Section 7

ELECTRONIC ASSEMBLY

7.1 GENERAL

The two reproduce amplifier assemblies in the 3200 duplicator systems and the four reproduce amplifier assemblies in the slower speed 3300 duplicator systems are identical and each consists of a seven-stage, resistance-coupled amplifier and an unregulated power supply. The four reproduce amplifier assemblies in the higher speed 3300 duplicator systems are similar and differ only in the equalization networks. If rack mounted, each reproduce amplifier assembly would occupy 5-1/4 inches of standard 19-inch rack space.

The record amplifier assembly in the 3200 duplicator systems consists of a power supply, two record amplifiers, two pre-emphasis equalizer bracket assemblies and two VU output meters. In the slower speed 3300 duplicator systems, two record amplifier assemblies are used and each is similar to the 3200 record amplifier assembly differing only in the equalization networks. In the higher speed 3300 duplicator systems, the equalization networks of the two record amplifier assemblies are different again. The record amplifier assembly occupies 8-3/4 inches of standard 19-inch rack space.

The bias oscillator assembly provides the high frequency a-c bias current required to record on the linear portion of the tape characteristic. It consists of an oscillator, an amplifier stage and a regulated d-c power supply. The bias oscillator assembly will supply sufficient current to operate twenty record head channels. The bias amplifier assembly is an optional power amplifier which is used when bias current must be supplied to more than twenty record head channels. The bias oscillator assembly and the bias amplifier assembly each occupy 8-3/4 inches of standard 19-inch rack space.

The slave switch panels associated with each slave transport, act as the distribution points for record current from the record amplifier and bias current from the bias oscillator and/or bias amplifier. If rack mounted, each slave switch panel would occupy 5-1/4 inches of standard 19-inch rack space.

7.2 REPRODUCE AMPLIFIER

A magnetic flux pattern, proportional to the signal originally recorded, exists on the master tape. As this tape passes over the reproduce head on the master tape transport, a voltage is induced in the coil of the head by the moving magnetic flux.

The voltage in the reproduce head coil is introduced into the reproduce amplifier assembly at INPUT connector J2701P, and is impressed on the grid of V2701, a conventional amplifier stage enploying an EF86/6267 vacuum tube. From this tube, the signal passes to the grid of V2702, which uses also employs an EF86/6267 vacuum tube,

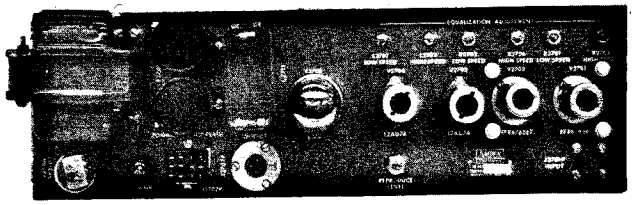

Fig. 7-1 Reproduce Amplifier

where it is amplified and fed to the grid of V2703A. Stage V2703A use one-half of a 12AU7 vacuum tube connected as a cathode follower. Equalizing feedback circuits for the two available speeds are connected from the cathode of V2703A back to the cathode circuit of the first stage through the contacts of relay K2701. The signal is also fed to the grid of V2703B through level control R2722 which provides a means of controlling signal strength.

The next three stages (V2703B, V2704A, and V2704B) each use one-half of a 12AU7 vacuum tube connected as a conventional resistance-coupled amplifier. These stages amplify the signal and deliver it to the grid of tube V2705A which, along with V2705B, forms the single-ended push-pull output stage employing a 6080 vacuum tube. Negative feedback is achieved through resistor R2744 and capacitor C2717 connected from the output circuit back to the cathode circuit of V2703B. The output signal is available at OUTPUT connector J2703P.

The high voltage d-c power supply uses a conventional full wave rectifier, employing a GA34/5AR4 vacuum tube. Unregulated plate voltage for all tubes in the amplifier, and actuating power for relay K2701, is provided. Filtering is accomplished by choke L2703, resistor R2742, and the three sections of capacitor C2720. Decoupling networks are provided by resistors R2738, R2739, R2740, and R2741 in conjunction with the four sections of capacitor C2719. A-c filament voltage for the amplifier tubes is provided by a 6.3 volt center-tapped winding of transformer T2701.

Actuation of relay K2701 is controlled by a position of the TAPE SPEED switch on the master tape transport. When this switch is in its HIGH position the relay is actuated whenever power is applied to the assembly, and its contacts select the high speed equalizing circuit. In its LOW position, the TAPE SPEED switch shorts out the coil of K2701 through terminals 9 and 10 of J2702P; the relay is de-energized and its contacts select the low speed equalizing circuit.

7.3 RECORD AMPLIFIER

The two record amplifiers in the record amplifier assembly are identical and the following circuit description for channel one also applies to channel two. An input signal from the master reproduce amplifier is introduced at J401S which is terminated in a 560 ohm resistor R401 and a pre-emphasis equalizer assembly mounted on switch S401. This equalizer section provides the pre-emphasis necessary for making either 3-3/4 or 7-1/2 ips copies from the master tape. Additional fixed pre-emphasis in the record amplifier compensates for certain losses present in the recording process. The control switch S401 is located on the record amplifier panel and is labeled RECORD EQUALIZATION - SPEED RATIO. This label acts as an operational check list indicating the speed relationship between master and slave tape transports, and the normal speeds of the master and duplicate tapes. The equalizer provides the record current pre-emphasis required for producing the 3-3/4 or 7-1/2 ips NAB copies.

When the desired speed ratios and appropriate equalization have been selected, the signal is impressed on the 600 ohm twenty step attenuator, a 2 db per step gain control. The output of this attenuator feeds the 20,000 ohm potentiometer R403, providing a means to calibrate the gain of the amplifier channel. Control R403 is a screwdriver adjustment on the front panel below the vu meter, and should be set near the high side (maximum output).

7.4 BIAS OSCILLATOR AND BIAS AMPLIFIER

The oscillator section (V501) employs a 5687 vacuum tube connected as a push-pull colpitts oscillator. Nominal oscillation frequency of this circuit is 350 kc; the absolute frequency is not critical. The output of the oscillator is fed to the grids of two 6L6 vacuum tubes, V502 and V503, connected as a push-pull amplifier. In the plate circuit of this stage is a tuned circuit, resonant at the oscillator frequency. This circuit is tuned to resonance by variable capacitor C507, which is connected across capacitor C508. If resonance cannot be achieved in the mid-range of C507 (with bias cables connected to the slave heads) it may be necessary to change the value of the padding capacitor. Use a silver mica capacitor rated at 1000 vdcw; if C507 is close to its maximum capacity increase the value of the paralleled capacitor,

and if C507 is close to its minimum capacity decrease the value of the paralleled capacitor.

The power supply uses a 5U4G vacuum tube as a full wave rectifier (V504), and a conventional regulating circuit consisting of a 6AS7 vacuum tube (V505), a 6AC7 vacuum tube (V506), and a VR75 vacuum tube (V507).

Filament voltage for V501 (5687) is provided by a single 6.3 volt a-c secondary winding of transformer T503; a second winding provides 6.3 volts a-c for the filament of tube V505 (6AS7); a third winding provides 6.3 volts a-c for the filament of tube V506 (6AC7) and meter illumination lamp I501; a fourth winding provides 6.3 volts a-c for the filaments of the two 6L6's (V502 and V503).

The bias amplifier uses the identical chassis and parts of the bias oscillator. The basic difference being that tube V501 is connected as an amplifier with a small amount of drive voltage obtained from the output of the bias oscillator. In other respects, the amplifier assembly is identical to the oscillator assembly.

The first four stages are resistance-coupled amplifiers, comprising V401 (12AU7) and V402 (6BX7GT). The EL34/6CA7 output tube is cathode follower V403. Two feedback loops are provided in the amplifier to compensate for certain losses within the system. Partial equalization is accomplished in the feedback loop from the grip of V402A to the cathode of V401A by the bypass capacitor C407. The other compensation network is contained in the feedback loop from the output of V403 to the cathode of V402A by R417 and C411. The cathode follower stage V403 provides a low impedance driving source for the slave heads which are fed from the output connector J402P through the slave switching panels. A VU meter (M401) is shunted across the amplifier output.

The output of the record amplifier is normally short circuited by relay K402. This relay is energized when the system has been started by the record start button on the master control panel. The function of the relay is to short the slave record heads whenever the system is not actually recording, thus preventing transient power on and power off signals from magnetizing the slave record heads or damaging the output meter.

Plate power is supplied by parallel full wave rectifiers, vacuum tubes, V407 and V408, the filtering consisting of capacitor C433, inductance L401 and capacitor C434. Two isolation filters, inductance L402 and capacitor C437, inductance L403 and capacitor C436, feed respective record channels.

Two separate filament windings are used. One winding supplies 6.3 vac to V401, V402, V404, V405 and meter illumination. This winding is balanced to ground return by R463 and R465. The second winding provides 6.3 vac to the output tubes V403 and V406. This winding is balanced to +135 volts d-c to prevent excessive potential between the cathode and the filament of the output tubes.

A 47,000 ohm resistor, R471, is used to limit the output voltage of the power supply until the tubes have warmed up. The thermal time delay relay K401, short circuits this resistor fifteen seconds after power is applied.

7.5 SLAVE SWITCH PANEL

Each output of the record amplifier assembly(ies) is fed to one of the record INput connectors on the slave switch panels associated with each slave tape transport. From the INput connector, the signal is fed to the appropriate slave HEAD connector through a variable resistor, a fixed resistor and a head switch.

The bias current is delivered from the bias oscillator (or bias amplifier if used) by a bias buss to the slave switch panel, thence to the proper slave HEAD connectors through a fixed capacitor, a variable resistor and the same head switch as the record signal.

The return path of each record head to circuit ground continues through a 10 ohm resistor which is shunted across its respective record current jack.

An a-c vtvm can be used to measure the record and bias currents. To measure bias current, connect the vtvm to the appropriate head current jack. Turn the level controls of the record amplifiers to zero and energize the bias oscillator (or bias amplifier) by pressing the RECORD button on the master control panel. Set the bias oscillator (or bias amplifier) VU meter to read zero VU. Energize the appropriate head switch. The reading on the vtvm should be approximately -18 dbm (which corresponds to 10 milliamperes of bias current). To measure record current, connect the vtvm to the appropriate head current jack and disconnect the bias relay plug from the rear of the

master bias oscillator (and the master bias amplifier). Connect an oscillator to INPUT jack J401S or J403S of the appropriate record amplifier. Set the oscillator at a frequency of 2000 cycles with an output of +4 dbm. Set the record amplifier LEVEL CONTROL to provide 0 VU level on the record amplifier meter. The vtvm reading should be approximately -42 dbm (which corresponds to 0.62 milliamperes of record current).

7.6 MASTER CONTROL PANEL

Theory of operation

Power is supplied to the panel through (Power Socket) J201P. Refer to System Cabling Diagram in Section 2. Placing Switch S203 in the "ON" position supplies power to J206S (AC to Bias) and J207S (AC to Record) thence through interconnecting cables to the Bias Oscillator (and Bias Amplifier if used) and the record amplifiers.

Voltage is supplied to POWER indicator lamp I202 and through current limiting resistor R201 to half wave rectifier SR201. Pulsating DC voltage from the rectifier is smoothed by capacitor C201. Bleeder resistor R202 provides a load for the rectifier system to prevent excessive peak voltage during standby periods.

When "START-RECORD" button is pressed one section of Switch S201 supplies DC voltage to J202S, J203S and remote control connector J208S. The DC voltage from J202S and J203S is carried by interconnecting cables to the fast start boxes of all transports including the master transport and momentarily energizes all start relays K101, the contacts of which are paralleled with the "START" switch in each transport. Holding contacts are not required on start relay K101 as the play relay in each transport carries its own holding contact.

The second section of "START-RECORD" switch S201 supplies DC voltage to "RECORDING" lamp I201, remote control connector J208S and relay K201. When Relay K201 energizes one set of its contacts removes bleeder resistor R202 from the DC supply and supplies DC voltage to "BIAS RELAY BUSS" connector J209S. Voltage from this connector is taken to the BIAS OSCILLATOR (and bias amplifier if used) through interconnecting cables and energizes relay K501 in that assembly. The second set of contacts on K201 provides a holding circuit through J203S, an interconnecting cable, and de-energized contacts of K102 in the master transport fast start box.

Depressing the "STOP" button of Switch S202 supplies DC voltage to J202S, J203S and "Remote Control" connector J208S. Interconnecting cables to the "FAST START" boxes on each transport carry the DC voltage to relay K102 in each box and momentarily energizes this relay. One set of K102 contacts opens the circuit of "Tape Motion Relay" holding contact in its associated transport causing the transport to stop. A second set of contacts on K102 opens the circuit holding relay K201 which de-energizes and the system returns to standby condition.

The remote control connector J208S may be used when remote or multiple controls for the system may be desirable. A suggested circuit for the remote control is shown on schematic diagram in Section 8. The remote "START" and "RECORD" switches may be combined into a double pole switch if convenient.

7.7 FAN AND CIRCUIT BREAKER PANEL

The fan and circuit breaker panel is mounted at the bottom of the 3300B racks assembly. It provides forced draft cooling to the electronic assemblies and is the central point for a-c power distribution within the rack. Secondly, the four connector receptacle (J1A, J1B, J2A and J2B) may be used as an auxiliary outlet or can supply power to the master duplicator and if desired the first slave duplicator. A circuit breaker reset switch controls a-c power to the entire rack, the on-off switch and a fuse for the fan motor.