(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 278 393 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.01.2003 Bulletin 2003/04

(51) Int Cl.[7]: **H04R 1/00**

(21) Application number: **02254663.4**

(22) Date of filing: **03.07.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **19.07.2001 US 909197**

(71) Applicant: **AUDIO-TECHNICA U.S., INC.**
Stow Ohio 44224 (US)

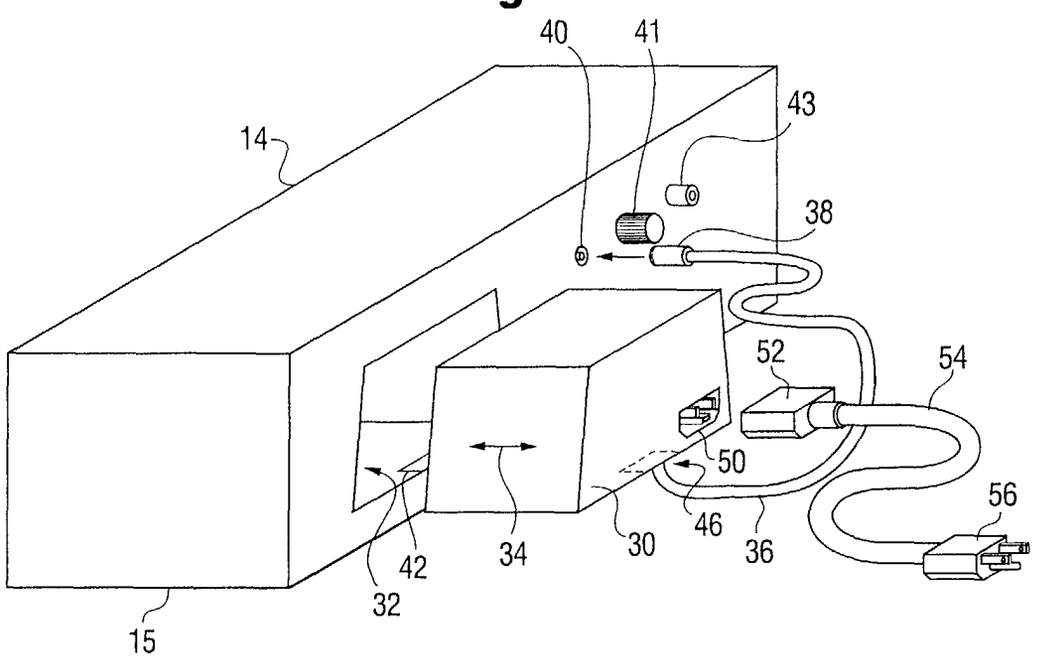
(72) Inventors:
- **Narumi, Tomoyuki**
  Sabee-Shi, Fukui (JP)
- **Ishikawa, Ayako**
  Imadate-Gun,Fukui (JP)

(74) Representative: **Gymer, Keith Francis et al**
Page Hargrave,
Southgate,
Whitefriars
Lewins Mead, Bristol BS1 2NT (GB)

(54) Removable power supply

(57) A method and apparatus are described for providing power to an audio signal processor. The method includes the steps of providing a receptacle for a housing of a voltage converting power supply within an enclosure of the audio signal processor and removably disposing the voltage converting power supply within the enclosure of the audio signal processor.

Fig. 2



EP 1 278 393 A2

Description

Field of the Invention

[0001] The field of the invention relates to audio devices. More particularly, the invention relates to power supplies for audio devices.

Background of the Invention

[0002] Power supplies for audio devices such as portable microphones and amplifiers are generally provided as an integral part of the device that it powers. A power supply cord is typically provided to connect the power supply in to an alternating current (AC) supply. The AC supply is usually obtained from a public power grid.

[0003] Within the power supply, a transformer is usually provided to reduce a voltage of the AC supply to a level convenient for use within a set of integrated circuits of the audio device. The reduced voltage is often rectified within the power supply to further simplify powering the integrated circuits.

[0004] As a recent trend, unitary power supplies have become available that are separate from the devices which they power. Often the newly available power supplies are provided with their own enclosure and a cord for connecting the power supply to the device that it is intended to power. A set of prongs are usually provided on an exterior surface of the enclosure for engaging a wall outlet or power strip.

[0005] While the unitary power supplies are useful, they are often inconvenient to use. Because of the size of the enclosure, only one (or at most two) power supplies may be used in adjacent outlets. Because of the importance of audio devices, a need exists for a more convenient way of powering audio devices.

Summary of the Invention

[0006] A method and apparatus are described for providing power to an audio signal processor. The method includes the steps of providing a receptacle for a housing of a voltage converting power supply within an enclosure of the audio signal processor and removably disposing the voltage converting power supply within the enclosure of the audio signal processor.

Brief Description of the Drawings

[0007]

FIG. 1 is a perspective view of an audio system in accordance with an illustrated embodiment of the invention;

FIG. 2 is a rear prespective view of the base station of the system of FIG. 1;

FIG. 3 is a cross-sectional view of the power supply of the base station of FIG. 2;

FIG. 4 is a top cut-away view of the base station of FIG. 2;

FIG. 5 is a block diagram of the signal processing functions performed by the base station of FIG. 2;

FIG. 6 is a detailed schematic of the block diagram of FIG. 5;

FIG. 7 is a detailed schematic of the block diagram of FIG. 5;

FIG. 8 is a top view of a circuit board used within the base station of FIG. 2 and

FIG. 8 is a bottom view of a circuit board used within the base station of FIG. 2.

Detailed Description of a Preferred Embodiment

[0008] FIG. 1 depicts a microphone/amplifier system 10 under an illustrated embodiment of the invention. The system 10 may be used in any of a number of environments where the microphone user cannot be encumbered by a wires connected to an amplifier.

[0009] The system 10 includes a handheld microphone transmitter 12, belt-worn transmitter 16 and base station receiver 14. As would be familiar to persons of skill in the performing arts, the transmitters 12, 16 are equipped with a radio-frequency (RF) transmitter. The RF transmitter may be of a relatively low power and have a relatively short range. During use, the transmitters 12, 16 may transmit a signal 13, 22 to the base station receiver 14.

[0010] The transmitter 16 may be provided with a clip 18 that may be attached to a belt of the user (not shown). An antenna 20 may be provided for transmitting a signal 22 to an antenna 24 of the base station 14.

[0011] The base station 14 and transmitters 12, 16 may include a channel selector 26. The channel selector 26 may be used to select one of a number of RF channels, free of noise from nearby noise sources.

[0012] A squelch control 41 (FIG. 2) may be provided on a back surface of an enclosure 15 of the base station 14. The squelch control 41 may be used to further reduce interference from the other noise sources.

[0013] The base station 14 may also include a volume control 28. The volume control 28 may be used to control an amplitude of an output signal available through an AF output 43.

[0014] The base station 14 may receive and amplify the signal received from the transmitters 12, 16. The amplified signal may, in turn, be provided to a power amplifier and speakers (not shown) through the AF out 43.

[0015] In order to reduce space, the base station 14 may be equipped with a removable, unitary power supply 30. The enclosure 15 of the base station 14 may be provided with a receptacle 32 (FIG. 2) to slidably receive the unitary power supply 30. A set of dimensions of the inside of the receptacle 32 may be complementary to (e.g., 1/8 inch larger than) the outer dimensions of the power supply 30.

[0016] To prevent insertion of the power supply upside

down, the sides 60 (FIG. 3) of the power supply 30 and the sides of the receptacle 32 may be tapered. More specifically, the edge 60 may taper inwards by an appropriate angle (e.g., 5 degrees) to ensure proper insertion of the power supply 30 into the enclosure 15 of the power supply 30.

[0017] As shown in FIG. 2, the power supply 30 may be easily and conveniently moved 34 into and out of the receptacle 32. Once fully inserted into the receptacle 32, the power supply 30 may be substantially enclosed by the enclosure 15 with only a back surface of the power supply 30 exposed for making power connections.

[0018] Once the power supply 30 is fully inserted into the receptacle 32, a resiliently biased detent (e.g., a peg) 42 may engage a recessed area 46 of the power supply 30 securing the power supply within the receptacle 32. Alternatively, the detent 42 may engage a back edge of an enclosure of the power supply 30, thereby securing the power supply within the receptacle 32.

[0019] Whether inserted into the receptacle 32, or not, an external set of conductors 36 may be provided to couple electrical power from the power supply 30 to the base station 14. A plug 38 may be provided on one end of the conductors 36 to engage an electrical receptacle 40 on the enclosure 15. The receptacle 40 may receive power from the plug 38 and, in turn, function as a source of power for the base station 14.

[0020] Also provided on the power supply 30 is a recessed male plug 50. The recessed plug 50 may be adapted to receive a female plug 52 of an external power cord (mains plug) 54. The power supply cord 54 may be provided to conduct AC power from another male plug 56 to the female plug 52. The male plug 56 may receive power from a wall outlet or outlet strip, in turn, receiving power from a public utility.

[0021] In order to further reduce interference, the power supply 30 and receptacle 32 may be located remotely from any low-level signal processing functions. FIG. 4 may be used to depict to top view of a component layout map of the base station 14. As shown, the power supply 30 may be substantially located at a first end of the base station 14. In contrast, low-level signal processing of a circuit board 66 may be located proximate a second end of the base station 14.

[0022] The positioning of the power supply 30 at an opposing end of the base station 14 allows the low-level signal processing board 66 to be shielded from interference. For example, a separate shield 68 may be installed around the receptacle 32 to further shield a class 2 transformer 64 and rectifier 62 of the power supply 30.

[0023] In addition, a person of skill in the art would recognize the importance of the specifics of the physical separation between the transformer 64 and noise sensitive signal processing elements. For example, FIG. 5 is a block diagram of signal processing functions occurring within the base station 14 and FIGs. 6 and 7 are detailed schematics of the physical devices providing the processing functions of the circuit of the base station 14. FIGs. 8 and 9 are top and bottom views of the layout of the circuit board of the base station 14 showing the physical separations of the noise sensitive signal processing elements and the transformer 64.

[0024] The bandpass filtering provided by FIL 30 and the second mixing functions occurring within IC 100 (FIGs. 5-7) would be recognized as being functions that would be particularly susceptible to noise. In order to reduce noise, a separation of 5 cm may be provided between the filter FIL 30 and the transformer 64. A separation of 7.5 cm may exist between the IC100 and the transformer 64.

[0025] Another sensitive element may be the tank circuit used in conjunction with the second mixer of the IC100. An inductor L100 of this tank circuit may be placed 7.5 cm from the transformer 64.

[0026] Further, the AF OUT provided through connector JK201 would be recognized as another sensitive device. The separation between the connector JK201 and transformer 64 may be 6 cm.

[0027] In order to improve the separation between the noise sensitive components and the transformer 64, other components may be moved closer to the transformer 64 to allow greater separation for the noise sensitive components. In effect, the separation of the sensitive components may be achieved by preferentially separating noise sensitive components at the expense of less sensitive components.

[0028] Under the illustrated embodiment, the base station 14 may be used with an integral power supply 30 (i.e., the power supply 30 inserted into the receptacle 32) or with the power supply 30 located remotely from the base station 14. The ability of the base station 14 to use the power supply 30 in either configuration improves the utility of the base station 14 in a number of regards. First, the use of a removable power supply 30 eliminates obstructions at the power source by providing a transformer module that may be located away from the power source within the enclosure 15. For example, a common complaint of prior art wall adapter units is that they take up too much room in an audio equipment power rack or power strip.

[0029] Further, the integrated AC supply 30 can located at any convenient location. This is of benefit when many base stations 14 are to be used in close proximity to avoid interference among receivers 14.

[0030] Further the external power cord 54 may be equipped with an IEC-approved AC mains plug 56. This allows the end user to use whichever AC plug configuration is appropriate for his/her country.

[0031] Because the IEC mains cord 54 allows cables to be exchanged, it is easy for the end user to alter the length of the AC cable 54. Not only does this make things neater and more convenient, but it also helps in reducing hum and interference.

[0032] A specific embodiment of a method and apparatus for providing power to an audio device has been described for the purpose of illustrating the manner in

which the invention is made and used. It should be understood that the implementation of other variations and modifications of the invention and its various aspects will be apparent to one skilled in the art, and that the invention is not limited by the specific embodiments described. Therefore, it is contemplated to cover the present invention and any and all modifications, variations, or equivalents that fall within the true spirit and scope of the basic underlying principles disclosed and claimed herein.

Claims

1. A method of providing power to an audio signal processor, such method comprising the steps of:

providing a receptacle for a housing of a voltage converting power supply within an enclosure of the audio signal processor; and
removably disposing the voltage converting power supply within the enclosure of the audio signal processor.

2. The method of providing power to an audio signal processor as in claim 1 further comprising disposing a receptacle for a plug of an external power source within the housing of the power supply.

3. The method of providing power to an audio signal processor as in claim 1 further comprising providing a set of external conductors for coupling the power supply to the audio signal processor.

4. The method of providing power to an audio signal processor as in claim 3 further comprising disposing an electrical receptacle in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.

5. The method of providing power to an audio signal processor as in claim 3 further comprising disposing a plug on an end of the external conductors for engaging the electrical receptacle in the enclosure of the audio signal processor.

6. The method of providing power to an audio signal processor as in claim 3 further comprising defining the audio signal processor as being an audio amplifier.

7. The method of providing power to an audio signal processor as in claim 1 further comprising providing a inner set of dimensions of the receptacle that are complementary to an outer set of dimensions of the converting power supply.

8. The method of providing power to an audio signal processor as in claim 7 further comprising tapering the power supply and receptacle to prevent improper insertion.

9. The method of providing power to an audio signal processor as in claim 7 further comprising preferentially separating noise sensitive signal processing components from a transformer of the voltage converting power supply.

10. The method of providing power to an audio signal processor as in claim 9 further comprising shielding the noise sensitive signal processing components from the transformer.

11. An apparatus for providing power to an audio signal processor, such apparatus comprising:

a voltage converting power supply; and
a receptacle disposed within an enclosure of the audio signal processor, said receptacle being adapted to removably receive the voltage converting power supply.

12. The apparatus for providing power to an audio signal processor as in claim 11 further comprising a receptacle for a plug of an external power source disposed within the housing of the power supply.

13. The apparatus for providing power to an audio signal processor as in claim 11 further comprising a set of external conductors adapted to couple the power supply to the audio signal processor.

14. The apparatus for providing power to an audio signal processor as in claim 13 further comprising an electrical receptacle disposed in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.

15. The apparatus for providing power to an audio signal processor as in claim 13 further comprising a plug disposed on an end of the external conductors for engaging the electrical receptacle in the enclosure of the audio signal processor.

16. The apparatus for providing power to an audio signal processor as in claim 13 wherein the audio signal processor further comprises an audio amplifier.

17. The apparatus for providing power to an audio signal processor as in claim 11 wherein an inner surface of the receptacle and an outer surface of the voltage converting power supply further comprise a complementary set of dimensions.

18. The method of providing power to an audio signal processor as in claim 17 wherein the receptacle and

converting power supply further comprise a tapered cross-section.

19. An apparatus for providing power to an audio signal processor, such apparatus comprising:

a voltage converting power supply; and
means disposed within an enclosure of the audio signal processor for removably receiving the voltage converting power supply.

20. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means disposed within the housing of the voltage converting power supply for receiving power from an external source.

21. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means coupled to the means for receiving power for coupling the power supply to the external power source.

22. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means disposed in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.

FIG. 1

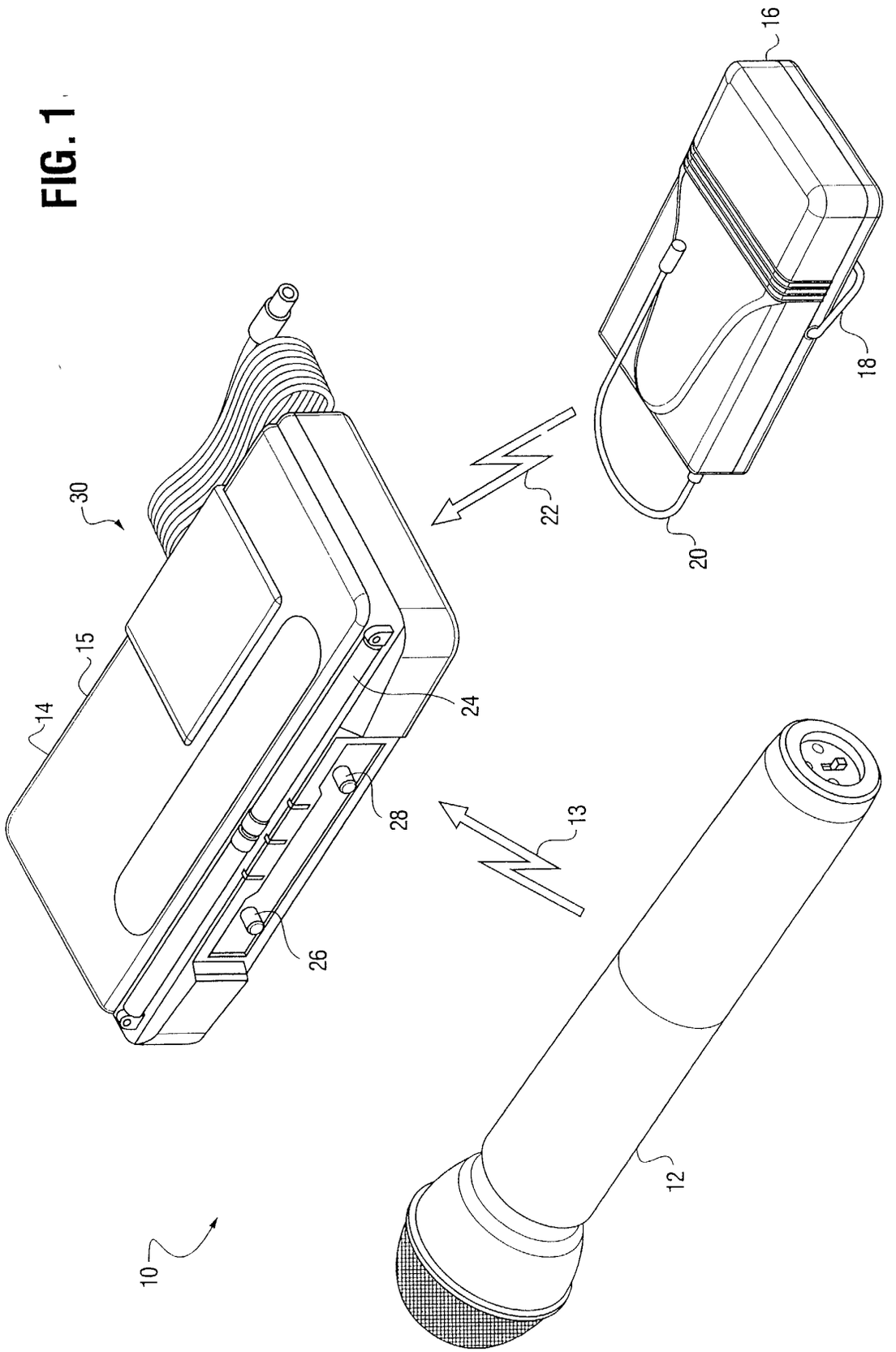


Fig. 2

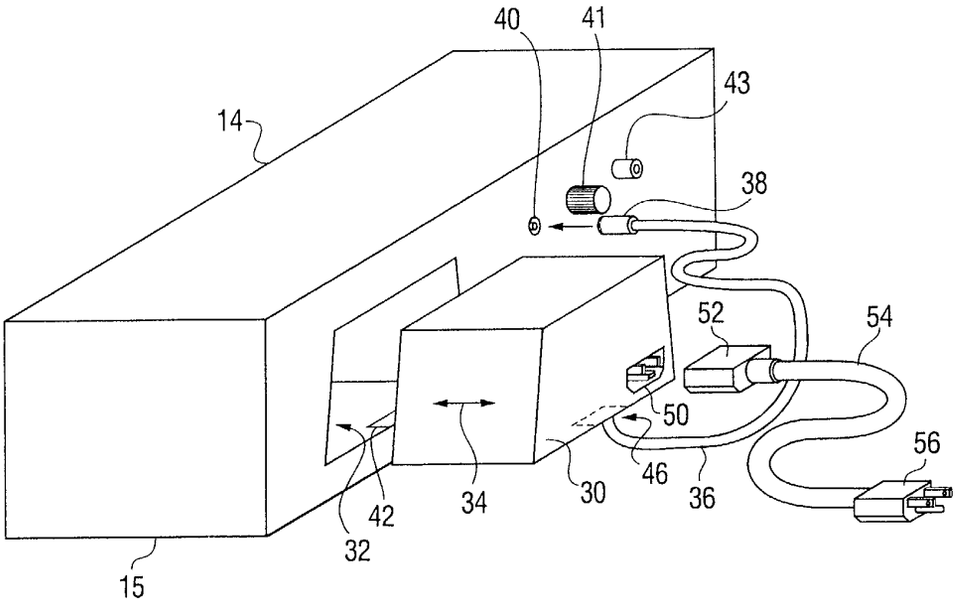


Fig. 3

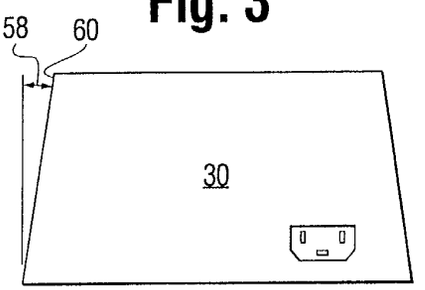


Fig. 4

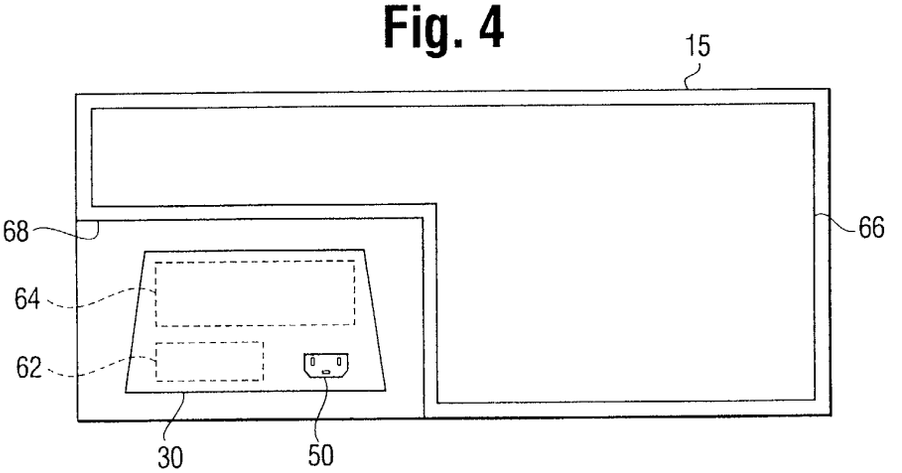


FIG. 5

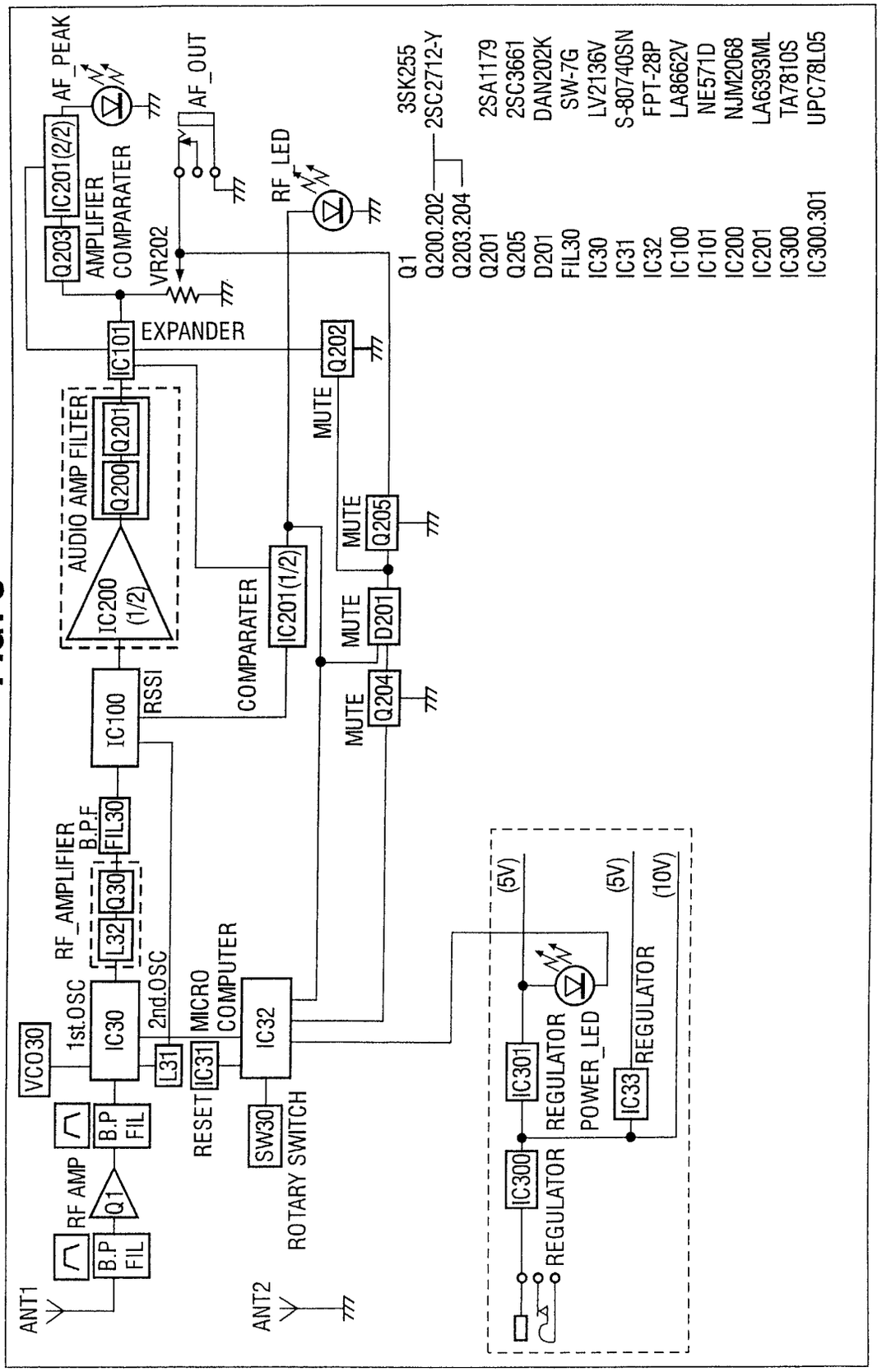

ANT1
B.P FIL
RF AMP
Q1
B.P FIL
VCO30
1st.OSC
IC30
2nd.OSC
L31
IC31
MICRO COMPUTER
RESET
IC32
SW30
ROTARY SWITCH
ANT2
RF_AMPLIFIER
L32
Q30
B.P.F
FIL30
IC100
RSSI
AUDIO AMP FILTER
Q200
Q201
IC200 (1/2)
EXPANDER
IC101
COMPARATER
IC201(1/2)
Q203
IC201(2/2)
AMPLIFIER
COMPARATER
AF_PEAK
AF_OUT
VR202
RF_LED
MUTE
Q202
MUTE
Q205
MUTE
D201
MUTE
Q204
Q1
Q200.202
Q203.204
Q201
Q205
D201
FIL30
IC30
IC31
IC32
IC100
IC101
IC200
IC201
IC300
IC300.301
3SK255
2SC2712-Y
2SA1179
2SC3661
DAN202K
SW-7G
LV2136V
S-80740SN
FPT-28P
LA8662V
NE571D
NJM2068
LA6393ML
TA7810S
UPC78L05
IC300
REGULATOR
IC301
REGULATOR
(5V)
POWER_LED
IC33
REGULATOR
(5V)
(10V)

FIG. 6

FIG. 6A	FIG. 6B
FIG. 6C	FIG. 6D

FIG. 6A

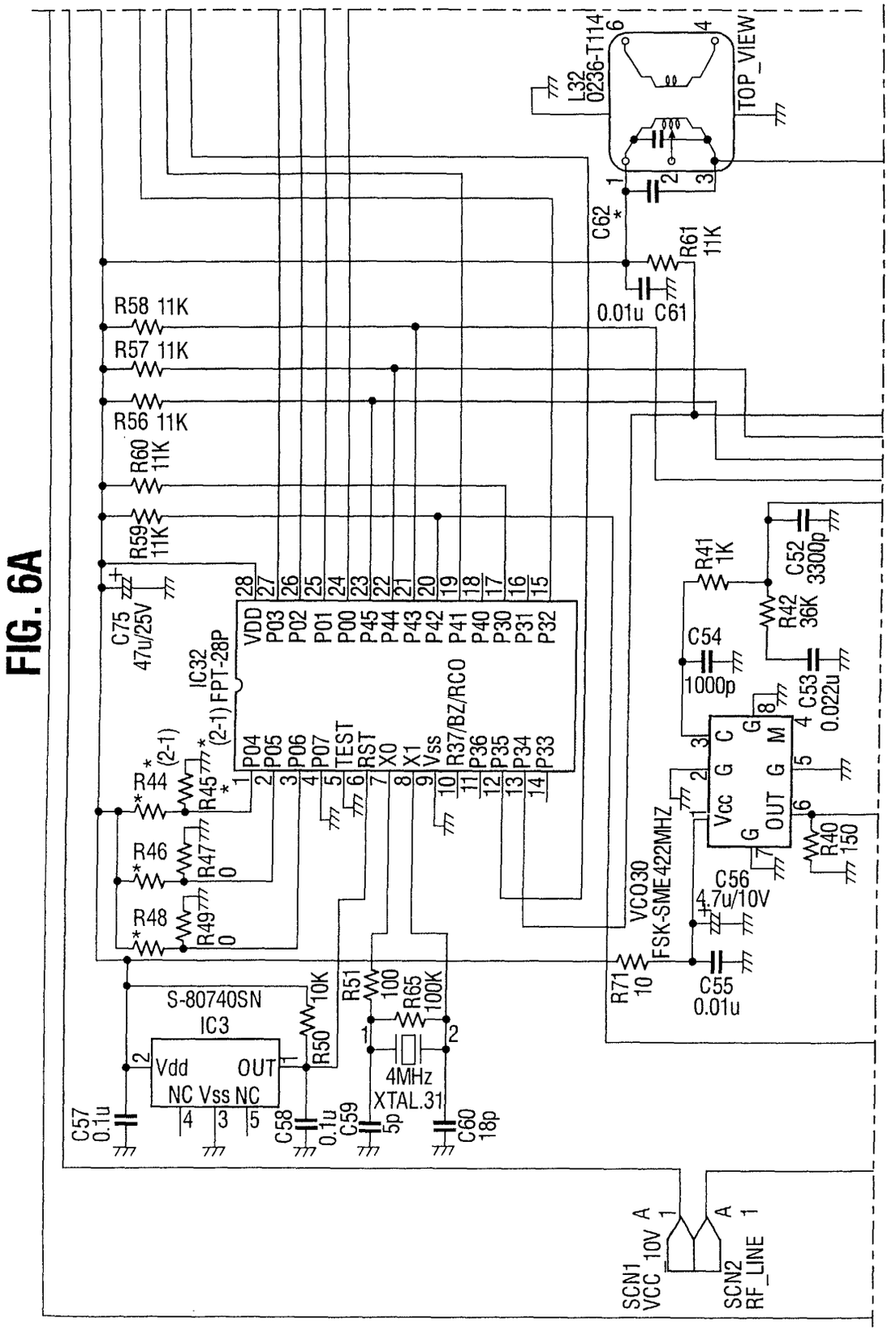

L32
0236-T114
TOP_VIEW
C62
R61
11K
0.01u C61
R58 11K
R57 11K
R56 11K
R60
11K
R59
11K
C75
47u/25V
IC32
(2-1) FPT-28P
VDD
P03
P02
P01
P00
P45
P44
P43
P42
P41
P40
P30
P31
P32
P04
P05
P06
P07
TEST
RST
X0
X1
Vss
R37/BZ/RCO
P36
P35
P34
P33
R44
R45
(2-1)
R46
R47
0
R48
R49
0
R41
1K
C52
3300p
R42
36K
C54
1000p
C53
0.022u
VCO30
FSK-SME422MHZ
Vcc
OUT
R40
150
C56
4.7u/10V
C55
0.01u
R71
10
S-80740SN
IC3
Vdd
OUT
NC Vss NC
R50
10K
R51
100
R65
100K
4MHz
XTAL.31
C57
0.1u
C58
0.1u
C59
5p
C60
18p
SCN1
VCC_10V
SCN2
RF_LINE

FIG. 6B

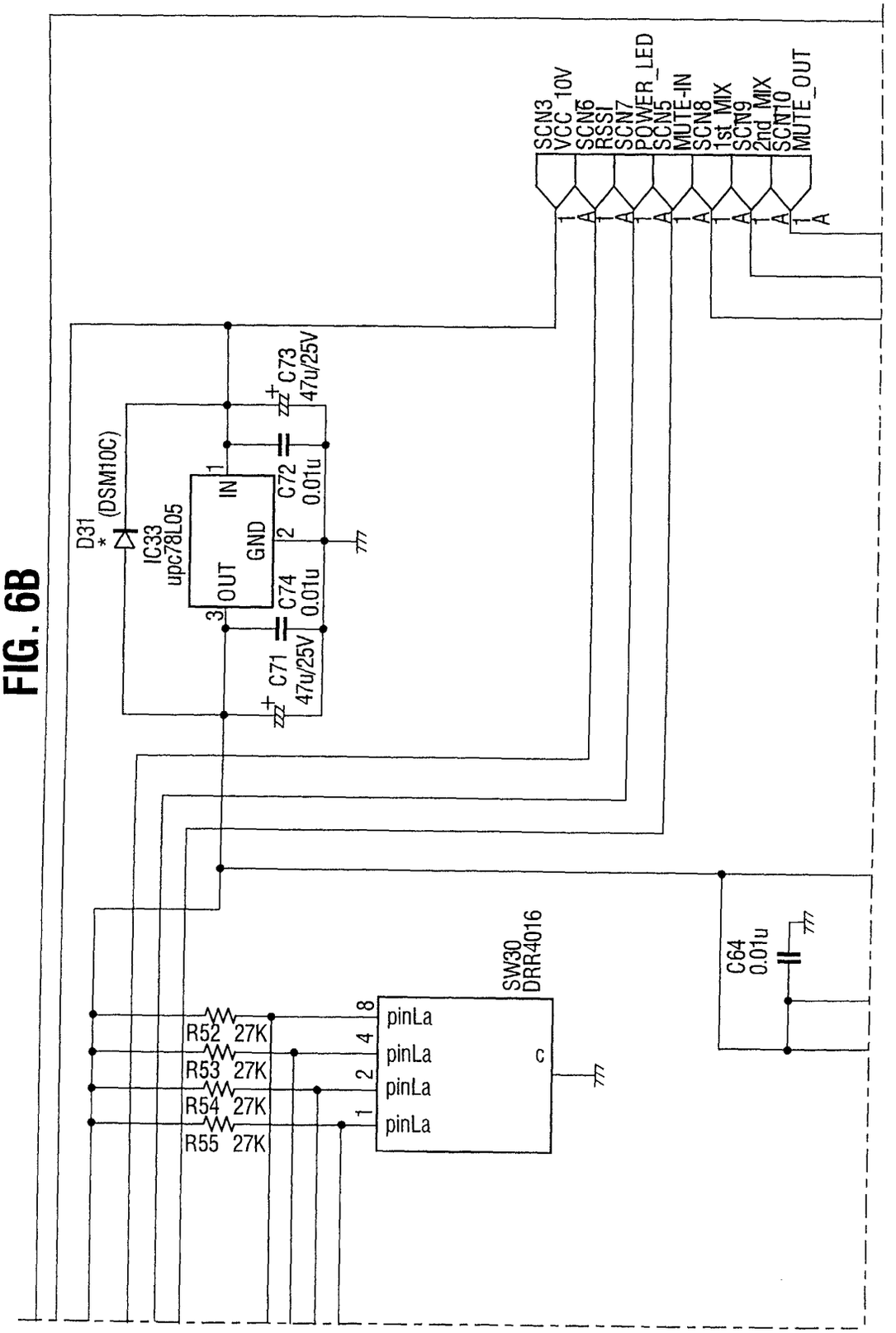

SCN3
VCC_10V
SCN6
RSSI
SCN7
POWER_LED
SCN5
MUTE-IN
SCN8
1st_MIX
SCN9
2nd_MIX
SCN10
MUTE_OUT
C73
47u/25V
C72
0.01u
C74
0.01u
C71
47u/25V
D31
(DSM10C)
IC33
upc78L05
IN
GND
OUT
SW30
DRR4016
pinLa
pinLa
pinLa
pinLa
c
R52 27K
R53 27K
R54 27K
R55 27K
C64
0.01u

FIG. 6C

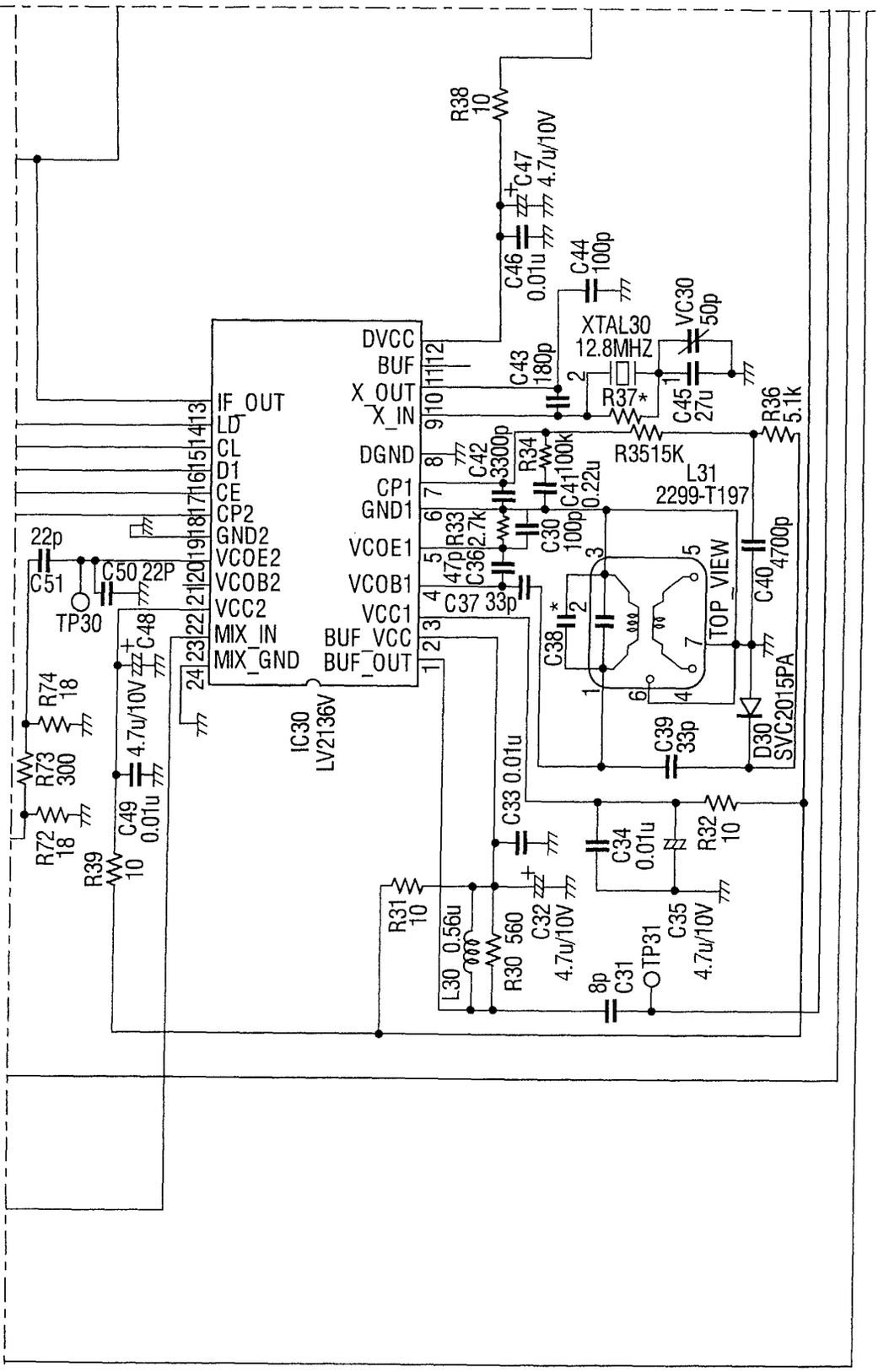

IC30
LV2136V
IF_OUT
LD
CL
D1
CE
CP2
GND2
VCOE2
VCOB2
VCC2
MIX_IN
MIX_GND
DVCC
BUF
X_OUT
X_IN
DGND
CP1
GND1
VCOE1
VCOB1
VCC1
BUF_VCC
BUF_OUT
R38 10
C47 4.7u/10V
C46 0.01u
C44 100p
XTAL30
12.8MHZ
VC30 50p
C43 180p
R37*
C45 27u
R36 5.1k
R3515K
C42 3300p
R34 100k
C41 0.22u
L31
2299-T197
R33 2.7k
C36 47p
C30 100p
C37 33p
C38 *
C40 4700p
TOP_VIEW
D30
SVC2015PA
C39 33p
C33 0.01u
C34 0.01u
R32 10
R31 10
L30 0.56u
R30 560
C32 4.7u/10V
C35 4.7u/10V
8p
C31
TP31
22p
C51
C50 22P
TP30
C48 4.7u/10V
R74 18
R73 300
R72 18
C49 0.01u
R39 10

FIG. 6D

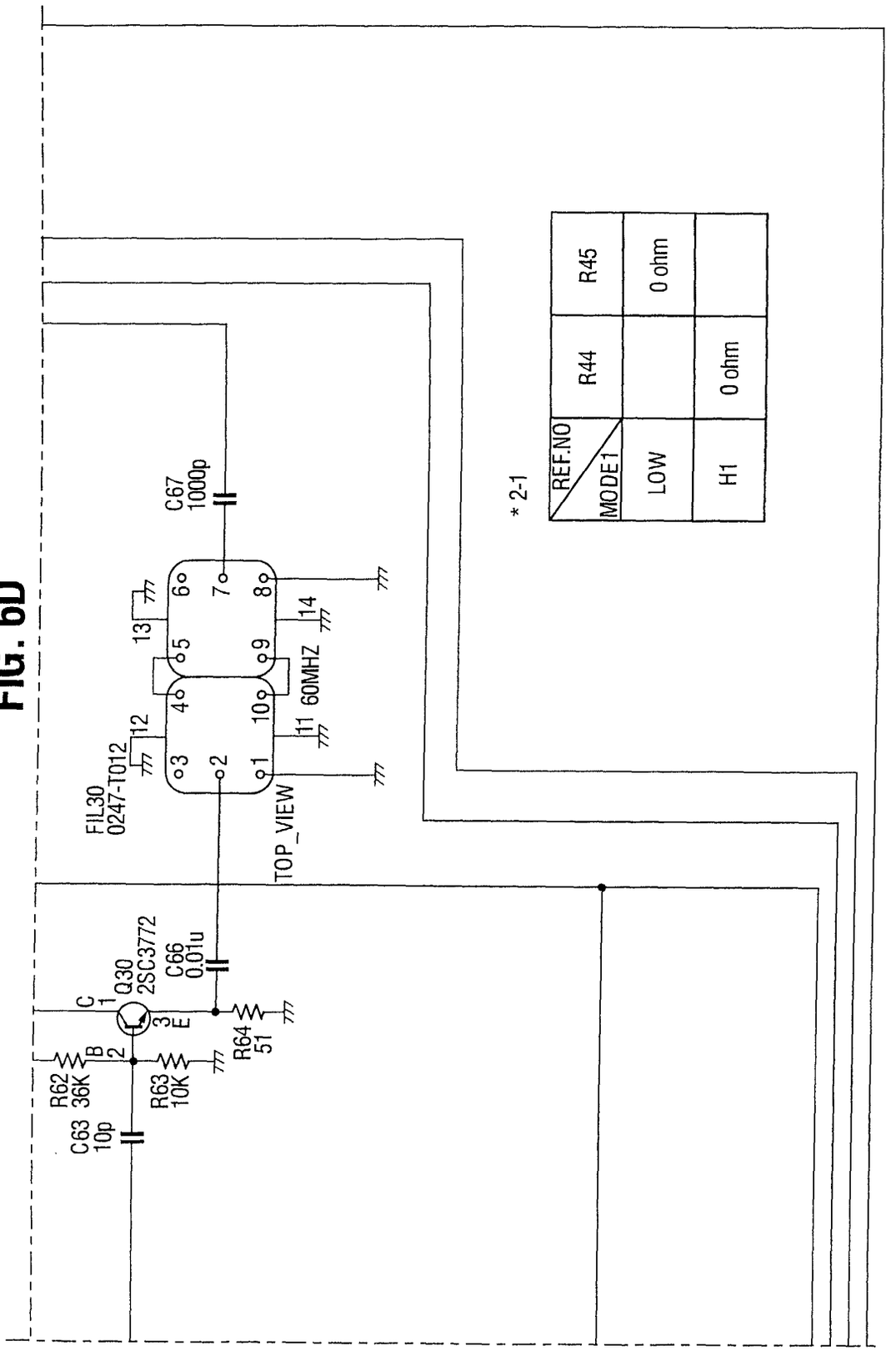

C67
1000p
FIL30
0247-T012
TOP_VIEW
60MHZ
Q30
2SC3772
C66
0.01u
R64
51
R62
36K
R63
10K
C63
10p
* 2-1
REF.NO
MODE1
R44
R45
LOW
H1
0 ohm
0 ohm

FIG. 7

FIG. 7A	FIG. 7B
FIG. 7C	FIG. 7D

FIG. 7A

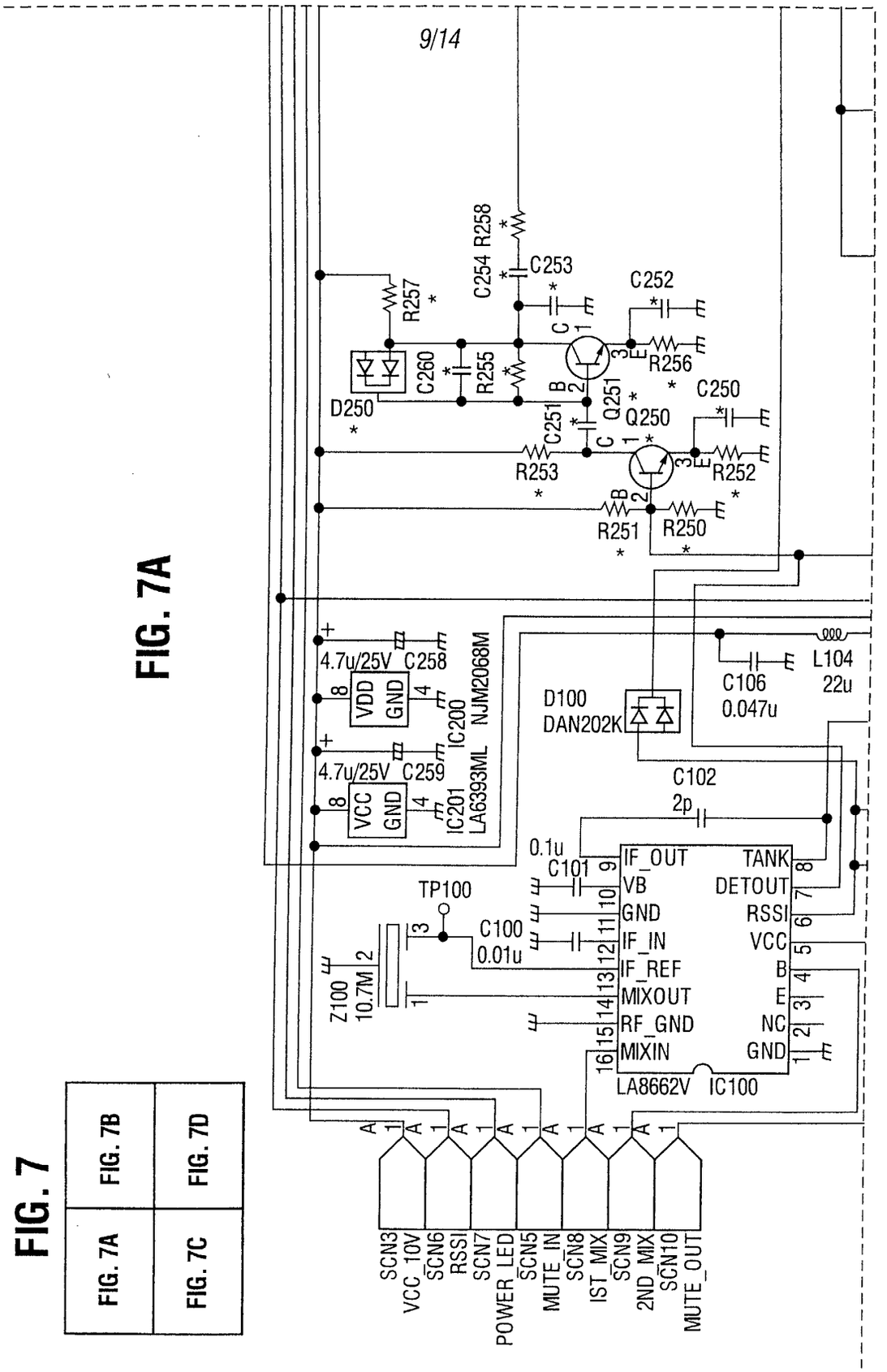
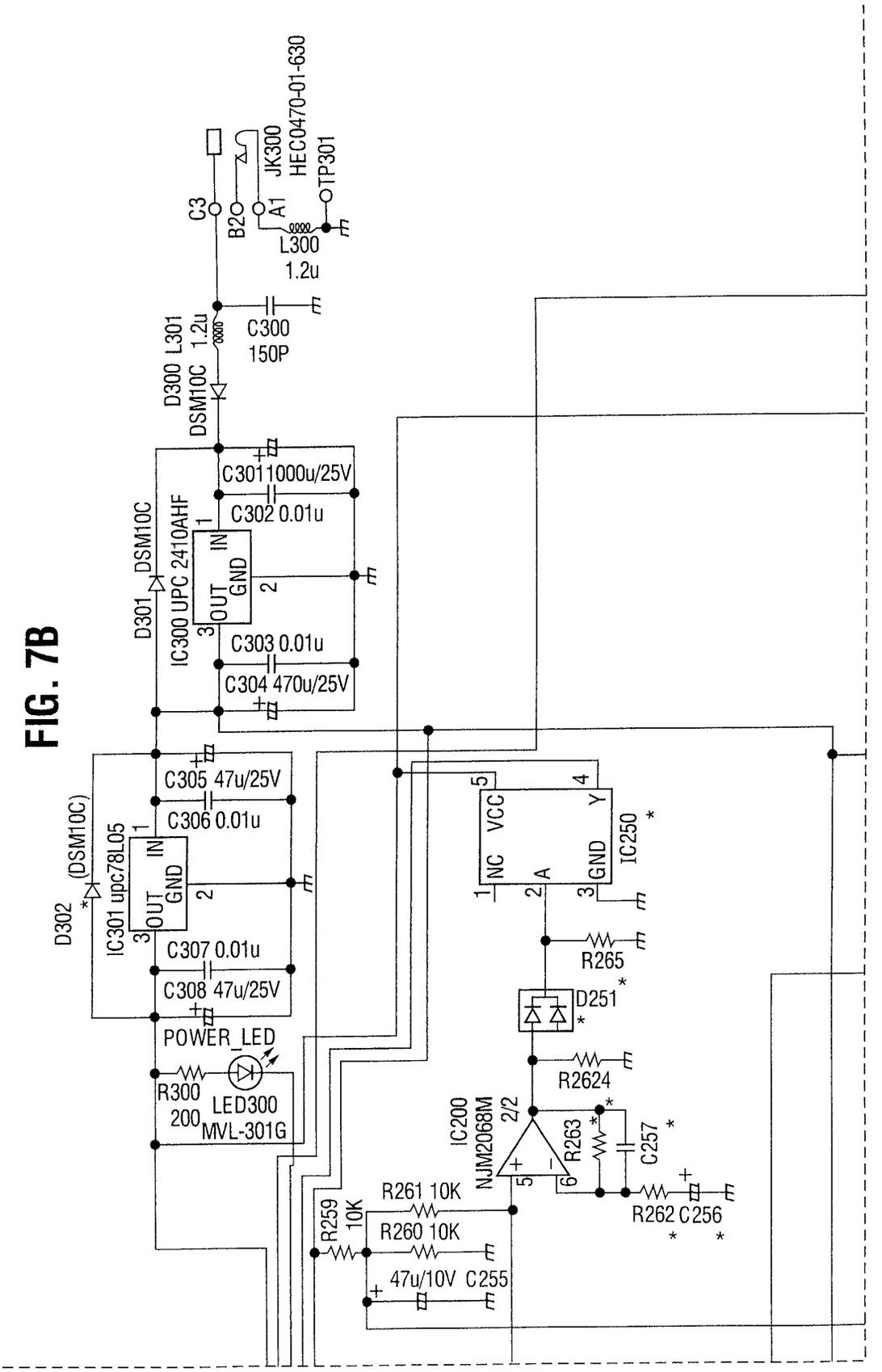


FIG. 7B


C3
B2
A1
JK300
HEC0470-01-630
OTP301
L300
1.2u
C300
150P
D300 L301 1.2u
DSM10C
C3011000u/25V
C302 0.01u
IC300 UPC 2410AHF
IN
GND
OUT
C303 0.01u
C304 470u/25V
D301
C305 47u/25V
C306 0.01u
IC301 upc78L05
C307 0.01u
C308 47u/25V
D302
POWER_LED
R300
200
LED300
MVL-301G
IC250
VCC
NC
GND
R265
D251
R2624
IC200
NJM2068M
2/2
R263
C257
R261 10K
R259
10K
R260 10K
R262 C256
47u/10V C255

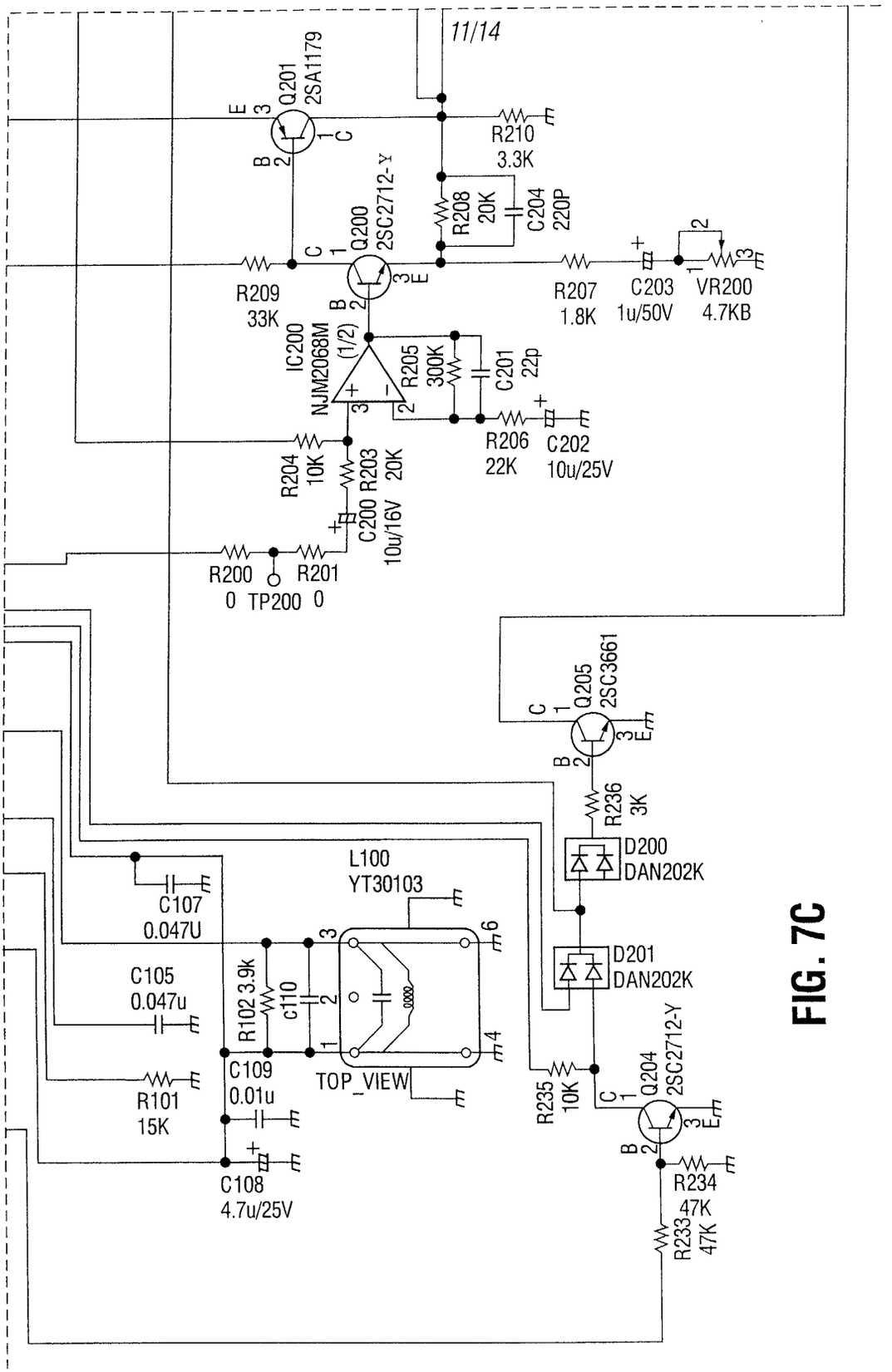

11/14
Q201
2SA1179
R210
3.3K
R208
20K
C204
220P
Q200
2SC2712-Y
R209
33K
R207
1.8K
C203
1u/50V
VR200
4.7KB
IC200
NJM2068M
(1/2)
R205
300K
C201
22p
R206
22K
C202
10u/25V
R204
10K
R203
20K
C200
10u/16V
R200
0
TP200
R201
0
Q205
2SC3661
R236
3K
D200
DAN202K
D201
DAN202K
L100
YT30103
TOP_VIEW
C107
0.047U
C105
0.047u
R102
3.9k
c110
C109
0.01u
R101
15K
C108
4.7u/25V
R235
10K
Q204
2SC2712-Y
R234
47K
R233
47K

FIG. 7C

FIG. 7D

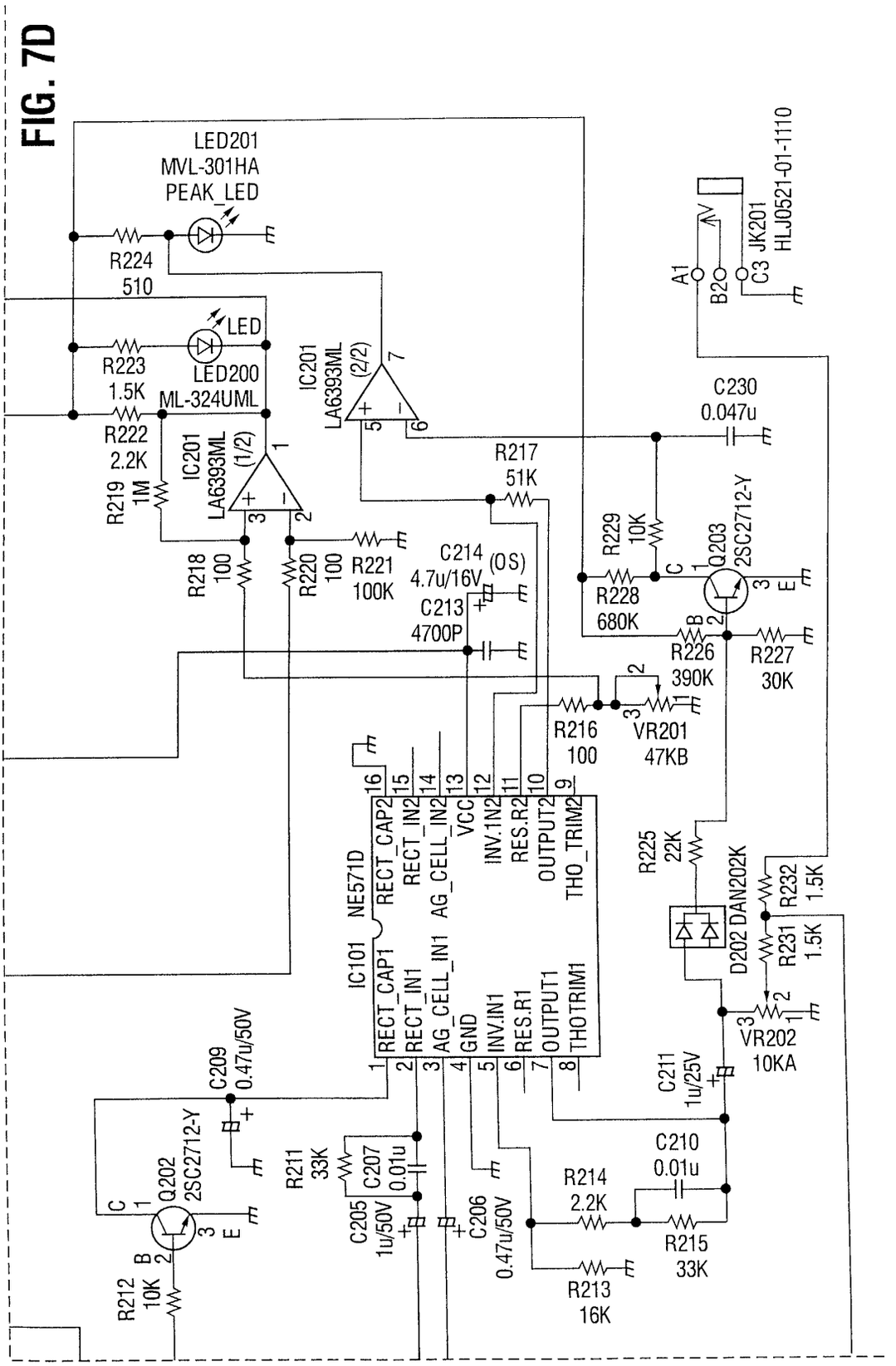

LED201
MVL-301HA
PEAK_LED
R224
510
LED
R223
1.5K
LED200
ML-324UML
R222
2.2K
R219
1M
IC201
LA6393ML
(1/2)
IC201
LA6393ML
(2/2)
R218
100
R220
100
R221
100K
C214
4.7u/16V
(OS)
C213
4700P
R217
51K
C230
0.047u
R229
10K
Q203
2SC2712-Y
R228
680K
R226
390K
R227
30K
R216
100
VR201
47KB
A1
B2
C3 JK201
HLJ0521-01-1110
IC101
NE571D
RECT_CAP2
RECT_IN2
AG_CELL_IN2
VCC
INV.IN2
RES.R2
OUTPUT2
THO_TRIM2
RECT_CAP1
RECT_IN1
AG_CELL_IN1
GND
INV.IN1
RES.R1
OUTPUT1
THOTRIM1
R225
22K
D202 DAN202K
R232
1.5K
R231
1.5K
VR202
10KA
C211
1u/25V
C209
0.47u/50V
Q202
2SC2712-Y
R211
33K
C207
0.01u
C205
1u/50V
C206
0.47u/50V
C210
0.01u
R214
2.2K
R215
33K
R213
16K
R212
10K

FIG. 8

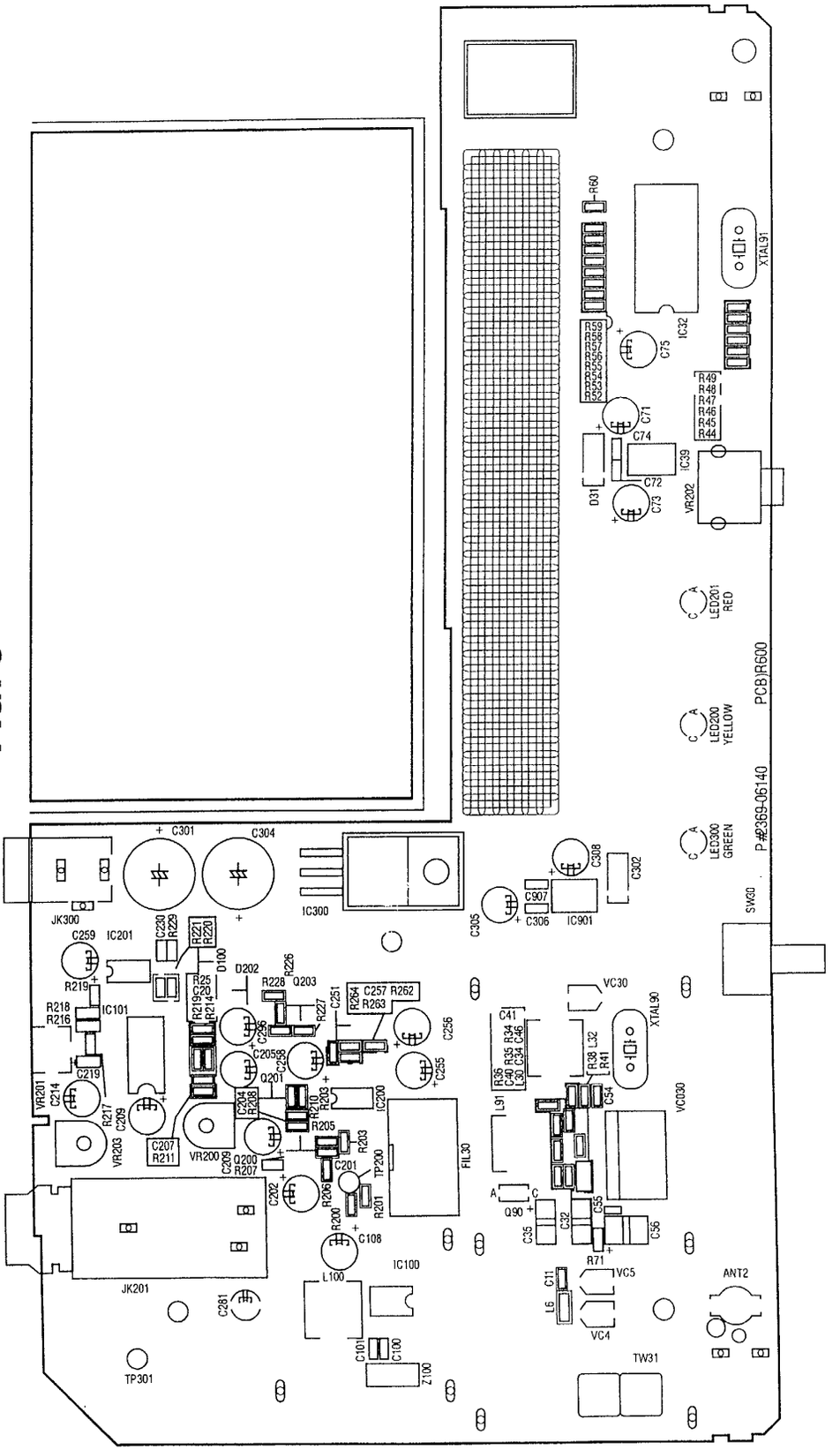
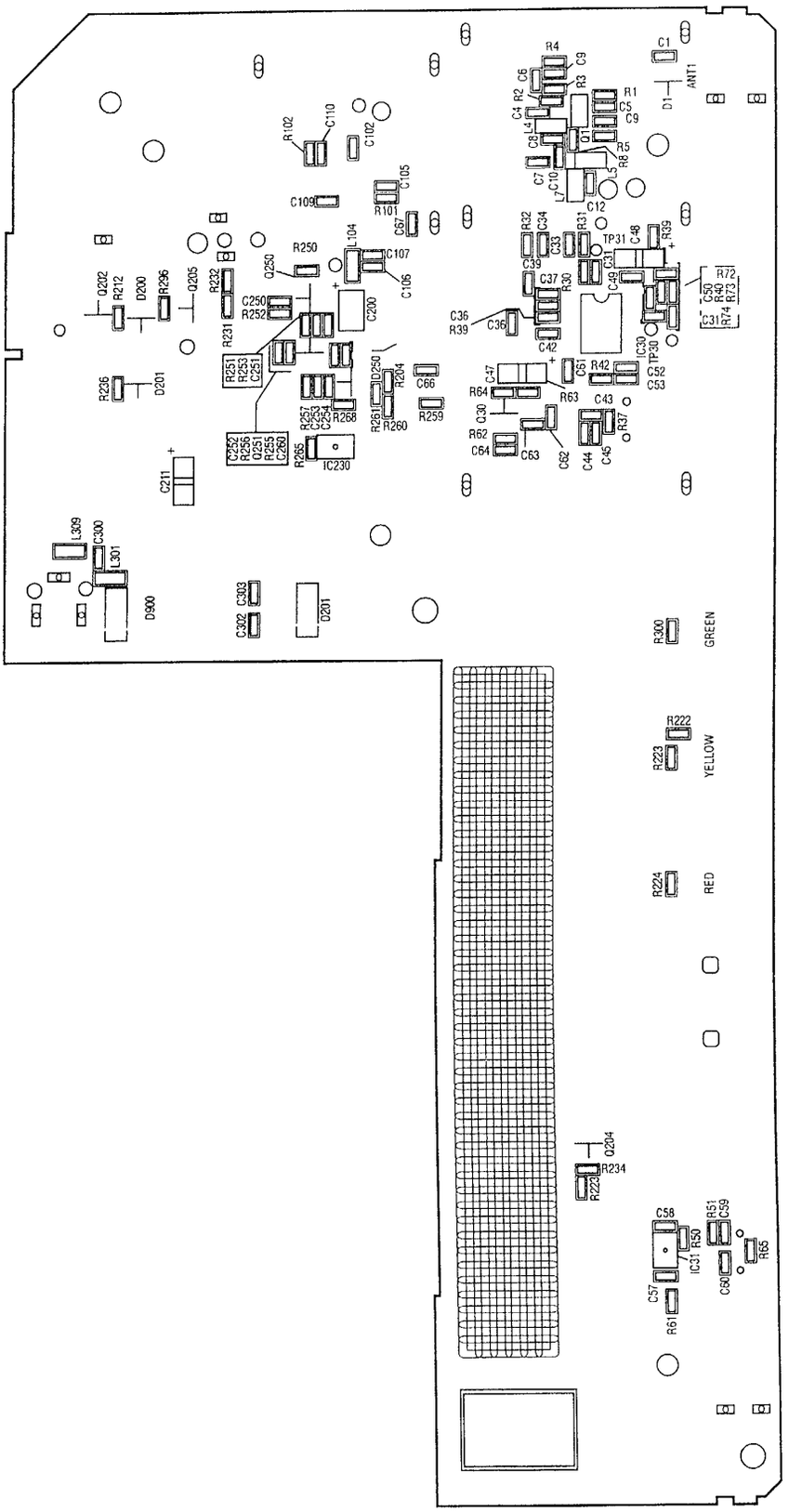

PCB(R600
P.#2369-06140
LED201 RED
LED200 YELLOW
LED300 GREEN
XTAL91
XTAL90
IC32
IC39
IC300
IC901
IC101
IC100
IC200
JK300
JK201
TP301
TW31
ANT2
SW30
VC30
VC5
VC4
VC030
FIL30
L100
Z100
Q90
Q200
Q201
Q203
D100
D202
D31
VR202
VR203
VR200
VR201
TP200
C301
C304
C259
C230
C229
C221
C220
C219
C214
C217
C209
C207
C211
C209
C208
C206
C205
C204
C202
C201
C108
C281
C101
C100
C907
C306
C308
C302
C305
C256
C255
C251
C41
C40
C35
C34
C46
C30
C32
C55
C54
C56
C11
L6
L91
L32
L41
R60
R49
R48
R47
R46
R45
R44
C75
C74
C72
C73
C71
R219
R218
R216
R214
R213
R212
R211
R210
R209
R208
R207
R206
R205
R204
R203
R202
R201
R200
R228
R227
R226
R264
R263
C257
R262
R221
R220
R38
R36
R35
R34
R71

FIG. 9


C1
ANT1
D1
R4
C9
R3
R2
C6
C4
R1
C5
C8
L4
Q1
R5
R6
C7
C10
L2
L3
C12
R102
C110
C102
C105
C109
R101
C67
L104
C107
R250
Q250
C106
C200
Q202
R212
D200
R296
Q205
R232
C250
R252
R231
R251
R253
C251
D201
R236
R257
C253
C254
R268
C252
R256
Q251
R255
C260
R265
IC230
D250
R204
C66
R261
R260
R259
C211
L309
C300
L301
D900
C302
C303
D201
R32
C34
C33
R31
TP31
C48
R39
C39
C37
R30
C49
C31
C50
R40
R73
R72
R74
C36
R39
C36
C42
C30
TP30
C52
C53
C-47
R64
R63
R42
C51
C43
R37
C30
R62
C64
C63
C62
C44
C45
R300
GREEN
R222
R223
YELLOW
R224
RED
Q204
R234
R223
C58
R51
C59
R50
IC31
R65
C57
R61
C60