Heathkit MR-18 Marine direction finder radio

Aug. 30, 2017

最近收集到一台 HEATHKIT MR-18 船用定位收音機(1970).

初始故障: 開機無電源指示,無聲.
修復故障: 電瓶能工作但 AC 不工作; 耳機插口受海水侵蝕損坏,喇叭線斷路;
聲音嚴重失真; 喇叭受潮碰極失真; 推挽放大失調等.

該機是 1970 年產品,全晶體管. 見網上找到的當年廣告.

船用定位機與一般收音機結構不同,很有意思.幸運地從網上找到了線路圖,故不難修復. 在此略作特色回顧及檢修記录.

因是船上專用,故該機有以下特卖:

1) 有電台方向定位器可搜索燈塔電台方向.下面有個示意圖(圖 6)告訴你如何在海上定位.
2) 波段廣: 長波,中波及二個短波頻段.

3) 靈敏度极高: 除了高放加二級中放, 還特別地帶有一個天線放大器. 故靈敏度比一般老的收訊機(Ham Radio)均強. (该天線放大器試用後發現作用很大, 線路簡單僅一個高頻三極管, 见下图 1, 图 2)
4) AC, 電瓶(12V)二用. 內部還有 9.6V 充電電池. 在失電後可持用一到二個小時.
5) 因為要用定向線圈定位故而所有其它線圈及波段開關等全部封鎖在一個金屬盒以屏蔽可能的干擾電波信號.
6) 为提高增益, 混頻及二級中放和檢波均用高阻抗場效應管而且不用中周變壓器改用晶體中頻濾波器.

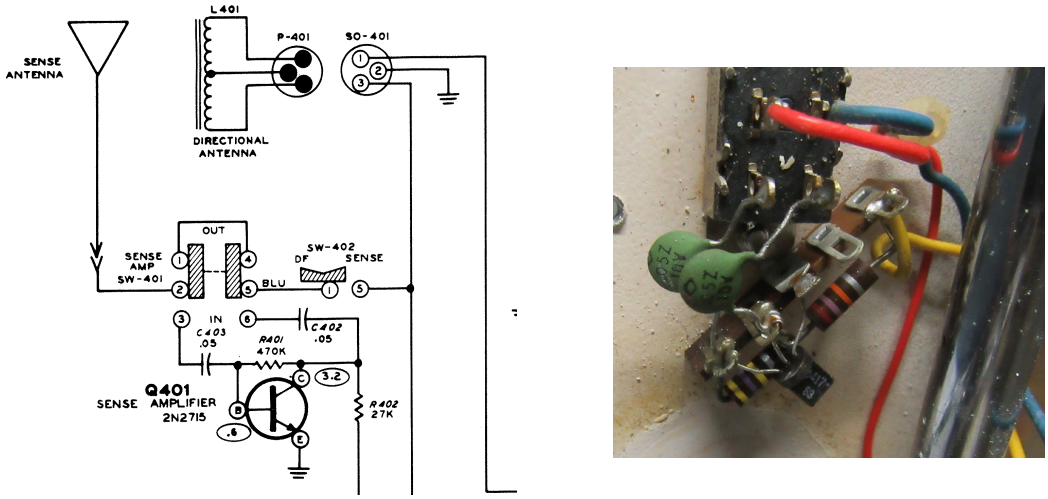


图 1. 天線放大器和方向定位線圈

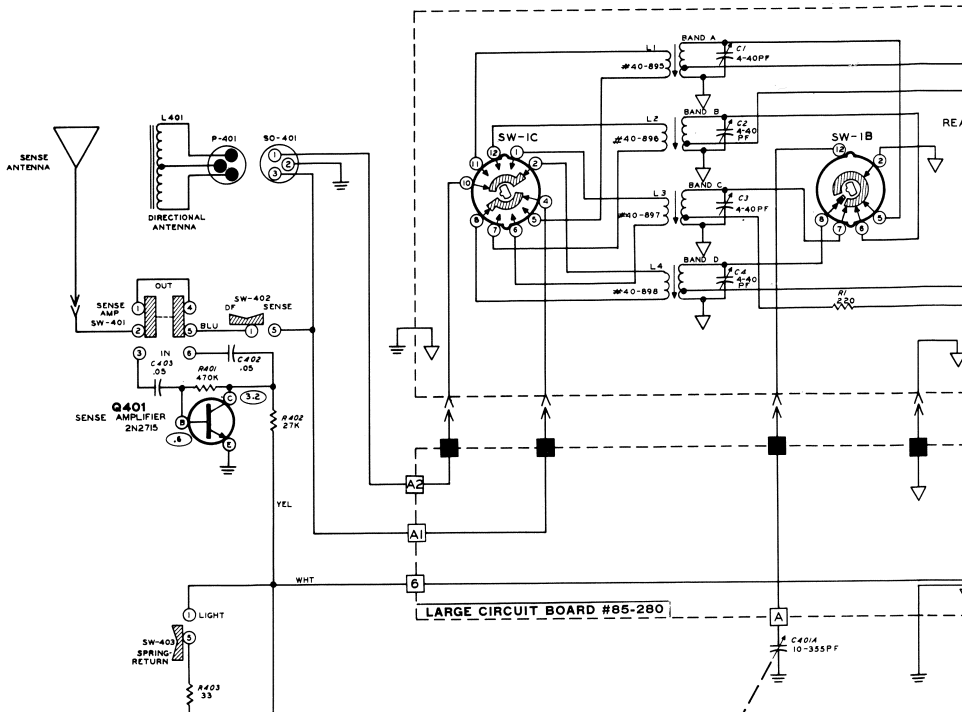


图 2. 天線放大器如何连接

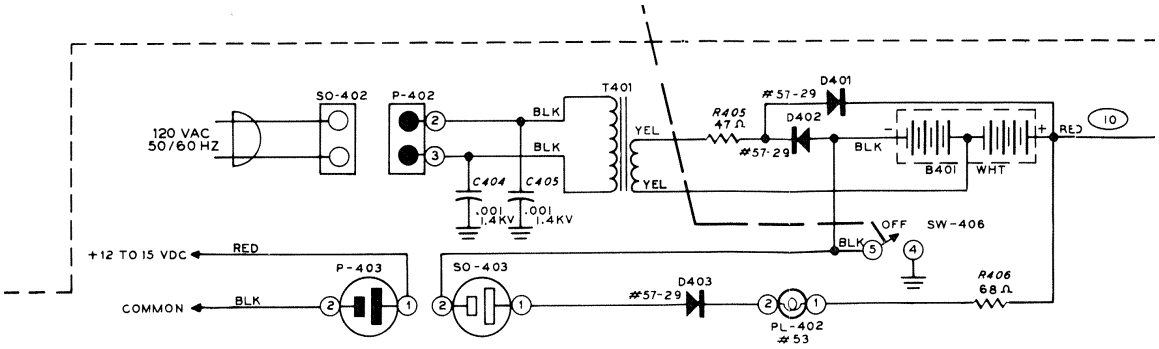


图 3. AC, 電瓶(12V)二用

图 4. 內部有 9.6V 充電電池

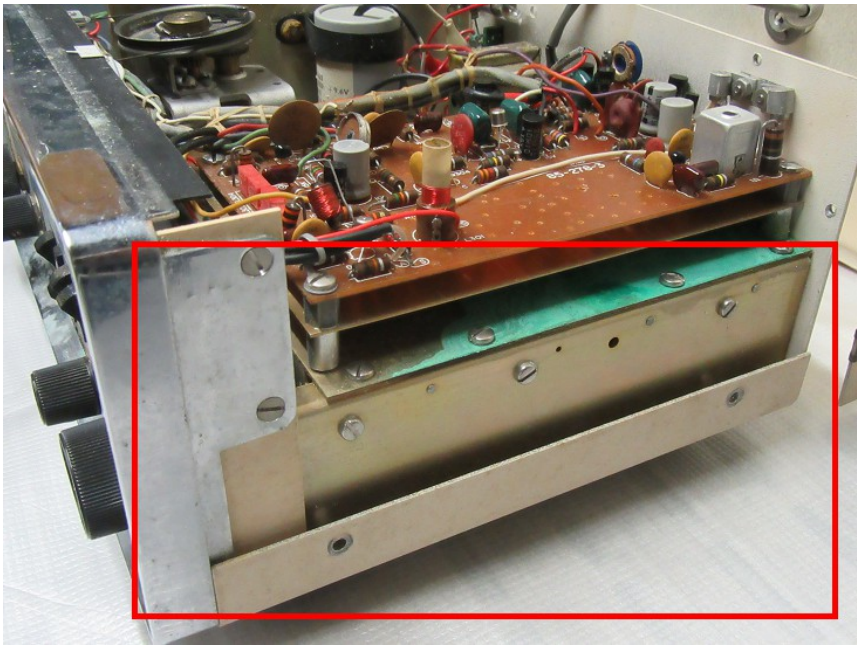
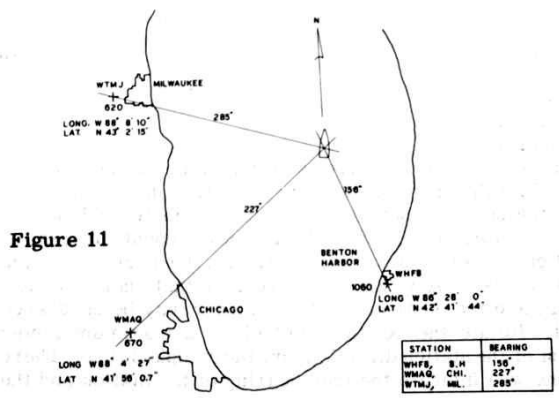


图 5. 線圈及波段開關等全部封鎖在一個金屬盒以屏蔽可能的干擾電波信號.

formed by the bearing plots. Refer to Figure 11.



The direction finder may also be used to "Home" on a station. set the tuning indicator to the frequency of the station you wish

图 6. 如何在海上定位

修理步聚:

1) 耳機插座爛了, 故喇叭線接地端開路.
2) 接好喇叭地線仍無聲, AC 整流器壞. 先用 12V 電池供電.
3) 聲音嚴重失真. 查前置放大器輸出好, 查推輓輸出級中心点電壓高度偏移 (應該是供電電壓 10V 的一半實際是 8.6v)
4) 有 47k(R338) 半調電位器可調. 調整到中心值但聲音仍失真. 發現喇叭碰極. 換喇叭(8 歐姆)後仍失真. 半思不得其解. 用示波器查波形, 最後發現在小負載時(如用 40 歐姆阻抗的耳機)聲音即正常. 看來毛病是最後二個功率晶體管退化無法輸出正常功率?
5) 測原喇叭为 16 歐姆, 找到一 40 歐姆喇叭換上, 聲音变正常. 虽音量略小, 尚可使用.

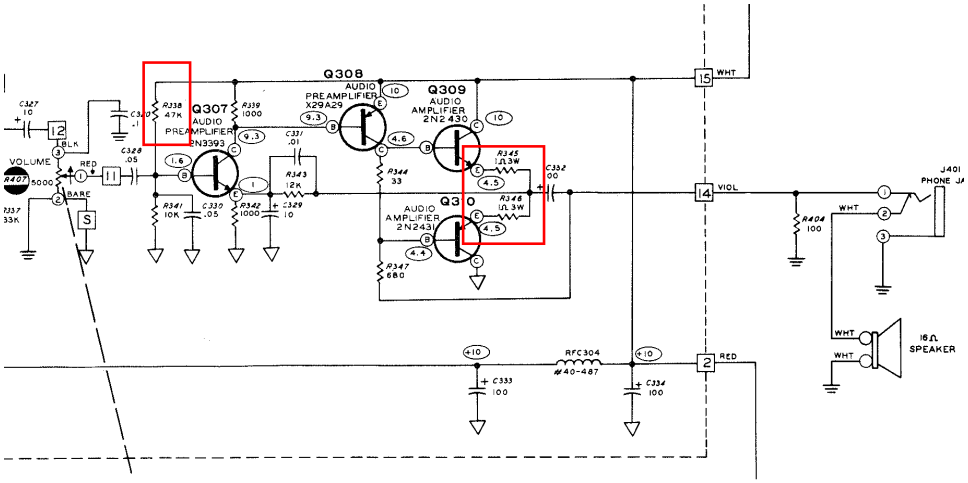


图 7. 推輓輸出級

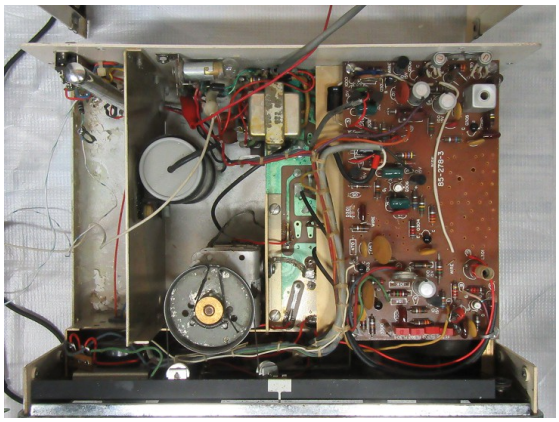


图 8. 机壳打开顶视图 1

图 9. 机壳打开顶视图 2

查第一級中放輸出的中频信号，大概是 30mVpp；第二級中放輸出大概是 1Vpp

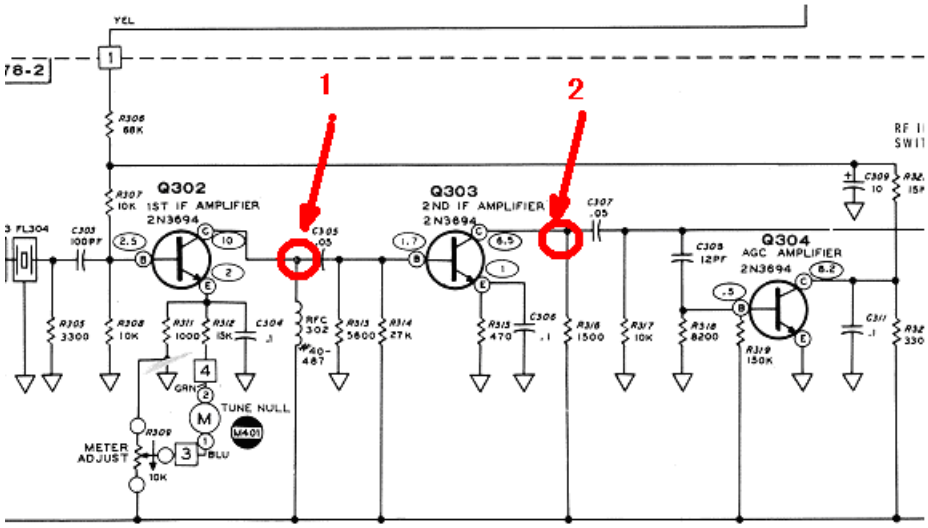


图 10. 第二中放輸出的中频信号，1Vpp

SCHEMATIC OF THE HEATHKIT® RADIO DIRECTION FINDER MODEL MR-18

NOTES:

1. COMPONENT PART NUMBERS ARE IN THE FOLLOWING GROUPS:

1-99	ANTENNA SWITCHBOARD.
100-199	RF SWITCHBOARD.
200-299	OSCILLATOR SWITCHBOARD.
300-399	RECEIVER CIRCUIT BOARD
400-499	CHASSIS.

2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE.

3. CAPACITOR VALUES ARE IN µF UNLESS MARKED OTHERWISE.

4. BAND SWITCH WAFERS ARE IN BAND D POSITION AS VIEWED FROM THE KNOB END OF THE SWITCH SHAFT.

5. VOLTAGE MEASUREMENTS ARE MADE WITH THE SWITCHES AND CONTROLS IN THE FOLLOWING POSITIONS:

SENSITIVITY	-	FULLY CLOCKWISE.
VOLUME-OFF	-	1/4 TURN CLOCKWISE.
SENSE-DF	-	DF POSITION.
AM-CW/SSB	-	CW/SSB POSITION.
ANL-ON	-	ON POSITION.
BAND	-	BAND D POSITION.
TUNING	-	ANY DIAL LOCATION.

6.  THIS SYMBOL INDICATES THAT A PART IS MOUNTED ON THE CHASSIS EVEN THOUGH ITS POSITION ON THE SCHEMATIC SUGGESTS ANOTHER LOCATION.

7.  THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT TAKEN WITH AN 11 MEGOHM INPUT VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%.

8.  THIS SYMBOL INDICATES AN RF VOLTAGE.

9.  THIS SYMBOL INDICATES A COMMON CIRCUIT BOARD FOIL.

10.  THIS SYMBOL INDICATES CHASSIS GROUND.

11.  THIS SYMBOL INDICATES CONNECTING POINTS TO THE CIRCUIT BOARD.

12.  THIS SYMBOL INDICATES A CIRCUIT BOARD CONNECTOR PIN.

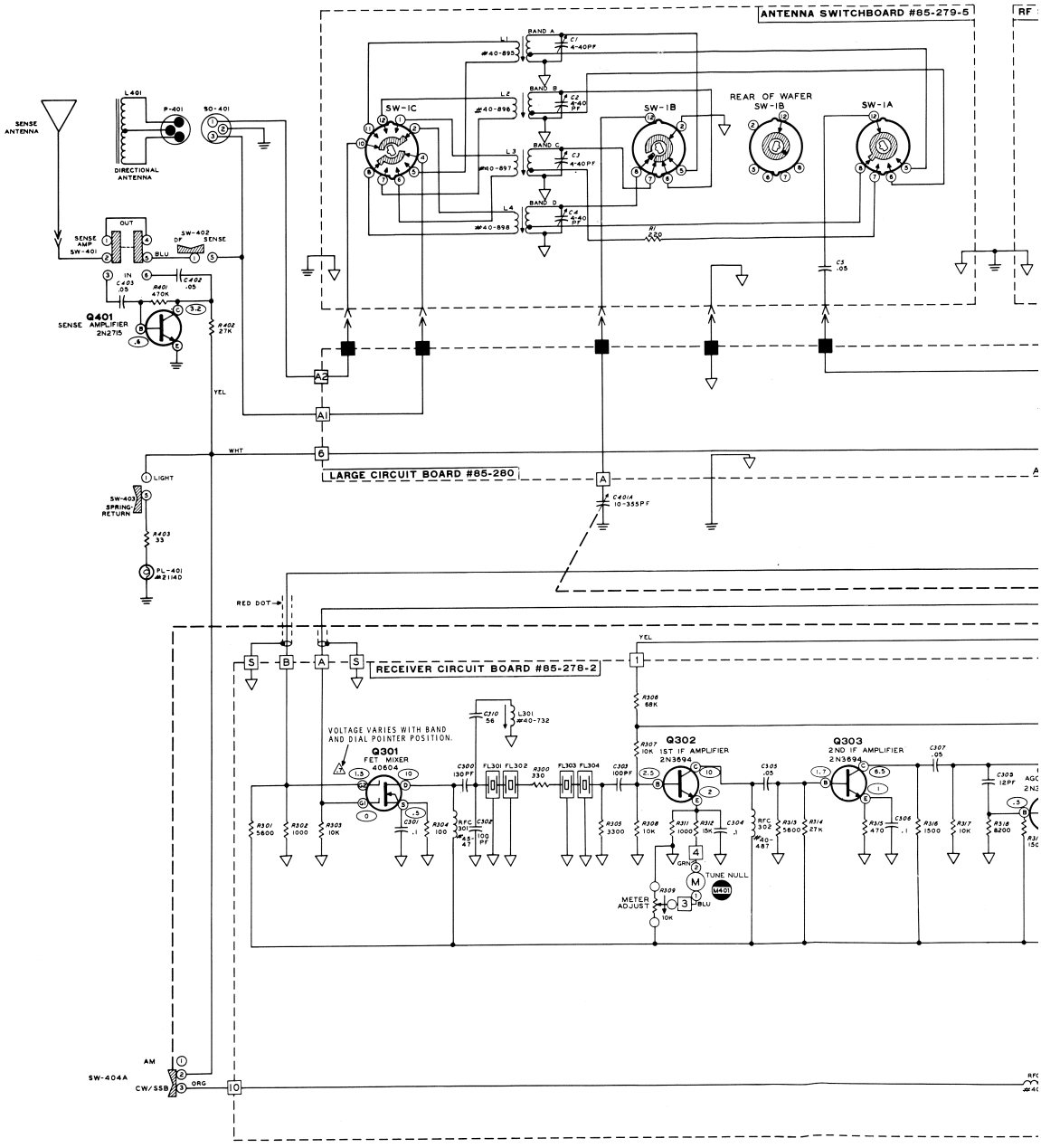
13.  THIS SYMBOL INDICATES CLOCKWISE ROTATION OF CONTROLS AS VIEWED FROM THE KNOB END OF THE SHAFT.

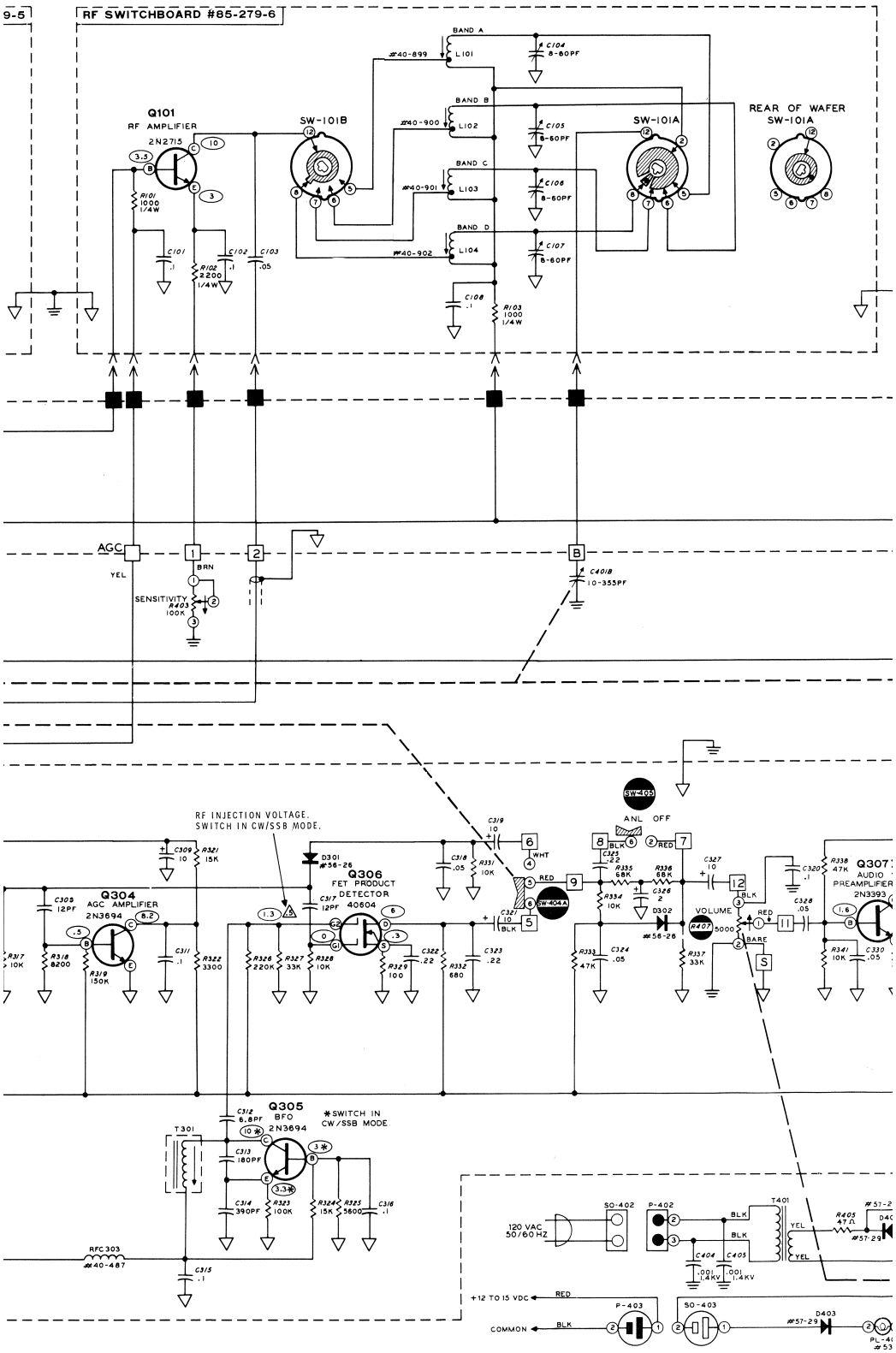
14.  THIS SYMBOL INDICATES A SLIDE SWITCH.

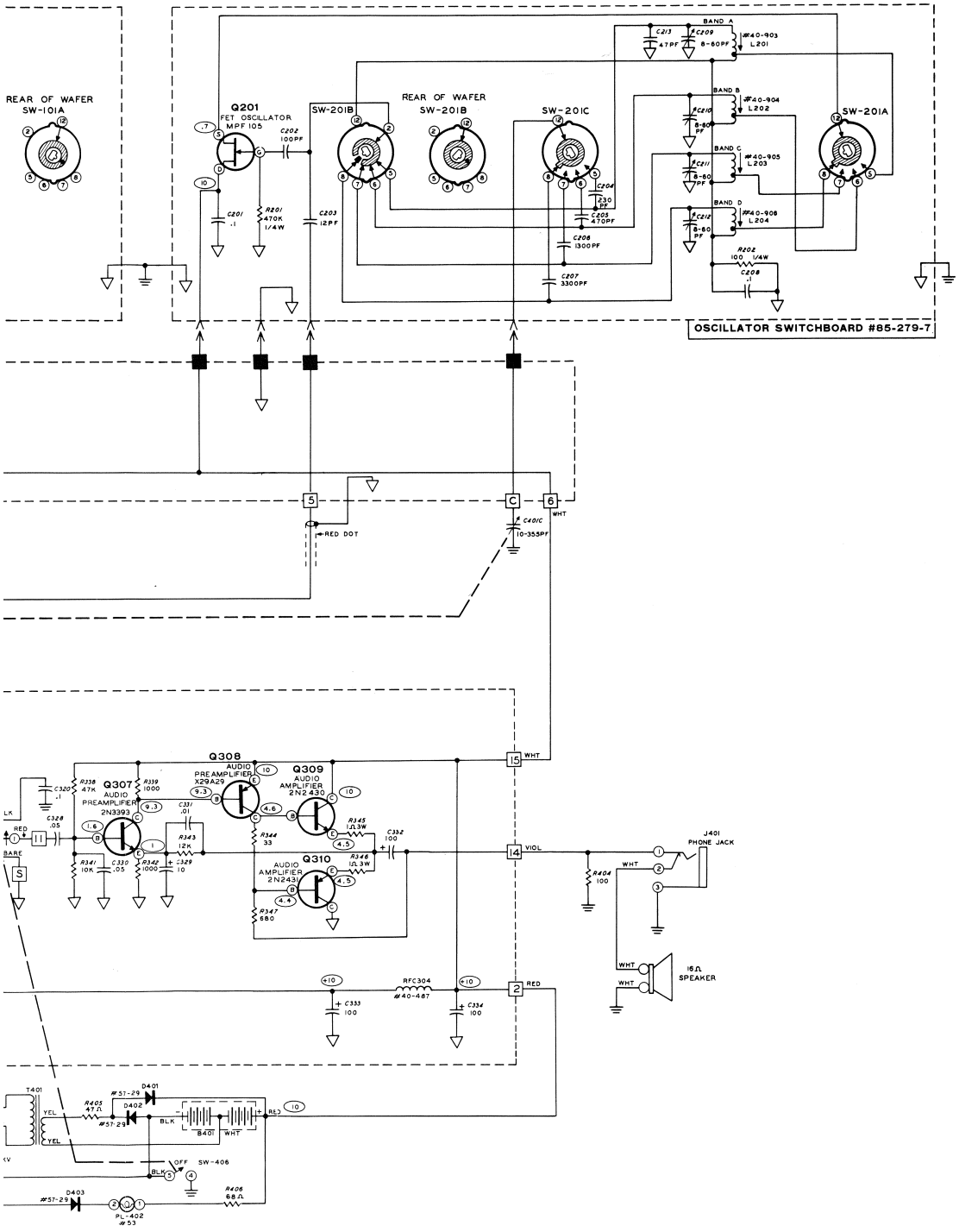
15.  THIS SYMBOL INDICATES A ROCKER SWITCH.

16.  THIS SYMBOL INDICATES THE GROUND CONNECTIONS MADE BY THE CIRCUIT BOARD GUIDES.

17. THE DOT LOCATED ON THE ROTOR OF SOME SWITCHES INDICATES A TIE PIN WHICH CONNECTS A CONTACT ON ONE SIDE OF THE ROTOR TO CONTACTS ON THE OTHER SIDE OF THE SAME ROTOR.


ANTENNA SWITCHBOARD #85-279-5
SENSE ANTENNA
L401
P-401
SO-401
DIRECTIONAL ANTENNA
SW-1C
SW-1B
REAR OF WAFER SW-1B
SW-1A
BAND A
BAND B
BAND C
BAND D
L1 #40-895
L2 #40-896
L3 #40-897
L4 #40-898
C1 4-40PF
C2 4-40PF
C3 4-40PF
C4 4-40PF
R1 330
C3 .05
SENSE AMP SW-401
OUT
IN
SW-402 DF SENSE
BLU
C402 .05
C403 .05
R401 470K
Q401 SENSE AMPLIFIER 2N2715
R402 27K
YEL
WHT
A2
A1
6
LIGHT
SW-403 SPRING-RETURN
R403 33
PL-401 #2140
LARGE CIRCUIT BOARD #85-280
A
C401A 10-355PF
RED DOT
RECEIVER CIRCUIT BOARD #85-278-2
S
B
A
S
1
YEL
R306 68K
C710 56
L301 #40-732
VOLTAGE VARIES WITH BAND AND DIAL POINTER POSITION.
Q301 FET MIXER 40604
Q302 1ST IF AMPLIFIER 2N3694
Q303 2ND IF AMPLIFIER 2N3694
C300 130PF
FL301 FL302
R300 330
FL303 FL304
C303 100PF
C305 .05
C307 .05
C305 12PF
R307 10K
R308 10K
R311 1000
R312 15K
C304 .1
RFC 302 #40-487
R313 5800
R314 27K
C306 .1
R315 470
R316 1500
R317 10K
R318 8200
R301 5800
R302 1000
R303 10K
C301 .1
R304 100
RFC 301 #25-47
C302 100 PF
R305 3300
GRN
TUNE NULL
M
M401
R309 METER ADJUST 10K
3
BLU
AM
SW-404A
CW/SSB
ORG
10


RF SWITCHBOARD #85-279-6
BAND A
BAND B
BAND C
BAND D
L101
L102
L103
L104
#40-899
#40-900
#40-901
#40-902
C104 8-60PF
C105 8-60PF
C106 8-60PF
C107 8-60PF
Q101
RF AMPLIFIER
2N2715
SW-101B
SW-101A
REAR OF WAFER SW-101A
R101 1000 1/4W
R102 2200 1/4W
R103 1000 1/4W
C101 .1
C102 .1
C103 .05
C108 .1
AGC
YEL
BRN
SENSITIVITY R403 100K
C401B 10-355PF
RF INJECTION VOLTAGE. SWITCH IN CW/SSB MODE.
Q304
AGC AMPLIFIER
2N3694
Q306
FET PRODUCT DETECTOR
40604
D301 #56-26
SW-404B
ANL OFF
SW-404A
D302 #56-26
VOLUME R407 5000
Q305
BFO
2N3694
*SWITCH IN CW/SSB MODE
T301
RFC303 #40-487
T401
120 VAC 50/60 HZ
SO-402
P-402
P-403
SO-403
+12 TO 15 VDC
COMMON
D403 #57-29


REAR OF WAFER
SW-101A
Q201
FET OSCILLATOR
MPF 105
SW-201B
REAR OF WAFER
SW-201B
SW-201C
SW-201A
BAND A
BAND B
BAND C
BAND D
#40-903
L201
#40-904
L202
#40-905
L203
#40-906
L204
C213
47PF
C209
8-60PF
C210
8-60 PF
C211
8-60 PF
C212
8-60 PF
C202
100PF
C201
.1
R201
470K
1/4W
C203
12PF
C204
230 PF
C205
470PF
C206
1300PF
C207
3300PF
R202
100 1/4W
C208
.1
OSCILLATOR SWITCHBOARD #85-279-7
5
C
6
WHT
C401C
10-355PF
RED DOT
Q308
AUDIO
PREAMPLIFIER
X29A29
Q309
AUDIO
AMPLIFIER
2N2430
Q307
AUDIO
PREAMPLIFIER
2N3393
Q310
AUDIO
AMPLIFIER
2N2431
R338
47K
R339
1000
C320
.1
C328
.05
C331
.01
R343
12K
R344
33
R345
1/3W
C332
100
R346
1/3W
R347
680
R341
10K
C330
.05
R342
1000
C329
10
15
WHT
4
VIOL
2
RED
J401
PHONE JACK
R404
100
WHT
WHT
16Ω
SPEAKER
RFC304
#40-487
C333
100
C334
100
T401
YEL
YEL
R405
47Ω
#57-29
D401
D402
BLK
B401
WHT
RED
D403
#57-29
OFF
SW-406
BLK
R406
68Ω
PL-402
#53
RED
BARE
S