MOTOROLA

SERVICE MANUAL
— VP39 —

COMPOSITE VIDEO CRT DISPLAY MONITORS

DS3000, 3003 SERIES*
(12-INCH)

DS4000, 4003 SERIES*
(15-INCH)

* SEE MODEL COMPLEMENT TABLE/PAGE 4

GENERAL INFORMATION

The CRT display monitors described herein are fully transistorized (except CRT) and applicable for displaying alphanumeric characters. The DS3000, DS3003 series monitors use a 12-inch CRT, and the DS4000, DS4003 series monitors use a 15-inch CRT. Each monitor accepts and operates from a 0.5—2.5V P-P composite video signal (white positive).

A universal power transformer permits operating this series of monitors from 120, 220, or 240 volts @ 50/60Hz. A built-in regulated power supply provides operating voltages of +24V, +13V and +5V.

Signal input connections for a monitor may be made through an assortment of connectors using shielded single-conductor cable. In addition, some models may utilize one or two BNC receptacles on the rear of the chassis. AC power to the monitor is interconnected via a separate connector, which may also vary between models.

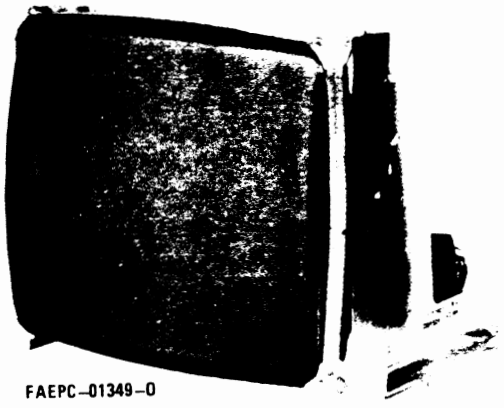
Depending on the monitor model number, there may be a maximum of three (3) circuit cards present.

1. Differential Amplifier circuit card (optional)
2. Composite Video circuit card (standard)
3. Monitor circuit card (standard)

The optional Differential Amplifier circuit card, when present, receives the incoming composite video signal. Its circuitry consists of a two-stage differential amplifier, and a one-stage constant current source. Output from this circuit card, to the Composite Video circuit card, is composite video (white positive).

The Composite Video circuit card can receive the composite video signal direct from an external source, or from the (optional) Differential Amplifier circuit card (when present). Circuitry consists of a one-stage composite video amplifier, two stages of video pre-driver, one stage of composite sync separator, and an (optional) one-stage composite blanking amplifier (when present). Output from this circuit card, to the monitor circuit card, is separate (TTL level) horizontal/vertical sync and video.

TTL level inputs to the monitor circuit card are received from the Composite Video circuit card, which is soldered into the Monitor circuit card. Circuitry consists of two stages for video amplification, one integrated circuit for vertical sync/deflection processing, five stages for horizontal sync/deflection processing, and a three stage regulated power supply. All models also contain dynamic focusing and spot kill circuitry on the monitor circuit card.



FAEPC-01349-O

Model DS4000, DS4003 Series (15" CRT)

Model DS3000, DS3003 Series (12" CRT)

MOTOROLA INC.

Display Systems

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MANUAL VP39
9/81

PART NO. 68P25253A85-O

SAFETY WARNING

CAUTION: NO WORK SHOULD BE ATTEMPTED ON AN EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.

1. SAFETY PROCEDURES should be developed by habit so that when the technician is rushed with repair work, he automatically takes precautions.

2. A GOOD PRACTICE, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.

3. Extreme care should be used in HANDLING THE PICTURE TUBE as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in.). Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

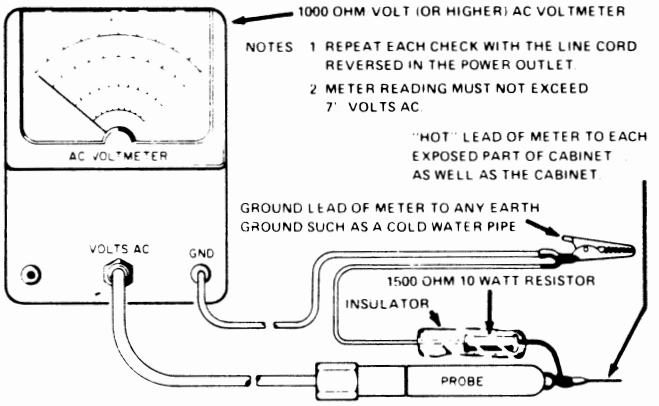
4. An ISOLATION TRANSFORMER should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always REPLACE PROTECTIVE DEVICES, such as fishpaper, isolation resistors and capacitors and shields after working on the unit.

6. If the HIGH VOLTAGE is adjustable, it should always be ADJUSTED to the level recommended by the manufacturer. If the voltage is increased above the normal setting, exposure to unnecessary X-ray radiation could result. High voltage can accurately be measured with a high voltage meter connected from the anode lead to chassis.

7. BEFORE RETURNING A SERVICED UNIT, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER WHEN MAKING THIS TEST.

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories should be performed by the service technician before any unit which has been serviced is returned.



Voltmeter Hook-up for Safety Check

A 1000 ohm per volt AC voltmeter is prepared by shunting it with a 1500 ohm, 10 watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

The AC voltage indicated by the meter may not exceed 7½ volts. A reading exceeding 7½ volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and "earth" ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

NEVER RETURN A MONITOR which does not pass the safety test until the fault has been located and corrected.

SPECIFICATIONS*

DISPLAY

- **DS3000** – 12" diagonal measure
- **DS4000** – 15" measured diagonally, 14" diagonal viewable area
- 110° deflection angle
- 3 X 4 aspect ratio
- P4 phosphor standard (other EIA phosphors available)
- T band U.L. implosion protection
- Direct etch and PPG optional
- **Standard Display Size:** (DS3000) 8.5 X 6.0, (DS4000) 10.0 x 7.5
- Capable of displaying over 3400 characters.

VIDEO PERFORMANCE

- **Resolution:** 1200 lines center, 950 lines corners (P4 phosphor)
- **Bandwidth:** within 3 dB, 10 Hz to 30 MHz is typical.

SYNCHRONIZATION

- **Horizontal:** 15.7 kHz ± 500 Standard, 18.7 kHz ±500 optional
- **Vertical:** 47 to 63 Hz
- **Horizontal Blanking:** 11 μSec minimum (for scanning frequency of 15.7 kHz). 10 μSec minimum (at 18.7 kHz). Time includes retrace and delay.
- **Vertical Blanking:** 800 μSec (includes retrace and video delay)

INPUT SIGNAL

- **Composite Video:** positive white, input termination 75 ohms ± 5%, 0.5-2.5V PP (RS170 compatible.)

POWER INPUT

- 120/240V AC (105–135), 50/60 Hz, 65VA max.
- 24V DC optional

INTERCONNECT TO CUSTOMER SYSTEM

- BNC type connector(s)
- Other types optional

CONTROLS

- **Internal:** Horizontal size, horizontal video centering, brightness, focus, vertical hold, vertical size, vertical linearity. (All controls adjustable from top or back of unit).
- **External:** Brightness and contrast (as operator controls).

GEOMETRY (Pin and Barrel)

- Sides equal less than 1% of height.
- Top and bottom equal less than 1% of width.

LINEARITY

- Character height or width will not vary ±7% from the average character size.
- Adjacent characters will not vary more than 5%.

ENVIRONMENT

- **Operating Temperature:** 0° to +55°C
- **Storage Temperature:** –40°C to +65°C **Note:** CRT's with bonded etched panels should not be subjected to storage or operating temperatures above 50°C
- **Operating Altitude:** 10,000 ft. max. Designed to comply with DHHS Radiation Performance Standards, U.L. and C.S.A. specifications.

*In a continual effort to upgrade our standard products as new technological advances are made, specifications are subject to change without notice.

MODEL COMPLEMENT TABLE

	– MODEL NUMBER – (Note 1)	COMPOSITE VIDEO CIRCUIT CARD	COMPOSITE BLANKING AMPLIFIER CIRCUIT (Note 2)	VIDEO IN/ VIDEO OUT (LOOP-THRU) & 75 OHM TERM. SW.	DIFFERENTIAL AMPLIFIER CIRCUIT CARD
12" CRT DISPLAY MONITORS	DS3000, 3003 – ___55	X			
	DS3000, 3003 – ___56	X	X	X	
	DS3000, 3003 – ___57				
	DS3000, 3003 – ___58				
	DS3000, 3003 – ___59				
	DS3000, 3003 – ___65	X			X
	DS3000, 3003 – ___66	X	X	X	X
	DS3000, 3003 – ___67				
	DS3000, 3003 – ___68				
	DS3000, 3003 – ___69				
15" CRT DISPLAY MONITORS	DS4000, 4003 – ___55	X			
	DS4000, 4003 – ___56	X	X	X	
	DS4000, 4003 – ___57				
	DS4000, 4003 – ___58				
	DS4000, 4003 – ___59				
	DS4000, 4003 – ___65	X			X
	DS4000, 4003 – ___66	X	X	X	X
	DS4000, 4003 – ___67				
	DS4000, 4003 – ___68				
	DS4000, 4003 – ___69				

NOTES:

1. This column will contain an alpha or numeric designator, which denotes CRT Phosphor. It will vary between models.
2. Optional circuit on composite video circuit card (when present).

IONITOR CIRCUIT CARD

ower Supply (Refer to Figure 19)

The power supply is a transformer operated, full wave, egulated series pass circuit that maintains a constant utput voltage with line input variations of ± 12.5%. De- ending on how connector S1 is wired, operation from 20, 220 or 240 volts, 50/60 Hz is possible. Integrated ircuit IC101 is the reference amplifier, transistor Q102 ; the regulated output driver, and Q101 is the series pass ransistor.

he output voltage, +24V, appears at the collector of 1101. The +24V is used on the monitor circuit card, and is lso routed to the composite video circuit card and differ- ntial amplifier circuit card via pin 7 of P2. This voltage ; divided between R106, R107 and R109. Resistor R108 mits the range of R107. The voltage appearing on the rm of potentiometer R107 (24V ADJ. control) is the eference input to the inverting input (–) of reference mplifier IC101.

A temperature compensated zener diode, VR101, estab- ishes a fixed reference voltage at the non-inverting input +) to IC101. Resistors R110 and R111 and diode D105 rovide bias current for VR101. The junction of R110 and R111 is the +13V source for the horizontal oscillator, C402. Regulator VR101 is also the 5 volt source for the nonitor circuitry. Operating voltage for IC101 is derived rom resistor network R101 and R105.

An increase in output current will cause a decrease in out- ut voltage due to internal supply impedance. This will ause the voltage at the base of Q102 to become more ositive via the inverting amplifier IC101. With the base nore positive, Q102 will conduct more, increasing its collector current. This increases the base current in Q101. The result is increased output current from Q101, raising he output voltage and maintaining the proper output oltage level.

Electrolytic capacitor C101, section "A", filters the bridge rectifier (D101–D104) output, while section "B" provides additional filtering of the +24V regulator output. Capacitor C103 filters the +5 volt source. R102 is the load resistor for Q102. Resistors R103, R104 bias Q102. Capacitor C102 increases regulation at high frequencies for improved transient response.

Video Amplifier (Refer to Figure 20)

The linear video amplifier consists of two stages, Q201 and Q202, which are connected in a cascode configuration. This common emitter-common base arrangement greatly reduces the effect of Miller capacity (when compared to a conventional single transistor video amplifier/output stage).

A TTL compatible (white positive) video signal, approximately 2.5-4.0 volts P-P, is DC coupled to the base of Q201 via R202. R203 and C201 provide high frequency compensation to maintain a flat response when Q201 and Q202 conduct.

During a no-signal condition, video driver transistor Q201 is off. At the same time, video output transistor Q202 is base biased at 6.0V by R217 and R218. When a video signal is applied to the base of Q201, it turns on, allowing Q202 to conduct. The resultant output is developed across collector load resistor R210 and DC coupled to the CRT cathode via peaking coil L201 and resistor R211. Q202 is protected from CRT arcing by a spark gap built into the CRT socket, and R211 further isolates Q202 from transcients. Capacitor C204 shorts video frequency signals from the base of Q202 to ground. Peaking coil L201 increases the high frequency response of the video amplifier. Capacitor C205 provides filtering of the +70V supply, while C206 is a high frequency AC bypass capacitor to ground.

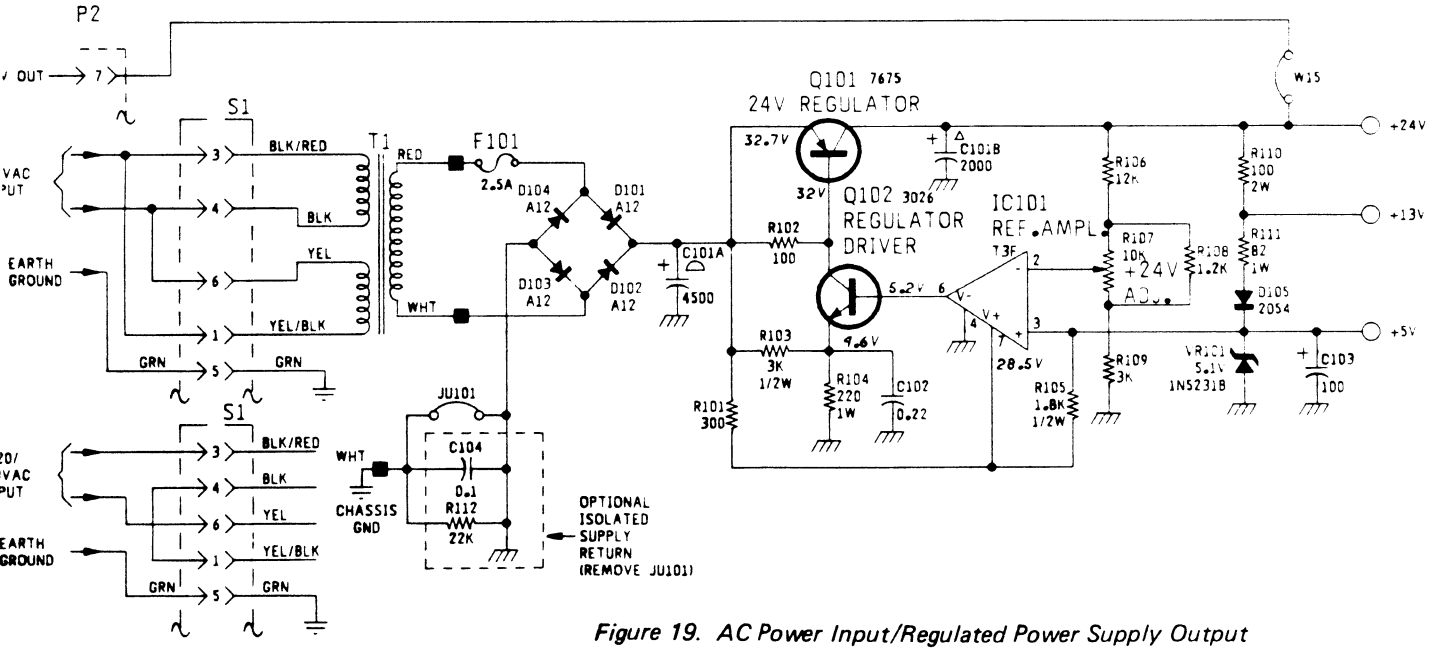


Figure 19. AC Power Input/Regulated Power Supply Output

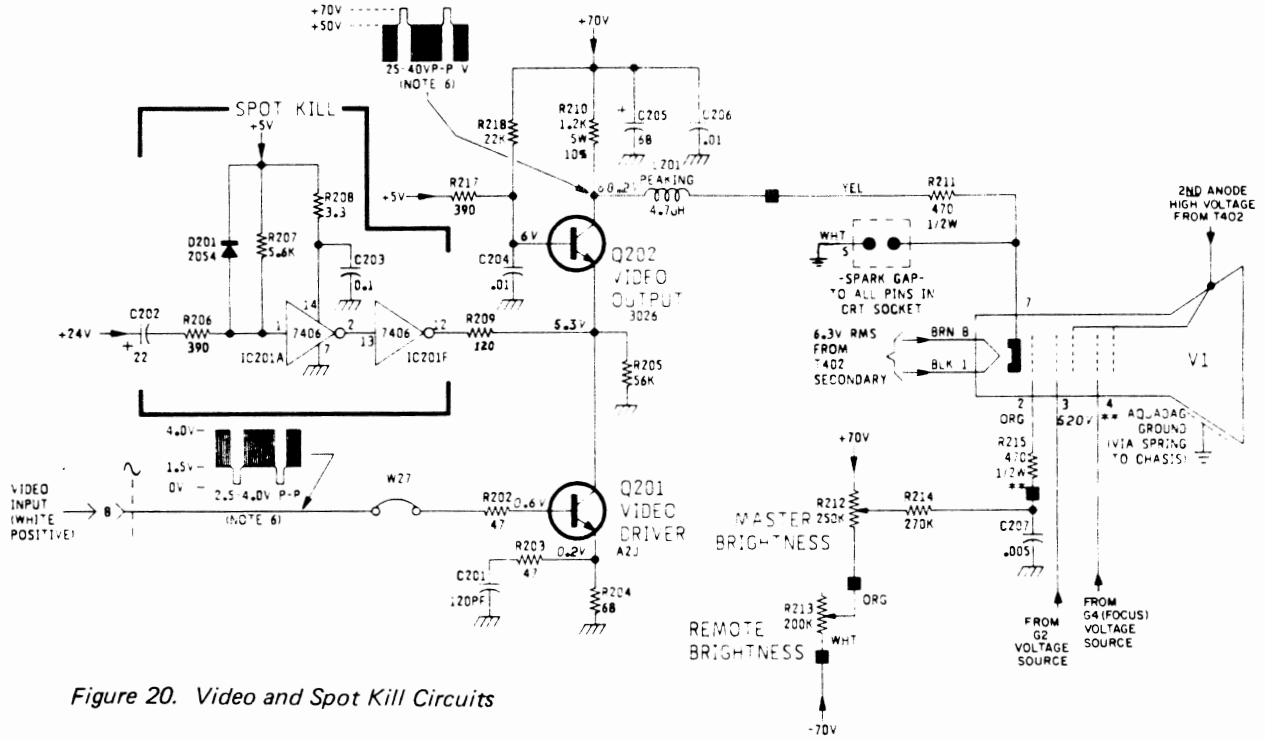


Figure 20. Video and Spot Kill Circuits

Spot Kill (Refer to Figure 20)

When power is removed from the monitor, the horizontal and vertical scans collapse and a bright spot is left that will burn a spot in the phosphor screen unless prevented from doing so.

When the monitor is turned off, the decrease in the 24V supply voltage is coupled through capacitor C202 and resistor R206 to pin 1 of IC201A. This TTL input is normally held in the high state by resistor R207. The falling 24V supply switches IC201A to the low state at pin 1, which is inverted to a high at pin 2 of IC201A; then inverted to a low again by IC201F at pin 12. The open collector output of IC201F, now in the low state (conducting), pulls R209 to ground to become the emitter resistor of Q202. With 6.0 volts on its base, Q202 saturates. The resulting low collector voltage on Q202 is coupled to the CRT cathode causing it to conduct heavily. The large cathode current in the CRT discharges the second anode during scan collapse. The second anode is completely discharged before the scan currents collapse completely so that a spot can not form.

Vertical Scan (Refer to Figure 21)

Negative-going TTL level pulses pass through resistor R301 and protective diodes D301 and D302 to IC201B. The input to IC201B accepts, through jumper JU302, negative vertical sync.

Output pulses from IC201E (pin 10) are differentiated by capacitor C301 and resistor R306. Diode D303 couples only the negative-going spikes from the differentiator circuit to the sync input of IC301 (pin 8). R307 and R308 provide input current limiting. The sync input (pin 8) performs several functions. It strips away any random noise that may be present on the input line and conditions the vertical pulses for processing. It also converts the input voltage pulses to current to control the internal oscillator. The oscillator generates a non-symmetrical square wave with a short duty cycle at the vertical scan frequency (50 to 60 Hz). Components R310, R311 and C304 determine the frequency. This square wave signal is applied to a ramp generator whose slope and amplitude is determined by R312, R313, C305 and C306. The ramp voltage signal is applied to a buffer stage which isolates the ramp generator from the output stages and reduces any loading effect on the previous stages. Components R314, R316 and R315 reshape the ramp voltage to make it extremely linear.

The output signal from pin 4 (IC301) drives the vertical deflection coils directly via coupling capacitor C312. Components R321 and C311 provide damping to prevent any oscillations in the output circuit. R320, R322, R319, R318, R323, C310 and C308 provide AC and DC feedback for the output stage to maintain proper gain and linearity. When the scan reaches the bottom of the screen a sync pulse initiates retrace. To insure a quick return to the top of the screen the voltage across the yoke is doubled during retrace to quickly discharge the yoke inductance. This voltage doubling circuit consists of diode D304, capacitor C302 and a transistor network in IC301. Capacitor C314 provides additional (external) compensation for IC301, pin 11. Resistor R325 (when present) is used to up-center the raster and video display.

Positive-going vertical rate pulses (@ 25V P-P), from IC301-3, are supplied to the composite blanking circuit (when present) on the composite video circuit card.

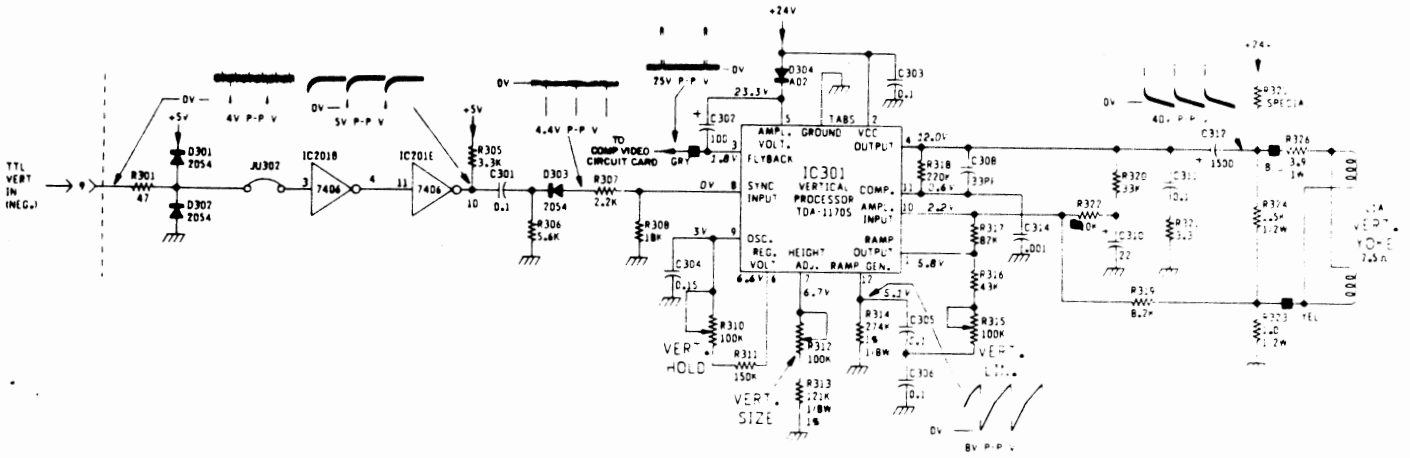


Figure 21. Vertical Processing/Scan Circuit

Horizontal Drive/Sync Delay and Regenerator (Refer to Figure 22)

Negative-going horizontal rate sync is coupled to the input of IC401B through the protective network consisting of resistor R401 and diodes D401 and D402. IC401B is a monostable multivibrator with its time constant being established by resistor R403, HORIZ. DELAY control R402, and capacitor C401. A positive pulse appears at pin 13 of IC401B, the leading edge coincident with the selected leading edge of horizontal sync and the trailing edge determined by the HORIZ. DELAY control, R402.

The falling edge of this pulse triggers IC401A, another monostable multivibrator, whose time constant (established by R406 and C403) regenerate a positive pulse at pin 5 of IC401A. Pulse width at this point is approximately equal to the input sync pulse. This pulse is inverted and increased in amplitude to 24V P-P by IC201D.

Phase Detector (Refer to Figure 22)

The phase detector consists of two diodes D403 and D404 in a keyed clamp circuit. Its function is to develop a control voltage for synchronizing the horizontal oscillator with the incoming sync pulses. Two inputs are required to generate the required output; one from the horizontal sync regenerator IC401A, and one from the horizontal output circuit, Q402. The required output must be of the proper polarity and amplitude to correct phase differences between the input horizontal sync pulses and the horizontal time base. Each pulse from the collector of the horizontal output, Q402, is integrated into a sawtooth by R411 and C405. Capacitor C406 blocks DC from the collector of Q402. The output transistor of IC201D is normally at cut-off and its collector voltage rests at approximately 24 volts. Since C404 is connected to the output of IC201D, it will charge up to the collector voltage. When a pulse turns on and saturates the output of IC201D, its collector voltage drops to near ground potential. C404 will now discharge, coupling a negative-going sync pulse to the cathodes of D403 and D404. This negative potential is sufficient to forward bias both diodes to conduct and discharge any positive or negative charge on C405 to ground. In other words, it clamps the voltage on capacitor C405 during sync pulse time to approximately zero volts.

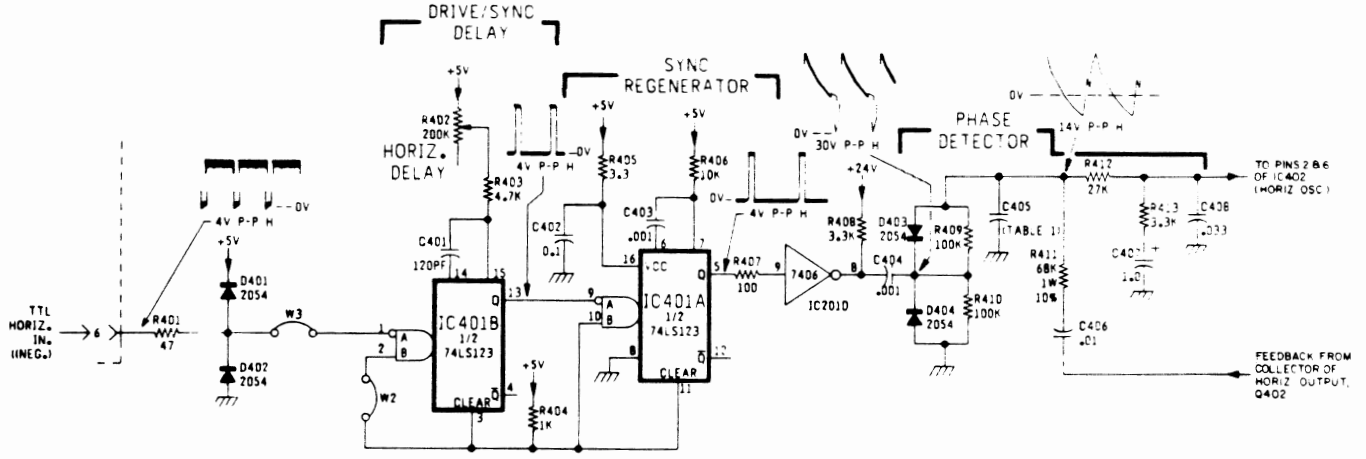


Figure 22. Horizontal Drive/Sync Delay, Sync Regenerator and Phase Detector Circuits

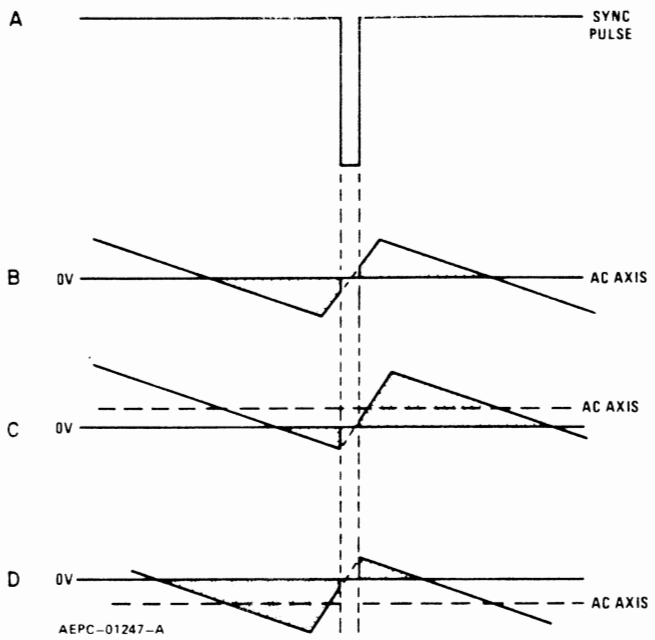


Figure 23. Phase Synchronization Waveforms

Without considering the sync pulses, the sawtooth wave would cause current flow into capacitor C405 when it is negative, and out of C405 when it is positive. Since the sawtooth is symmetrical about its AC axis, the charge and discharge currents of C405 are equal. C405 would therefore average a zero voltage level. A sync pulse (waveform A, Figure 23), clamping the sawtooth as it passes through its AC axis (waveform B, Figure 23), will not affect its positive and negative symmetry. Therefore, the average voltage on C405 would remain zero. However, if the horizontal time base begins to lag, the sync pulse will clamp the sawtooth to ground at a point below its AC axis, resulting in a non-symmetrical charge on C405. This clamping action will cause the sawtooth's AC axis to shift to a point above the ground reference (waveform C, Figure 23). Therefore, most of the sawtooth's waveform is now above ground which will produce a positive voltage on C405. This is the correct polarity to cause the horizontal oscillator to speed up to correct the phase lag. Likewise, if the horizontal time base is leading the sync pulse, the sawtooth will be clamped to ground at a point above its AC axis. This clamping action will cause the sawtooth's AC axis to shift to a point below the ground reference (waveform D, Figure 23). Now most of the sawtooth's waveform is below ground, which will produce a negative voltage on C405. This is the correct polarity to cause the horizontal oscillator to slow down. The voltage level on C405 is dependent upon which point of the sawtooth is clamped. This also determines how far its AC axis will shift above or below ground.

R412, C407, R413 and C408 comprise the phase detector filter. The bandpass of this filter is designed to provide correction of horizontal oscillator phase without ringing or hunting.

Horizontal Oscillator/Driver (Refer to Figure 24)

Integrated circuit timer IC402 operates as an astable square wave oscillator. Its free running frequency is determined by resistors R415, R416, and capacitor C409. The phase detector correction voltage is coupled through resistor R414 to pins 2 and 6 of IC402 to vary the frequency of the oscillator. A second input to IC402, pin 5, allows control of the oscillator free-run frequency by means of R418, HORIZ. HOLD control.

The non-symmetrical output of IC402 (pin 3) is coupled to the horizontal driver transistor, Q401, through C411 and current limiting resistor R419. D405 protects Q401 from reverse base-emitter voltage. Q401 operates as a switch to drive the horizontal output transistor Q402 through transformer T401. T401 is a voltage stepdown transformer to provide a low impedance drive to Q402. R421 is a current limiting resistor for Q401 and C414 is an AC bypass capacitor. R420 and C413 damp the transformer to prevent ringing when Q401 goes into cutoff.

Horizontal Output (Refer to Figure 24)

The secondary of T401 provides the required low drive impedance for Q402. Components R422 and C415 form a time constant for fast turn-off of Q402. The horizontal output transistor, Q402, is simply a switch that is turned on and off at the horizontal scan rate by the drive signal applied to its base. A sawtooth current through the deflection coils is required to sweep the beam linearly across the CRT screen. The sweep begins at the center of the CRT and sweeps to the right. This happens when Q402 is turned on and its collector voltage drops to near zero. C419 begins discharging through the deflection coils to deflect the beam to the right edge of the CRT. At this time, Q402 cuts off and C419 ceases to supply current to the deflection coils. However, an induced voltage appears across the deflection coil as the magnetic field collapses, and an oscillation occurs between the deflection coils and C416.

During the first half cycle of this oscillation, the induced voltage is felt across the collector of now cut off Q402, C416, and the primary of T402, the flyback transformer. This voltage is stepped up by T402 and rectified to produce the required high voltage that is applied to the 2nd anode of the CRT. The electron beam is also deflected to the left edge of the CRT at this time because the collapsing magnetic field of the deflection coils reverses polarity.

During the second half cycle of the deflection coils/C416 oscillation, the voltage on the collector of still cut off Q402 becomes negative. At this time, camper diode D406 becomes forward biased and begins conduction. The deflection coil current gradually decreases to zero during damper conduction allowing the beam to sweep linearly to the center of the screen.

The horizontal retrace pulse charges C422 through D407 to provide operating voltage for G2 of the CRT. Momentary transients at the colleator of Q402, should they occur, are limited to the voltage on C422 since D407 will conduct if the collector voltage exceeds this value. Coil L402 is a magnetically biased Horiz. Linearity coil that shapes the deflection current for optimum trace linearity. Coil L401 is a series Horiz. Width control. Components R425 and C418, R424 and C417 are damping network components for the Horizontal Linearity (L402) and Width (L401) controls.

The 24 volt supply to the horizontal output is coupled through diode D409 to pin 3 of the transformer, T402. Autoformer action of the transformer boosts the effective supply voltage to the transformer to the 70 volts appearing on pin 1 of T402. This voltage is filtered by C205 and provides the 70 volt source for the chassis. A capacitive divider, C421 and C420, and diode D408 provides a −70 volt supply for the CRT G1 electrode.

Positive-going horizontal rate pulses (@400V P-P), from pin 3 of T402, are supplied to the composite blanking circuit (when present) on the composite video circuit card.

Dynamic Focus (Refer to Figure 24)

Due to the geometry of a CRT, the electron beam travels a greater distance when deflected to a corner as compared to the distance traveled at the center of the CRT screen. As a result of these various distances traveled, optimum focus can be obtained at only one point. For general applications, an adequate adjustment can be realized by setting the focus while viewing some point mid-way between the center of the CRT screen and a corner, thus optimizing the overall screen focus. When an application requires a tighter specification, one of the simplest methods for improvement is to modulate the focus voltage at a horizontal sweep rate. Now optimum focus voltage is made variable on the horizontal axis of the CRT, which compensates for the beam travel along this axis. The AC component of the focus voltage is developed by stepping up the voltage across capacitor C419 via transformer T403. The linear current ramp in the horizontal yoke winding, L1B, also flows through capacitor C419. The ramp is integrated, the result being a parabolic waveform. This parabola is coupled through capacitor C424 and resistor R433 to the primary of transformer T403. The approximately 250V P-P parabola present at pin 6 of T403 is superimposed on the DC voltage from the FOCUS control, R429, via capacitor C423. This mixed AC and DC voltage results in a waveform of proper phase and amplitude, which is coupled through isolating resistor R431 to the CRT focus anode.

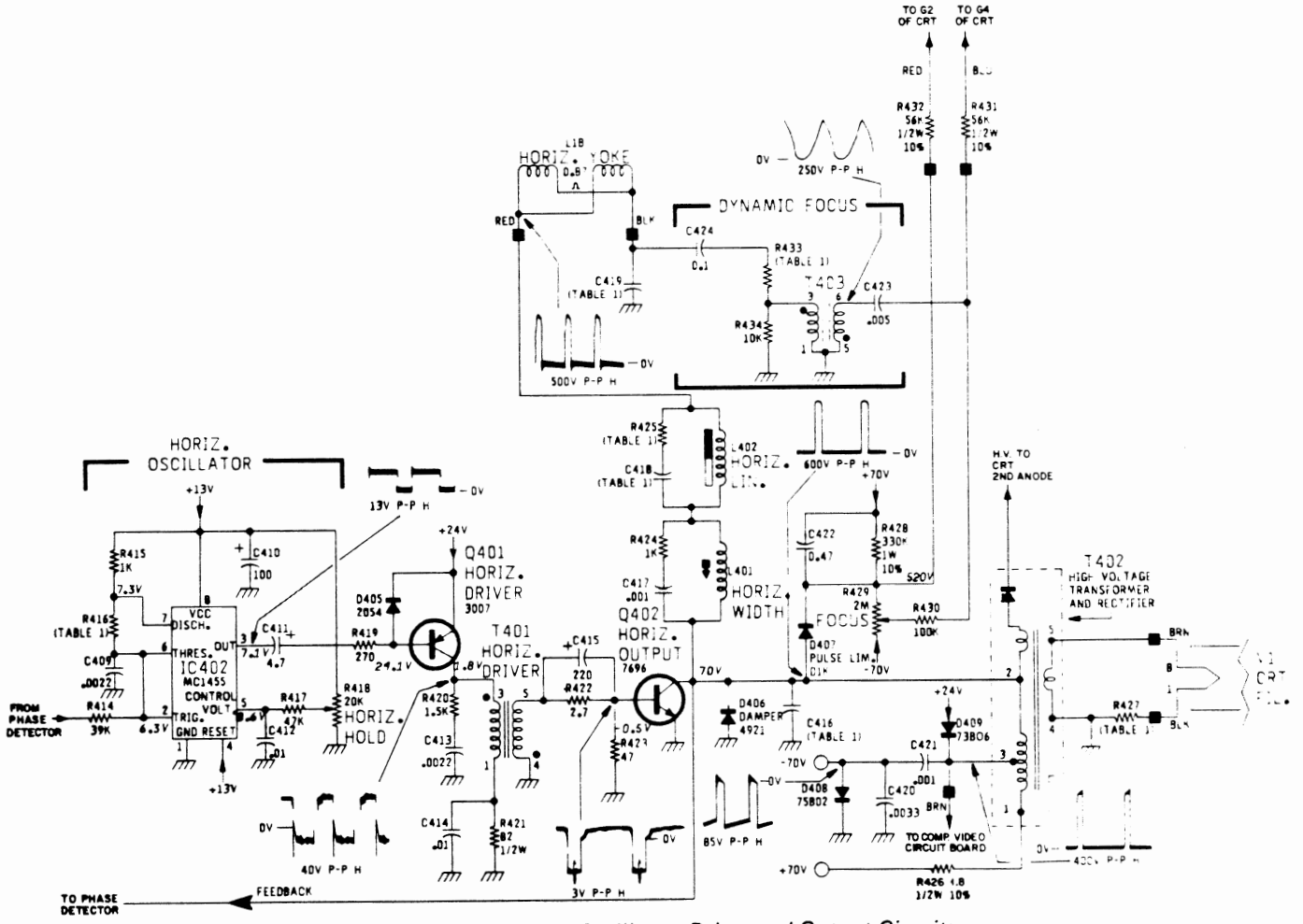


Figure 24. Horizontal Oscillator, Driver and Output Circuits, and Dynamic Focus Circuit

-COMPONENT SIDE SHOWN-

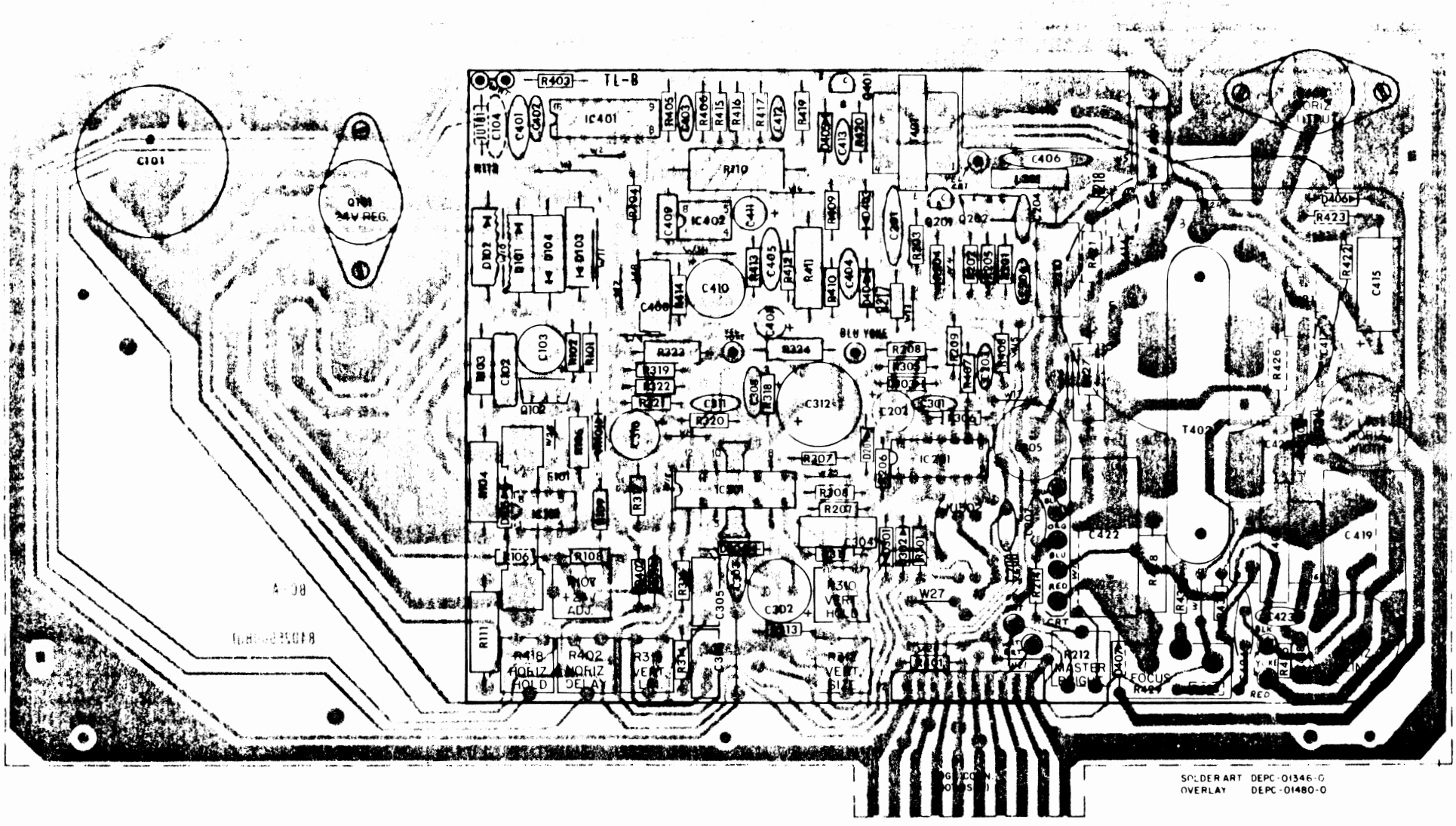


Figure 27. Monitor Circuit Card Layout — Component Side

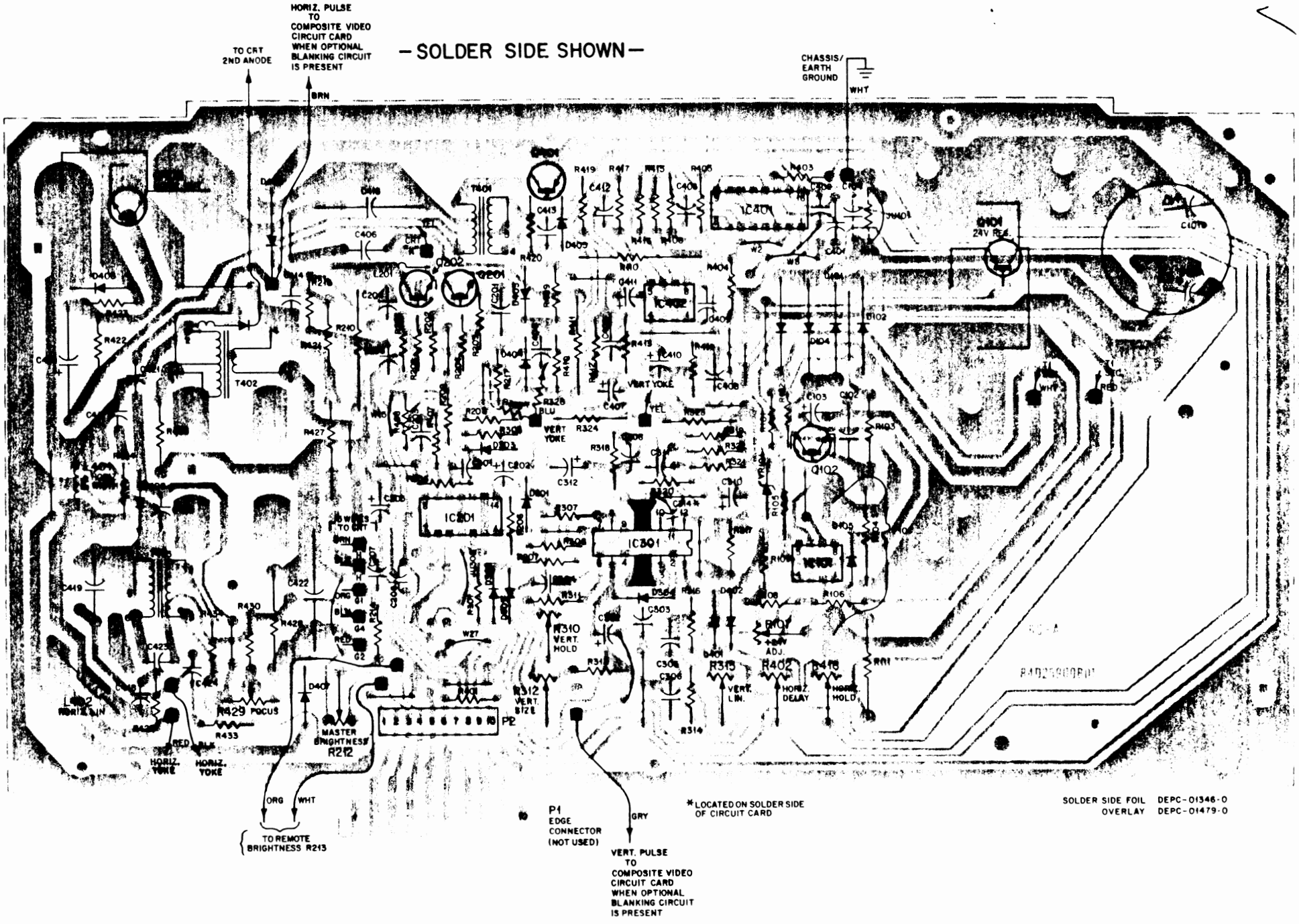


Figure 28. Monitor Circuit Card Layout — Solder Side

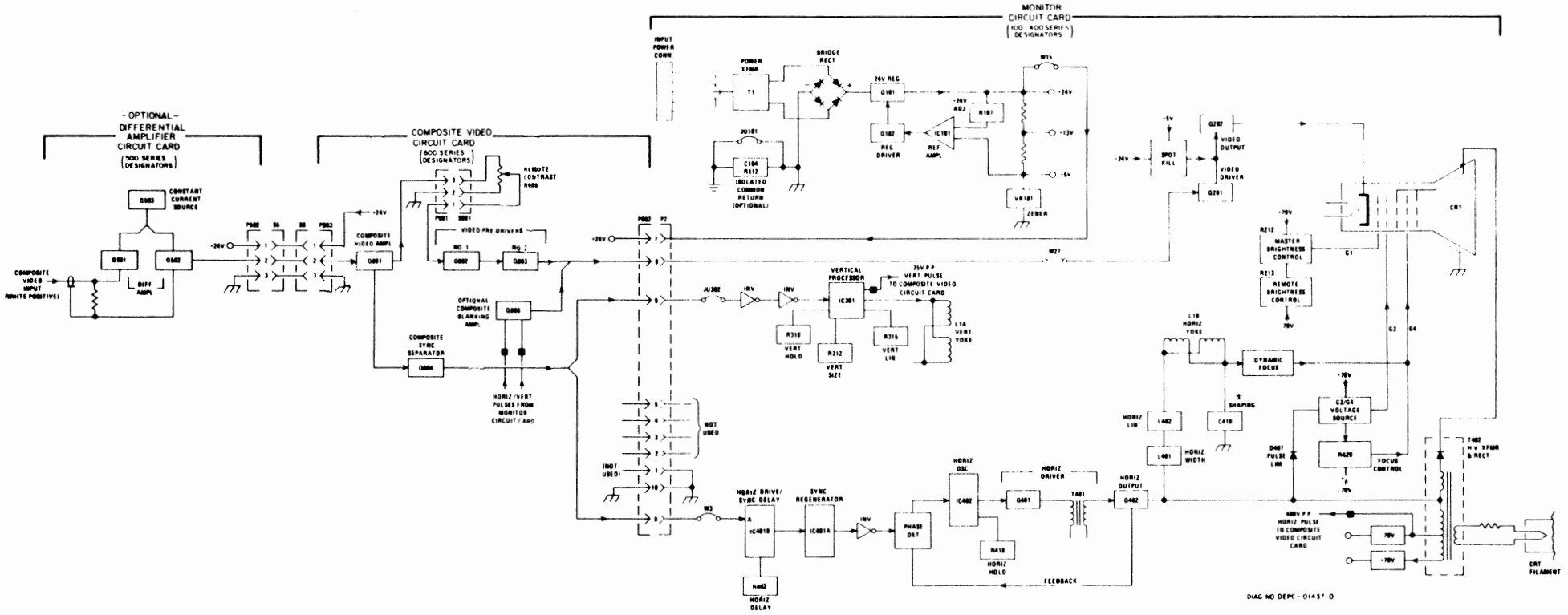


Figure 29. Functional Block Diagram

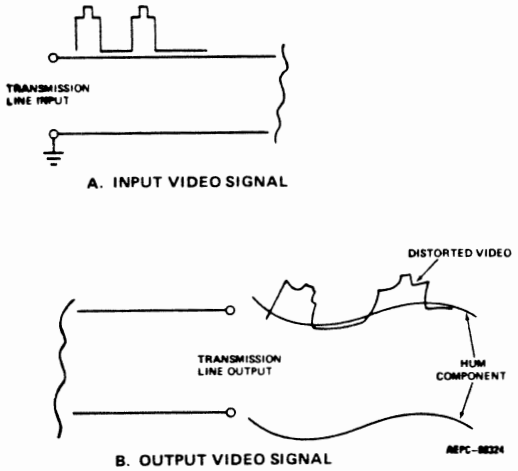


Figure 16. Input and Output Waveforms of Long Transmission Line

C505 isolate the incoming composite video signal from ground.

COMPOSITE VIDEO CIRCUIT CARD (See Figure 18)

Composite Video Circuit (Signal Flow)

A 0.5-2.5 volt P-P composite video signal (white positive) is (AC) coupled by C601 to the base of Q601. Transistor Q601 serves two functions; it is an amplifier with a gain of 2, and it isolates (buffer) the video pre-driver stages from the composite video signal source. Two outputs are derived from Q601; both are composite video. From the collector, inverted composite video (sync positive) is routed to the composite sync separator, Q604. From the emitter of Q601, composite video (white positive) is direct coupled to the CONTRAST control, R605, via P601/S601; then AC coupled by C602 to the base of the first video pre-driver, Q602. The setting of CONTRAST control R605 determines the overall amplitude of the composite video signal to be coupled to Q602.

Transistors Q602 and Q603 (video pre-drivers No. 1 and No. 2 respectively) are complementary, direct-coupled, common emitter amplifiers; they provide a voltage gain of 6. The voltage variations that appear at the base of Q602 are amplified and direct coupled to the base of Q603. The voltage gain of Q602 is limited by the value of unbypassed emitter resistor R608. The signal at the base of Q603 is amplified and AC coupled from its collector to the video clamping circuit (D601 and R612) through C603. The gain of Q603 is limited by the value of R610 and by connecting it back to the degenerative emitter of Q602. The output from pin 8 of R602 will be white positive video less blanking (unless the optional composite blanking amplifier, Q606, circuit is present).

Composite Video Circuit (Component Description)

Resistor R601 serves to terminate the incoming composite video signal when the differential amplifier circuit card is not present. When the differential amplifier circuit card is present, however, R601 is removed. Resistors R602 and R603 provide base biasing for Q601, while R604 and R621 are load resistors. Capacitors C610 and C611 are present to maintain a flat video frequency response. Resistor R606 and R607 provide base biasing for Q602. Resistors R608, R609, R611 and Q602 are the biasing components for Q603. Resistor R613 is a dropping resistor for the +24 volt source, and capacitor C604 provides low reactance to low frequencies for additional filtering of the +24 volt source.

Sync Separator Circuit (Signal Flow/Component Description)

A composite video signal (sync positive) from the collector of Q601 is (AC) coupled by C607 to the base of Q604. Resistor R622 is for base biasing, and R623 is the load resistor for Q604. Capacitor C606 is a rolloff filter to remove the video frequencies and ensure that only composite (vertical and horizontal) sync appears at the collector of Q604.

One path for the composite sync is to the video clamp diode, D601, which is used to restore a DC reference voltage to the video signal. This action maintains a uniform black level at the CRT regardless of video content. The composite sync is also (AC) coupled by C608 to output pins 6 and 9 of connector P602. (C608 also blocks DC from getting to the monitor circuit card.) The output from pin 9 is a negative-going vertical sync (only). This is accomplished by R625 and C609, an RC integrator network, which removes the high frequency horizontal sync component. The output from pin 6 is a negative-going composite (horizontal and vertical) sync signal. Resistor R624 is required to limit the current for the TTL input to the monitor circuit card.

Overvoltage Protection Circuit

Transistor Q605 and associated components form an overvoltage protection circuit. Whereby, if the +24 volt source, which operates all stages on this circuit card, ever exceeds +25.6 volts, zener diode VR601 will begin to conduct. Once VR601 begins to conduct, and the base-emitter voltage reaches 0.6 volts, Q605 turns on. With Q605 on, ground is applied to the base of the input composite video amplifier, Q601, which turns off. With Q601 off, the incoming composite video signal is prevented from being processed to produce the necessary vertical and horizontal sync to the monitor circuit card.

Composite Blanking Circuit (Optional)

This circuit, when present, permits the reinsertion of horizontal and vertical blanking to the video signal. To operate, however, it requires separate (positive-going) horizontal and vertical pulses from the monitor circuit card. These two pulses are mixed at the base of common-emitter transistor, Q606, to become composite blanking at the collector of Q606. Resistor R618 fixes the level of composite blanking added to the video. Resistor R616 is a summing resistor for the mixed vertical/horizontal pulses at the base of Q606.

Not included

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Flow/Component Descrip-

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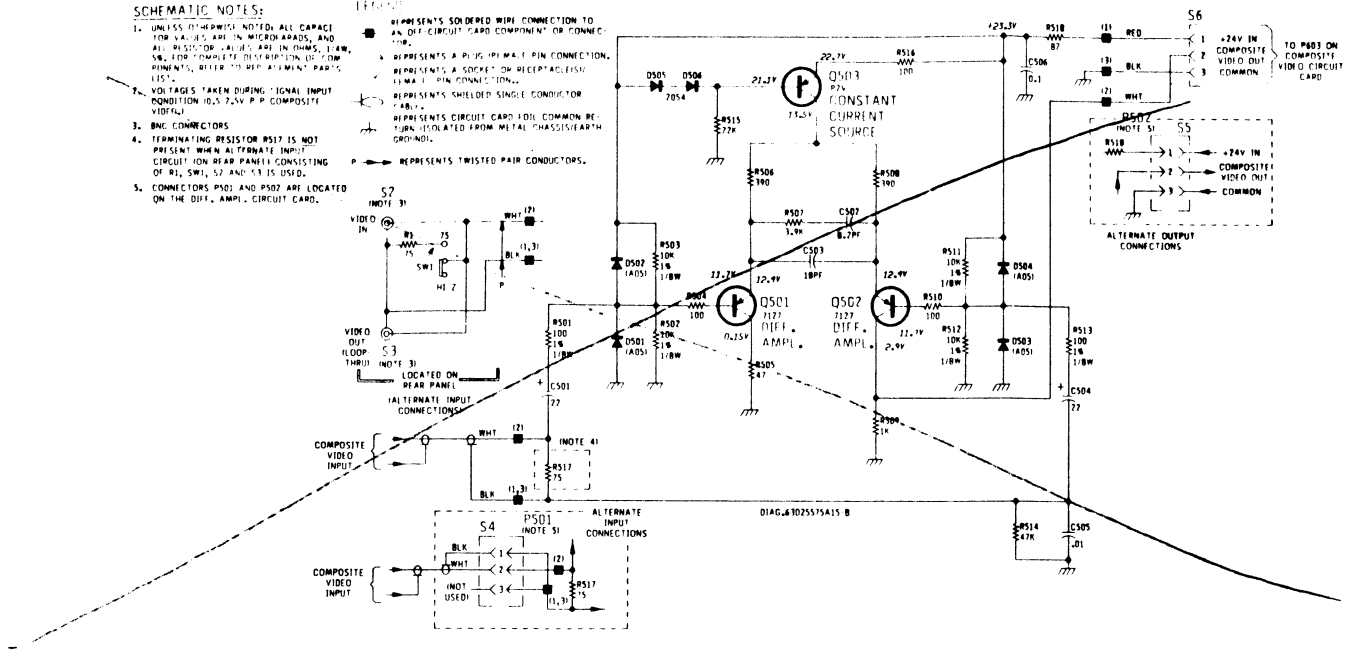


Figure 17. Differential Amplifier Circuit Card

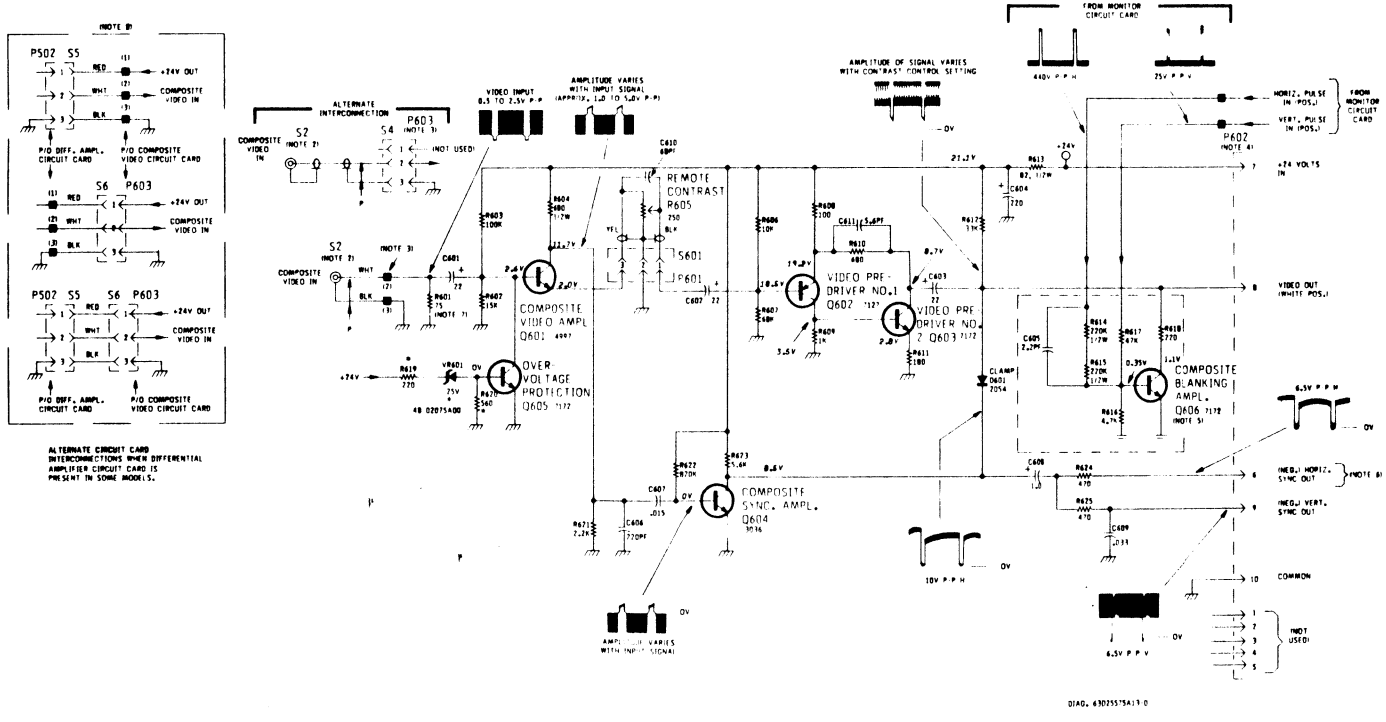


Figure 18. Composite Video Circuit Card (Incl. Optional Blanking)

NOT INCLUDED

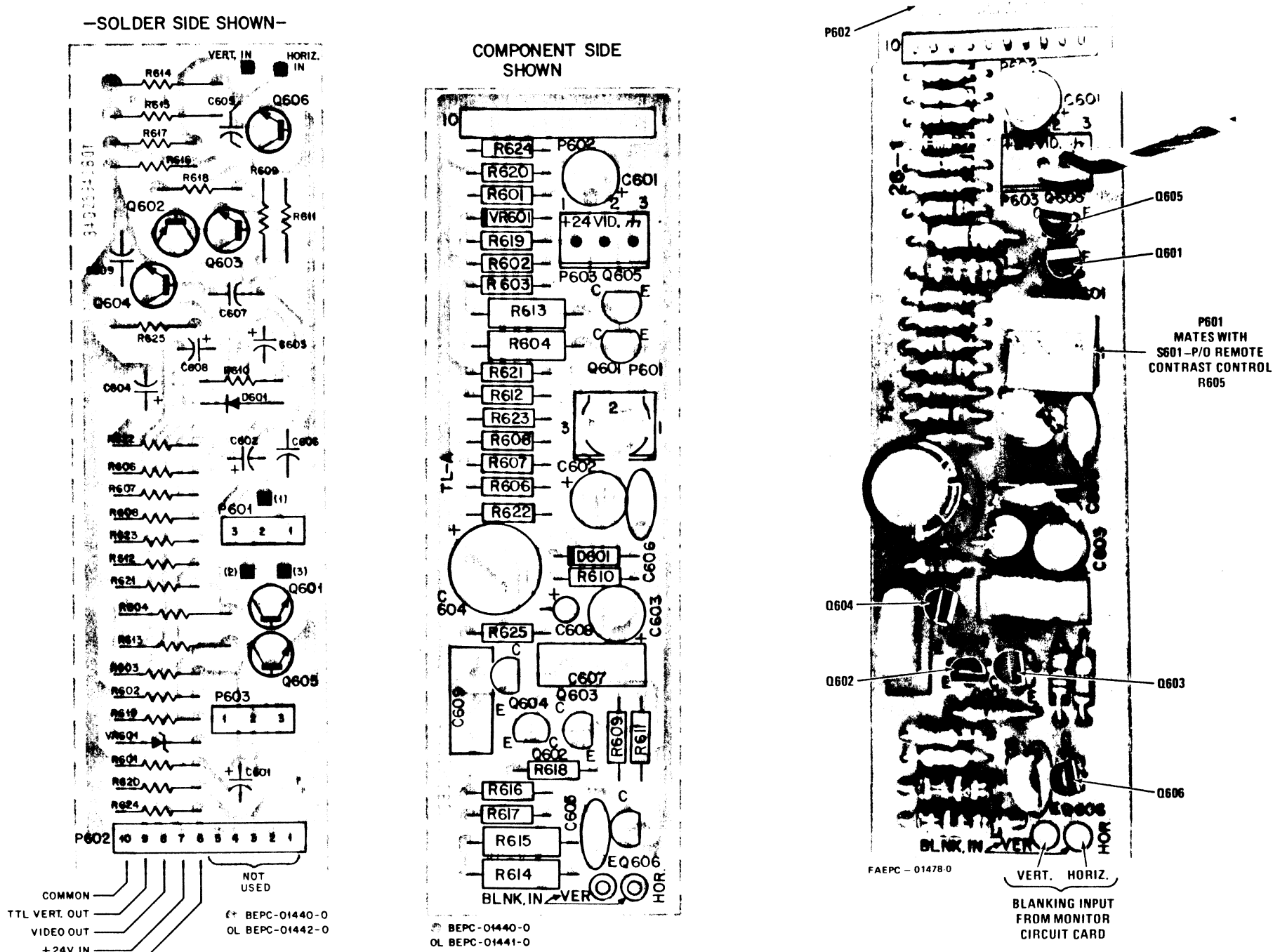


Figure 26. Composite Video Circuit Card

– NOTE –

When a component requires replacement, it is recommended that only Motorola part numbers be used. This is necessary to ensure optimum performance and reliability from selected components with specific operating characteristics. When a part number is not listed, however, an equivalent may be substituted.

The following parts list represents components for the basic composite video CRT display models; DS3000, DS3003, DS4000 and DS4003 (155, 255, 156, 256, etc.) Series. For replacement of components that differ in unique composite video CRT display models, compared to the basic models, order by the unique model number, schematic designator and description.

DS-SERIES COMPOSITE VIDEO MONITOR CIRCUIT CARD – REPLACEMENT PARTS LIST

CIRCUIT CARD ASSEMBLY: (Order by model number only)

CAPACITORS: (Unless otherwise noted, all capacitor values are in microfarads)

REF NO.	PART NO.	DESCRIPTION
C101	23R29944A05	4500/50V, 2000/30V; Lytic
C102	8R29967A12	0.22 10%, 50V; Poly
C103	23R29914A21	100, 10V; Lytic
C104	8R29959A77	0.1 10%, 200V; Poly
C201	21S180E50	120 pF 5%, NPO, 100V; Cer.
C202	23R29914A77	22, 35V; Lytic
C203	21R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C204	21R29943A08	.01 +80–20%, Z5V, 100V; Cer.
C205	23R29944A06	68, 100V; Lytic
C206	21R29943A08	.01 +80–20%, Z5V, 100V; Cer.
C207	21S180A62	.005 20%, Z5U, 500V; Cer.
C208	(Not Used)	
C301	21R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C302	23R29914B06	100, 50V; Lytic
C303	21R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C304	8R29967C31	0.15 10%, 100V; Poly
C305,C306	8R29967C29	0.1 10%, 100V; Poly
C307	(Not Used)	
C308	21S180B94	33 pF 10%, NPO, 500V; Cer.
C309	(Not Used)	
C310	23R29914A77	22, 35V; Lytic
C311	21R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C312	23R29914A68	1500, 25V; Lytic
C313	(Not Used)	
C314	21S180B51	.001 10%, X5F, 500V; Cer.
C401	21S180E50	120 pF 5%, NPO, 100V; Cer.
C402	23R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C403,C404	21S180B51	.001 10%, X5F, 500V; Cer.
C405	21S180C41	.0027 10%, Z5F, 100V; Cer. (DS3003, 4003 Series)
C405	21S180E91	.0039 10%, Z5F, 100V; Cer. (DS3000, 4000 Series)
C406	21S180C31	.01 20%, Z5U, 1kV; Cer.
C407	23R10229A32	1.0, 16V; Lytic
C408	8R29967A36	.033 10%, 200V; Poly
C409	21R29964A06	2200 pF 2%, NPO, 100V; Cer.
C410	23R29914A40	100, 16V; Lytic
C411	23R29914A73	4.7, 35V; Lytic
C412	21S180E60	.01 +80–20%, Z5V, 50V; Cer.
C413	21S180C08	.0022 10%, Z5F, 50V; Cer.
C414	21S132492	.01 +80–20%, Z5V, 100V; Cer.
C415	23S10255B81	220, 10V; Lytic
C416	8R29930E45	.0091 5%, 1200V; Poly Carb (DS4000)
C416	8R29930E46	.01 5%, 1200V; Poly Carb (DS4003)
C416	8R29930E41	.0068 5%, 1200V; Poly Carb (DS3000)
C416	8R29930E97	.011 5%, 1200V; Poly Carb (DS3003)
C417	21S180B51	.001 10%, X5F, 500V; Cer.
C418	21S131625	330 pF 10%, X5F, 500V; Cer. (DS3003, 4000)
C418	21S180E78	270 pF 10%, X5F, 500V; Cer. (DS3000, 4003)
C419	8R29951A07	1.0 10%, 200V; Poly (DS4000, 4003)
C419	8R29951A06	.068 10%, 200V; Poly Carb (DS3000, 3003)
C420	8R29967A31	.0033 10%, 200V; Poly
C421	8R29967A58	.001 10%, 600V; Poly
C422	8R29969A85	0.47 10%, 600V; Mtlz. Poly
C423	21S180A62	.005 20%, Z5U, 500V; Cer.
C424	21R29964A05	0.1 +80–20%, Z5U, 100V; Cer.
C425	–	(Special)

DIODES:

D101-D104	48R191A12	Rectifier, Silicon; (91A12)
D105	48R02054A00	Silicon Diode, Gen. Purpose; (2054)
D201	48R02054A00	Silicon Diode, Gen.Purpose (2054)
D301-D303	48R02054A00	Silicon Diode, Gen.Purpose (2054)
D304	48R191A02	Rectifier, Silicon; (91A02)
D401-D405	48R02054A00	Silicon Diode, Gen. Purpose (2054)
D406	48R134921	Silicon Diode, Damper; 800V (4921)
D407	48R134978	Silicon Diode; (D1K)
D408	48R02075B02	Diode, Fast Recovery; 200V (75B02)
D409	48R02073B06	Diode, Fast Recovery; 600V (73B06)

FUSES:

F101	65S129421	2.5 Amp., 250V (120, 220 240VAC Operation)

INTEGRATED CIRCUITS:

IC101	51R10732A01	IC, Op. Ampl.; T3F
IC201	51R06436A00	IC, 6-Inverter; 7406
IC301	51R06015A00	IC, Vert. Processor; TDA1170S
IC401	51R06621A00	IC, Dual Retrig. Monostable; 74LS123
IC402	51R06332A00	IC, Timing; NE555

COILS:

L201	24D25601A02	Coil, 4.7 uH; (Peaking)
L401	24D25603A14	Coil, Horiz. Size
L402	24D25600A10	Coil, Horiz. Linearity (DS4000)
L402	24D25600A13	Coil, Horiz. Linearity (DS4003)
L402	24D25600A11	Coil, Horiz. Linearity (DS3000)
L402	24D25600A12	Coil, Horiz. Linearity (DS3003)

TRANSISTORS:

Q101	48R137675	PNP; 7675 (24V Reg.)
Q102	48R03026A00	NPN; 3026 (Reg. Driver)
Q201	48R134952	NPN; A2J (Video Driver)
Q202	48R03026A00	NPN; 3026 (Video Output)
Q401	48R03007A00	PNP; 3007 (Horiz. Driver)
Q402	48R137696	NPN; 7696 (Horiz.Output)

RESISTORS/CONTROLS: (Unless otherwise noted, all values are in ohms, 1/4 watt, 5%. Resistors not listed are of the fixed carbon film type, 1/4 or 1/2 watt, 5%, as noted on the schematic.)

Abbr: FCF = Fixed Carbon Film
FCC = Fixed Carbon Composition
FMF = Fixed Metal Film
WW = Wirewound
MOF = Metal Oxide Film

R104	6S126A33	FCC; 220 5%, 1W
R107	18D25904A05	Control, Var.; 10k (+24V Adj.)
R110	6S127A25	FCC; 100 5%, 2W (Standup Type)
R111	6S126A23	FCC; 82 5%, 1W
R210	17–136197	WW; 1.2k 5%, 5W
R212	18D25904A02	Control, Var.; 250k (Master Brightness)
R213	18D25212A39	Control, Var.; 200k (Remote Brightness)
R214	6S124B08	FCC; 270k
R216	–	Control, Var.; Contrast (Optional)
R310	18D25904A04	Control, Var.; 100k (Vert. Hold)
R312	18D25904A12	Control, Var.; 100k (Vert. Size)
R313	6S10621E06	FMF; 150k 1%, 1/8W
R314	6S10621E31	FMF; 274k 1%, 1/8W
R315	18D25904A04	Control, Var.; 100k (Vert. Lin.)
R323	6R29872J01	MOF; 1.0 2%, 1/2W
R326	6–126B59	FCC; 3.9 5%, 1W
R402	18D25904A03	Control, Var.; 200k (Horiz.Delay)
R411	6S124481	FCC; 68k 10%, 1W
R416	6R29891A19	FMF; 15.4k 1%, 1/8W (DS3003, 4003)
R416	6R29891A26	FMF; 18.2k 1%, 1/8W (DS3000,4000)
R418	18D25904A06	Control, Var.; 20k (Horiz.Hold)
R421	6R29872L48	MOF; 82 5%, 1/2W
R426	6S10053J04	FCC; 1.8 10%, 1/2W
R427	6S10053J05	FCC; 1.0 5%, 1/2W
R428	6S125793	FCC; 330k 10%, 1W
R429	18C25218A14	Control, Var.; 2M (Focus)

TRANSFORMERS:

T401	25D25772A04	Transformer, Horiz. Driver
T402	24D25291A12	Transformer, High Voltage; Incl. H.V. Rect. (DS4000)
T402	24D25291A13	Transformer, High Voltage; Incl. H.V. Rect. (DS4003)
T402	24D25291A10	Transformer, High Voltage; Incl. H.V. Rect. (DS3000)
T402	24D25291A11	Transformer, High Voltage; Incl. H.V. Rect. (DS3003)
T403	25D25772B05	Transformer, Dynamic Focus

ZENER DIODES:

VR101	48S10813A06	Diode, Zener; 5.1V (IN5231B)

CHASSIS MOUNTED COMPONENTS: (Not part of circuit card)

L1	24D25687B18	Yoke, Deflection (DS4000 Series)
L1	24D25687B17	Yoke, Deflection (DS4003 Series)
L1	24D25687B19	Yoke, Deflection (DS3000 Series)
L1	24D25687B16	Yoke, Deflection (DS3003 Series)
S1	15R29982A06	Housing, Recept.; 6-Contact (less contacts)
	39S10184A64	Contact, Recept,; Female (S1 requires 5)
T1	1V25564B27	Transformer, Power (Incl. Conn S1)
T1	25D25239B49	Transformer, Power (Less Conn.S1)

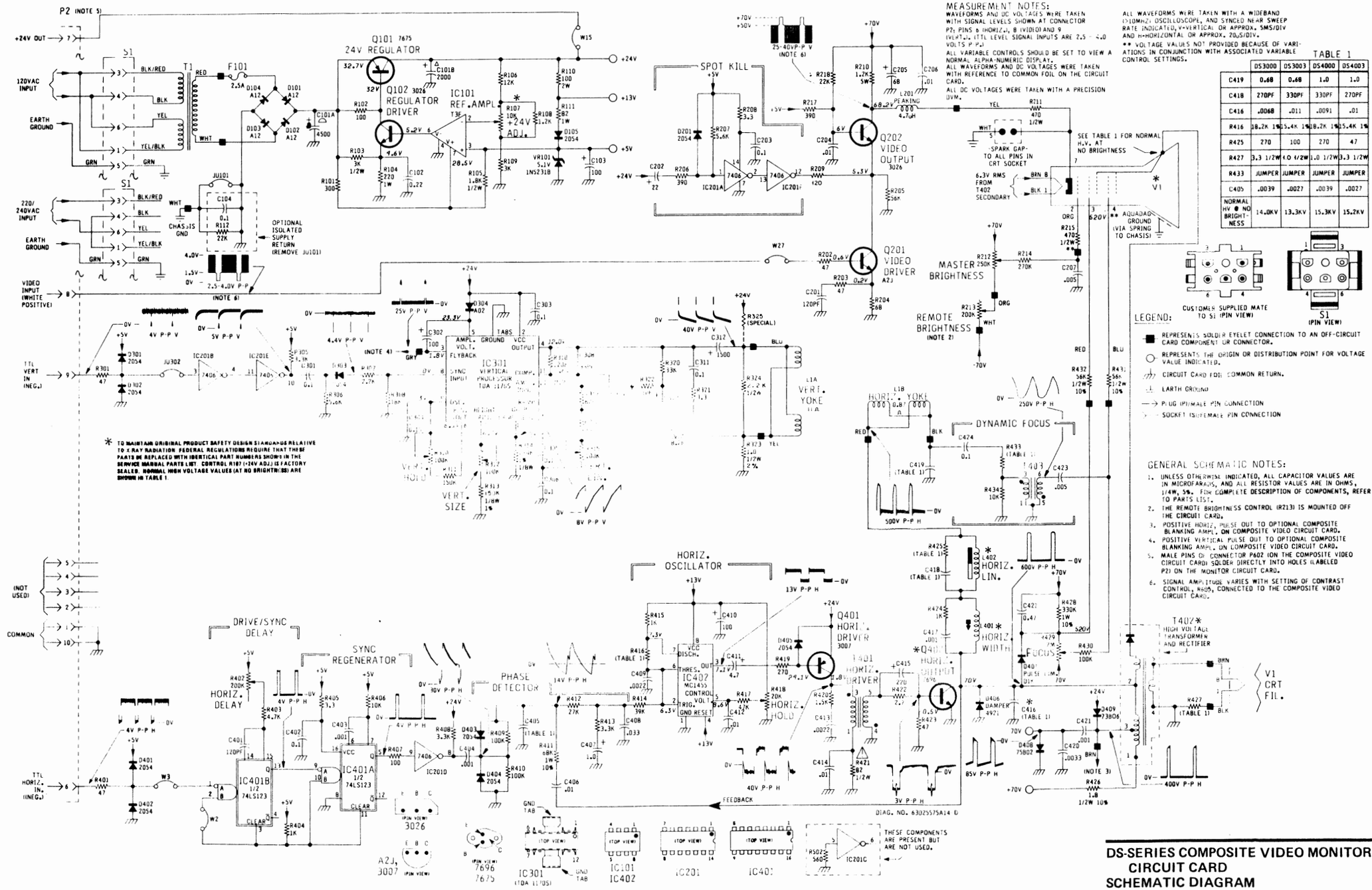
– CRT REPLACEMENT NOTE –

Order replacement CRT's by referring to the CRT Identification Label on the bell of the tube. There will be a manufacturers Type Number, and a Motorola Part Number that begins with a 96 prefix. (An example of the complete Motorola No. would be 96R02500B04.) If the label is not present, or legible, order the replacement CRT by the complete model number; such as a DS4000–155, DS3000–256, etc. . .

MECHANICAL PARTS LIST

REF. NO.	PART NO.	DESCRIPTION
	41C25930A02	Spring, Aquadag
	42B25158C01	Clamp, Deflection
	1V25574A01	Socket, CRT (Incl. leads and resistors)
	14S562353	Insulator, Transistor
	7D25901A01	Bracket, Side; Right-Hand (DS4000, 4003)
	7D25901A02	Bracket, Side; Left-Hand (DS4000, 4003)
	7C25902A01	Bracket, Mounting Foot (2 Req'd.)
	7C25826A04	Heat Sink/Support (IC301)
	42S10122A12	Clip, Fuse; F101 (2 Req'd.)
	7D25307C01	Bracket, Side; Right-Hand (DS3000, 3003)
	7D25307C02	Bracket, Side; Left-Hand (DS3000, 3003)
	58B25944A01	Adapter, Adjusting Control
	59B25840A01	Magnet, Yoke: Non-Flexible Hard Core
	59B25840A02	Magnet, Yoke: Flexible Soft Core
	7C25974A01	Bracket, Circuit Card Mtg.*
	7R29882A01	Support, Circuit Card*

*For Diff. Ampl. and/or Comp. Video Circuit Cards



DS-SERIES COMPOSITE VIDEO MONITOR CIRCUIT CARD SCHEMATIC DIAGRAM