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NTE7047
Integrated Circuit
TV Color Small Signal Sub System

Features:
- Vision IF Amplifier with Synchronous Demodulator
- Automatic Gain Control (AGC) Detector Suitable for Negative Modulation
- AGC Tuner
- Automatic Frequency Control (AFC) Circuit with Sample–and–Hold
- Video Preamplifier
- Sound IF Amplifier and Demodulator
- DC Volume Control or Separate Supply for Starting the Horizontal Oscillator
- Audio Preamplifier
- Horizontal Synchronization Circuit with Two Control Loops
- Vertical Synchronization (Divider System) and Sawtooth Generation with Automatic Amplitude Adjustment for 50Hz and 60Hz
- Transmitter Identification (Mute)
- Generation of Sandcastle Pulse

Absolute Maximum Ratings:

Supply Voltage (Pin7), $V_P = V_{7–6}$ 13.2V
Total Power Dissipation, P_{tot} 2.3W
Operating Ambient Temperature Range, T_A . . . . . –25° to +65°C
Storage Temperature Range, T_{stg} . . . . . –25° to +150°C

Electrical Characteristics: (T_A = +25°C, $V_P = V_{7–6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supplies						
Supply Voltage Range (Pin7)	$V_{7–6}$		9.5	12.0	13.2	V
Supply Current (Pin7)	I_7	At no input	75	125	165	mA
Start Current (Pin11)	I_{11}	Note 1	–	6.5	9.0	mA
Start Voltage Horizontal Oscillator	V_{11}		9.5	–	–	V
Start Protection Level	V_{11}	I_{11} = 12mA	–	–	16.5	V

Note 1. Pin11 has a double function. When during switch–on a current of 9mA is supplied to this pin, it is used to start the horizontal oscillator. The main supply can then be obtained from the horizontal deflection stage. When no current is supplied to this pin it can be used as a volume control.

Electrical Characteristics (Cont'd): (T_A = +25°C, $V_P = V_{7-6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Vision IF Amplifier (Pin8 and Pin9)						
Input Sensitivity (RMS Value)	V_{8-9}	At 38.9MHz, Note 2	25	40	60	µV
		At 45.75MHz, Note 2, Note 26	25	40	60	µV
Differential Input Resistance	R_{8-9}	Note 3	–	1300	–	Ω
Differential Input Capacitance	C_{8-9}	Note 3	–	5	–	pF
Gain Control Range	G_{8-9}		–	77	–	dB
Maximum Input Signal	V_{8-9}		100	170	–	mV
Output Signal Expansion for 48dB Variation of Input Signal	ΔV_{17}	Note 4	–	1	–	dB
Video Amplifier (Note 5)						
Zero Signal Output Level	V_{17}	Note 6	–	50.4	–	V
Top Sync Level	V_{17}		2.3	2.5	2.7	V
Video Output Signal Amplitude	V_{17}	Note 7	2.3	2.65	3.0	V
White–Spot Threshold Level			–	5.7	–	V
White–Spot Insertion Level			–	3.8	–	V
Video Output Impedance			–	25	–	Ω
Internal Bias Current of Output Transistor (NPN Emitter Follower)	$I_{17(int)}$		1.4	1.8	–	mA
Maximum Source Current	I_{17}		10	–	–	mA
Bandwidth of Demodulated Output Signal	B		5	7	–	MHz
Differential Gain	G_{17}	Note 8	–	4	8	%
Differential Phase	φ	Note 8	–	2	5	deg.
Video Non–Linearity	NL	Note 9	–	2	5	%
Intermodulation		f = 1.1MHz (Blue), Note 10	50	60	–	dB
		f = 1.1MHz (Yellow), Note 10	50	60	–	dB
		f = 3.3MHz (Blue), Note 10	55	65	–	dB
		f = 3.3MHz (Yellow), Note 10	55	65	–	dB
Signal–to–Noise Ratio	S/N	V_i = 10mV, Note 11	50	57	–	dB
		End of gain control range, Note 11	50	62	–	dB
Residual Carrier Signal	V_{17}		–	2	10	mV
Residual 2nd Harmonic of Carrier Signal	V_{17}		–	2	10	mV
Tuner AGC						
Minimum Starting Point Tuner Take–Over (RMS Value)	$V_{8-9(rms)}$		–	–	0.2	mV
Maximum Starting Point Tuner Take–Over (RMS Value)	$V_{8-9(rms)}$		100	150	–	mV
Maximum Tuner AGC Output Swing	$I_{5(max)}$	V_5 = 3V	4	–	–	mA
Output Saturation Voltage	$V_{5(sat)}$	I_5 = 2mA	–	–	300	mV
Leakage Current (Pin5)	I_L		–	–	1	µA
Input Signal Variation Complete Tuner Control	ΔV_i		0.5	2.0	4.0	dB

Electrical Characteristics (Cont'd): (T_A = +25°C, $V_P = V_{7–6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Tuner AGC (Cont'd)						
Minimum Voltage Tuner Take–Over	V_1		–	–	1	V
Voltage to Switch on the X–Ray Protection	V_1	Horizontal output high resistance	–	–	0.8	V
AFC Circuit (AFC Sample–and–Hold/Switch)						
AFC Switch–Off Current	I_{19}		0.1	–	–	mA
Output Current	I_{19}	V_{19} = 0V	–	0.1	0.3	mA
Leakage Current at Pin19	I_{LO}		–	–	2	µA
AFC Circuit (AFC Output)						
AFC Output Voltage Swing	V_{18}	Note 12, Note 13	10.5	–	11.5	V
Available Output Current	I_{18}		0.2	–	–	mA
Control Steepness			–	100	–	mV/kHz
AFC Output Voltage with AFC Off	V_{18}		5.5	6.0	6.5	V
AFC Output Resistance	R_{18}		–	40	–	kΩ
Measured With an Input Signal Amplitude = 150µV (RMS value)						
Output Voltage Swing	V_{18}	Note 26	–	11	–	V
Control Steepness		Note 26	–	80	–	mV/kHz
Sound Circuit (Note 14)						
Input Limiting Voltage	V_{15}	$V_{o(max)}$ = –3dB	–	400	800	µV
Input Resistance	R_{15}		–	2.6	–	kΩ
Input Capacitance	C_{15}		–	6	–	pF
AM Suppression	AMS		53	58	–	dB
AF Output Signal (RMS Value)	$V_{12(rms)}$	Note 15	400	600	800	mV
AF Output Signal when Pin11 is used as a Starting Pin or Connected to V_P (RMS Value)	$V_{12(rms)}$	Δf = 50kHz	500	900	1500	mV
AF Output Impedance	Z_{12}		–	25	100	Ω
Total Harmonic Distortion	THD	Note 16	–	0.5	2.0	%
Ripple Rejection	RR	Volume control 20dB; f_k = 100Hz	–	35	–	dB
Output Voltage When Muted	V_{12}		–	2.5	–	V
Output Level Shift due to Muting	V_{12}	Volume control –20dB	–	–	0.5	V
Signal–to–Noise Ratio	S/N	Note 17	–	47	–	dB
Voltage with Pin11 Disconnected	V_{11}		–	6.0	–	V
Current with Pin11 Short Circuited to GND	I_{11}		–	1	–	mA
Temperature Dependence of the Output Signal Amplitude	V_{12}	T_A = +20° to +65°C, –30dB volume control and voltage of Pin11 fixed, Note 26	–	2.5	–	dB
Volume Control (Note 18)						
External Control Resistor	R_{11}	Note 18	–	4.7	–	kΩ
Suppression Output Signal during Mute Condition	OSS		60	66	–	dB

Electrical Characteristics (Cont'd): (T_A = +25°C, V_P = $V_{7–6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Horizontal Synchronization Circuit (Sync Separator)						
Required Sync Pulse Amplitude	V_{25}	Note 19	200	750	–	mV
Input Current, Pin25	I_{25}	V_{25} > 5V	–	8	–	μA
		V_{25} = 0V	–	–10	–	mA
Horizontal Synchronization Circuit (First Control Loop)						
Holding Range PLL	±Δf		–	1500	2000	Hz
Catching Range PLL	±Δf		600	1500	–	Hz
IF Input Signal at which the Time Constant is Switched (RMS Value)	$V_{8–9}$	Strong to weak	–	2.2	–	mV
Horizontal Synchronization Circuit (Second Control Loop)						
Control Sensitivity	$\Delta t_d/\Delta t_o$	Note 21	–	100	–	
Control Range	t_d		–	25	–	μs
Controlled Edge				positive		
Horizontal Synchronization Circuit (Phase Adjustment, via Second Control Loop)						
Control Sensitivity			–	25	–	μA/μs
Maximum Allowed Phase Shift	α		–	±2	–	μs
Horizontal Synchronization Circuit (Horizontal Oscillator, Pin23)						
Free Running Frequency	f_{fr}	R = 34.3kΩ, C = 2.7nF	–	15625	–	Hz
Spread with Fixed External Components	Δf		–	–	4	%
Frequency Variation	Δf_{fr}	ΔV_P = 9.5 to 13.2V	–	–	2	%
Frequency Variation with Temperature	TC	Note 26	–	–1.6	–	Hz/°C
Maximum Frequency Deviation at Start of Horizontal Output	Δf_{fr}		–	–	10	%
Frequency Variation when Only Noise is Received	Δf_{fr}	Note 26	–	–	500	Hz
Horizontal Synchronization Circuit (Horizontal Output)						
Output Limiting Voltage	V_{26}		–	–	16.5	V
Output Voltage LOW	V_{26}	I_{sink} = 10mA	–	0.2	0.5	V
Maximum Sink Current	I_{26}		10	–	–	mA
Duty Cycle Output Signal			–	46	–	%
Rise Time of Output Pulse	t_r		–	260	–	ns
Fall Time of Output pulse	t_f		–	100	–	ns
Horizontal Synchronization Circuit (Flyback Input and Sandcastle Output, Note 22)						
Input Current Required During Flyback Pulse	I_{27}		0.1	–	2.0	mA
Output Voltage During Burst Key Pulse	V_{27}		8	–	–	V
Output Voltage During Horizontal Blanking	V_{27}		4.0	4.4	5.0	V
Output Voltage During Vertical Blanking	V_{27}		2.1	2.5	2.9	V
Pulse Width, Burst Key Pulse	t_W	60Hz	2.9	3.3	3.7	μs
		50Hz	3.2	3.6	4.0	μs
Pulse Width, Horizontal Blanking Pulse				Flyback Pulse Width		

Electrical Characteristics (Cont'd): (T_A = +25°C, $V_P = V_{7–6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Horizontal Synchronization Circuit (Cont'd) (Flyback Input and Sandcastle Output, Note 22)						
Vertical Blanking Pulse		50Hz divider in search window	–	21	–	lines
		60Hz divider in search window	–	17	–	lines
		50Hz divider in narrow window	–	25	–	lines
		60Hz divider in narrow window	–	21	–	lines
Delay Between Start of Sync Pulse at the Video Output and the Burst Key Pulse		Trailing edge, 60Hz	–	–	9.3	µs
		Rising edge	4.7	5.4	6.1	µs
Horizontal Synchronization Circuit (Coincidence Detector)						
Voltage for Synchronized Condition	V_{22}		–	9.8	–	V
Voltage for No Signal Condition	V_{22}		–	1.5	–	V
Switching Level to Switch the Phase Detector from Fast to Slow	V_{22}		6.2	6.7	7.2	V
Hysteresis Slow to Fast	V_{22}		–	0.6	–	V
Switching Level to Activate the Mute Function (Transmitter Identification)	V_{22}		2.5	2.8	3.1	V
Hysteresis Mute Function	V_{22}		–	2	–	V
Delay Time of Mute Release after Transmitter Insertion			–	–	300	µs
Allowable Load on Pin22			–	–	10	µA
External Video Mode	V_{22}		–	–	0.7	V
Current at Pin22	I_{22}	V_{22} = 0V	–	–	0.8	mA
Vertical Circuit (Vertical Ramp Generator, Note 24)						
Input Current During Scan	I_2		–	–	2	µA
Discharge Current During Retrace	I_2		–	0.8	–	mA
Sawtooth Amplitude (peak–to–peak value)	$V_{2(p–p)}$		–	1.9	–	V
Interlace Timing of the Internal Pulses			30	32	34	µs
Vertical Circuit (Vertical Output, Note 24)						
Available Output Current	I_3	V_3 = 4V	–	–	3	mA
Maximum Output Voltage	V_3	I_3 = 0.1mA	4.4	5.0	–	V
Vertical Circuit (Vertical Feedback Input, Note 24)						
Input Voltage, DC Component	V_4		2.9	3.3	3.7	V
Input Voltage, AC Component (peak–to–peak value)	$V_{4(p–p)}$		–	1	–	V
Input Current	I_4		–	–	12	µA
Internal Precorrection to Sawtooth	Δt_p		–	3	–	%
Deviation Amplitude		50Hz/60Hz	–	–	2	%
Temperature Dependence of the Amplitude		T_A = +20°C to +65°C	–	–	2	%
Vertical Circuit (Vertical Guard, Note 24, Note 25)						
Active Switching Level at a Deviation with Respect to the DC Feedback Level: Guard Level LOW	ΔV_4	V_{27} = 2.5V	–	2.1	–	V

Electrical Characteristics (Cont'd): (T_A = +25°C, $V_P = V_{7–6}$ = 12V, carrier 38.9MHz, negative modulation unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Vertical Circuit (Cont'd) (Vertical Guard, Note 24, Note 25)						
Active Switching Level at a Deviation with Respect to the DC Feedback Level: Guard Level HIGH	ΔV_4	V_{27} = 2.5V	–	2.0	–	V

Notes:

Note 2. On set AGC.

Note 3. The input impedance has been chosen such that a SAW–filter can be applied.

Note 4. Measured with 0dB = 450μV.

Note 5. Measured at 10mV (RMS value) top sync input signal.

Note 6. So–called projected zero point; i.e. with switched demodulator.

Note 7. White 10% of the top sync amplitude.

Note 8. The differential gain is expressed as a percentage of the difference in peak amplitude between the largest and smallest value relative to the subcarrier amplitude at blanking level. The differential phase is defined as the difference in degrees between the largest and smallest phase angle. The differential gain and phase are measured with a DSB signal.

Note 9. This figure is valid for the complete video signal amplitude (peak white–to–black). The non–linearity is expressed as a percentage of the maximum deviation of a luminance step from the mean step, with respect to the mean step.

Note 10. The figures are measured at an input signal of 10mV (RMS value).

Note 11. Measured with a source impedance of 75Ω.

$$\text{Signal–to–noise ratio} = 20 \log \frac{V_{out\ black–to–white}}{V_{n(rms)} \text{ at B = 5MHz}}$$

Note 12. The AFC control voltage is obtained by multiplying the IF output signal (which is also used to drive the synchronous demodulator) with a reference carrier. This reference carrier is obtained from the demodulator tuned circuit via a 90 degree phase shift network. The IF output signal has an asymmetrical frequency spectrum with respect to the carrier frequency. To avoid problems due to this asymmeterical signal the AFC circuit is followed by a sample–and–hold circuit which samples during the sync level. As a result the AFC output voltage contains no video information. The specified control steepness is without using an external load resistor. The control steepness decreases when the AFC output is loaded with two resistors between the voltage supply and GND.

Note 13. At very weak input signals the drive signal for the AFC circuit will have a high noise content. This noise input has an asymmetrical frequency spectrum which will cause an offset of the AFC output voltage. To avoid problems due to this effect a notch filter can be built in to the demodulator tuned circuit. The characteristics given for waek input signals are measured without a notch circuit, with a SAW filter connected in front of the IC (input signal such that the input signal of the IC is 150μV (RMS value).

Note 14. The sound circuit is measured (unless otherwise specified) with an input signal of V_{15} of 50mV (RMS value), a carrier frequency of 5.5MHz at a Δf of 27.5kHz and AF frequency of 1kHz. The QL of the demodulator tuned circuit is 16 and the volume control is connected to the supply. The reference circuit must be tuned in such a way that the output is symmetrical clipping at maximum volume.

Note 15. The output signal is measured at a Δf = 7.5kHz and maximum volume control.

Note 16. The demodulator tuned circuit must be tuned at minimum distortion.

Note 17. Weighted noise, measured according to: CCIR 468.

Note 18. See also Note 1. The volume can be controlled by using a potentiometer connected to GND (value 10kΩ) or by means of a variable direct voltage. In the latter case the relatively low input impedance (Pin11) must be taken into account.

Notes (Cont'd):

Note 19. The minimum value is obtained with a 1.8kΩ series resistor connected between Pin17 and Pin25. The slicing level can be varied by changing the value of this resistor (a higher resistance results in a larger value of the minimum sync pulse amplitude). The slicing level is independent of the video information.

Note 20. Frequency control is obtained by supplying a correction current to the oscillator RC–netword. This is achieved via a resistor connected between the phase 1 detector output and the oscillator network. The oscillator can be adjusted to the correct frequency by:

- short–circuit the sync separator bias network (Pin25) to the voltage supply.

To avoid the necessity of a VCR switch, the time constant of the phase detector at strong input signals is sufficiently short to obtain a stable picture during VCR playback. During the vertical retrace period the time constant is even shorter so that VCR head errors are compensated for at the beginning of the scan. During weak signal conditions (information derived from the AGC circuit) the time constant is increased to obtain a good noise immunity.

Note 21. This figure is valid for an external load impedance of 82kΩ connected between Pin28 and the shift adjustment potentiometer.

Note 22. The horizontal flyback input and the sandcastle output have been combined on Pin27. The flyback pulse is clamped to a level of 4.5V. The minimum current to drive the second control loop is 0.1mA.

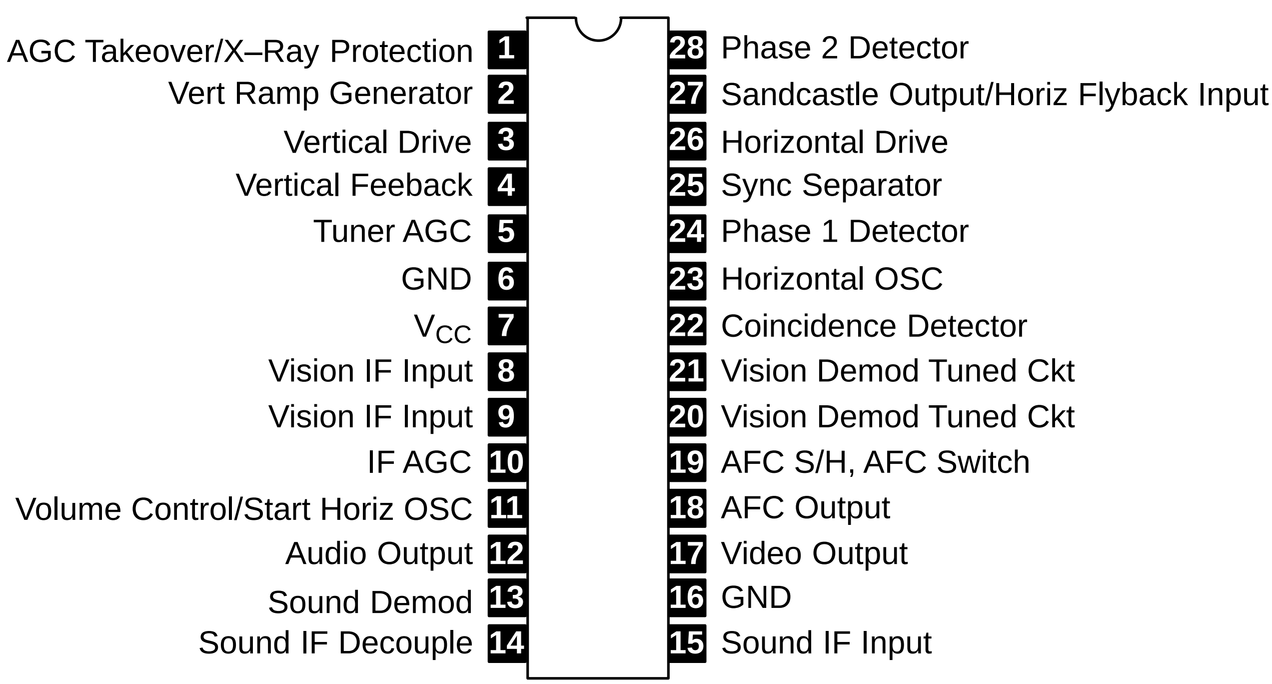
Note 23. The in–sync/out–of–sync and transmitter identification have been combined on Pin22. The capacitor is charged during the sync pulse and discharged during the time difference between gating and sync pulsxe.

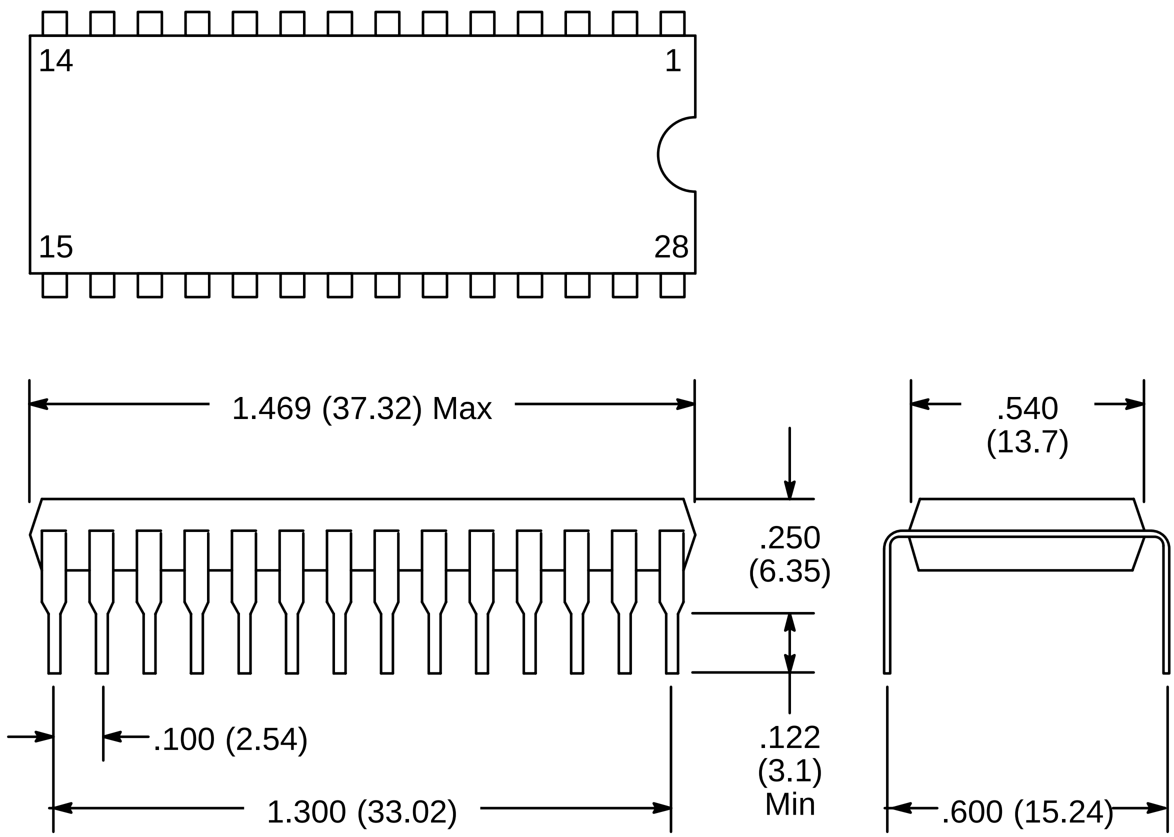
Note 24. The vertical scan is synchronized by means of a divider system, therefore no adjustment is required for the ramp generator. The divider detects whether the incoming signal has a vertical frequency of 50Hz or 60Hz and corrects the vertical amplitude.

Note 25. To avoid screenburn due to a collapse of the vertical deflection, a continuous blanking level is inserted into the sandcastle pulse when the feedback voltage of the vertical deflection is not within the specified limits.

Note 26. These figures are based on sampled tests.

Pin Connection Diagram




14
1
15
28
1.469 (37.32) Max
.540
(13.7)
.250
(6.35)
.122
(3.1)
Min
.100 (2.54)
1.300 (33.02)
.600 (15.24)