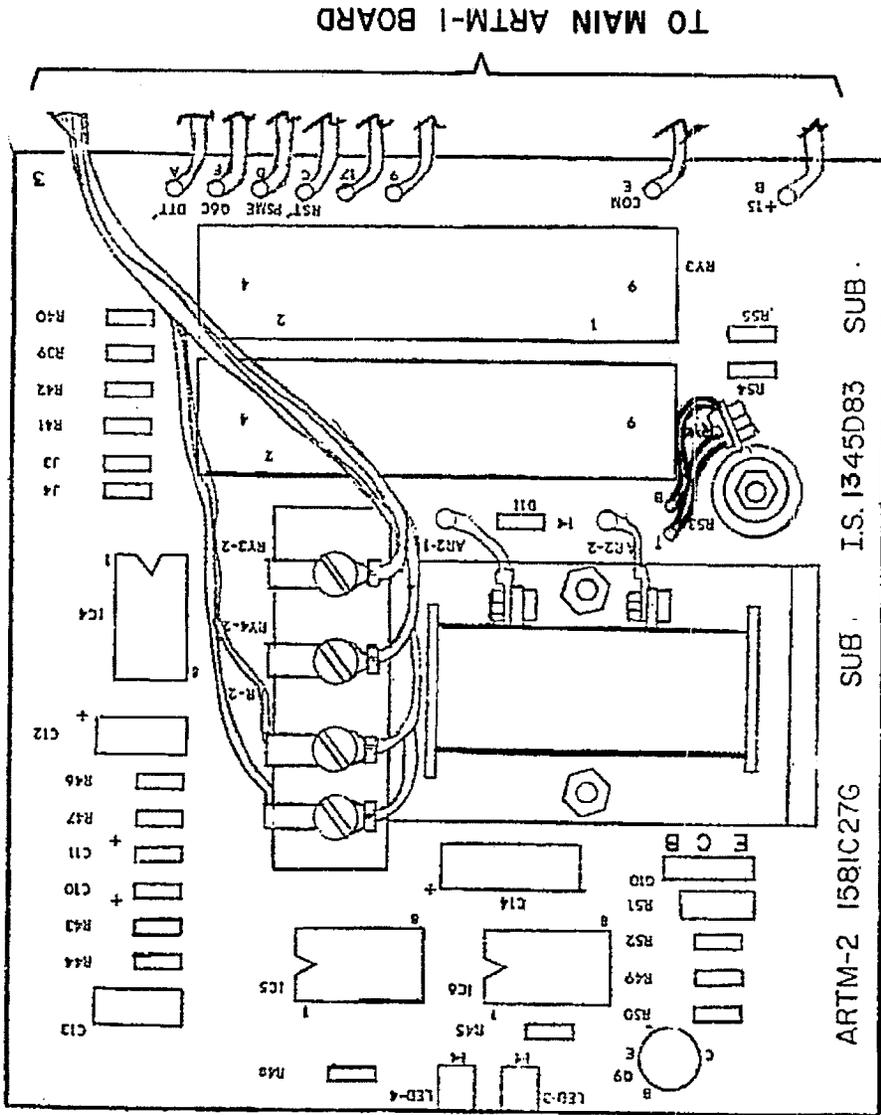


Figure 18: Component Location ARTM-2 Module

**NOTES**



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