

FAA APPROVED
RUNWAY LIGHT CONTROLLER
MODELS M15RCU-x-x(N)

Reginald Bennett International, Inc.

This operator's manual applies to the following specific models:

Model	Application	Control Voltage
M15RCU-120-A	Aviation	120 VAC
M15RCU-24-A	Aviation	24 VDC
M15RCU-120-M	Marine	120 VAC
M15RCU-24-M	Marine	24 VDC

* Note: Any model can be configured as a non FAA Approved unit for general applications not requiring FAA certification. The differences between FAA and non FAA versions will be annotated with a (*) to designate the non FAA version. The part number for the non FAA version unit will be the base part number with a "N" suffix.

The first two of these (-A) operate in the aviation radio frequency band (118-137 MHz) and permit remote radio control of airport lighting from aircraft. The second two models (-M) operate in the marine vhf radio band (156-162 MHz) and permit remote radio control of marine buoy lighting and foghorns from ships.

Features:

- FAA Approved per L-854, type I
- * non FAA version unit is not FAA Approved
- Unattended All-Weather Operation
- Microprocessor Control
- 10,000 Hour MTBF Reliability
- * non FAA units are configured with optional 1,2 or 3 relays.



Description:

All models consist of a radio receiver and a microprocessor-based decoder/controller assembly mounted inside a steel Nema 4 weatherproof enclosure. The receiver detects microphone “clicks”—short radio transmissions when the transmitter operator presses the push-to-talk switch. The decoder operates relays according to the patterns of clicks.

The receiver is based on the model M15 receiver/transmitter. Except for the oscillator circuit, the transmitter circuits are not installed; the oscillator is used to generate a test signal to check operation of the receiver and decoder/controller assembly.

The solid-state receiver is a crystal-controlled superheterodyne. To obtain good rejection of off-channel signals, the receiver contains a quadruple-tuned mosfet RF amplifier stage followed by a dual-gate field-effect mixer. The local oscillator is crystal-controlled and operates 10.7 MHz above the channel frequency (below the channel frequency for marine versions). Receiver selectivity is primarily determined by a six-pole 10.7 MHz crystal filter with ± 9 KHz bandwidth, connected between the mixer and first i.f. amplifier stage. The sensitivity of the receiver is adjustable to accommodate the differing operating range requirements among airports, typically from several miles up to about 30 miles air-to-ground. (For marine applications, the sensitivity is usually set to maximum and the ground-to-ground range is approximately 5 miles.) The filtered output of the receiver’s diode detector is connected to the input of the decoder/controller board.

The decoder/controller board assembly is essentially a small dedicated computer. It includes the Microchip PIC 16C711 microprocessor with its internal read-only-memory containing the computer program. Pulses from the radio receiver’s detector, caused by receiving microphone “clicks”, are applied to the microprocessor via a two-stage Schmitt Trigger type amplifier on the decoder board. The microprocessor responds to sequences of 3, 5 or 7 pulses within a 5-second “window” by energizing up to three relays. The relay contacts are connected to the terminal strip on the decoder/controller board, for controlling lights or other electrical equipment. For protection, all relay contact connections from the decoder/controller to external load circuits pass through three 5-ampere circuit breakers. (* - non FAA version units provide no relay circuit breaker protection.)

All (FAA VERSION) M15RCU-x-x models operate from 120 vac ($\pm 15\%$) 60 Hz, per FAA L-854. The decoder/controller assembly is designed to operate from a d.c. power source between 9 and 30 volts, which is obtained from an 120 vac/24 vdc power supply located adjacent to the circuit breakers. The decoder/controller assembly also contains a regulated switching type dc power supply which produces 7 volts dc to operate the M15 receiver. The M15RCU-120 models assume that external heavy-duty relays with 120 VAC coils are used. The M15RCU-24 models assume that the external relays have 24 VDC coils.

The receiver and decoder/controller printed circuit boards are coated with a board sealant to reduce the risk that dirt, humidity and moisture or condensed water droplets can interfere with correct operation. The coating does not extend over sockets or components that are adjustable. For additional protection, underneath the sealant both sides of the controller board are covered with a durable solder mask.

Operation

When a radio operator wants to control airport lighting or other electrical equipment, he first sets his transmitter frequency to the channel known to be used by the M15RCU. He then briefly presses his push-to-talk (ptt) microphone switch to produce a sequence of short “clicks”. For each click, the decoder board receives a voltage pulse which is amplified and applied to the microprocessor. The first “click” starts the “window”, after which the operator has 5 seconds to complete the desired sequence of either 3, 5 or 7 clicks. On the first click, the microprocessor starts its built-in timer and counts the pulses. When the third pulse is received, the first of the decoder’s three relays is energized (pulls in). For aviation models, on the 5th pulse, the second relay is energized, and on the 7th pulse the third relay is energized. After the 5 second window ends, all energized relays remain pulled-in for the preset timeout period, which is 15 minutes for airport lighting. At the end of the timeout period, all relays drop out at once.

During a timeout period, another series of microphone clicks may be transmitted. As before, the first click starts the 5 second window. For aviation models, a third click before the 5 seconds is over will cause the second and third relays to drop out. On a fifth click, the second relay will pull in again, and on a seventh click the third relay will pull in again. In this way, a pilot can change the lighting or which loads are controlled, if desired, without waiting for the end of the timeout period. A new timeout period will begin at the end of the 5 second window.

The relays connect to the airport lighting system or other equipment. The exact operation of airport lights depends on the external connections to the relays. In most airport installations, relays turn lights on or off, or change the intensity of the lights. In marine and other applications, eight “DIP” option switches provide for alternate window and timeout durations, as well as variations in the way relays operate for different sequences of microphone clicks.

Installation

The M15RCU-x-x is enclosed in a Nema 4 weatherproof enclosure, which may be installed indoors or out of doors. There are two optional mounting methods: (1) using mounting brackets on the sides of the enclosure (2) mounting directly from the rear through the four 3/8 inch holes on the rear of the enclosure. If the second method is used out of doors, weatherproof gaskets must be used to prevent moisture from entering the enclosure. The first method may be preferable because the second method also requires that the internal mounting plate (on which the receiver and decoder/controller assembly mounted) be removed temporarily for access to the insides of the mounting holes.

The enclosure is normally oriented so that the type SO239 coaxial antenna connector is on the top of the enclosure. The electrical connections (power, control) are normally made via a 1/2" to 1" hole on the bottom of the enclosure, which the installing electrician must create. (* - on non FAA version units two (2) 1/2 inch holes are provisioned on the bottom of the unit.) Wiring is usually connected through rigid conduit, or as required by local electrical codes. The contacts of the relays on the decoder assembly are rated for 3 amperes at either 120 VAC or 24 VDC. If the external power relays have 24 VDC coils, the internal 24 VDC power supply can provide up to 300 ma. total to the coils of these relays. (* - for non FAA version units it is assumed that external 24VDC will power the receiver and controller and no internal power will be generated.) The installing electrician may refer to the attached wiring diagram, drawing 2101780 and the assembly drawing 1101786.

A suitable antenna is required for this equipment. On the FAA version the antenna supplied is a model ASP-7A and for the non FAA version the unit comes with a whip antenna. The model ASP-7A can be used at 118-137 MHz for aviation applications or 156-162 MHz for marine applications, provided the vertical radiator element is cut to the correct length per the instructions supplied with the antennas. Both the antenna and the M15RCU-x-x require PL259 ("UHF male" type) mating connectors. The 50 ft. coaxial cable supplied is terminated with these connectors. If this cable is unnecessarily long, excess cable may be coiled and stored. However, if the length is considerably longer than needed, and maximum radio range is needed, the cable should be shortened.

When the M15RCU-x-x is mounted outside, then except where maximum range is required, an antenna mounted directly to the antenna connector may give sufficient radio range, provided that it is not "shadowed" by buildings in directions from which aircraft may approach. For maximum radio range, mount the antenna as high as practical. The antenna supplied does not include a mounting pole, which is often required to suit a particular installation. Application of a waterproof sealant over outdoors coaxial connectors is recommended.

The installer should confirm that the enclosure is properly sealed and that the door is tightly closed and padlocked (if required). This includes the connections at the antenna.

Initial Testing and Adjustments

For testing and adjustments, open the enclosure door.

WARNING. Since the enclosure may contain 120 VAC power, present on exposed terminals, the following should be done only by persons trained in safety precautions for these conditions.

Make sure that the on-off switch on the decoder/controller board is in the “on” position. To confirm that the switch is “on” and that AC line power is applied, the green LED adjacent to the 8-position options switch should be blinking once per second.

The 8-position options switch on the decoder/controller assembly is factory set to default settings for each model. Do not change these settings unless the new ones are known to be acceptable for the installation. For aviation models, only the default settings meet FAA L-854.

Initial tests may be made without load connections made or power applied to the lighting circuits. LED indicator lamps (red, green, yellow) adjacent to the relays on the decoder board show which relays are energized. A red LED labeled “window” is lit whenever a microphone click has activated the 5-second window and the microprocessor is awaiting additional clicks to count. If at any time when the M15RCU is operating the green LED in the corner of the board blinks faster than once per second, a microprocessor error has occurred. Refer to the section on maintenance.

The push-to-test switch on the M15 receiver can be used to simulate microphone clicks from in-range aircraft, and can establish that the receiver and decoder are operating correctly. Pressing this switch button on the receiver operates an internal test oscillator which simulates pressing a microphone ptt switch on an aircraft transmitter. Alternatively, if installers have available a handheld aviation communications transceiver, such as the ICOM Model A3 or equivalent, it may be used to create signals like those from an aircraft.

After a complete runway lighting system is installed, it is essential that daytime flight tests be conducted to confirm that the system operates as expected before aircraft depend on the operation for night landings.

Maintenance

Periodic inspection is recommended. Make sure no dust, moisture or corrosive atmosphere is entering the enclosure. Inspect all electrical connections for firmness and freedom from corrosion.

If at the time of inspection the green LED is blinking four times per second rather than the normal once per second, the microprocessor's "watchdog" feature has detected an error in its operation, but has corrected the problem. If it blinks sixteen times per second the error was caused by a power "brown out"; that is, the 120 VAC line voltage at some time has fallen below the 98-132 v operating range. Note: these fast blinking rates are intended to alert users to a past problem that has been self corrected, not that there is an existing problem. These problems may have been of such short duration that they were not noticed. The blinking LED may be reset to once per second either by pressing the small reset switch button near the LED, or by moving the on-off slide switch briefly to off, then back on. Unless the LED is reset, any future error will not be indicated, although the self-correction capability of the microprocessor is not affected.

Spurious Operations

Occasional spurious (unexpected) operations are nearly inevitable. Usually the spurious operations are not caused by a defect in this equipment. For airport lighting, some possible causes of these "spurs" include:

1. an aircraft intending to operate lights at another airport accidentally transmits on the wrong frequency, or both airports use the same frequency for light control
2. two aircraft transmit simultaneously on the channel with transmitters whose frequencies differ by less than 20 Hz (causing a low frequency heterodyne)
3. an aircraft transmits with a defective transmitter, microphone, cables, or antenna system ("cuts in and out" or "breaks up").
4. certain lightning static patterns from in-range electrical storms

If pilots feel that the operating range is greater than necessary, and that spurious operations are troublesome and may be caused by distant aircraft, the sensitivity of the receiver can be reduced. The sensitivity is adjusted by the small potentiometer labeled "SENS" on the receiver printed circuit board assembly. To access this it is necessary to remove the top cover of the receiver. Then use a small screw driver to rotate the control CCW to reduce sensitivity. It may be necessary to experiment with several settings before finding the best one for a particular installation.

Occasionally airport lights will not respond as intended. If this happens, the pilot should try a second sequence of microphone clicks. Sometimes the microphone ptt switch may not make contact each time it is pressed, or may produce two clicks when only one is intended. Microphone clicks must be at least 1/20 second long to register. If the sequence of clicks is too slow, the 5 second window may expire before the last click is

counted. The pilot should make certain his radio is tuned to the correct frequency and should be aware that the range of operation is dependent on altitude. In some installations, the range will be less for aircraft approaching from some directions, due to multipath reflections of the radio signal or to shadowing from hills and buildings.

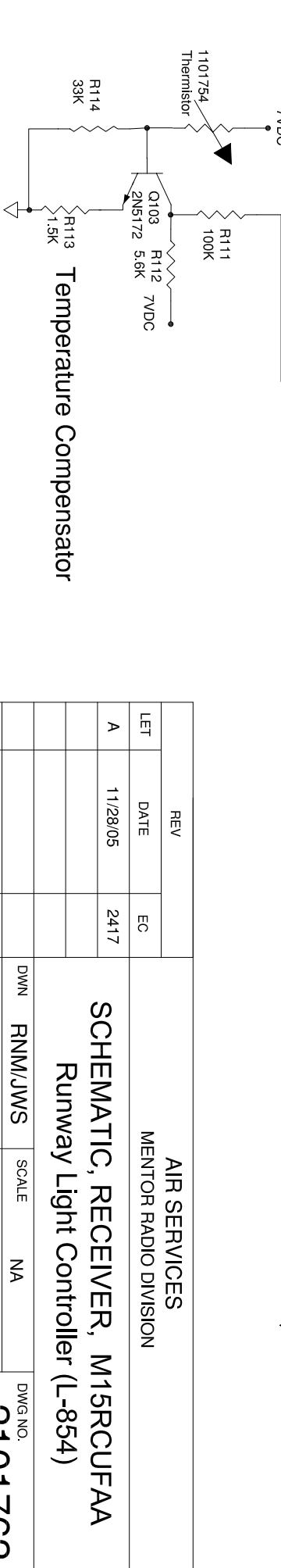
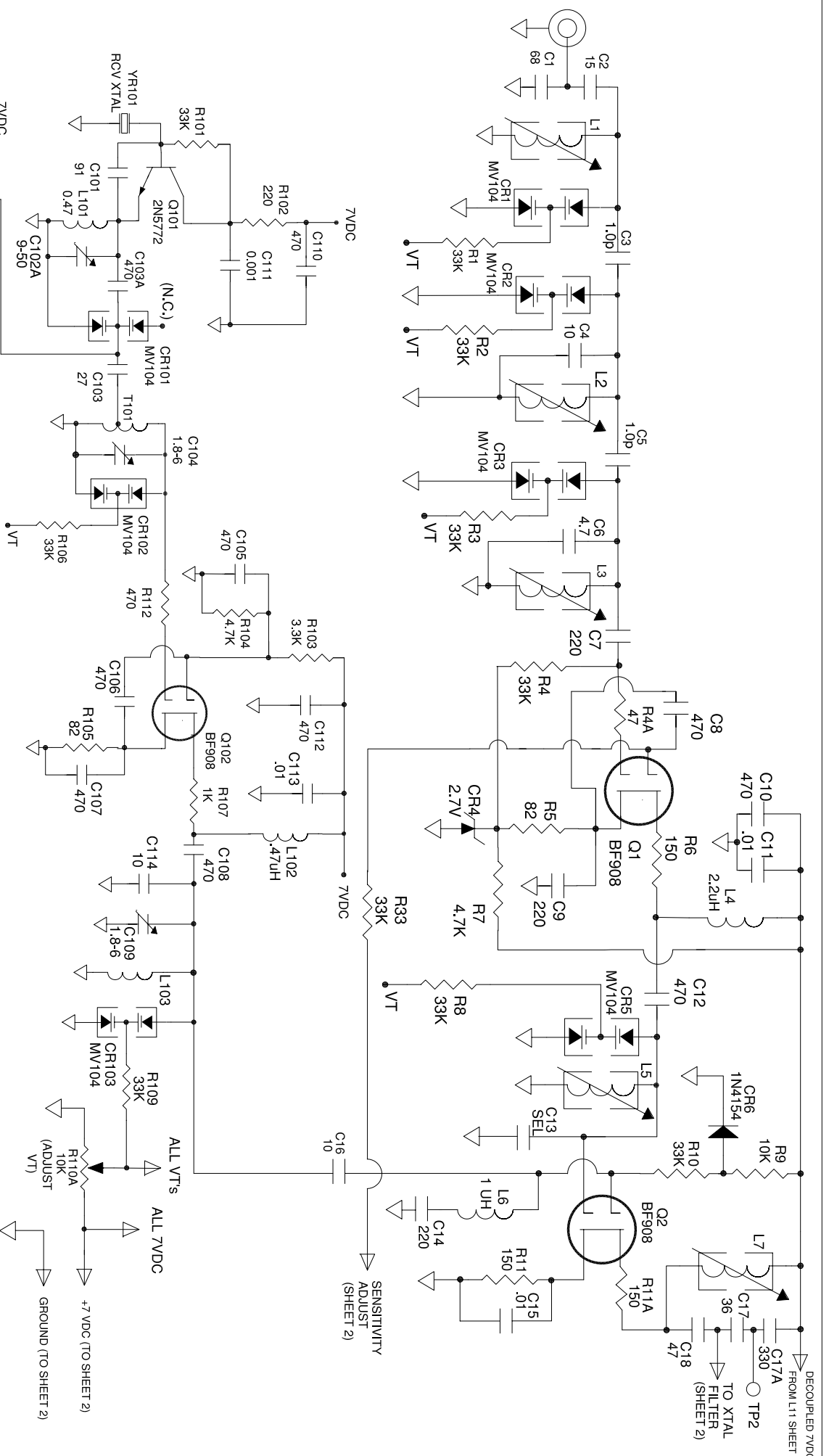
Trouble Shooting

The object of troubleshooting is to identify a probable defective component so that it can be replaced. The relays are the only field-replaceable components. If the unit does not respond to aircraft signals (actual or simulated), observe the behavior of the LED indicators on the decoder assembly. If the green LED in the corner of the decoder assembly is blinking, then the decoder assembly is turned, AC power is properly applied to the unit and the small power supply is operating properly. If any LED's other than the blinking green one are on, press the small black reset switch—all LED's should then turn off. If any lights remain on, unplug the 3-terminal connector that connects to the receiver and press the reset switch again. If all lights do not turn off, the decoder assembly must be replaced.

If the blinking green LED is operating normally but the red “window” LED does not turn on when the receiver press-to-test button is pressed, use a dc digital voltmeter to measure the voltages at the 3-terminal connector. Connect the meter's black probe to the center terminal (ground) and the red probe to the “A+” terminal. (Use a very fine probe or slip a small short uninsulated wire down alongside the white/orange connector wire to make contact.) It should read approximately 7 vdc. Do the same for the “DET” terminal, where the voltage should be between 0.015 vdc and .030 vdc. When the push-to-test switch is pressed, this should increase to at least 0.6 vdc. If the 7 vdc is present but the voltage at the DET terminal is incorrect, the receiver is defective.

To establish that contacts on a relay are not operating correctly, observe the associated LED (red, green, yellow). If the LED lights up, but the controlled lights do not respond, connect a jumper across the relay contacts. If the lights *do* respond as expected, the relay may be defective. Note that in many installations there will be another external relay between the decoder relay and the lights.

Warning: After installation, this equipment will contain internal voltages that can cause injury or death. The foregoing tests should be performed only by personnel trained in appropriate safety procedures.



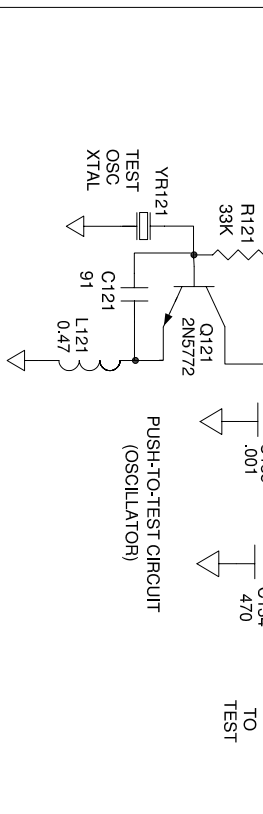
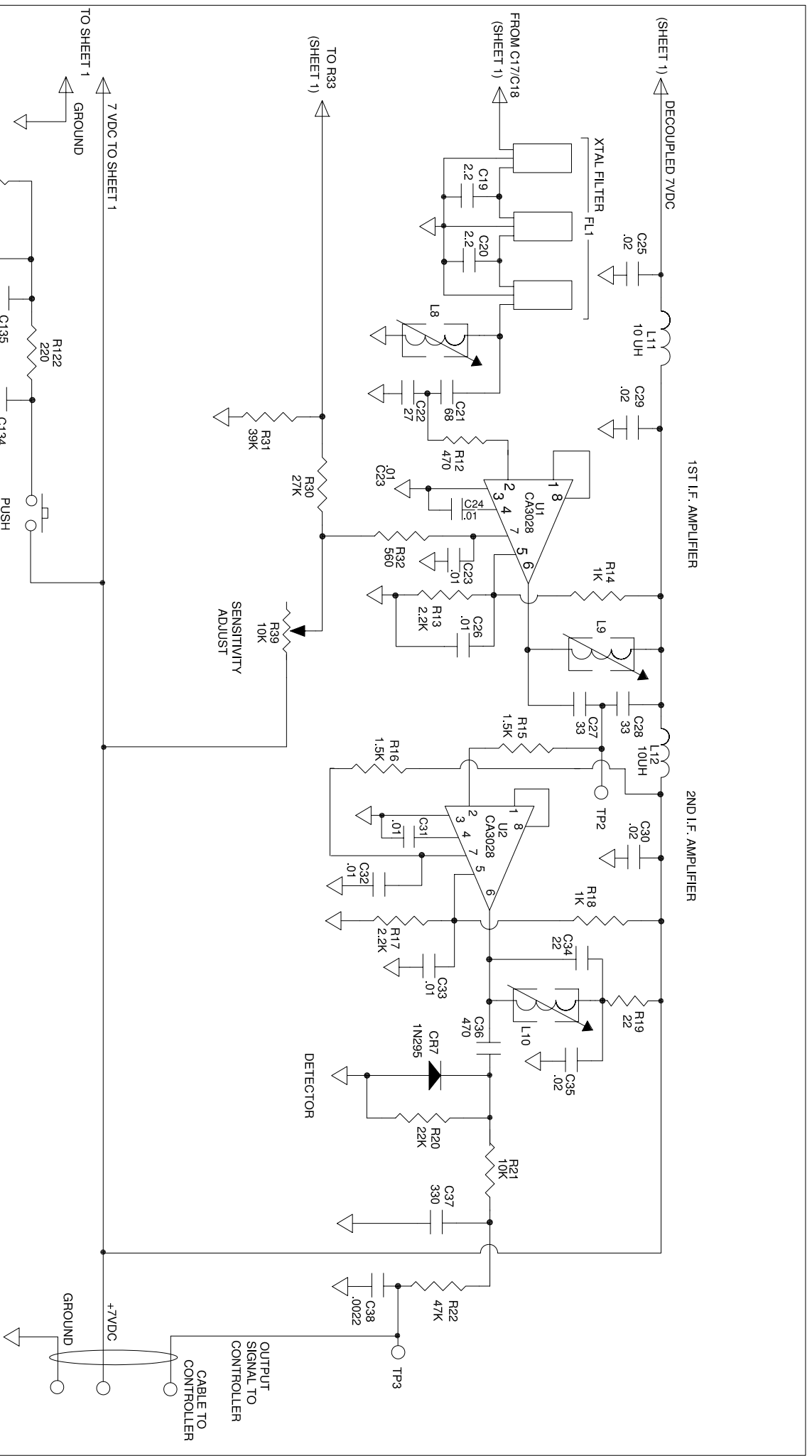
REV		
LET	DATE	EC
A	11/28/05	2417

AIR SERVICES
MENTOR RADIO DIVISION

SCHEMATIC, RECEIVER, M15RCUF6A
Runway Light Controller (L-854)

DWN	RNM/JWS	SCALE	NA	DWG. NO.
SHEET	1 OF 2	DATE	7/1/2005	2101762

DECOUPLED 7VDC
FROM L11 SHEET 2
TP2
TO XTAL
FILTER
(SHEET 2)

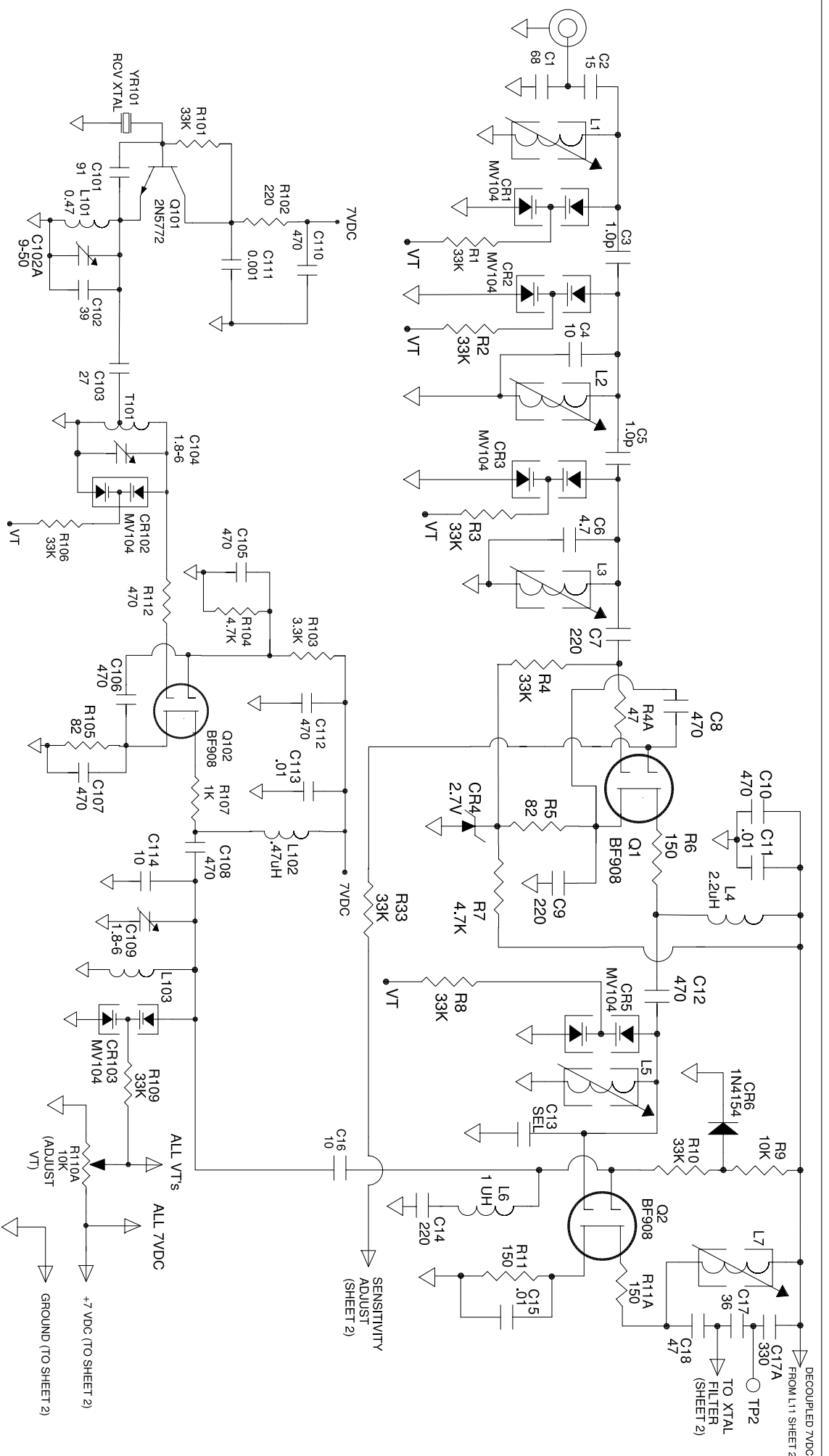


REV	DATE	EC
A	11/28/05	2417

AIR SERVICES
MENTOR RADIO DIVISION

SCHEMATIC, RECEIVER, M15RCUF_{FAA}
Runway Light Controller (L-854)

DWN	RNM/JWS	SCALE	NA	DWG NO.
SHEET	2 OF 2	DATE	7/1/2005	2101762

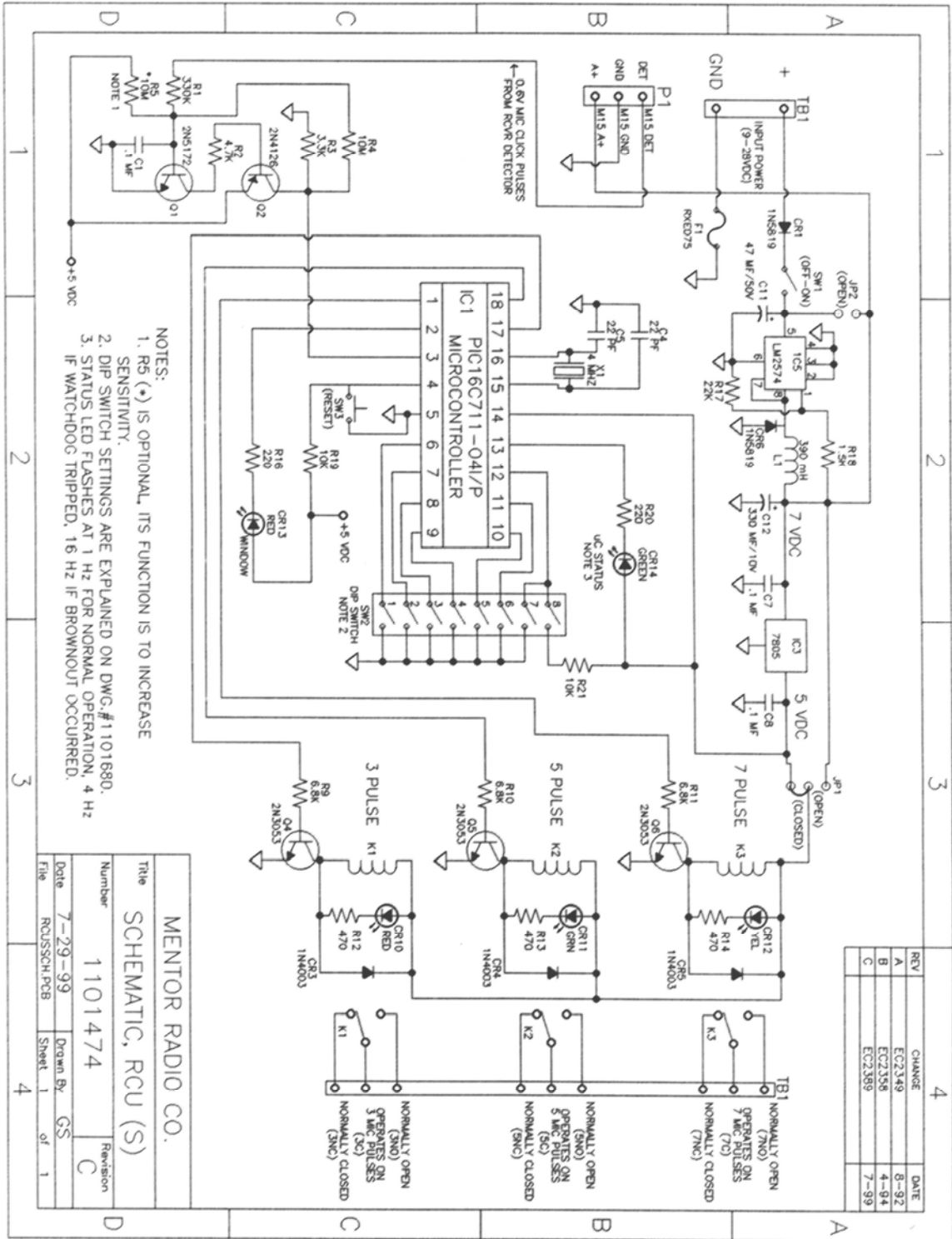


REV		EC
LET	DATE	
A	12/28/2005	2419

AIR SERVICES
MENTOR RADIO DIVISION

SCHEMATIC, RECEIVER, M15RCU Non-FAA Runway Light Controller

DWN	RNM/JWS	SCALE	NA	DWG NO.
SHEET	1 OF 2	DATE	11/28/2005	2101480



- NOTES:
1. R5 (*) IS OPTIONAL, ITS FUNCTION IS TO INCREASE SENSITIVITY.
 2. DIP SWITCH SETTINGS ARE EXPLAINED ON DWG.#1101690.
 3. STATUS LED FLASHES AT 1 HZ FOR NORMAL OPERATION, 4 HZ IF WATCHDOG TRIPPED, 16 HZ IF BROWNOUT OCCURRED.

MENTOR RADIO CO.	
Title	SCHEMATIC, RCU (S)
Number	1101474
Date	7-29-99
File	RCUSSCH.PCB
Drawn By	GS
Sheet	1 of 1

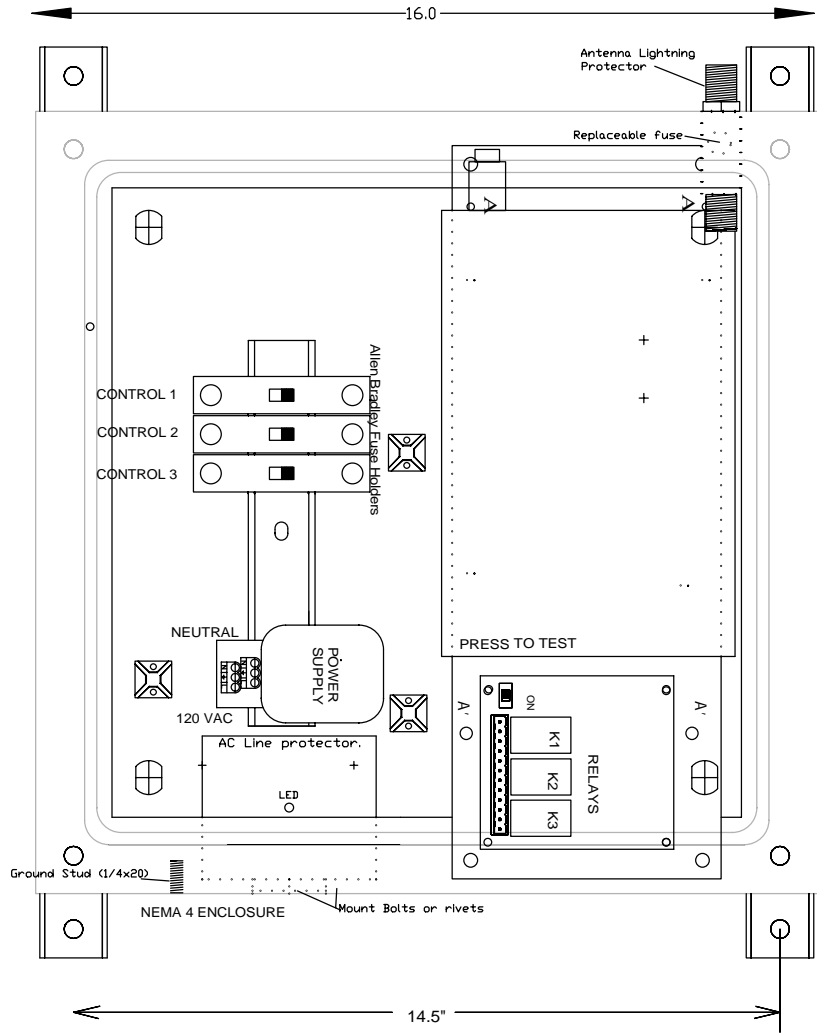
A		B			C		D
1	TIMEOUT SELECTION	1	2	3	5 OR 7 CLICK OFF OPT.	SW#7	SW#8
	NO TIMEOUT	CLOSED	CLOSED	CLOSED	5 OR 7 DISABLED	CLOSED	OPEN
	3 SECONDS	OPEN	CLOSED	CLOSED	5 OR 7 DISABLED	CLOSED	CLOSED
	5 MINUTES	CLOSED	OPEN	CLOSED	5 CLICK OFF ENABLED	OPEN	OPEN
	10 MINUTES	OPEN	OPEN	CLOSED	7 CLICK OFF ENABLED	OPEN	CLOSED
	15 MINUTES	CLOSED	CLOSED	OPEN			
	30 MINUTES	OPEN	CLOSED	OPEN			
	45 MINUTES	CLOSED	OPEN	OPEN			
	60 MINUTES	OPEN	OPEN	OPEN			
2	WINDOW SELECTION	SW#4					
	3-SECOND WINDOW	CLOSED					
	5-SECOND WINDOW	OPEN					
3	OLD or NEW FAA	SW#5					
	OLD FAA	CLOSED					
	NEW FAA	OPEN					
	RELAY'S MUTUALLY EXCLUSIVE (ONLY WITH OLD FAA)	SW#6					
	DISABLED	CLOSED					
	ENABLED	OPEN					
4							

1	OPEN	CLOSED
2		
3		
4		
5		
6		
7		
8		

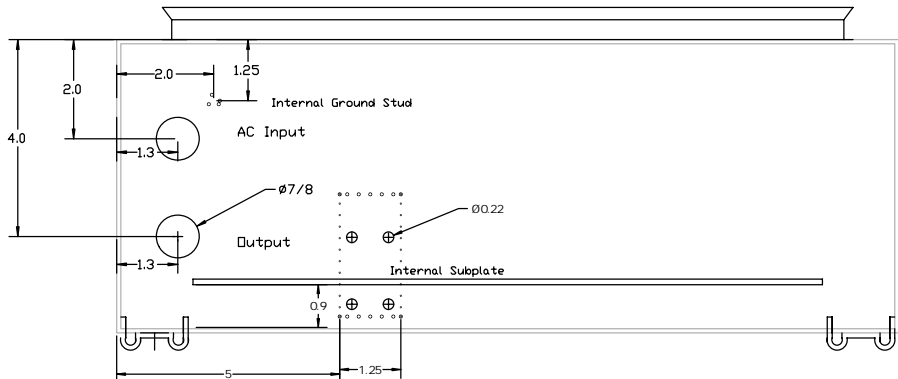
1 → TIMEOUT SELECTION
 2 → WINDOW SELECTION
 3 → OLD or NEW FAA
 4 → RELAY'S MUTUALLY EXCLUSIVE
 5 → 5 OR 7 CLICK OFF OPTION

Title	UC-DIP SWITCH SETTINGS		
Size	Number	1101680	Rev
A			A
Date	6-30-99	Drawn by	CS
Filename	RCUDIPSW.PCB	Sheet	1 of 1

0.39" DIA MOUNTING HOLE



Qty	Part No.	Description
1	1101717	Case, NEMA 4
1	1101812	PCB, Receiver
1	1101763	PCB, Controller
1	1101787-2	Rail, DIN
3	1101830	Fuseholder, DIN
3	1101833	Fuse, 5A
1	1101785	Outlet, DIN



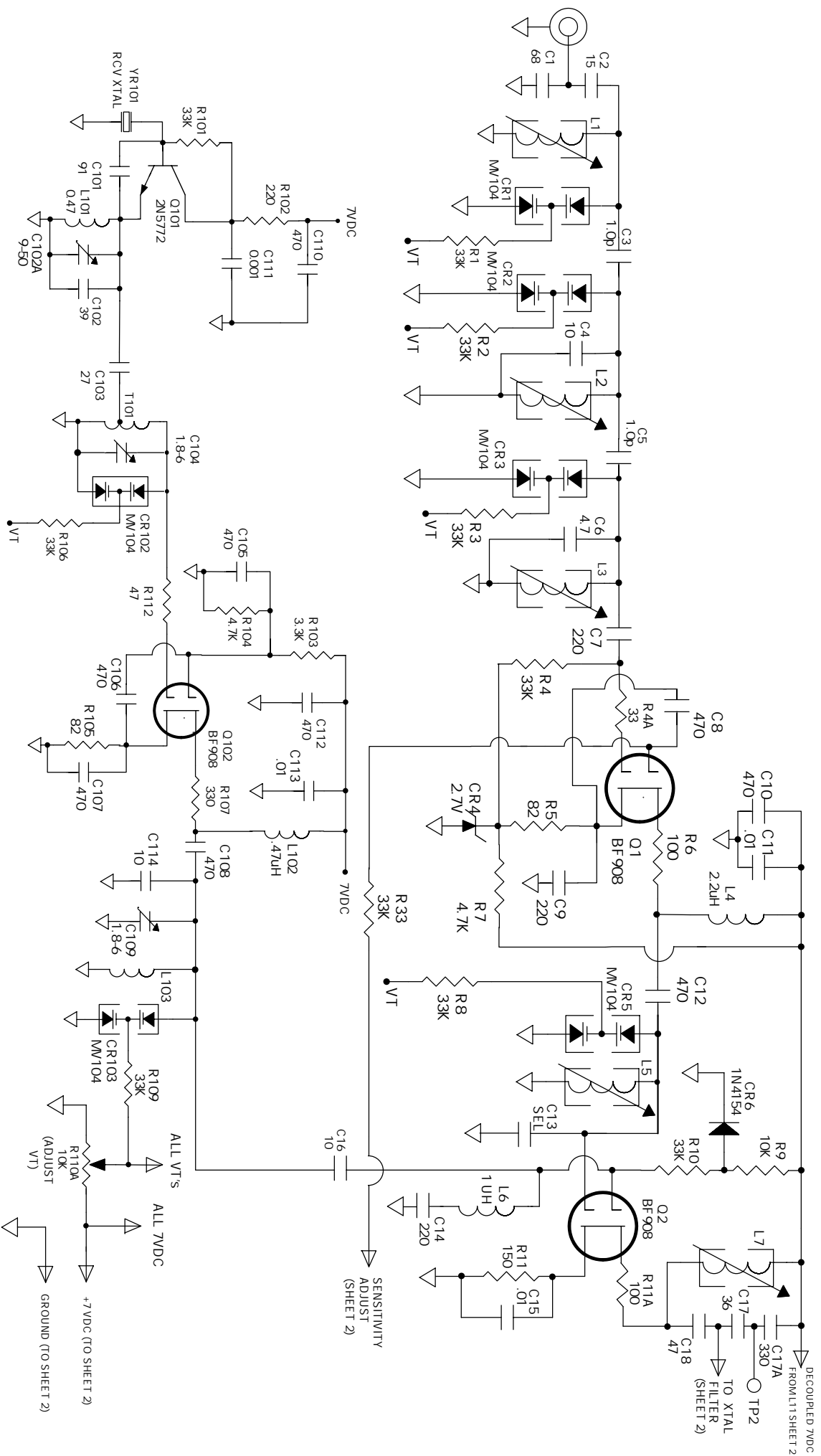
A and A' holes drilled to 1/4" through base plate and subplate
Secure with 1/4"x20" bolt using flat washer and lockwasher
between subplate and base plate.

MENTOR RADIO
Constant Aviation

M15RCU FAA Radio Control Unit
(-49B)

REV	LET	DATE	EC
A		7/7/2006	2423
B		11/10/2006	2425

DWN	RNM	SCALE	4:1	DWG NO.	1101782
APP		DATE	7/7/2006		



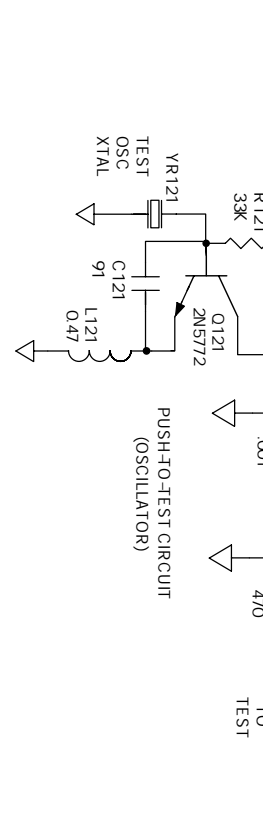
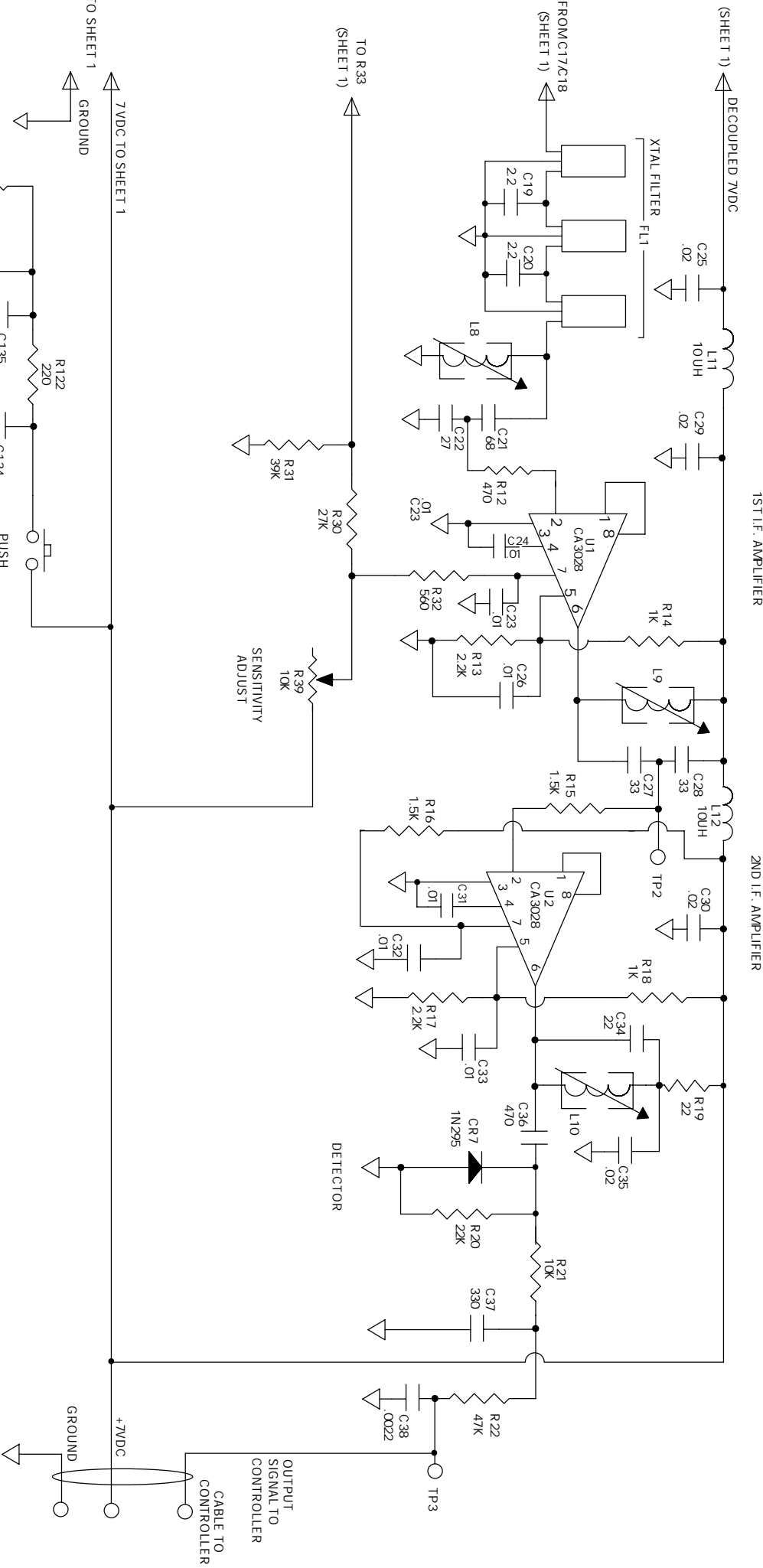
AIR SERVICES OF CLEVELAND
MENTOR RADIO DIVISION

SCHEMATIC, RECEIVER, M15RCU-24-M
Marine Version, Radio Control Unit

REV	LET	DATE	EC
A		11/13/2006	2426

DWN	SCALE	DATE
RNM/JWS	NA	11/13/2005

DWG. NO. **1101834**



REV	DATE	EC
A	11/13/2006	2426

AIR SERVICES OF CLEVELAND
MENTOR RADIO DIVISION

SCHEMATIC, RECEIVER, M15RCU-24-M
Marine Version, Radio Control Unit

DWN	RNM/JWS	SCALE	NA	DWG NO.
SHEET	2 OF 2	DATE	11/13/2005	1101834