

## NTE1547 Integrated Circuit Video Chroma Deflection System for Color TV

### **Description:**

The NTE1547 combines the video-chroma subsystem and the deflection combination on a single monolithic integrated integrated circuit to provide a color television video-chroma-deflection system. This device includes a video amplifier, color demodulator that is designed to provide color differential output, and improved sync-separator, horizontal oscillator with saw tooth wave type AFC, horizontal pre-driver in a 42-Lead DIP type plastic package.

### **Features:**

#### **Video-Chroma Section**

- Minimum number of external parts required
- Stabilized with respect to variation of temperature and supply voltage
- A few initial adjustments required

#### **Deflection System**

- Excellent temperature stability of horizontal oscillator
- Exact 50% duty cycle output due to the  $2-f_H$  oscillator and flip-flop circuit
- Excellent inter-race
- Stable sync separator with V/H input terminals.

### **Absolute Maximum Ratings:** ( $T_A = +25^\circ\text{C}$ unless otherwise specified)

|                                                                 |                                     |
|-----------------------------------------------------------------|-------------------------------------|
| Supply Voltage, $V_{3\text{max}}$                               | 15V                                 |
| Supply Current, $I_{33\text{max}}$                              | 40mA                                |
| Input Signal Level, $e_{IN}$                                    | $5V_{P-P}$                          |
| Demodulator Min Load Resistance, $R_{LD}$                       | $1.8k\Omega$                        |
| Horizontal Drive Peak Current, $-I_{24}$                        | 30mA                                |
| Horizontal Drive Operating Current, $-I_{24}$                   | 15mA                                |
| Vertical Ouput Current, $I_{26\text{max}}$                      | -5mA                                |
| Sync Separator Input Level, $V_{38\text{max}}/V_{39\text{max}}$ | $3V_{P-P}$                          |
| Pin7 Max Operating Current, $I_7$                               | 5mA                                 |
| Pin2 Max Operating Current, $I_2$                               | 4mA                                 |
| Power Dissipation, $P_D$                                        | 2.2W                                |
| Derate Above $25^\circ\text{C}$                                 | $17.6\text{mW}/^\circ\text{C}$      |
| Operating Temperature Range, $T_{opr}$                          | $-20^\circ$ to $+65^\circ\text{C}$  |
| Storage Temperature Range, $T_{stg}$                            | $-55^\circ$ to $+150^\circ\text{C}$ |

**Electrical Characteristics:** ( $V_3 = 12V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

| Parameter                                                    | Symbol              | Test Conditions                                                                                                                                                     | Min  | Typ  | Max  | Unit           |
|--------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|----------------|
| <b>Video Section</b>                                         |                     |                                                                                                                                                                     |      |      |      |                |
| 12v Supply Current                                           | $I_{CC3}$           | Measure Pin3 Currnt                                                                                                                                                 | 60   | 82   | 100  | mA             |
| Video Gain                                                   | $v_{22}/v_6$        | $V_6 = 4.25V$ , $v_6 = 4MHz$ , $1V_{P-P}$ ,<br>$V_5 = 10V$ , $V_B = 8V$                                                                                             | 2.0  | 3.5  | 5.0  | dB             |
| Contrast Gain Control Range                                  | $\Delta G_V$        | $V_6 = 4.25V$ , $v_6 = 500kHz$ , $1V_{P-P}$ ,<br>$V_5 = 5$ to $10V$                                                                                                 | 11.2 | 12.3 | 13.4 | dB             |
| Video Frequency Characteristics                              | $\Delta G_{Vf}$     | $V_6 = 4.25V$ , $V_5 = 10V$ , $V_B = 8V$ ,<br>$v_6 = 4MHz$ , $0.5MHz$ , $1V_{P-P}$ ,<br>$20\log(22(4MHz)/22(0.5MHz))$                                               | -3.5 | -1.5 | 0.5  | dB             |
| DC Restoration Ratio                                         | K                   | $V_{41} = 4.1V$ , Change APL 10% to 90%,<br>measure pedestal level change of Pin22                                                                                  | 63   | 70   | 77   | %              |
| Max. Video Output                                            |                     | Pin5 OPEN, Change $V_{40}$ DC Voltage,<br>Measure 90% of Voltage Change at Pin22                                                                                    | 5.0  | 7.5  | —    | $V_{P-P}$      |
| Video DC Output Temperature Coefficient                      |                     | $V_6 = 3.25V$ , $V_{41} = 4.1V$ , $T_A = -20^\circ$ to $+65^\circ C$                                                                                                | -2.5 | 0    | +2.5 | mV/ $^\circ C$ |
| Inv. Amp Gain                                                | $v_7/v_6$           | $V_6 = 4.25V$ , $v_6 = 4MHz$ , $1V_{P-P}$ , $V_5 = 10V$ ,<br>$V_B = 8V$                                                                                             | 2.2  | 3.5  | 4.6  | dB             |
| Inv. Amp Differential Gain                                   | $DG_R$              | $V_6 = 3.3$ to $5.2V$ , $v_6 = 3.58MHz$ , $100mV_{P-P}$                                                                                                             | —    | 2.5  | 10.0 | %              |
| Inv. Amp Frequency Characteristics                           | $\Delta G_{Rf}$     | $V_6 = 4.25V$ , $V_5 = 10V$ , $V_B = 8V$ ,<br>$v_6 = 4MHz$ , $500kHz$ , $1V_{P-P}$ ,<br>$20\log(v_7(4MHz)/v_7(0.5MHz))$                                             | -3.5 | -0.1 | 0.5  | dB             |
| Inv. Amp 3.58MHz Linearity                                   | $L_7$               | $V_6 = 4V$ , $v_6 = 3.58MHz$                                                                                                                                        | 1.6  | —    | —    | $V_{P-P}$      |
| <b>Chroma (1)</b> (Gate Pulse and Blanking Pulse is applied) |                     |                                                                                                                                                                     |      |      |      |                |
| Max. Chroma Output                                           | $e_{CH}$            | $V_1 = 12V$ , $V_5 = 10V$ , $V_8$ : OPEN,<br>$v_9$ : $120mV_{P-P}(B:C = 1:1)$ , $V_G = 8V$ ,<br>$V_B = 15V$ , Measure Pin12                                         | 0.5  | 0.75 | 1.05 | $V_{P-P}$      |
| Burst Output                                                 | $e_B$               |                                                                                                                                                                     | 0.45 | 0.70 | 0.95 | $V_{P-P}$      |
| ACC Characteristics (1)                                      | $e_a$               | $V_1 = 12V$ , $V_5 = 10V$ , $V_8$ : OPEN,<br>$v_9 = 1.5mV_{P-P}(B:C = 1:1)$ ,<br>measure Chroma Amplitude Pin12                                                     | 0.16 | 0.34 | —    | $V_{P-P}$      |
| ACC Characteristics (2)                                      | A                   | $v_9 = 100mV_{P-P}$ , $300mV_{P-P}(B:C = 1:1)$ ,<br>Chroma Amplitude Ratio at Pin12<br>$A = v_{12}(v_9 = 300mV_{P-P})/v_{12}(v_9 = 100mV_{P-P})$                    | —    | 1.0  | 1.3  |                |
| Color Control Residual Signal                                | $e_{CS}$            | $V_1 = 0V$ , $V_5 = 10V$ , $V_8$ : OPEN,<br>$S_1$ : 1, $S_2$ : 1, $V_G = 5V$ , $V_B = 15V$ ,<br>$v_9 = 120mV_{P-P}(B:C = 1:1)$                                      | —    | —    | 3    | $mV_{P-P}$     |
| Uni Color Control Gain Range                                 | $\Delta e_{cu}$     | $V_1 = 12V$ , $V_5 = 5$ to $10V$ , $V_8$ : OPEN,<br>$S_1$ : 1, $S_2$ : 1, $V_G = 8V$ , $V_B = 15V$ ,<br>$v_9 = 120mV_{P-P}(B:C = 1:1)$                              | 7.5  | 8.5  | 9.5  | dB             |
| Uni Color Control Phase Range                                | $\Delta \phi_{cu}$  | Same as above. Burst Chroma Phase<br>Change at Pin12                                                                                                                | —    | 4    | 10   | deg.           |
| HUE Phase Control Range (1)                                  | $\Delta \phi_{bH1}$ | $V_1 = 12V$ , $V_5 = 10V$ , $V_8 = 0$ to $12V$ ,<br>$v_9 = 120mV_{P-P}$ , $V_G = 8V$ , $V_B = 15V$ ,<br>Burst Chroma Phase Change at Pin12,<br>$S_1$ : 1, $S_2$ : 1 | 75   | 105  | —    | deg            |
| HUE Phase Control Range (2)                                  | $\Delta \phi_{bH2}$ | Same as above. Phase cahnge from $V_8$<br>OPEN                                                                                                                      | 37   | 51   | 62   | deg            |

**Electrical Characteristics (Cont'd):** ( $V_3 = 12V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

| Parameter                                                  | Symbol                                                                        | Test Conditions                                                                                                                        | Min       | Typ       | Max  | Unit          |
|------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|------|---------------|
| Chroma (2) (Gate Pulse and Blanking Pulse is applied)      |                                                                               |                                                                                                                                        |           |           |      |               |
| Color Control Phase Change                                 | $\Delta\phi_{cc}$                                                             | $V_1 = 0$ to 12V, $V_5$ : OPEN, $V_8$ : OPEN, $v_9 = 120mV_{P-P}$ (B:C = 1:1), $V_G = 8V$ , $V_B = 15V$ , $S_1$ : 1, $S_2$ : 1         | –         | 3         | 5    | deg           |
| Burst–Chroma Phase Difference                              | $\Delta\phi_{bc}$                                                             | Same as above. $V_1$ : OPEN                                                                                                            | –8        | 0         | +8   | deg           |
| APC Pull–In Range                                          | $f_P$                                                                         | $v_{14} = 0.6V_{P-P}$ (Burst), Measure Pin16 Frequency Difference between $f_c$ and $f_o$ when APC is Out                              | $\pm 250$ | $\pm 350$ | –    | Hz            |
| Killer Sensitivity                                         | $e_{bk}$                                                                      | $v_{14}$ Burst Amplitude when $V_1 = 2V$ , $S_1$ : 1, $S_2$ : 2                                                                        | 18        | 29        | 45   | $mV_{P-P}$    |
| Residual Carrier of Demodulator Output                     | $e_{car R}$<br>$e_{car G}$<br>$e_{car B}$                                     | $v_{14}$ : AC GND, 3.58MHz Component at Pin19, Pin20, and Pin21, $S_1$ : 1, $S_2$ : 2                                                  | –         | –         | 300  | $mV_{P-P}$    |
| Color Diff. Signal Output                                  | $e_{OR}$                                                                      | $S_1$ : 1, $S_2$ : 2, $v_{14} = 3.56945MHz$ , $0.2V_{P-P}$ , CH: 3.579549MHz                                                           | 1.45      | 1.85      | 2.30 | $V_{P-P}$     |
|                                                            | $e_{OG}$                                                                      |                                                                                                                                        | 0.49      | 0.62      | 0.77 | $V_{P-P}$     |
|                                                            | $e_{OB}$                                                                      |                                                                                                                                        | 1.55      | 1.95      | 2.42 | $V_{P-P}$     |
| Color Diff. Signal Relative Output                         | R–Y/B–Y                                                                       | Same as above                                                                                                                          | 0.85      | 0.95      | 1.05 | $V_{P-P}$     |
|                                                            | G–Y/B–Y                                                                       |                                                                                                                                        | 0.25      | 0.31      | 0.38 | $V_{P-P}$     |
| Color Diff. Signal Max. Output                             | $e_{ORM}$                                                                     | $S_1$ : 1, $S_2$ : 2, $v_{14} = 3.56945MHz$ , $1.2V_{P-P}$ , CW: 3.579545MHz                                                           | 4.5       | 5.5       | –    | $V_{P-P}$     |
|                                                            | $e_{OGM}$                                                                     |                                                                                                                                        | 1.4       | 1.8       | –    | $V_{P-P}$     |
|                                                            | $e_{OBM}$                                                                     |                                                                                                                                        | 4.5       | 5.5       | –    | $V_{P-P}$     |
| Relative Phase                                             | $\phi_{R-Y}$                                                                  | $S_1$ : 1, $S_2$ : 2, $v_{14}$ : Burst $0.6V_{P-P}$ , Chroma $0.2V_{P-P}$                                                              | 100       | 107       | 112  | deg           |
|                                                            | $\phi_{G-Y}$                                                                  |                                                                                                                                        | 230       | 240       | 250  | deg           |
| Chroma (3) (Gate Pulse and Blanking Pulse is applied)      |                                                                               |                                                                                                                                        |           |           |      |               |
| Demodulator Bandwidth                                      | $f_{BR}$<br>$f_{BG}$<br>$f_{BB}$                                              | $S_1$ : 1, $S_2$ : 2, $v_{14}$ : 10kHz to 5MHz, $0.2V_{P-P}$ , –3dB Frequency (0db: 10kHz)                                             | 1.13      | 1.77      | 3.16 | MHz           |
| Blanking Operation Voltage                                 |                                                                               | $S_1$ : 1, $S_2$ : 2, $v_{14}$ : Burst $0.6V_{P-P}$ , Chroma $0.2V_{P-P}$ , Blanking Pulse Height when Demodulator Output is Disappear | 10.4      | 11.1      | –    | V             |
| Demodulator Output DC Voltage                              | $E_{OR}$<br>$E_{OG}$<br>$E_{OB}$                                              | $S_1$ : 1, $S_2$ : 2, $v_{14}$ : AC GND                                                                                                | 7.00      | 7.71      | 8.35 | V             |
| Demodulator Output Difference Voltage                      | $E_{O(R-G)}$<br>$E_{O(R-B)}$<br>$E_{O(B-G)}$                                  | Same as above                                                                                                                          | –0.3      | –         | +0.3 | V             |
| Demodulator DC Output Thermal Coefficient                  | $\Delta E_{OR\phi}$<br>$\Delta E_{OG\phi}$<br>$\Delta E_{OB\phi}$             | Same as above. $T_A = -20^\circ$ to $+65^\circ C$                                                                                      | –3        | 0         | 2    | $mV/^\circ C$ |
| DC Output Voltage Difference Component Thermal Coefficient | $\Delta E_{O(R-G)\phi}$<br>$\Delta E_{O(R-B)\phi}$<br>$\Delta E_{O(B-G)\phi}$ | Same as above                                                                                                                          | –2        | 0         | +2   | $mV/^\circ C$ |
| Color Control Pin Voltage                                  | $V_1$                                                                         | Measure Pin1 Open Circuit Voltage                                                                                                      | 5.4       | 6.0       | 6.52 | V             |
| Uni Color Control Pin Voltage                              | $V_5$                                                                         | Measure Pin5 Open Circuit Voltage                                                                                                      | 6.9       | 7.5       | 8.02 | V             |
| Hue Control Pin Voltage                                    | $V_8$                                                                         | Measure Pin8 Open Circuit Voltage                                                                                                      | 5.4       | 6.0       | 6.52 | V             |

**Electrical Characteristics (Cont'd):** ( $V_3 = 12V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

| Parameter                           | Symbol               | Test Conditions                                                                                                           | Min    | Typ        | Max    | Unit    |
|-------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------|--------|------------|--------|---------|
| <b>Horizontal (1)</b>               |                      |                                                                                                                           |        |            |        |         |
| Horizontal $V_{CC}$                 | $V_{33}$             | $V_B = 20.3V$                                                                                                             | 7.4    | 8.2        | 9.0    | V       |
| Recommended Supply Current          | $I_{33}$             |                                                                                                                           | 22     | 26         | 30     | mA      |
| Horizontal Frequency                | $f_H$                | $S_{39}$ : b, $S_{38}$ : b, $S_{35}$ : ON, $V_X = 4V$                                                                     | 150.69 | 15.569     | 16.069 | kHz     |
| $f_H$ Thermal Drift                 | $\Delta f_{HT}$      | Same as above. $T_A = -20^\circ$ to $+65^\circ C$                                                                         | -70    | 80         | 230    | Hz      |
| AFC Clamping Voltage                | $V_{CL}$             | Measure Pin35 Open, Circuit Voltage $S_1$ : ON                                                                            | 3.71   | 4.2        | 4.75   | V       |
| AFC Input Current                   | $I_{IN35}$           | $S_1$ : ON, $S_5$ : 2                                                                                                     | 2.2    | 3.42       | 5.1    | mA      |
| AFC Output Current                  | $I_{O35}$            | $S_1$ : ON, $S_5$ : 2                                                                                                     | 2.4    | 3.99       | 5.6    | mA      |
| Horizontal Drive Saturation Voltage | $V_{OL24}$           | $S_1$ : ON, $S_3$ : ON, Measure $V_{24}$                                                                                  | —      | —          | 0.3    | V       |
| Horizontal Drive Output Duty Cycle  | $T_{O24}$            | $S_{39}$ : b, $S_{38}$ : b, $S_{35}$ : OPEN, $V_X = 4V$ , H Level Period/1 Cycle Period = 100, Measure $v_{24}$ Wave Form | 45     | 50         | 55     | %       |
| Oscillator Starting Voltage         | $V_{33min}$          | Minimum $V_{33}$ when Output Duty of Pin24 is 50%                                                                         | —      | —          | 4.0    | V       |
| Starting Supply Current             | $I_{33min}$          | $V_{33} = 4V$ , Measure $I_{33}$                                                                                          | 5.5    | 8.8        | 11.5   | mA      |
| AFC Pull-In Range                   | $\Delta f_{HPULL}$   | $S_{38}$ : a, $S_{35}$ : ON, $S_{39}$ : a, Changing $V_X$ , Measure Pull-In Range                                         | —      | $\pm 600$  | —      | Hz      |
| <b>Horizontal (2)</b>               |                      |                                                                                                                           |        |            |        |         |
| AFC Hold-In Range                   | $\Delta f_{H\ HOLD}$ | Same as Pull-In Range, Measure Hold-In Range                                                                              | —      | $\pm 1000$ | —      | Hz      |
| X-Ray Protector Voltage Range       | $V_{IN23}$           | Measure $V_{23}$ when $v_{24}$ Output becomes L Level, $T_A = +25^\circ C$                                                | 0.50   | 0.88       | 1.10   | V       |
| X-Ray Protector Current Sensitivity | $I_{IN23}$           | Measure $I_{23}$ when $v_{23}$ Output becomes L Level, $T_A = +25^\circ C$                                                | 0.060  | 0.178      | 1.000  | $\mu A$ |
| X-Ray Protector Operating Voltage   | $V_{IN23\phi}$       | Same as $V_{IN23}$ , $T_A = -20^\circ$ to $+65^\circ C$                                                                   | 0.30   | 0.84       | 1.28   | V       |
| X-Ray Protector Operating Current   | $I_{IN23\phi}$       | Same as $I_{IN23}$ , $T_A = -20^\circ$ to $+65^\circ C$                                                                   | 0.030  | 0.178      | 2.000  | $\mu A$ |
| <b>Sync Separator</b>               |                      |                                                                                                                           |        |            |        |         |
| Sync Separator Sensitivity (1)      | $I_{IN39}$           | Pin38: OPEN, Measure $I_{39}$ when $V_{37}$ is Low-to-High                                                                | 18.1   | 35.0       | 11.3   | $\mu A$ |
| Sync Separator Sensitivity (2)      | $I_{IN38}$           | Pin39: OPEN, Measure $I_{38}$ when $V_{37}$ is Low-to-High                                                                | 13.3   | 21.4       | 54.2   | $\mu A$ |
| Sync Output High Level              | $V_{OH37}$           | Pin38: OPEN                                                                                                               | 7.04   | 8.19       | 9.34   | V       |
| Sync Output Low Level               | $V_{OL37}$           |                                                                                                                           | 0      | 1.5        | 2.4    | V       |
| Sync Clamp Voltage                  | $V_{CL31}$           | Measure $V_{31}$ at $I_{31} = -1mA$                                                                                       | -0.85  | -0.63      | -0.5   | V       |
| <b>Vertical</b>                     |                      |                                                                                                                           |        |            |        |         |
| Vertical Free-Running Frequency     | $f_V$                | $S_{31}$ : ON, Measure Pin28                                                                                              | 56     | 60         | 64     | Hz      |
| Retrace Time                        | $T_r$                | Pin28 Output Pulse                                                                                                        | 500    | 690        | 850    | $\mu s$ |

**Electrical Characteristics (Cont'd):** ( $V_3 = 12V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

| Parameter                      | Symbol                     | Test Conditions                                                                                                                                                      | Min  | Typ  | Max  | Unit    |
|--------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------|
| <b>Vertical (Cont'd)</b>       |                            |                                                                                                                                                                      |      |      |      |         |
| $f_V$ Pull-In Range            | $\Delta f_{V\text{ PULL}}$ | $S_{31}$ : ON/OFF, Pin31 to $V_R$ ,<br>$S_{31}$ : OFF, $f_{OSC28} = 60Hz$ ,<br>$S_{31}$ : ON, Measure $f_{OSC28}$ ,<br>$\Delta f_{V\text{ PULL}} = f_{OSC28} = 60Hz$ | 11.1 | 12.1 | 12.9 | Hz      |
| Ramp Max. Voltage              | $V_{O28}$                  | $V_{30} = 6V$ , Measure $V_{28}$                                                                                                                                     | 7.05 | 7.65 | 8.25 | V       |
| Ramp Max. Current              | $I_{O28}$                  | $V_{30} = 6V$ , Measure $I_{28}$ , $S_6$ : ON                                                                                                                        | 16.7 | 26.8 | 48.4 | mA      |
| Max. Common Mode Input Voltage | $V_{IH28}$                 | $S_{26}$ , $S_{27}$ : ON, $V_{30} = 0V$ , $V_{28} = 6$ to $12V$ ,<br>Measure $V_{28}$ when $V_{27}$ is saturated                                                     | 11.9 | —    | —    | V       |
| Min. Common Mode Input Voltage | $V_{IL28}$                 | Same as above. $V_{28} = 6$ to $0V$                                                                                                                                  | —    | 2.86 | 3.7  | V       |
| Pin28 Input Current            | $I_{I28}$                  | $S_{26}$ , $S_{27}$ : ON, $V_{30} = 0V$ ,<br>Measure $I_{28}$ at $V_{28} = 6V$                                                                                       | 0.25 | 0.98 | 4.50 | $\mu A$ |
| Pin27 Input Current            | $I_{I27}$                  | Same as above. Measure $I_{27}$ at $V_{28} = 4V$                                                                                                                     | 0.18 | 0.94 | 6.21 | $\mu A$ |
| Max. Vertical Output Voltage   | $V_{OH26}$                 | $S_{26}$ : OFF, $S_{27}$ : ON, $V_{30} = 6V$ , Measure $V_{26}$                                                                                                      | 5.6  | 6.3  | 7.2  | V       |
| Min. Vertical Output Voltage   | $V_{OL26}$                 | $S_{26}$ , $S_{27}$ : OFF, $V_{30} = 6V$ , Measure $V_{26}$                                                                                                          | —    | —    | 0.3  | V       |
| Pin29 Bias Voltage             | $V_{29}$                   | Measure $V_{29}$ when $I_{29} = -0.2mA$                                                                                                                              | 3.7  | 3.9  | 4.1  | V       |

**Pin Connection Diagram**

|                   |           |           |                      |
|-------------------|-----------|-----------|----------------------|
| Color Control     | <b>1</b>  | <b>42</b> | C-Contrast Output    |
| E-Contrast Output | <b>2</b>  | <b>41</b> | Brightness Control   |
| $V_{CC}$          | <b>3</b>  | <b>40</b> | Clamp Input          |
| Delay Input       | <b>4</b>  | <b>39</b> | Horiz Sync Separator |
| Contrast Control  | <b>5</b>  | <b>38</b> | Vert Sync Separator  |
| Video Inv Input   | <b>6</b>  | <b>37</b> | Sync Output          |
| Video Inv Output  | <b>7</b>  | <b>36</b> | Horiz OSC Discharge  |
| Hue Control       | <b>8</b>  | <b>35</b> | AFC                  |
| Chroma Input      | <b>9</b>  | <b>34</b> | Horiz OSC Timing     |
| ACC Filter        | <b>10</b> | <b>33</b> | Horiz $V_{CC}$ (8V)  |
| GND               | <b>11</b> | <b>32</b> | GND                  |
| Chroma Output     | <b>12</b> | <b>31</b> | Vert Sync Input      |
| Killer Filter     | <b>13</b> | <b>30</b> | Timing               |
| Demodulator Input | <b>14</b> | <b>29</b> | Height Control       |
| APC Filter        | <b>15</b> | <b>28</b> | Ramp Capacitor       |
| X'tal Drive       | <b>16</b> | <b>27</b> | NFB Input            |
| X'tal Input       | <b>17</b> | <b>26</b> | Vert Drive Output    |
| $-\pi/4$ Input    | <b>18</b> | <b>25</b> | Phase Compensation   |
| B-Y Output        | <b>19</b> | <b>24</b> | Horiz Drive Output   |
| G-Y Output        | <b>20</b> | <b>23</b> | X-Ray Protect        |
| R-Y Output        | <b>21</b> | <b>22</b> | Y Output             |

