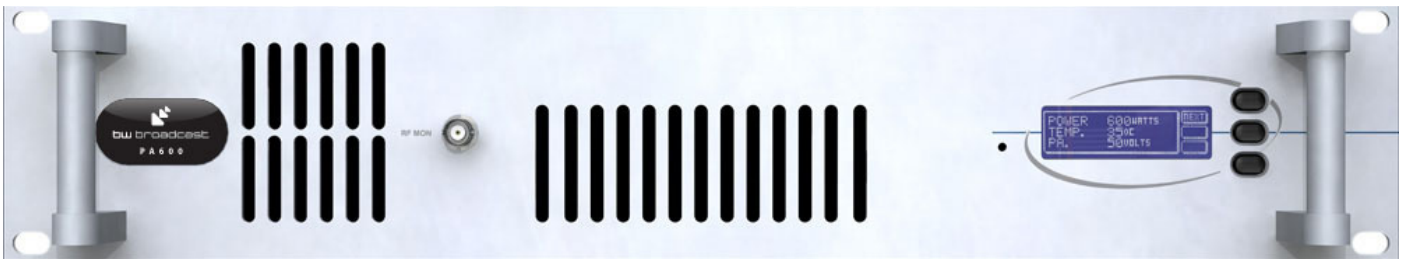




bw broadcast

PA600 FM Broadcast Amplifier



Technical manual

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1.1 PA600 FM POWER AMPLIFIER

The BW Broadcast PA600 is a high specification FM broadcast power amplifier. Its broadband “no-tune” design allows 87.5-108 MHz operation and digital PWM techniques provide an easily adjustable and accurate automatic level controlled R.F. output of the MOS-FET power amplifier stage.

RF power, temperature and other parameters are shown on the LCD graphics display. This display offers a very easy method of transmitter parameter monitoring and a new level of ease for setup and installation, with metering accuracy normally only found on expensive test equipment. Local and remote personal computer control and metering are achievable via RS232 interface and there's an alarm I/O as well.

The lightweight universal mains input design ensures a high reliability efficient design compatible with any mains system in the world.

1.2 SAFETY

MAINS VOLTAGE

This equipment operates from an AC power source of between 90 and 265 volts. There are hazardous voltages present internally. PLEASE OBSERVE CAUTION WITH THE COVER REMOVED.

SWITCHED MODE POWER SUPPLY HAZARD

Please note that the power supply units in this equipment is of the switched mode variety and have lethal voltages present internally. The switched mode supplies are universal input fully approved type. They are non serviceable modules and should be fully replaced should they fail.

FUSES

Only use fuses with the specified voltage and current ratings as stated on the back panel. Failure to do so may increase the risk of equipment failure, shock and fire hazard.

R.F.

The N type R.F. power output socket contains R.F. voltages which may burn or present a shock. Please make sure that the equipment is connected to an adequately rated load or antenna system while in operation.

TOXIC HAZARD

This equipment includes R.F. components that may contain Beryllium oxide which is a highly toxic substance that could be hazardous to health if inhaled or ingested. Care should be taken when replacing or discarding such devices. Seek expert advice from the manufacturer should you physically damage a device that contains Beryllium Oxide. The main R.F. output power transistor contains Beryllium oxide.

OTHER SAFETY CONSIDERATIONS

Do not operate this equipment in the presence of flammable gases, fumes or liquids

Do not expose this equipment to rain or water.

CE CONFORMANCE

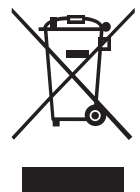
This device complies with the requirements of the 1995/5/EC Radio and Telecommunications Terminal Equipment (R&TTE). The equipment will meet or exceed the following standards: EN 60215:1996 (Safety Requirements for Radio Transmitting Equipment), EN 301 489-11 (ERM/EMC for Radio Equipment, Part 11 Specific Conditions for FM Transmitters), EN 302 018-2 ERM (Transmitting Equipment for FM Radio Broadcasting service)

This amplifier together when used with an FM exciter may form an FM transmitter system intended for FM audio broadcasting utilising operating frequencies not harmonised in the intended countries of use. The user must obtain a license before using the product in the intended country of use. Ensure respective country licensing requirements are complied with. Limitations of use can apply in respect of operating frequency, transmitter power and/or channel spacing.

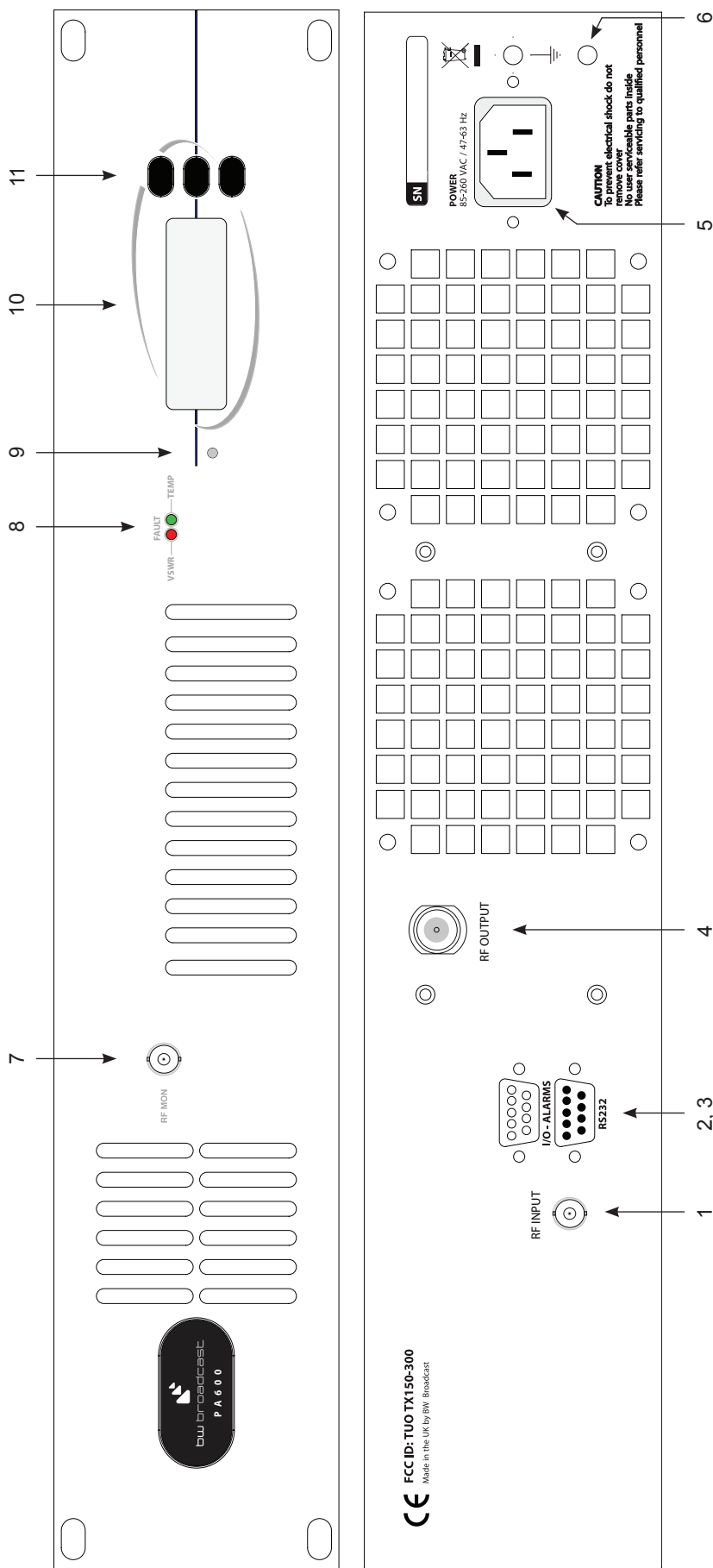
WEEE COMPLIANCE

BW Broadcast Ltd is registered with Northern Compliance PCS number WEE/UP3438PR/SCH and has been issued with WEE/FA0268RX as its unique producer ID by the appropriate environment agency. BW Broadcast Ltd full comply with it explicit responsibilities, subject to WEEE Collections Policy outlined in their General Terms and conditions of Sale, when it sells Electrical and Electronic Equipment (EEE) to B2B customers in the UK and EU.

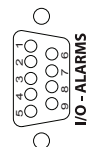
This appliance has been designed and manufactured with high quality materials and components that can be recycled and reused. Electronic appliances are liable to contain parts that are necessary in order for the system to work properly but which can become a health and environmental hazard if they are not handled and disposed of in the proper way. Consequently, please do not throw your inoperative appliance with the household waste. Having purchased this appliance it is your responsibility to dispose of this equipment appropriately.



1.3 FRONT AND REAR CONNECTIONS



- 1. RF Input
- 2. I/O + Alarms
- 3. RS232
- 4. R.F. output
- 5. Power socket
- 6. Chassis ground post
- 7. RF monitor output -50dBc (not suitable for harmonic measurements)
- 8. VSWR and temperature fault LEDs
- 9. Maximum forward power adjust
- 11. LCD display
- 11. Up / Down frequency buttons



I/O - Alarms D-type connector pinout:

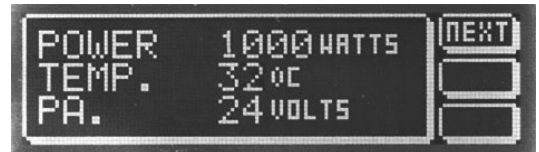
- Pin 3 RF failure alarm (TTL)
- Pin 4 RF Mute
- Pin 5 +18V DC 200mA
- Pin 8 RF failure alarm (OC)
- Pin 9 GND

1.4 CONTROL AND MONITOR LCD

The front panel LCD graphics display has seven screens (shown below). These allow monitoring of the transmitter's R.F., audio and other parameters and the adjustment of the transmitter's power. You can move through the screens by pressing the NEXT button, which will display them in the following order.

Main parameter screen.

This shows together the three most important transmitter parameters. R.F. output power, PA temperature and DC voltage.



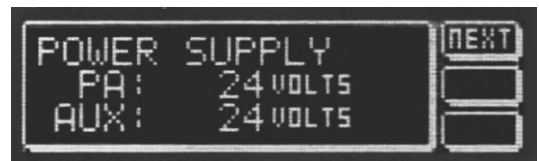
R.F. Power

The forward and reverse R.F. powers are displayed. The up/down buttons will allow power control if internally allowed. The maximum output power is governed by the maximum power set adjustment (see R.F. pwr control section).



Power supply

Power amplifier voltage is shown together with the transmitter's secondary supply that feeds the exciter section. The power amplifier voltage will vary depending on set output power and the presence of any fault conditions which also cut the voltage back and with it the R.F. output.



P.A. temperature

This display indicates the temperature of the heatsink that the R.F. power transistor is bolted to. The normal operating temperature range is 40-60 degrees at full R.F. power output.

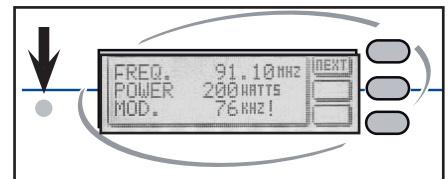


2.1 R.F. POWER SETUP

The R.F. power output from the transmitter can be controlled by an analogue potentiometer (POT) or from the front panel LCD screen or a combination of both.

When the power is to be controlled from the front panel the max power set POT takes on a new role of setting the maximum power of the transmitter. If you want the LCD screen to have full power range control of the transmitter you will need to ensure that the max power set control is at maximum power. Otherwise your control range may be limited. This feature enables you to limit the transmitters maximum power to a fixed level but to still allow the LCD screen to provide adjustment of the R.F. power down from that maximum power set point. This can be desirable in transmitter hire situations where you wish to govern the maximum output to a fixed level but to allow the customer (hirer of the transmitter) to run the power of the transmitter at a lower level if they so decide.

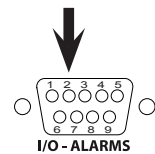
The maximum power set is positioned to the lower left of the LCD screen on some models, other models may not have the hole in the front panel and you will need to remove the lid of the transmitter to access the adjustment which will be in the same position but on the other side of the PCB. You will need a small 'tweaker style' flat-head screwdriver to adjust the pot. This control is quite delicate so try to not be too heavy handed in it's adjustment.



Please note that the VSWR and temperature protection circuitry will turn back the R.F. power if a fault condition exists. Make sure that you have a good VSWR (low reverse power reading) before setting the R.F. power as the removal of a fault condition may cause the R.F. power to increase.

RF POWER MUTE (analogue)

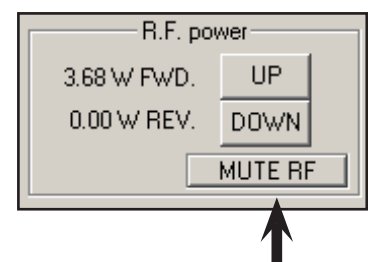
There is a pin (2) on the back panel I/O D-type that can be pulled low to mute the transmitter's RF power.



RF POWER MUTE (digital/RS232)

The transmitter's RF power output can be muted via the RS232 control system. Terminal software can mute/unmute the RF power with the 'o' and 'f' commands respectively.

The windows application has a button that can toggle the RF output of the transmitter.



Please consult the RS232 section of this manual for more information on controlling the transmitter remotely.

2.2 R.F. FAIL ALARM

The transmitter has an alarm that can alert the broadcaster if RF power fails. The alarm when set is available on the back panel 9-pin D-type as an open collector (OC) and a TTL level contact. The alarm induced active open collector can pull down any external signals and the TTL output will provide a 5 Volt indication. The open collector can sink 100 mA MAX with an absolute maximum switched voltage of 25 volts. The alarm is also visible if any RS232 monitoring (through the Windows Remote Control application or terminal software) is employed.

The RS232 interface provides the ability to reset the alarms either through Windows Remote Control application or terminal software. More info is found in the following pages of the manual.

BW Broadcast can also customise the alarm / fault software to meet the requirements of major broadcasters and networks or supply N+1 solutions. More information on this and other custom features can be obtained from our technical department.

For the alarm to function correctly the transmitter must be left on the default menu screen. This is the screen that displays R.F. power, temperature and PA voltage. To ensure that the alarm system functions correctly the transmitter will return to the default menu screen if the LCD is left on another menu screen for more than 5 minutes.

The R.F. power alarm will be set if the R.F. power falls below a threshold level during normal operation. This threshold is set below the normal operating lowest wattage available from the transmitter. If you require a different setting for the alarm, contact our tech dept. The alarm will only be set if the fault condition exists for sixty seconds or more. You will need to reset the transmitter to clear the alarm/s or you can do it via the RS232 connection.

2.3 RS232 CONTROL AND MONITORING

The PA range of FM power amplifiers can be monitored or controlled from a personal computer either locally or remotely. The Transmitters can "chat" either by a windows application or via a standard serial terminal program. The windows application is the more versatile option and is to be preferred but the ability to use a terminal program can prove useful in the absence of the windows application or a computer that runs windows.

2.31 Windows remote control application

The latest version of Windows remote control application can be downloaded from:

<http://www.bwbroadcast.com>

Installation

After downloading just click on the .msi file to run the set up program. The set up will place icons in both the Windows start menu and on your desktop. Simply run the program by clicking on icon from either location.

Running the application

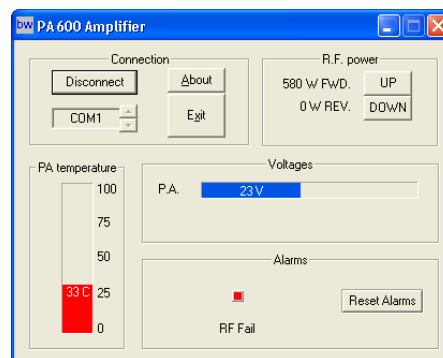
When started the application will resemble the picture to the right.

The application can connect to any COM port currently available on your computer that is running the application. Connect a serial cable between the RS232 connector on the rear of the transmitter and one of your computers COM ports. If you are using a codec or other STL device then you may be able to connect that device in line to act as part of the serial link.



Remote Control Application startup screen

Selected the COM port you want to use and then click the Connect button.



Remote Control Application

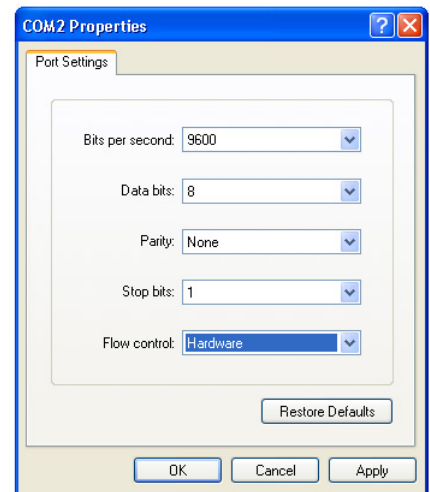
If the application is able to connect to the transmitter then you will be presented with a screen similar to the one above. Once connected you should be able to monitor all the parameters of the transmitter as well as being able to mute the R.F., change the R.F. power and reset an alarm flag.

2.32 Terminal control of the transmitter

Installation

Please see the instructions for your terminal software package to find out how to connect to a remote serial device. The transmitter is internally set to communicate at 9600 bps, no parity with 1 stop bit and hardware flow control. This is commonly known as 9600 8N1. If your using Windows then you can use the pre-bundled terminal program "Hyper-terminal". This is located in the Programs -> Accessories -> Communications folder accessible

from the Start menu. Select direct to COM port x where x is the com port that the transmitter is connected to. You will be presented with a dialog box like the one shown to the right. Select 9600, 8, none ,1 with hardware flow control and then click OK.



Hyper Terminal connection

If you are using another terminal program then you may need to consult the documentation for that software, but it should be pretty much straight forward.

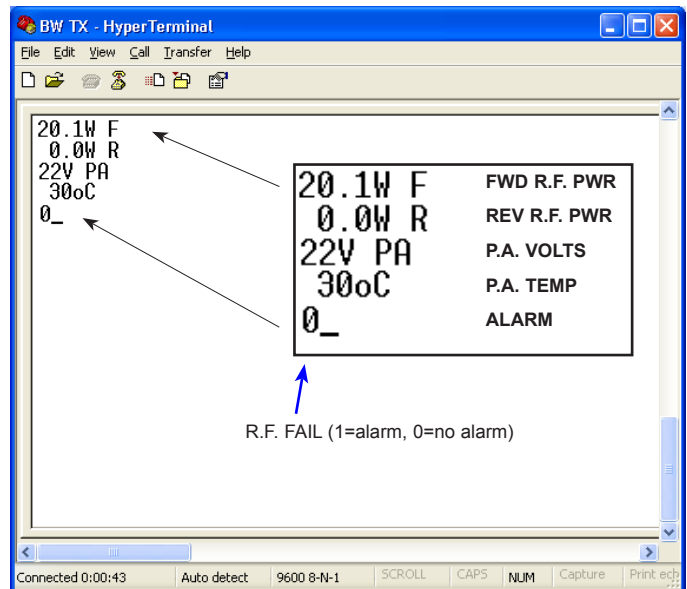
Operation

The transmitter will respond to certain key presses and each one has a certain function. See the list below for details of what key to press for each function.

The most important key press is the 'Enter' key. This will need to be pushed as soon as you connect to the transmitter so you can get the transmitter to refresh your terminal window with the transmitters status and parameters.

The transmitter won't respond to any of the other key presses until it detects the 'Enter' key is pressed. Once the Enter key is pressed the transmitter will listen out for other key presses for 60 seconds. This Initial 'Enter' key validation and time window is a safety feature to prevent the transmitter from detecting an erroneous key press such as R.F. mute and causing a service affecting problem.

After performing a function you may need to press the 'Enter' key to see a response to your function. For example, If you pressed 'o' for R.F. Mute you would not see the effect of the R.F. power change until you refreshed the screen again because the terminal window would still be showing the transmitters R.F. power from the previous 'Enter' (screen refresh) command, prior to you performing the R.F. mute command.



Hyper Terminal window

In some circumstances you may need to press the refresh screen key several times in order to see what's happening. Take the R.F. mute function again as an example. You press the R.F. mute key ('o') and then press refresh screen key ('ENTER') to get a status update. The transmitters power control circuitry may not have had time to turn the R.F. power down into full R.F. mute by the time it has sent back to you the status requested by the refresh screen command. It does no harm to wait a second or two before asking for a refresh screen or by asking for several refresh screens by pressing the 'Enter' key a few times in succession.

KEY	COMMAND
3	R.F. power up
4	R.F. power down
6	Reset alarm (to 0 / off)
o	Mute R.F.
f	Unmute R.F.
ENTER	Refresh screen

3.1 SPECIFICATIONS

RF

Output Power	15W - 600W
Input Power	12W
Input connector	BNC
Output connector	N-type 50 Ohm
Harmonics	better than 88 dBc
Spurious	better than 90 dBc
Frequency range	87.5 - 108 MHz

OTHER

Control system	3 buttons, 122x32 graphics display
External control/monitor	I/O Alarm D9-type Male; RS232 D9-Type Female
Size	489mm x 44mm x 322mm
Weight	11 kg
Voltage input	85 - 260 VAC
Current input	110V - 4A / 220V - 2A
Power connector	IEC, FUSED and switchable
Switched mode approvals	UL / TUV / CE

3.2 CIRCUIT DESCRIPTION

3.2.1 LCD CONTROL BOARD

The LCD control board is the heart of the amplifier. The board contains an eight bit microcontroller, LCD display, a voltage regulator and a dual op-amp together with a few passive components.

CON1 provides a 10 way interface to the power amplifier board and its sensors. Some of the connections of CON1 are routed around to the power supply modules. CON2 provides a 16 way interface to the back panel D-type sockets for alarm/RS232 signals to the main microcontroller.

The voltage regulator REG1 and decoupling capacitors C1 and C2 takes the 18 volt auxillary supply from CON1 and regulate it down to 5 volts for the microcontroller and LCD circuitry. The microcontroller is a 40 pin 8 bit type running at 8 MHz. The microcontroller has several ports that have various functions and connect to external components.

PORTA (6 bits) is primarily used for the analogue voltage inputs. Bit 3 is the Fwd RF power. Bit 1, Bit 2 and Bit 4 are not used and bit 5 of PORTA has a control connection to the LCD display.

PORTB (8 bits) has a few different functions. Bits 7,6 and 3 of the port are the alarm signal outputs and are routed off via CON2 to the D-type on the back of the control/alarm board. Bit's 5,4 and 2 are connected to the front panel buttons to allow navigation of the LCD functions.

PORTC (8 bits) bits 0 and 1 are used to write information to the LCD display. Bit 2 is the pulse width modulator output (PWM) and connects into unity gain DC amplifier op-amp IC2A. The voltage generated by the PWM is set by the software in the microcontroller. This PWM level is then fed through potentiometer VR2 and smoothed by C13 before being buffered by the aforementioned op-amp. PORTC bits 3-5 are not used. Bit's 6 and 7 of PORTC are used by the UART inside the microcontroller. These pins are RXD and TXD for the RS232 interface. They are routed via CON2 to the back panel D-type.

PORTD's 8 bit's are interfaced to the 8 bit data bus of the LCD display. The data byte on PORTD can be latched into the LCD display by the LCD control bits on PORTC.

PORTE (3 bits) has the remaining A/D inputs. Bit 0 is the PA volts, Bit 1 is the Rev RF power and bit 2 is for the PA temperature.

The microcontrollers software reads all the analogue voltages, converts and displays them where necessary and outputs alarm signals in the event of a transmitter error. There are various passive components associated with IC1. Each A/D port has input current limiting resistors R1-11 and decoupling capacitors C5-11. X1, C3 and C4 provide the 8 MHz signal for the clock of the microcontroller. R12 and R13 provide pull downs for correct operation of the inter processor communications channel. C12 provides supply decoupling for the microcontroller and VR1 sets the contrast of the LCD display.

IC2 is a dual op-amp whose purpose is to control the output power of the transmitter. Side A of the op-amp is configured as a unity gain buffer for the PWM and was described previously. VR2 provides an adjustable DC level to side B of the op-amp. Side B is configured as a DC amplifier with the gain set by R17, R18, R19, R20 and R25. The larger the DC signal provided by side A and the larger the DC signal at the output of Side B. This DC signal is used to turn down the output of the Power amplifiers power supply and with it the RF power output level.

LED3 and R20 provide a connection from the reverse RF power sensor into the input the non inverting input of side B of the op-amp. LED3 only allows DC through above a certain level. Any DC above this level will increase the output voltage from the op-amp and the RF power level will decrease. This forms the VSWR protection for the transmitter. LED1 and LED2 also provide the same function but with the DC level this time being supplied by the temperature sensor on the PA board. Too high a temperature will cause the DC level to exceed the turn on point of the two diodes and voltage will once again turn up the op-amps voltage and turn down the RF power level which should lower the temperature of the transmitter. The output from side B is fed to the switched mode power supply of the power amplifier via R21 and CON1. R22 and C15 provide supply decoupling for the op-amp. C14,15,16,17,18 provide further decoupling and feedback for the power control feedback loop formed around side B of the op-amp.

3.22 CONTROL AND ALARM PORT

The control and alarm board is the interface of the transmitter with the outside world. It has two main functions - one is the remote control of the transmitter with a personal computer (via RS232). The other is to provide TTL and open collector alarm for RF fail and the ability to mute RF power (i.e. for backup switch-over).

CON1A is a 9-pin D-type connector for RS232 connection to the PC. Pins 6 and 8 are transmit and receive connections for the RS232 interface (IC1 and associated C1-C5). IC1 communicates via pins 11 and 13 on CON4 with the microcontroller on the LCD control board.

TTL signals coming from LCD control board on pins 14-16 are routed through R4-R6 to the control/alarm D-type connector CON1B on the back of the transmitter. They are also used to drive NPN transistors T1-T3 that provide open collector outputs for these alarm signals. Pin 2 on CON1B is used as an input to mute the power amplifier RF output.

REG1 is a 5V voltage regulator for IC1. It is fed by 18V from the LCD control board (pin 1 on CON4). REG1 supply rails are decoupled with C6, C7 and C8.

3.23 POWER AMPLIFIER BOARD

PSU interface

The voltage from the PSU arrives at input of REG1 through 36-pin EDGE connector. REG1 is a switching regulator. The 52kHz output signal from REG1 is half rectified by D1 and smoothed out through L1, C2 and C3. The resulting DC voltage is used to drive the transmitter fans. R1 which is in the feedback loop of REG1, adjusts the maximum voltage to accommodate different fan types. Also part of the feedback loop is a temperature sensor (placed on the bus bar board), making the amount of airflow in the transmitter temperature dependent. LED D2 indicates there is an output voltage present.

Bus bar board

A bus bar board accommodates the mentioned temperature sensor R1 which is extrudes into the main heatsink, provides further voltage smoothing for fans and routes the supply voltages from CON1 to appropriate sections of the power amplifier.

Controller board

The controller board controls the power output of an output amplifier based on forward VSWR detection, reverse VSWR detection, forward power signal from the LCD board and temperature. All op-amps are supplied with +18V from the AUX power supply line, buffered by the capacitors C1, C2, C8 and C15.

Detected reverse VSWR (sniffed of the power amplifier's main RF output line) arrives through CON2 and input filter C5-R7 to the IC2A. The gain of the op-amp is set by R22 and R23. Amplified signal is smoothed by C13 and C14 and fed to the OR-ing circuit on the input of IC1B.

Detected forward VSWR (sniffed of the power amplifier's main RF output line) arrives through CON1 and input filter C7-R24 to the IC2B. The gain of the op-amp is set by R9, R10 and VR2. Amplified signal is smoothed by C12 and fed to the OR-ing circuit on the input of IC1B.

Forward power control signal comes from the micro controller on the LCD board to the inverting input of IC1A through R4 and C10. A voltage divider R12 and R13 sets the voltage reference to the non-inverting input to be half of the AUX power supply rail. The gain of the op-amp is set by R4 and R5. Output signal is fed directly to the IC1B.

IC1B includes an OR-ing circuit on the input and a summer (R32-R34) to combine the reverse VSWR, forward VSWR and PA control signals together. Output of IC1B is then a final control signal that controls the output of the power amplifier by controlling its power supply voltage. R27 and VR3 set the voltage reference to the inverting input of IC1B.

A temperature sensor circuit is located close to the main RF transistors. This temperature sensor is mounted into the heatsink and consists of the sensor itself which is located under the board and an op-amp circuit for level adjustment. The op-amp IC3A provides a suitable voltage reference while IC3B and associated components convert the output signal from the temperature sensor to a level more suitable for the micro controller and protection circuitry on the LCD board.

15W driver board

The RF signal from the exciter section of the combo board arrives at the MCX RF input connector CON1 via a coaxial cable. From here the 50 ohm input impedance is matched to the gate of the FET transistor T1 by the impedance matching network formed by C8, C3, L2, C9 and L3. R3, D2, R9, R5 and VR2 provide bias control to the gate of T1 from the output of REG1 which is a switching regulator. PLL signal coming through R6 from the exciter section, can pull the T1 bias voltage low, effectively reducing the power output of T1.

R4, FB1, L5 and C5 provide supply voltage to T1's drain as well as providing some impedance matching to the output of T1. Further impedance matching from T1's drain is composed of L4, C6 and C10.

Switching regulator REG1 generates 50 kHz signal from the +50V main power supply line, which is rectified by commutating diode D1, low pass filtered by L6, L1, R1, R2, C4 and decoupled by capacitors C1 and C4 to produce +25V DC voltage for the T1.

Double pallet

The RF signal from the 15W driver board arrives at the input connector CON1. From here the 50 ohm input impedance is distributed to two branches via a bridge consisting of two quarter-length 70 Ohm lines. In each branch a RTF3 (RTF4) impedance matching balun provides an unbalanced to balanced connection to the two gates of gemini packaged FET transistor T1 (T2). Transistors are biased through R9 (R17), VR1 (VR2), R1, R2, R5 and R6. In case of excessive VSWR, a sniffed signal from the output combiner coming through VR3 will turn the diodes D5 and D6 on, and negatively bias transistors T1 and T2 off.

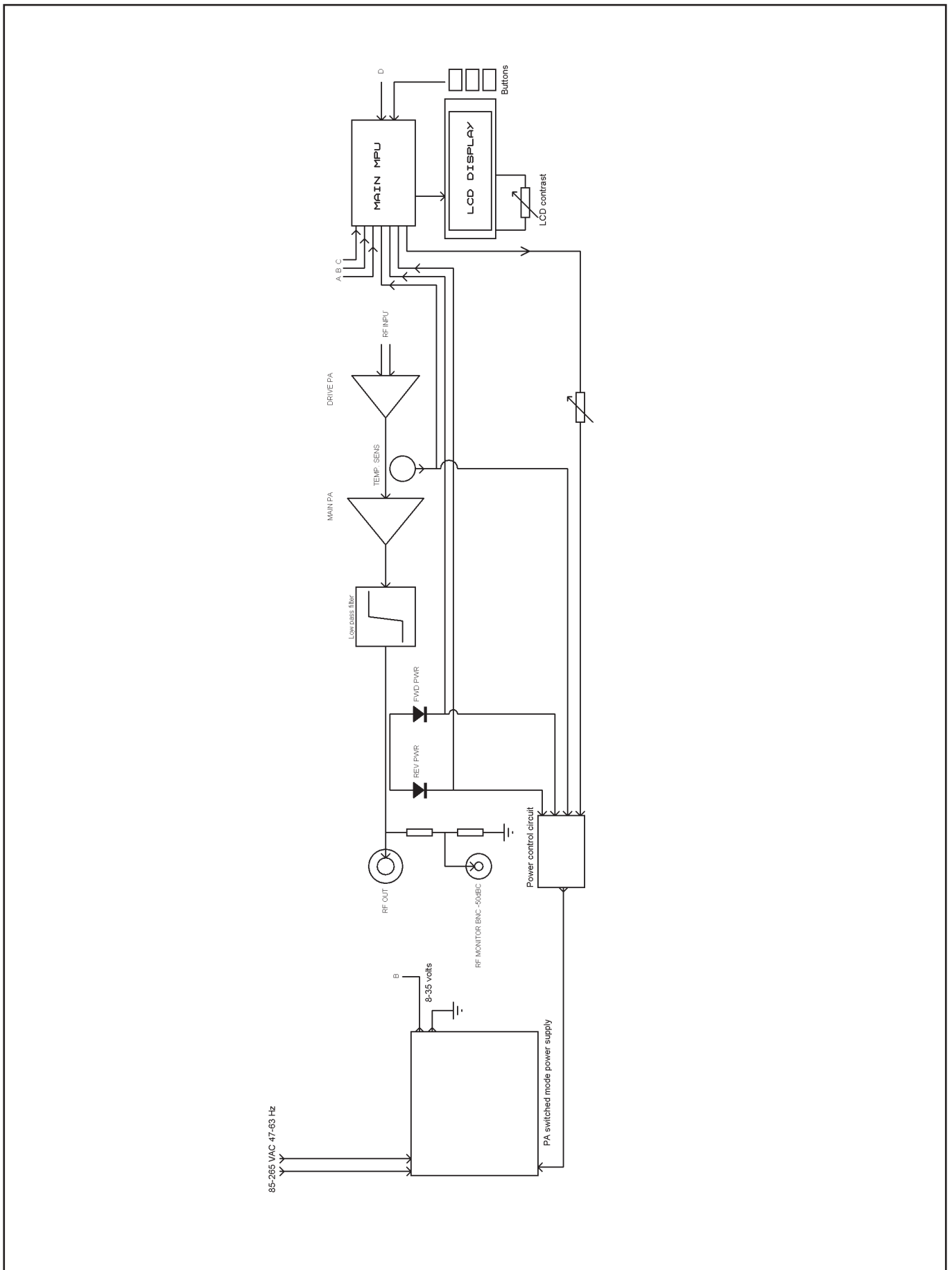
The drain outputs of T1 (T2) are connected to another balun transformer RFT1 (RTF2) which provides impedance step up as well as proving a DC feed to the transistors drains via a center tapped winding. The DC power applied to the center of balun comes from the main adjustable power supply module which can control the RF power output by having it's output voltage adjusted. C6-7 (C12-13), FB1 (FB2), R10-11 (R14-15), and C7 (C12) provide filtering and RF decoupling to the power feed into the center tap of balun RFT1 (RTF2).

Output combiner

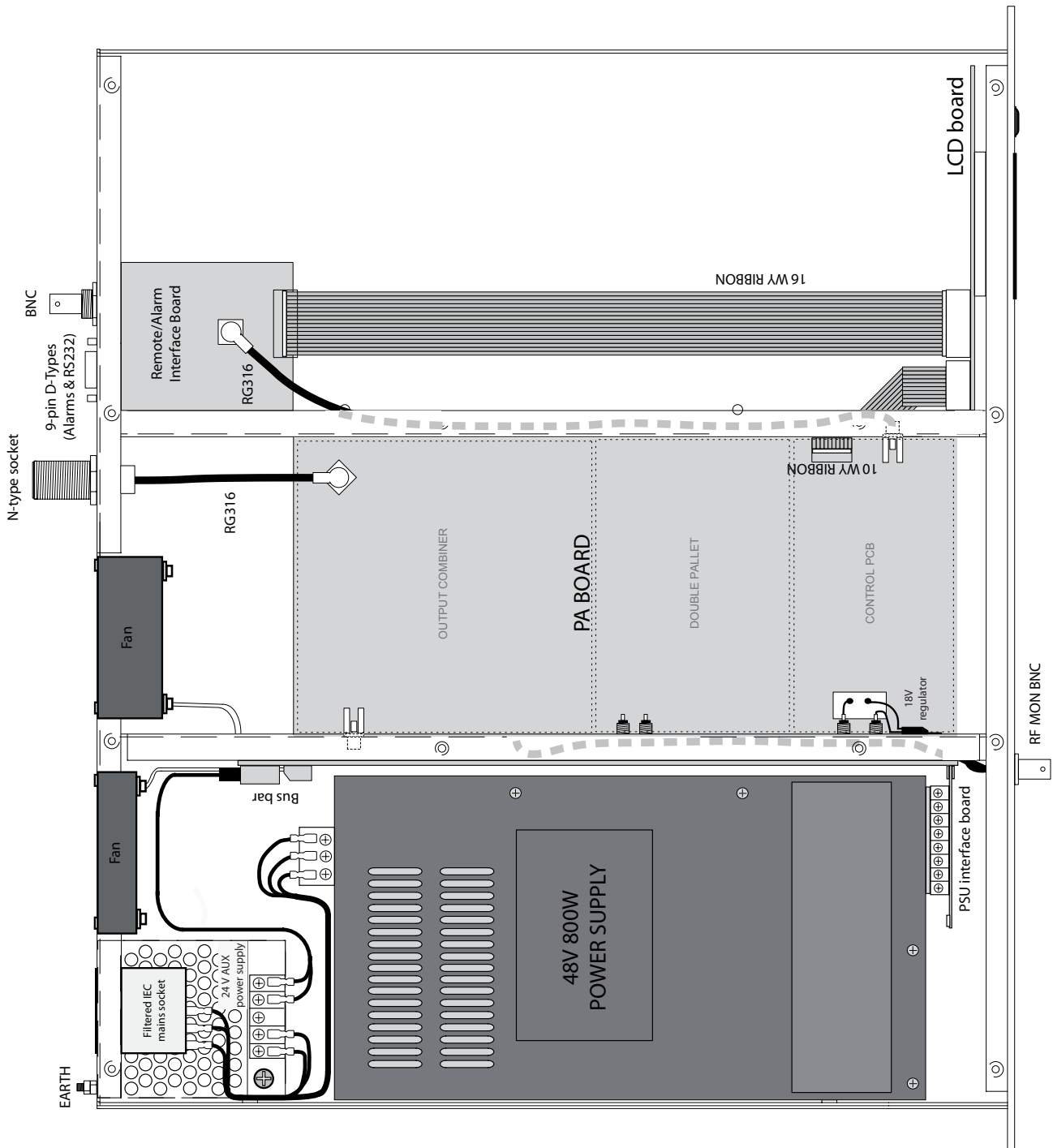
Two output signals from RTF1 and RTF2 are combined together via a bridge consisting of two quarter-length 70 Ohm lines. On each line there is a sniffed signal that drives LEDs D5 and D7 in case of excessive VSWR and/or bridge unbalance. Another RF sense circuit consisting of R1, R2, C1, C2, D1 and R3 produces a negative voltage in the event of excessive VSWR on the combined output which shuts transistors T1 and T2 on the double pallet off.

The output of the bridge is fed into a low pass output filter. These components reduce the level of any harmonic products generated by the power amplifier. The output of the low pass filter is sniffed by VSWR sensors R4, R5, C3, D2, C4 and R6, R7, C5, D3, C6 which generate forward and reverse RF power measurements for metering and for VSWR fault protection and alarms.

3.3 BLOCK DIAGRAM

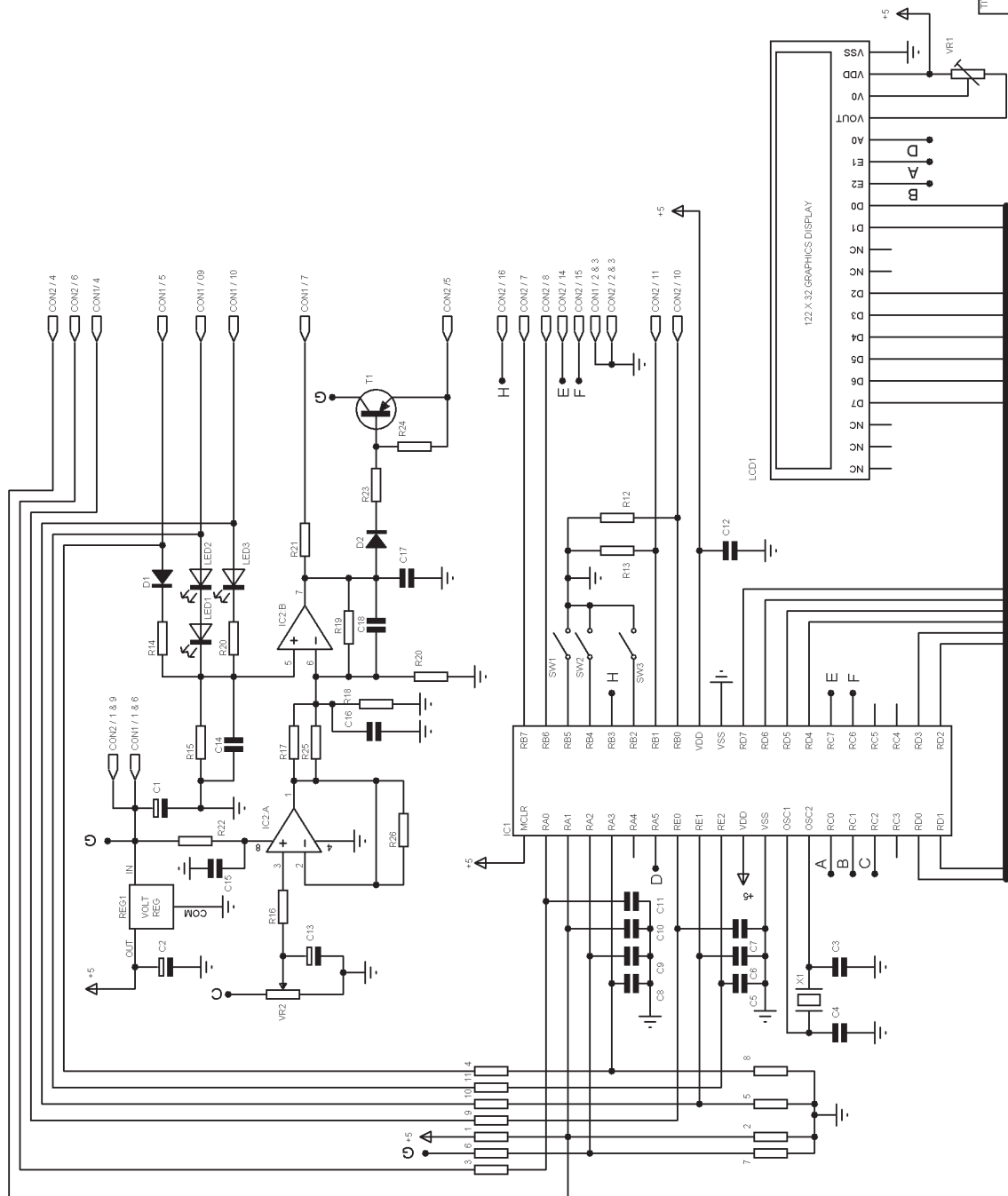


3.4 WIRING AND INTERNAL OVERVIEW

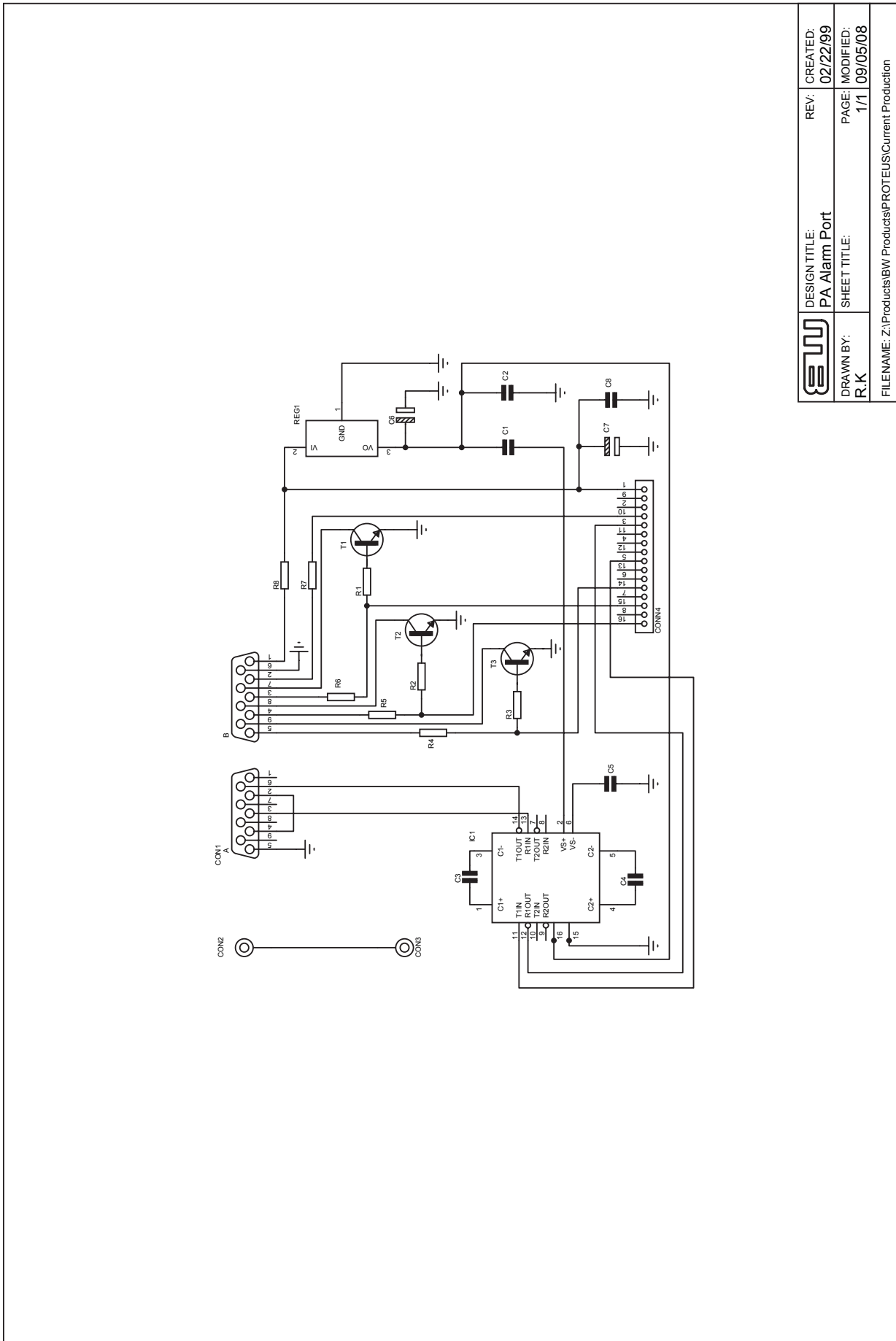


3.51 LCD CONTROL BOARD

TITLE: LCD CONTROL BOARD	DATE: 12/04/01
	PAGE: 1/1
BY: S.I.	REV: 1

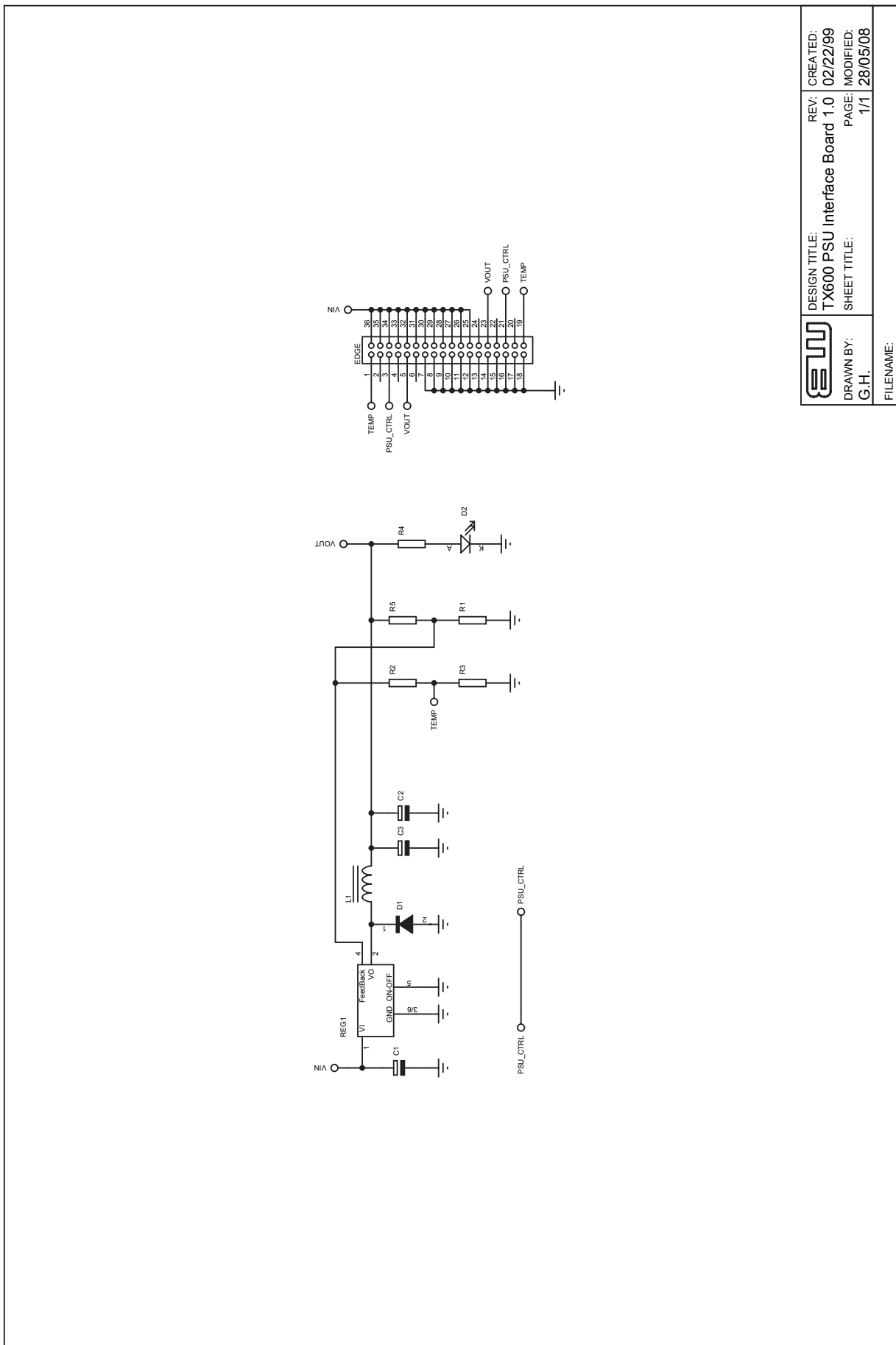



3.52 REMOTE CONTROL AND ALARM BOARD



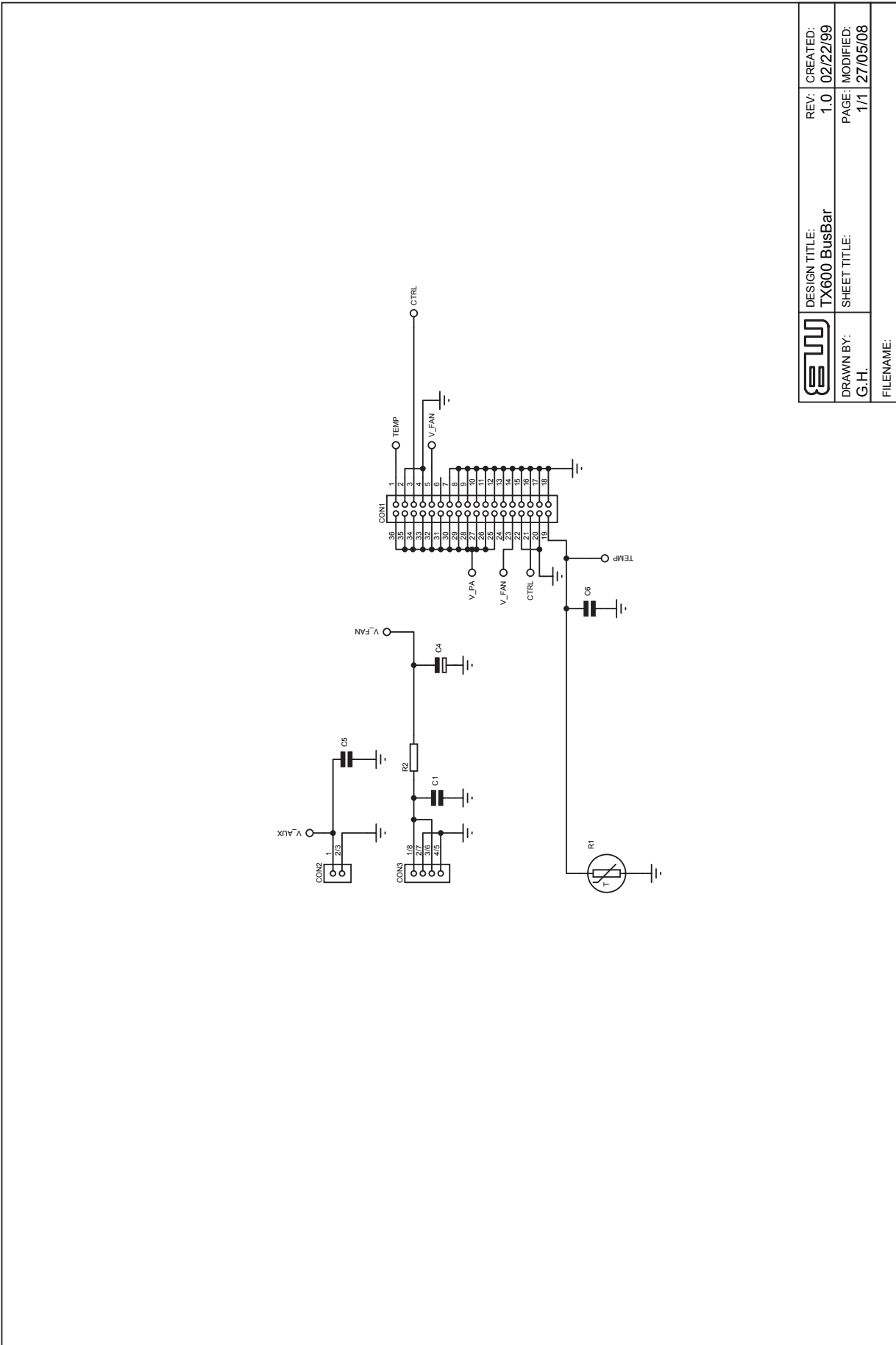
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	PA Alarm Port	02/22/99	
DRAWN BY:	SHEET TITLE:	PAGE:	MODIFIED:
R.K		1/1	09/05/08
FILENAME: Z:\Products\BW Products\PROTEUS\Current Production			

3.531 PSU Interface



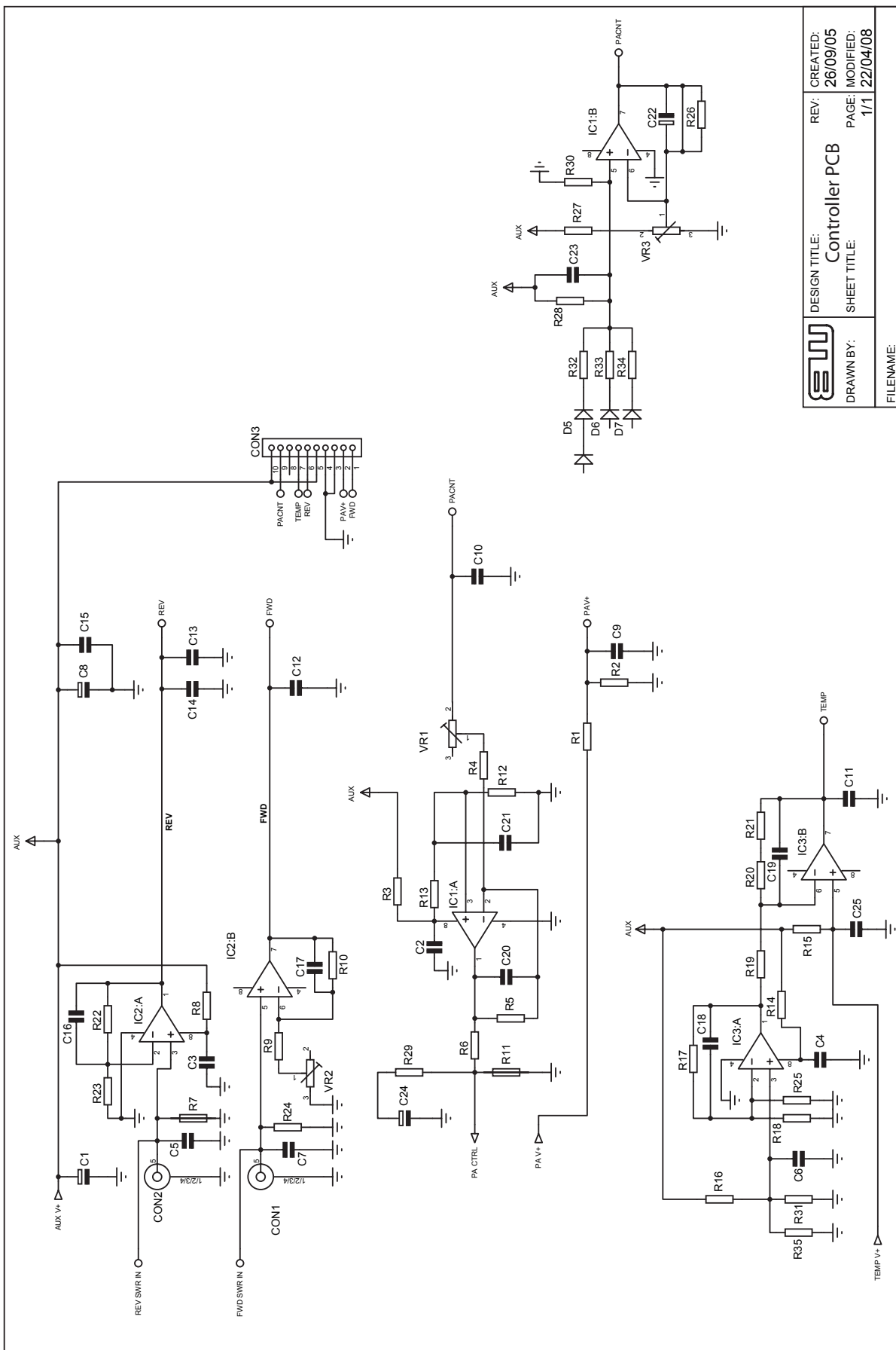
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	DRAWN BY:	PAGE:	MODIFIED:
	G.H.	1/1	28/05/08
FILENAME:			

3.532 Bus Bar



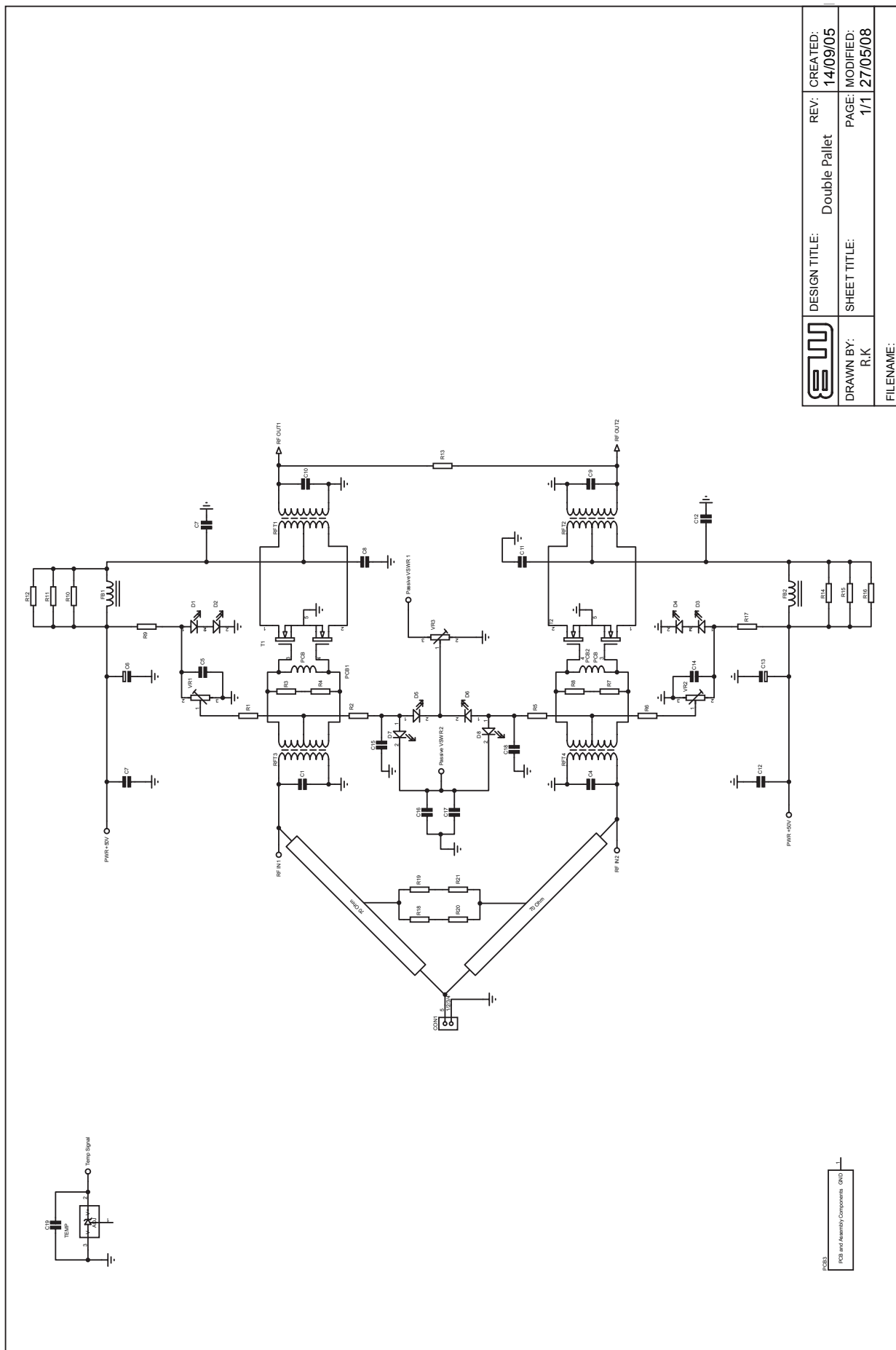
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FILENAME:						


3.533 Controller PCB



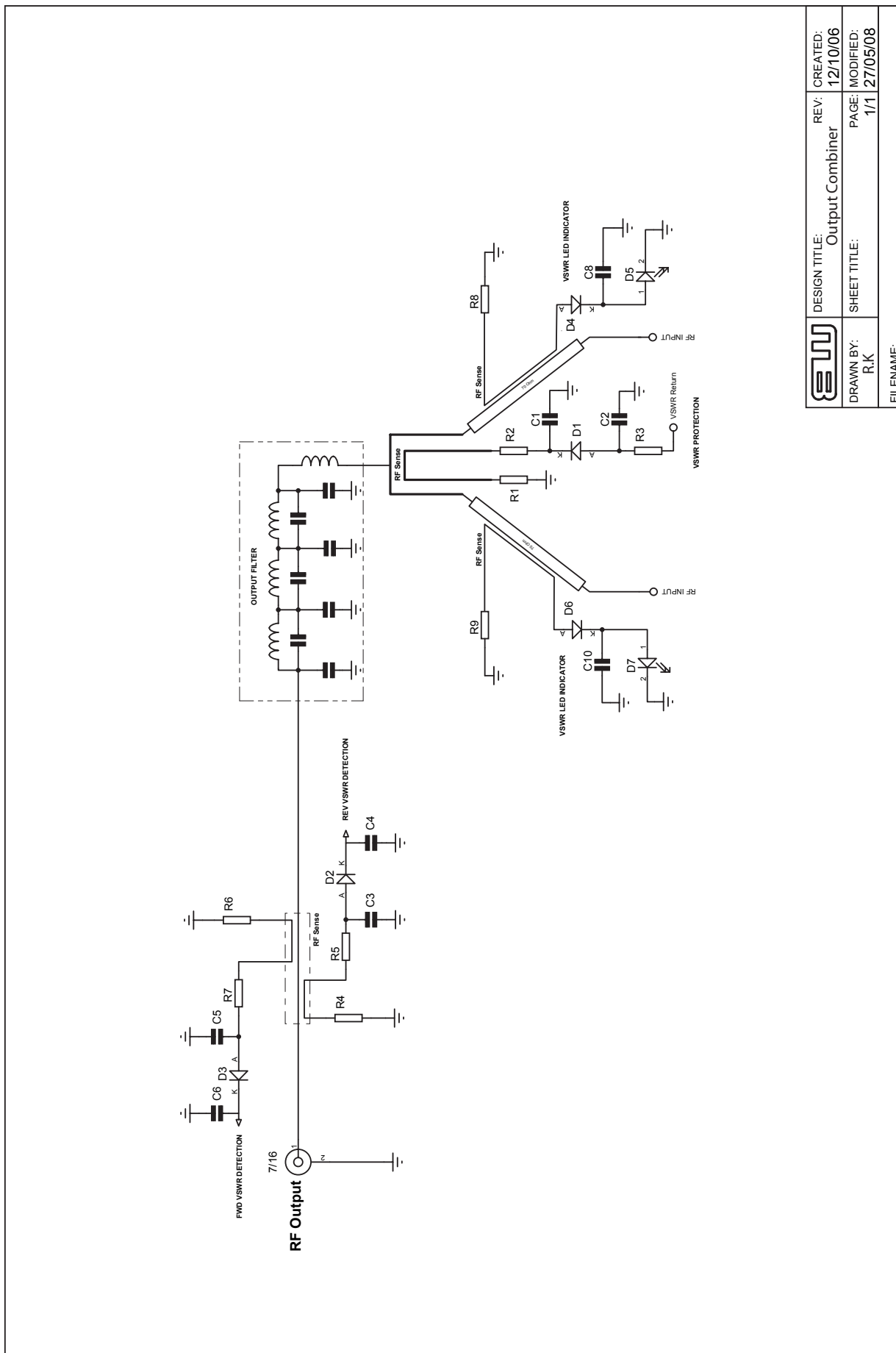
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REV:	26/09/05	CREATED:
PAGE:	1/1	MODIFIED:
SHEET TITLE:	22/04/08	
FILENAME:		

3.535 Double Pallet



	DESIGN TITLE: Double Pallet	REV: 14/09/05	CREATED: 14/09/05
	DRAWN BY: R.K	SHEET TITLE: 1/1	PAGE: 27/05/08
FILENAME:			

3.536 Output Combiner



	DESIGN TITLE:	Output Combiner	REV:	12/10/06
	DRAWN BY:	R.K	PAGE:	1/1
SHEET TITLE:		1/1 27/05/08		
FILENAME:				

3.6 PARTS LIST

3.61 LCD control board

Qty	Reference	Value	Description
4	C1, C2, C13, C18	2.2uF	63V Electrolytic Cap
2	C12, C15	100n	2.5mm Pitch Radial Multilayer Ceramic (Y5V)
2	C3, C4	33pF	33pF Ceramic 2.5mm Pitch
10	C5, C6, C7, C8, C9, C10, C11, C14, C16, C17	560pF	560pF Ceramic
1	D1	1N4148	1N4148
1	LED1	3mm	Mini 3mm Green LED - L-7104GD
1	LED2	3mm	Mini 3mm Red LED - L-7104GD
3	R1, R2, R16	33k	1/8 W Metal Film 1% - CR12
3	R12, R13, R14	1k8	1/8 W Metal Film 1% - CR12
4	R15, R18, R20, R22	100R	1/8 W Metal Film 1% - CR12
1	R17	560R	1/8 W Metal Film 1% - CR12
1	R19	100k	1/8 W Metal Film 1% - CR12
6	R3, R7, R8, R9, R10, R11	820R	1/8 W Metal Film 1% - CR12
2	R4, R5	390R	1/8 W Metal Film 1% - CR12
1	R6	10k	1/8 W Metal Film 1% - CR12
1	R21	4k7	1/8 W Metal Film 1% - CR12
1	R23, R24	4R7	1/8 W Metal Film 1% - CR12
1	R25	1K	1/8 W Metal Film 1% - CR12
1	VR3	200R	Bourns 3296 W 3/8in
1	VR1	500R	Bourns Minipot
1	VR2	100k	Minipot Spectrol 63M
1	Reg1	7805	7805CV 1A VOLTAGE REGULATOR
1	IC1	40 Pin	40 Pin PIC16F877-20P (NOT FITTED)
1	IC2	CA3240EZ	CA3240 Op Amp
0	IC3	TBA	NOT FITTED
3	SW1-3	9.5mm	9mm Tactile Switch
1	X1	8MHz	8MHz Crystal
1	Connector	20-Way	Header Strip (20-Way)
1	LCD Screen	LCD	Blue LCD Display
1	IC1	40-Pin	40 Pin IC Socket
2	IC2,IC3	8-Pin	8-Pin IC Socket
3	Panel Buttons	n/a	Molded Cap for Switch (NOT FITTED)
1	Con1	10-Way	10 Way Boxed Header
1	Con2	16-Way	16 Way Boxed Header

3.62 Remote and alarm board

Qty	Reference	Value	Description
6	R1-R6	1K2	1/8 Watt Carbon Film - Tolerance +- 5%
2	R7,R8	10R	1/4 Watt Metal Film Resistor- Tolerance 1%
6	C1-C5, C8	100n Y5V	Radial Multilayer Ceramic 2.5mm pitch - Y5V Dielectric
2	C6,C7	100uF	Radial Electrolytic - 6mm Dia, 2.5mm Pitch, Tolerance +- 20%
1	IC1	ST232CN	ST232CN RS232 TRANSCIEVER
3	T1, T2, T3	BC337 (C3371)	C337-16 TO92 50V NPN GP TRANS
1	REG1	78L05	+5V Voltage regulator 78L05
1	CON1	15 Way Dual	Female Dual Double Height D-Type PCB-Mount Connector
1	CON2	R/A BNC	Right Angled BNC PCB-Mount Connectors
1	CON3	MCX	MCX PCB Mount Socket
1	CON4	16 way	Straight IDC Header
1	CON	16 pin	16 Pin Dil IC socket

3.631 PSU Interface

Qty	Reference	Value	Description
1	R1	3k3	1/4W Metal Film Resistor
1	R2	22R	1/8W Carbon Film Resistor
0	R3	N/A	NOT FITTED
1	R4	1k2	1/4W Metal Film Resistor
1	R5	15k	1/4W Metal Film Resistor
1	C1	100uF	5mm Pitch Electrolytic Capacitor
2	C2,C3	470uF	5mm Pitch Electrolytic Capacitor
1	D1	UF5401	3A Ultrafast rectifier diodes
1	D2	LED	3mm Green LED
1	L1	100uH	DVE SRL 104
1	LM2575HVT-ADJ		LM2575HVT-ADJ/NOPB Regulator

3.632 Bus Bar

Qty	Reference	Value	Description
1	R1	5k	Minature Disc Thermistor
1	R2	1R	3W Wirewound Resistor
2	C1,C4	100uF	35V Radial electrolytic capacitor
2	C5,C6	10pF	Ceramic disc capacitor
1	CON1	CONN-DIL36	36 Way card edge connector
1	CON2	CONN-SIL2	2.1mm DC Power socket
1	CON3	CONN-SIL4	4 Way, 45° screwless terminal

3.633 Controller PCB

Qty	Reference	Value	Description
1	R1	22k	2512 0.05% Resistor
1	R2	1k8	0805 5% Resistor
3	R3,R8,R14	33R	0805 5% Resistor
2	R4,R11	5k1	0805 5% Resistor
8	R5,R6,R12,R13,R16,R17,R19,R30	10k	0805 5% Resistor
	R23	18k	0805 5% Resistor
2	R7,R24	1M	0805 5% Resistor
2	R10,R22	100k	0805 5% Resistor
2	R15,R21	22k	0805 5% Resistor
2	R18,R25	NOTUSED	0805 1% Resistor
1	R20	6k2	0805 1% Resistor
6	R26-R28,R32-R34	NOTUSED	0805 5% Resistor
1	R29	680R	0805 5% Resistor
1	R31	4k7	0805 5% Resistor
1	R35	5k6	0805 5% Resistor
1	R9	15k	0805 5% Resistor
1	VR1	0R	1206 0 Ohm Link
1	VR2	10k	10k 20% 4mm 3314G SMT Cermet Trimmer
1	VR3	NOTUSED	SMT Cermet Trimmer Resistor
1	C1	NOTUSED	SMT Capacitor (4X5.4mm)
15	C2-C4,C6,C9-C16,C18-C21	100nF	100N 0805 50V Y5V Capacitor
1	C16	1uF	0805 SMT Capacitor
2	C5,C7	1nF	0805 SMT Capacitor
1	C8	10uF	SMT Capacitor (4X5.4mm)

1	C17	NOTUSED	0805 SMT Capacitor
1	C22	NOTUSED	0805 SMT Capacitor
1	C23	NOTUSED	0805 SMT Capacitor
1	C24	47uF	SMT Electrolytic Capacitor
1	C25	2n2	0805 SMT Capacitor
3	D5-D7	NOTUSED	SMT Diode
3	IC1-IC3		CA3240EZ DUAL BIMOS Op-Amp
2	CON1,CON2	NOTUSED	
1	CON3	CONN-H10	10 WAY Straight boxed header

3.634 15W Driver

Qty	Reference	Value	Description
1	R1	43k	1/4W Metal film resistor
1	R2	2k2	1/4W Metal film resistor
1	R3	3k3	1/4W Metal film resistor
1	R4	10R	1/4W Metal film resistor
1	R5, R9	75R	1/4W Metal film resistor
1	R6	100R	1/4W Metal film resistor
1	VR1	1k	6mm Cermet trimmer potentiometer
2	C1,C2	470uF	Radial electrolytic capacitors
1	C3	27pF	Low K ceramic plate capacitor
2	C4,C12	10nF	Ceramic disc capacitors
2	C5,C10	560pF	Ceramic disc capacitors
1	C6	39pF	Low K ceramic plate capacitor
1	C7	100uF	63V Radial electrolytic capacitor
1	C8	47pF	Ceramic disc capacitor
1	C9	82pF	Low K ceramic plate capacitor
1	C11	220nF	Polyester Capacitor
0	C13-C15	Not fitted	Ceramic disc capacitor
1	FB1		Axial Bead inductor
1	L1	330uH	Choke Inductor
1	L2	1.5t	S18 Toko Inductor
1	L3	Loop	Wire Loop Inductor
1	L4	2.5t	S18 Toko Inductor
1	L5	3.5t	S18 Toko Inductor
1	L6	330uH	Choke Inductor
0	L7	Not fitted	S18 Toko Inductor
1	D1	UF5401	300A, 100V Fast diode
1	D2	GREEN	5mm Green LED
1	T1	IRL510	IRL510PBF
0	CON1	MCX	MCX PCB Socket N.F
1	CON2	CONN-H2	MCX PCB Socket
1	REG1	LM2575HV-ADJ	Step down switch regulator

3.635 Double Pallet

Qty	Reference	Value	Description
2	R1,R6	5k1	SMT 1/8W Resistor
2	R2,R5	100R	SMT 1/8W Resistor
4	R3,R4,R7,R8	3R3	SMT 1W Resistor
2	R9,R17	22K	SMT 1W Resistor
6	R10-R12,R14-R16	12R	SMT 1W Resistor
1	R13	100R	400W Power Resistor

4	R18-R21	100R	SMT 1W Resistor
3	VR1-VR3	10k	SMT 10k Variable Resistor
2	C1,C4	82pF	SMT 100nF Capacitor
4	C5,C14,C15,C18	100nF	SMT 100nF Capacitor
2	C6,C13	100uF	100uF 63V Electrolytic Capacitor
2	C7,C12	15nF	SMT 100V Capacitor
2	C8,C11	1nF	Polyester Capacitor
2	C9,C10	3p3	Metal clad capacitor
2	C16,C17	Not fitted	SMT 100nF Capacitor
1	C19	100nF	SMT Capacitor
2	FB1,FB2	1H	SMT Ferrite Bead, 11.4 x 6.5mm
6	D1-D6	BLU-LED	SMT Blue LED
2	D7,D8	Not fitted	SMT Blue LED
2	T1,T2	BLF278	BLF278 Transistor
1	CON1	CONN-H2	MCX Connector
2	PCB1,PCB2	PCB	PCB Feedback Inductor
1	PCB3	PCB	
2	RFT1,RFT2	4-1 SemiRigid Coax CCW	
2	RFT3,RFT4	PCB	PCB Transformer
1	TEMP	LM335Z	

3.636 Output Combiner

Qty	Reference	Value	Description
1	R1	47R	1W Resistor
1	R2	120R	1W Resistor
3	R3,R4,R5,R6,R7	120R	1W Resistor
2	R8,R9	68R	1W Resistor
2	LINKS	18k	Bridge points
3	C1,C3,C5	27pF	
3	C2,C8,C10	1nF	
2	C4,C6	2n2	
5	D1-D4,D6	BAT42 DIODE	
2	D5,D7	LED	
4	L1-L4	2.5T	



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