555
DECTAPE
DUAL TRANSPORT

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS

H-555

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COPY NO.

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CHAPTER 1

INTRODUCTION AND DESCRIPTION

INTRODUCTION

The DECtape Dual Transport Type 555 is composed of the motor drives, tape heads, and control relays necessary for the selection, motion control, and transfer of stored digital information. The Type 555 records bits in the Manchester system (phase recording) at a density of 375 (plus or minus 60) bits per track inch.

The dual transport consists of two logically independent tape transports each capable of handling two 3-1/2 inch reels of 3/4 inch tape. The Mylar tape is 1.0 mil thick, 260 feet long, and stores approximately 3 million bits. The transports are capable of bidirectional operation; reading, writing, or searching can be done in either direction.

Reliable recording is obtained by redundantly pairing the ten tracks of the head assembly. The resulting tape recording consists of three paired information tracks, a pair of mark tracks, and a pair of timing tracks. Since tape speed is approximately 80 inches-per-second, an effective information transfer rate of 90,000 bits is achieved. No pair of tracks is adjacent, and redundancy is achieved by series wiring the two heads for a pair of tracks. On reading, the analog sum of the heads is used to detect the correct value of the bits. Thus, a bit cannot be misread unless the noise on the tape is sufficient to change the polarity of the sum of the signals being read. Noise that reduces the signal amplitude has no effect on bit detection.

The Type 555 Transport uses a simple drive system without capstans, pinch rollers, or tensioning mechanisms.

The reels are designed so that the ratio of the outside tape diameter to the inside tape diameter is a relatively low 1.3 to 1. Thus, the torque requirements and the tape tension are almost constant in either direction throughout the tape length.

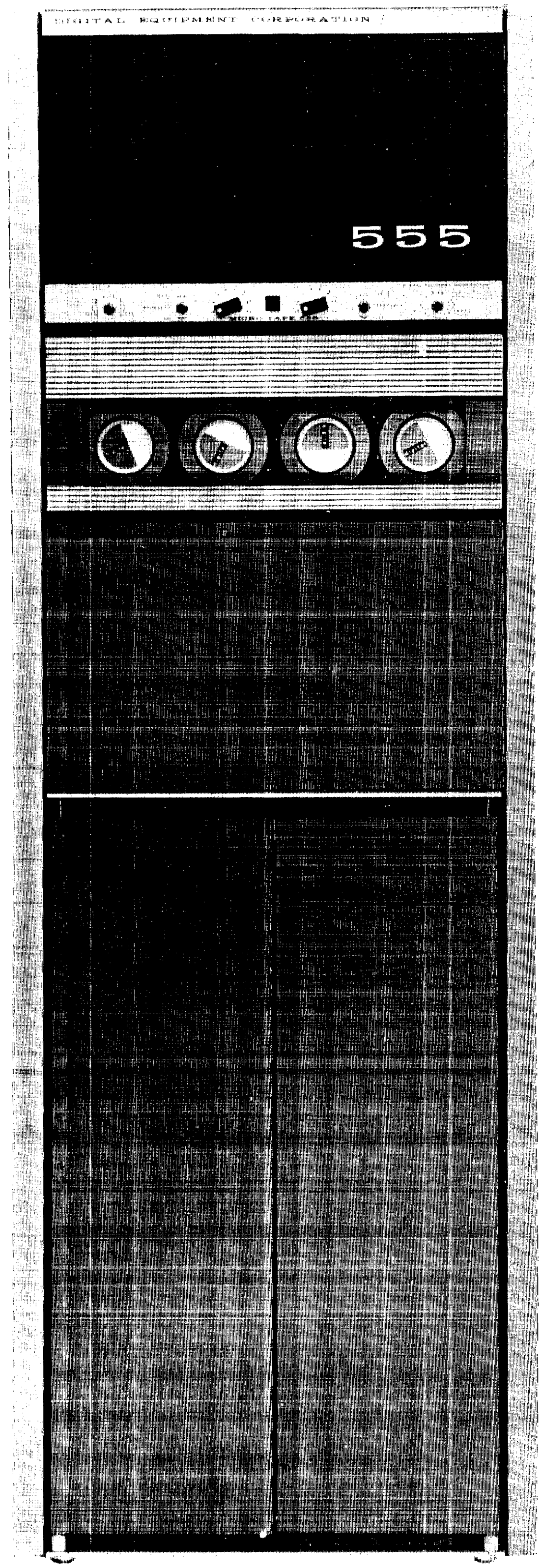


Figure 1 Dual Transport Type 555 as shown in System I

SPECIFICATIONS FOR DECTAPE TRANSPORT MODEL 555

General

Overall Size	10-1/2 in. high, 19-1/2 in. wide, 17 in. deep
Weight	65 lbs
Mounting	Standard 19 in. rack. Four No. 10-32 screws spaced the same as for a standard 10-1/2 in. panel are used for mounting. Transport extends 13 in. behind mounting surface. Desk model also available on request (30 ft max interconnecting cable).
Power Requirements	-15 vdc 2.0 amp max 115 vac ±10% 1.2 amp idle 3.2 amp max 60-cycle models standard, 50-cycle models on request.
Connectors	1 ea chassis-mounted male power socket 4 ea Type 133 male 22-pin amphenol connectors, paired to provide jumpering to sequential transports for both head connection and control connection.
Cooling	Internally mounted fans are provided
Operating Temperature	50°F to 110°F ambient
Humidity	10 - 90% relative humidity

NOTE: The manufacturer of the magnetic tape for DECtape recommends 40 - 60% relative humidity and 60 - 80°F as acceptable for operating environment.

Tape Characteristics

Capacity	260 ft of 3/4 in. 1 mil Mylar sandwich tape
Reel Size	3-1/2 inches diameter
Real Diameter	1.3
Tape Handling	Direct drive hubs and specially designed guides which float the tape on a cushion of air. No capstans or pinch rollers are used.
Speed	90 ±14 ips

Density	350 ±55 bits per inch
Information Capacity	2.6×10^6 bits per reel assembled into computer length words by control
Tape Motion	Bidirectional

Drive Characteristics

Times given are for 90 percent full speed.

Start Time	<300 ms
Stop Time	<150 ms
Turn Around Time	<300 ms
Start Distance	<9 in.
Stop Distance	9 ±2 in.

Control Inputs (ground level for assertion from -15 v dc)

8 selection lines

1 forward command

1 reverse command

1 GO command

1 STOP command

1 two wire interlock for write amplifiers

1 ALL STOP line - absence of the ground level causes the unselected transport to stop. Used to stop transports when program stops.

All control inputs except the ALL STOP line require 150 ma dc max. The ALL STOP line requires 1.2-amp dc max. (150 ma dc each drive).

TIMING CONSIDERATION

The 555 Transport uses relays which have a maximum operate time of 17 milliseconds. Therefore, to insure reliable operation the commands to the transport must be held long enough for the relays to respond. See Figure 2 for acceptable command sequences and times.

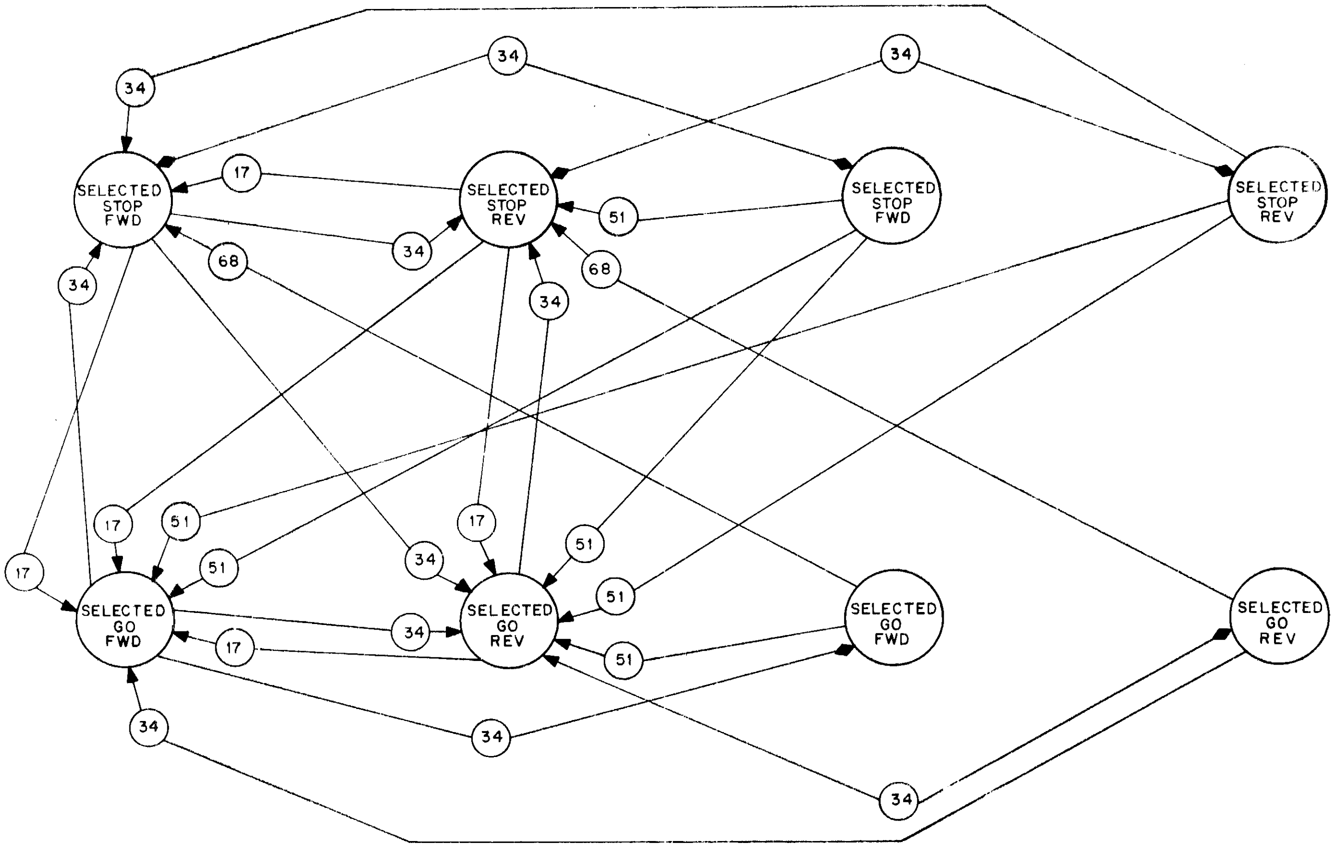


Figure 2 555 Timing Diagram

NOTE:

1. Circled numbers indicate the minimum time in milliseconds necessary for the transport to accept and hold the indicated commands.

2. Diamond shaped arrows indicate reversable paths.

3. Only those paths which are not illegal, meaningless or impossible are shown.

4. A STOP command should not be given for at least 150 milliseconds after a GO command.

INFORMATION HANDLING

Connection to the bus is done when a drive is selected. The tape head is a 10-track head paired to form five redundant channels; one timing channel, one mark channel, and three information channels.

Information to and from each drive is accomplished via the tape head which is connected to a 20-wire bus.

CHAPTER 2

THEORY OF OPERATION

This section provides a functional description of the chassis wiring shown on Drawing No. D-25326 in Appendix 1. The Type 555 is composed of two identical tape drives; only one will be described here. The Type 555 can be divided into three areas for the purpose of description: the tape head (see Chapter 1); the motors and their voltage supply network; and the motion control relay network.

DRIVE MECHANISM

Motor voltage is applied whenever the OFF-WRITE LOCK-WRITE switch is in either the WRITE LOCK or the WRITE position. The motors are electrically connected for contrarotation and are matched for equal torque characteristics at assembly. At standstill, equal voltage is applied to both motors; the equal torques developed by the motors buck out any tape movement. The tape moves when one of the 200-ohm resistors is shunted out in each motor voltage supply path. The resulting increased current then allows that motor to develop more torque than its mate and rotates the tape in the desired direction.

Braking occurs when the 200-ohm resistor is momentarily shunted out in the voltage supply path of the trailing motor while inserting a 200-ohm resistor in the path of the leading motor. The trailing motor then develops the greater torque until the tape is brought to a halt. At tape halt, the 200-ohm resistor is reinserted in the voltage supply path of the trailing motor, and equal voltages are again applied to both motors. Adjustments are provided to exactly govern the duration in which braking voltage is applied to the trailing motor. A 100-ohm resistor is in series with the motor voltage supply paths to limit power dissipation while the transport is idle.

MOTION CONTROL RELAY NETWORK

The motion control relay network is composed of seven relays and a 3-position switch. The network provides for tape motion under direction of an external control or under the direction of an operator. During automatic operation, the control applies ground-level reverse, forward, stop, and go commands to the transport. The relay energizing voltage is taken from a -15 vdc supply common to all relays. Each command line draws 120 ma dc. The transport must first be selected for operation before command signals can be applied; energizing the select relays enables the command lines. The motion control commands are then applied to corresponding relays that control the amount of resistance in the motor voltage supply paths.

In manual operation, motion is stopped in the AUTO position of the REV-AUTO-FWD switch. Holding the switch in the REV or FWD position applies a ground to the appropriate relays to command motion to start in either the forward or reverse direction. Releasing the switch de-energizes the relays and stops the motors.

Reliable electrical operation is enhanced by the incorporation of damping networks and limiting diodes across the relay coils as well as arc-suppression networks across the relay and switch contacts.

Automatic Operation

For automatic operation, the SELECT switch must be set to the proper address, the OFF-WRITE LOCK-WRITE switch must be in either the WRITE LOCK or the WRITE position, and the REV-AUTO-FWD switch must be in the AUTO position. The red lamp is illuminated when a switch in the control is set to write "mark and timing" information on the tape. This lamp warns the operator that the write amplifiers for the mark and timing track are enabled and if any write commands are given, the mark and timing channels will be destroyed. When the OFF-WRITE LOCK-WRITE switch is not in the OFF position, operating power is applied to the motors. However, the motors are held at standstill by the equal voltages developed across the series-parallel resistor network. Thus, the unit is ready to operate under command of the external control, but command signals cannot be applied until the transport is selected for operation.

The transport is selected by a select command (ground) applied through the SELECT switch. The select command energizes the SEL 1 relay K3. When K3 is energized, it enables the FWD and REV command lines; it also energizes the SEL 2 relay K5 through contacts 1 and 3 of K3. The energizing of K5 enables the STOP and GO command lines and also applies energizing voltage to the head relays. Thus, once a select command is received, the motion control command paths are enabled and the head relays are energized. In addition, the write interlock loop is completed through contacts 1 and 3 of K5. The transport is now ready to receive motion commands.

Motion Commands

Assume that the transport receives a FWD command (ground). The command energizes the FWD relay K4 and connects it to a latching network through its normally open contacts 6 and 7 and the normally closed contacts 1 and 4 of REV relay K7.

Now, assume that a GO command (ground) is applied to the transport. The command energizes the GO relay K2 and connects it to a latching network through its normally open contacts 1 and 3 and the normally closed contacts 1 and 4 of STOP relay K6. Closing the GO relay K2 places ground on the TIME relay K1 through contacts 6 and 7 of K2. The TIME relay K1 energizes, and the RC time constant across its coil begins to charge. The charging time is adjusted by the 1K variable resistor (R2 or R4).

When the TIME relay K1 energizes, the tape begins to move forward. Initially, the motors are held at standstill by the equal voltages developed across the series-parallel resistor network. When the TIME relay K1 energizes, the 100-ohm resistor in the motor voltage supply path is shunted out by a 2-ohm resistor. When the TIME relay K1 energizes, operating voltage for the FWD motor is developed through the parallel combination of the 2-ohm resistor and the 100-ohm resistor; the voltage is applied through the closed contacts 1 and 3 and 11 and 9 of the TIME relay K1. With nearly full line voltage applied, the FWD motor produces greater torque than the REV motor and moves the tape forward.

Stop Command

Assume that a STOP command is now applied to the transport. The command (ground) energizes the STOP relay K6, interrupting the latching circuit at its contacts 1 and 4 for the GO relay. The GO relay K2 immediately de-energizes. However, the TIME relay K1 is held energized by the RC network across its coil for a period dependent on the charge of the capacitor. Since one leg of the RC network limits the charging time of the capacitor, the amount of charge (and the time to discharge) is a function of the time the transport has been in motion. During the period when the GO relay K2 is de-energized and the TIME relay K1 remains energized, the voltage formerly used to drive the FWD motor is applied through the normally closed contacts 11 and 8 of the GO relay K2 as braking voltage for the REV motor. When the TIME relay K1 de-energizes, the motors stop. The motors are then held at standstill by the equal voltages developed across the 200-ohm resistors and the 100 ohm-limiting resistor. The transport has been designed to retain all motion commands. Therefore, if selection to the transport is removed, the last motion command will dictate its condition.

Reverse Command

A REV command (ground) energizes the REV relay K7, opening its normally closed contacts 1 and 4 to unlatch the FWD relay K4. Note that the FWD relay K4 latches on the receipt of the first FWD command and remains latched until a reverse command is received.

Operation for a reverse command is identical to that for a forward command, with the obvious exception that resistance is shunted out of the REV motor voltage supply path to move the tape in the reverse direction.

Manual Operation

In manual operation, the OFF-WRITE LOCK-WRITE switch must be either in the WRITE LOCK or the WRITE position. During manual operation, the write interlock loop is interrupted and the transport cannot respond to write commands from the control.

Tape movement during manual operation is manipulated by the REV-AUTO-FWD switch. Assume that the switch is held in the FWD position. Ground is applied from pin D of P4 through contacts 1 and 2 of the D section of the REV-AUTO-FWD switch to energize the FWD relay K4. Simultaneously, ground is applied through contacts 1 and 2 of Section C of the switch to energize the GO relay K2 and the STOP relay K6. The 50 MFD capacitor on the line to the STOP relay K6 charges to the relay energizing voltage. When the GO relay K2 is energized, it immediately energizes the TIME relay K1. Resistance is then shunted out of the FWD motor voltage supply path and the tape moves forward.

Returning the REV-AUTO-FWD switch to the AUTO position removes the ground from the GO relay K2 and it immediately de-energizes. The motors are then braked to a halt in the usual manner. The charge on the capacitor holds the STOP relay K6 energized for a short period after the GO relay K2 de-energizes; this guarantees that the transport to come to a halt. The sequence of operations to stop the drive is the same as described for the stop command (previously explained under Automatic Operation).

Placing the REV-AUTO-FWD switch in the REV position has the same effect, except that REV relay K7 is energized, opening its normally closed contacts to allow the FWD relay K4 to de-energize to insure reverse motor rotation.

CHAPTER 3

OPERATION

CONTROLS

The DECtape Dual Transport Type 555 is fitted with duplicate controls for each channel (Figure 3).

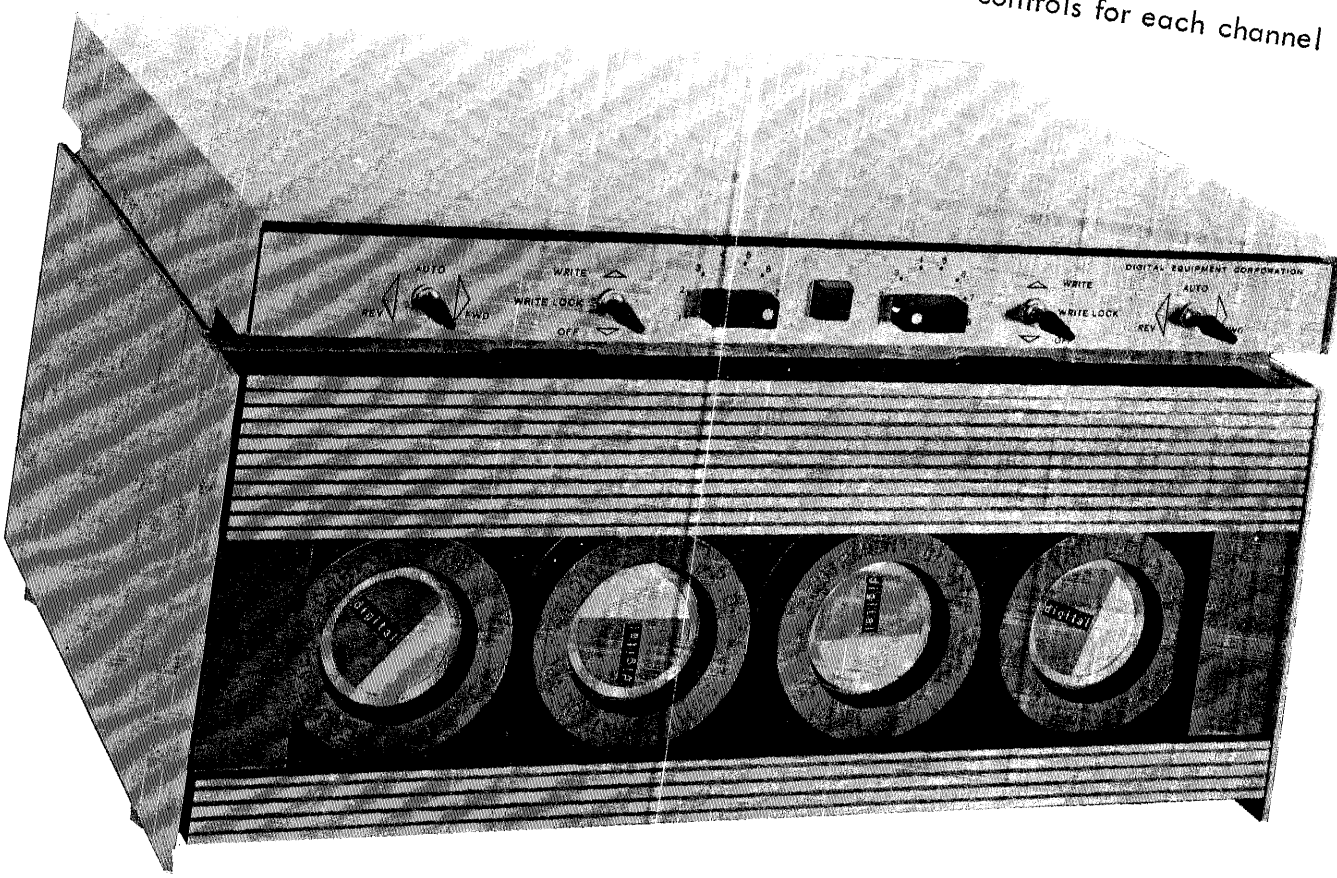


Figure 3 Dual Transport - Type 555

MANUAL CONTROLS

OFF - WRITE LOCK - WRITE - Switch

In the OFF position the AC voltage to the motors is interrupted. The WRITE position completes the 2-wire interlock if the drive is selected. The WRITE LOCK position supplies 117 vac to the motors and inhibits write functions via the 2-wire interlock.

REV - AUTO - FWD - Switch

Provides manual control to move tape either reverse or forward. The AUTO position returns motion control to the DECtape control.

Selection Switch

Allows the user to designate any available drive to the number desired. Numbers provided are 1-8, inclusive.

Indicator Lamp

A red indicator lamp warns the user that the writers for the timing and mark track are enabled.

TAPE LOADING

The 3-1/2 inch tape reels are loaded by pressing the reel onto the hub, bringing the loose end of the tape across the tape head, and attaching it to the take-up reel. The reels are then spun by hand for a few revolutions. The AUTO-REV-FWD control allows the user to manipulate the tape in either direction. Figure 4 shows the tape properly loaded on the tape head and tape guide.

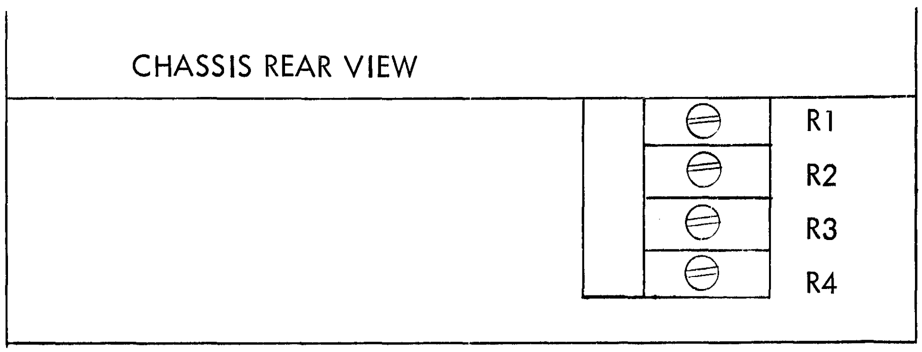
Figure 4 Tape on Head and Guide

CHAPTER 4

MAINTENANCE

ADJUSTMENTS

There is only one type of field adjustment on the 555: the "STOP" time adjustment on the rear of the chassis governs the time interval in which the time relay remains energized. The adjustments are shown below.



R1 - Side B Long "GO" Time "Stop" Adjustment
R2 - Side B Short "GO" Time "Stop" Adjustment
R3 - Side A Long "GO" Time "Stop" Adjustment
R4 - Side A Short "GO" Time "Stop" Adjustment

NOTE: Clockwise adjustment decreases resistance.

There are two "STOP" adjustments for each drive, a long "GO" time "STOP" adjustment and a short "GO" time "STOP" adjustment. The long "GO" time "STOP" adjustment (LGSA) is used to correct the stop characteristics of a drive which has been running at full speed. Therefore, when adjusting the LGSA, the drive must be in motion for longer than 1 second. The short "GO" time "STOP" adjustment (SGSA) is used to correct the stop characteristics of a drive which has not attained full speed. The SGSA is done for a GO command of 120 milliseconds.

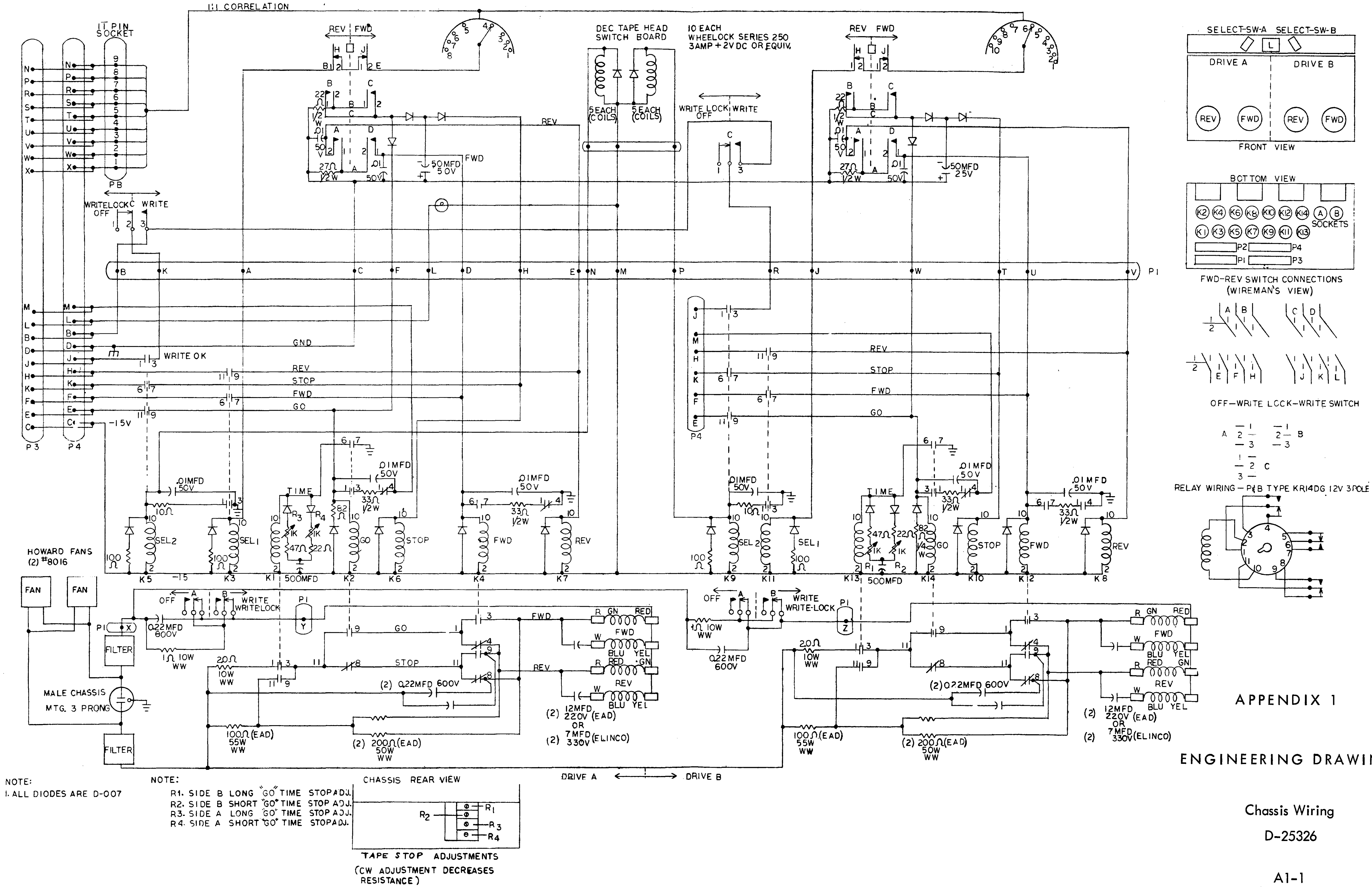
The adjustment may be made either automatically via a computer program or manually via the REV-AUTO-FWD switch. The computer program is preferred. For best results the LGSA should be set first and the SGSA second. There is no interaction as long as this sequence is followed and the long GO command given as specified above. Optimum performance is usually obtained when the adjustments are done with the tape equally distributed on both reels and when the settings cause the tape to come to either a rigid stop or with a slight amount of drift. The drive should never be adjusted for a condition where the tape backs up after a stop command.

CLEANING

The Type 555 requires no periodic cleaning or lubrication. However, the tape heads and tape guides must be regularly inspected for cleanliness and cleaned with Freon 5 solvent whenever contamination is noticed.

CONNECTORS

The connectors and the pins should be checked every time a connector is disconnected. Bent pins can be straightened by the careful use of a pin-straightener.



APPENDIX 1

ENGINEERING DRAWING

Chassis Wiring

D-25326