FM25

FM EXCITER/TRANSMITTER

TECHNICAL MANUAL

CONTENTS

1 Introduction

The FM25 is a top specification broadcast FM exciter that is also ideally suited as a low power stand alone transmitter. Featuring wideband design techniques, frequency adjustment is easily achieved by internally set direct reading dial switches - no further tuning is required. The FM25 uses the renowned **sbs** ultra linear modulator to give superb sound reproduction with freedom from overshoots and artifacts. It will operate into any load without damage thanks to its VSWR cut back circuit that protects the power amplifier stage from adverse operating conditions.

The FM25 front panel metering shows forward and reflected power together with internal voltages and the modulation level. Additionally monitor points for both audio multiplex input and RF output are provided. Quick-view status monitoring using dual colour LEDs indicate that PLL lock, forward power and reflected power are within a preset tolerance when green. The rear panel includes a remote control/monitoring socket that allows carrier muting and status signalling to an external system.

Very conservatively rated components and a switch mode DC-DC converter are used to ensure extremely high reliability and to give good efficiency. The FM25 is in service with broadcasters worldwide and has been giving many years of trouble free service.

The FM25 is built, together with the MPX5 Stereo Encoder as a transmission system, to exceed the requirements of ETSI 300 384: January 1995, Radio broadcasting systems standard for VHF FM sound broadcasting transmitters, specifying equipment for radio transmission.

2 Safety, Electrical hazard

This unit contains high voltages which could be fatal. YOU MUST ALWAYS ISOLATE THE UNIT FROM THE AC SUPPLY BY COMPLETELY DISCONNECTING IT BEFORE ATTEMPTING TO OPEN THE CASE.

THIS EQUIPMENT MUST BE EARTHED.

Do not expose this equipment to rain or any other source of water.

In common with all AC operated equipment, only suitably trained competent personnel should attempt to adjust, modify or repair this equipment or operate it with the cover removed. In case of query please contact your local agent or **sbs**.

Any unauthorised adjustment, modification or repair of this equipment may invalidate any warranty and/or safety approvals that apply.

Please read all of this manual and familiarise yourself with the controls before attempting to use this equipment.

To ensure safety, it is the responsibility of the user to install and operate this equipment in a manner that is within the manufacturers specifications.

Where the following safety critical components are used in **sbs** products they will have one or more of the listed approvals. It must have any approval in bold type. Copies of the 'Certificate of Conformance' from our suppliers are available for these items.

ITEM	APPROVAL
Toroidal transformers	**BS415 or IEC65**, VDE0550/1
Filtered IEC connectors	CSA, SEV, UL, VDE
Fuse links	**IEC127 or BS4265**
Relays	UL, CSA, VDE
IEC free socket and cable assembly:	
IEC connector	VDE, SEV, BSI
Cable	**BASEC BS6500**

3 Safety, Toxic hazard

This equipment includes devices which contain Beryllium Oxide which is a highly toxic substance. Inhalation or ingestion of even tiny particles could be injurious to health or even FATAL!

Extreme care must be exercised when replacing and discarding components which may contain Beryllium Oxide. If any such device is physically damaged you should seek expert advice, e.g. by contacting the device's manufacturers.

All such devices must be disposed of in accordance with local regulations. In the UK your local council will have a toxic waste disposal department who will be able to advise you. Elsewhere you should contact the responsible authorities.

NEVER DISPOSE OF A DEVICE CONTAINING BERYLLIUM OXIDE WITH GENERAL WASTE.

4 Unpacking

This package should contain:-

1x FM25 Series broadcast exciter/transmitter
1x IEC Power lead
1x FM25 series manual

If any items are missing or damaged please inform your supplier immediately.

Initial Checks

Ensure that the FM25 has been set to the correct power/line voltage for your country. The standard version is set to 230V.

5 Controls and Connectors

Front Panel:

PLL LOCK	Modulator functioning correctly (when green).
P.FWD	Green when the RF output level is above a predetermined level (see installation section).
P.REF	Green while the reflected RF power is below a pre-determined level (see installation section). Red when the VSWR cut-back system is operating.
RDS/SCA	Green when an external RDS or SCA unit is connected to the rear RDS/SCA socket.
I/P Monitor	Un-buffered monitor of modulator input.
O/P Monitor	Monitor of RF output (approx. -40dB). This point should not be used for harmonic measurements.

Meter and selector Selects and indicates important FM25 parameters.

Rear Panel:

Audio input	Unbalanced on BNC female connector or balanced on female XLR connector with optional limiter (pin 2 hot). Stereo version 5 pin female XLR which is electronically balanced. Pin 1 ground, pin 2 left hot, pin 3 left cold, pin 4 right hot and pin 5 right cold.
Monitor	25 way female D-type. Pin 1 Forward power alarm. Pin 2 Reverse power alarm. Pin 3 PLL lock alarm. Pin 4 Mute RF output (link to ground). Pin 5 - 14 Reserved. Pin 25 Ground. All outputs are open collector and low in their normal state. The output transistors are BC184L's, which can sink up to 100mA max. with an absolute maximum switched voltage of 30V.
RDS/SCA	10 pin female AV connector (if fitted) Pin 1 & 2 Ground. Pin 3 & 4 + 24V unregulated, 1A maximum. Pin 5 & 6 reserved. Pin 7 RDS/SCA + MPX IN Pin 8 MPX OUT Pin 9 Relay +V IN Pin 10 Relay -V IN
RF Out	N type female connector.
DC IN	4 pin XLR male, pin 1 and 2 negative, 3 and 4 positive.
AC Mains	Filtered IEC female connector with T2A fuse in pull out drawer

Before normal operation of the FM25 can commence the following parameters will require setting, assuming the equipment supplier has not done so:

6.1 Frequency
6.2 Output power
6.3 Forward power alarm
6.4 Modulator input level
6.5 VSWR Cut-back level

Please read through ALL of the following stages before attempting any adjustment. When an automatic change over system is in use (such as the ACU2) this should be disconnected/overridden such that the FM25 operates continuously during the set-up procedure.

6.1 FREQUENCY SETTING

Setting the frequency is a simple operation and may, if required be performed with the unit in operation (though only with a dummy load connected to the output).

For example, to set a frequency of 97.30MHz, set the 100MHz dial to 0, the 10MHz dial to 9, the 1MHz dial to 7, the 100kHz dial to 3 and the 50kHz shift switch to OFF. If the 50kHz switch was set to ON the output frequency would be 97.35MHz.

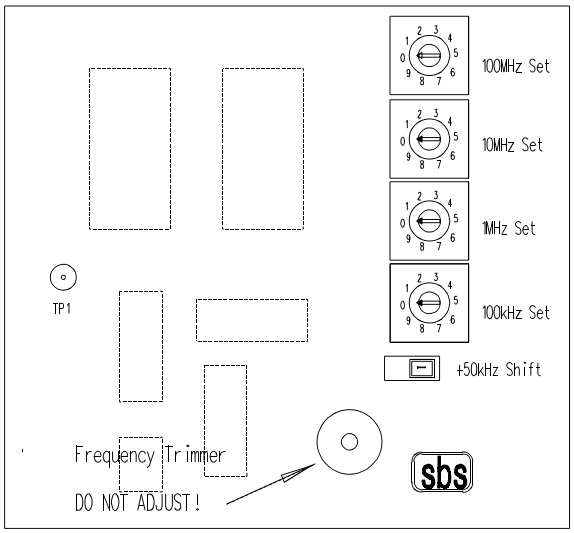


Figure 1 PLL3 Digital board.

Whilst the Phase Locked Loop is Locking up the modulator output is muted (indicated by the front panel PLL LOCK LED). When the FM25 is either powered up or the frequency changed, it will normally take about 5 seconds for the PLL to lock up. However if the frequency is changed from a high one to one at the bottom of band two, with the unit in operation, it can take up to 10 seconds for the PLL to lock up properly.

6.2 OUTPUT POWER

A small trimmer tool or precision screwdriver will be required to adjust the output power.

The output power should ideally be set using an accurate power meter connected to the RF output which in turn should be connected to an adequately rated dummy load. If either of these items are not available then the front panel meter could be used and/or it could be operated into the aerial or PA stage. In this latter case the

Output Power control (rear panel) should be set to minimum (counter clockwise) before powering up the FM25.

Connect the FM25 to the mains or DC supply and wait for the PLL to LOCK (the front panel LED indicates lock when green). Using the rear panel power adjust control (PWR. ADJ.) set the power to that required.

6.3 FORWARD POWER ALARM

This setting defines the point at which the front panel P. FWD. light changes to red and also the point at which a forward power fault is indicated at the Control/Monitor socket (for telemetry and/or operation of an automatic change over system). Adjust the output power to the fault level required. This must always be less than the normal output power level by enough to prevent spurious triggering, 1dB is an appropriate margin (80% of the correct full power). Adjust the P FWD OK (RV4) control on the FM25-DIS board such that the front panel P. FWD. light just turns red from green. Finally set the output power back to the normal output level.

6.4 MODULATOR INPUT LEVEL

For FM25/M and FM25/S see sections below covering LimX or DLM3 PCB's.

The FM25 is normally supplied with the modulator input level set so that an input level of +8dBu over the range 5Hz to 100kHz (without pre-emphasis) gives a deviation of 75kHz. If a different level is required then it will be necessary to reset the AUDIO LEVEL control on the PLL3-R modulator board. To set it properly a deviation meter will be required. This should be connected to the front panel O/P monitor socket. If a deviation meter is not available then the front panel meter should be used, though this will not be as accurate. Apply a 400Hz sine wave at the level required for maximum deviation (normally 75kHz). Adjust the AUDIO LEVEL control to give the required deviation.

If an RDS/SCA unit is to be connected, the output level of it may need re-calibration.

6.5 VSWR CUT-BACK LEVEL

This is the minimum RF output power that the FM25 will provide with a badly matched load such as a defective aerial. It should never be set above 7.5W to protect the power amplifier unit. As supplied it will be set to 5W. To set a different value turn the FM25 output power down to minimum, connect a power meter to the output and disconnect the dummy load or aerial. Remove jumper LK1 on the FM25DIS PCB. Turn the output power up until the desired reflected power cut-back level is obtained. Replace LK1 and adjust the CUTBACK control (RV2) such that the front panel P. REF LED just changes from RED to GREEN. Turn the output power up to full and if necessary slightly adjust the CUTBACK control to reduce the cut-back level to the value required. Finally reset the forward power to

the required level.

LimX PCB (FM25/S Only)

6.6 FET BIAS

Connect an audio input at 400Hz to the LEFT and RIGHT or mono inputs that is below the limit threshold, for example -20dBu.

LimX: Turn R40 and R31fully anti clockwise. Connect an oscilloscope or level meter to U7 pin 7. Turn R31 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R31 is turned. Connect the oscilloscope/level meter to U6 pin 7. Turn R40 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R40 is turned.

6.7 MODULATOR INPUT LEVEL

Connect an audio oscillator, level +8dBu at 1kHz to the MPX IN socket and turn the EXT MPX LOOP switch on (right position). Using a deviation meter, adjust the AUDIO LEVEL control on the PLL3-R PCB to give 75kHz deviation. Return the EXT MPX LOOP switch to the OFF position (left).

6.8 LimX OUTPUT LEVEL

Connect an audio input at 400Hz to the LEFT and RIGHT audio inputs such that the front panel limit LED is fully ON. LINK TP1 on the LimX PCB to ground. This disables the limiters, leaving the clippers active. Switch the pilot off. Adjust R1 to give 75kHz-6.75kHz-(Guard-band) deviation. A typical value would be between 50 and 60 kHz. Disconnect the ground link from TP1.

6.9 INPUT LEVEL

Switch the pilot off. Connect an audio oscillator to the left and right inputs. Set its output to 400Hz and the output level to the desired limit threshold. Turn R15 and R3 fully anti clockwise. Connect an oscilloscope to the MPX OUTPUT connector. Turn R15 clockwise and observe that the peak level shown on the oscilloscope increases. Stop adjusting R3 at the point where the peak level stops increasing. Now adjust R15 clockwise until the waveform is a pure sine wave.

6.10 PILOT LEVEL

Disconnect the audio input. Switch the pilot on. Adjust R86 to give a deviation of 6.75kHz.

If an RDS/SCA unit is to be connected, the output level of it may need re-calibration.

DLM3 PCB (FM25/M Only)

6.11 FET BIAS

Connect an audio input at 400Hz to the Mono input that is below the limit threshold, for example -20dBu.

Turn R33 fully anti clockwise. Connect an oscilloscope or level meter to U3 pin 7. Turn R33 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R33 is turned.

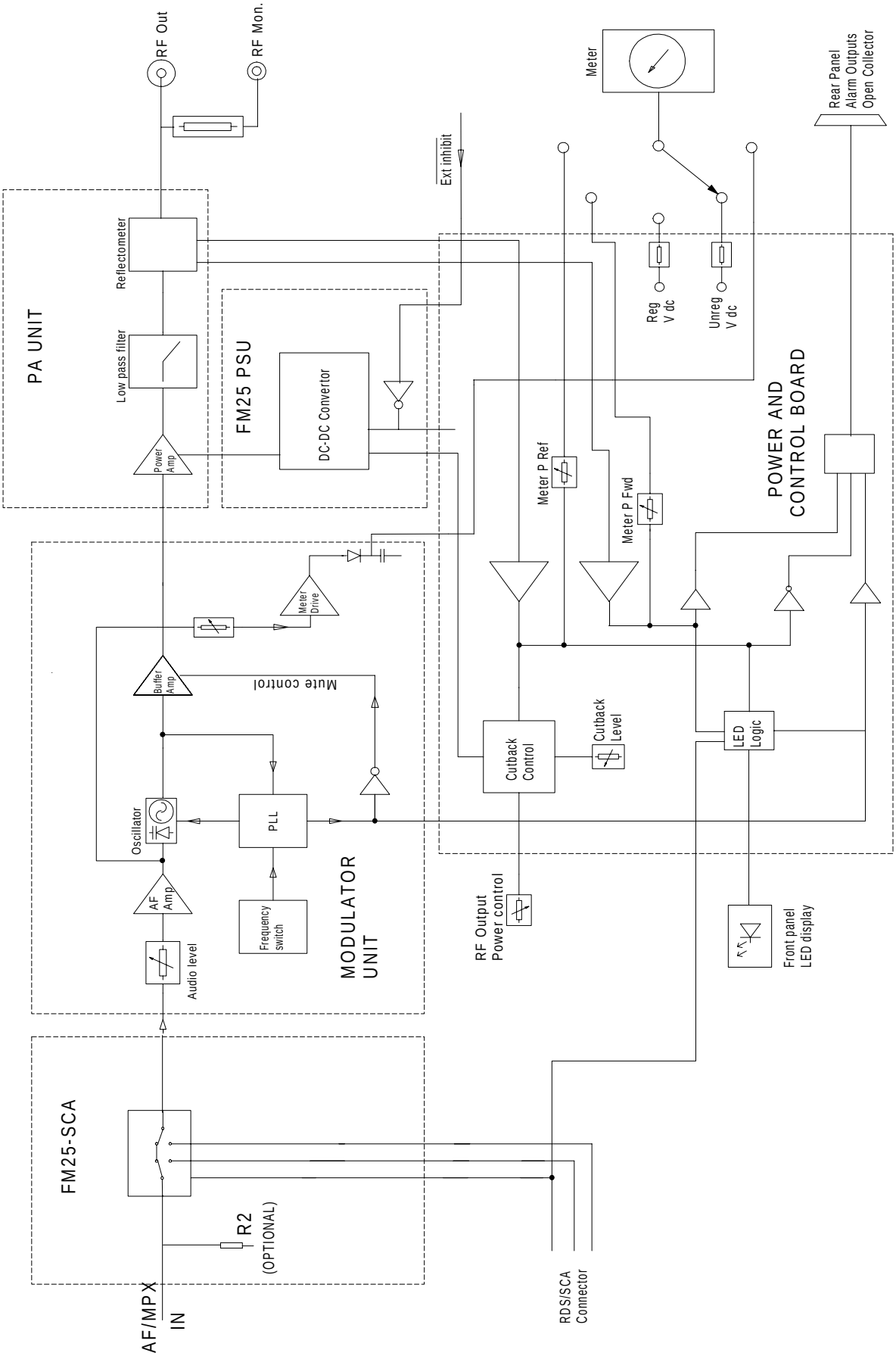
6.12 MODULATOR INPUT LEVEL

Connect an audio input at 400Hz to the audio input such that the front panel limit LED is fully ON. LINK TP1 on the DLM3 PCB to ground. This disables the limiter, leaving the clipper active. Adjust the AUDIO LEVEL control on the PLL3-R PCB to give 75kHz-(Guard-band) deviation. A typical value would be between 55 and 65 kHz. Disconnect the ground link from TP1.

6.13 INPUT LEVEL

Connect an audio oscillator to the audio input. Set its output to 400Hz and the output level to the desired limit threshold. Turn R19 fully anti clockwise. Connect an oscilloscope to the MPX OUTPUT connector. Turn R19 clockwise and observe that the peak level shown on the oscilloscope increases. Stop adjusting R19 at the point where the peak level stops increasing.

7 Block Diagram



8 Specifications

RF Interface ports	Output type N, monitor BNC. All 50Ω
Power output	0 - 17W typ. (15W min.)
Power output stability	$< \pm 0.5$dB[1] $< \pm 1.0$dB[2]
Minimum return loss for full power output	6dB
Frequency range	87.5 to 108 MHz in 50kHz steps
Frequency error	$< \pm$ 200Hz[1] $< \pm$ 400Hz[2]
Frequency drift (3 month interval)	$< \pm$ 200Hz
Frequency adjustment	continuously variable to $< \pm$ 10Hz
Mute attenuation (PLL out of lock)	>90dB
External mute control attenuation	>35dB
Deviation sensitivity stability[3]	$< \pm$ 1%
Spurious outputs (87.5 to 137Mhz @ $f_c > \pm 0.5$MHz)	< -100dBc
Harmonic & spurious output (30MHz to 1GHz)	< -72dBc
Synchronous AM (500Hz @ 40kHz dev.)	<0.5%
AM Hum & Noise	<0.3%
Input sensitivity for 75 kHz dev.	+8dBu (adj)
AF response (MPX Input)	$< \pm 0.5$dB (5Hz-100kHz)
THD	< 0.15% at 75kHz
Power supply	$220/230V_{AC}$ +10%/-20%
	24 - $30V_{DC}$
Power consumption	< 60VA
Ambient temperature range (normal conditions)	10 to 40 Celcius
Ambient temperature range (extreme conditions)	-20 to 45 Celcius
Humidity	≤90% non condensing
Dimensions	3Ux260mm

Dimensions exclude rear panel connectors and front panel heatsink (40mm).

[1] Under normal operating conditions
[2] Under extreme operating conditions
[3] Under all operating conditions

9 How to contact sbs

For all enquiries write to:-

sbs
PO Box 100
Hastings
East Sussex
TN35 4NR

Or telephone 01424 445588 within the UK, +44 1424 445588 from outside the UK.

Or fax 01424 443388 within the UK, +44 1424 443388 from outside the UK.

Or email sales@sbs.uk.com for sales enquiries or support@sbs.uk.com for technical support.

Alternatively visit our web site: http://www.sbs.uk.com/

10 Technical Section Contents

10.1 Introduction

The FM25 transmitter/exciter is built around several distinct PCB modules, broadly as outlined in the block diagram of section 7. Each PCB performs a separate, distinct function. The only minor exception to this being the separation of the digital and analogue functions of the modulator onto two boards. To fully understand the operation of the FM25 it will be necessary to know how each board is interconnected with the other sections of the transmitter.

10.2 PLL3

AUDIO STAGES

The baseband/audio input enters the PLL3/R board via a pin near R62. It is fed, via potentiometer R34 to IC6, which serves as an input buffer amplifier.

The output from IC6 feeds, via R39 and C48, to the modulator AF input. Also fed from the output of IC6 via C43 and a potentiometer R40 (meter sensitivity) is IC7 which is a rectifier stage. This provides the drive for the deviation meter (where fitted).

Both of these stages are supplied from a single rail. This is made possible by deriving a half rail 'ground' using resistors R44 and R45 as a potential divider. This is then decoupled by capacitors C50 and C51.

VOLTAGE CONTROLLED OSCILLATOR

A Colpitt's oscillator is formed by cascoded transistors TR3/4. The frequency of oscillation is determined by L4 and the parallel capacitance provided by varicap diodes D1 and D2. These diodes are biassed by the control voltage output from the loop filter. Diode D3 is also biased by this voltage via R14. This diode equalises the modulation sensitivity across the entire band. This is achieved by varying the coupling of varicap diode D4 into the tuned circuit formed by D1, D2 and L4. D4 is the modulation diode. It obtains DC bias via R17, R16 and decoupling capacitor C19. The bias is optimised for minimum audio distortion. The audio modulating signal is applied to this diode via C48 and R18.

A sample of the oscillator frequency is taken from the base of TR4 via C14 and fed to IC1 which is configured as a ÷40 pre-scaler. This is then fed to the PLL3-D PCB.

RF AMPLIFIER

The input to the RF amplifier stage is taken from the collector of TR3 via C9. This is amplified by TR2. The gain of this stage is controlled by potentiometer R60 (Output level). The collector of TR2 is tuned by L3. The DC supply for this stage is derived from the output of IC3. This IC switches the supply voltage to mute the output whilst the PLL is out of lock. The full operation of this circuit is explained later.

The next amplifier stage is fed from the collector of TR2 via C7/C6 which act as a matching network into TR1. This is the final amplifier on the PLL3-R board. The bias to this stage is also derived from the output of IC3, via R2 to further increase the attenuation in the muted condition. L15 and its associated components form a low pass filter.

PLL LOOP FILTER

The control voltage from the PLL3-D board is filtered by R33/C38. The filtered control voltage then feeds IC4, a quad switch, via R32 and separately by buffer IC5. The output from IC5 is only used when the PLL is out of lock. Its purpose is to increase the loop bandwidth thus accelerating the time for the PLL to reach its required frequency. The switching for this is done by IC4. In the out of lock condition R29 is placed in parallel with R30 and the output of IC5 is coupled to the output of the loop filter by R31. The low resistance of R31 effectively overrides the in lock path for the control voltage via R32.

When in lock IC5's output is switched out of circuit, as is R29. The control voltage passes to the loop filter output via R32. It is filtered via R30 by C36, giving a very long time constant. The purpose of this long time constant is to prevent the loop responding to very low modulation frequencies and thus causing distortion/phase shift.

The remaining switches in IC4 are configured as a timer (using C35 and R63/R28). In the lock condition C35 is charged via the R63/R28, switching on the final gate of IC4 after a short delay. This gate is used to link the junction of R26 and D10 anode to ground when in lock. The lock LED, D5, is driven via R26. Linking D10 to ground removes the positive bias (via R26 and R27/D5) applied to the input of IC3 causing its output to go high (+15V). The output of IC3 is used to drive the RF amplifier, as described above. The reason for the delay is to allow the loop to stabilise after the long time constant filter is switched in.

PLL3-D DIGITAL BOARD

Incoming clock pulses from IC1 on the PLL3-R board (output frequency ÷40) enter this PCB via PL2 pins 4/13. This is fed to TR1 which shifts their level from $8V_{PK}$ to the $15V_{PK}$ that is required by IC1.

IC1 is a programmable divide by N counter. The purpose of this is to divide the clock frequency by a ratio defined by the setting of the four frequency set switches and the 50kHz shift switch.

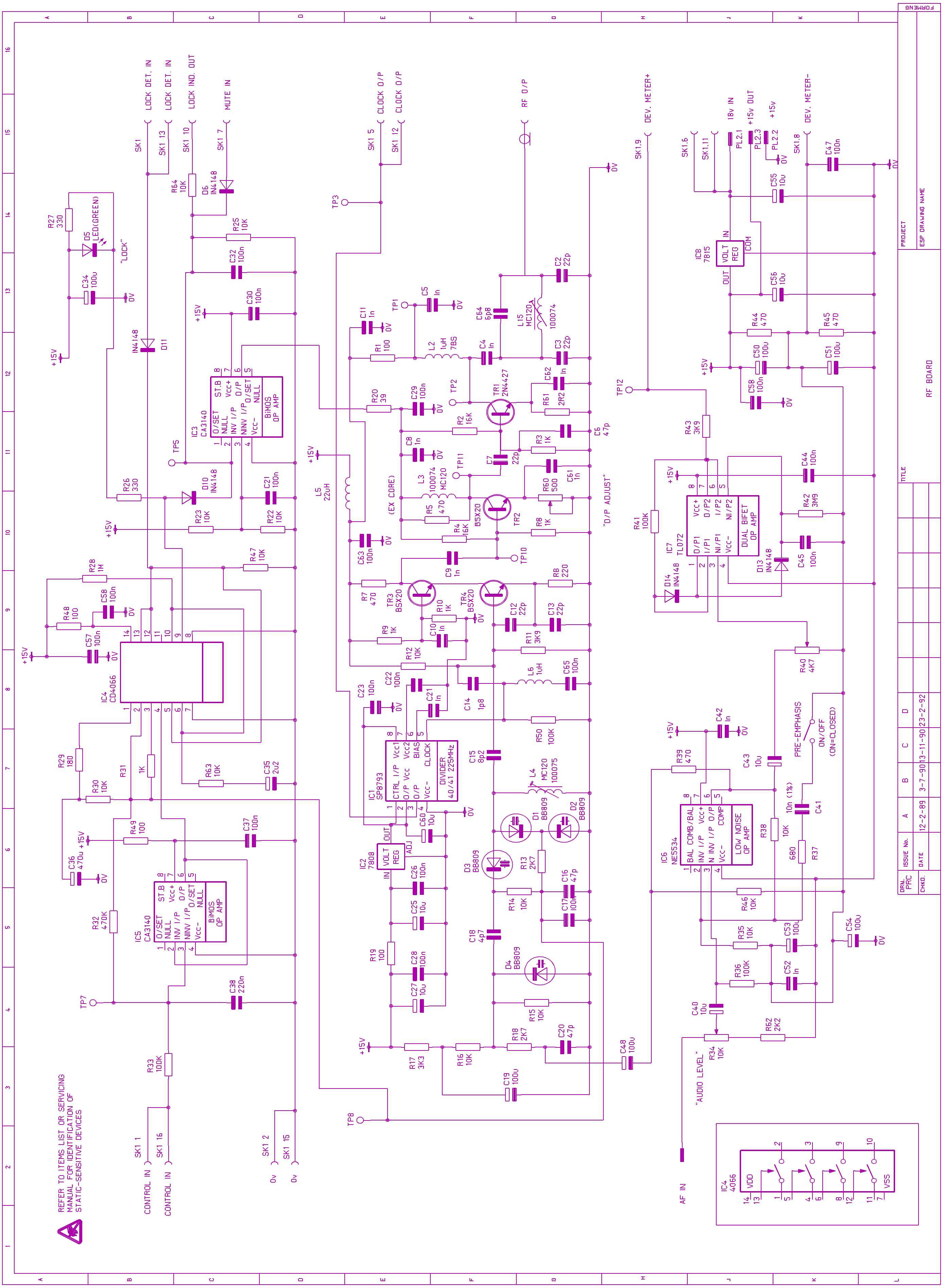
The divided output can be monitored at TP3. It should be noted that this output consists of pulses of the same duration as the incoming clock. The duty cycle is therefore very low. It may be difficult to see this on an oscilloscope .

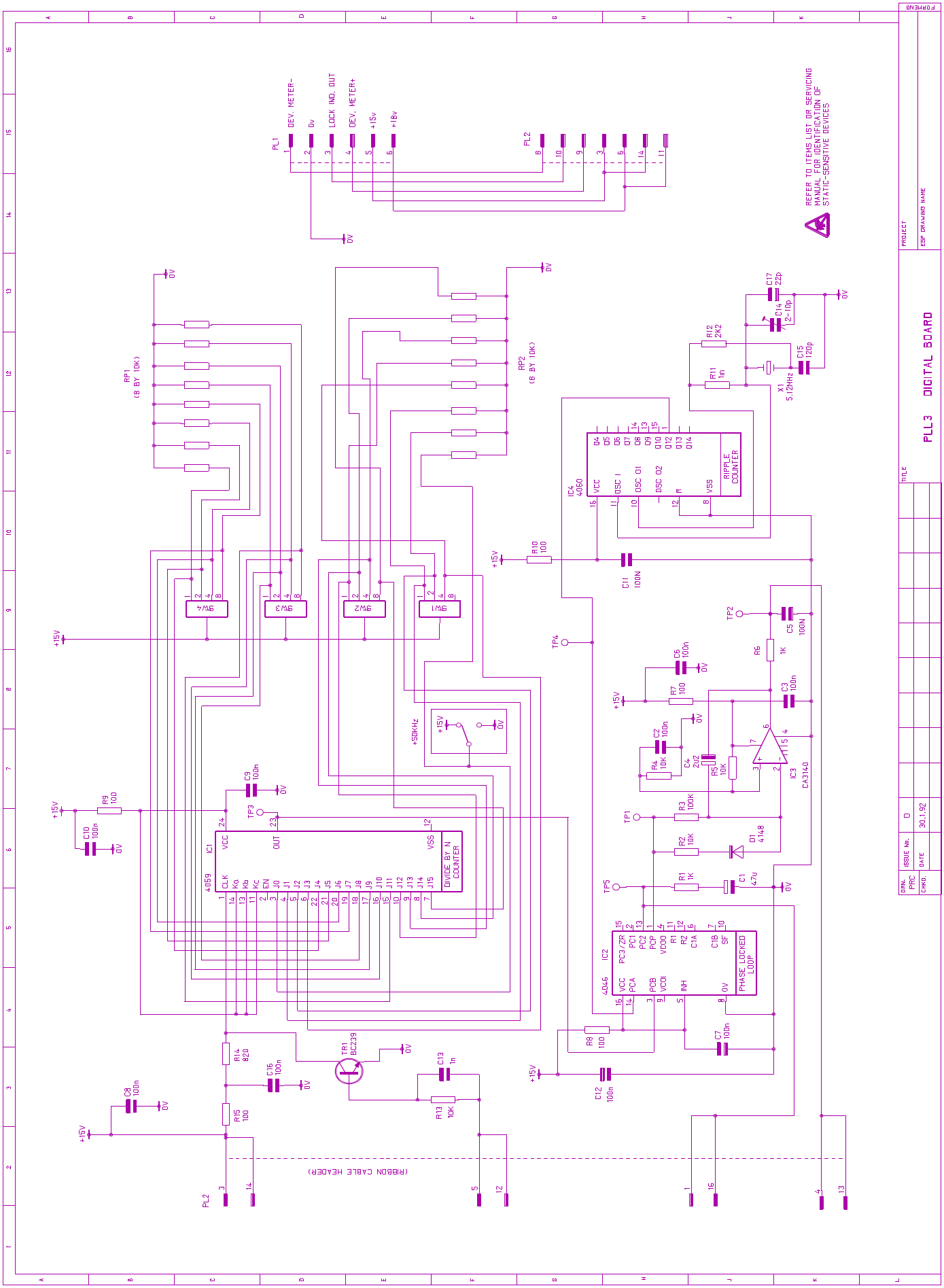
IC4 is a crystal controlled reference oscillator and divider. The crystal frequency of 5.120MHz can be trimmed over a small range by C14. The output frequency of 1.25kHz is taken from Pin 1. This can be checked at TP4. This is the reference

frequency used by the PLL.

IC2 is a CMOS 4046 phase locked loop. It compares the phase of the divided VCO signal from IC1 with the output of the reference oscillator. It has two outputs; one from pin 13 (TP5) is fed via PL2 pins 8 and 9 to the loop filter on the PLL3-R PCB. The network R1/C1 is a low pass filter with a much shorter time constant than that of the loop filter. This reduces the tendency for output transitions from IC2 producing spurious sidebands. The other output feeds the lock detector circuit, IC3.

IC3 is an integrator whose output is low when the PLL is in the locked condition. It feeds the loop bandwidth control on the PLL3-R PCB via pins 5 and 12. Its output can be monitored at TP2.


RF BOARD
FORMENS
PROJECT
ESP DRAWING NAME
TITLE
ISSUE No.
DATE
DRN. PRC
CHKD.
12-2-89
3-7-90
13-11-90
23-2-92
REFER TO ITEMS LIST OR SERVICING MANUAL FOR IDENTIFICATION OF STATIC-SENSITIVE DEVICES
LOCK DET. IN
LOCK IND. OUT
MUTE IN
CLOCK O/P
RF O/P
DEV. METER+
DEV. METER-
18v IN
+15v OUT
CONTROL IN
AF IN
"AUDIO LEVEL"
"D/P ADJUST"
PRE-EMPHASIS ON/OFF (ON=CLOSED)
"LOCK"
IC1 SP8793
IC2 7808
IC3 CA3140
IC4 CD4066
IC5 CA3140
IC6 NE5534
IC7 TL072
IC8 7815
DIVIDER 40/41 225MHz
BiMOS OP AMP
DUAL BIFET OP AMP
LOW NOISE OP AMP
VOLT REG
(EX CORE)


PL1
DEV. METER-
0v
LOCK IND. OUT
DEV. METER+
+15v
+18v
PL2
REFER TO ITEMS LIST FOR SERVICING
MANUAL FOR IDENTIFICATION OF
STATIC-SENSITIVE DEVICES
PROJECT
ESP DRAWING NAME
TITLE
PLL3 DIGITAL BOARD
DRN.
CHKD.
ISSUE No.
D
DATE
30.1.92
RP1
(8 BY 10K)
RP2
(8 BY 10K)
SW1
SW2
SW3
SW4
IC1
4059
DIVIDE BY N
COUNTER
IC2
4046
PHASE LOCKED
LOOP
IC3
CA3140
IC4
4060
RIPPLE
COUNTER
X1
5.12MHz
+50KHz
TR1
BC239
D1
4148
TP1
TP2
TP3
TP4
TP5
R1
1K
R2
10K
R3
100K
R4
10K
R5
10K
R6
1K
R7
100
R8
100
R9
10Ω
R10
100
R11
1m
R12
2K2
R13
10K
R14
820
R15
100
R16
100
C1
47u
C2
100n
C3
100n
C4
2u2
C5
100N
C6
100n
C7
100n
C8
100n
C9
100n
C10
100n
C11
100N
C12
100n
C13
1m
C14
2-10p
C15
120p
C17
22p
C16
100n
(RIBBON CABLE HEADER)

10.3 FM25-PSU

The power supply takes its input from the unregulated DC supply. It is used to supply the RF power amplifier with its DC supply. This supply must vary between 5V and 13V dependent on the output power required.

The supply is designed around a SGS-Thomson step-down switching voltage regulator, type GS-R400V. This supply provides soft start, inhibit, over current and over voltage protection.

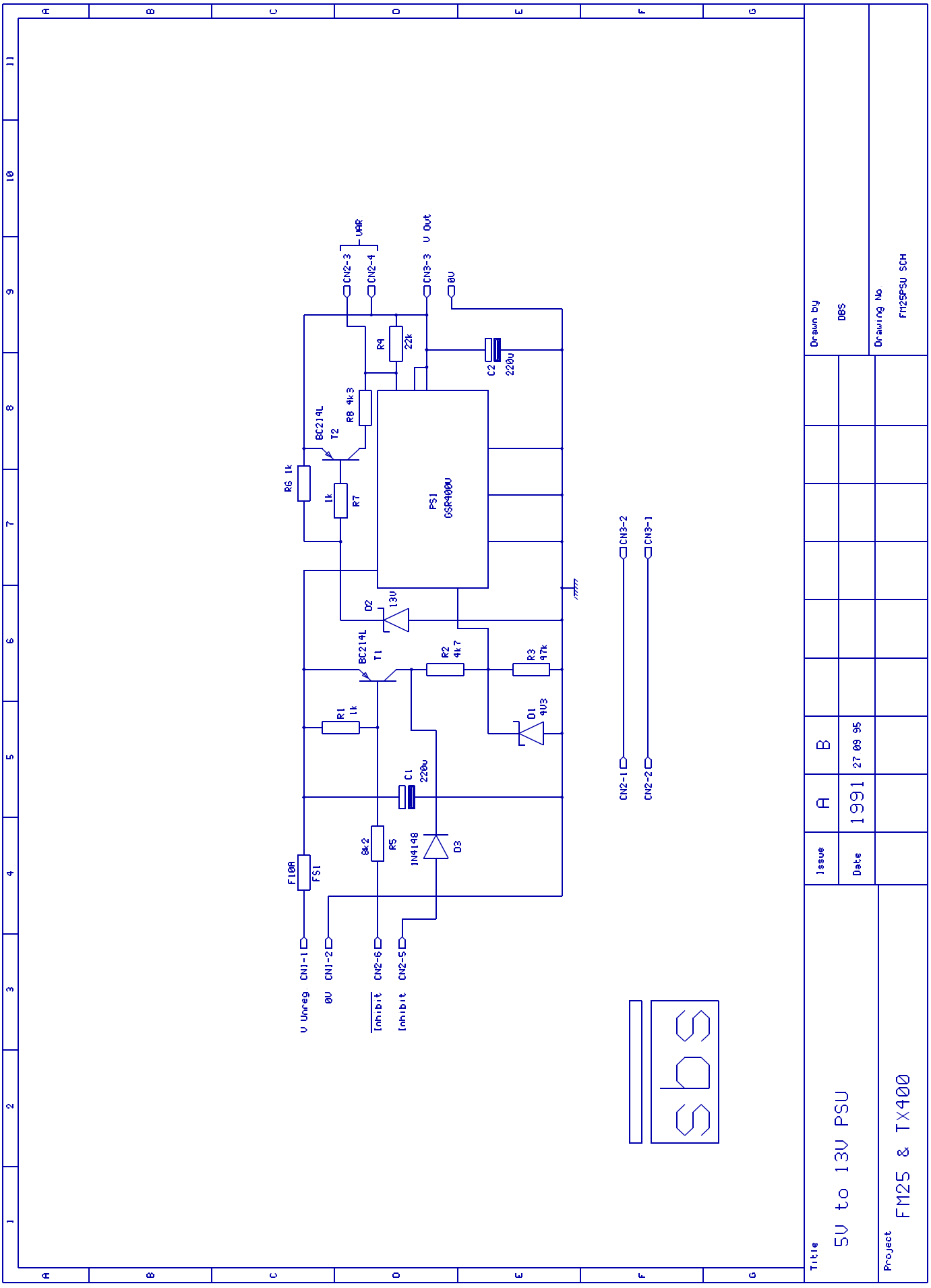
The DC input to the board is fused at 10A (fast acting). This fuse should only fail if the convertors internal over-voltage crowbar trip operates. This will normally only happen if there has been an internal failure in the convertor. The fuse must only be replaced with a fast acting type of the same value.

The DC supply is decoupled at the convertor input by C1 (Low ESR type). The same type of capacitor, C2 is used to decouple the convertor output.

The output voltage is set by the parallel combination of R4 and the external 5kΩ power set control. The parallel value of these two components is 4.3kΩ for 13V (maximum power) and 0Ω for 5.1V. The VSWR cut-back system feeds a positive current into the VAR input when it operates, to reduce the output voltage (and therefore output power).

T2, R8, R6, R7 and zener diode D2 provide over voltage protection in the event that the power set control should become open circuit, through disconnection or failure. This prevents damage to the RF power amp unit. This part of the circuit is designed only for protection. It should not be used to control the output in normal conditions since the output stabilisation and noise performance will be degraded.

The power supply can be shut down to provide the muting facility using the inhibit inputs. A positive voltage >5V can be supplied to the convertor via D3 and the potential divider R2/R3. Alternatively R5 can be linked to ground, turning on T1. The former input is not used and the latter is linked to the rear panel control connector to provide the external mute facility.


CN2-3
VAR
CN2-4
CN3-3
V Out
0V
R4
22k
C2
220u
R8 4k3
BC214L
T2
R6 1k
1k
R7
PSU
QSR400V
D2
13V
BC214L
T1
R2
4k7
R3
47k
R1
1k
D1
4V3
C1
220u
8k2
R5
IN4148
D3
F10A
FS1
CN3-2
CN3-1
CN2-1
CN2-2
V Unreg
CN1-1
0V
CN1-2
Inhibit
CN2-6
Inhibit
CN2-5
sbs
Drawn by
DBS
Drawing No
FM25PSU SCH
Issue
A
B
Date
1991
27 09 95
Title
5V to 13V PSU
Project
FM25 & TX400

10.4 FM25 PA

The power amplifier is designed around a Phillip's BGY33 module. They will produce >20W into a 50Ω load. They incorporate a 2 stage RF amplifier using NPN transistor chips, together with lumped element matching components. This component contains beryllium oxide, please read the section of this manual regarding safety and toxic hazard.

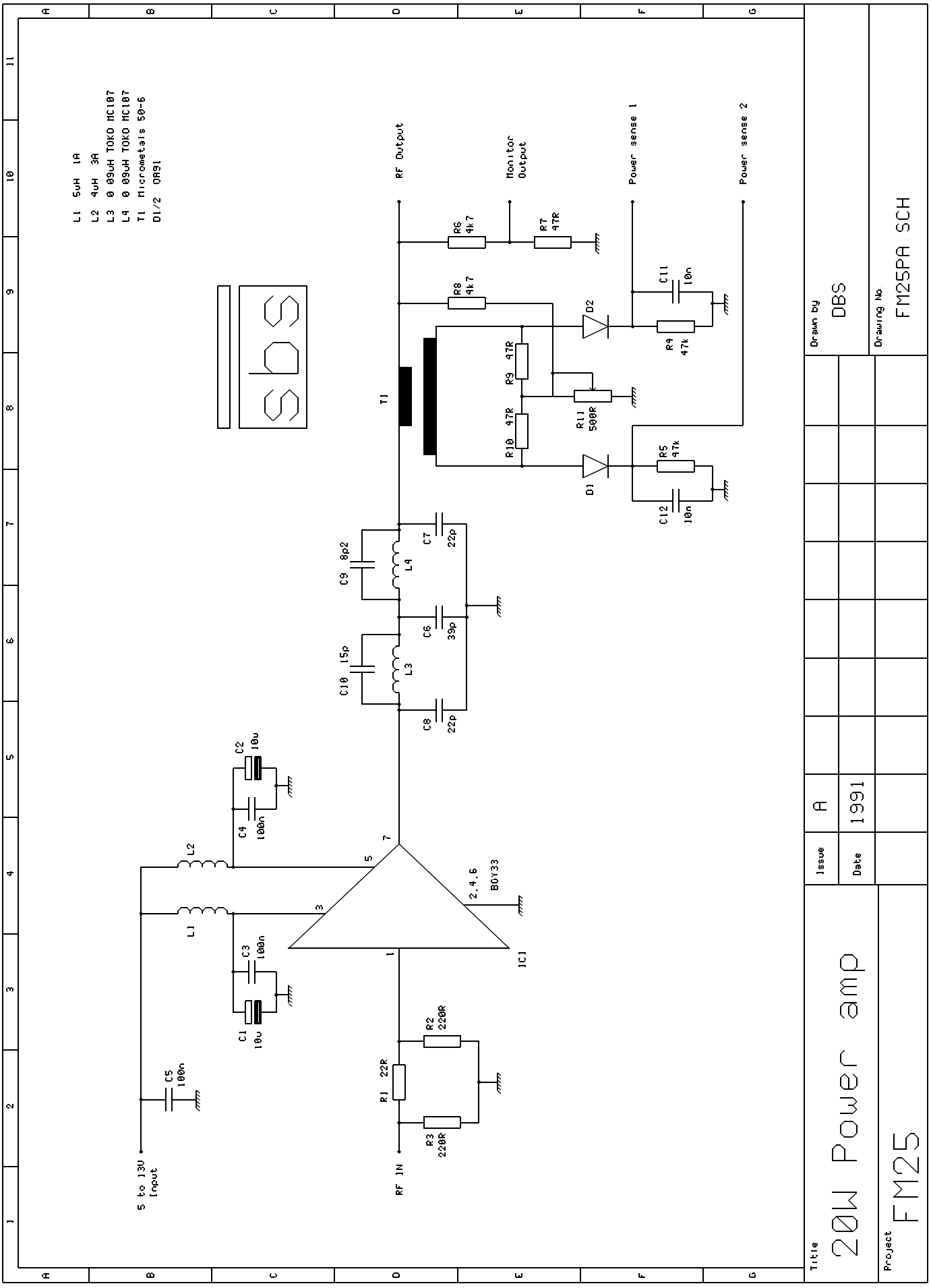
The RF input to the module is first taken via a 4dB attenuator formed by R1, R2 and R3. The purpose of this attenuator is to provide a good 50Ω impedance match for the module input. This is required to guarantee stability under all conditions. Also, with the RF output level control on the PLL3-R board set to maximum (150mW approx.) the input power to the module is reduced to 60mW. This is significantly below the maximum permitted 200mW indicated by the manufacturers. Experience has shown that this margin provides for maximum reliability of the module.

The output power is set by varying the DC supply voltage to both of the module RF stages. By doing this, both stability and output matching at all powers is improved. The supply to each stage is separately decoupled by L1, L2 and their associated capacitors.

The output from the amplifier module is first filtered by the low pass filter comprising L3, L4 and associated capacitors. The filter is designed to specifically reject the second and third harmonics.

The directional power sensor circuit follows the filter. The RF output is fed through the ferrite ring T1, giving one turn for the primary. The secondary is formed by three turns of enamelled wire. It is required to provide separate output voltages representing forward and reflected power. When a perfect output match is obtained, the output voltage and current waveforms will be in phase. With other than a perfect match the voltage and current waveforms will be out of phase by some amount. In the worst case they will be 180° out of phase (ie output short or open circuit). T1 will provide an output voltage proportional to the output current. The output voltage is added (and subtracted) from the output of T1 by R8. The voltage and current sensed are balanced by R11. The resulting in phase and out of phase waveforms are rectified by D1, D2 and decoupled by C12, R5, C11 and R4.

To set R11 to the correct operating point, operate the transmitter with a perfectly matched dummy load and set R11 for minimum reading on the reflected power meter setting.


L1 5uH 1A
L2 4uH 3A
L3 0 09uH TOKO MC107
L4 0 09uH TOKO MC107
T1 Micrometals 50-6
D1/2 OA91
RF Output
Monitor Output
Power sense 1
Power sense 2
R6 4k7
R7 47R
R8 4k7
C11 10n
D2
R4 47k
R9 47R
R11 500R
R10 47R
T1
D1
R5 47k
C12 10n
C9 8p2
L4
C7 22p
C6 39p
C10 15p
L3
C8 22p
C2 10u
C4 100n
L2
L1
C3 100n
C1 10u
C5 100n
2,4,6
BGY33
IC1
R2 220R
R1 22R
R3 220R
5 to 13V Input
RF IN
Drawn by DBS
Drawing No FM25PA.SCH
Issue A
Date 1991
Title 20W Power amp
Project FM25

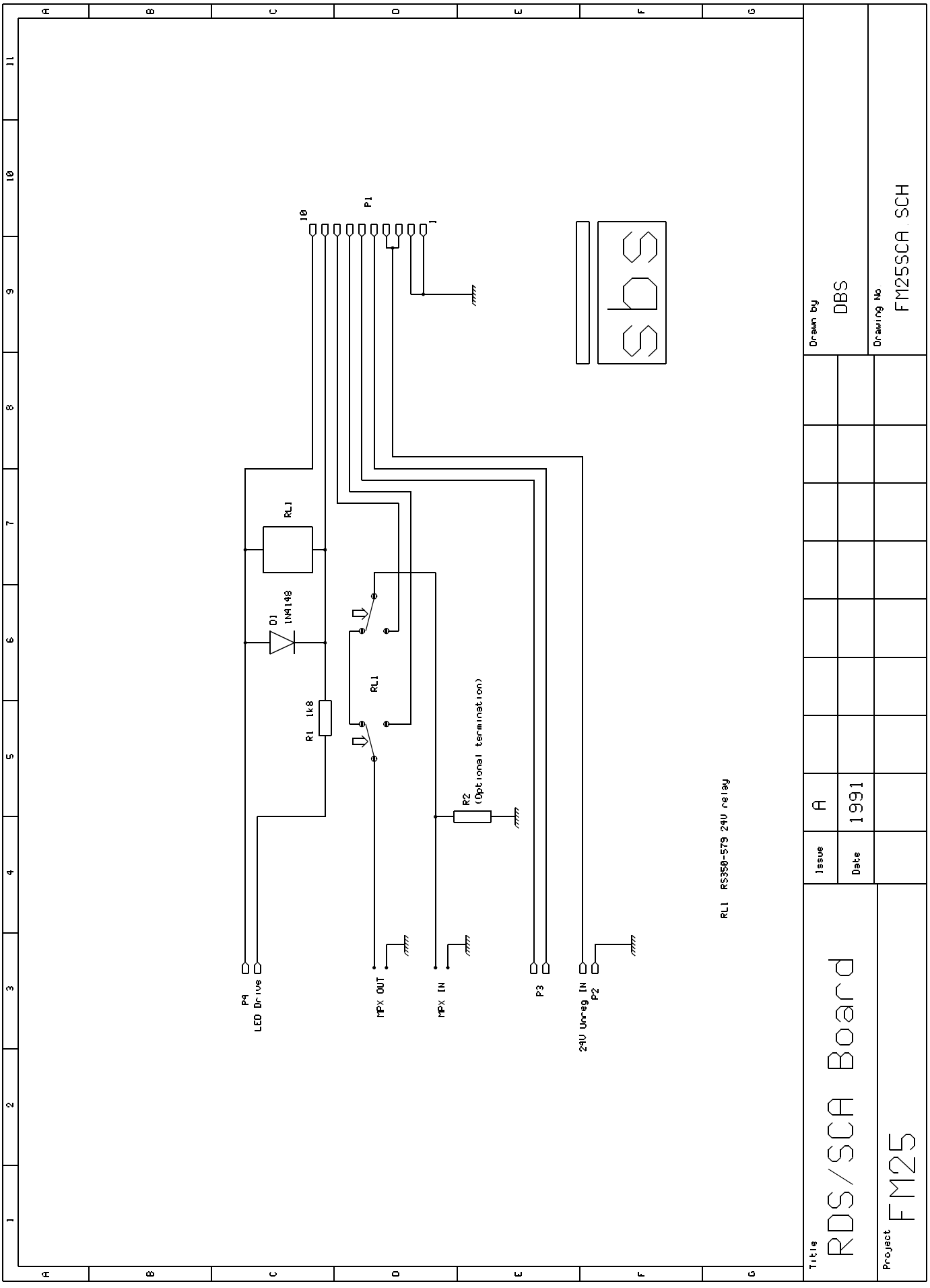
10.5 FM25-SCA

The RDS/SCA board provides a means of breaking into the audio/multiplex signal path to enable the connection of a SCA or RDS unit such as the FM25/RDS. In the normal condition the audio/multiplex signal is linked straight to the output of the board. The external SCA/RDS unit can switch itself into circuit by supplying approximately 24V to the relay RL1. Ideally it should only energise the relay if its own power supplies etc are in order.

This arrangement has been adopted to enable the connection and disconnection of the SCA/RDS unit whilst the FM25 is in use, without the need for a noticeable break in the audio multiplex.

The resistor, R2, is not normally fitted. It is there to provide for the possibility of a low impedance termination of the audio/multiplex input.

There are two spare cores in the 10 way interface connection from P1. These are linked to header P3. They are currently un-assigned, but reserved for future use.


RDS/SCA Board
FM25
Drawn by DBS
Drawing No FM25SCA SCH
Issue A
Date 1991
RL1 RS350-579 24V relay
P4 LED Drive
MPX OUT
MPX IN
P3
24V Unreg IN
P2
R1 1k8
D1 1N4148
RL1
R2 (Optional termination)
P1

10.6 FM25DIS

The FM25DIS PCB performs three tasks:- The basic power supply function, a central point for the interconnection of the other PCB's and indicators and the VSWR cut-back system.

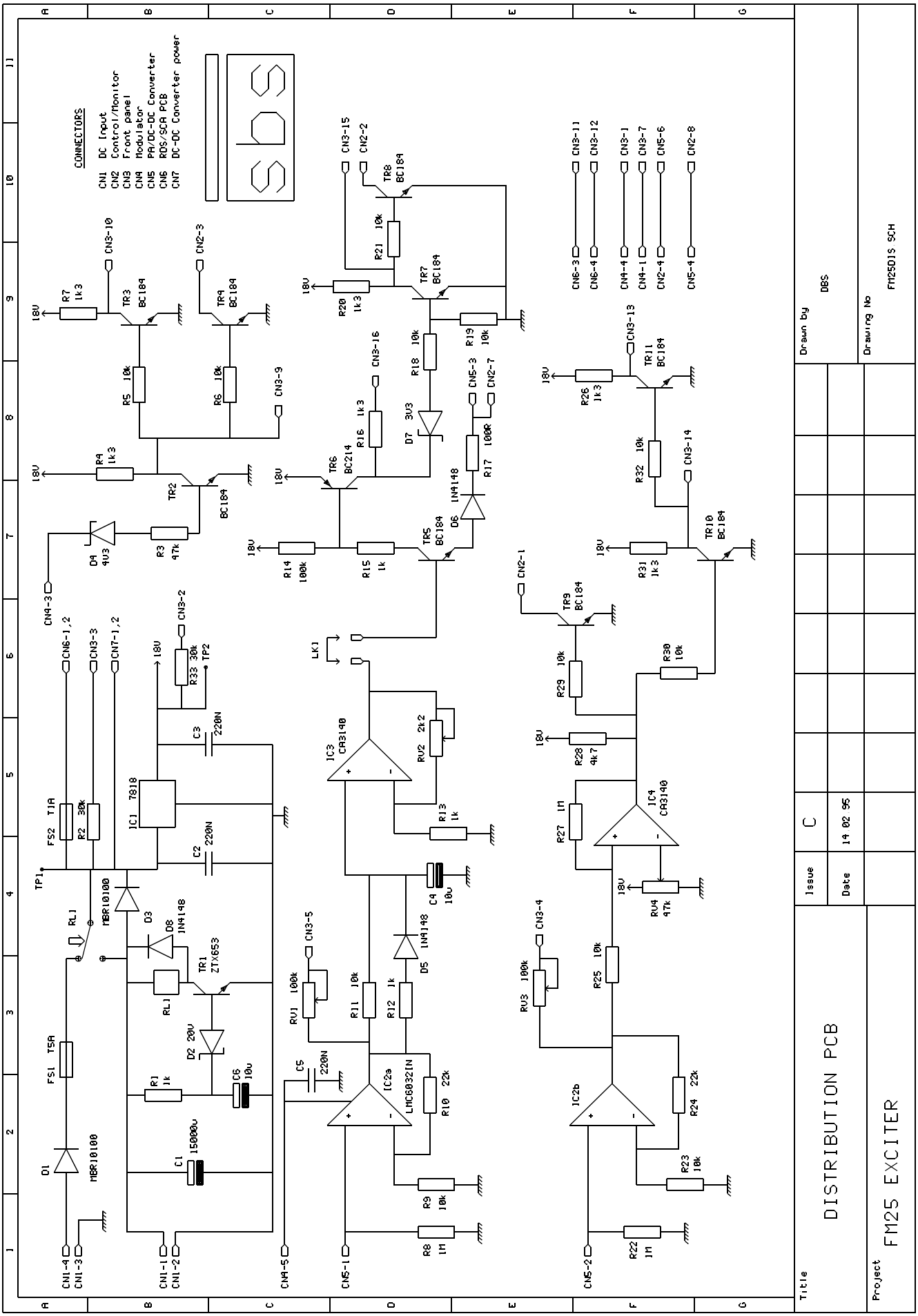
The AC output from the mains transformer is connected to the bridge rectifier. The output from the bridge rectifier enters the FM25DIS board at connector CN1 pins 1 and 2. It is smoothed by C1. The external DC input enters the PCB at connector CN1 pins 3 and 4, reverse voltage protection is provided by D1. The mains derived DC supply is monitored by TR1 and its associated components. Should this supply drop below about 20V the relay RL1 will be switched off selecting the external DC input. D3 ensures that power is drawn from the mains derived DC supply if the external supply is lower or absent. D3 also takes the load current during the relay change-over time.

From this point this unregulated supply feeds the FM25-PSU via connector CN7 pins 1 and 2, the FM25-SCA board via FS2 and connector CN6 pins 1 and 2, the front panel meter via R2 and connector CN3 pin 3 and IC1 which is a 7818 voltage stabiliser. The output from IC1 supplies most of the FM25DIS board electronics and the PLL3 boards via connector CN4 pin 6. IC2 receives a 15V supply from the PLL3 boards via connector CN4 pin 5.

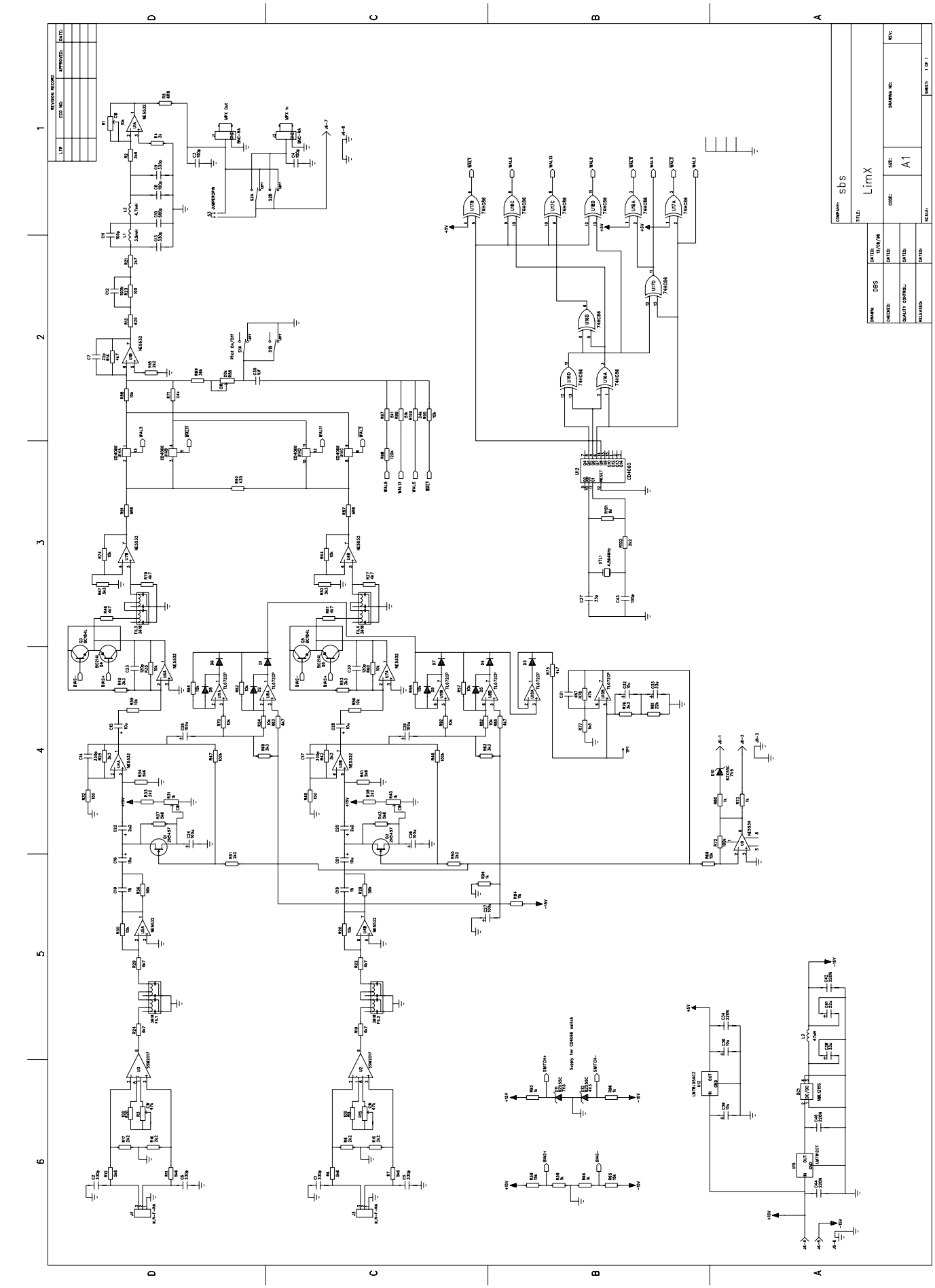
Transistors TR2, TR3 and TR4 provide the PLL LOCK LED drive and the external PLL LOCK OK indications. TR2 is turned off when the PLL is in lock. This in turn will turn on TR3 and TR4.

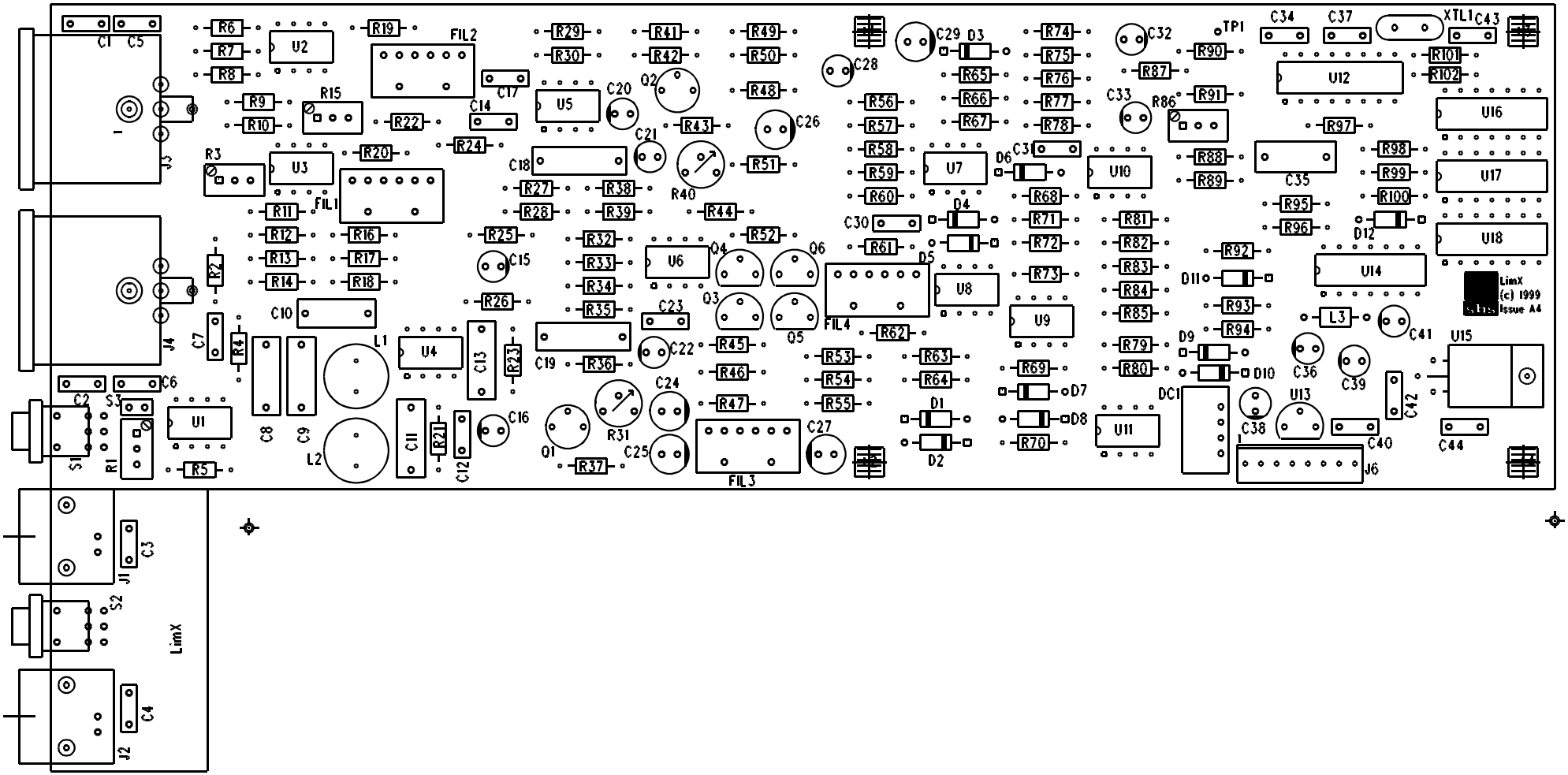
The forward power sensed voltage enters the board via connector CN5 pin 2. It is buffered and amplified by IC2b. The meter is driven via RV3. IC4 is operated as a comparator with its threshold set by RV4. Transistor TR9 drives the external forward power OK indication. Transistors TR10 and TR11 drive the front panel P FWD LED.

The reflected power sensed voltage enters the board via connector CN5 pin 1. It is buffered and amplified by IC2a. The meter is driven via RV1. C4 is charged by R11, R12 and D5. This provides a rapid peak hold with a slower decay. IC3 further amplifies this voltage. The gain of this stage (and therefore the maximum amount of cut-back) is set by RV2. The output of IC3 drives the control input of the FM25-PSU unit via LK1, TR5, D6, R17 and pin 3 of connector CN5. Feeding a positive current into this control input reduces the power supply output and therefore the RF output power and the consequent reflected power. The output power potentiometer is connected between pins 7 and 8 of connector CN2. The purpose of TR5 is to turn on TR6 as soon as the cut-back system stars to operate. TR6 drives the red part of the P REF LED and turns on TR7 which will turn off TR8.

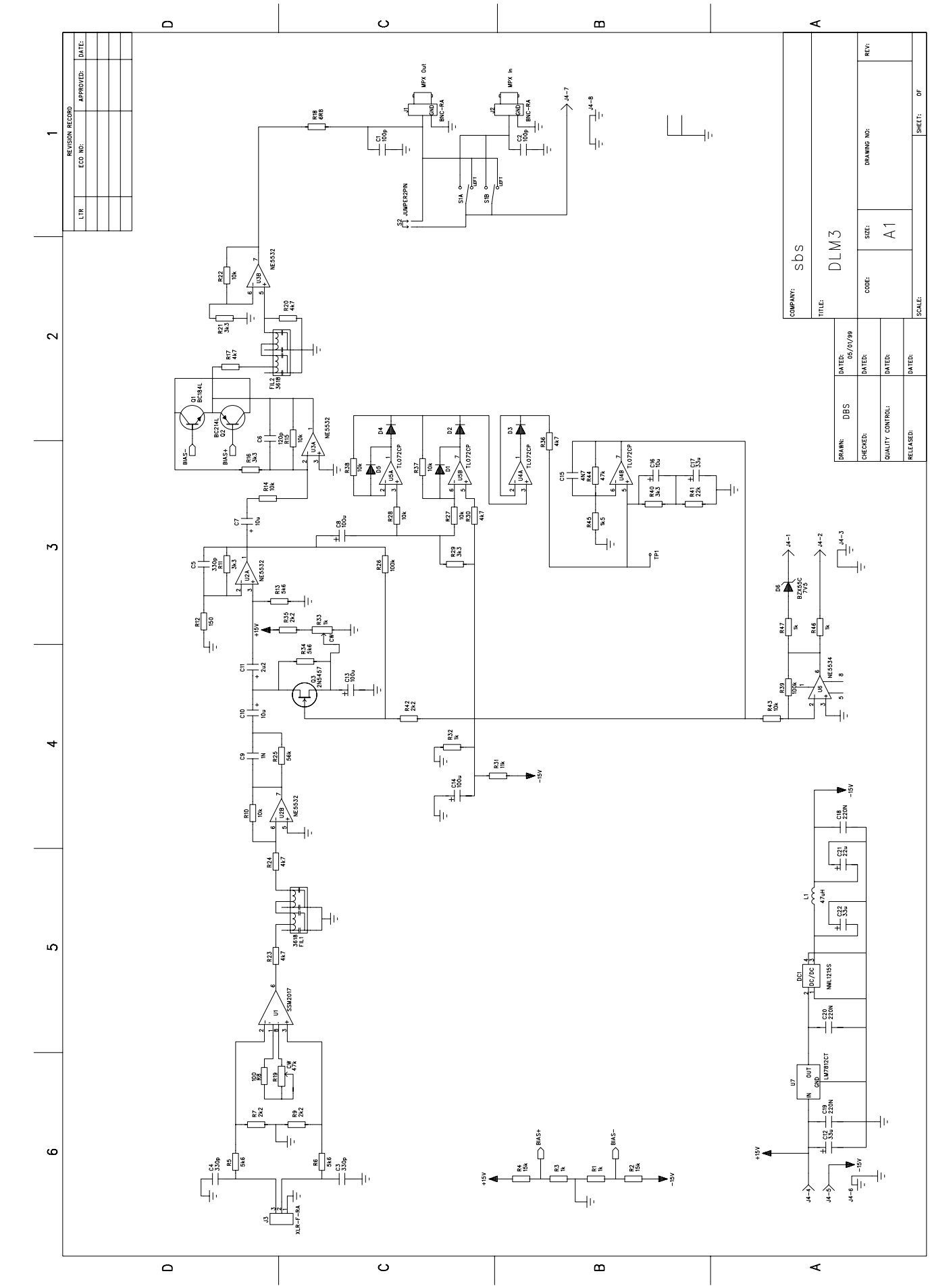

CONNECTORS
CN1 DC Input
CN2 Control/Monitor
CN3 Front panel
CN4 Modulator
CN5 PA/DC-DC Converter
CN6 RDS/SCA PCB
CN7 DC-DC Converter power
DISTRIBUTION PCB
FM25 EXCITER
DBS
FM25DIS SCH
Issue C
Date 14 02 95

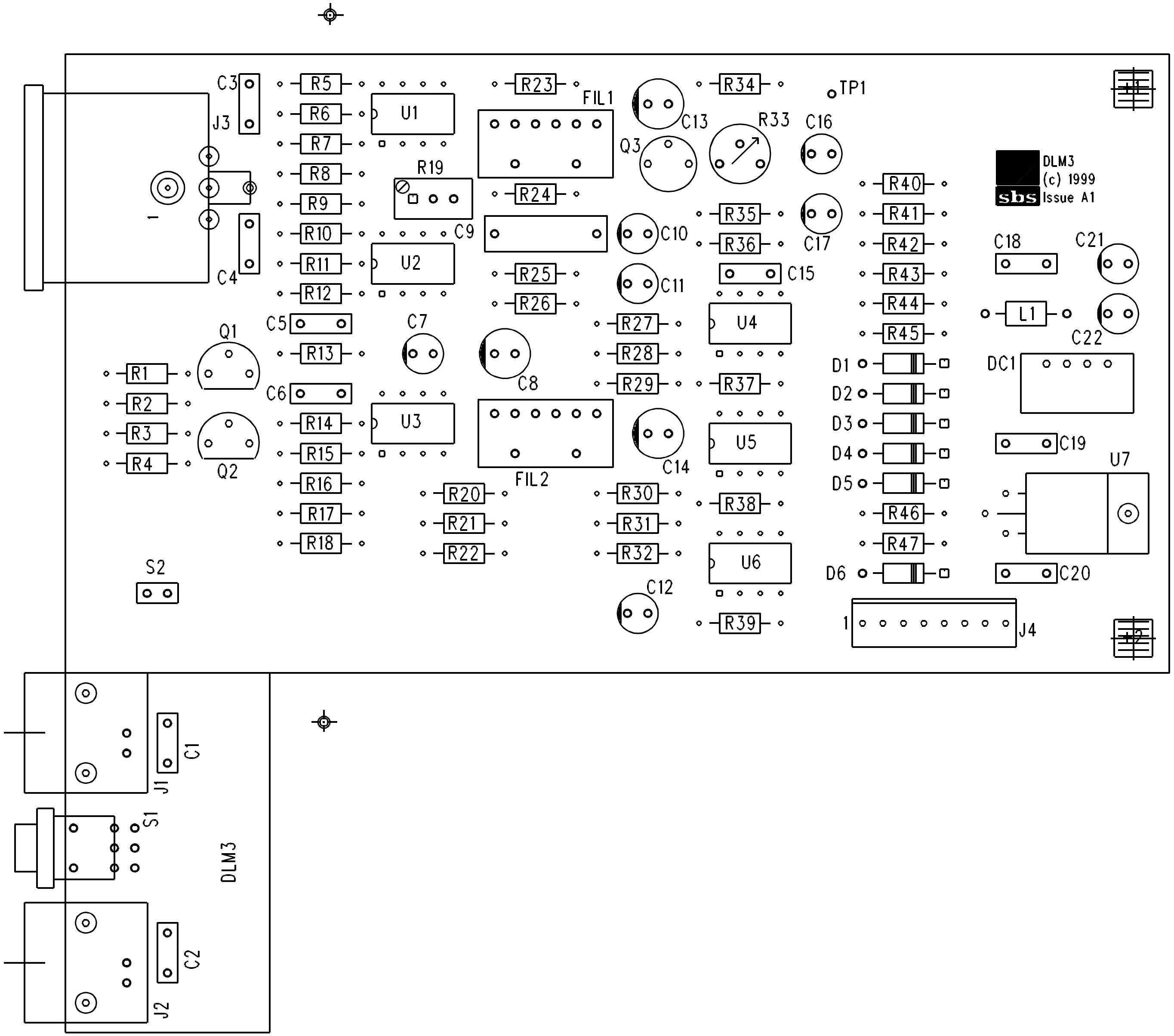
10.7 LimX



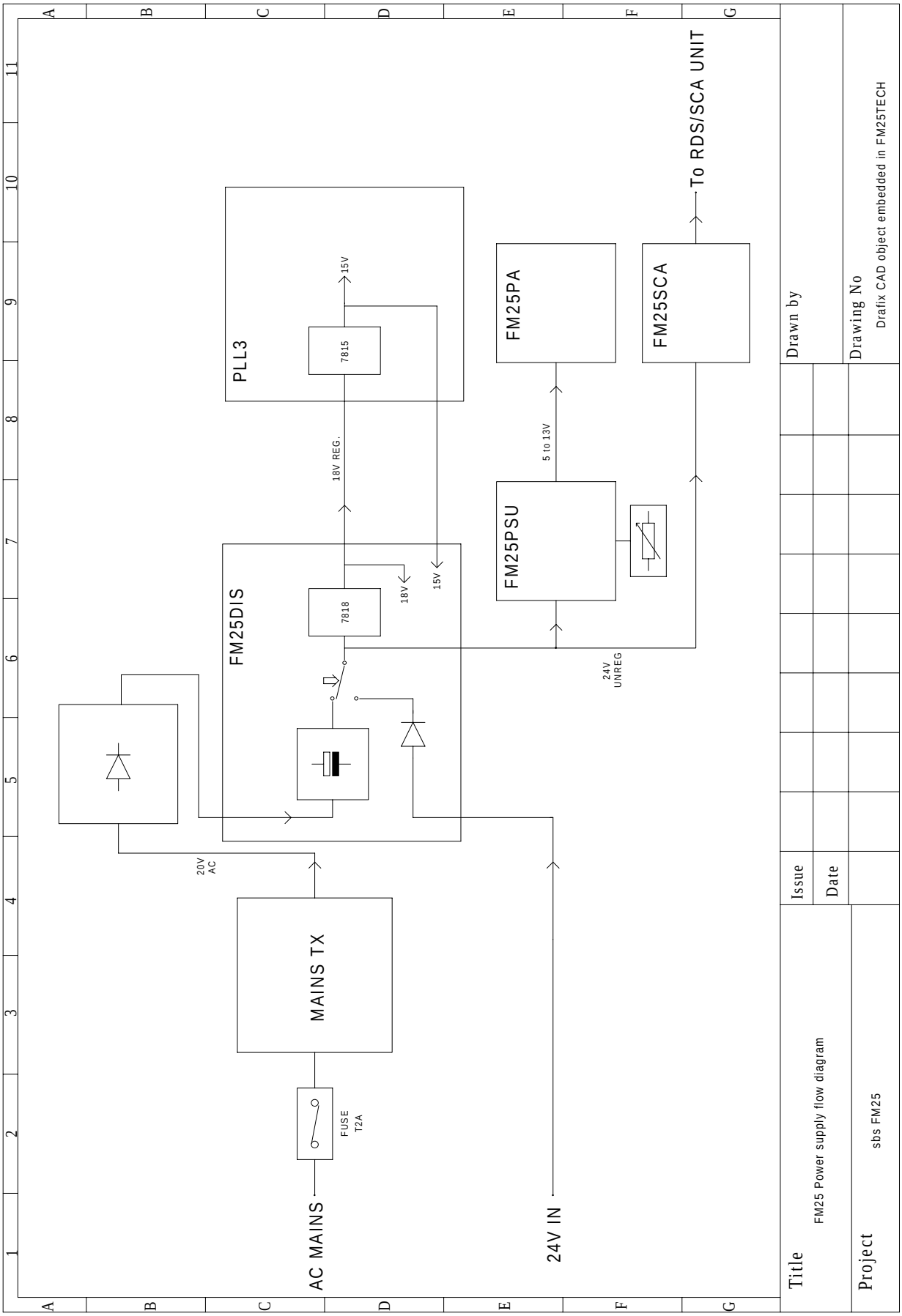

C1
C5
R6
R7
R8
U2
R19
FIL2
R29
R30
R41
R42
R49
R50
C28
C29
D3
C32
TP1
C34
C37
XTL1
C43
R9
R10
R15
C17
U5
C20
Q2
R48
R90
R101
R102
U12
R91
R87
C33
R86
R14
C21
R43
C26
R97
U16
R3
U3
R20
C18
R40
R51
R88
R98
U17
R11
FIL1
R27
R38
R44
U7
D6
C3
U10
C35
R89
R99
R100
R12
R16
R25
R28
R39
R52
C30
R61
D4
D5
R95
R96
D12
U18
R13
R17
R32
C15
Q4
Q6
R68
R81
R92
R2
R14
R18
R33
U6
U8
R71
R82
D11
U14
R26
R34
Q3
R72
R83
R93
C10
R35
C23
R73
R84
R94
U9
L3
C41
C7
R4
C19
C22
R45
R53
R63
R69
R79
D9
U15
L1
U4
C13
R23
R36
R46
R54
R64
D7
R80
D10
C36
C39
C6
C2
S3
C24
R62
FIL4
C8
C9
U1
R47
R55
D1
D8
DC1
U13
C42
S1
R1
R5
L2
C11
R21
C12
C16
Q1
R31
C25
R37
C27
D2
U11
C38
C40
C44
J6
FIL3
LimX
(c) 1999
Issue A4
C3
J1
S2
LimX
C4
J2

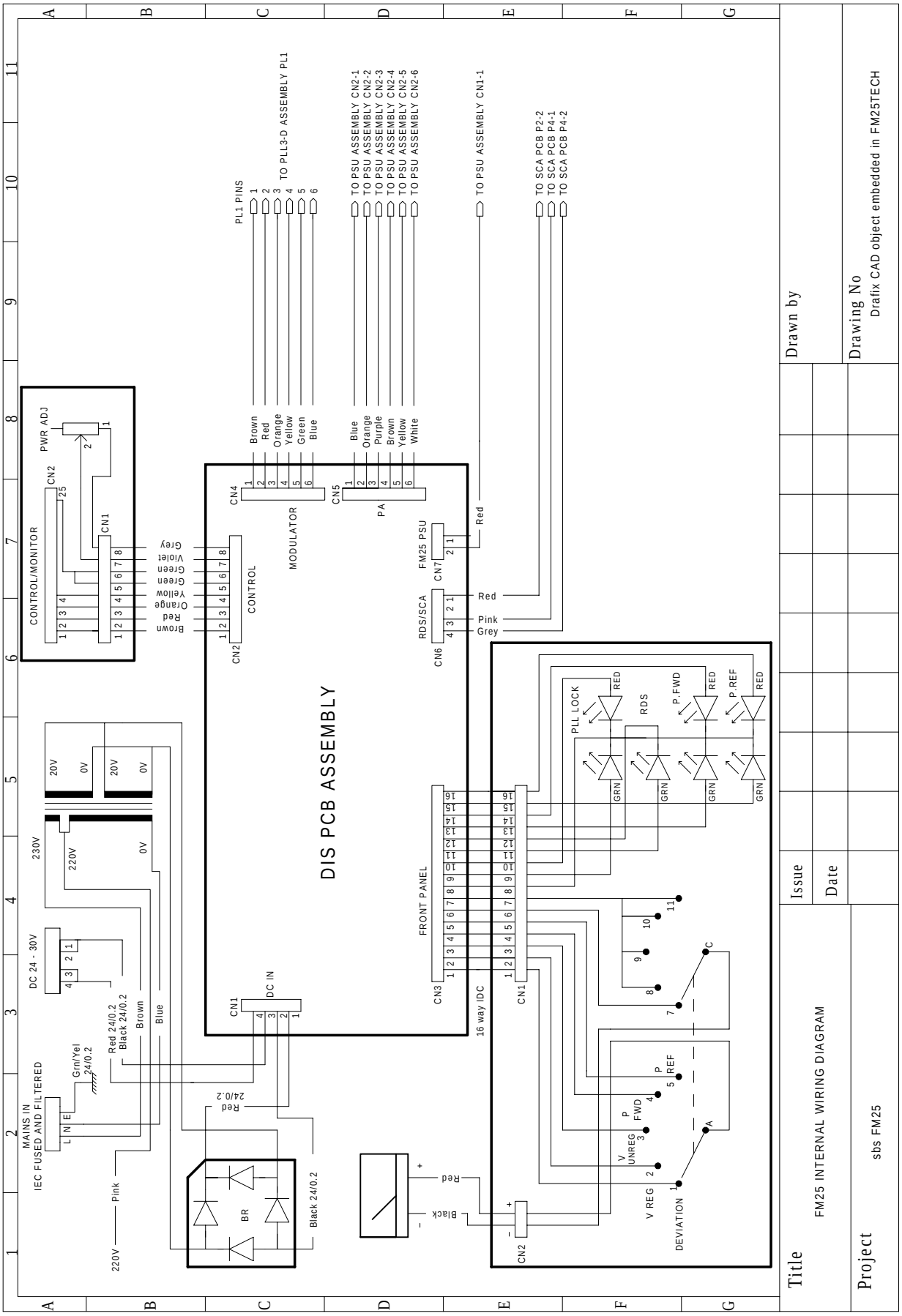
10.8 DLM3

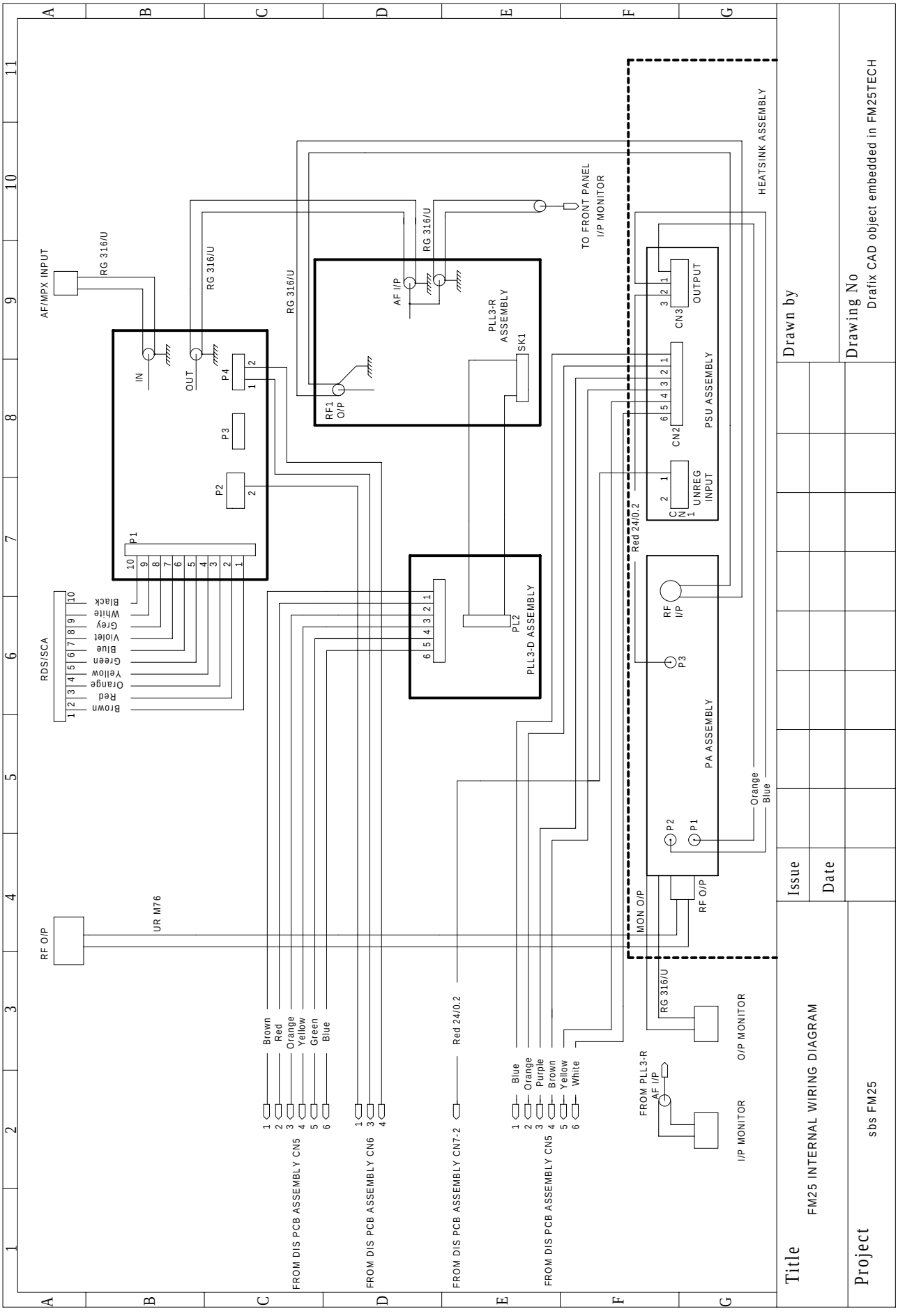

REVISION RECORD
LTR
ECO NO:
APPROVED:
DATE:
COMPANY: sbs
TITLE: DLM3
CODE:
SIZE: A1
DRAWING NO:
REV:
SCALE:
SHEET: OF
DRAWN: DBS
DATED: 05/01/99
CHECKED:
QUALITY CONTROL:
RELEASED:
MPX Out
MPX In
BNC-RA
JUMPER2PIN
NE5532
TL072CP
BC184L
BC214L
2N5457
SSM2017
LM7812CT
NMA1215S
BZX55C 7V5
XLR-F-RA
+15V
-15V
BIAS+
BIAS-


C3
J3
C4
R5
R6
R7
R8
R9
R10
R11
R12
U1
U2
R19
C9
R23
FIL1
R24
R25
R26
C13
Q3
C10
C11
R34
TP1
R33
C16
C17
R35
R36
C15
R40
R41
R42
R43
R44
R45
DLM3
(c) 1999
sbs
Issue A1
C18
C21
L1
C22
DC1
Q1
C5
C7
R13
R1
R2
R3
R4
C6
Q2
R14
R15
R16
R17
R18
U3
C8
FIL2
R20
R21
R22
R27
R28
R29
U4
R37
U5
R38
C14
R30
R31
R32
U6
C12
R39
D1
D2
D3
D4
D5
R46
R47
D6
C19
U7
C20
J4
1
S2
C1
J1
S1
DLM3
C2
J2

10.9 Power supply flow diagram




DIS PCB ASSEMBLY
CONTROL/MONITOR
PWR ADJ
CN1
CN2
CONTROL
MODULATOR
PA
CN4
CN5
FM25 PSU
CN7
RDS/SCA
CN6
FRONT PANEL
CN3
16 way IDC
CN1
DC IN
CN2
PLL LOCK
RDS
P.FWD
P.REF
RED
GRN
MAINS IN
IEC FUSED AND FILTERED
DC 24 - 30V
230V
220V
0V
20V
BR
Red 24/0.2
Black 24/0.2
Brown
Blue
Grn/Yel 24/0.2
Pink
PL1 PINS
TO PLL3-D ASSEMBLY PL1
TO PSU ASSEMBLY CN2-1
TO PSU ASSEMBLY CN2-2
TO PSU ASSEMBLY CN2-3
TO PSU ASSEMBLY CN2-4
TO PSU ASSEMBLY CN2-5
TO PSU ASSEMBLY CN2-6
TO PSU ASSEMBLY CN1-1
TO SCA PCB P2-2
TO SCA PCB P4-1
TO SCA PCB P4-2
Brown
Red
Orange
Yellow
Green
Blue
Purple
White
Grey
Violet
Pink
DEVIATION
V REG
V UNREG
P FWD
P REF
Drawn by
Drawing No
Drafix CAD object embedded in FM25TECH
Issue
Date
Title
FM25 INTERNAL WIRING DIAGRAM
Project
sbs FM25


AF/MPX INPUT
RG 316/U
IN
OUT
P4
P3
P2
P1
RDS/SCA
Brown
Red
Orange
Yellow
Green
Blue
Violet
Grey
White
Black
RF O/P
UR M76
RG 316/U
AF I/P
RF1 O/P
PLL3-R ASSEMBLY
SK1
PL2
PLL3-D ASSEMBLY
TO FRONT PANEL I/P MONITOR
HEATSINK ASSEMBLY
CN3
OUTPUT
CN2
PSU ASSEMBLY
CN1
UNREG INPUT
Red 24/0.2
RF I/P
PA ASSEMBLY
MON O/P
RF O/P
Orange
Blue
FROM DIS PCB ASSEMBLY CN5
FROM DIS PCB ASSEMBLY CN6
FROM DIS PCB ASSEMBLY CN7-2
FROM DIS PCB ASSEMBLY CN5
Purple
FROM PLL3-R AF I/P
O/P MONITOR
I/P MONITOR
Drawn by
Drawing No
Drafix CAD object embedded in FM25TECH
Issue
Date
Title
FM25 INTERNAL WIRING DIAGRAM
Project
sbs FM25

10.11 Safety components

The following items are classed as safety components. To ensure continued safety they should only be replaced with parts of identical type and electrical approval.

PART	APPROVAL
IEC free socket and cable assembly	Connector: BSI or VDE Cable: BASEC BS6500
Filtered IEC mains inlet	VDE, CSA or UL
Mains fuse	IEC127 or BS4265
Mains transformer	BS415 or IEC65, Insulation to VDE0550/1