FREDMAN2
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Version: RB-04

# FRED

O P E R A T I N G  I N S T R U C T I O N S

# G E N E R A L

The FRED tape deck is specially designed for playback and cut and splice editing of 1/4" magnetic tape.

The tape path is simple and it is easy to lace the tape.

A tape cutter is provided close to the playback head.

On the right side of the sloping front panel, a splicing block is provided for convenient tape splicing.

The tape transport operates without capstan motor and pinch roller. The tape transport is entirely controlled by the reel motors. Nominal tape speeds are 7½ and 15 ips (19.05 and 38.1 cm/s). The nominal speed can be continuously increased up to 3 times nominal speed.

The tape transport is fully logic and servo controlled. The push buttons can be operated in any sequence without any risk for damage.

The erase facility makes it possible to do fade-in and fade-outs. The erase fade time is adjustable between 50 milliseconds and 2 seconds.

Tapes can be monitored in mono over the built in loudspeaker or monitored in stereo with headphones connected. Headphone monitoring can be selected to stereo, track 1 or track 2. Loudspeaker monitoring can be selected to mono, track 1 or track 2.

The electronic tape timer displays hour, minutes and seconds correctly in relation to selected tape speed.

FRED is a complement to existing studio equipment and can in many situations replace a complete control room, which is then made free for more complex tasks.

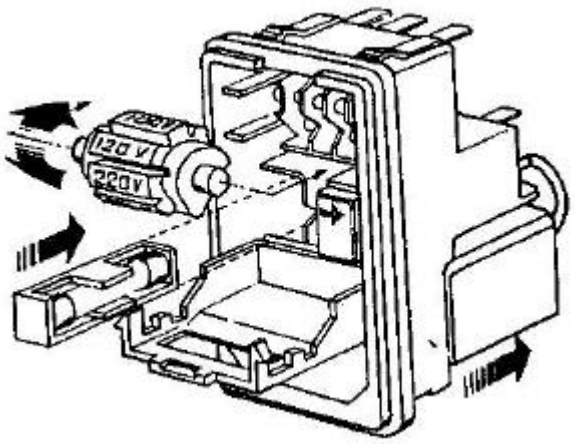
FRED is fully operational without any external equipment.

FRED is not bigger than a typewriter and just as easy to handle.

FRED is virtually foolproof and therefore perfect for non-technical operators. Even with severe mis-treatment, it is almost impossible to ruin a master tape.

## INSTALLATION

The mains power entry is located on the rear panel. Check that the voltage selector is set for the available mains voltage before power is connected.




Mains can be set to either 115 or 230 V. Remember to change the primary fuse to correct value after selection.

## VOLTAGE SELECTION

To change selected voltage; disconnect the power cord, open cover using a small blade screwdriver or similar tool. Insert tool into the voltage selection slot and rotate wheel to desired voltage. Replace the cover making sure the selected voltage appears in connector window.

Fuse values; 230 V = 1 A  115 V = 2 A

The mains power switch is located in the middle of the tape deck, between the reels. Switch power on.

This completes the installation and FRED is ready for operation.

Before you start using FRED, take the time to read the operating instructions and get familiar with your FRED.

## REEL SIZE

On the take-up side, always use a 10½" reel or other reel with a minimum of 4" (10 cm) inner core diameter. Smaller reels can be used but will have a negative influence on wow and flutter.

On the supply side, any reel size between 5" and 12" (12 to 30 cm) can be used.

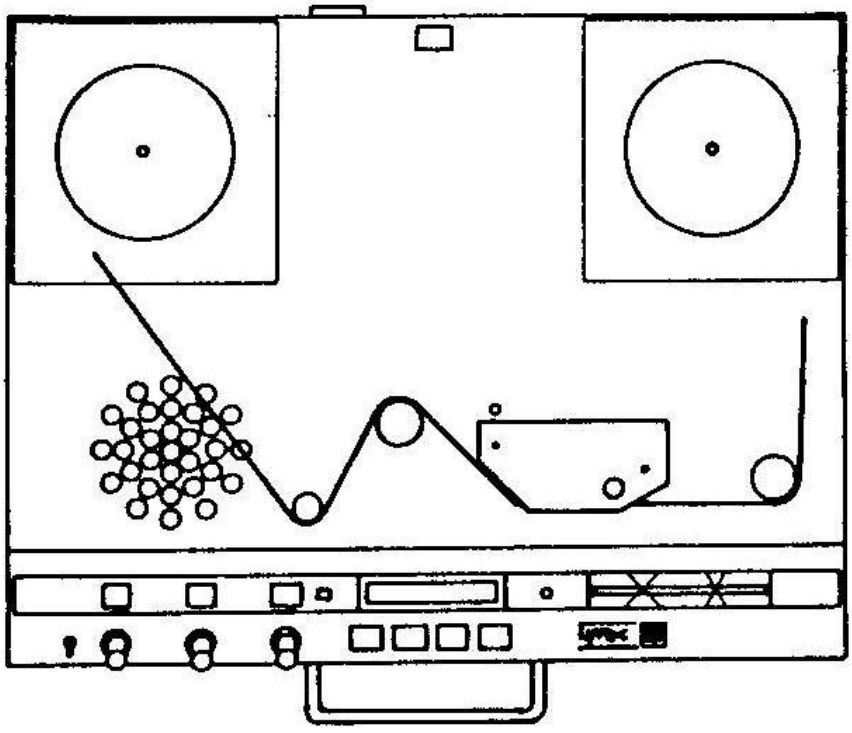
Tape tension is automatically controlled to correct value independent of reel sizes.

## REEL TYPES

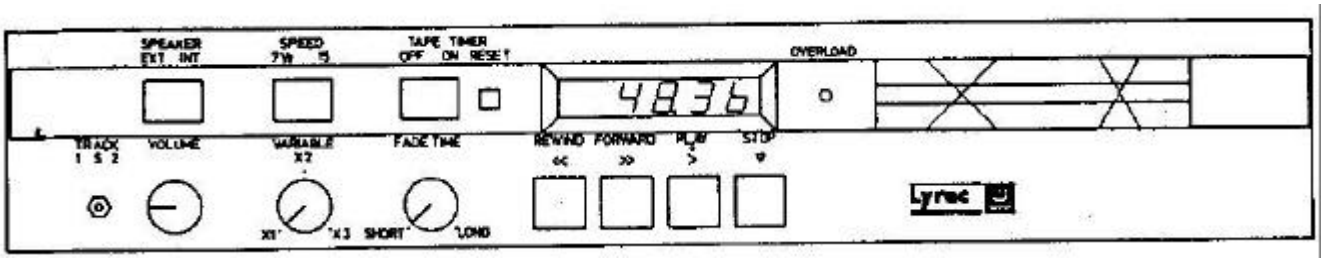
The reel platforms accepts CINE type reels. Adapters are available for both NAB and DIN/AEG type reels.

## LOADING TAPE

Thread the tape as shown below.



FRONT PANEL CONTROLS




NOMINAL TAPE SPEED

The SPEED selector can be set to either 7½ or 15 ips nominal tape speed.

NOTE: For correct play speed, the varispeed potentiometer must be turned fully c
counter clockwise (x1).

VARIABLE TAPE SPEED

With the potentiometer VARIABLE, the tape speed can be continuously increased up to 3 times the selected nominal speed.

WIND SPEED

In wind and rewind modes, the speed is internally limited to approx 200 ips (530 cm/s). The wind speed is not influenced by the varispeed control.

TAPE TIMER

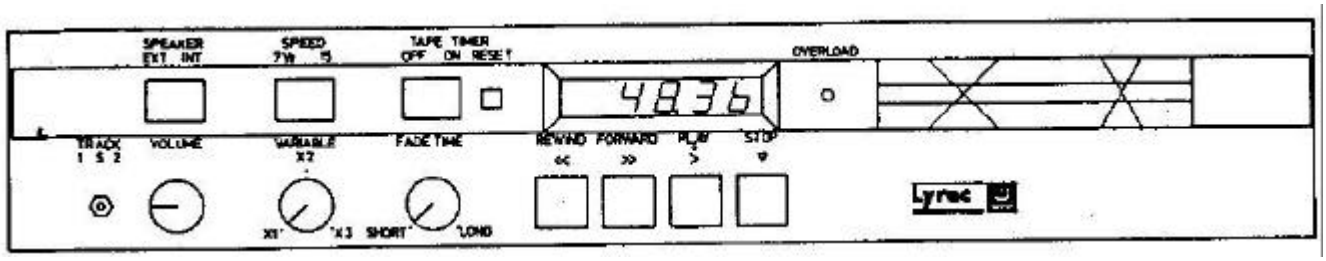
The electronic tape timer has a maximum reading of +/- 1 hour, 59 minutes and 59 seconds. The tape timer displays correct reading in relation to selected tape speed.

When rewinding through zero, the tape timer counts positive but with a negative prefix (-) to allow timing of programme in rewind mode.

At tape end, the timer stops, although the timer roller continues to rotate.

RESET

With the red RESET button, the tape timer can at any time be reset to zero reading.




TAPE TIMER OFF/ON

With the rocker switch ON/OFF the tape timer can be switched ON or OFF.

In the normal ON mode the tape timer counts the elapsed playtime continuously.

In OFF mode the tape timer display is 'frozen' and the display flashes as a reminder. The OFF mode is used when tape is manually pulled out and dumped. After splicing the timer can then be switched back to ON mode and the total programme time is shown correctly in the display.

TIMER TRIM

By manually turning the tacho idler roller it is possible to 'TRIM' the timer display.

1 second corresponds to 4 turns at 15 ips.
1 second corresponds to 2 turns at 7½ ips.

Trimming can only be done when the tape is properly loaded for normal play mode and the timer is in ON mode.

TAPE TRANSPORT COMMANDS

Four pushbuttons are provided for the operation of the tape transport;

STOP PLAY REWIND FORWARD

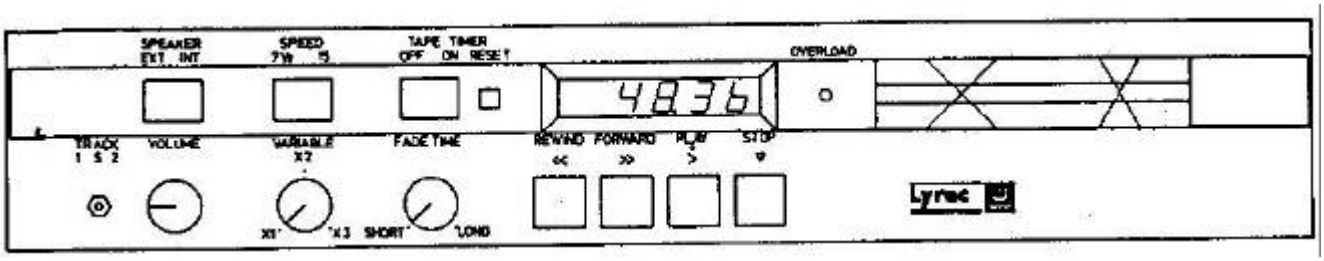
To eliminate any risk for faults if several buttons are depressed simultaneously, the logic only accepts commands according to a pre-programmed order of priority.

PLAY has top priority, followed by WIND, REWIND and lowest priority for STOP.

If two or more buttons are simultaneously depressed, the function with the highest priority will decide.

The pushbuttons can be operated in any sequence without going through STOP, for example WIND directly followed by a PLAY command.

When power is switched on FRED will wake up in STOP mode and with the tape timer set to zero.




IF THE TAPE IS NOT PROPERLY LOADED

If the tape is not properly loaded and positioned in the tape path in front of the left tape presence opto sensor, the tape transport will not accept commands in the normal way.

If the tape is laced loosely and ANY push button is depressed, the take-up reel will start to slowly absorb the slack. When the tape is placed properly, the selected function will be activated.

NOTE: It is necessary to keep the push-button depressed until the tape enters the selected function.

WARNING: Make sure the tape is properly fixed to the take-up reel. If not, the take-up motor will start to spin and might - in worst case - tear off the tape.

TAPE END AUTO STOP

When the tape comes to the end, either in PLAY or WIND mode, the automatic tape-end stop is activated. Simultaneously the tape timer stops and the mechanical parking brakes are activated.

The tape-end stop is activated by the optical sensor located to the left of the erase head.

PLAYBACK MONITORING

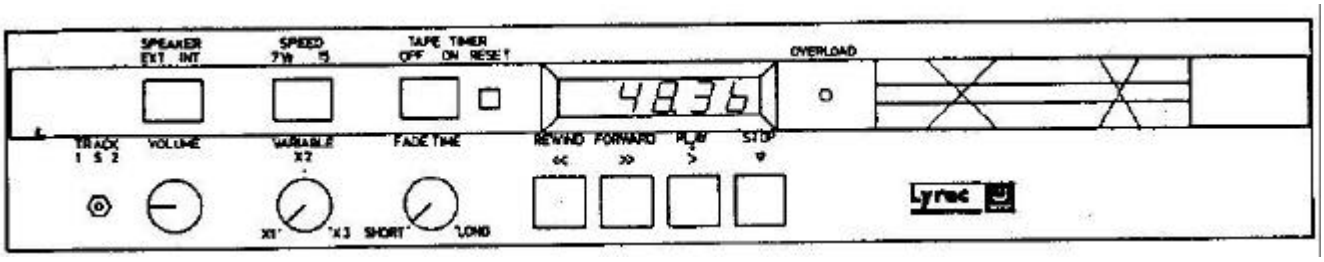
FRED is equipped with a 2-track playback head connected to a stereo playback amplifier followed by a mono loudspeaker amplifier.

If no headphone is connected, the signal is automatically routed to the built-in loudspeaker which will reproduce the tape in mono. The loudspeaker amplifier is equalised to give maximum clarity with the small built-in speaker.

1-S-2 TRACK SELECTOR

With the track selector it is possible to select the monitoring to be either track 1, track 2 or stereo over the headphone output.

For the loudspeaker (internal or external) the selection is track 1, track 2 or mono.




EXTERNAL SPEAKER

An external speaker can be connected and powered from the speaker socket on the lower front panel. The rocker switch EXT/INT SPEAKER shall then be in position EXT. In the EXT mode the frequency response is flat.

HEADPHONES

Headphones are connected at the 1/4" stereo socket on the lower front panel. When connected, the headphones automatically disconnects the loudspeaker (internal or external).

VOLUME

The VOLUME control sets the monitoring level for either the loud speaker or headphones.

ERASING

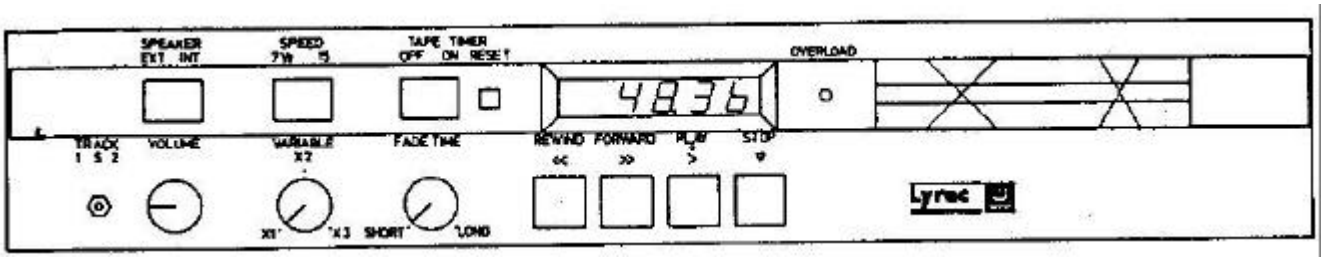
FRED is equipped with an erase facility which makes it possible to fade in and fade out direct on the tape being edited.

The erase head is placed 33 mm to the left of the playback head, corresponding to a time difference of 90 mS at 15 ips.

The switch activating the erase function is deliberately placed somewhat hidden behind the head block to avoid accidental erasure.

The erase switch has three positions;

SAFE  Toggle switch towards head block.
READY  Toggle switch in centre position.
ERASE  Toggle switch towards back panel.




In SAFE position the erase head is galvanically short circuited. This guarantees that no unwanted erasing can take place, even if there is a fault in the electronics.

In READY position the erase head is connected to the erase circuit and ready to be activated.

In ERASE position (spring loaded) erasing goes on as long as the switch is held in ERASE position.

Clicks do not appear on the tape when erasing is activated/de activated.

## ERASE FADING TIME

With the FADE TIME potentiometer, the fade-in/fade-out time can be varied between SHORT and LONG. The fading time range is from 50 milliseconds to 2 seconds.

NOTE; It is 'easier' to erase high frequencies than low frequencies. With long fade times it can sometimes be noticed that the treble disappears before the low frequencies.

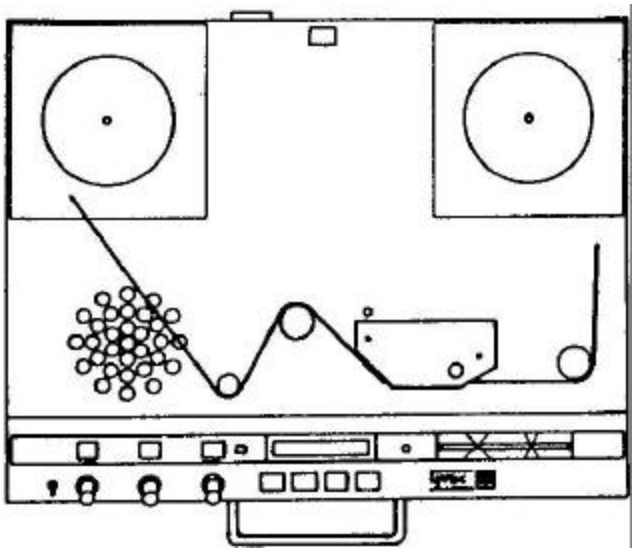
## OVERLOAD

An electronic fuse protects FRED against faulty handling.

If the rotation of a reel is manually blocked in play or wind mode, or if a reel is allowed to spin freely for more than 25 seconds, the electronic OVERLOAD fuse is triggered and cuts the power to the reel motors. At the same time the OVERLOAD indicator lights up.

In OVERLOAD mode the tape deck becomes completely inoperative and a slight hum is heard from the loudspeaker. The number in the tape timer display remains unaffected.

To reset the tape deck after an OVERLOAD, press STOP and wait for the OVERLOAD warning to disappear.



T A P E  D E C K

TAPE GUIDE ROLLERS

The first tape guide roller in the tape path is spring loaded and will absorb excentrities in the supply reel.

The second roller is the tacho idler that is equipped with an optical system for speed control and tape timing.

The third roller is the take up idler which gives the proper tape path for either play or edit modes.

TAPE CUTTER

A mechanical tape cutter is mounted 30 mm after the playback head (corresponding to 0.08 sec at 15 ips). The tape cutter is activated by pressing the knob on the head block.

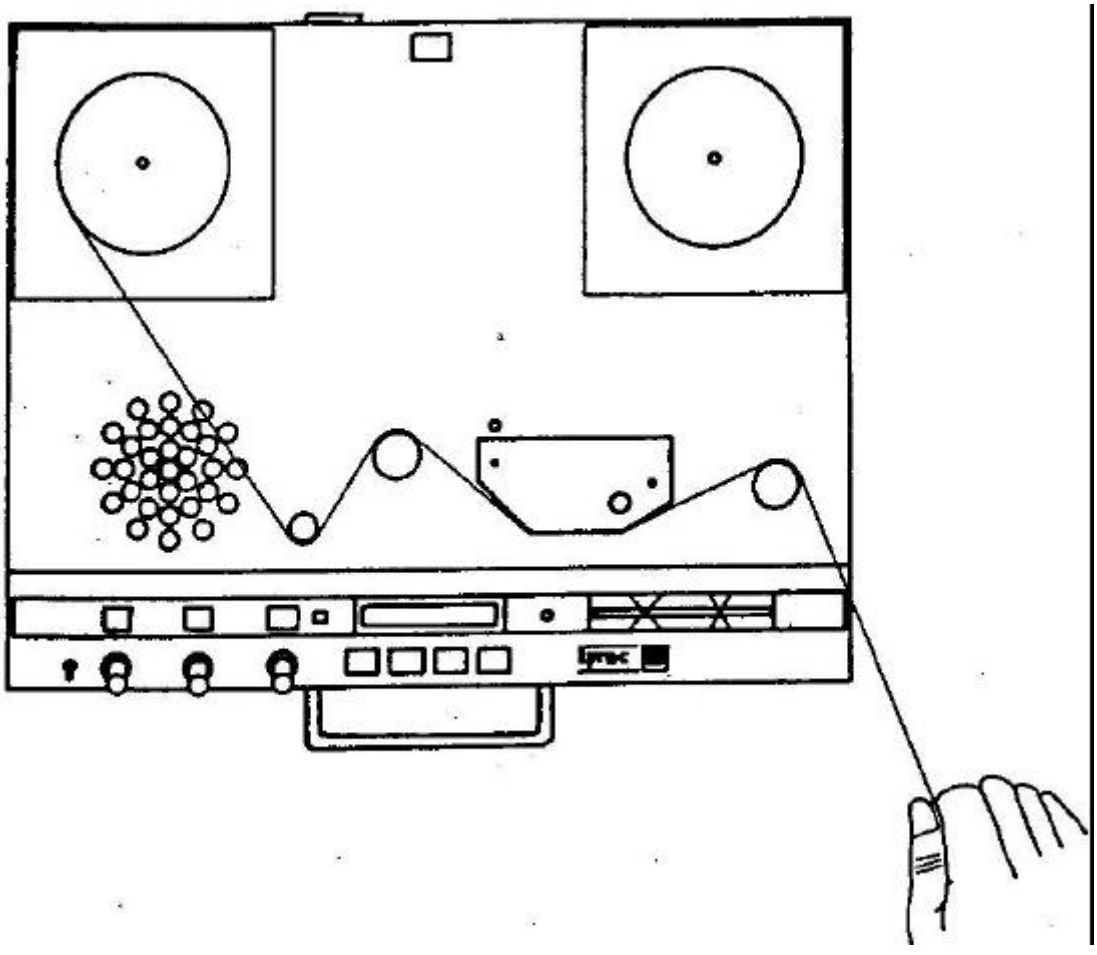
EDITING

For normal play, the tape is laced according to the unbroken line printed on the tape deck, i.e. around the take up idler.

For editing the tape is laced according to the dotted line printed on the tape deck, i.e. behind the take up idler.

EDIT mode is sensed by the optical edit sensor and;

Supply motor is activated to give back tension.
Take up motor is deactivated.
Tape timer is deactivated.
All tape transport controls are deactivated.



When the tape is laced behind the take-up roller it can be pulled out by hand in order to locate the next cutting point.

In EDIT mode, the tape can - with one hand - be moved backwards and forwards with tape tension on the supply motor to keep the tape-to-head contact.

When a cut is made, tape tension is immediately released and the parking brakes are activated.

As FRED operates without conventional capstan and pinchroller it is not possible to dump tape. Longer pieces of tape has to be wound onto a waste reel, preferably with the tape timer in position OFF.

## SPLICING BLOCK

A splicing block is located on the right side of the sloping front panel, conveniently close to the tape cutter.

## DUMP MODE KIT (OPTIONAL)

### GENERAL DESCRIPTION, HARDWARE

In order to achieve a dump mode facility for the FRED editing tape deck, a kit has been made available that can either be factory installed or retrofitted to existing machines.

The dump mode kit consists of a motorised pinchroller fitted in a compact aluminium housing and connected to the tape deck through a standard 1/4" plug that positions the pinchroller and supplies the necessary voltage.

The dump mode kit is plugged into a 1/4" socket mounted on the tape deck and located close to the take up side guide roller.

Internally there is connection between the 1/4" socket and the logic board. The circuit board interfaces to the logic and controls the speed of the pinchroller.

When the dump mode kit has been installed the maximum reel size on the take up side is limited to 10,5".

### INSTALLATION.

Once the hardware has been installed the operation is easy.

Insert the motorised pinchroller module in the socket on the tape deck. This completes the installation.

### OPERATION.

When the dump kit is pulled out ALL functions remain as described in the operating instructions.

When the dump kit is plugged in a few changes in the logic are introduced.

In normal PLAY mode all functions remain as described in the operating instructions.

To DUMP tape, lace the tape behind the take up roller and press PLAY. This will release the edit back-tension.

Press the motorised pinchroller lightly against the take up roller. This will activate the built in micro switch and the dump motor will start.

NOTE: If the machine is left for approx. 30 seconds with tape laced for dump and PLAY has been pressed the OVERLOAD is released. If this happens, press STOP to reset and continue work.

DUMP mode is cancelled by pressing STOP. DUMP mode will also be cancelled the moment the tape is removed from the left opto sensor.

DUMP SPEED follows the selected nominal tape speed AND the vari speed setting up to maximum 30 ips (approx.).

Pressing FAST FORWARD will set the dump speed to maximum (30 ips) and activate the tape lifter.

In EDIT mode it is possible to press REWIND and quickly rewind tape from the floor. It is necessary to give back tension by holding the tape by hand.

## TAKING CARE OF YOUR FRED

FRED is designed to give long and trouble free operation. FRED does not require any lubrication and has very few internal adjustments.

You are recommended to clean the tape deck with a damp cloth regularly and keep it free of splicing tape. Check that the two opto sensors in the head block are free from dust, if not, unwanted stops might occur, particularly with tapes that have poor reflex characteristics. The opto sensors can be cleaned with a small soft brush.

Do not use the tape deck as a storage place for tapes, books etc.

Be careful to protect all tape guides rollers when you carry FRED. For travel, the optional fibre glass flight case is recommended.

NOTE; FRED is primarily designed and intended to be a practical and portable tool for playback and editing of 1/4" tape. Simple tape path and easy handling together with a large speed range is obtained with the pinch roller less tape transport. The take up motor is servo controlled to give correct tape speed. This type of tape transport has more wow & flutter than conventional capstan system. The user should bear this in mind and use FRED for its intended purpose.

# THEORY OF OPERATION

The tape deck logic board, drw 2922 - pcb 8501 REV 7 performs most of the control functions in the FRED editing tape deck.

Information is received from 7 optical transducers, 5 pushbuttons, 2 rocker switches and 1 potentiometer.

No relays or micro switches are used in the tape deck.

The following pages is a technical description of the various functions and logical sequences.

## POWER ON RESET

When power is switched on, the internal circuit in IC4 sets the unit to STOP. The tape timer is reset to zero by R17 - C9 at IC7-2. After about 0.5 seconds, C9 has charged to "high" and IC7-3 goes "low", enabling the timer to work.

## GETTING THE TAPE TO MOVE

If PLAY is depressed, IC4-14 goes high, resulting in IC4-1 goes high. This signal is sent to the priority encoder IC3-1.

IC3 is used to select the function with the highest priority if more than one button is depressed at the same time. The priority order is (from the highest to the lowest) PLAY, -->>, <<-- and STOP.

If both PLAY and -->> is depressed at the same time, the PLAY command has priority and is accepted and -->> is rejected as it has lower priority.

The output at IC3 has the following code for the different modes;

| | IC3-6 | IC3-7 | IC3-9 | IC3-14 | IC3-15 |
|---|---|---|---|---|---|
| PLAY | 1 | 0 | 0 | 1 | 0 |
| -->> | 0 | 1 | 0 | 1 | 0 |
| <<-- | 0 | 0 | 1 | 1 | 0 |
| STOP | 0 | 0 | 0 | 0 | 0 |

The signals sent from IC3 are sent to another priority encoder, IC16, which adds further priority to the control signals before they reach the motors and brakes. The input of IC16 have the following order of priority (from highest to lowest);

| IC16 pin no | Function |
|---|---|
| 4 | Electrical braking at PLAY or -->>. |
| 3 | Electrical braking at <<--. |
| 2 | Inhibits electrical braking at end of tape. |
| 1 | PLAY mode. |
| 13 | -->> mode. |
| 12 | <<-- mode. |
| 11 | EDIT mode. |
| 10 | Not used. |

The outputs of IC16 form a 3-bit binary code which is used to control the analogue electronic switches, IC13 (for supply motor) and IC14 (for take-up motor).

The table below shows the IC16 output code at various conditions;

| IC16 pin no | 9 | 7 | 6 | 14 | 15 | IC13/14 pin active |
|---|---|---|---|---|---|---|
| STOP | 0 | 0 | 0 | 0 | 1 | 13 |
| PLAY | 0 | 0 | 1 | 1 | 0 | 1 |
| -->> | 1 | 1 | 0 | 1 | 0 | 12 |
| <<-- | 0 | 1 | 0 | 1 | 0 | 15 |
| El. braking -> | 1 | 1 | 1 | 1 | 0 | 4 |
| El. braking <- | 0 | 1 | 1 | 1 | 0 | 2 |
| EDIT | 1 | 0 | 0 | 1 | 0 | 14 |

Suitable DC-signals are routed to the IC13/14 pins, which are selected through the binary code and exits at pin 3 from the tape deck logic pcb and reaches the pcb 8505 power supply unit.

These signals are in the range from 0 to +5 V dc, depending on the actual function.

On the pcb 8505 power supply unit the signals are converted into constant current for feeding the supply and take-up motors. A 1  V dc signal corresponds to 1 A motor current.

## TAPE SPEED CONTROL SERVO

The FRED tape drive is designed without capstan and pinchroller. The tape speed is controlled by a servo system.

The centre idler roller rotates with the tape and is equipped with a optical tacho disc mounted on the idler roller shaft. The tacho disc  gives 250 pulses per revolution. The diameter of the idler roller is designed to give exactly 4 revolutions per 15 inches of tape passing the roller. With 250 pulses/rev this gives 1000 pulses/15 inches.

To achieve 15 ips tape speed it is obvious that the tacho output must be 1000 Hz. The tacho sensor (pcb 94038X) contains some signal conditioning components in order to get a 5  Vp-p square wave, which is sent to the tape deck logic pcb 8501 and enters at pin 4a which is connected to IC12-4.

IC12 is a precision double monostable multivibrator whose first half is used to convert the tacho frequency to an analogue DC voltage for later comparison with a reference voltage, resulting in an error voltage which is sent to IC14-1. From IC14-3 the signal reaches the pcb 8505 power supply unit, driving the take-up motor.

The monostable IC12 gets its reference from the preset potentiometers POT1 (15 ips) or POT2 (7.5 ips). The varispeed potentiometer is also included in this circuit.

In PLAY mode a current is developed going out of IC2-6 through R39 via pin 15c to the arm of the varispeed potentiometer, which in position X1 is in direct connection with pin 14c (the CCW end).

Pin 15a (the CW end) is connected via POT1, R79, IC15 and T7 to ground (at 7.5 ips). The small voltage developed across R39 creates a voltage at IC2-7, controlling the current generator IC2-8 and T3. The capacitors C6 and C40 in parallel are the timing capacitors for play speed. In wind and rewind modes T13 is switched off and the wind speed limit is then controlled by C6 only.

IC1-1 is an active low pass filter, removing the ripple in order to be able to compare the DC level within narrow tolerances.

IC1-6 is the error amplifier inverting input to which the filtered output from IC1-1 is connected. Comparison with the reference at IC1-5 gives the resulting amplified error signal which is routed to IC14-1.

Low tape speed corresponds to low voltage at IC1-1, making IC1-7 go high increasing the current drive to the take-up motor.

To increase the tape speed, the current generator T3 is simply adjusted for a higher current. This happens if for instance the varispeed control is turned clockwise.

As the potentiometer wiper moves towards a lower DC level, a higher current is developed over R39, giving a higher current in T3 which in turn results in shorter pulses at the output of IC12-6. This means a lower mean value of the filtered DC level at IC1-1. Then IC1-7 gives a higher output voltage, thereby trying to increase the tape speed until the new speed is reached.

IC1-8 is the output of the "SPEED TOO HIGH" detector. At correct or too low speed this output is high, but if the actual tape speed is more than 10 % higher than it should, the IC1-8 goes low, thereby making IC33-6 low enabling the electrical braking.

In -->> or <<-- the servo reference speed is set to about 300 ips due to the current developed in R38 when IC33-14 goes low. Further, T13 is switched off enabling only C6 to control the one shot timing circuit. Note that there is no real servo speed control in -->> and <<--, but the servo signals are used to control when back-tension shall be applied.

The motor that at the moment takes up tape in -->> and <<-- runs at the maximum available current, which is about 6 A at stand still and decreases to about 3 A when the reel speed increases.

The output from the tape deck logic board to the motor that takes up tape is 5 Vdc which corresponds to 5 A motor current in play mode. In forward and rewind higher currents are available.

## AUTOMATIC TAPE TENSION CONTROL

The tape tension is fully automatic and self adjusting, giving correct tape tension for supply reels ranging from 5" to 12".

Note: That only 10.5" or 12" reels are allowed at the take-up side, otherwise increased wow & flutter will be the result. Ignoring this, smaller reels may be used also on the take-up side.

FRED operates without any tape tension sensing arms. Instead, the tape tension is calculated from the signals received from different optical sensors in the machine.

As mentioned earlier, a tacho disc is used to sense the tape speed. The supply and take-up motors have also been equipped each with one optical sensor.

A black and white optical strip has been placed around the circumference of the lower part of the brake drums giving 100 black and 100 white markings per revolution. An IR reflective sensor is used to retrieve the movement of the motors.

The principle of calculating the tape tension needed is to sample how many pulses

that has been received from the tape speed tacho disc when 32 pulses have elapsed from the supply reel (if in PLAY or -->> mode). This is the same as the ratio between the tacho disc and reel rotation. A high value means high back tension current is needed.

In <<-- mode the tape tension is calculated the same way but now it is the ratio between the tacho disc and take-up reel that is of interest. The circuit is then simply switched to the take-up reel sensor instead.

Besides taking the tape speed tacho signal at pin 4a to IC12-4, it is also routed to IC26-14, a frequency divider connected to reset after 7 received pulses. This is a pre-divider connected to IC25, a binary counter with its 4 outputs connected to a 4-bit latch, IC24.

The pulses from the actual reel motor are selected in IC15-15 and fed to IC27, the reel frequency divider which is connected to count to 32. Every time 32 pulses have been counted a negative pulse is received by IC17-11 resulting in a positive pulse from IC17-10.

This pulse clocks the latch IC24 in order to store the contents of IC25. After a short delay via R83, IC27 is reset and ready to start counting another 32 pulses from the reel.

The output from latch IC24 (4-bit binary code) is connected to a resistor combination R73 - R76 making a simple D/A converter. The DC voltage at the common points of R73 - R76 is directly proportional to the reel back tension needed. This signal is fed to IC15-14 through which the tension signal is sent to IC2-3 or IC2-12 depending on the tape movement direction.

After IC2-1 and IC2-14 the signal value is divided so it will be suitable for the different values needed for play, braking, fast wind and edit. Via IC13 and IC14 respectively, the signals reach the reel motor drive circuits consisting of a current generator for each reel motor and placed on the 8505 pcb power supply unit.

## TAPE TIMER

Two additional optical sensors are mounted on the 94038X pcb (Tacho sensor, tape speed & tape timer) unit. These are used for sensing direction and rotation of the tacho disc for timing purposes. The direction information is also necessary for the tape control logic to know how to brake the reels.

The two opto sensors are mounted at some angular offset from each other in order to get a 2-phase signal for determining the direction of tape travel. The signals are connected to the tape deck logic pcb 8501 at pins 4c and 5a.

The data at IC29-5 is clocked into IC29 by clock pulses at IC29-3 occurring every time a change in the level at pin 5a is detected. The IC29-1 output gives the direction of tape travel (1 = forward, 0 = rewind).

IC30 is a prescaler which divides the input frequency by 8. If 15 ips is selected a further division by 2 is accomplished by the IC7-4 signal that defeats every other clock pulse.

If pin 16a is low (timer off) a 2 Hz a-stable in IC20 starts generating a square wave whose positive half periods are injected via D11 to IC8-23 (display off input), giving a flashing display to remind the operator that the counter is off.

There are two other cases that can make the tape timer stop; end of tape and edit. In all cases IC11-9 goes high inhibiting count pulses to go out of IC21-4.

## OVERLOAD CONTROL

If the reels are blocked for a longer time (more than 25 seconds) a protection circuit will break the power to the reel motors.

IC17-9 is a speed sense input which goes high when sufficient speed is reached. This speed value is different depending on if play or fast mode is selected. As a rule, about 70-80 % of nominal speed is needed for IC17-9 to be accepted as high.

At start of tape travel IC17-9 is low, therefore IC17-8 is high making T2 and T5 to conduct, setting the tape back-tension to zero during this start-up period, in order to speed up the tape to the desired speed. When speed is about to reach correct value, IC17-8 goes low opening T2 and T5 so that tape back-tension is applied.

However, during this start-up period IC17-6 is low = IC23-6 low and as IC23-5 already is low, IC23-4 will be high = IC23-12 high and therefore IC23-11 will be low T11 is off, enabling C13 to charge via R20.

After about 25 seconds IC10-12 has reached about 2.5 V and triggers the overload flip-flop so that IC10-10 goes high. Then T6 will go off, disconnecting the drive signal to the two thyristors on the pcb 8505 power supply unit. This terminates the power to the motors. Pin 10c turns the overload driver transistor, on motherboard 8502, on so the overload LED goes on.

Note that during electric braking no overload condition is detected. It is only the acceleration time that is measured. Therefore, using the <<-- and -->> buttons to let the tape run back and forth can not cause an overload condition.

Reset of the overload condition is made by depressing STOP. Then IC23-9 goes low and as IC23-8 already is low, IC23-10 will go high making IC10-11 high and thereby resetting IC10-10 to low. This makes T6 to conduct again and the overload LED to go out. The thyristors starts to conduct again giving power to the motors.

## TAPE LIFT CIRCUIT AND ELECTRICAL BRAKING

At -->> and <<-- IC33-15 goes high setting the bi-stable IC10-9 output high. This output is fed to pin 30c and reaches via mother board 8502 the power supply unit 8505. Here T3 will start conducting and the tape lifter go out, dis-engaging the tape from the heads.

If for example PLAY is depressed, IC10-9 still will remain high. IC33-14 goes high removing the current in R38 (which sets the servo reference speed at -->> and <<--). Then, as the tape speed still is much too high compared to the selected play speed, IC1-8 will be low, which in turn enables electric braking via R9, IC33-6, IC33-10, IC 22-5, IC22-6, IC22-11 and 8, and depending on direction of tape travel results in that IC22-9 will go high if the tape moves forward, or IC22-10 will go high if the tape moves in reverse direction.

When the tape speed has been reduced so that it is only about 10 % higher than the selected speed, IC1-8 goes high again ending the electric braking command at IC33-6 and also resetting the bi-stable IC 10-9 to low, and the tape lifter will return so the tape comes in contact with the heads. The tape now runs at play speed. The end of braking and tape lift resetting always occurs at about +10 % of selected tape speed regardless of if it is 7.5 or 45 ips.

## TAPE STAND STILL DETECTOR

The tacho signal at pin 4a is also routed to IC17-1. The output at IC17-2 is driving a diode pump. If the tape is moving, the diode pump output at IC17-4 is high. If the tape speed is less than about 2.5 ips IC17-4 goes low making IC11-5 low and IC11-6 high and IC10-3 high resetting the bi-stable IC10-2 output to low. In this way the electric braking is ended when STOP is selected and the mechanical brakes are engaged.

No mechanical braking takes place until the tape has stopped completely. Thus the wear on the mechanical brakes are very low, as they only are used as parking brakes.

## END OF TAPE DETECTOR

An IR reflective sensor is used to detect if the tape is in the tape path. It is placed to the left of the erase head, at a distance of about 3 mm from the emulsion side of the tape. The sensor is independent of surrounding ambient light because it uses pulsed IR light.

On the motherboard 8502, IC1-6 is the output of an a-stable multivibrator running at about 180 Hz, giving 0.5 mS negative pulses driving T4. Via R17 75 mA pulses are sent to the (series connected) IR-emitters of the end of tape and edit reflective sensors.

The receiver side of the end of tape sensor is connected to the T5 preamplifier. 5 Vp-p pulses are sent to IC1-1 whose output carries the amplified 0.5 mS pulses. These pulses are stored in C6 until the next pulse occurs. Therefore IC1-8 is at a constant high level as long as repetitive pulses are received from the magnetic tape surface. If the tape is removed from the tape path, the pulses at IC1-1 will disappear, C6 charges to 5 V and IC1-8 goes low. This information is sent to the tape deck logic board 8501, pin 23c.

## EDIT DETECTOR

The edit detector has identical function as the end of tape detector. T6 is the preamplifier, IC1-13 the input and IC1-10 the output of the pulse detector, connected to pin 23a on the tape deck logic pcb.

## POWER SUPPLY

The two secondary windings of the mains transformer are connected in series, driving a full wave rectifier consisting of the two diodes D6 and D7 and the two thyristors TH1 and TH2.

TH1 and TH2 are fed with an ignition current coming from T6 via R24 on the tape deck logic pcb. If no overload condition is present this combination acts exactly like an ordinary four diode full wave rectifier.

The voltage at the C4 filter capacitor is typically 19 Vdc at stop condition. On the centre tap of the transformer the C5 filter capacitor is connected. Here the voltage is about 9.5 Vdc at stop condition. This voltage is used to feed the reel motors. The voltage at C4 is used to get stabilised voltages for the logic and audio circuits.

## OVERLOAD CONDITION

If an overload is detected by the tape deck logic pcb, the drive current coming from T6 via R24 on the tape deck logic pcb is interrupted. Then the thyristors TH1 and TH2 do not get any ignition current.

Now the diodes D6 and D7 will act like a push-pull rectifier and the centre tap of the transformer will bias D8 and resulting in a -0.7 Vdc potential at the transformer centre tap. The voltage at C4 is now only 9.5 Vdc, sufficient to drive the logic with 5 Vdc stabilised voltage. In this way the positive supply to the motors is removed. When the STOP button is depressed the thyristor drive comes on again and the voltages are rising to their normal values.

## MOTOR DRIVE CIRCUIT

The supply motor drive will be discussed here, the take-up drive is identical.

The control signal from the tape deck logic board 8501 enters the power supply pcb 8505 at pin 2.

The signal level here is: 0 V = no drive
+5 V = full drive

IC1A and T5, T1 forms a current generator driving the motor. R5 is a current sense resistor over which a voltage of 0.1 V/A is developed. This voltage is connected to the inverting input of IC1A via R4. R4 is only needed to increase the impedance at the op-amp input to enable high frequency feedback from C6 to avoid high frequency parasitic oscillations.

Therefore the feedback voltage at IC1-2 is still 0.1 V/A. R1 and R2 makes a voltage divider lowering the control voltage range from the tape deck logic pcb to 0 - +0.45 V in play mode. In fast forward and rewind T7 is switched off and thus connecting R29 in series with R2. The voltage dividing will therefore be 1:2.8 instead of 1:11 (play mode).

If, for instance, the control voltage at pcb 8505 pin 2 is 2.5 V this is divided by R1 and R2 to 0.227 V. This is injected at IC1-3, the non-inverting input of the op-amp. Now the output IC1-1 will rise and T5, T1 begin to conduct. Current will begin to flow from +9.5 V supply via the motor and T1 through R5 to ground.

The current flow will cause a voltage over R5 which is sent back to the inverting input of IC1A. When the voltage over R5 has increased to 0.227 V, the IC1A is in balance.

Now it can be seen that as the voltage over R5 is 0.227 V and the resistance is 0.1 ohms, the motor current must be 2.27 A. The current generator range will be 0 to 4.5 A for a 0 to +5 V signal from the tape deck logic pcb.

## DUMP MODE

The dump circuit consist of a power transistor, T12, to drive the dump kit motor and an error amplifier IC18, and 2 nand gates to control the logic. From IC1-7 the play drive signal, which is obtained from the normal tacho system, is routed to the error amplifier IC18-3 (non inverting input) which controls the output transistor T12. From the emitter of T12, which connects to the motor, a voltage feed back is routed through a voltage divider, R86/R56, to IC18-2 (inverting input) and thus closing the servo loop. If a dump kit is present, J2-2 is pulled low, disabling the normal edit circuit and enabling the dump circuit by setting IC6-3 low and releasing the feed back input of the error amplifier.

When entering stop mode T10 is turned on, discharging C25 to obtain a quick stop.

APPLICATION NOTE

LOUDSPEAKER FREQUENCY RESPONSE.

The amplifier driving the internal loudspeaker has a built-in equalisation in order to achieve maximum clarity.

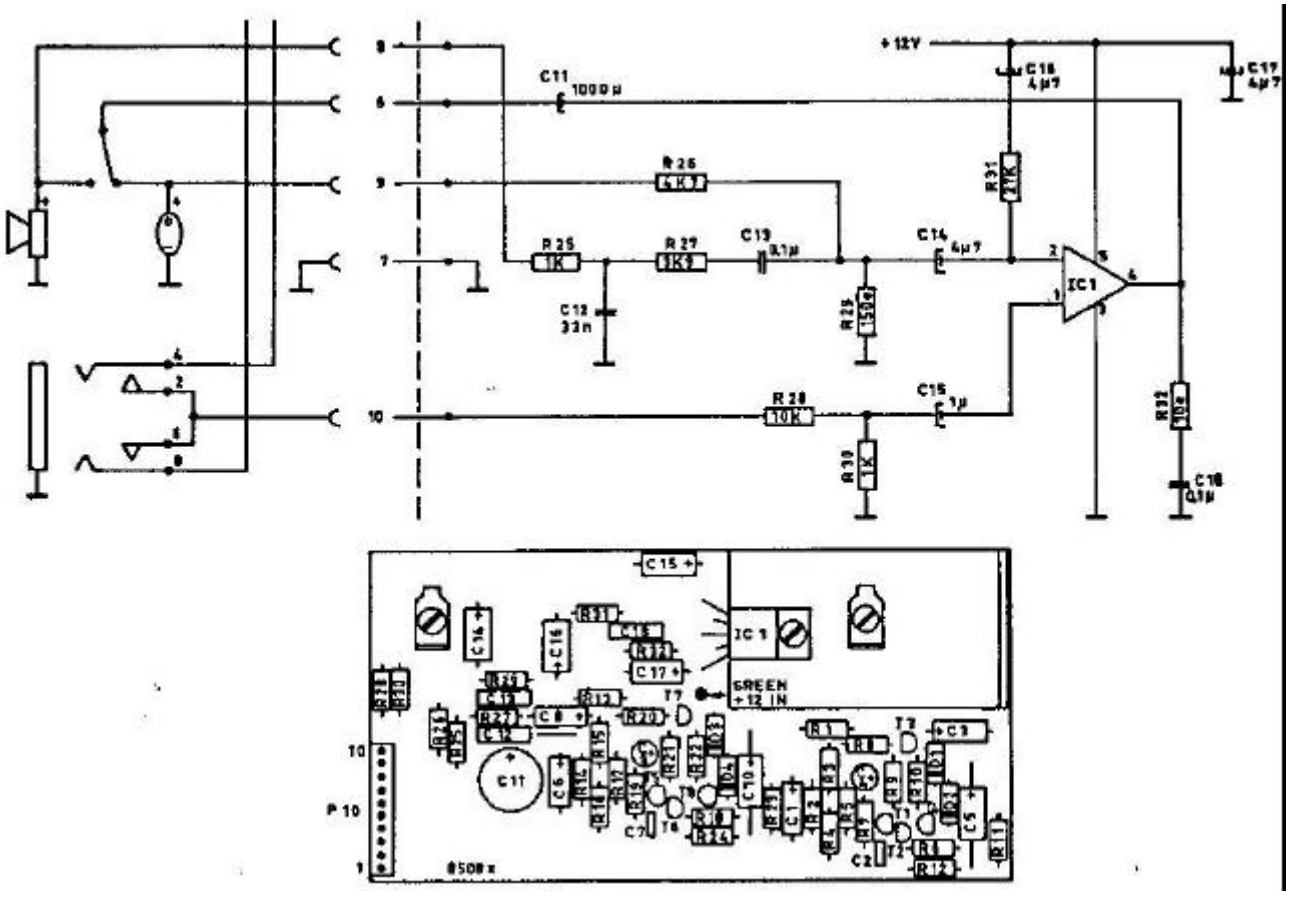
To suit personal taste and listening conditions this equalisation can be modified or removed.

The components involved are located on the Headphone & Monitor amplifier (diagram 1666).

A. The bass lift can be removed by short-circuiting capacitor C13.

B. The treble lift can be removed by removing capacitor C12.

These component will only affect the built in speaker. Headphone output and external speaker output are not affected.



APPLICATION NOTE

SENSITIVITY OF OPTICAL TAPE SENSORS

A problem concerning editing tapes with very dark magnetic coatings has been reported.

This is caused by the spread in sensitivity of the two optical sensors in the tape path, in particular the 'EDIT' sensor to the right of the head block assembly.

Eventual problem is verified by threading the tape in the EDIT mode as described in the operating instructions.

If the sensitivity of the sensor is too low, the back tension will cease to work properly, but a fine adjustment of the angle of the optical sensor in relation to the tape will usually cure the problem.

To adjust, remove the two 1.5 mm Allen screws holding the head cover. Remove the head cover, and using a 5 mm wrench, untight the lacquered nut which keeps the optical sensor in position. Now adjust the angle of the sensor for optimum results.

1. Using a tape with dark oxide in the 'EDIT' path, adjust the position of the sensor until the 'EDIT' function is working properly, i.e. that the brake release solenoids are activated and back tension is supplied.

2. Make sure that a white leader tape is running in the 'normal' play mode tape path.

Usually, the backmost and right angled position in respect to the tape in the edit path gives the best results, but it might be necessary to turn the sensor slightly CCW to match the 2nd criteria.

PART LIST

| PART # | DESCRIPTION |
|---|---|
| 420009 | TAPE CUTTER |
| 420013 | REEL MOTOR ASSEMBLY, TAKE UP |
| 420014 | REEL MOTOR ASSEMBLY, SUPPLY |
| 421501 | PCB 85020 MOTHERBOARD |
| 421502 | PCB 85010 TAPE DECK LOGIC, Mk I (500:1 TACHO) |
| 421503 | PCB 85050 POWER SUPPLY |
| 421504 | PCB 85060 TACHO SENSOR, TAPE SPEED (500:1 TACHO) |
| 421505 | PCB 85040 REELMOTOR SENSOR |
| 421506 | PCB 85010 TAPE DECK LOGIC, Mk II (500:1 TACHO) |
| 421507 | PCB 85060 TACHO SENSOR, TAPE SPEED. From 9021301 |
| 421508 | PCB 85010 TAPE DECK LOGIC, Mk3.Fr9021301(250:1TACHO) |
| 422501 | PCB 85080 HEADPHONE & MONITOR AMLIFIER |
| 422502 | PCB 85070 ERASE & PLAYBACK AMLIFIER |
| 425004 | HEABLOCK COVER WITH SLOT |
| 426001 | SEE 426501 |
| 426011 | SEE 426501 |
| 426501 | SPARE PART KIT, FRED |
| 501102 | TAPE GUIDE ROLLER, CENTER (TACHO) |
| 501103 | TACHO DISC 500:1 |
| 501104 | TAPE GUIDE ROLLER, RIGHT |
| 501105 | SEE 501164, 501187, 501188 |
| 501106 | SCREWS, NUTS AND WASHERS, SET OF 100 GRAM |
| 501107 | BEARING ASSY FOR CENTER/RIGHT GUIDE ROLLER |
| 501108 | REEL MOTOR WITH BRAKE DRUM |
| 501109 | PLAYBACK HEAD, 2/2 TRACK |
| 501110 | BRAKE PAD, SUPPLY/TAKE UP |
| 501111 | (BRAKE PAD, TAKE UP) see 501110 |
| 501113 | SEE 420009 |
| 501126 | FRED DUMP MODE KIT, FACTORY INSTALLATION |
| 501127 | SEE 501142 |
| 501128 | FRED ERASE FADE IN/OUT KIT |
| 501131 | RELAPPING OF 1/4" METAL HEAD |
| 501138 | EXTENSION CABLE FOR FRED LOGIC PCB |
| 501142 | FRED DUMP KIT, FIELD INSTALLATION KIT |
| 501143 | REEL PLATFORM ASSY |
| 501160 | FOOTPEDAL (PLAY-STOP-WIND) |
| 501164 | AEG ADAPTER WITH 295 mm PLATTER |
| 501174 | TAPE GUIDE ROLLER, CENTER (TACHO) DSL |
| 501187 | AEG ADAPTER WITH 270 mm PLATTER |
| 501188 | AEG ADAPTER WITH 282 mm PLATTER |
| 501207 | MOVING GUIDE ROLLER COMPLETE |
| 814042 | HEADBLOCK COVER |
| 814072 | TAPE GUIDE, CENTER |
| 814082 | TAPE GUIDE PIN |
| 814092 | TENSION ARM |
| 814132 | ADAPTER PLATE 10,5" FOR AEG ADAPTER |
| 814152 | REEL PLATFORM |
| 814172 | (MOVING GUIDE ROLLER BOTTOM FLANGE MkI) |
| 814182 | (MOVING GUIDE ROLLER TOP COVER MkI) |
| 814202 | CAP FOR TAPE CUTTER |
| 814252 | TAPE LIFTER GUIDE PIN |
| 814272 | SPACER FOR GUIDE PIN L=2.2 |
| 814342 | BUSHING |
| 814932 | SPLICING BLOCK |

815000 CINE CENTER, UPPER PART
815010 CINE CENTER, LOWER PART
815242 SPRING, TENSION ARM
815342 SPRING FOR TAPE LIFT
816400 SCREW, CINECENTER TO HUB
816955 HEADBLOCK COVER
817645 CAP FOR TAPE CUTTER
817665 CUTTER BLADE, MOVING
817685 CUTTER BLADE, FIXED
823290 MOVING GUIDE ROLLER, BOTTOM FLANGE MkII
825012 TACHO DISC Mk II. From 9021301
826020 MOVING GUIDE ROLLER, TOP COVER MkII
827090 TAPE GUIDE ROLLER Mk II, CENTER/RIGHT. From 9021301
871501 SPRING, HEAD ADJUSTMENT
898871 SPRING, CINE CENTER
898880 SCREW, CINE CENTER
899999 REPAIR OF CIRCUIT BOARDS
903111 POTENTIOMETER 4K7 SINGLE TURN VA05V
903141 POTENTIOMETER 2K7
903142 POTENTIOMETER 4K7
903156 POTENTIOMETER 2K2 LIN, VARISPEED
903157 POTENTIOMETER 470K LIN, FADE TIME
903159 POTENTIOMETER 2 X 22K LOG, VOLUME
905305 CAPACITOR 4.7OOuF/40V
905318 CAPACITOR 22.000uF/16V
911101 DIODE 1N4148
911221 DIODE 1N4001
911232 DIODE 1N5402
911320 DIODE ZENER 5V6 5W
911324 DIODE ZENER 9V1 0.4W
912101 TRANSISTOR BC237/547B/BC184
912111 TRANSISTOR BC307/557B/BC214
912141 TRANSISTOR BC 327-25
912142 TRANSISTOR BC 337-25
912205 TRANSISTOR TIP 120
912210 TRANSISTOR TIP140
912245 TRANSISTOR BD 645
912651 THYRISTOR BSTC 1040 M/S0810, 4A/600V/25mA
913114 IC OPAMP TDA 2002, POWER AMP
913122 IC OPAMP LM393
913133 IC OPAMP LM324N/CA324
913135 IC OPAMP LM358
913142 IC OPAMP LM387N DUAL PRE AMP
913151 IC SAS 560 S, SWITCH AMP
913155 IC ICM 7217 BIJI COUNTER
913202 VOLTAGE REGULATOR uA 7805/L7805CV (5 V)
913212 VOLTAGE REGULATOR uA 7812/L7812CV (12 V)
913241 VOLTAGE REGULATOR uA 78 GU (16 V)
914401 IC CMOS CD4001B
914402 IC CMOS CD4002B
914404 IC CMOS CD4011U
914406 IC CMOS CD4013B
914408 IC CMOS CD4017B
914410 IC CMOS CD4023B
914415 IC CMOS MC14043 BCP
914416 IC CMOS CD4040
914418 IC CMOS CD4051B
914420 IC CMOS CD4053B
914422 IC CMOS CD4069U

914423 IC CMOS CD4071B
914424 IC CMOS CD4073B
914425 IC CMOS CD4077B
914426 IC CMOS CD4093B
914438 IC CMOS CD40107
914440 IC CMOS CD40175B
914443 IC CMOS MC 14501 UBCP
914444 IC CMOS CD4070
914445 IC CMOS CD4511B
914449 IC CMOS CD4516B
914461 IC CMOS CD4532B
914464 IC CMOS MC 14538 BCP
915103 LED 5 mm, RED
915131 LED IR OP 140
915235 DISPLAY HD 1105 R  7-SEGMENT
915305 OPTO INTERRUPTOR OPB 865T51, IR
915306 OPTO FORK OPB867T51
915321 OPTO REFLEX OPB 704, IR
915325 OPTO REFLEX OPB 708, IR
915431 TRANSISTOR OPTO OP550, IR
921231 SWITCH, ROCKER 1852.1102 MAINS
921232 SWITCH, ROCKER 1801-0102 SPEED/TIMER
921233 SWITCH, ROCKER 1803-0102 SPEAKER
921234 SWITCH, ROCKER 1801-1102 MAINS 1-POLE
921256 SWITCH, TOGGLE TRACKSELECTOR
921257 SWITCH, TOGGLE ERASE
922111 PUSHBUTTON, RESET
922113 PUSHBUTTON, TAPE DECK COMMANDS
922114 PUSHBUTTON CAP
923210 TRANSFORMER, MAINS 115/230 V, 2 x  7 V MkI
923235 TRANSFORMER, MAINS 115/230 V, 2 x 10 V MkII
924203 ERASE    HEAD 1/4" FULL TRACK
924222 SEE 501109
925110 (BEARING, BALL RV516X/625ZZ)
925116 BEARING, BALL 624ZZY
925143 BEARING, BALL ULKZ688ZZ
955115 CABLE, MAINS 2 M
955131 MAINS INLET WITH VOLTAGE SELECTOR
955402 SOCKET, HEADPHONE (UK/BBC standard)
955403 SOCKET, HEADPHONE
956001 SOCKET, SPEAKER
960121 SOLENOID, TAPE LIFTER
960122 SOLENOID, BRAKE
960451 FLIGHT CASE, FIBREGLASS
960611 LOUDSPEAKER AD 4472 X4
961049 DUMMY PLUG, 9.5 mm
961051 DUMMY PLUG, 11 mm
961053 DUMMY PLUG, 12.7 mm
961058 DUMMY PLUG, 6.4 mm
961433 CARRYING HANDLE C/C 128 MM
961651 KNOB FOR POTENTIOMETER
961652 CAP FOR KNOB
961653 FLANGE FOR KNOB
961906 FUSE 0.63 A S
961910 FUSE 1 A S
961941 FUSE 4 A S
961961 FUSE 10 A S
962211 ADAPTER, NAB
962231 SEE 420009

969006 DUST COVER, PLASTIC
969052 OPERATORS MANUAL FRED
970102 WASHER M5x0.2 MM, SHIM
970103 WASHER M5x0.5 MM, SHIM
974711 SCREW (DOME) M4 x 10 FOR REEL PLATFORM

# T E C H N I C A L  S P E C I F I C A T I O N S

## F R E D  E D I T I N G  T A P E  D E C K

## R B - 0 4

| | |
|---|---|
| Tape speeds.....: | 7½ and 15 ips (19.05 and 38.1 cm/s). |
| Varispeed.....: | Continuously variable up to 3 times selected nominal speed. |
| Speed stability....: | +/- 0.4 %. |
| Wind speed.....: | 200 ips (530 cm/s). |
| Wind time.....: | 140 sec for 730 m tape (2400 ft). |
| Wow & flutter.....: | 15 ips, 0.25 % RMS weighted.<br>7½ ips, 0.4 % RMS weighted.<br>Average values over 30 sec with 10½" reels. |
| Take-up reel.....: | 10½" or 12" (27 to 30 cm). |
| Supply reel.....: | 5" to 12" (12 to 30 cm). |
| Tape thickness.....: | 50 um (2.0 mil) standard tape. |
| Tape timer.....: | +/- hour, minutes, seconds. |
| Timer accuracy.....: | 0.2 % relative nominal speed. |
| Equalisation.....: | CCIR/IEC. |
| Headphone output...: | Stereo, min load 32 ohms.<br>Headphone disconnects speaker. |
| Loudspeaker.....: | Mono, amplifier 3 W, frequency compensated. |
| External speaker...: | Mono output for 4 ohm external speaker. Max continuous output 3 W RMS. Flat frequency response. |
| Erase frequency....: | Approx. 100 kHz. |
| Power requirements.: | 115/230 V +/- 10 %, 50/60 Hz. Max 70 W. |
| Dimensions (mm)....: | 455 (W), 350 (D) + handle 35.<br>75 (H) tape deck, total height 107. |
| Weight.....: | 7.5 kg. |

Specifications are typical values and are subject to change without prior notice. We reserve the right to make alterations as technical progress may warrant.

# DRAWINGS COVERING FRED RB-04 EDITING TAPE DECK

| # | TITLE | DESCRIPTION/REMARKS | SIZE |
|---|---|---|---|
| 1667 | TAPE DECK LAYOUT | TOP AND SIDE VIEW | A4 |
| 1668 | FRONT PANEL LAYOUT | | A3>A4 |
| 3220 | ERASE & PLAYBACK AMP 1/3 | PCB 941091 | A3>A4 |
| 3220 | ERASE & PLAYBACK AMP 2/3 | COMPONENT LAYOUT | A3>A4 |
| 3220 | ERASE & PLAYBACK AMP 3/3 | COMPONENT LIST | A3>A4 |
| 1666 | HEADPHONE AND MONITOR AMP | PCB 8508 | A3>A4 |
| 1669 | MOTHERBOARD | PCB 8502 | A3>A4 |
| 2547 | TACHO SENSOR | PCB 940380 | A3>A4 |
| 1671 | INTERCONNECTIONS | PCB 8118 | A4 |
| 1672 | INTERCONNECTIONS | PCB 8119 | A4 |
| 1772 | POWER SUPPLY | PCB 8505 | A3>A4 |
| 1773 | POWER SUPPLY | COMPONENT LAYOUT | A3>A4 |
| 1673 | REELMOTOR TACHO SENSORS<br>TAPE/EDIT TAPE SENSORS | PCB 8506, 8504 | A3>A4 |
| 2652 | TAPE DECK LOGIC | BLOCK DIAGRAM | A3>A4 |
| 2922 | TAPE DECK LOGIC 1/4 SERVO | PCB 8501 REV 7 | A3>A4 |
| 2922 | TAPE DECK LOGIC 2/4 LOGIC | PCB 8501 REV 7 | A3>A4 |
| 2922 | TAPE DECK LOGIC 3/4 DISPLAY | PCB 8501 REV 7 | A3>A4 |
| 2922 | TAPE DECK LOGIC 4/4 | COMPONENT LAYOUT | A3>A4 |
| 1658 | INTERNAL LAYOUT | | A3>A4 |
| 1675 | TAPE PATH | | A4 |
| 1676 | MOTHERBOARD | COMPONENT LAYOUT | A3>A4 |
| 3532 | TAPE DECK PARTS | MECHANICAL ASSEMBLY | |
| 3543 | HEAD ASSEMBLY | MECHANICAL ASSEMBLY | |
| 3202 | REEL PLATFORM | MECHANICAL ASSEMBLY | |
| 3125 | AEG ADAPTER | MECHANICAL ASSEMBLY | |
| 3203 | TAPE GUIDE ROLLERS & TACHO | MECHANICAL ASSEMBLY | |
| 3279 | TENSION ARM ASSY | MECHANICAL ASSEMBLY | |
| 3286 | BRAKE ADJUSTMENTS | MECHANICAL ASSEMBLY | |

## THEORY OF OPERATION

The tape deck logic board, drw 2922 - pcb 8501 REV 7 performs most of the control functions in the FRED editing tape deck.

Information is received from 7 optical transducers, 5 pushbuttons, 2 rocker switches and 1 potentiometer.

No relays or microswitches are used in the tape deck.

The following pages is a technical description of the various functions and logical sequences.

### POWER ON RESET

When power is switched on, the internal circuit in IC4 sets the unit to STOP. The tape timer is reset to zero by R17 - C9 at IC7-2. After about 0.5 seconds, C9 has charged to "high" and IC7-3 goes "low", enabling the timer to work.

### GETTING THE TAPE TO MOVE

If PLAY is depressed, IC4-14 goes high, resulting in IC4-1 goes high. This signal is sent to the priority encoder IC3-1.

IC3 is used to select the function with the highest priority if more than one button is depressed at the same time. The priority order is (from the highest to the lowest) PLAY, -->>, <<-- and STOP.

If both PLAY and -->> is depressed at the same time, the PLAY command has priority and is accepted and -->> is rejected as it has lower priority.

The output at IC3 has the following code for the different modes;

| | IC3-6 | IC3-7 | IC3-9 | IC3-14 | IC3-15 |
|---|---|---|---|---|---|
| PLAY | 1 | 0 | 0 | 1 | 0 |
| -->> | 0 | 1 | 0 | 1 | 0 |
| <<-- | 0 | 0 | 1 | 1 | 0 |
| STOP | 0 | 0 | 0 | 0 | 0 |

The signals sent from IC3 are sent to another priority encoder, IC16, which adds further priority to the control signals before they reach the motors and brakes. The input of IC16 have the following order of priority (from highest to lowest);

| IC16 pin no | Function |
|---|---|
| 4 | Electrical braking at PLAY or -->>. |
| 3 | Electrical braking at <<--. |
| 2 | Inhibits electrical braking at end of tape. |
| 1 | PLAY mode. |
| 13 | -->> mode. |
| 12 | <<-- mode. |
| 11 | EDIT mode. |
| 10 | Not used. |

The outputs of IC16 form a 3-bit binary code which is used to control the analog electronic switches, IC13 (for supply motor)

and IC14 (for take-up motor).

The table below shows the IC16 output code at various conditions;

| IC16 pin no | 9 | 7 | 6 | 14 | 15 | IC13/14 pin active |
|---|---|---|---|---|---|---|
| STOP | 0 | 0 | 0 | 0 | 1 | 13 |
| PLAY | 0 | 0 | 1 | 1 | 0 | 1 |
| -->> | 1 | 1 | 0 | 1 | 0 | 12 |
| <<-- | 0 | 1 | 0 | 1 | 0 | 15 |
| El. braking -> | 1 | 1 | 1 | 1 | 0 | 4 |
| El. braking <- | 0 | 1 | 1 | 1 | 0 | 2 |
| EDIT | 1 | 0 | 0 | 1 | 0 | 14 |

Suitable DC-signals are routed to the IC13/14 pins, which are selected through the binary code and exits at pin 3 from the tape deck logic pcb and reaches the pcb 8505 power supply unit.

These signals are in the range from 0 to +5 V dc, depending on the actual function.

On the pcb 8505 power supply unit the signals are converted into constant current for feeding the supply and take-up motors. A 1 V dc signal corresponds to 1 A motor current.

**TAPE SPEED CONTROL SERVO**

The FRED tape drive is designed without capstan and pinchroller. The tape speed is controlled by a servo system.

The centre idler roller rotates with the tape and is equipped with a optical tacho disc mounted on the idler roller shaft. The tacho disc gives 250 pulses per revolution. The diameter of the idler roller is designed to give exactly 4 revolutions per 15 inches of tape passing the roller. With 250 pulses/rev this gives 1000 pulses/15 inches.

To achieve 15 ips tape speed it is obvious that the tacho output must be 1000 Hz. The tacho sensor (pcb 94038X) contains some signal conditioning components in order to get a 5 Vp-p square wave, which is sent to the tape deck logic pcb 8501 and enters at pin 4a which is connected to IC12-4.

IC12 is a precision double monostable multivibrator whose first half is used to convert the tacho frequency to an analog DC voltage for later comparison with a reference voltage, resulting in an error voltage which is sent to IC14-1. From IC14-3 the signal reaches the pcb 8505 power supply unit, driving the take-up motor.

The monostable IC12 gets its reference from the preset potentiometers POT1 (15 ips) or POT2 (7.5 ips). The varispeed potentiometer is also included in this circuit.

In PLAY mode a current is developed going out of IC2-6 through R39 via pin 15c to the arm of the varispeed potentiometer, which in position X1 is in direct connection with pin 14c (the CCW end).

Pin 15a (the CW end) is connected via POT1, R79, IC15 and T7 to ground (at 7.5 ips). The small voltage developed across R39 creates a voltage at IC2-7, controlling the current generator IC2-8 and T3. The capacitors C6 and C40 in parallel are the timing capacitors for play speed. In wind and rewind modes T13 is

switched off and the wind speed limit is then controlled by C6 only.

IC1-1 is an active low pass filter, removing the ripple in order to be able to compare the DC level within narrow tolerances.

IC1-6 is the error amplifier inverting input to which the filtered output from IC1-1 is connected. Comparison with the reference at IC1-5 gives the resulting amplified error signal which is routed to IC14-1.

Low tape speed corresponds to low voltage at IC1-1, making IC1-7 go high increasing the current drive to the take-up motor.

To increase the tape speed, the current generator T3 is simply adjusted for a higher current. This happens if for instance the varispeed control is turned clockwise.

As the potentiometer wiper moves towards a lower DC level, a higher current is developed over R39, giving a higher current in T3 which in turn results in shorter pulses at the output of IC12-6. This means a lower mean value of the filtered DC level at IC1-1. Then IC1-7 gives a higher output voltage, thereby trying to increase the tape speed until the new speed is reached.

IC1-8 is the output of the "SPEED TOO HIGH" detector. At correct or too low speed this output is high, but if the actual tape speed is more than 10 % higher than it should, the IC1-8 goes low, thereby making IC33-6 low enabling the electrical braking.

In -->> or <<-- the servo reference speed is set to about 300 ips due to the current developed in R38 when IC33-14 goes low. Further, T13 is switched off enabling only C6 to control the one shot timing circuit. Note that there is no real servo speed control in -->> and <<--, but the servo signals are used to control when back-tension shall be applied.

The motor that at the moment takes up tape in -->> and <<-- runs at the maximum available current, which is about 6 A at stand still and decreases to about 3 A when the reel speed increases.

The output from the tape deck logic board to the motor that takes up tape is 5 Vdc which corresponds to 5 A motor current in play mode. In forward and rewind higher currents are available.

**AUTOMATIC TAPE TENSION CONTROL**

The tape tension is fully automatic and self adjusting, giving correct tape tension for supply reels ranging from 5" to 12".

**Note: That only 10.5" or 12" reels are allowed at the take-up side, otherwise increased wow & flutter will be the result. Ignoring this, smaller reels may be used also on the take-up side.**

FRED operates without any tape tension sensing arms. Instead, the tape tension is calculated from the signals received from different optical sensors in the machine.

As mentioned earlier, a tacho disc is used to sense the tape speed. The supply and take-up motors have also been equipped each with one optical sensor.

A black and white optical strip has been placed around the circumference of the lower part of the brakedrums giving 100 black and 100 white markings per revolution. An IR reflective sensor is used to retrieve the movement of the motors.

The principle of calculating the tape tension needed is to sample how many pulses that has been received from the tape speed tacho disc when 32 pulses have elapsed from the supply reel (if in PLAY or -->> mode). This is the same as the ratio between the tacho disc and reel rotation. A high value means high back tension current is needed.

In <<-- mode the tape tension is calculated the same way but now it is the ratio between the tacho disc and take-up reel that is of interest. The circuit is then simply switched to the take-up reel sensor instead.

Besides taking the tape speed tacho signal at pin 4a to IC12-4, it is also routed to IC26-14, a frequency divider connected to reset after 7 received pulses. This is a pre-divider connected to IC25, a binary counter with its 4 outputs connected to a 4-bit latch, IC24.

The pulses from the actual reel motor are selected in IC15-15 and fed to IC27, the reel frequency divider which is connected to count to 32. Every time 32 pulses have been counted a negative pulse is received by IC17-11 resulting in a positive pulse from IC17-10.

This pulse clocks the latch IC24 in order to store the contents of IC25. After a short delay via R83, IC27 is reset and ready to start counting another 32 pulses from the reel.

The output from latch IC24 (4-bit binary code) is connected to a resistor combination R73 - R76 making a simple D/A converter. The DC voltage at the common points of R73 - R76 is directly proportional to the reel backtension needed. This signal is fed to IC15-14 through which the tension signal is sent to IC2-3 or IC2-12 depending on the tape movement direction.

After IC2-1 and IC2-14 the signal value is divided so it will be suitable for the different values needed for play, braking, fast wind and edit. Via IC13 and IC14 respectively, the signals reach the reel motor drive circuits consisting of a current generator for each reel motor and placed on the 8505 pcb power supply unit.

**TAPE TIMER**

Two additional optical sensors are mounted on the 94038X pcb (Tacho sensor, tape speed & tape timer) unit. These are used for sensing direction and rotation of the tacho disc for timing purposes. The direction information is also necessary for the tape control logic to know how to brake the reels.

The two opto sensors are mounted at some angular offset from each other in order to get a 2-phase signal for determining the direction of tape travel. The signals are connected to the tape deck logic pcb 8501 at pins 4c and 5a.

The data at IC29-5 is clocked into IC29 by clock pulses at IC29-3 occurring every time a change in the level at pin 5a is detected. The IC29-1 output gives the direction of tape travel (1 = forward,

0 = rewind).

IC30 is a prescaler which divides the input frequency by 8. If 15 ips is selected a further division by 2 is accomplished by the IC7-4 signal that defeats every other clock pulse.

If pin 16a is low (timer off) a 2 Hz a-stable in IC20 starts generating a square wave whose positive half periods are injected via D11 to IC8-23 (display off input), giving a flashing display to remind the operator that the counter is off.

There are two other cases that can make the tape timer stop; end of tape and edit. In all cases IC11-9 goes high inhibiting count pulses to go out of IC21-4.

**OVERLOAD CONTROL**

If the reels are blocked for a longer time (more than 25 seconds) a protection circuit will break the power to the reel motors.

IC17-9 is a speed sense input which goes high when sufficient speed is reached. This speed value is different depending on if play or fast mode is selected. As a rule, about 70-80 % of nominal speed is needed for IC17-9 to be accepted as high.

At start of tape travel IC17-9 is low, therefore IC17-8 is high making T2 and T5 to conduct, setting the tape back-tension to zero during this start-up period, in order to speed up the tape to the desired speed. When speed is about to reach correct value, IC17-8 goes low opening T2 and T5 so that tape back-tension is applied.

However, during this start-up period IC17-6 is low = IC23-6 low and as IC23-5 already is low, IC23-4 will be high = IC23-12 high and therefore IC23-11 will be low T11 is off, enabling C13 to charge via R20.

After about 25 seconds IC10-12 has reached about 2.5 V and triggers the overload flip-flop so that IC10-10 goes high. Then T6 will go off, disconnecting the drive signal to the two thyristors on the pcb 8505 power supply unit. This terminates the power to the motors. Pin 10c turns the overload driver transistor, on motherboard 8502, on so the overload LED goes on.

Note that during electric braking no overload condition is detected. It is only the acceleration time that is measured. Therefore, using the <<-- and -->> buttons to let the tape run back and forth can not cause an overload condition.

Reset of the overload condition is made by depressing STOP. Then IC23-9 goes low and as IC23-8 already is low, IC23-10 will go high making IC10-11 high and thereby resetting IC10-10 to low. This makes T6 to conduct again and the overload LED to go out. The thyristors starts to conduct again giving power to the motors.

**TAPE LIFT CIRCUIT AND ELECTRICAL BRAKING**

At -->> and <<-- IC33-15 goes high setting the bi-stable IC10-9 output high. This output is fed to pin 30c and reaches via mother-board 8502 the power supply unit 8505. Here T3 will start conducting and the tape lifter go out, dis-engaging the tape from the heads.

If for example PLAY is depressed, IC10-9 still will remain high. IC33-14 goes high removing the current in R38 (which sets the servo reference speed at -->> and <<--). Then, as the tape speed still is much too high compared to the selected play speed, IC1-8 will be low, which in turn enables electric braking via R9, IC33-6, IC33-10, IC 22-5, IC22-6, IC22-11 and 8, and depending on direction of tape travel results in that IC22-9 will go high if the tape moves forward, or IC22-10 will go high if the tape moves in reverse direction.

When the tape speed has been reduced so that it is only about 10 % higher than the selected speed, IC1-8 goes high again ending the electric braking command at IC33-6 and also resetting the bi-stable IC 10-9 to low, and the tape lifter will return so the tape comes in contact with the heads. The tape now runs at play speed. The end of braking and tape lift resetting always occurs at about +10 % of selected tape speed regardless of if it is 7.5 or 45 ips.

**TAPE STAND STILL DETECTOR**

The tacho signal at pin 4a is also routed to IC17-1. The output at IC17-2 is driving a diode pump. If the tape is moving, the diode pump output at IC17-4 is high. If the tape speed is less than about 2.5 ips IC17-4 goes low making IC11-5 low and IC11-6 high and IC10-3 high resetting the bi-stable IC10-2 output to low. In this way the electric braking is ended when STOP is selected and the mechanical brakes are engaged.

No mechanical braking takes place until the tape has stopped completely. Thus the wear on the mechanical brakes are very low, as they only are used as parking brakes.

**END OF TAPE DETECTOR**

An IR reflective sensor is used to detect if the tape is in the tape path. It is placed to the left of the erase head, at a distance of about 3 mm from the emulsion side of the tape. The sensor is independent of surrounding ambient light because it uses pulsed IR light.

On the motherboard 8502, IC1-6 is the output of an a-stable multivibrator running at about 180 Hz, giving 0.5 mS negative pulses driving T4. Via R17 75 mA pulses are sent to the (series connected) IR-emitters of the end of tape and edit reflective sensors.

The receiver side of the end of tape sensor is connected to the T5 preamplifier. 5 Vp-p pulses are sent to IC1-1 whose output carries the amplified 0.5 mS pulses. These pulses are stored in C6 until the next pulse occurs. Therefore IC1-8 is at a constant high level as long as repetitive pulses are received from the magnetic tape surface. If the tape is removed from the tape path, the pulses at IC1-1 will disappear, C6 charges to 5 V and IC1-8 goes low. This information is sent to the tape deck logic board 8501, pin 23c.

**EDIT DETECTOR**

The edit detector has identical function as the end of tape detector. T6 is the preamplifier, IC1-13 the input and IC1-10 the output of the pulse detector, connected to pin 23a on the tape deck logic pcb.

**POWER SUPPLY**

The two secondary windings of the mains transformer are connected in series, driving a full wave rectifier consisting of the two diodes D6 and D7 and the two thyristors TH1 and TH2.

TH1 and TH2 are fed with an ignition current coming from T6 via R24 on the tape deck logic pcb. If no overload condition is present this combination acts exactly like an ordinary four diode full wave rectifier.

The voltage at the C4 filter capacitor is typically 19 Vdc at stop condition. On the centre tap of the transformer the C5 filter capacitor is connected. Here the voltage is about 9.5 Vdc at stop condition. This voltage is used to feed the reel motors. The voltage at C4 is used to get stabilised voltages for the logic and audio circuits.

**OVERLOAD CONDITION**

If an overload is detected by the tape deck logic pcb, the drive current coming from T6 via R24 on the tape deck logic pcb is interrupted. Then the thyristors TH1 and TH2 do not get any ignition current.

Now the diodes D6 and D7 will act like a push-pull rectifier and the centre tap of the transformer will bias D8 and resulting in a -0.7 Vdc potential at the transformer centre tap. The voltage at C4 is now only 9.5 Vdc, sufficient to drive the logic with 5 Vdc stabilised voltage. In this way the positive supply to the motors is removed. When the STOP button is depressed the thyristor drive comes on again and the voltages are rising to their normal values.

**MOTOR DRIVE CIRCUIT**

The supply motor drive will be discussed here, the take-up drive is identical.

The control signal from the tape deck logic board 8501 enters the power supply pcb 8505 at pin 2.

The signal level here is: 0 V = no drive
+5 V = full drive

IC1A and T5, T1 forms a current generator driving the motor. R5 is a current sense resistor over which a voltage of 0.1 V/A is developed. This voltage is connected to the inverting input of IC1A via R4. R4 is only needed to increase the impedance at the op-amp input to enable high frequency feedback from C6 to avoid high frequency parasitic oscillations.

Therefore the feedback voltage at IC1-2 is still 0.1 V/A. R1 and R2 makes a voltage divider lowering the control voltage range from the tape deck logic pcb to 0 - +0.45 V in play mode. In fast forward and rewind T7 is switched off and thus connecting R29 in series with R2. The voltage dividing will therefore be 1:2.8 instead of 1:11 (play mode).

If, for instance, the control voltage at pcb 8505 pin 2 is 2.5 V this is divided by R1 and R2 to 0.227 V. This is injected at IC1-

3, the non-inverting input of the op-amp. Now the output IC1-1 will rise and T5, T1 begin to conduct. Current will begin to flow from +9.5 V supply via the motor and T1 through R5 to ground.

The current flow will cause a voltage over R5 which is sent back to the inverting input of IC1A. When the voltage over R5 has increased to 0.227 V, the IC1A is in balance.

Now it can be seen that as the voltage over R5 is 0.227 V and the resistance is 0.1 ohms, the motor current must be 2.27 A. The current generator range will be 0 to 4.5 A for a 0 to +5 V signal from the tape deck logic pcb.

**DUMP MODE**

The dump circuit consist of a power transistor, T12, to drive the dump kit motor and an error amplifier IC18, and 2 nand gates to control the logic. From IC1-7 the play drive signal, which is obtained from the normal tacho system, is routed to the error amplifier IC18-3 (non inverting input) which controls the output transistor T12. From the emitter of T12, which connects to the motor, a voltage feed back is routed through a voltage divider, R86/R56, to IC18-2 (inverting input) and thus closing the servo loop. If a dump kit is present, J2-2 is pulled low, disabling the normal edit circuit and enabling the dump circuit by setting IC6-3 low and releasing the feed back input of the error amplifier.

When entering stop mode T10 is turned on, discharging C25 to obtain a quick stop.

Re: FRED DEC 1992

CONVERSION OF STANDARD FRED TO BBC VERSION.

i.e. removal of tape cutter and erase facility.

1. Remove headblock cover. Install 12.7 mm plug in the hole.
2. Remove bottom plate.
3. Remove logic board.
4. Remove playback/erase circuit board (2 screws).
5. Unplug related connectors.
6. Remove the tape cutter by removing the two outer screws. Remove cutter with holding plate.
7. Cover cut out for tape cutter with adhesive metal foil.

8. Remove erase on off switch
9. Cover hole with 6.4 mm plug
10. Remove erase fader knob (remove top cap to get access to knob fixing nut).
11. Remove erase fade potentiometer.
12. Cover hole with 9.5 mm plug
13. Remove erase head
14. Remove erase head mounting plate.
15. Install tape guide in hole made free by removing erase head mounting plate.
16. Remove erase head connection (green and blue wire) from connector.
17. Re install circuitboards.

Parts: 1 ea 961053 Dummy plug 12.7 mm
1 ea 961058 Dummy plug 6.4 mm
1 ea 961049 Dummy plug 9.5 mm
1 ea 824012 Adhesive foil
1 ea 820452 Tape guide
1 ea 974512 Screw M2x6

INSTALLATION OF DUMP MODE KIT

VALID FOR MACHINES FITTED WITH LOGIC BOARD 8501-5, 8501-7.

1. Remove bottom plate.
2. Remove plug fitted in prepared hole.
3. Install the 1/4" socket and place the guide plate on the tape deck facing right. In rest position the the dump kit shall go free from a 10.5" reel. When activated, the microswitch shall activate just before the pinchroller touches the guide roller.
4. Connect black wire (ground) to the screw holding the playback circuit board.
5. Solder connector J2 on the prepared holes on the logic board.
6. Cut out diode D9 on the logic board.
7. Re install logic board and connect J2.