APRS® Mic-Lite™

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The Mic-Lite is the ultimate APRS Mic-Encoder for maximum flexibility and versatilty. It can be plugged into any radio in place of the microphone and gives you instant APRS position, telemetry and message reporting on any Radio. It is assembled from the MIM Module and a few off-the shelf Radio Shack components.

This Mic-Lite design solves many of the complications of the original APRS Mic-E for lightweight and portable applications. It solves the plethoria-of-mic-connectors problem by including an electret Microphone element and its own PTT within the Mic-Lite enclosure. Further it solves ground loop and power supply problems by operating from its own internal battery. Finally it solves the interface problem of combined PTT/Mic-Audio as used on most HT's. For most ICOM, Alinco, Yeasu and other HT's, only a single sub-mini phone plug is required. Kenwoods require two plugs and an external earphone.

Since the Mic-Lite is completely self-contained and runs on its own internal battery or Mic power, its best application is for special events where rapid configuration and portability are important. The internal 9v battery should last about 60 hours or over a month of typical commuting. The battery voltage is included in the telemetry packets so predicting battery replacement is easy to do. For mobile rigs, microphone power can be used instead of the internal battery.

ASSEMBLY: The Mic-Lite is a good evening construction project. Purchase the wired-and-tested MIM as indicated below, and then visit your local Radio Shack to pick up the remaining components for under $10 (you will pay slightly more since many components are packed 2 or more per package). The MIM module uses the same chip and firmware used in the TAPR Mic-E, and can be configured at any time in either the MIM or Mic-E mode. Since the bulk of the TAPR Mic-E is due to the front panel controls, Mic connectors and room for an internal GPS, this file shows how to use the basic MIM to make a much smaller and cheaper one called Mic-Lite(tm)

MIC-LITE: The full size TAPR Mic-E has two 16 position thumb wheel switches and a PERIOD pot to give the operator full control over Mic-E operations. For the Mic-Lite, most of these can be wired to small dip switches, replaced with single toggles or just jumpered to defaults with no switches. With no switches it can even be integrated inside the radio! Many routine applications of the Mic-E concept can be set to a default condition and front panel controls are unnecessary. Here is a table showing various levels of control.

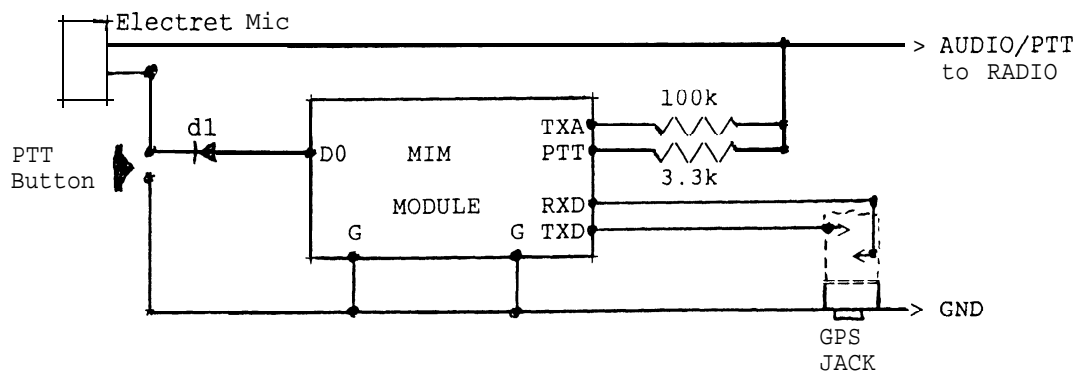| Front Panel	PATH Switch	MSG Switch	RATE	AUTO
Thumbwheels	16 paths	7 msgs	Pot 1-16	On/Off
10 pos Dip Sw	16 paths	7 msgs	Hi/Low	On/Off
Four switches	2 paths	two msqs	Hi/low	On/Off
Three switches	2 paths	One msg	Hi/low	ON/OFF
т w o switches	one path	one msg	Hi/Low	ON/off
One switch	one path	one msg	Hi/Low	ON or OFF
No switches	one path	one msg	HI or LOW	ON or OFF

I consider the Hi/Low to be the most important since it not only allows switching between "driving" and "parked", but also it triggers a "report now" whenever it is toggled. The next most important in some applications is the AUTO switch, since it allows you to operate in Mic-E mode on a voice repeater, or go to auto mode on 144.39 as a stand-alone tracker.
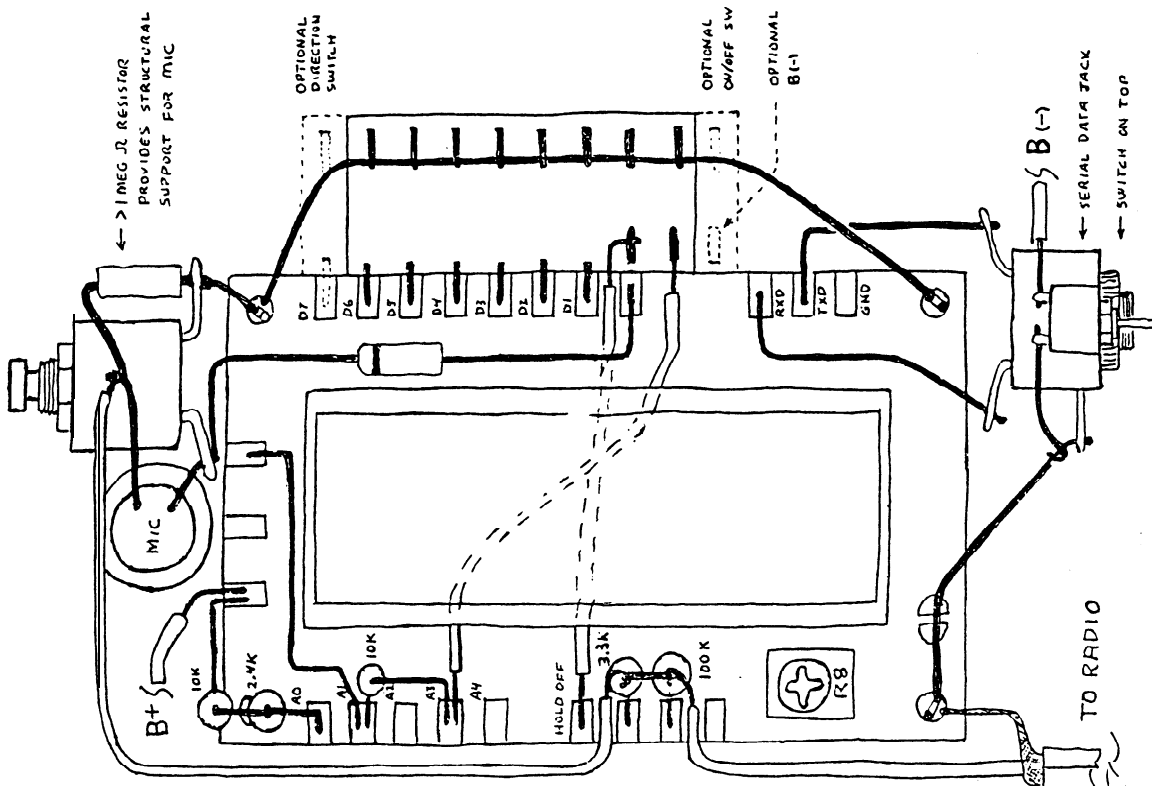
PACKAGING: There are five basic ways to package a Mic-Lite:

* IN-RADIO: This is easiest installation, but requires internal radio work and adding an external GPS jack.   It also lacks front panel control which may or not be good.

* IN-MIC: This works well for mobile radios with room in their big Mic's when you can power the Mic-Lite from the mic power.   You must add a GPS jack to the Mic enclosure and may want to add some buttons or switches. Wire the Hi/Low Period input to the UP button the Mic, and then any time you want to trigger a NOW packet, just press the UP (and then DN). The UP button still works as an UP button too!   I got a MIM to fit in a very small Alinco TTONE mic!   See also section on powering.

* IN-LINE: This either requires mic-in and out jacks so you can insert the Mic-Lite between the Mic and the Radio, or attaching it in parallel at the Mic connector on a dangel. This makes it easy to place anywhere for button access.

* NEW-MIC: This just adds an electret Mic and PTT to a small plastic case on which you can put any/all buttons you want.   In effect, you are building your own Mic-E in your own Microphone case.   Actually this is the most flexible option when included with a battery.

* FOR-HT: This arrangement is any of the above options, but uses its own internal battery so that it is trivial to plug into ANY radio (HT) with out any concern over power.
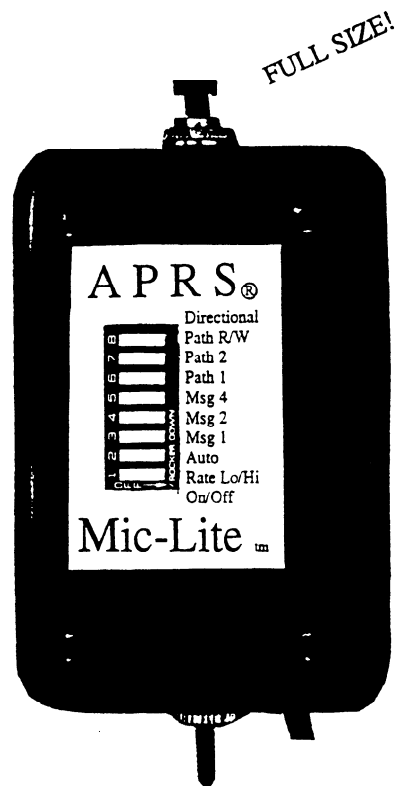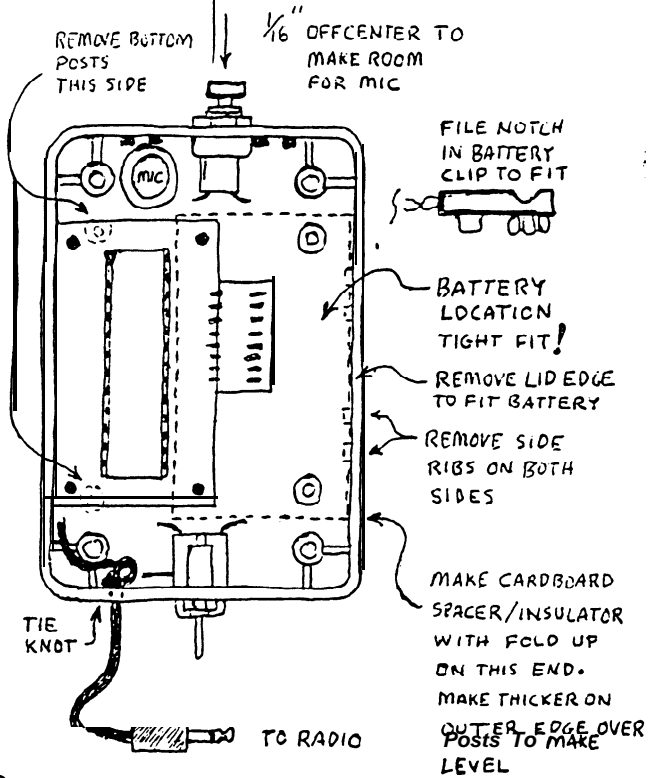
STAND-ALONE-MIC-E: This is the NEW-MIC and FOR-HT combination which I think is the most flexible.   It builds the Mic-Lite into a small Mic enclosure with internal 9v battery so that it can plug into ANY radio or HT at the Mic Connector.   The GPS then plugs into it.   Here is the easy way to build this using the small plastic mini-box from Radio shack.   Notice that it includes its own Electret Mic element to make it a completely self contained Mic-Encoder.   Total parts cost at Radio Shack is $6.75 plus the MIM and Battery.

HARDWARE CONFIGURATION: The MIM is simply connected between the Microphone and the radio.   For Handi-Talkies with combined PTT such as ICOMS, Yeasu Alinco's and most FRS radios, simply use a 3k and 100k resistor to join these two to a sub-mini phone plug as shown below.

> 1 MEG Ω RESISTOR PROVIDES STRUCTURAL SUPPORT FOR MIC

OPTIONAL DIRECTION SWITCH

OPTIONAL ON/OFF SW

OPTIONAL B(-)

SERIAL DATA JACK

SWITCH ON TOP

B (-)

D7 D6 D5 D4 D3 D2 D1

RXD TXD GND

MIC

B+

10K 2.4K A0 10K A1 A1 A4 HOLD OFF 3.3K 100K R8

TO RADIO

VIEW ₵ INTO BOX

REMOVE BOTTOM POSTS THIS SIDE

1/16" OFFCENTER TO MAKE ROOM FOR MIC

mic

FILE NOTCH IN BATTERY CLIP TO FIT

BATTERY LOCATION TIGHT FIT!

REMOVE LID EDGE TO FIT BATTERY

REMOVE SIDE RIBS ON BOTH SIDES

MAKE CARDBOARD SPACER/INSULATOR WITH FOLD UP ON THIS END. MAKE THICKER ON OUTER EDGE OVER POSTS TO MAKE LEVEL

TIE KNOT

TO RADIO

FULL SIZE!

APRS ®

Directional
Path R/W
Path 2
Path 1
Msg 4
Msg 2
Msg 1
Auto
Rate Lo/Hi
On/Off

Mic-Lite ™
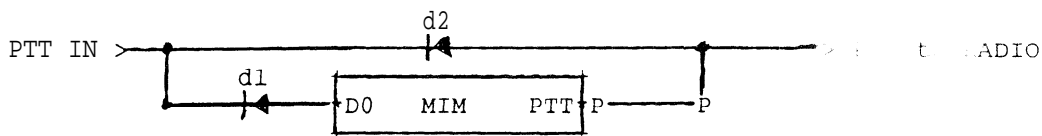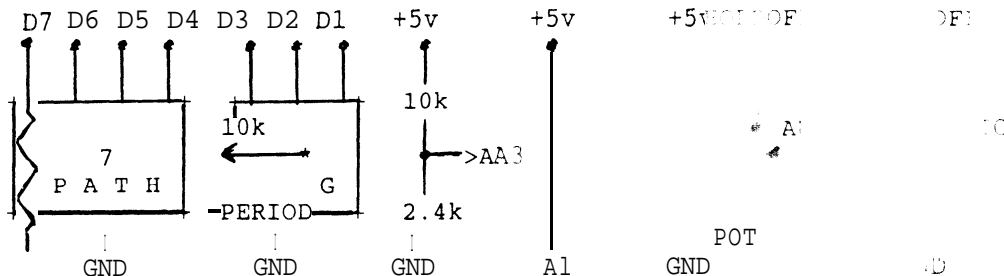
GPS/SERIAL PORT CONNECTOR: Please consider using a 1/8th ,   ᵃ   ᵒO
mini jack for the GPS connector as shown. This is the sa   ᵃ
connector used on the TAPR Mic-E, the PacComm Handi-Packeʳ
Kenwood HT(though the Kenwood is a sub-mini 3/32, but th·   ʳ
the same and only needs a RS adapter part # 274-397. TIPᵃ   ᴵ   ᵀT
and RING is DATA-IN. Connect the GPS to DATA-IN.

CIRCUIT DESCRIPTION: Diode d1 lets the MIM sense PTT whi   ʳ
providing isolation to prevent the MIC-E from grounding ᵃᵇ .   ᵈ wheᵣ
the MIC-E is turned off. The 100k audio resistor isolate   ᴹ   ᵈo it
does not load down normal Mic audio, and the 3k combines
signal onto the Mic lead. For Kenwoods or other radios ᵥ   ₚ   ᵗe
PTT lines, then the following circuit is needed on the Pᵀ   ᵈ   Here
diode d2 lets either the PTT-IN or the MIM key the radio.   ₚ ᵗs
P--E) show where to add a PTT LED if desired.

```
                              d2
      PTT IN >──┬──────────────▷├──────────────┬────────── > ᵗ  ᴀADIO
                │   d1          │              │
                └──▷├───┌───────────────────┐  │
                        │D0   MIM    PTT│P───┴──P
                        └───────────────────┘
```

PATH and MESSAGE SWITCHES: Not shown in the schematic abᵒᵥᵉ ᵉ ·y of
the optional PATH, MESSAGE and PERIOD connections. If unᶜᵒᵣₜ   tₑ then
the bits are considered a logic "0". Bits D2 to D8 connecᵗ· ᵃ ᵗ ᵀH and
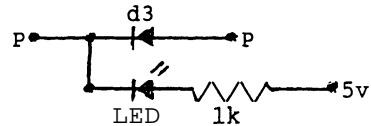MESSAGE switches and A3 is the PERIOD adjust pot as follows:

```
 D7 D6 D5 D4 D3 D2 D1   +5v        +5v        +5vᴹᴼᴵ ᴼF          ᴼFᶠ
  ↑  ↑  ↑  ↑  ↑  ↑  ↑    ↑          ↑          ↑
 ┌──────────┬────────┐   │         10k
 │          │ 10k    │   │          │                 ᵃ A         ᴵO
 │    7     │ ←──────→│   ├──>AA3              ᵃ
 │  P A T H │      G  │  2.4k              ᵃ
 │          └─PERIOD──┘   │
  │          │          │           POT
 GND        GND        GND    A1   GND            ᵈᴅ
```

Note that A1 must be jumpered to +5 to enable the currentₗy ᵈ ᴵGI
mode instead of SSID mode. For the Mic-Lite, needing only ᵗᵒw ᶜh
between R,W,W and W,W,W, simply ground D4 and D5 and add a sᵉ ᵉc ₛwitch
to D6. D7 is unused until we begin using directional and SSᴵ rₒᵤting
some time in the future. A0 is connected to a 10k/2.4k volᵗᵃᵍᵉ ᵈivider
so that telemetry includes the battery voltage. A3 sets ᵗ   ᴾ ᴶ and
the HOLDOFF pin may be connected to an AUTO switch, or GROUNᴰᴱD.

MESSAGES: You can choose any number of switches and combinaᵗᵒn ᵢodes t
select any messages as follows:

```
     No switches     Off duty
     GND D1          Enroute
     GND D2          In Service    (Note AUTO PERIOD CIRCUIT BLᴸ W)
     GND D1&D2       Returning
     GND D3          Committed
     GND D3&D1       Special
     GND D3&D2       PRIORITY
     GND D3&D2&D1    EMERGENCY!    Trips alarms & centers aᵢ   ₛ  ᵗ unit
```

PERIOD POT: You can use a PERIOD POT or a **10k Pullup** resistor and
switch to control the "period" on input A3.   With the switch open the
+5 pullup will result in 16 times the programmed period.   Grounding A3
will result in a POSIT-NOW and the pre-programmed rate.   Or just hook
to an existing Mic **UP/DN** button to serve as a POSIT-NOW button.   See
the section below on Automatic PERIOD adjustment between IGNITION on
and IGNITION off.

PTT READY LED: **You** can **add** an LED to the PTT circuit to see when the
Mic-E has a packet scheduled.   You may want to talk a little longer and
wait till a packet is ready before you release the PTT.   To do this,
add diode d3 to isolate the LED from the normal PTT circuit and connect
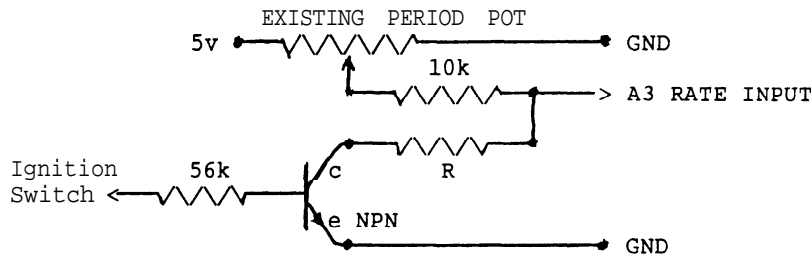at points **"P"** shown in the above PTT circuit.

```
                                        d3
                                  P●────────▷|───────●P
                                        │
                                        └──▷|──/\/\/──●5v
                                          LED    1k
```

GPS ACTIVE LED: To see when the GPS has good **RMC** data, connect an LED
to the TXD data line as follows:

```
                           LED    2.2k
              TXD◄─────────|◁──/\/\/──●5v
```
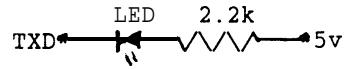
BATTERY VOLTAGE TELEMETRY: Connect analog input pin **A0** to a **10k/2.4k**
voltage divider so that your telemetry will contain your battery voltage.
This combo makes **9v** approximately equal to a telemetry value of 90.
Or use a 5k pot in place of the **2.4k** to tweak it exactly.   Thus you
can see the voltage of your battery to the tenth of a volt.

AUTOMATIC PERIOD ADJUSTMENT: Although the front panel PERIOD pot makes
it easy to adjust your reporting rate, you can make it automatic between
a short period when the engine is running and a long period when it is
parked using the following circuit:

```
                  EXISTING  PERIOD  POT
          5v ●──/\/\/\/──────────────────● GND
                      ↑         10k
                      │      /\/\/──────●──> A3 RATE INPUT
                      │  /\/\/──────────│
                      └──┐/c    R       │
  Ignition    56k       │ │             │
  Switch ◄──/\/\/───────┤ │
                        │ \e NPN
                        └────────────────● GND
```

NOTE 1:   The **10k** resistor in series with the existing PERIOD pot input is
there so that the new automatic circuit can share the input as shown.

NOTE 2:   You can connect the collector to message bit **D1** and this will
change your message between OFF DUTY and IN SERVICE automatically!

NOTE 3:   Software program your Mic-E to a peak rate of 1 minute so the
the **16:1** front panel PERIOD pot gives you a range of 1 to 16 minutes.   The
added transistor and new value R are switched in when the ignition switch
is on.   **ALthough** the front panel PERIOD pot can still override to any
setting, set it normally to your desired max value, say 16.   Now then you
can choose R to give you:

```
 PANEL POT will set the maximum period when the ignition is off.
 R - O   will always force the peak rate no matter where the pot is
 R = 2k will force at least a MAX/8 rate
 R = 4k will force at least a MAX/4 rate
 R = 10k will force at least a MAX/2 rate
```

 (These values are approximate, your milage will vary)

POWERING THE MIC-E: Although the Mic-E can be powered by the Mic power in some cases, the problems with alternator whine, GPS and processor digital noise on the power bus can be a big problem when interfacing to the mic connector of a mobile radio. If the GPS is also on internal batteries, then Microphone power should work fine. But if the GPS is externally powered by the vehicle battery, then you will surely have ground loop problems unless you are careful about grounding. The safest option is to use a 9v battery. It should last a month at 2 hours a day. See Mic-E.txt for other options. To minimize GPS noise, you may want to insert additional resistance in the GPS data line. See if 100K will work?
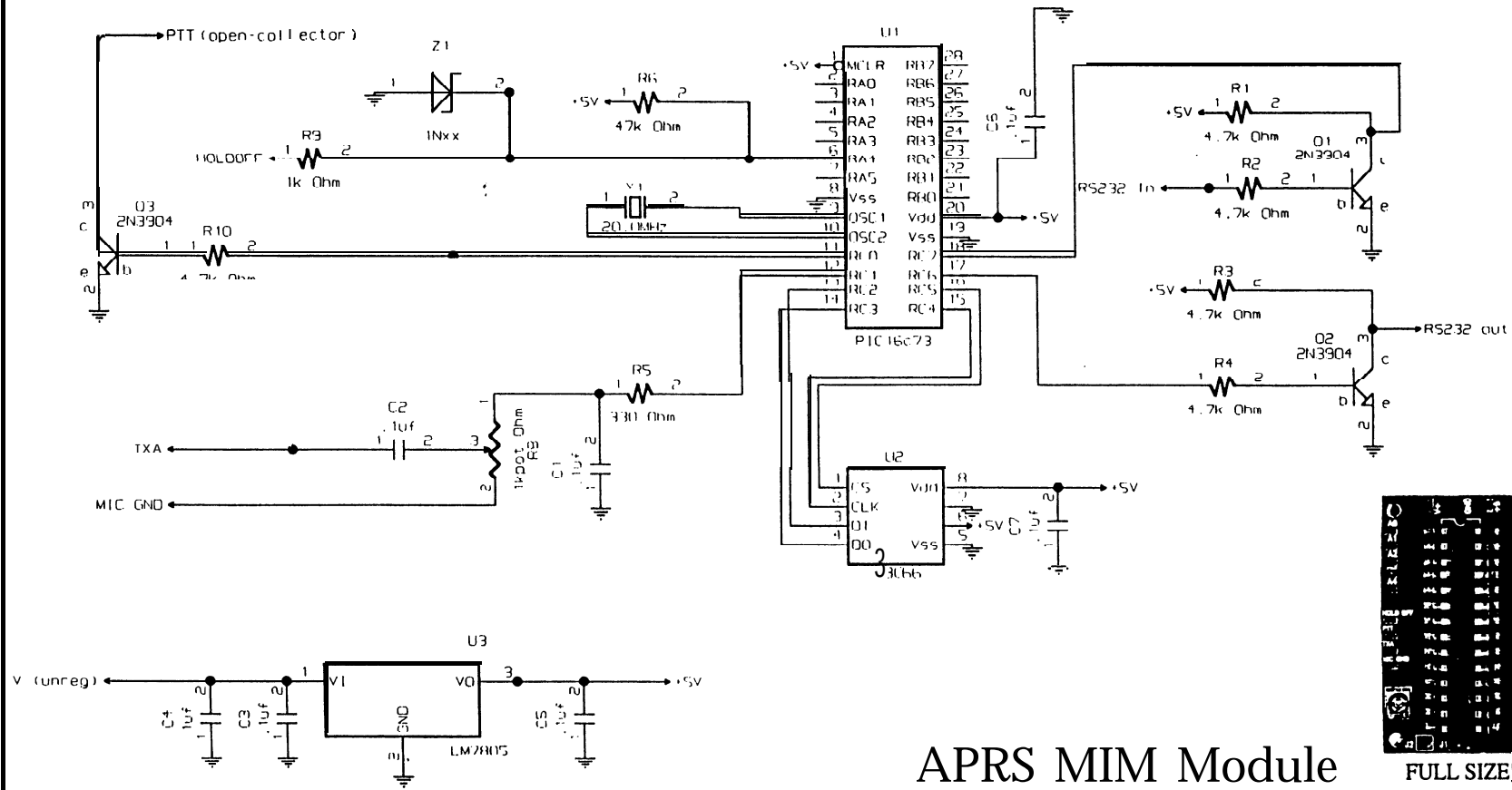
MICROPHONE-POWER: Note, in the simple circuit shown above, the electret mic element is also powered by the PTT voltage. If you build a Mic-Lite for any other microphone circuit, then you will need to provide a few volts of power for the mic element too. Add the two resistors and two caps in the circuit below to make sure the 8 volt microphone jack power (which is also powering the MIM) is clean enough for the mic:
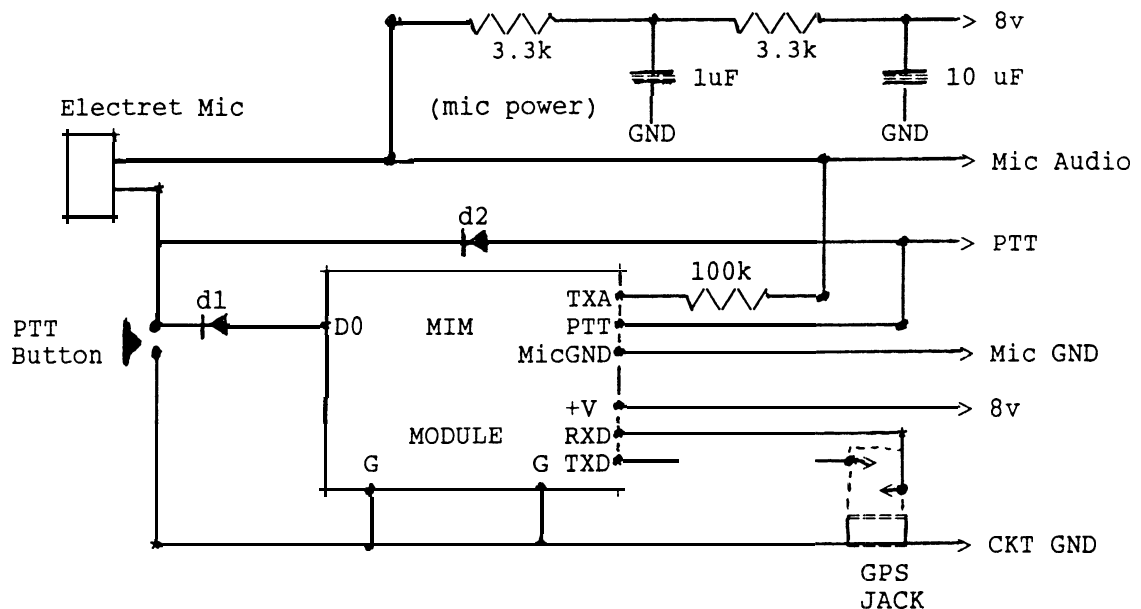
RECEIVER DETECTOR/AUTO MODE: If you want to operate in AUTO mode with carrier detect for collision avoidance (Not really needed for the Mic-Lite, since your EAR can tell you when to press PTT), add the following audio receive circuit to amplify the speaker audio high enough to trigger the hold off circuit. (This circuit has not been tested).
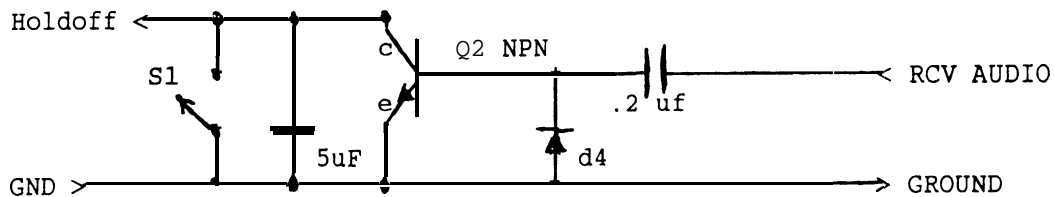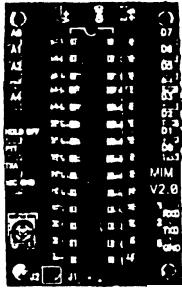

Q2, d4 and the two caps are an audio rectifier to drive the HOLDOFF input to the MIM when the radio is in use. This keeps the MIM from sending a packet. S1 is the AUTO switch. It can be used with or without this circuit. When it is shorted to ground, then this is the same as an "always busy" channel, so the Mic-Lite will never auto-initiate a packet. (It still will do the Mic-E function on release of PTT).

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PTT (open-collector)

Z1

1Nxx

R3
1k Ohm

HOLDOFF

R6
47k Ohm

·5V

Q3
2N3904

R10
4.7k Ohm

C2
.1uf

TXA

MIC GND

R8
10k0t Ohm

R5
330 Ohm

C1
1uf

U1

MCLR   RB7
RA0   RB6
RA1   RB5
RA2   RB4
RA3   RB3
RA4   RB2
RA5   RB1
Vss   RB0
OSC1   Vdd
OSC2   Vss
RC0   RC7
RC1   RC6
RC2   RC5
RC3   RC4

·5V

PIC16C73

20.0MHz

·5V

C6
.1uf

R1
4.7k Ohm

·5V

Q1
2N3904

R2
4.7k Ohm

RS232 In

·5V

R3
4.7k Ohm

·5V

Q2
2N3904

RS232 out

R4
4.7k Ohm

U2

CS   Vdd
CLK
DI
DO   Vss

·5V

·5V

C7
.1uf

·5V

3C66

U3

V (unreg)

C4
1uf

C3
.1uf

VI   VO

GND

C5
.1uf

·5V

LM7805

APRS MIM Module

FULL SIZE!

Complete APRS Packet **TNC** transmit
module. Transmits Position, **BText**
Telemetry at user specified rate.

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