

Specifications

The material in this section is organized into two main groupings: the specification tables and the supporting figures. The specification tables include:

1. PAL general and test signal specifications
2. Signal level specifications
3. Power supply, physical, and environmental specifications

The supporting figures (waveform diagrams and related data) follow the specification tables.

Reference Documentation

The following documents were used as references in the preparation of this specification:

1. Product Classification Environmental Test Summary, 13 June 1977; Tektronix Standard 062-2853-00
2. Electrostatic Discharge Environmental Test, 20 October 1977; Tektronix Standard 062-2862-00
3. Electromagnetic Compatibility Environmental Test, 31 March 1977; Tektronix Standard 062-2866-00
4. Recommendations and Reports of the CCIR, 1978; Transmission of Sound Broadcasting and Television Signals Over Long Distances (CMTT)
5. IEEE Standard Dictionary of Electrical Terms, Second Edition (1977); IEEE Standard 100-1977
6. Safety Standard for Electrical and Electronic Equipment, Draft 6, June 1978; ANSI C39.5
7. Canadian Standards Association Electrical Bulletin; CAN/CSA C22.2 No. 1010.1

Performance Conditions

The Performance Requirements are valid within the environmental limits if the instrument is adjusted at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, and a minimum warm-up time of 20 minutes is allowed.

Safety Standards

The following safety standards apply to the TSG 111:

- UL 3111
- CAN/CSA C22.2 No. 231
- ANSI/ISA S82.02.01

NOTE. Any figures referenced in this section are found after the specification tables.

Table 2–1: General test signal characteristics

Characteristics	Performance requirements	Supplemental information	Performance check step no.
Luminance Amplitude Accuracy	$\pm 1\%$		6
Chrominance-to-Luminance Gain	$\pm 1\%$		9
Chrominance Accuracy	$\pm 1\%$		7
DC Level	0 mV \pm 50 mV		2
Luminance Rise Time	250 ns \pm 25 ns	Except Color Bars, 2T Bar, and Convergence.	
Chrominance Rise Time	350 ns \pm 35 ns		
Burst Amplitude	300 mV \pm 6 mV _{p-p}		4
Burst Rise Time	350 ns \pm 35 ns	Slower than BBC spec to avoid ringing.	
Sync Amplitude	300 mV \pm 30 mV		3
Sync Rise Time	250 ns \pm 25 ns		10
Horizontal Timing	See Figures 2–1 to 2–6.	All signals comply with PAL timing specs.	
Front Porch Duration	1.55 μ s minimum		
Line Blanking Interval	12.0 μ s \pm 1.15 μ s	Beginning at 50% point of active video.	12
Breezeway Duration	900 ns \pm 50 ns		
Horizontal Sync Duration	4.7 μ s \pm 50 ns	50% amplitude point.	11
Vertical Serration Duration	4.7 μ s \pm 50 ns	50% amplitude point.	11
Equalizing Pulse Duration	2.35 μ s \pm 50 ns	50% amplitude point.	11
Burst Delay from Sync Burst Duration	5.6 μ s \pm 50 ns 2.255 μ s \pm 0.1 μ s	From 50% point of sync. 10 subcarrier cycles.	
Output Impedance	75 Ω		

Table 2-1: General test signal characteristics (cont.)

Characteristics	Performance requirements	Supplemental information	Performance check step no.
Return Loss		≥ 36 dB to 5 MHz	
Crosstalk		≥ 60 dB down	
Residual Subcarrier		≥ 60 dB down	
Oscillator Frequency Stability Normal Option 10	$F_{\text{clk}} \pm 40$ Hz over 5 °C to 35 °C $F_{\text{clk}} \pm 20$ Hz over 5 °C to 35 °C	$F_{\text{clk}} = 17.734375$ MHz	1
Subcarrier Frequency Stability Normal Option 10	$F_{\text{sc}} \pm 10$ Hz over 5 °C to 35 °C $F_{\text{sc}} \pm 5$ Hz over 5 °C to 35 °C	$F_{\text{sc}} = \frac{1135 H + 100}{4}$ = 4.43361875 MHz	
SC/H Accuracy	$0^\circ \pm 5^\circ$		15
Chrominance-to-Luminance Delay	≤ 5 ns		8
Frequency Response	2% to 5 MHz		13

Table 2-2: Test signals

Characteristics	Performance requirements	Supplemental information	Performance check step no.																											
75% Color Bars over Red Luminance Rise Times Field Timing Color Bars Red	150 ns ± 25 ns Lines 24 – 166 and 336 – 479 Lines 167 – 310 and 480 – 622 <table><tr><td>Luminance Amplitude</td><td>Subcarrier Amplitude</td><td>Subcarrier Phase</td></tr><tr><td><i>mV</i></td><td><i>mV_{p-p}</i></td><td><i>Degree</i></td></tr><tr><td>White</td><td>700.0</td><td>000.0</td></tr><tr><td>Yellow</td><td>465.1</td><td>470.5</td></tr><tr><td>Cyan</td><td>368.0</td><td>663.8</td></tr><tr><td>Green</td><td>308.2</td><td>620.1</td></tr><tr><td>Magenta</td><td>216.8</td><td>620.1</td></tr><tr><td>Red</td><td>157.0</td><td>663.8</td></tr><tr><td>Blue</td><td>59.9</td><td>470.5</td></tr></table>	Luminance Amplitude	Subcarrier Amplitude	Subcarrier Phase	<i>mV</i>	<i>mV_{p-p}</i>	<i>Degree</i>	White	700.0	000.0	Yellow	465.1	470.5	Cyan	368.0	663.8	Green	308.2	620.1	Magenta	216.8	620.1	Red	157.0	663.8	Blue	59.9	470.5	Figure 2-1 Figure 2-2	
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100% Color Bars over Red Luminance Rise Times Field Timing Color Bars Red	150 ns ± 25 ns Lines 24 – 166 and 336 – 479 Lines 167 – 310 and 480 – 622 <table><tr><td>Luminance Amplitude</td><td>Subcarrier Amplitude</td><td>Subcarrier Phase</td></tr><tr><td><i>mV</i></td><td><i>mV_{p-p}</i></td><td><i>Degree</i></td></tr><tr><td>White</td><td>700.0</td><td>000.0</td></tr><tr><td>Yellow</td><td>620.2</td><td>627.3</td></tr><tr><td>Cyan</td><td>490.7</td><td>885.1</td></tr><tr><td>Green</td><td>410.9</td><td>826.8</td></tr><tr><td>Magenta</td><td>289.1</td><td>826.8</td></tr><tr><td>Red</td><td>209.3</td><td>885.1</td></tr><tr><td>Blue</td><td>79.8</td><td>627.3</td></tr></table>	Luminance Amplitude	Subcarrier Amplitude	Subcarrier Phase	<i>mV</i>	<i>mV_{p-p}</i>	<i>Degree</i>	White	700.0	000.0	Yellow	620.2	627.3	Cyan	490.7	885.1	Green	410.9	826.8	Magenta	289.1	826.8	Red	209.3	885.1	Blue	79.8	627.3	Figure 2-3 Figure 2-4	
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Convergence Amplitude Pattern Pulse HAD	525.0 mV 14 lines/field and 19 lines/horiz 225 ns ± 25 ns	Figures 2-7, 2-8.																												
5-Step (Gray Scale) Amplitude Linearity Error	700 mV ≤1%	Figure 2-5.	5																											
Ramp/Modulated Ramp Luminance Amplitude Chrominance Amplitude Differential Gain Differential Phase	700 mV 280.0 mV _{p-p} 0.8% maximum 0.8° maximum	When averaged with a Tek 1781 or VM 700, the quantizing errors in the Mod Ramp are greatly reduced. This allows a more accurate measurement of dg and dφ errors. Figures 2-9, 2-10.	15 15																											

Table 2-2: Test signals (cont.)

Characteristics	Performance requirements	Supplemental information	Performance check step no.
Line Sweep Frequency Amplitude	500 kHz – 5.5 MHz 700 mV _{p-p}	Figure 2-11. Markers at 1, 2, 3, 4 and 5 MHz	
Pluge Matrix Pluge Levels Lum Ref Levels	–14 mV and +14 mV 700 mV, 450 mV, 200 mV, and 110 mV	Figure 2-12.	
CCIR 17 2T bar width rise time 2T pulse HAD 20T modulated pulse 5-step	10 μ s 192.9 ns \pm 20 ns 200 ns \pm 20 ns 60.7°	Figure 2-13.	
CCIR 18 (Multiburst) White Reference Bar Amplitude Packet Amplitudes Pedestal Burst Frequencies Packet Rise Time	420 mV _{p-p} 420 mV _{p-p} 350 mV 0.5, 1.0, 2.0, 4.0, 4.8, and 5.8 MHz 350 ns typical	Figure 2-14. Equal width packets Sine squared shaped packets.	
CCIR 330 2T bar width 2T bar rise time 2T pulse HAD 5-Step with 280 mV _{p-p} modulation	10 μ s 192.9 ns \pm 20 ns 200 ns \pm 20 ns 60.7°	Figure 2-15.	
CCIR 331 Luminance Pedestal Rise Time	350 mV luminance pedestal with three levels, 140 mV _{p-p} , 420 mV _{p-p} , and 700 mV _{p-p} , of chroma bar (60.7°) followed by 420 mV _{p-p} of chroma bar (60.7°). 192.9 ns \pm 20 ns	Figure 2-16.	
UK ITS 1	2T bar (width = 10 μ s, rise time = 192.9 ns \pm 20 ns), 2T pulse (HAD = 200 ns \pm 20 ns), 10T modulated pulse (60.7°), and 5-Step with 140 mV _{p-p} modulation (60.7°).	Figure 2-17.	

Table 2-2: Test signals (cont.)

Characteristics	Performance requirements	Supplemental information	Performance check step no.
UK ITS 2	700 mV _{p-p} 60.7° chroma bar on a 350 mV luminance pedestal. 280 mV _{p-p} 60.7° chroma bar (no pedestal).	Figure 2-18.	
Luminance Pedestal Rise Time	192.9 ns ±20 ns		
Matrix Standard	CCIR 17, CCIR 330, CCIR 331, CCIR 18, 75% Bars, Sin(x)/x, Red, 15 kHz Square Wave, 50% Field, Shallow Ramp, ITS 1, ITS 2.	Figures 2-13, 2-15, 2-16, 2-14, 2-1 2-6, 2-4, 2-20, 2-19, 2-21, 2-17, 2-18.	
Option 01	CCIR 17, CCIR 18, CCIR 330, CCIR 331, 75% Bars, Sin(x)/x.	Figures 2-13, 2-14, 2-15, 2-16, 2-1, 2-6.	

Table 2-3: Black burst characteristics (Option 02)

Characteristics	Performance requirements	Supplemental information
Black Amplitude	0 mV ±50 mV	Figure 2-22.
Blanking Width	12 μs ±0.15 μs	
Sync Timing	See Figure 2-22	

Table 2-4: Power supply specifications

Characteristics	Supplemental information
Supply accuracy +5V -5.2V +12V -12V	5V ±250 mV -5.2V +300 mV, -500 mV +12V ±600 mV -12V ±600 mV
Power limit	18 Watts
Hum +5V -5.2V +12V -12V	Typical 10 mV 20 mV 10 mV 10 mV

Table 2-4: Power supply specifications (cont.)

Characteristics	Supplemental information
Noise +5V -5.2V +12V -12V	± 50 mV (5 MHz bandwidth) ± 50 mV (5 MHz bandwidth) ± 50 mV (5 MHz bandwidth) ± 50 mV (5 MHz bandwidth)
Line voltage range 115 VAC 240 VAC	90 – 130 VAC 180 – 250 VAC
Fuse date 110 VAC Setting 220 VAC Setting	0.4 A Med. Blow 0.2 A Med. Blow
Power consumption, typical	15 Watts
Line frequency	48 – 62 Hz
DC input range	11 – 16 VDC

Table 2-5: Audio tone characteristics

Characteristics	Performance requirements	Performance check step no.
Amplitude	0 to +8 dBu into 600 Ω , or a high-impedance load.	
Frequency	1 kHz	
Distortion (THD)	$\leq 0.5\%$ THD	18
Audio ID "click" frequency range (one channel only)	Adjustable from 0.2 – 4 Hz.	

Table 2-6: Physical characteristics

Characteristics	Supplemental information
Dimensions Height Width Length	43.4 mm (1.71 in) 205.7 mm (8.10 in) 381.0 mm (15.0 in)
Net weight	1.47 kg (4 lbs, 6 oz)
Shipping weight	3.2 kg (7 lbs, 1 oz)

Table 2–7: Environmental characteristics

Characteristics	Supplemental information
Temperature Non-operating Operating	–40 to +65° C 0 to +35° C
Altitude Non-operating Operating	To 50,000 feet To 15,000 feet
Vibration (operating)	15 minutes each axis at 0.025 inch, with frequency varied from 10–55–10 cycles per second in 4-minute cycles, with instrument secured to vibration platform. Ten minutes each axis at any resonant point or at 55 cycles per second.
Shock	50 g, $\frac{1}{2}$ sine, 11 ms duration, 3 guillotine-type shocks per side.
Transportation	Qualified under NTSB Test Procedure 1A, Category II (24-inch drop).

Table 2–8: Certifications and compliances

EC Declaration of Conformity - EMC	<p>Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <p>EN 50081-1 Emissions: EN 55022 Class B Radiated and Conducted Emissions</p> <p>EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity IEC 801-4 Electrical Fast Transient/Burst Immunity</p> <p>¹ Must use high-quality cables to insure compliance with advertised specifications.</p>
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits
EC Declaration of Conformity – Low Voltage	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC</p> <p>EN 61010-1:1993 Safety requirements for electrical equipment for measurement, control, and laboratory use</p> <p>EN 61010-2-031:1994 Particular requirements for hand-held probe assemblies for electrical measurement and test equipment</p> <p>EN 61010-2-032:1995 Particular requirements for hand-held current clamps for electrical measurements and test</p>
Safety Class	Class I (as defined in IEC 1010–1, Annex H) – grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 1010–1, Annex J)
Pollution Degree	<p>Pollution Degree 2 (as defined in IEC 1010–1)</p> <p>Note: Rated for indoor use only.</p>

Table 2-8: Certifications and compliances (cont.)

Approvals	<p>ANSI/ISA S82.01 – Safety standard for electrical and electronic test, measuring, controlling, and related equipment, 1994</p> <p>UL3111-1 – Standard for electrical measuring and test equipment</p> <p>CAN/CSA C22.2 No. 1010.1 – Safety requirements for electrical equipment for measurement, control and laboratory use</p> <p>IEC1010-1 – Safety requirements for electrical equipment for measurement, control, and laboratory use</p>
Installation Category Descriptions	<p>Terminals on this product may have different installation category designations. The installation categories are:</p> <p>CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location</p> <p>CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected</p> <p>CAT I Secondary (signal level) or battery operated circuits of electronic equipment</p>

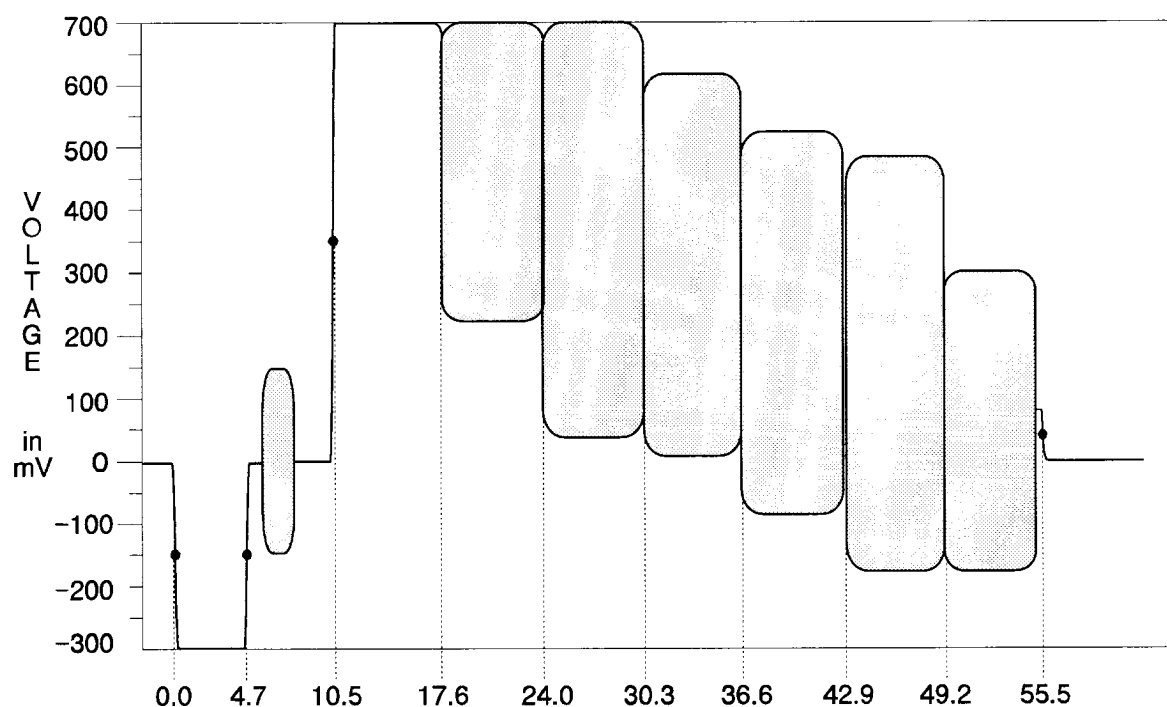


Figure 2-1: 75% color bars

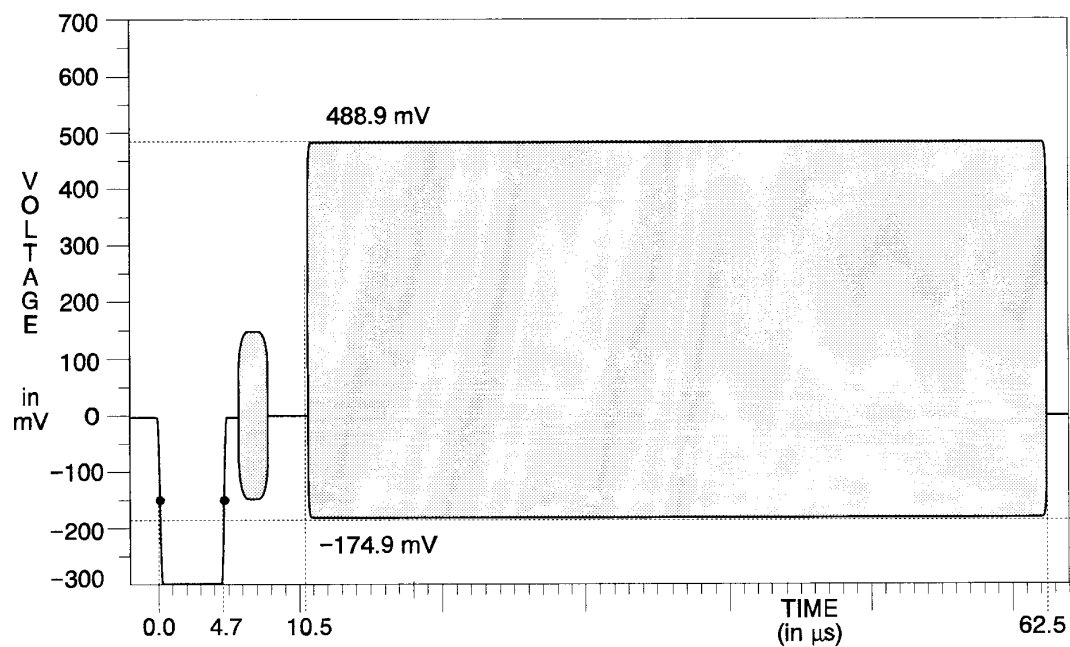


Figure 2-2: 75% red

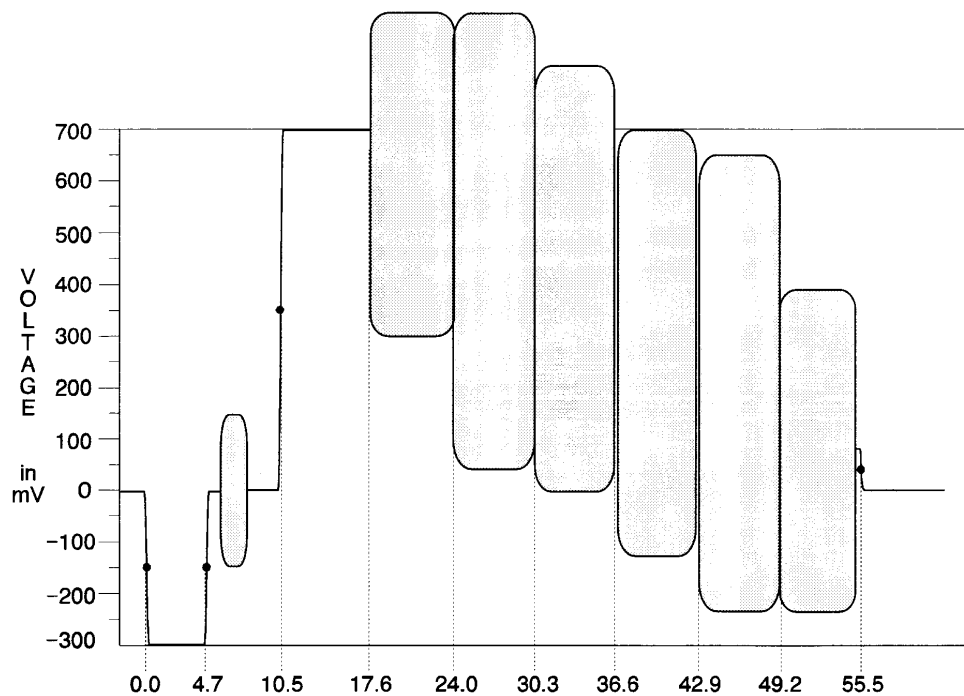


Figure 2-3: 100% color bars

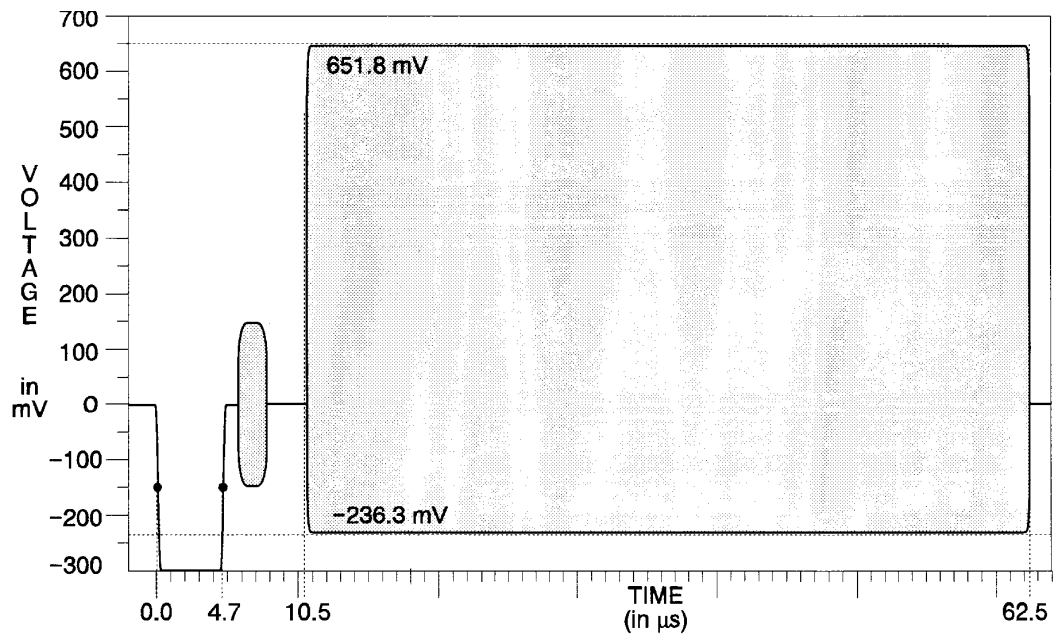


Figure 2-4: 100% red

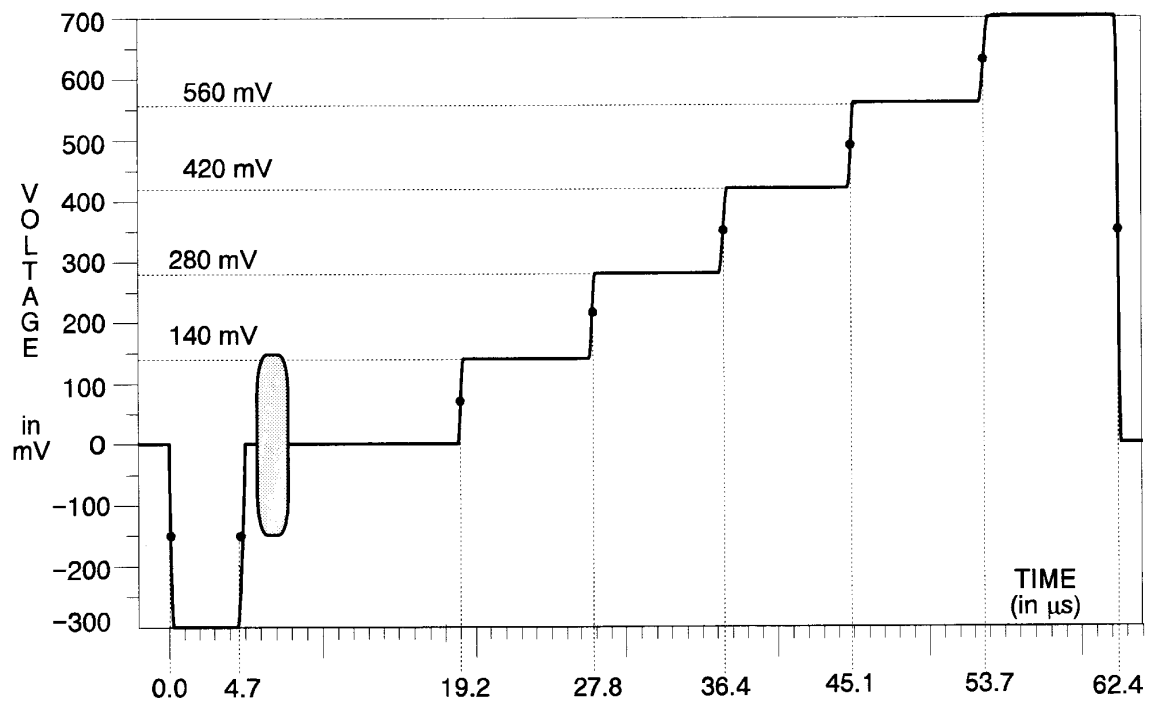


Figure 2-5: 5-step (gray scale)

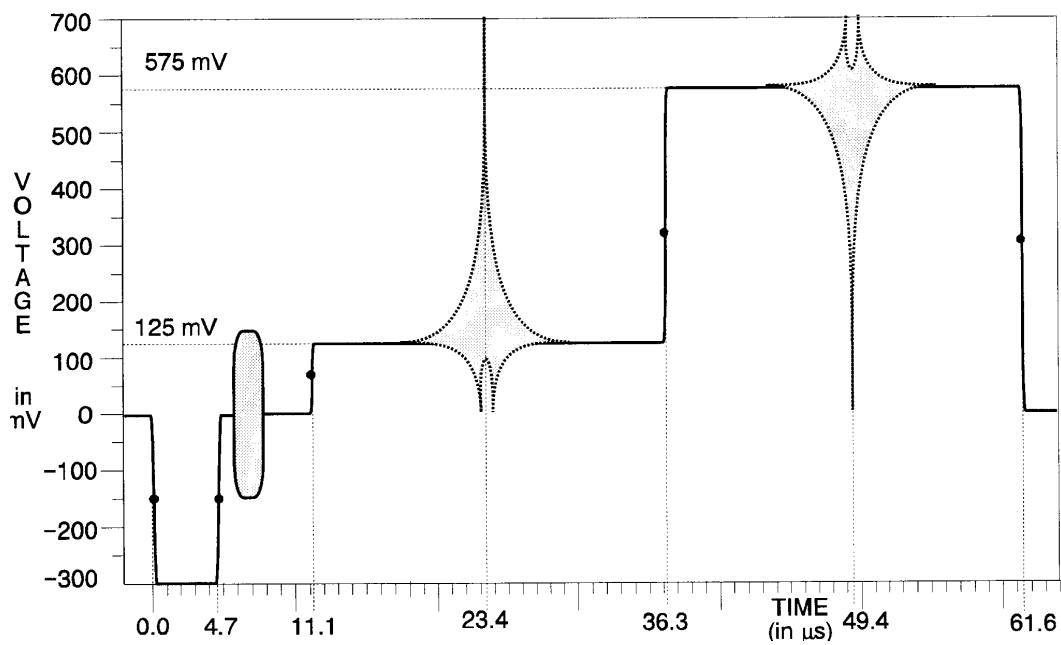


Figure 2-6: $\text{Sin}(x)/x$

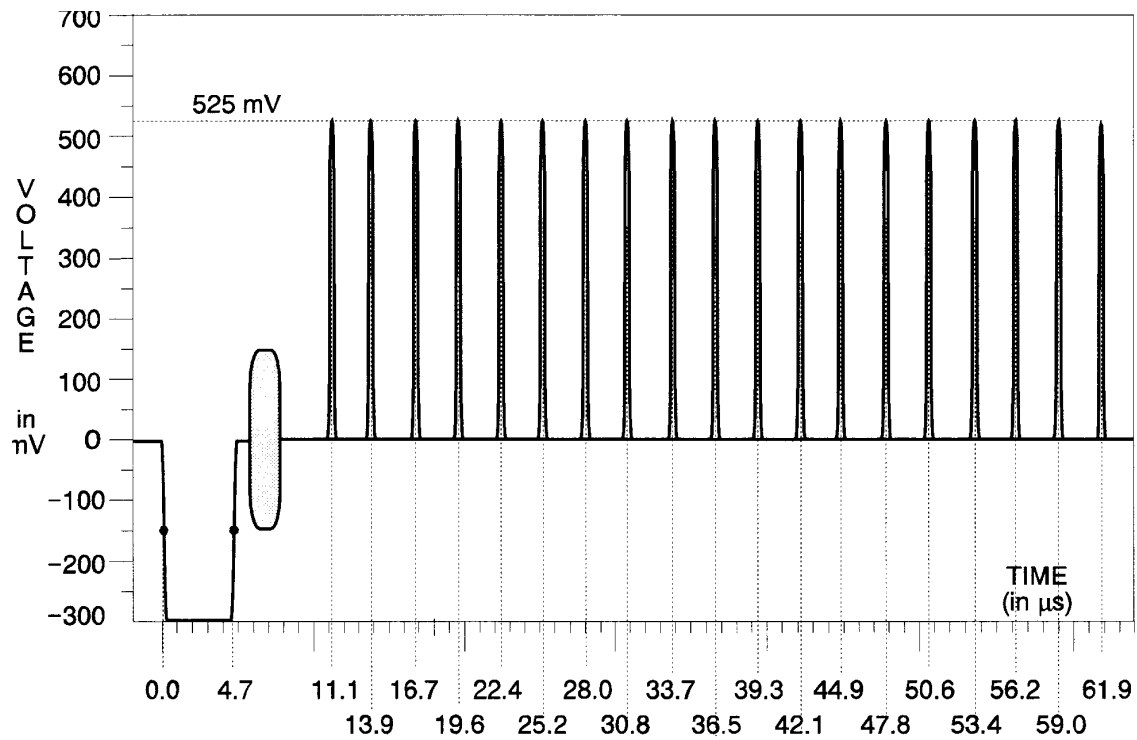


Figure 2-7: Convergence (vertical)

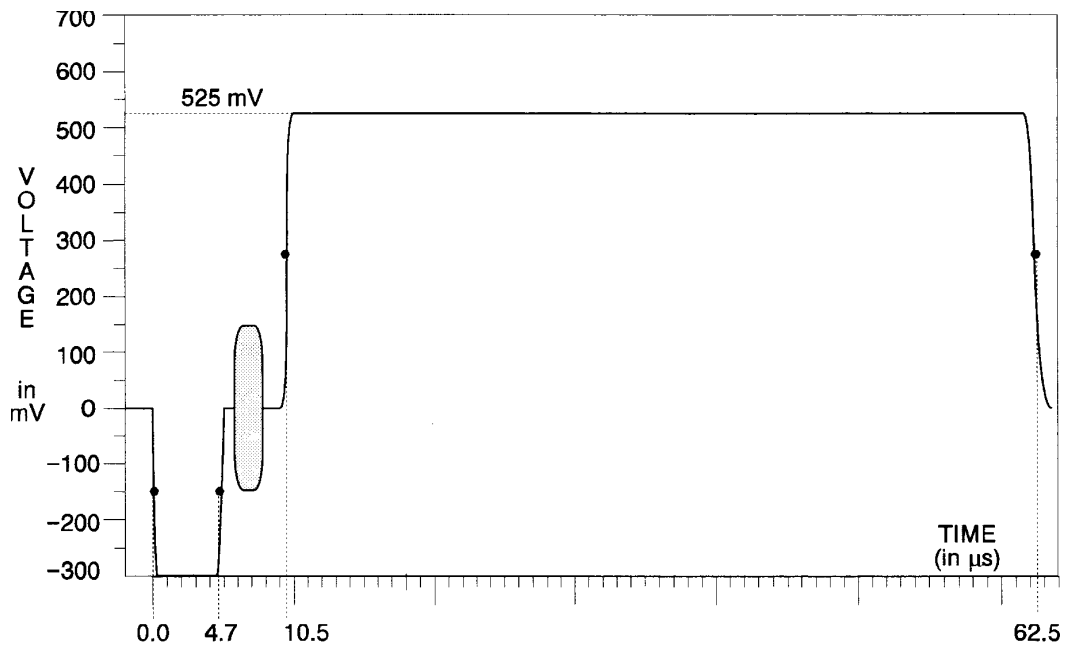


Figure 2-8: Convergence (horizontal)

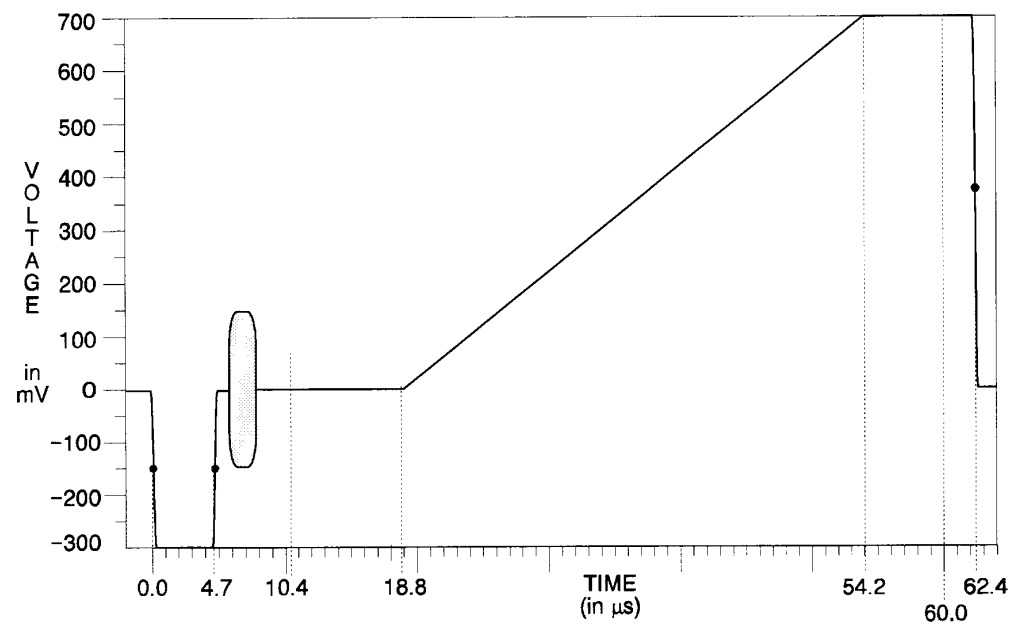


Figure 2-9: Ramp

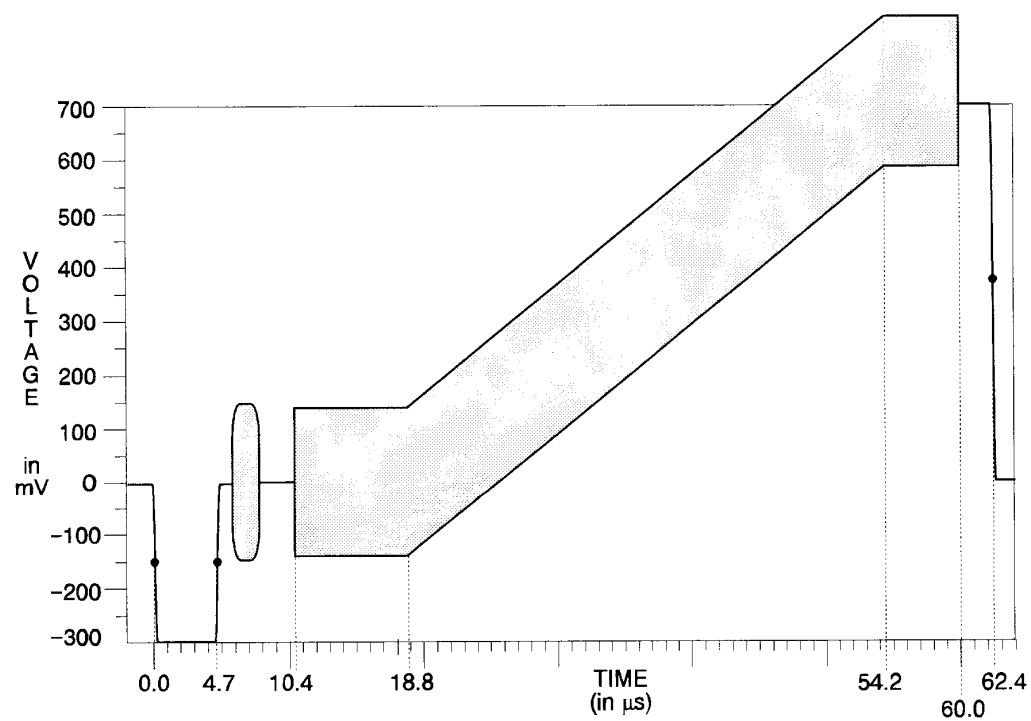


Figure 2-10: Modulated ramp

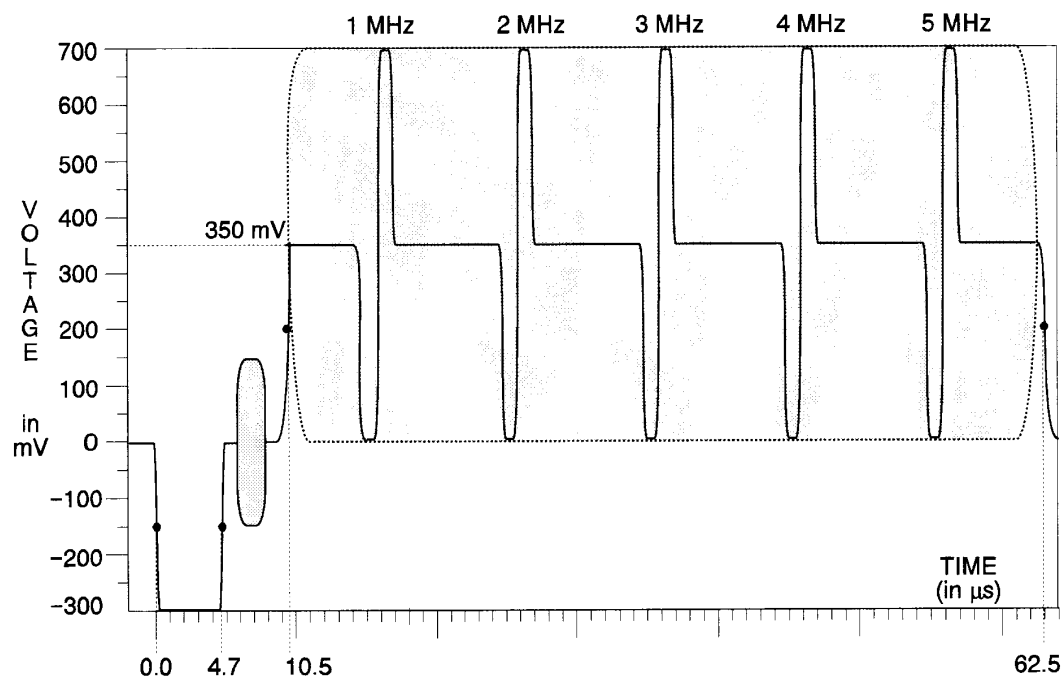


Figure 2-11: Line sweep

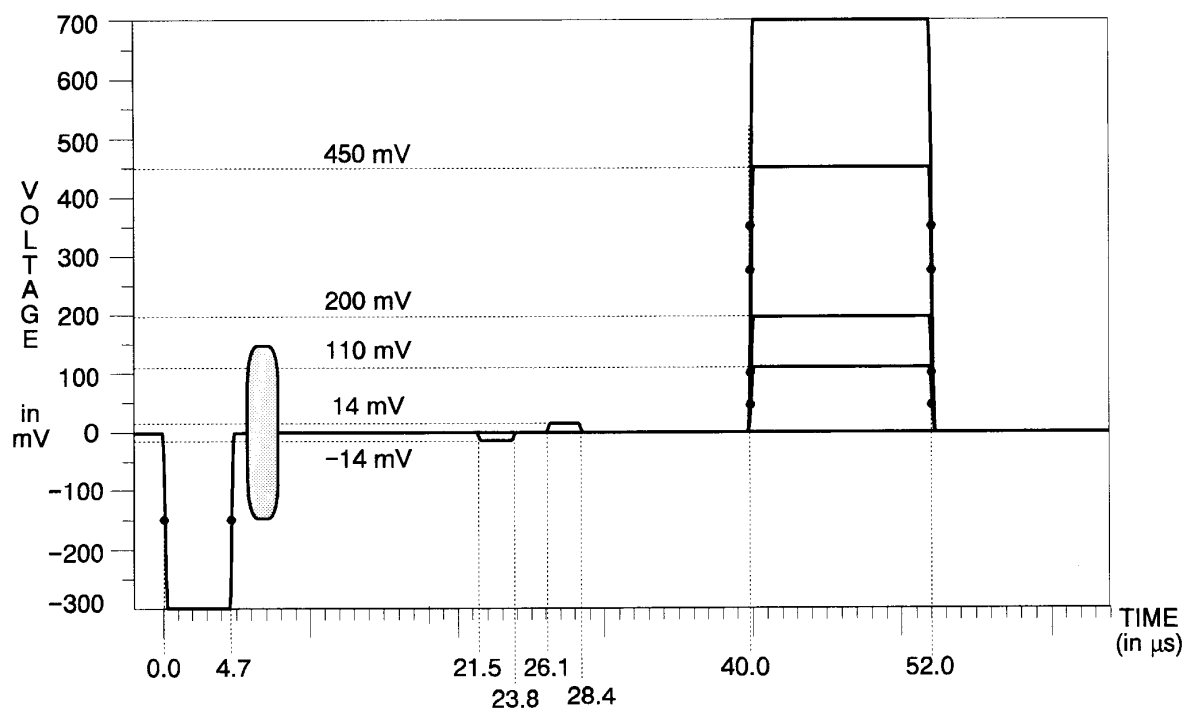


Figure 2-12: Pluge

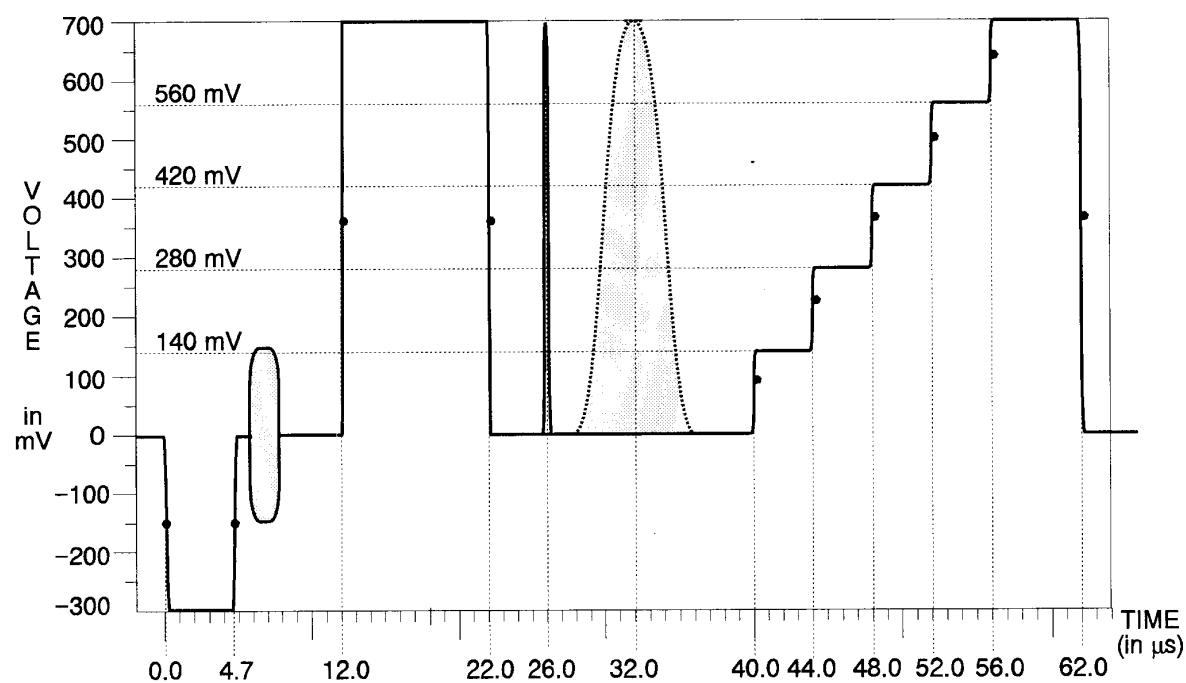


Figure 2-13: CCIR 17

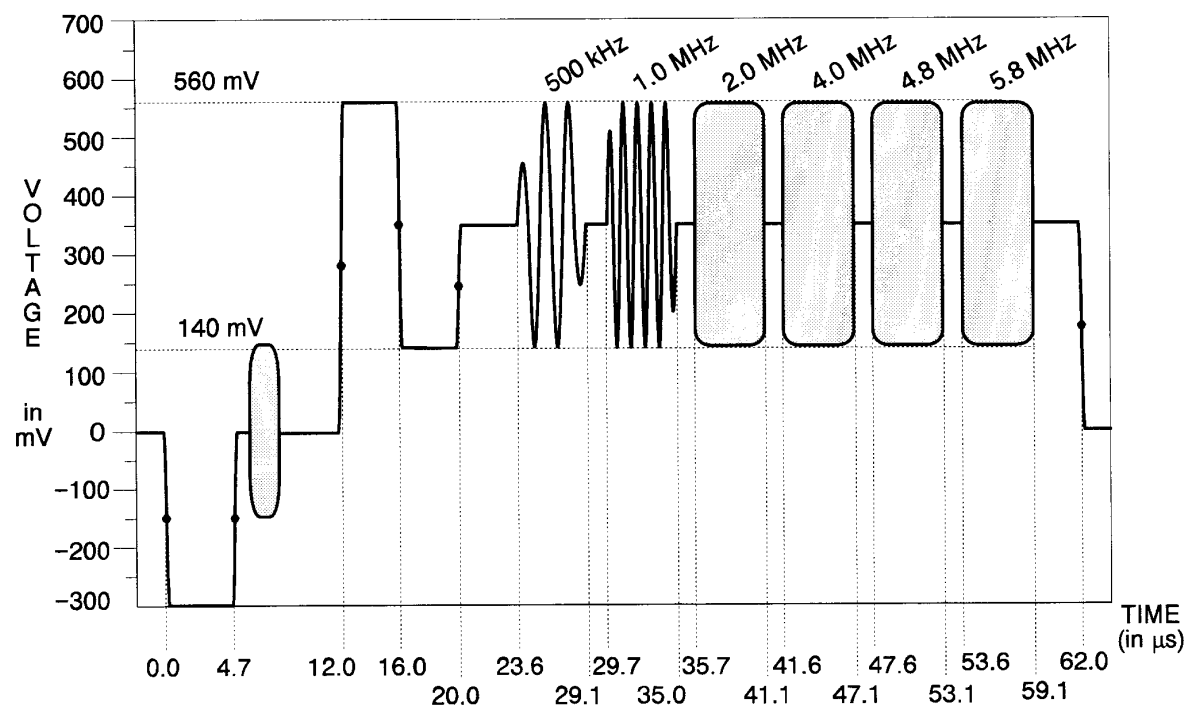


Figure 2-14: CCIR 18 (multiburst)

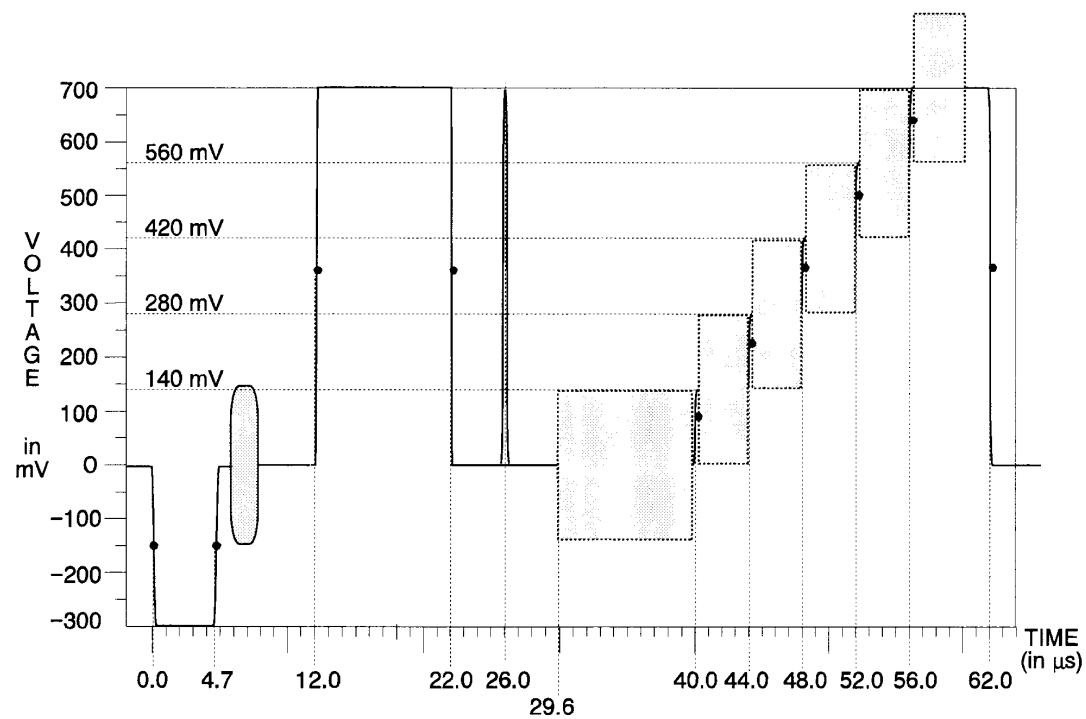


Figure 2-15: CCIR 330

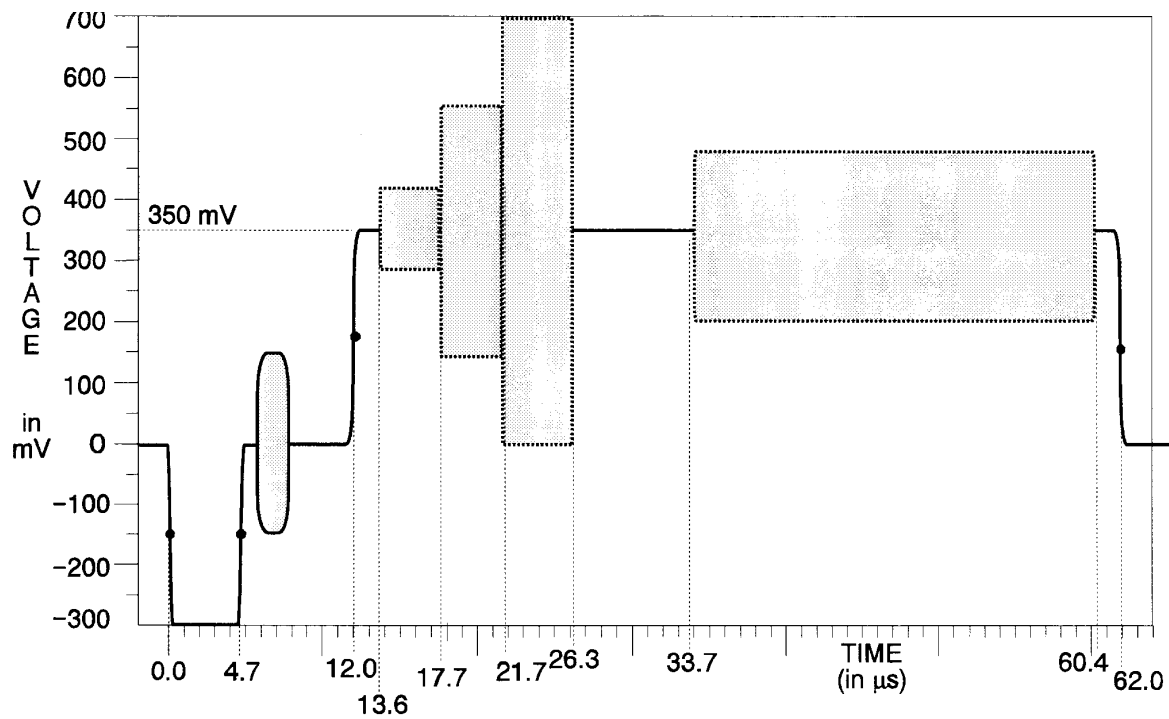


Figure 2-16: CCIR 331

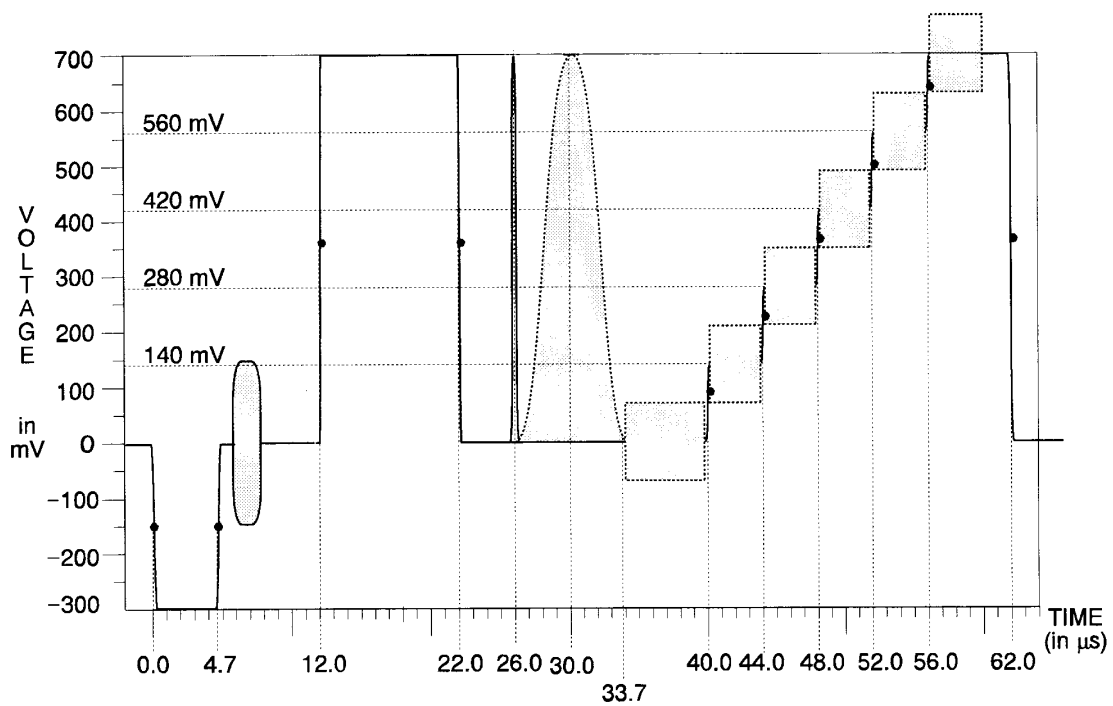


Figure 2-17: UK ITS 1

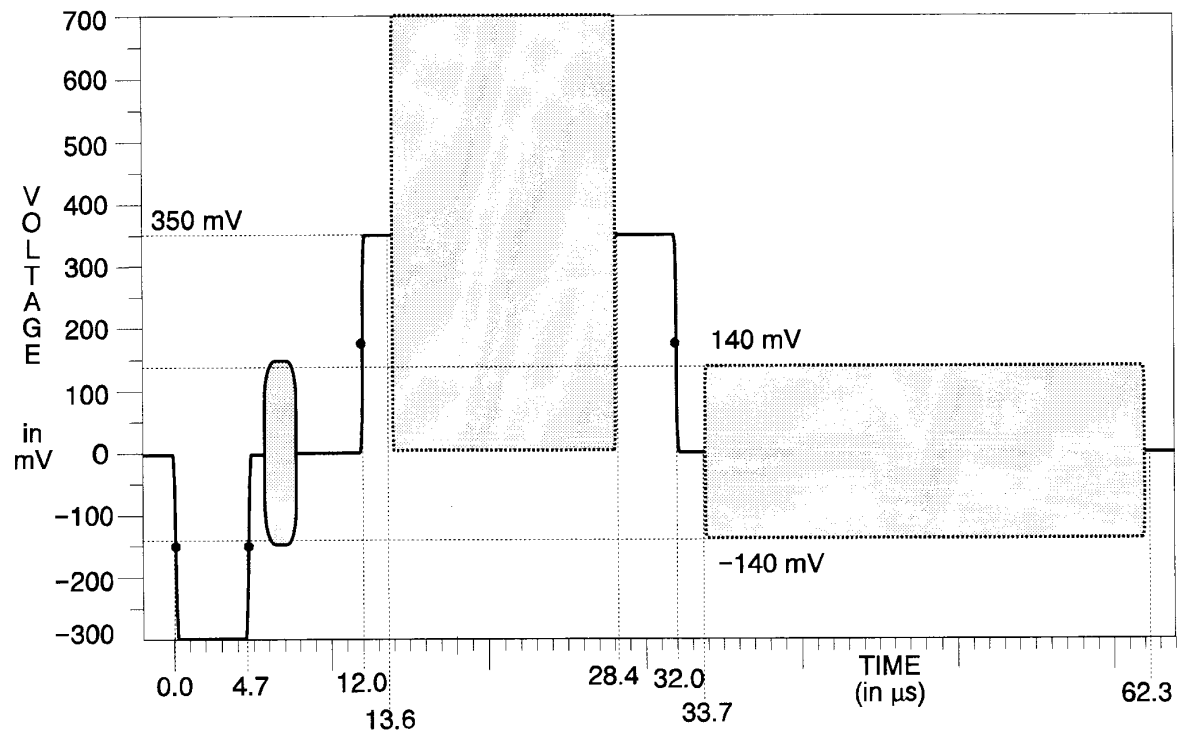


Figure 2-18: UK ITS 2

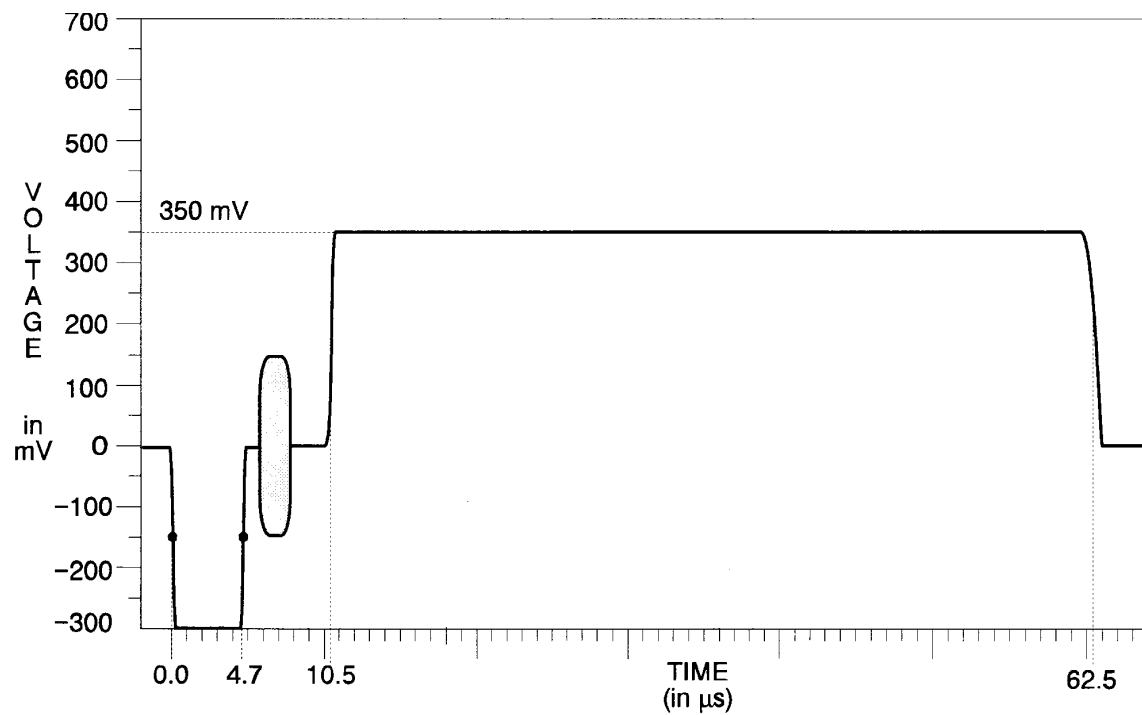


Figure 2-19: 50% field

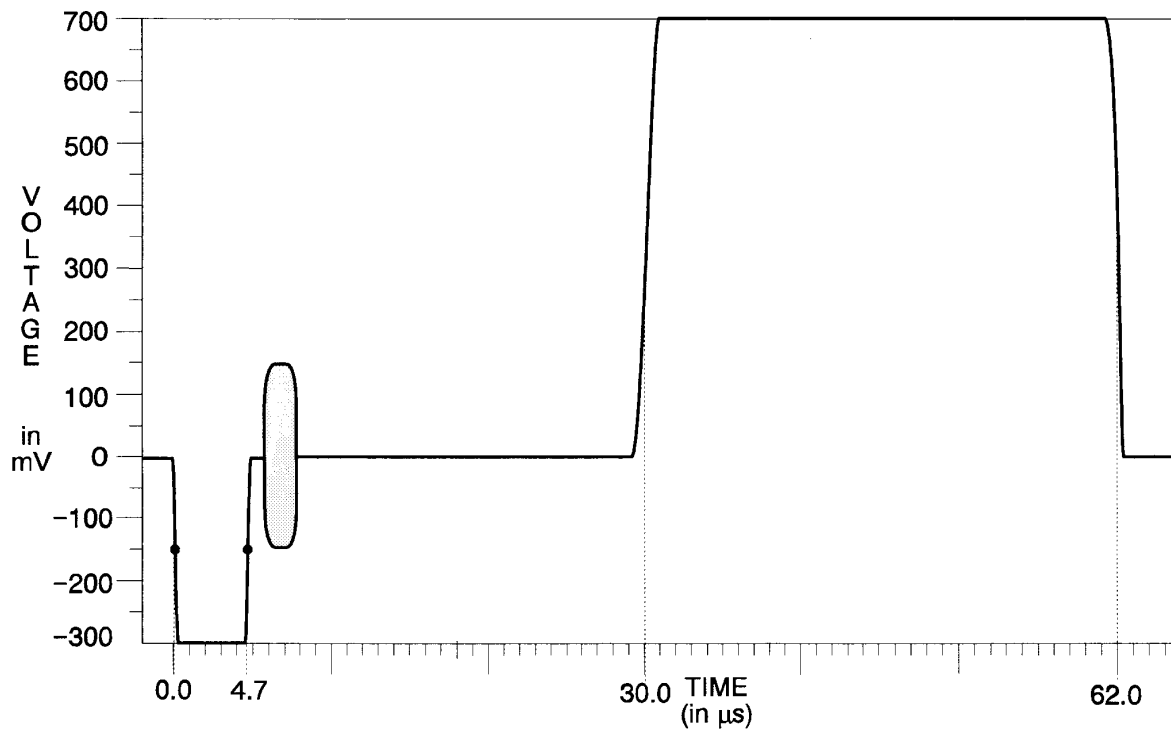


Figure 2-20: 15 kHz square wave

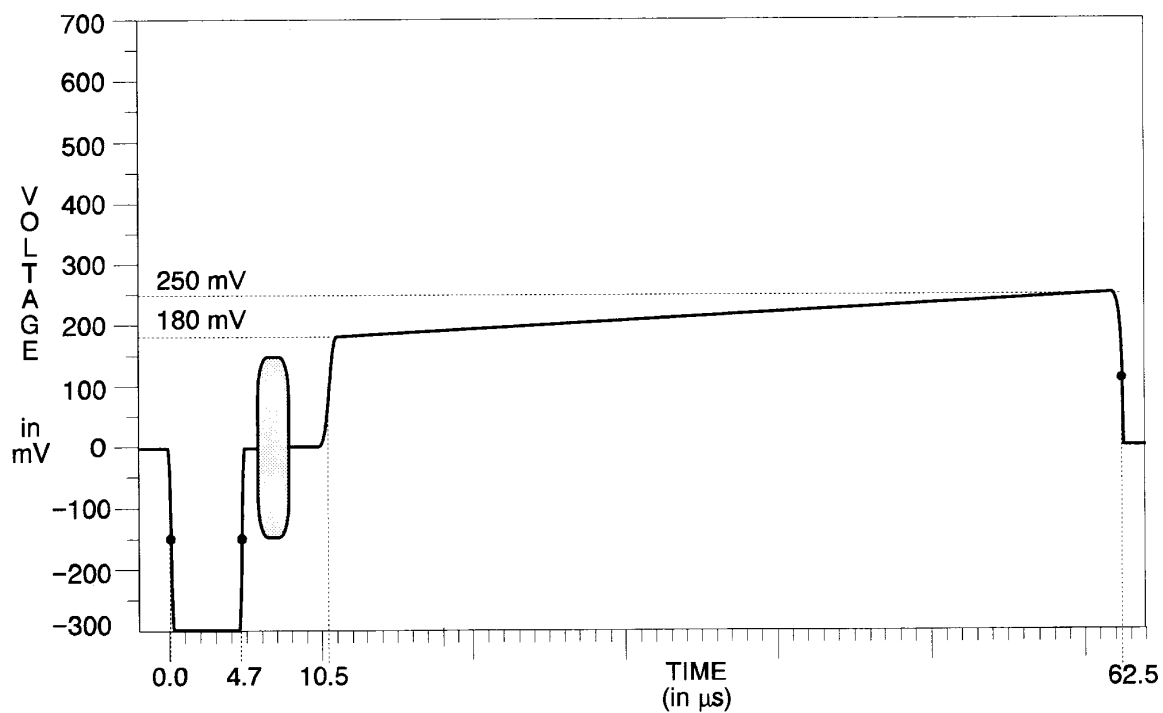


Figure 2-21: Shallow ramp

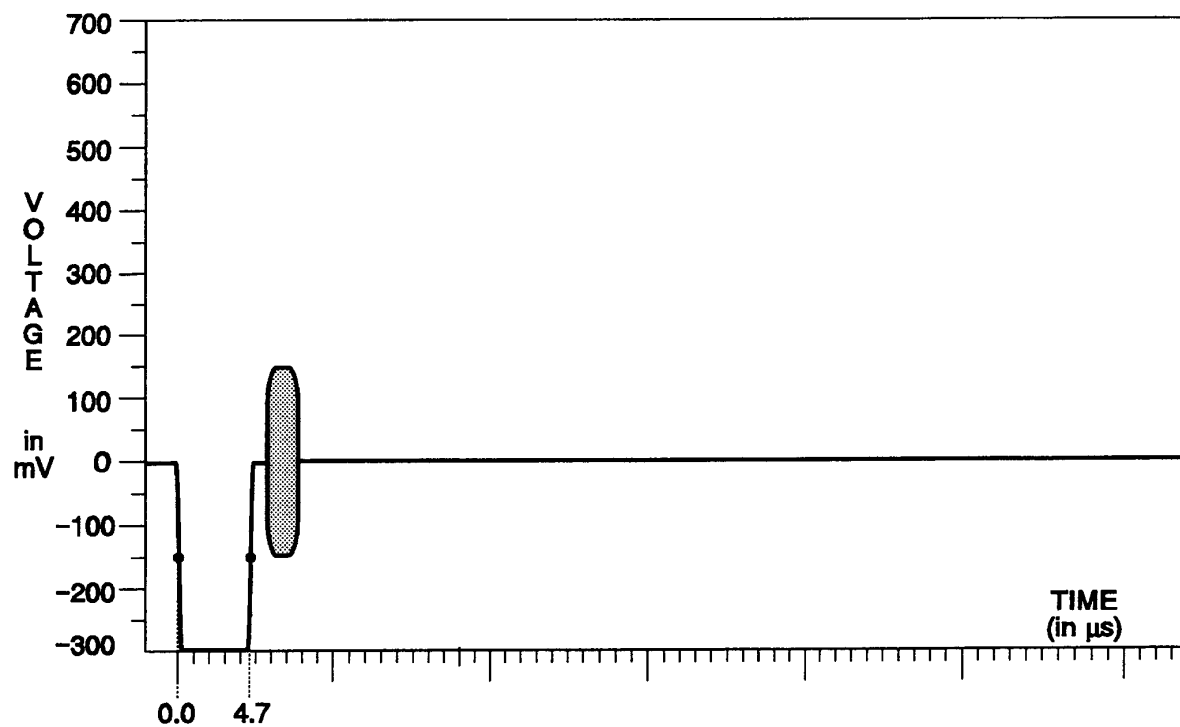


Figure 2-22: Black burst (Option 02)