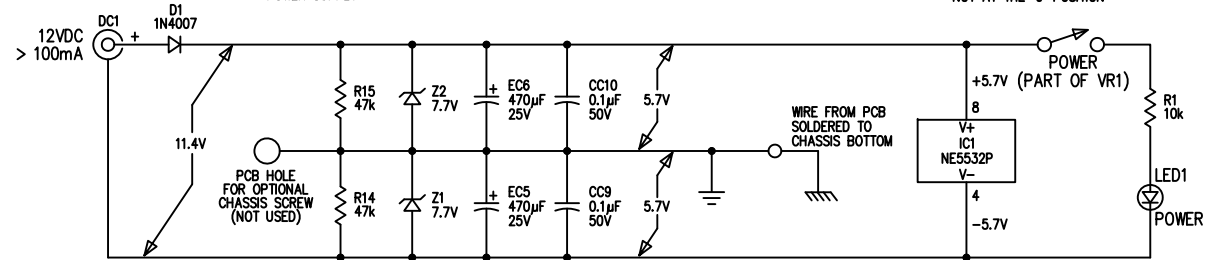


DIODE D1 PROTECTS THE CIRCUIT FROM REVERSED POLARITY POWER AT DC1, AND DROPS ABOUT 0.6V. RESISTORS R14 & R15 SPLIT THE RESULTING 11.4V IN HALF, CREATING A VIRTUAL 'GROUND' HALF WAY BETWEEN THE TWO POWER RAILS, WITH THEM ESSENTIALLY BECOMING A +/- 5.7V BIPOLAR POWER SUPPLY

ZENER DIODES Z1 & Z2 PREVENT DAMAGE TO IC1 IF THE POWER SOURCE AT DC1 EXCEEDS ABOUT 15V. CAPACITORS EC5 & EC6 PROVIDE VOLTAGE SMOOTHING, AND CC9 & CC10 PROVIDE A BYPASS FOR ANY HIGHER FREQUENCY NOISE. THE VIRTUAL GROUND IS CONNECTED AT ONE POINT ONLY TO THE CHASSIS

OP-AMP IC1 IS ALWAYS POWERED WHEN THE AC POWER ADAPTER IS CONNECTED TO AC POWER AND PLUGGED INTO THIS UNIT AT DC1. THE 'POWER' SWITCH IS PART OF THE VOLUME CONTROL AND IS CLOSED IN ANY POSITION EXCEPT EXTREME COUNTER-CLOCKWISE (0). THE 'POWER' LED SHOWS THAT POWER IS AVAILABLE AND VOLUME IS NOT AT THE '0' POSITION



NOTES:

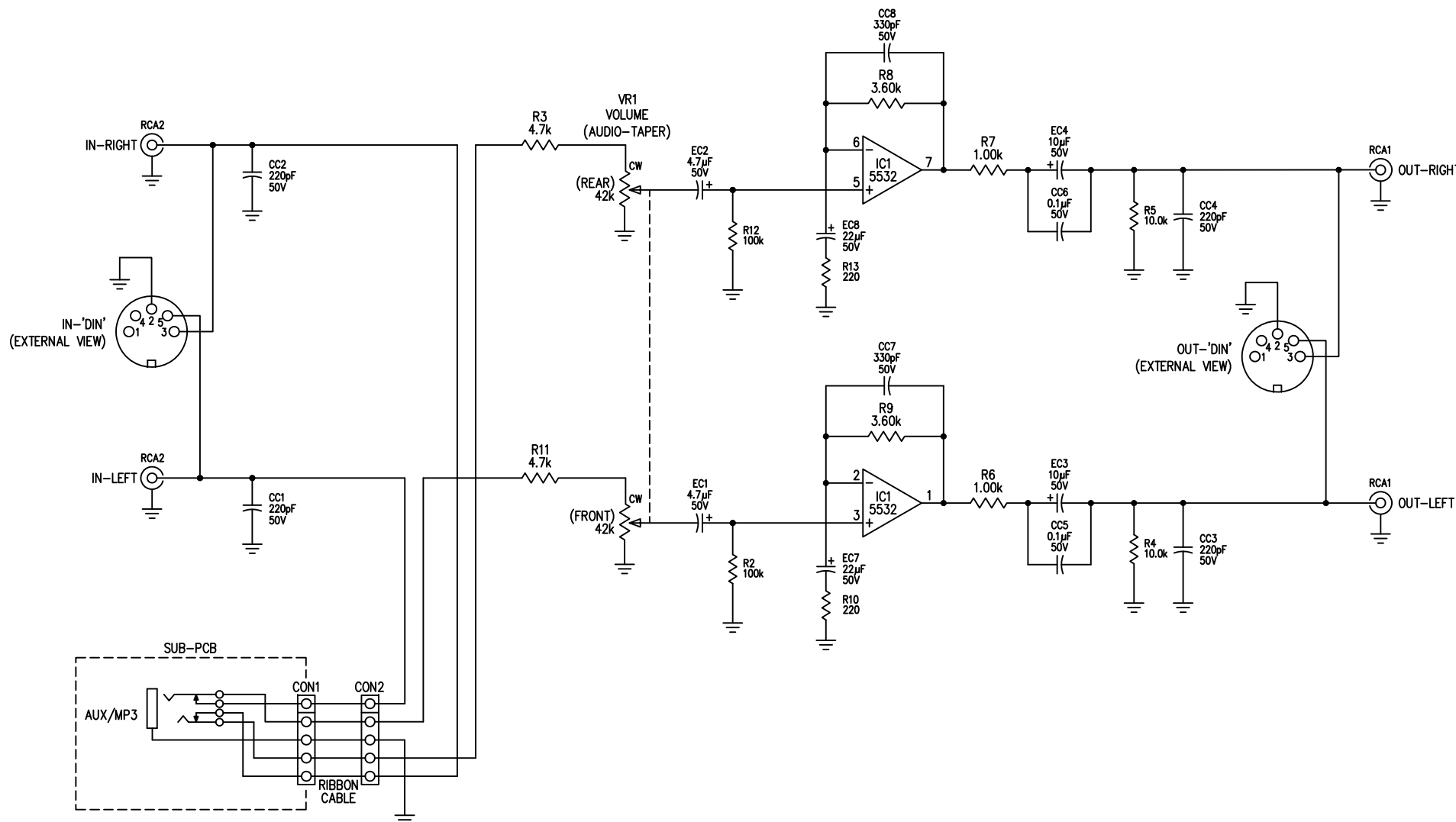
- 1) RESISTORS ARE 1/4W, 1% CARBON FILM TYPE, MARKED TO THREE SIGNIFICANT DIGITS. RESISTOR VALUES NOT MARKED 'K' (KILO) ARE IN OHMS (Ω SYMBOL NOT SHOWN).
- 2) UNLESS MARKED WITH ARROWS POINTING AT SPECIFIC POINTS IN THE CIRCUIT, VOLTAGES SHOWN ARE MEASURED FROM THE 'VIRTUAL GROUND' WHICH IS COMMON TO THE 'GROUND' CONTACTS ON ALL CONNECTORS, AND SHOWN WITH THE TRADITIONAL GROUND SYMBOL OF THREE PARALLEL LINES OF DIMINISHING LENGTH. ALL CONNECTORS ARE ELECTRICALLY ISOLATED FROM THE METAL CHASSIS, EXCEPT FOR THE SINGLE-POINT BONDING WIRE SOLDERED TO THE CHASSIS BOTTOM.
- 3) ALL COMPONENT VALUES ARE BASED ON STUDY AND MEASUREMENTS TAKEN OF TWO DIFFERENT EXAMPLES OF THIS PRODUCT, OBTAINED FROM DIFFERENT SOURCES OVER A FOUR YEAR PERIOD. COMPONENT & CONNECTOR DESIGNATIONS ARE SHOWN AS MARKED ON THE PRINTED CIRCUIT BOARD (PCB) OF THE AFOREMENTIONED TWO EXAMPLES. WHERE NO DESIGNATION WAS PRESENT ON THE PCB OR CHASSIS, NO DESIGNATION IS SHOWN HERE.
- 4) NOTE THE OBSERVATIONS AND EMPIRICAL SPECIFICATIONS LISTED SEPARATELY BELOW. THESE ARE NOT 'OFFICIAL' FROM THE MANUFACTURER.
- 5) THIS SCHEMATIC WAS DRAWN, USING AUTOCAD, AS A MEANS TO PROVIDE AN UNDERSTANDABLE SCHEMATIC FOR THE PRODUCT COMMONLY KNOWN AS THE 'TC-780LC', AND VARIOUSLY LISTED UNDER THE BRAND NAME INITIALS 'TCC' OR 'TEC' OR 'JEC'. AN EFFORT HAS BEEN MADE TO SIZE AND SCALE COMPONENTS AND TEXT FOR THE LARGEST AND BEST VISIBILITY AND LEGIBILITY WHILE STILL FITTING ON A NORMAL 11 X 17" SHEET OF PAPER. THE COPYRIGHT HOLDER HEREBY GIVES PERMISSION TO FREELY DISTRIBUTE THIS DOCUMENT, AS LONG AS NO ALTERATIONS ARE MADE AND CREDIT IS GIVEN, ALONG WITH THE COPYRIGHT NOTICE.

OBSERVATIONS:

- 1) AS NOTED ELSEWHERE ON THIS DRAWING, THERE SEEMS TO BE AN ERROR ON THE PCB THAT RESULTS IN THE POWER SWITCH (ON THE VOLUME CONTROL) ONLY SWITCHING POWER TO THE 'POWER' LED (LED1), RATHER THAN SWITCHING POWER TO ALL CIRCUITRY. TO MAKE SURE OF THE ERROR, THE PCB TRACES WERE TRIPLE-CHECKED, AND ALSO VOLTAGE MEASUREMENTS WERE TAKEN (USING A POWER-CONSUMING ANALOG VOM) AND OBSERVED OVER A 10 MINUTE PERIOD AFTER TURNING OFF THE POWER SWITCH, AND NO VOLTAGE REDUCTION WAS OBSERVED AT THE IC1 POWER PINS.
- 2) THE HIGH FREQUENCY FILTER CAPACITORS CC1 & CC2 ARE ONLY IN EFFECT FOR THE INPUTS VIA THE 'RCA2' INPUT JACKS; WHEN THE 'AUX/MP3' JACK IS USED, THE 'RCA2' INPUT CIRCUITS (INCLUDING CC1 & CC2) ARE DISCONNECTED FROM THE REST OF THE AMPLIFIER CIRCUIT. THIS APPEARS TO BE AN ERROR ON THE PCB LAYOUT.
- 3) THE 'VOLUME' POTENTIOMETER (VR1) CONSISTS OF TWO 42k AUDIO TAPER POTENTIOMETERS, WHICH SHARE A COMMON SHAFT AND KNOB WITH THE POWER SWITCH. BECAUSE 42k IS AN ODD VALUE, THE 'VR1' ASSEMBLY WAS DESOLDERED FROM THE PCB AND MEASURED 'OUT OF CIRCUIT' TO CONFIRM ITS VALUE. UNITY GAIN (NEITHER ATTENUATION OR GAIN) IS OBTAINED AT A POINT IN THE ROTATION OF 'VR1' SOMEWHAT TO THE LEFT OF THE 12 O'CLOCK ROTATIONAL POSITION. ANY POSITION COUNTER-CLOCKWISE OF THE UNITY GAIN POSITION RESULTS IN ATTENUATION (OR VOLUME REDUCTION) OF THE AUDIO SIGNAL, AND ANY POSITION CLOCKWISE OF UNITY GAIN PROVIDES AMPLIFICATION (OR VOLUME BOOST).
- 4) A NUMBER OF SMALL VALUE CAPACITORS, MOSTLY WITH VALUES OF 220pF & 330pF, APPEAR TO BE IN THE CIRCUIT EITHER TO BYPASS HIGH FREQUENCY NOISE (PICKUP OF RADIO FREQUENCIES) AND ALSO TO HELP EXTEND THE HIGH END OF THE AUDIO FREQUENCY RESPONSE.
- 5) BECAUSE THIS AMPLIFIER IS A 'PASS-THROUGH' DEVICE RATHER THAN AN ACTUAL SIGNAL SOURCE OR SIGNAL DESTINATION, THE DIN CONNECTOR PINS ARE THE SAME FOR INPUT AND OUTPUT, IN OTHER WORDS THE PINS USED IN BOTH PLACES ARE THOSE DEFINED IN THE DIN STANDARD AS 'INPUTS'.
- 6) THE SILK-SCREENED NOTE ON THE REAR OF THE CHASSIS (ON THE TWO UNITS STUDIED) READS "NOTICE: WHEN FRONT AUX/MP3 IS PLUGGED (IN), THE AUX INPUT WILL BE DISCONNECTED". THIS IS CLEARLY A MISPRINT OR BAD TRANSLATION, AND SHOULD READ "WHEN A PLUG CONNECTOR IS INSERTED INTO THE FRONT PANEL 'AUX/MP3' SOCKET, THE SIGNALS COMING IN THE REAR PANEL 'RCA' AND/OR 'DIN' INPUT CONNECTORS WILL BE INTERNALLY DISCONNECTED".

EMPIRICAL SPECIFICATIONS:

- 1) THIS PRODUCT, REGARDLESS OF THE SELLER OR CLAIMED MANUFACTURER OR SELLER, SEEMS TO NOT HAVE ANY OFFICIAL SPECIFICATIONS. SOME OF THE PACKAGING STATES: MAXIMUM OUTPUT OF 2V AT 1kHz, GAIN OF UP TO 20dB, AUDIO DISTORTION OF 0.06% MAXIMUM, S/N RATIO OF > 80dB, FREQUENCY RESPONSE OF 20Hz-20kHz +/- 0.5dB; THESE SEEM RATHER UNRELIABLE. THE FOLLOWING SPECIFICATIONS WERE ARRIVED AT BY MEASUREMENT OF TWO EXAMPLES OF THIS PRODUCT. THE AUTHOR OF THIS SCHEMATIC MAKES NO PROMISE REGARDING THE ACCURACY OF THESE SPECIFICATIONS.
- 2) THE ONLY POWER CONSUMING COMPONENTS IN THIS AMPLIFIER ARE THE IC OP-AMP (IC1) AND THE 'POWER' LED (LED1). WITH THE CURRENT LIMITING RESISTOR (R1) VALUE OF 10k, THE LED CURRENT IS ABOUT 1mA. ACCORDING TO THE TEXAS INSTRUMENTS DATASHEET OF THE NE5532 OP-AMP (IC1), THE MAXIMUM SUPPLY CURRENT USED IS 16mA (8mA NOMINAL). THIS MEANS THAT THIS AMPLIFIER CAN CONSUME NO MORE THAN 1mA + 16mA = 17mA. MAXIMUM OP-AMP OUTPUT VOLTAGE INTO A TYPICAL LOAD IS WELL BELOW 1mA, SO NEGLIGIBLE. A COMMON AC POWER ADAPTER FOR THIS PRODUCT HAS A 12VDC REGULATED OUTPUT, AND MOST OF THESE PROVIDE AT LEAST 100mA, MORE THAN FIVE TIMES WHAT THE PRODUCT CAN CONSUME. SOME SELLERS OF THIS PRODUCT PROVIDE AC POWER ADAPTERS CAPABLE OF DELIVERING OVER 300mA, WITH THE CLAIM THAT THIS PROVIDES BETTER AUDIO FIDELITY, ETC; WHICH IS CLEARLY NONSENSICAL BASED ON THE ABOVE.
- 3) MEASURED GAIN USING A 10kHz 0.5Vpp SINE WAVE AS AN INPUT SIGNAL: VOLUME CONTROL AT 12 O'CLOCK POSITION = 0.85Vpp (4.6dB GAIN), VOLUME CONTROL AT FULL CLOCKWISE POSITION = 6.8Vpp (22dB GAIN).
- 4) MEASURED AUDIO FREQUENCY RESPONSE, USING A 0.5Vpp SINE WAVE AS AN INPUT SIGNAL: OUTPUT VOLTAGE IS FLAT (NO VOLUME LOSS OR GAIN) BETWEEN 80Hz AND 80kHz. ABOVE 80kHz, OUTPUT BEGINS TO DROP SLOWLY, BUT THERE IS VERY LITTLE LOSS UNTIL AROUND 100kHz, WELL ABOVE THE AUDIO FREQUENCY RANGE. BELOW 80Hz, THE VOLUME DROPS SLIGHTLY, BUT NEGLIGIBLY, UNTIL BELOW 60Hz WHEN THE VOLUME DROPS MORE SIGNIFICANTLY, PROBABLY TO REDUCE ANY 50/60Hz LINE FREQUENCY HUM. BELOW 20Hz, THE OUTPUT VOLTAGE HAS DROPPED TO HALF OF ITS NORMAL LEVEL AT HIGHER FREQUENCIES (-6dB). SO, THIS AMPLIFIER, SET TO UNITY GAIN, FAVORS HIGHER FREQUENCIES BUT DOES NOT PERFORM QUITE AS WELL IN THE LOWEST AUDIBLE FREQUENCIES, ESPECIALLY FREQUENCIES BETWEEN 60Hz AND 20Hz WILL BE LESS THAN DESIRABLE, BUT STILL REASONABLY ADEQUATE.
- 5) SINCE THIS AMPLIFIER DESIGN APPEARS TO BE MANUFACTURED BY MORE THAN ONE COMPANY, THERE MIGHT BE COMPONENT VALUE DIFFERENCES BETWEEN MAKERS AND OVER TIME. ALSO, THE MODEL NUMBER 'TC-780LC', WHILE COMMON, IS NOT UNIVERSALLY USED FOR ALL VERSIONS OF THIS PRODUCT. THE TWO UNITS STUDIED AND MEASURED FOR THIS DOCUMENT ARE MARKED AS 'TEC' (LOOKS MORE LIKE 'JEC') ON THE FRONT PANEL, AND WERE PURCHASED BETWEEN EARLY 2018 AND LATE 2022.



TEC / TCC / JEC
STEREO LINE-LEVEL BOOSTER TC-780LC
SCHEMATIC DIAGRAM