
Dispatcher/Operator Board Assembly Instructions

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1. INTRODUCTION

This document describes the functional blocks of the Dispatcher/Operator interface (Active Telephone Speech Network) and how to assemble it.

2. DISPATCHER/OPERATOR INTERFACE OVERVIEW

The *Dispatcher/Operator interface (DSOP)*:

- operates on 24 volts, draws about 15 mA (can share a power supply with our [EBF31A](#) or other 24V battery feed arrangement)
- Independent receive, and transmit volume controls to ensure the DS/OP can hear and be heard
- “break-in” (when a station is trying to talk to the DS/OP while the DS/OP is talking) and output phase adjustments to control feedback when used with a desk mic (you must use a directional or cardioid pattern mic for reliable mic/speaker operation)
- Does not draw DC power from the Dispatcher’s “Train Wire”
- Supports “computer” headsets with separate 1/8” (3.5mm) plugs, or free standing microphone/speaker arrangements, including “candlestick” or “scissor” style telephones modified for dynamic or electret mics
- Jumpers for tip/ring/sleeve or tip/sleeve plugs on audio inputs and outputs
- Supports dynamic and electret microphones with built in electret power supply (for computer headsets)
- Push (stomp)-to-talk voice switching with screw terminals for footswitch
- Optional connections for remote volume controls
- 2 RJ11 jacks for connection to Dispatcher’s train line as well as screw terminals
- Uses Regulated 24VDC @ 15 mA on 2.5mm barrel jack, screw terminals, or on pair 3 of the RJ11
- Hybrid Null adjust to reduce line noise
- 2.75” x 6.5” (10x16 cm) form factor fits in a piece of 12” DINRail next to an EBF31A for a complete Dispatcher and Battery Feed Solution for a Dispatcher’s Train Line!

The EBF31A consists of three main sections.

- 2-4 wire hybrid matches microphone and speaker to 2 wire phone line with null adjustment
- Microphone control circuit (footswitch) with “talk” indicator LED
- 600 ohm line level output to external amplified speaker
- Adjustable pre-amplifiers for mic level, receive level and break-in

All components are through-hole technology for ease of assembly and repair.

Connectors are provided on RJ11 (for tip, ring – first pair and power on third pair), 2.5mm center positive barrel connector (for power) and 3.5mm stereo jack for microphone and line level audio. There is a 5mm 2 position terminal strip for a footswitch. In addition there is a 4 position 0.100” terminal strip for tip and ring and 24V(+) and ground in parallel with the RJ11. Pads are provided for a second 4 position 0.100” terminal strip.

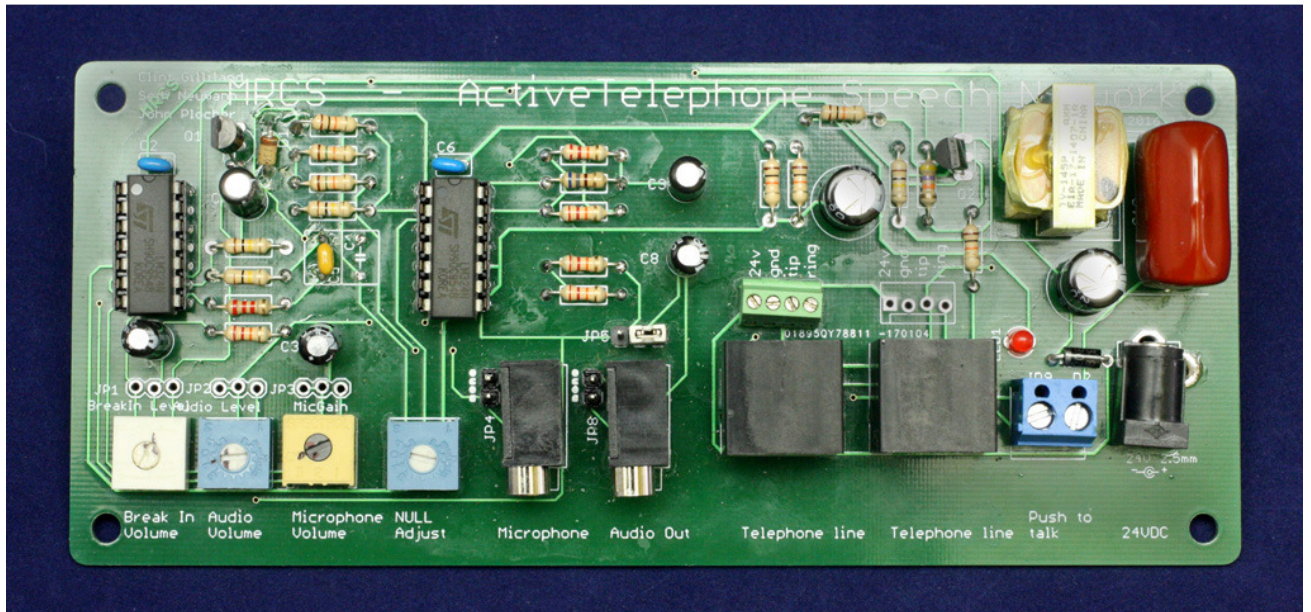


Figure 1 Dispatcher/Operator Top View

3. CONNECTIONS

3.1. POWER

The DS/OP uses regulated 24V DC. 15 mA is sufficient, although most commercial 24 VDC supplies start at 1A. Modern “Wall Warts,” open frame power modules, or traditional telephone supplies may be used. If your supply has a 2.5mm center positive plug, you may plug it in to the barrel jack, J1. If not use, pins 1 and 2 of SL1 or SL2. Pin 1 is +24V and Pin 2 is ground. Since the DS/OP draws a maximum of 15mA, you can use wire as small as 24 Ga for the power connections which will easily fit into the miniature screw terminals. D2 will protect the board if you connect power upside down, but the circuit will not work until you have polarity correct.

3.2. TIP AND RING (TELEPHONE)

The two sides of a traditional telephone line are called TIP (the more grounded side) and RING (the side towards supply or “battery”). These terms derive from the Tip/Ring/Sleeve plug (like a modern stereo plug) used on manual switchboards. Tip and Ring are available on the center pair of the RJ11 jack so you can plug a test phone directly into the DS/OP: if you can hear yourself talk through your microphone on the handset of the test phone you’re on the air! If you want to distribute signal through telephone style punch blocks or barrier strips, use pins 3 and 4 of JP3.

Do not plug a 6 wire phone (or DCC command bus) cable from the DS/OP directly into a V2.0N or earlier EF31A as the auxiliary contact will short out the power. Forthcoming EBF31As will share power on the third pair and move the “off hook” contact to the second pair.

3.3. MICROPHONE

The microphone is connected to JP6, a 3.5mm jack. Adapters are available from all the usual sources to reduce ¼” phone plugs to 3.5mm. You can either a dynamic or an electret mic with the DS/OP. There is an internal power supply to drive an electret mic (usually used in “computer” headsets). No adjustment is required to use an electret mic. If you don’t want the electret power, don’t install R10 and D1. There is a jumper JP4 to short the tip and ring of the mic together if you are using a stereo mic but that should not be necessary.

3.4. SPEAKER

The speaker is connected to JP7, a 3.5mm jack. As noted above adapters are available to convert 3.5mm to other formats. This jack is for a powered computer speaker or the earphones of a computer headset. Again, there is a jumper, JP8, to short the tip and ring of together if you are driving powered stereo speakers, such as typical computer speakers. You can also drive an amplifier for larger speakers with this output. There is a phase jumper, JP5, that can be moved to change phase of the output. This is sometimes useful in controlling feedback in a mic/speaker/footswitch installation. The jumper must be in and connected one way or the other to obtain output.

3.5. FOOTSWITCH

A 5mm screw terminal, JP9, is provided for us with a footswitch. The footswitch should be wired as normally open (form A) and depressing the pedal should close the switch. The LED above the connector will illuminate when the contact is closed and the mic is active. In some headset arrangements the mic may be left on continuously by running a jumper from one terminal of JP9 to the other. A good noise cancelling headset will provide enough isolation to prevent feedback. However any station coming off hook will hear the DS/OP talking with anyone in his space.

3.6. REMOTE VOLUME CONTROLS

The three volume controls: microphone, receiver and break-in, may be mounted remotely. In this case rather than using the screwdriver adjusted potentiometers on the board, 0.100 screw terminal strips or headers mounted in positions JP 1 through 3 respectively. A suitable cable is then run from the terminal to the remote pot. MRCS offers the pots as accessories. We recommend you only remote audio level, JP 2, but if you do remote the break-in and mic pots, remember to shield the mic connection as it is low-level. Always keep these cables as short as possible and away from possible sources of interference.

4. INSTALLATION AND ADJUSTMENT

4.1. MOUNTING

1. Find a location close to your battery feed source
2. The DS/OP is designed to snap into 70mm [DINRail](#) (a plastic track system) and you can cut notches in the rail to clear the various connectors. You may need to remove one of the “vanes” to allow for easier installation by scribing it with a hobby knife. Alternately you can use the four holes, I use 3/4” pan head sheet metal screws and 1/4” standoffs.

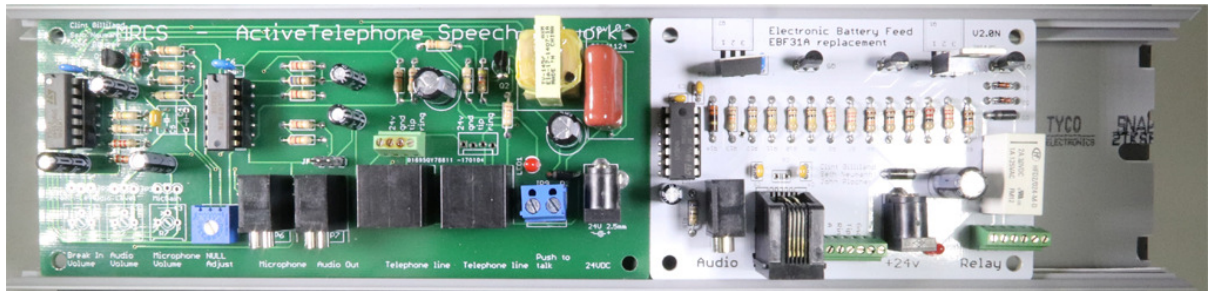


Figure 2 DS/OP board and EBF31A Mounted in 12" DINRail

3. Either plug a 2.5mm 24V wall wart into the power jack or run 24VDC and ground to the marked terminals on the 4 position green, 0.100” connecting block above the left RJ11 connector. Power can be daisy chained from the EBF31A. You can't hurt the DSOP board by connecting upside down, but nothing will happen. Check with a voltmeter: Black lead to ground, Red lead to 24v (it's marked on the board).
4. Connect your footswitch to the Blue, 2 position, screw terminal block marked “Push to Talk.” The footswitch should be normally open and the contacts should close when you stomp down on it.
5. Plug your microphone (mic side of headset) into the 3.5 mm jack marked “Microphone”
6. Plug your powered speaker (earphone side of headset) into the 3.5 mm jack marked “Audio Out”
7. Make sure there is a white jumper on the “Output Phase” header (JP5) above the “Audio Out” jack. The center and one side or the other should be connected; it isn't important which side at this point.
8. You don't need a jumper on either of the headers beside the jacks unless you've got a stereo device and want audio to come out on both channels.

4.2. INITIAL TEST AND SETUP

1. Smoke test: apply power and look for sparks or smoke. If none observed, leave power on for five minutes and check that nothing (ICs, transistors, resistors) is warm and that nothing smells of burning electronics. (Note: The electronics Gods can be propitiated by sacrificing a small goat or an old locomotive <g>). Seriously: check your wiring.
2. Null the hybrid: Have someone take a couple of phones on the line off hook, then while listening through the headphones or speaker, adjust the “Null Adjust” pot about 1 third from the left on the bottom. There will be a low level rushing or hissing noise, tweak the pot until the noise is at a minimum.
3. Adjust the transmit volume: stomp on the foot switch and talk in a normal voice: a 10 count or standard text (recite the Gettysburg address or whatever they made you memorize in school across the border) and have your helper(s) listen with 1 or 2 phones off hook. You may want to set it a little high as the room will be noisier during an op session. Use the “Microphone Volume” pot for this adjustment.
4. Adjust the receive volume: have your helper talk to you from one of the stations in a normal voice, Use the “Audio Volume” pot to make this adjustment. Note that we anticipate that working adjustments during a session will be made with the volume control on a powered speaker or on the lanyard of the headset but you can use a remote volume control if you opted for that.
5. Adjust Break-In Volume and Feedback control: In prototypical dispatching party lines, another station upon hearing something copied incorrectly, is supposed to break in and bring the issue to the DS’ attention. The break-in Volume pot adjusts how much this audio is muted when the foot switch is active. This helps prevent feedback in systems with an open Mic and Speaker (generally not a problem with headsets). This volume should be set as high as is comfortable for the DS without causing feedback. Normal steps to control feedback are: use a directional or cardioid pattern mic, placement of speaker and mic with respect to one another (mic not pointing at speaker) and the phase jumper can be changed.

5. BILL OF MATERIALS

Part	Quan	Value	Description	vendor	p/n
BOARD1	1	BOARD69X100			
C1,C7,C8,C9	4	10 uf @ 50	Electrolytic CAPACITOR, American symbol	Jameco	29891
C2, C6	2	0.1uF (104)	CAPACITOR, American symbol	Jameco	25523
C3	1	1uF@50V	POLARIZED CAPACITOR, American symbol	Jameco	29831
C5	1	.33uF	CAPACITOR, American symbol	Jameco	138237
C10,C11	2	100 uF @ 50V	POLARIZED CAPACITOR, American symbol	Jameco	29962
C12	1	2.2uF MYLAR_CAP	Digikey	Digikey	P10983-ND
D1	1	1N4734A 5.6 V	Zener Diode	Jameco	36118
D2	1	1N5819-B	1.0A SCHOTTKY BARRIER RECTIFIER	Jameco	177965
IC1, IC2	2	LM324N	OP AMP	Jameco	23683
J1,J2	2	RJ14	DigikeyWM5431-ND	Digikey	WM5431-ND
JP1,2,3,5	4	Remote POT, Phase			
JP4,8	1		PHOENIX CONNECTOR		
JP6,7	2	RS 2168149	3.5mm Audio Jack	Jameco	2168149
JP9	1		PHOENIX CONNECTOR 2x5mm	Jameco	2094485
JP10	1	Jameco 101187-RA	DC POWER JACK	Jameco	2094485
LED1	1		LEDs	eBay	2186603
Q1	1	2N4401/3904/2222	NPN Transistor	Jameco	783498
Q2	1	2N4403/3906	PNP Transistor	Jameco	38447
R1	1	10K	3386 Series	Jameco	43001
R2, R12	2	100K	3386 Series	Jameco	43027
R7	1	500K	3386 Series	Jameco	63212
R3,13,14,15,17	5	22K	Resistor	Jameco	691180
R4	1	2.2K	Resistor	Jameco	690945
R5,6,8,20	4	100K	Resistor	Jameco	691340
R9,10	2	15K	Resistor	Jameco	691147
R11, 18,19,22,23	5	10K	Resistor	Jameco	691104
R16	1	680	Resistor	Jameco	690822
R21	1	47K	Resistor	Jameco	691260
SL1,2	2		4 position 0.100 screw terminal	E-Salon	
T1	1	TY-145P		Jameco	630459

Table 1- Bill of Materials

6. ASSEMBLY

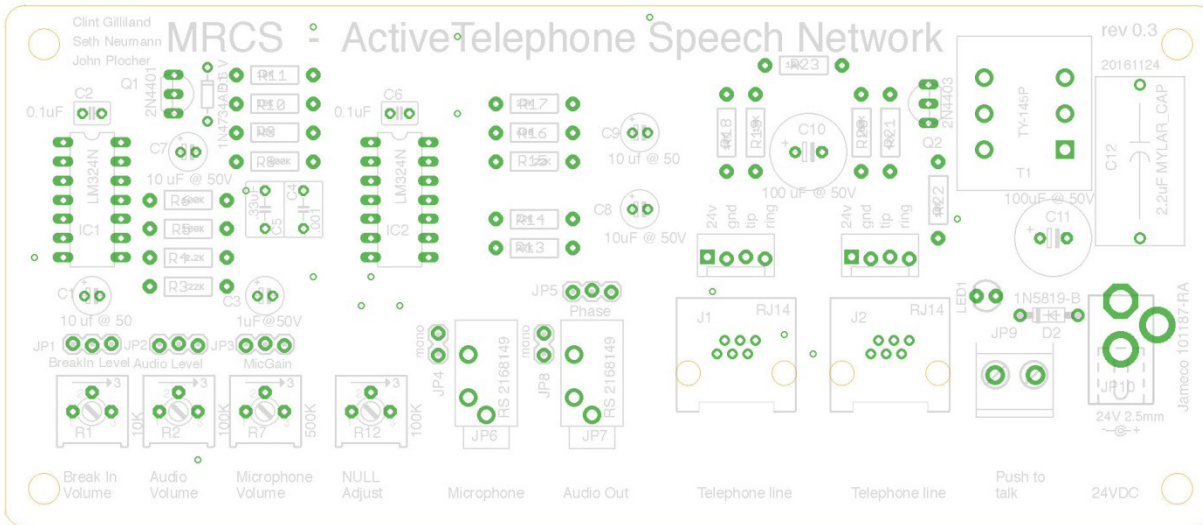


Figure 3 DS/OP Component Layout

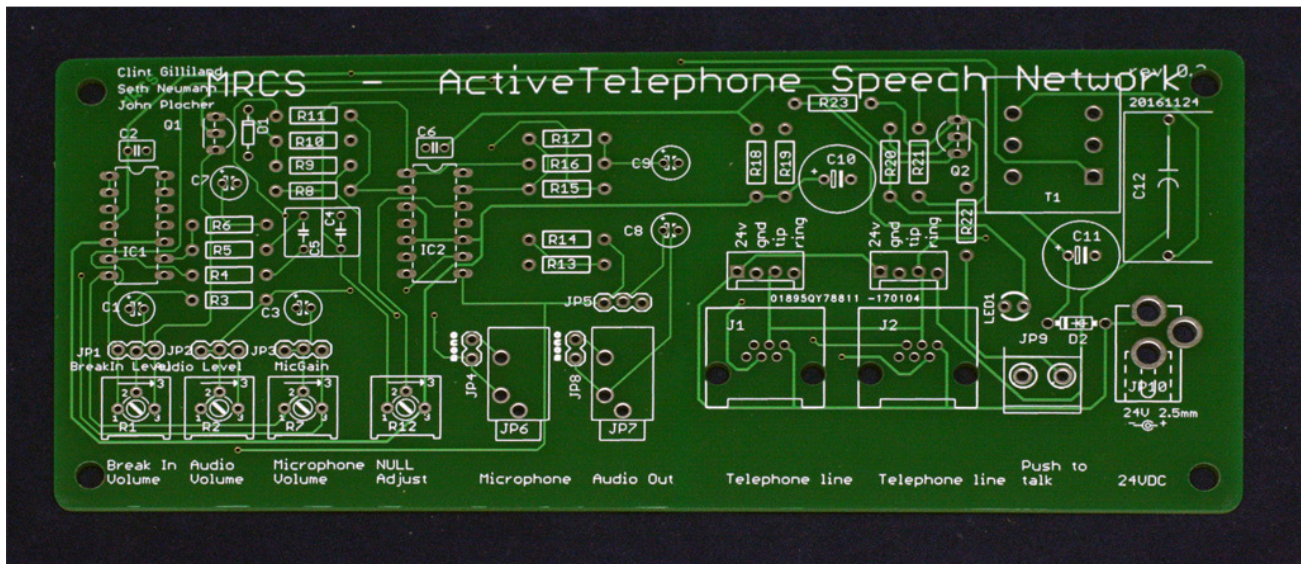


Figure 4 Top of Board

All of the components are through-hole technology with wire leads. A useful tool is a lead bender for forming the leads at 90 degrees for easy insertion into the pad holes. Start with inserting the lower height components. The general rule is to install the lowest components first, working towards components that are higher off the board. This enables you to support the low components as you solder them.

[] Resistors Diodes - Check options before installing Pots and Connectors!

[] Install Resistors R3 - 23 except for R7 and R12 (pots). Try to keep the gold tolerance band down or to the right for easier reading of values

[] Install diodes D1 and D2

[] Install LED1 (near the “push to talk” connector) Pad near “JP9” label is +. Observe the polarity of the component. Long lead on LED is Positive.

[] Monolithic Capacitors

[] Install C2 and C6 (.1uF)

[] Install C5 (.33uF)

[] I trim pots

[] install R1, R2, R7 and R12 unless your planning to use remote pots in which case omit any pots you're planning to remote. Remember to stuff JP1,2,3 with connectors or headers as required.

[] IC Sockets

[] Install sockets for IC1, IC2. Notches towards the top of the board

[] Transistors, small terminals and Electrolytic Capacitors

[] Install Q1 and Q2 - note they face away from each other

[] Install SL1 and SL2 (if used) wire openings point up towards the top of the board unless you aren't using RJ11s in which case it's your choice

[] Install C3, 1 uF. Note polarity, long lead is +

[] Install JP4,5, 8

[] Install C3, 1 uF. Note polarity, long lead is +

[] Install C10, C11, 100 uF. Note polarity, long lead is +

[] Jacks

[] Install J, J2 unless you will not be using RJ11s

[] Install JP6 and JP7 (3.5 mm audio jacks)

[] Install JP9 (2x5mm screw terminal) for foot switch

[] Install JP10 unless you will be using the modular jack only and are powering via SL1

[] Mylar Cap and Transformer

[] Install C12, label should facing away from the board

[] Install T1 with Black dot facing C12

[] Install IC1 and IC2, match notch with the socket and take care not to bend the legs

7. SCHEMATIC

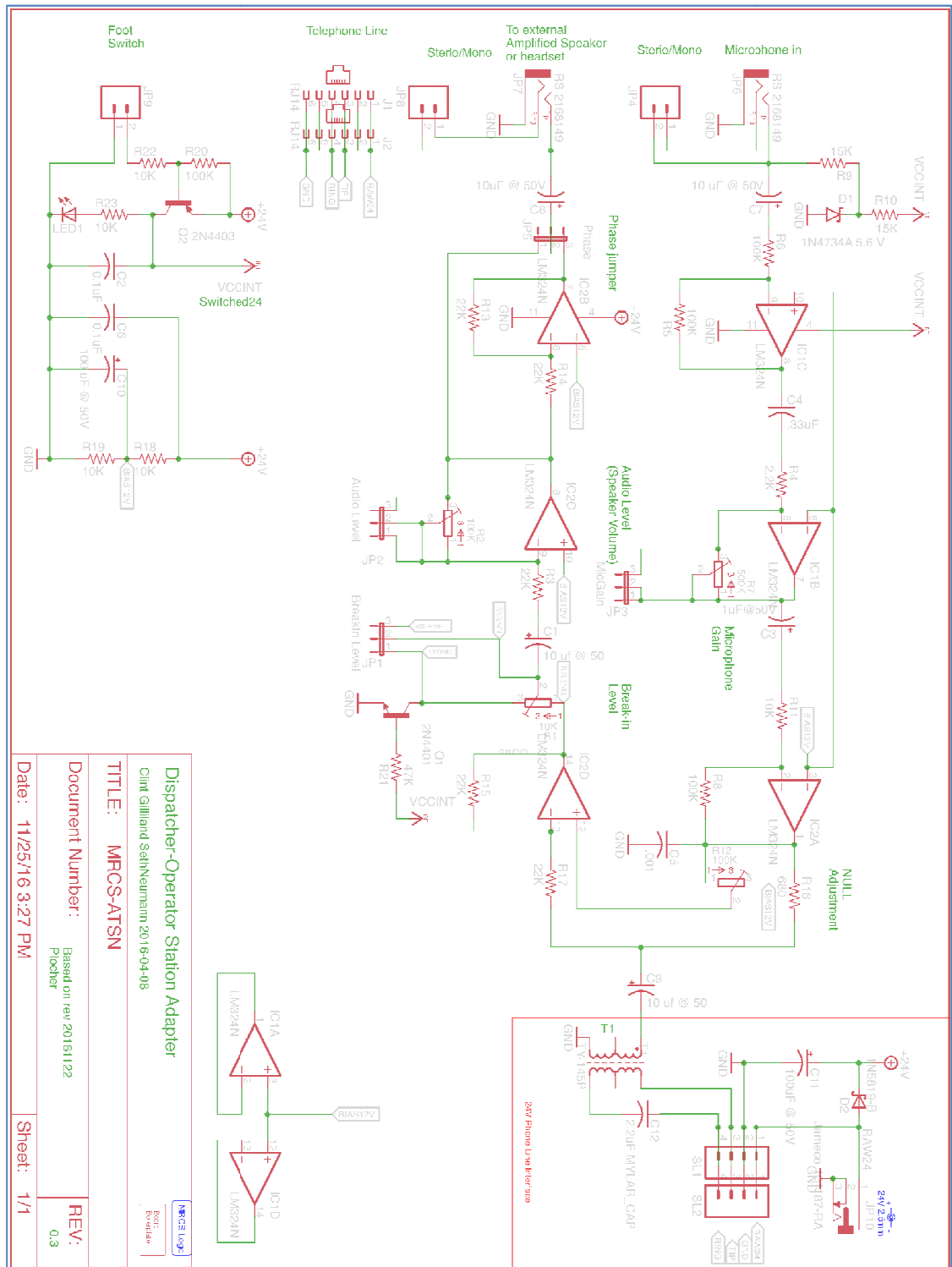


Figure 5 DS/OP Schematic

8. HISTORY AND BACKGROUND

The *Dispatcher/Operator Interface* grew out of a series of clinics I've been presenting since 2004 at various model railroad events on "Communications for Model Railroads" This material has also appeared as a 3 part series in the Operations SIG's journal, the "*Dispatcher's Office*" and appears as chapter 9 in the OPSIG book "*A Compendium of Model Railroad Operations*". The most recent version of the clinic is available on the MRCS website at <http://www.modelrailroadcontrolsystems.com/content/Communications%20for%20Model%20Railroads%20new%2020160416.pdf> I suggest you familiarize yourself with the book chapter or the clinic before installing a phone system for your model railroad

Almost every model railroad phone system needs a position for a dispatcher. I've published a number of designs which allow the use of standard audio components to support either microphone/speaker/footswitch or headset (with or without foot switch) operation. The response from the field has consistently been: make it simpler to assemble, preferably so that everything just plugs in. The Dispatcher/Operator Interface provides all of the internal functions needed to support DS/OP operation and has jacks and terminals to connect all of the devices you'll need.

As with the EBF31A battery feed board, I worked with Clint Gilliland and John Plocher to bring the board to production quality. Our focus was to build a reliable board using commonly available components and keeping the cost within reason for model railroad hobbyists.

9. SUBSTITUTION

In the unlikely event you can't find the transistors, you can substitute pretty freely: almost any small signal NPN transistor can be used in place of the 2N4401 for Q1, the 2N3904 is almost an exact match for the specs. For Q2 the 2N4402 can be replaced by 2N3906.

10. VARIATIONS

Most variations on our products are for connector preferences. This makes sense as connectors are usually the most expensive components (in this case it's the transformer and mylar cap) you can use any 0.100 connector for JP1-4 and JP6, as well as SL1 and 2. You can also solder the board directly to wires if you're sure you won't be moving it.

You can substitute a two position 0.100 connector or header for the LED if you'd like to remote the LED to provide an "On Air" light. You may need to adjust R23 in that case