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Tektronix

1910
Digital Generator
Operator Manual

070-4466-01

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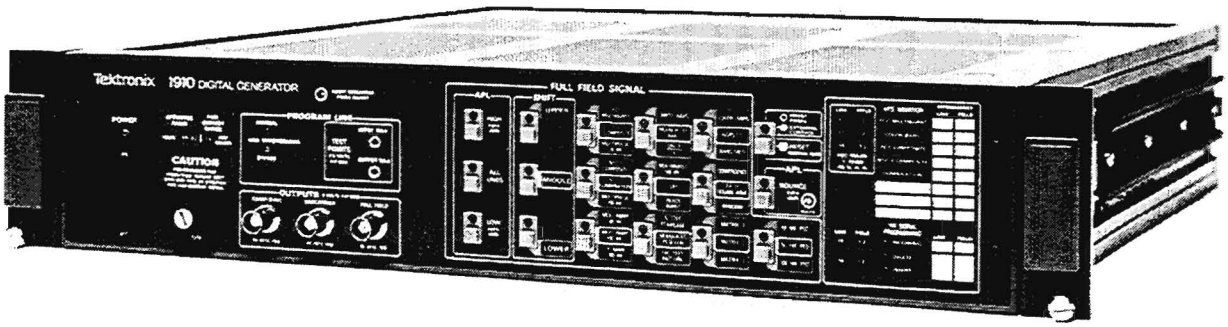
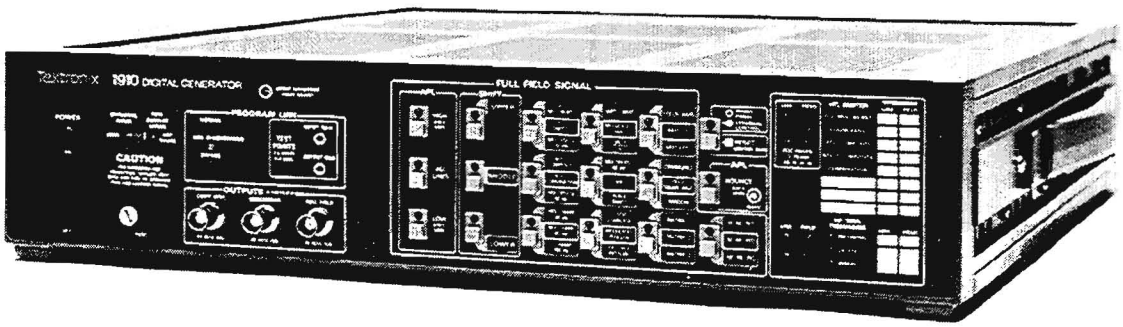


(A) Rackmount Version.



(B) Cabinet Version.

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Fig. 1-1. The 1910 Digital Generator.

SPECIFICATION

INTRODUCTION

Reference Documentation

The following documents were used as references in the preparation of this Operators Manual.

UL 1244—Standard for Electrical and Electronics Measuring and Testing Equipment.

FCC Rules and Regulations, Section 73.676(f) and Figures 13, 14, and 15 of Section 73.699 for Remote Control Monitoring of Television Broadcast Transmitters.

RS-170A—Color Television Studio Picture Line Amplifier Output.

RS-189 EIA STANDARD—Encoded Color Bar Signals.

RS-232-C EIA STANDARD—Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange.

Proposed SMPTE Standard for a Composite Parallel Digital Video Interface.

ANSI Y1.1—1972, Abbreviations.

Product Description

The TEKTRONIX 1910 DIGITAL GENERATOR (see Fig. 1-1) is a high quality test instrument capable of providing a variety of test signals useful for testing NTSC video systems or discrete parts of the systems. The test signals generated are available from the FULL FIELD OUTPUT as field information. Also, most of the test signals are available as Vertical Interval Test Signals (VITS) inserted on the incoming Program Line Signal.

A non-volatile memory maintains selected VITS and Full Field Signals after a power-line interruption. There is a provision for insertion of up to four external VITS for such services as Teletext and closed captioning. If external VITS is not needed, this provision can be replaced with a Pulse Output board that provides four signals: H Drive, V Drive, Comp Blanking. and Burst Flag.

The test signals generated by the 1910 are derived from information stored in sets of PROMs. This provides several advantages. Test signal format changes are accomplished by replacing the appropriate test signal memory. No recalibration is required and changing industry test signal standards will not cause absolescence. The other advantage is the exceptional stability of the test signals. This stability means that very little maintenance and recalibration is required.

The 1910 test signals may be genlocked[1] to the incoming Program Signal or to a Black Burst master generator, thus assuring accurate timing and phasing of the output signal. In the absence of burst, the 1910 locks to the leading edge of sync. A front-panel light will illuminate upon loss of sync, indicating a free-running state of the instrument's oscillator. In the free-running state the 1910 oscillator is controlled by a crystal in a constant-temperature oven.

The signals generated by the 1910 are programmed to be SCH (subcarrier-to-horizontal sync) phase referenced. Because of this it is not recommended to genlock the 1910 with a signal where sync and burst are non-synchronous.

The 1910 Digital Generator has remote-control capabilities for some of its functions. The remote-control capabilities may be utilized by either the REMOTE CONTROL interface or the RS-232 CONTROL interface on the rear panel. The 1910 is compatible with other instruments that have RS-232 interface; some examples are: TEKTRONIX 4006 Computer Display Terminal, TEKTRONIX 4010 Computer Display Terminal, TEKTRONIX 4052 Desktop Computer, and TEKTRONIX 1980 ANSWER. (Some hand-held computers and personal or home computers may be compatible with the 1910 RS-232 CONTROL port.)

The 1910 will also accept digital information from an external source through the DIGITAL INPUT connector to generate test signals. A DIGITAL OUTPUT connector provides access to the 10-bit words that are being used to generate the Full Field Signals.

[1]Synchronization of signal in both frequency and phase.

SPECIFICATION

The performance requirements listed here apply over an ambient temperature range of 0°C to +50°C after a warm-up time of 20 minutes. The rated accuracies are valid when this instrument is calibrated at +20°C to +30°C after a warm-up time of ten minutes minimum.

Test equipment used in verifying performance requirements must be calibrated and working within the limits specified under Table 3-1, Recommended Test Equipment, provided in Section 3, Performance Check Procedure, of the Service Manual.

Items listed in the Performance Requirements column of the Electrical Characteristics tables are verified by completing the Performance Check in Section 3 of the Service Manual, unless specifically stated otherwise. Items listed in the Supplemental Information column may not be verified in either manual; they are either explanatory notes or performance characteristics for which no limits are specified.

The Performance Check Step No. column lists the specific step number of the Performance Check procedure in Section 3 of the Service Manual that checks the appropriate Performance Requirement items.

Table 1-1
PROGRAM SIGNAL PATH/VITS INSERTER

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Program Line Input			
Input Level		1 V (0.7 to 1.4 V)	
Input Impedance	75 Ω nominal		53
Return Loss			
Power On	At least 46 dB to 5 MHz		53
Power Off/Bypass	At least 40 dB to 5 MHz		53
Program Line Out Program Monitor Out			
Impedance	75 Ω nominal		53
Return Loss	At least 36 dB to 5 MHz		53
Hum Rejection	At least 10 dB. Referenced to 1 V hum.	Jumper selectable to 20 dB. Requires unique test equipment capable of inserting 1 V hum on the program line.	15
Keyboard (no noise)	Less than 0.25 IRE		9
Video Gain	Unity Gain ±0.5%		1
DC Blanking Output Level	0 V ±100 mV		8
VITS Pedestal Offset from Blanking			
0 V Hum	2 mV or less		10
1 V Hum	10 mV or less	Requires unique test equipment capable of inserting 1 V hum on the program line.	

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Isolation			
Program Line to Program Monitor	At least 40 dB to 5 MHz	Referenced to 1 V	2
Pulse-to-Bar Ratio			
T/2	100% ±2%		3
T	100% ±0.5%		3
2T	100% ±0.25%		3
Pulse and Bar Aberrations			
T/2	2% or less		4
T	0.5% or less		4
2T	0.25% or less		4
Waveform Tilt			
Field Tilt (Field Rate Square Wave)	0.5% or less		5
Bar Tilt (25 μs Bar)	0.5% or less		5
Differential Phase (10—90 APL)	0.15° or less		22
Differential Gain (10—90 APL)	0.2% or less		23
Inserted VITS			
Differential Phase	0.4° or less		
Differential Gain	0.7% or less		
Amplitude Nonlinearity	0.25% or less		6
Frequency Response	±0.5% to 5 MHz ±1% to 10 MHz ±3% to 15 MHz		11
Random Noise Output	At least 75 dB (rms) down	Referenced to 1 V. 5 MHz low-pass filter and a noise weighting filter into a rms meter.	18
Residual Subcarrier	At least 60 dB down	Referenced to 1 V. 5 MHz low-pass filter into an oscilloscope.	12
Hum	At least 60 dB down	Referenced to 1 V. 5 MHz low-pass filter into an oscilloscope.	16

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Spurious Signals During Blanking			
Up to 5 MHz	At least 40 dB down (10 mV or less)	Insertion transient	17
Above 5 MHz	At least 46 dB down (5 mV or less)	Clock noise	17
Delete Mode Signal Attenuation			
2T Pulse	At least 70 dB down	Referenced to 0.714 V	14
Subcarrier	At least 60 dB down	Referenced to 0.714 V	14
Crosstalk (Internal to Program Line)			
2T	At least 70 dB down	Referenced to 0.714 V	13
Subcarrier	At least 60 dB down	Referenced to 0.714 V	13
Insert Delay Range	±8 μs, (16 μs total)	In 70 ns increments (internal DIP switch)	19
INSERT SUBCARRIER PHASE ADJUST RANGE	Minimum 10° total	Continuously adjustable over 70 ns (internally)	21
Instrument Delay		25 ns typical. Input to output delay.	
Insertion Width	9.8 μs ±100 ns to 10.9 μs ±100 ns	Front Porch (jumper selectable): 1.6 μs to 1.32 μs nominal. Back Porch (jumper selectable): 8.46 μs, 8.74 μs, 9.02 μs, or 9.3 μs nominal.	20

Table 1-2
GENLOCK FUNCTION

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step No.
Genlock Input (via PROGRAM IN or BLACK BURST IN)			
Burst Amplitude	40 IRE ±6 dB		25
Phase Change with APL		For 1° or less phase change over 10% to 90% APL.	
Sync Amplitude	40 IRE ±6 dB		25
Return Loss			
BLACK BURST IN	At least 46 dB to 5 MHz		53
Genlock Performance			
Burst Lock	3.579545 MHz ±20 Hz	0.00056%	
If Burst Not Present	Clock is referenced to leading edge of sync.		
Sync Lock	15.73426 kHz ±0.079 Hz	Requires unique test equipment capable of measuring 0.079 Hz sync frequency offset.	
If Sync and Burst Not Present		Clock is referenced to temperature-controlled crystal oscillator.	
Oscillator (Free Running)			
Subcarrier Frequency	3.579545 MHz ±10 Hz	Digitally derived from 14.3 MHz clock.	26
Sync Frequency	15.73426 kHz ±0.04 Hz	Digitally derived from 14.3 MHz clock. Locked to subcarrier by 455/2 ratio.	
Jitter	5 ns or less		27

Table 1-3
EXTERNAL VITS INPUT

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step No.
Maximum Input	±1 V peak	Ac plus dc.	
Input Impedance	75 Ω nominal		
Return Loss	At least 40 dB to 5 MHz	Power on and off.	53
Insertion Level	±5 mV	Referenced to External VITS In blanking level.	42
Insertion Gain	Unity ±1%		43
Frequency Response	Flat within 1% to 5 MHz	−3 dB at 8 MHz	44
Pulse-to-Bar Ratio			
2T	100% ±1%		45
T	100 ±2%		45
Pulse and Bar Aberrations			
2T	Less than 0.5%		45
T	Less than 1%		45
Differential Phase	0.5° or less	10 to 90% APL. Blanking at 0 Vdc.	48
Differential Gain	0.5% or less	10 to 90% APL. Blanking at 0 Vdc.	49
Amplitude Non-linearity	0.5% or less		47
Line-Time Tilt	1% or less		46
External Input Isolation	Greater than 60 dB to 5 MHz		50
Switching Transients	Less than 10 mV p-p to 5 MHz	(Switching transient at insertion time.)	51
	Less than 5 mV above 5 MHz	(Generator clock noise.)	51

Table 1-4
TEST SIGNALS—FULL FIELD & VITS

Characteristics	Performance Requirements		Supplemental Information	Perf. Ck. Step. No.
AC BOUNCE	0 to 100 IRE on 4 out of 5 lines		Refer to FIELD SQ WAVE Amplitude specification.	7
Bounce Frequency	Adjustable from approximately 1 Hz to greater than 1/30 Hz.			7
BOUNCE & APL			Selected full-field signal on one line with the Bounce or APL signal on the next four lines.	
Amplitude	100 IRE ±0.7 IRE			28
Rise Time	250 ns ±25 ns			
Line Timing	See Fig. 1-2A.			
FIELD SQ WAVE				
Field Timing				
Lines (White)	Lines 72 to 202			
Lines at Blanking			All remaining active lines.	
Field Tilt	0.5% maximum			34
Line Tilt	0.5% maximum			33
Amplitude	100 IRE ±0.7 IRE			28
Rise Time	250 ns ±25 ns			
Line Timing	See Fig. 1-2A.			
WINDOW/FIELD BAR				
White Bar Amplitude	100 IRE ±0.7 IRE			
Rise Time	250 ns ±25 ns			
Field Tilt	0.5% maximum			
Line Tilt	0.5% maximum			
Field Timing	Lines 72 to 202		Window only	
Line Timing	See Fig. 1-2B.			
FCC MULTIBURST/ MULTIBURST 100				
White Reference Bar Amplitude	100 IRE ±0.7 IRE			
Rise Time	250 ns ±25 ns			
Multiburst Packets	FCC MB	MB 100		
Amplitude	60 IRE, ±1 IRE, p-p	100 IRE ±2 IRE, p-p		
Average Level	40 IRE ±1 IRE	50 IRE ±1 IRE		

Table 1-4 (cont)

Characteristics	Performance Requirements		Supplemental Information	Perf. Ck. Step. No.
Frequencies	500 kHz 1.25 MHz 2.0 MHz 3.0 MHz 3.58 MHz 4.1 MHz		Digitally derived from 14.3 MHz clock.	
Packet Rise Time			The packets are envelope shaped.	
500 kHz	140 ns ±14 ns			
The Remaining	400 ns ±40 ns			
Harmonic Content	At least 40 dB down			
Line Timing	See Fig. 1-2C.			
MULTIPULSE 70/100				
70	70 IRE ±0.7 IRE white reference bar. 10 IRE ±0.5 IRE pedestal level.			
100	100 IRE ±0.7 IRE white reference bar. No pedestal.			
70 and 100				
Rise Time	250 ns ±25 ns			
Pulse-to-Bar Ratio	100% ±1%			
Pulse Half Amplitude Duration				
2T HAD	250 ns ±25 ns			
25T HAD	3.14 μs ±0.3 μs			
12.5T HAD	1.57 μs ±150 ns			
Modulated Pulse Frequencies	MP 70	MP 100		
1st Pulse	1.25 MHz	1.0 MHz	The first pulse HAD is 25T, and the remaining pulse HADs are 12.5T.	
2nd Pulse	2 MHz	2 MHz		
3rd Pulse	3 MHz	3 MHz		
4th Pulse	3.58 MHz	3.58 MHz	All pulses are digitally derived from 14.3 MHz clock.	
5th Pulse	4.1 MHz	4.2 MHz		
Group Delay	10 ns or less			31
Other Perturbations on Baseline	0.5 IRE or less.			
Line Timing	See Figs. 1-2D and 1-2E.			

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
COLOR MULTIPULSE			
White Reference Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time	250 ns ±25 ns		
Pulse-to-Bar Ratio	1:1 ±1%		
Pulse Half Amplitude Duration			
2T HAD	250 ns ±25 ns		
12.5T HAD	1.57 μs ±150 ns		
Modulated Pulse Frequencies			
1st	2.379545 MHz		
2nd	2.679545 MHz		
3rd	2.979545 MHz	HAD for all modulated pulses is 12.5T.	
4th	3.279545 MHz		
5th	3.579545 MHz	All pulses digitally derived from 14.3 MHz clock.	
6th	3.879545 MHz		
7th	4.179545 MHz	Phase of the 5th pulse is 327°.	
8th	4.479545 MHz		
9th	4.779545 MHz		
Group Delay	10 ns or less		31
Other Baseline Perturbations	0.5 IRE or less		
Line Timing	See Fig. 1-2F.		
SPECIAL MULTIPULSE		This signal occupies two adjacent television lines.	
White Reference Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time	250 ns ±25 ns		
Pulse-to-Bar Ratio	1:1 ±1% for pulses to 5 MHz		30

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
5.5 MHz		Typically −3%.	
6.0 MHz		Typically −7.5%.	
Pulse Half Amplitude Duration			
2T HAD	250 ns ±25 ns		
12.5T HAD	1.5 μs ±150 ns		
25T HAD	3.14 μs ±0.3 μs		
Modulated Pulse Frequencies			
First Line			
1st Pulse	1.0 MHz	First two pulses are 25T HAD.	
2nd Pulse	1.5 MHz	Last three pulses are 12.5T HAD.	
3rd Pulse	2.0 MHz		
4th Pulse	2.5 MHz	All pulses are digitally derived from 14.3 MHz clock.	
5th Pulse	3.0 MHz		
Second Line			
1st Pulse	3.5 MHz	All pulses are 12.5T HAD and digitally derived.	
2nd Pulse	4.0 MHz		
3rd Pulse	4.5 MHz		
4th Pulse	5.0 MHz		
5th Pulse	5.5 MHz		
6th Pulse	6.0 MHz		
Group Delay	10 ns or less for pulses of 5 MHz or less.		31
5.5 MHz Pulse		20 ns typical.	
6.0 MHz Pulse		100 ns typical.	
Line Timing	See Fig. 1-3A.		

Table 1-4 (cont)

Characteristics	Performance Requirements			Supplemental Information	Perf. Ck. Step. No.
COLOR BARS					
Luminance and Chrominance	Absolute amplitudes of luminance signal, setup, and sync are within 1% or 1.5 mV, whichever is greater, with respect to blanking. Chrominance amplitudes are within 1% of their given value.				
75% Amplitude, 7.5% Setup	LUM (mV)	CHROMA P-P (mV)	Phase (degrees)		
Full Field & SMPTE BARS					
White	714.3	1.0 or less			
Gray	549.1	1.0 or less			
Yellow	494.6	444.2	167.1		
Cyan	400.4	630.1	283.4		
Green	345.9	588.5	240.8		
Magenta	256.7	588.5	60.8		
Red	202.2	630.1	103.4		
Blue	108.1	444.2	347.1		
Full Field Black	53.6	1.0 or less			
IYQB −I	53.6	285.7	303.0		
IYQB White Ref	714.3	1.0 or less			
IYQB Q	53.6	285.7	33.0		
IYQB +Pluge	82.1				
IYQB −Pluge	25.0				
Luminance Rise Time					
Full Field	250 ns ±25 ns				
SMPTE	140 ns ±15 ns				

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Chrominance Rise Time			
−I	250 ns ±25 ns		
Q	833 ns ±80 ns		
All Others	400 ns ±40 ns		
Bar Duration			
Full Field		6.5 μs/bar (8 bars).	
SMPTE		7.5 μs/bar (7 bars).	
Time Difference Between Luminance and Chrominance	20 ns or less		
Residual Subcarrier	At least 52 dB below 1 V White, Black		40
Spurious Subcarrier	At least 52 dB below 1 V		
Other Spurious Outputs	At least 52 dB below 1 V, except 40 dB for 2nd harmonic		41
Field Timing			
FULL FIELD COLOR BARS		241 lines per field.	
BARS/Y (Full Field Color Bars)		Modulated bars first 181 active lines per field; unmodulated bars last 60 lines of the field.	
BARS/RED (Full Field Color Bars)		Same as for BARS/Y except last 60 lines of the field are red.	
SMPTE BARS		EIA Color Bars first 161 active lines per field; Reverse Blue Bars for 20 lines; and IYQB with Pluge for the last 60 lines of field.	
Line Timing			
FULL FIELD COLOR BARS	See Fig. 1-3B.		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Color Bars for SMPTE BARS or EIA COLOR BARS	See Fig. 1-3C.		
IYQB	See Fig. 1-3D.		
REVERSE BLUE BARS	See Fig. 1-3E.		
RED FIELD			
Luminance			
Amplitude	202.2 mV, ±1% or 1.5 mV, whichever is greater, with respect to blanking.	NOTE: These electrical characteristics are the same as for red color bar.	
Rise Time	250 ns ±25 ns		
Chrominance			
Amplitude	630.1 mV ±1%		
Phase	103.4° ±0.3°		
Rise Time	400 ns ±40 ns		
Duration	51.9 μs		
Line Timing	See Fig. 1-4A.		
FCC/NTC 7 COMPOSITE			
Modulated 5-step Staircase			
Luminance			
Amplitude			
FCC	80.4 IRE ±0.7 IRE		
NTC 7	90.2 IRE ±0.7 IRE		
Riser Amplitude	1/5 of 5-step amplitude ±0.5%		
Rise Time	250 ns ±25 ns		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Chrominance			
Phase	Same as burst ±0.3°		
Amplitude	40 IRE ±0.5 IRE (3.6 mV)		
Inherent Diff Gain	0.6% or less		38
Inherent Diff Phase	0.3° or less		37
Envelope Rise Time			
FCC	375 ns ±37.5 ns		
NTC 7	400 ns ±40 ns		
2T Pulse			
Pulse-to-Bar Ratio	100% ±0.5%		30
Half Amplitude Duration (HAD)	250 ns ±25 ns		
Ringing	1.0 IRE or less		36
Modulated Sine-Squared Pulse			
Pulse-to-Bar Peak Amplitude	100% ±0.5%		
Half Amplitude Duration (HAD)	1.563 μs ±150 ns		
Chrominance-to-Luminance Delay	10 ns or less		
Chrominance-to-Luminance Gain Inequality (RCL)	±0.5 IRE (±1%)		
Other Perturbations on Baseline	0.5 IRE or less		
Harmonic Distortion of Subcarrier	At least 40 dB down		41
Phase	60.8° ±1°		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time			
FCC	250 ns ±25 ns		
NTC 7	125 ns ±15 ns		
Line Timing			
FCC	See Fig. 1-4B.		
NTC 7	See Fig. 1-4C.		
MODULATED BAR			
White Reference Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time	250 ns ±25 ns		
Pulse-to-Bar	1:1 ±1%		
Pulse Half Amplitude Duration			
12.5 HAD	1.57 μs ±180 ns		
2T HAD	250 ns ±25 ns		
12.5 Modulated Pulse			
Frequency	3.579545 MHz	Digitally derived from 14.3 MHz clock.	
Phase	327° ±1°		
Modulated Bar Chrominance			
Amplitude	100 IRE ±1 IRE		
Rise Time	1.56 μs ±100 ns		
Frequency	3.579545 MHz	Digitally derived from 14.3 MHz clock.	

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Phase	33° ±1°		
Luminance Amplitude	50 IRE ±0.5 IRE		
Group Delay	Equal to or less than 10 ns		
Baseline Perturbations	0.5 IRE or less		
Line Timing	See Fig. 1-4D.		
INVERTED PULSE & BAR			
Reference Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time	250 ns ±25 ns		
Pulse-to-Bar Ratio	1:1 ±1%		
2T Pulse HAD	250 ns ±25 ns		
Baseline Perturbations	0.5 IRE or less		
Timing	See Fig. 1-4E.		
VIRS (Vertical Interval Reference Signal)			
Chrominance Reference			
Amplitude	40 IRE ±0.4 IRE		
Phase	Same as burst ±0.3°		
Envelope Rise Time Time (Sine-squared shaped)	1 μs ±100 ns		
Average Level of Chrominance Signal	70 IRE ±0.7 IRE		
Luminance Reference			
50 IRE Level	50 IRE ±0.5 IRE		
Black Reference	7.5 IRE ±0.5 IRE		
Line Timing	See Fig. 1-4F.		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
VICR (Vertical Internal Color Reference)		Removed S/N B023197.	
Chrominance Reference			
Amplitude	100 IRE ±1 IRE		
Phase	Same as burst within ±0.3°		
Envelope Rise Time	1 μs ±100 ns	Sine-squared shape	
Average Level Chrominance Signal	50 IRE ±0.5 IRE		
Luminance Reference			
100 IRE Level	100 IRE ±0.7 IRE		
Black Reference	7.5 IRE ±0.5 IRE		
Line Timing	See Fig. 1-5A.		
BLACK BURST, 10/25/50/100 IRE PED			
Pedestal			
Amplitudes			
BLACK	7.5 IRE ±0.5 IRE		
10 IRE	10 IRE ±0.5 IRE		
25 IRE	25 IRE ±0.5 IRE	Removed S/N B023197.	
50 IRE	50 IRE ±0.5 IRE		
100 IRE	100 IRE ±0.5 IRE		
Rise Time	250 ns ±25 ns		
Tilt	0.5% or less		
Line Timing	See Fig. 1-5B.		
GCR Positive (Ghost Cancellation Reference, Positive)		Added S/N B023197.	
Pedestal Amplitude.	30 IRE ±0.5 IRE		
Chrominance Amplitude	80 IRE ±1 IRE		
Spectrum	Flat to 4.1 MHz. –3 dB at 4.3 MHz		
Line Timing	See Fig. 1–6D.		
GCR Negative(Ghost Cancellation Reference, Negative)		Added S/N B023197.	
Pedestal Amplitude	30 IRE ±0.5 IRE		
Chrominance Amplitude	80 IRE ±1 IRE		
Spectrum	Flat to 4.1 MHz. –3 dB at 4.3 MHz		
Line Timing	See Fig. 1–6E.		
GCR (Ghost Cancellation Reference) for Options	See individual Appendix sections.		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
MOD PED (Modulated Pedestal)			
Pedestal			
Amplitude	50 IRE ±0.5 IRE		
Rise Time	250 ns ±25 ns		
Tilt	0.5% or less		
Chrominance			
Amplitudes			
20 IRE	20.01 IRE p-p, ±0.5 IRE		
40 IRE	40.02 IRE p-p, ±0.5 IRE		
80 IRE	80.04 IRE p-p, ±0.5 IRE		
Phase			
Relative to Burst	90° within 0.3°		
Relative to the Other Two	0° within 0.5°		
Harmonic Distortion	At least 40 dB down		
Rise Time	400 ns ±40 ns		
Line Timing	See Fig. 1-5C.		
5-STEP STAIRCASE, MODULATED 5 STEP			
Luminance			
Amplitude	100 IRE ±0.7 IRE		
Linearity	±0.5% of total amplitude	Any step amplitude will match any other by 0.5 IRE.	29
Rise Time	250 ns ±25 ns		
Chrominance			
5-STEP STAIRCASE	No modulation		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
MODULATED 5 STEP (each step)			
Amplitude	40 IRE ±0.5 IRE		
Rise Time	400 ns ±40 ns		
Phase	180°		
Line Timing	See Fig. 1-5D.		
10-STEP STAIRCASE, MODULATED 10 STEP			
Luminance			
Amplitude	100 IRE ±0.7 IRE		
Linearity	1/10 of 10-step amplitude ±0.5%		
Rise Time	250 ns ±25 ns		
Chrominance			
10-STEP STAIRCASE	No modulation		
MODULATED 10 STEP (Each Step)			
Amplitude	40 IRE ±0.5 IRE		
Rise Time	400 ns ±40 ns		
Phase	Same as burst		
Line Timing	See Fig. 1-5E.		
$\frac{\sin x}{x}$			
Spectrum	Flat within ±0.2 dB to 4.5 MHz. −3 dB at 4.75 MHz.		
Main Pulse Zero Crossing	210 ns ±21 ns		
Small Lobe Zero Crossing	105 ns ±15 ns		
Bar Rise Time	250 ns ±25 ns		
Line Timing	See Fig. 1-5F.		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
MOD RAMP 80/100, Y RAMP 100			
Luminance Amplitudes			
MOD RAMP 80	0 to 80 IRE ±0.7 IRE		
MOD RAMP 100, Y RAMP 100	0 to 100 IRE ±0.7 IRE		
Slope	1:1	LSB:Sample	
Linearity	Within 1%		
Chrominance			
Amplitude	40 IRE ±0.5 IRE		
Inherent Diff Gain	0.6% or less		38
Inherent Diff Phase	0.3° or less		37
Envelope Rise Time	400 ns ±40 ns		
Phase	Same as burst within ±0.3°		
Line Timing	See Figs. 1-6A & 1-6B.		
NTC 7 COMBINATION			
Multiburst White Reference Bar			
Amplitude	100 IRE ±0.7 IRE		
Rise Time	250 ns ±25 ns		
Overshoot	1% or less		
Tilt	0.5% or less		
Multiburst Packets			
Amplitude	50 IRE ±0.5 IRE p-p		
Average Level	50 IRE ±0.5 IRE		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Frequencies	500 kHz I.0 MHz 2.0 MHz 3.0 MHz 3.58 MHz 4.2 MHz	Digitally determined from 14.3 MHz.	
Packets Rise Time		The packets are envelope shaped as indicated.	
500 kHz, 1 MHz	140 ns ±14 ns		
Remaining Packets	400 ns ±40 ns		
Harmonic Content	40 dB down		
Modulated Pedestal			
Pedestal			
Amplitude	50 IRE ±0.5 IRE		
Rise Time	250 ns ±25 ns		
Tilt	0.5% or less		
Chrominance			
Amplitude			
20 IRE	20.01 IRE ±0.5 IRE		
40 IRE	40.02 IRE ±0.5 IRE		
80 IRE	80.04 IRE ±0.6 IRE		
Phase			
Relative to Burst	90° ±0.5°		
Relative to the Other Two Levels	0° ±0.3°		
Harmonic Distortion	At least 40 dB down		
Rise Time	400 ns ±40 ns		
Line Timing	See Fig. 1-6C.		

Table 1-4 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
CONVERGENCE			
Peak Level	77.0 IRE ±1 IRE		
Crosshatch Vertical Lines			
Number of Unblanked Pulses	17 per active line		
Pulse Polarity	Positive		
Line Pulse HAD	225 ns ±25 ns		
Dot Pulse HAD	350 ns ±35 ns		
Crosshatch Horizontal Lines			
Number of Unblanked Pulses	14 per frame		
Pulse Polarity	Positive		
Line Pulse Rise Time	140 ns ±15 ns		
Line Pulse Duration	2 lines (1 line on each field)		
Dot Pulse	3 lines (1 line on one field and 2 lines on the other field)		
EYE TEST PATTERN		This signal occupies two adjacent television lines. The second line is of opposite phase.	
Amplitude	68 IRE	High=70 IRE, Low=2 IRE	
Rise & Fall Times	100 ns ±25 ns	Sine-squared shape.	
Bit Period	174.6 ns/bit	5.727272 MHz bit rate.	
Bit Sequence	16 cycles at 2.86 MHz 8 cycles at 1.43 MHz 5 cycles at 954 kHz 4 cycles at 716 kHz 4 cycles at 573 kHz 3 cycles at 477 kHz 2 cycles at 409 kHz 2 cycles at 358 kHz 1 cycle at 716 kHz 1 cycle at 954 kHz 2 cycles at 1.43 MHz 2 cycles at 2.86 MHz		

Table 1-4 (cont)

Characteristics	Performance Requirements		Supplemental Information	Perf. Ck. Step. No.
EYE PATTERN REFERENCE SIGNAL			This signal occupies two adjacent TV lines. The second line is of opposite phase.	
Amplitude	68 IRE		High=70 IRE, Low=2 IRE	
Rise & Fall Times	100 ns ±25 ns		Sine-squared shape.	
Bit Period	174.6 ns/bit		5.727272 MHz bit rate.	
Bit Sequence	144 cycles at 2.86 MHz			
	Signal	Lines		
MATRIX 1	MOD 10 STEP COLOR BARS RED FIELD	21-103 104-182 183-262	Customer definable.	
MATRIX 2	MOD RAMP 100 EIA BAR REV. BLUE BAR MULTIPULSE 100	21-87 88-151 152-202 203-262	Customer definable.	
MATRIX 3	CONVERGENCE EIA BAR REV. BLUE BAR CONVERGENCE IYQB CONVERGENCE	21-54 55-87 88-103 104-151 152-214 215-262	Customer definable.	

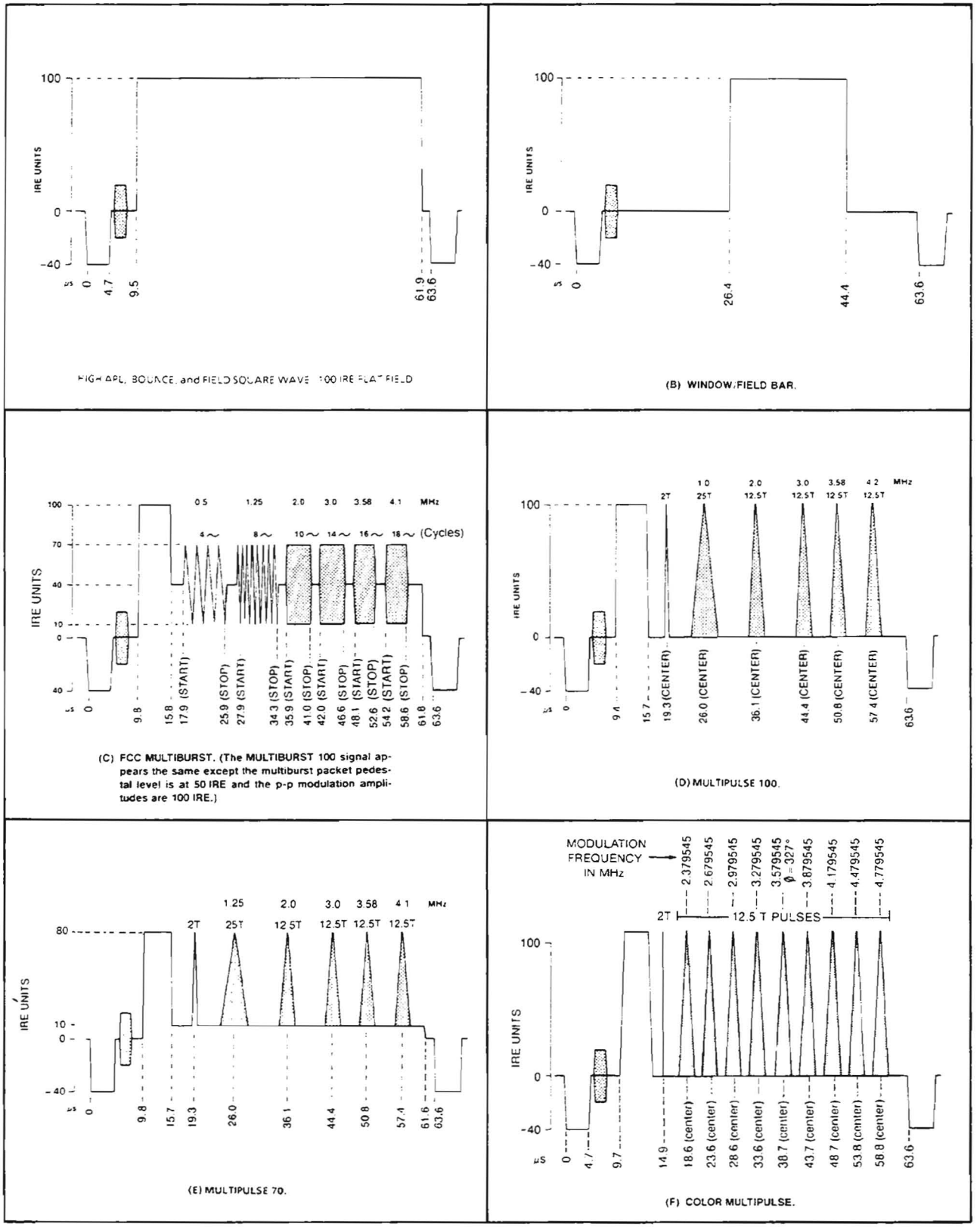


Fig. 1-2. Test Signals With Amplitude and Timing Details.

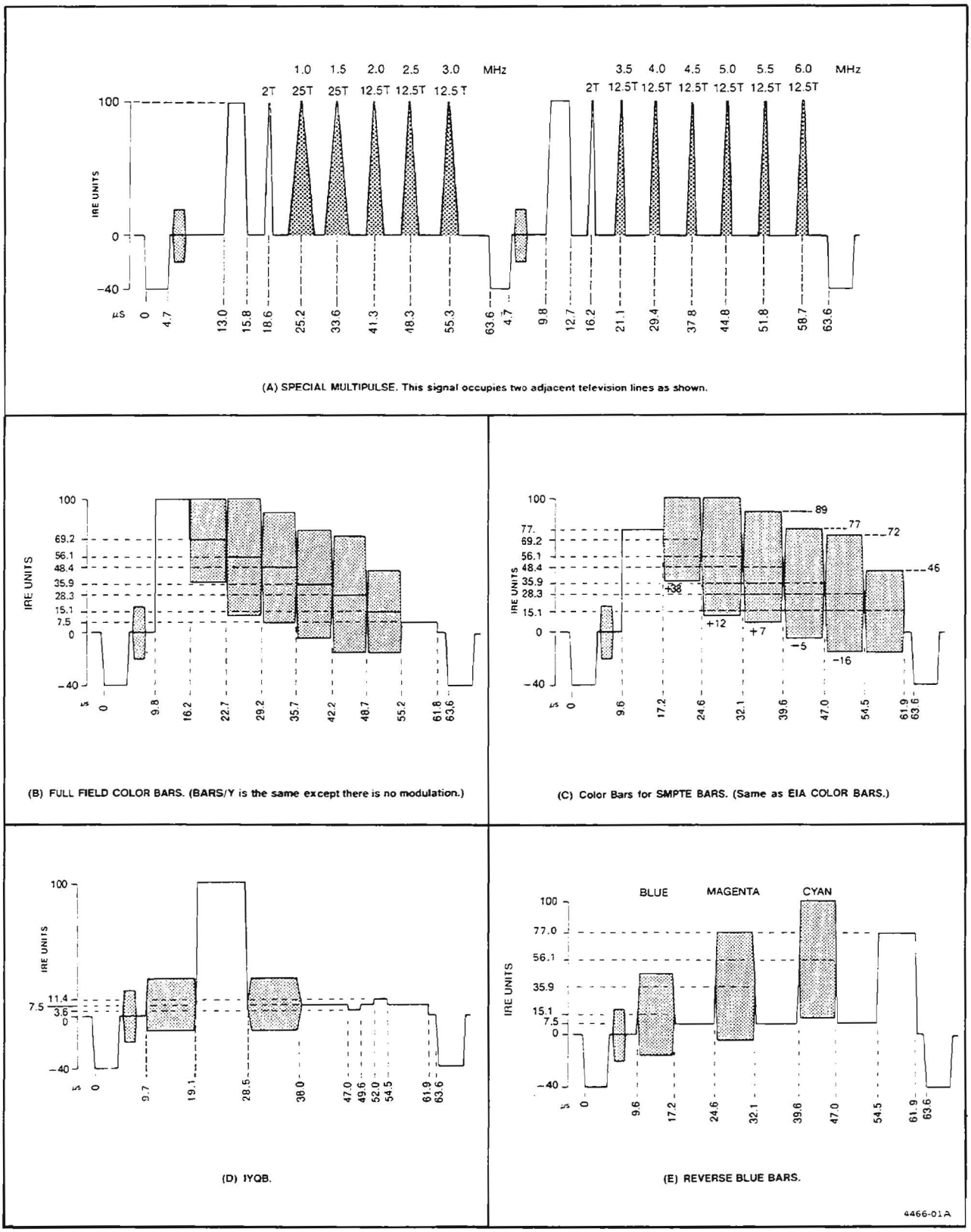


Fig. 1-3. Test Signals With Amplitude and Timing Details.

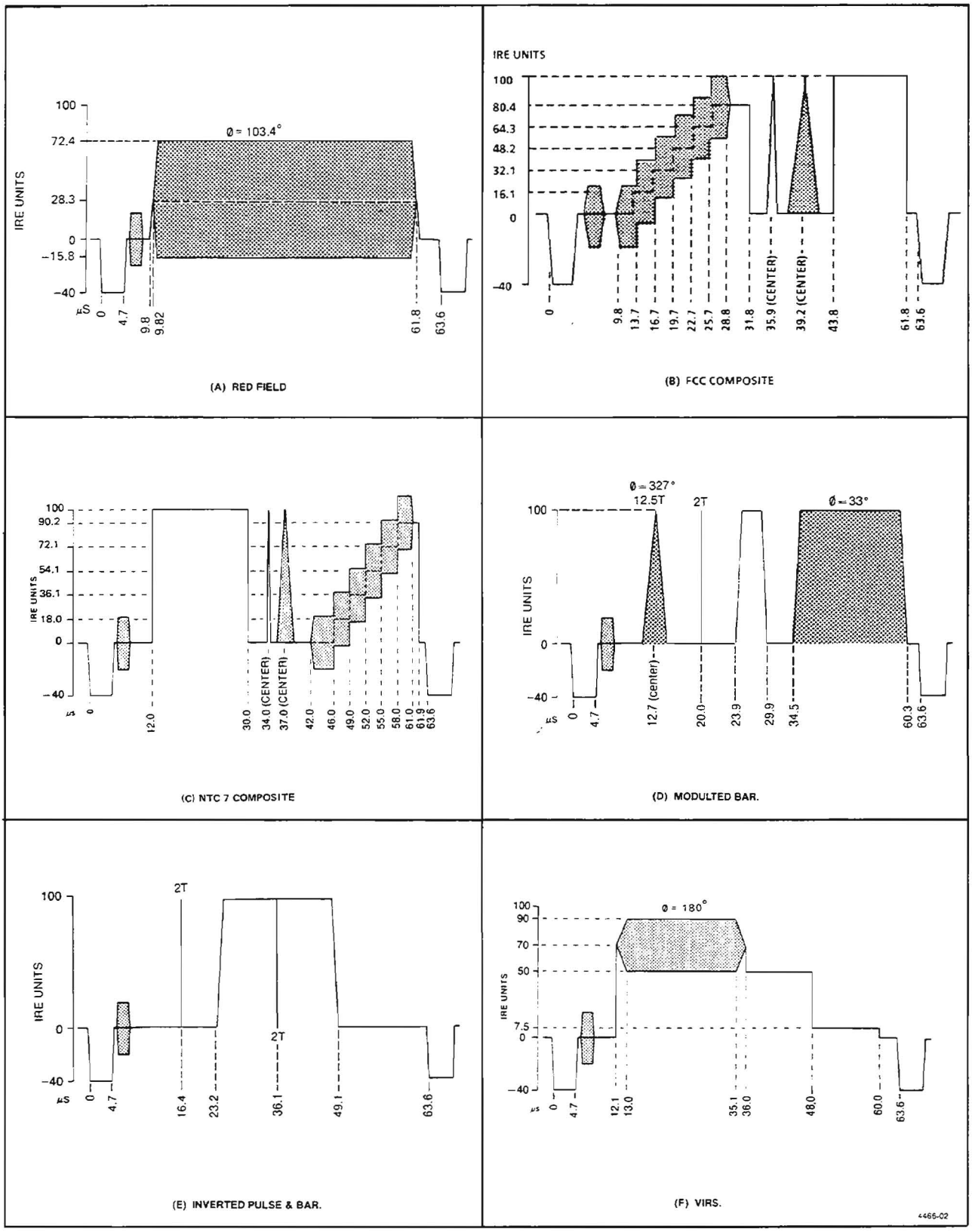
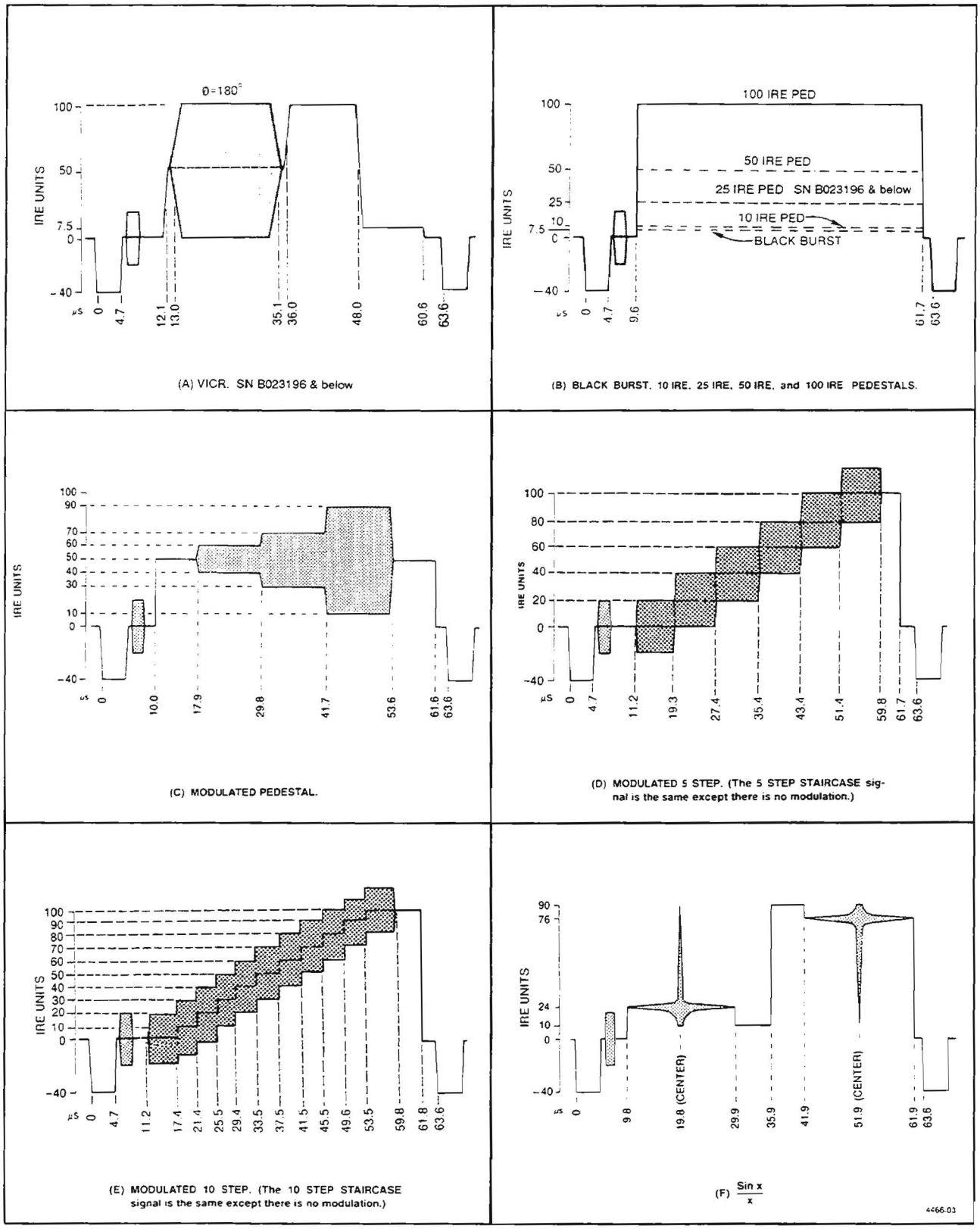


Fig. 1-4. Test Signals With Amplitude and Timing Details.



(A) VICR. SN B023196 & below

(B) BLACK BURST, 10 IRE, 25 IRE, 50 IRE, and 100 IRE PEDESTALS.

(C) MODULATED PEDESTAL.

(D) MODULATED 5 STEP. (The 5 STEP STAIRCASE signal is the same except there is no modulation.)

(E) MODULATED 10 STEP. (The 10 STEP STAIRCASE signal is the same except there is no modulation.)

(F) $\frac{\sin x}{x}$

Fig. 1-5. Test Signals With Amplitude and Timing Details.

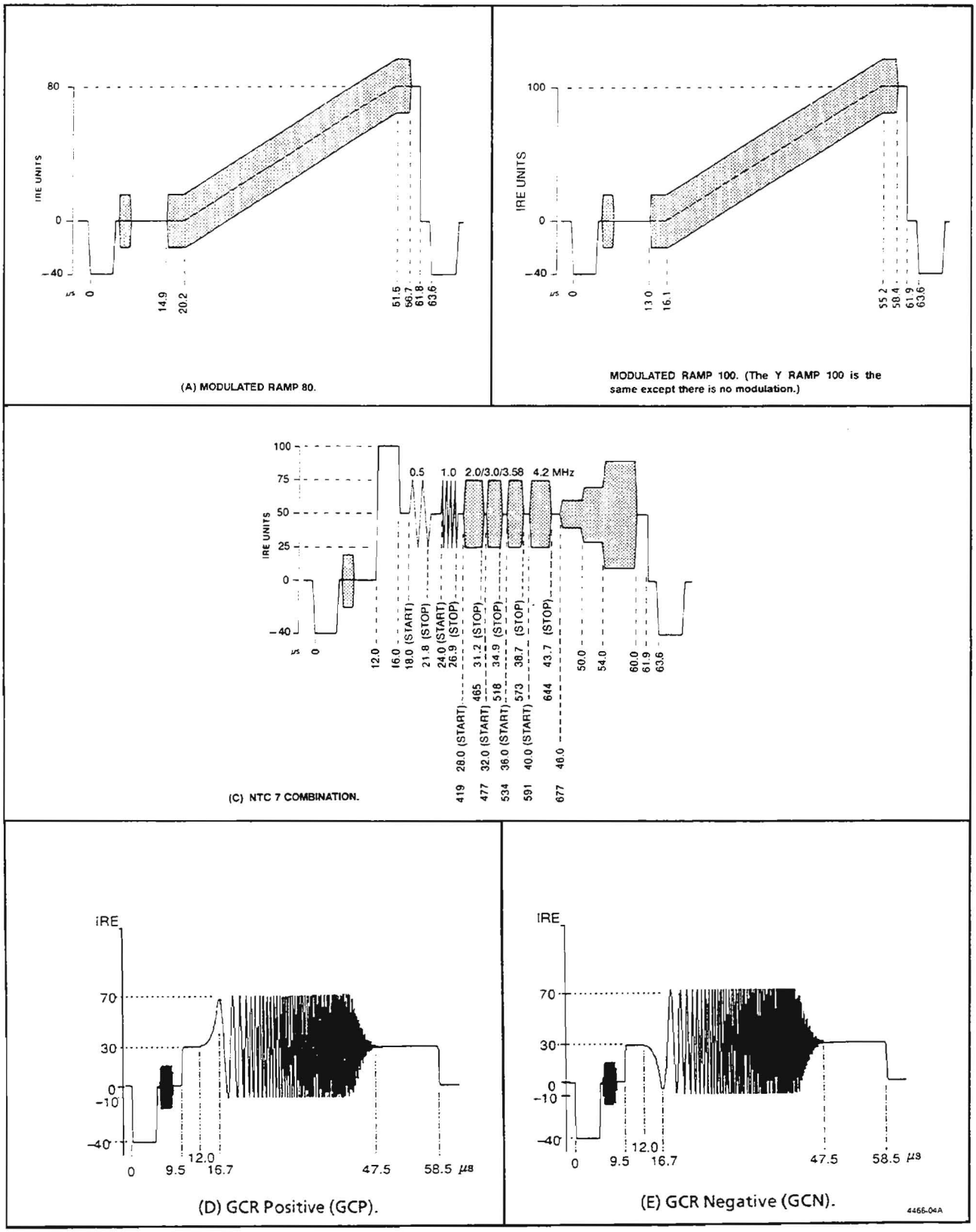


Fig. 1-6. Test Signals With Amplitude and Timing Details.

Table 1-5
TEST SIGNALS—FULL FIELD OUTPUT
(Sync & Burst)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Amplitude	1.2 V maximum p-p into 75 Ω		
Sync	285.7 mV ±2 mV		
Peak Level	714.3 mV ±5 mV		28
Blanking Level			
DAC DC Restorer On	0 V ±2 mV		40
DAC DC Restorer Off	0 V ±50 mV		40
Field Period	16.68 ms	Digitally determined from 14.3 MHz.	
Line Period	63.56 μs		
Sync Rise & Fall Time	140 ns ±15 ns	10% to 90% amplitude.	
Sync Timing	See Fig. 1-7.		
Front Porch	1.7 μs ±100 ns using a 100 IRE pedestal	Digitally determined from 14.3 MHz.	
Line Blanking Interval	11.28 μs ±100 ns at 20 IRE points using a 100 IRE Pedestal		
Breezeway	0.6 μs, ±50 ns, at 50% of sync to 50% of burst amplitude		
Back Porch Duration	4.83 μs, ±50 ns, at 50% of sync to 20 IRE using a 100 IRE pedestal		
Line Sync	4.7 μs, ±50 ns, at 50% amplitude point		
Vertical Serration	See Fig. 1-8.		

Table 1-5 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No
Duration	4.7 μs, ±50 ns, at 50% amplitude point		
Sequence		Three lines.	
Period	262.5 lines	Digitally determined from 14.3 MHz.	
Equalizing Pulse			
Duration	2.33 μs, ±50 ns, at 50% amplitude point		
Sequence		Three lines.	
Burst			
Rise & Fall Time	400 ns ±40 ns		
Delay from Line	5.308 μs ±35 ns	19 cycles of subcarrier.	
Half-Amplitude Duration of Envelope	2.51 μs ±100 ns	9 cycles of subcarrier.	
Amplitude	285.7 mV ±8.57 mV		
Residual Subcarrier (Luminance & Blanking)	At least 52 dB below 1 V (2.5 mV)	As viewed on a 1480 Waveform Monitor	40
Spurious Subcarrier on Outputs	At least 52 dB below 1 V (2.5 mV)		40
Chrominance Subcarrier Frequency			
Free Running	3.579545 MHz ±10 Hz		26
Locked Mode		Locked to incoming burst; locked to the leading edge of sync if burst is not present.	
Output Impedance	75 Ω nominal		
Return Loss	At least −36 dB to 5 MHz		53
Isolation (Front- & Rear-Panel Outputs)	At least −40 dB		35

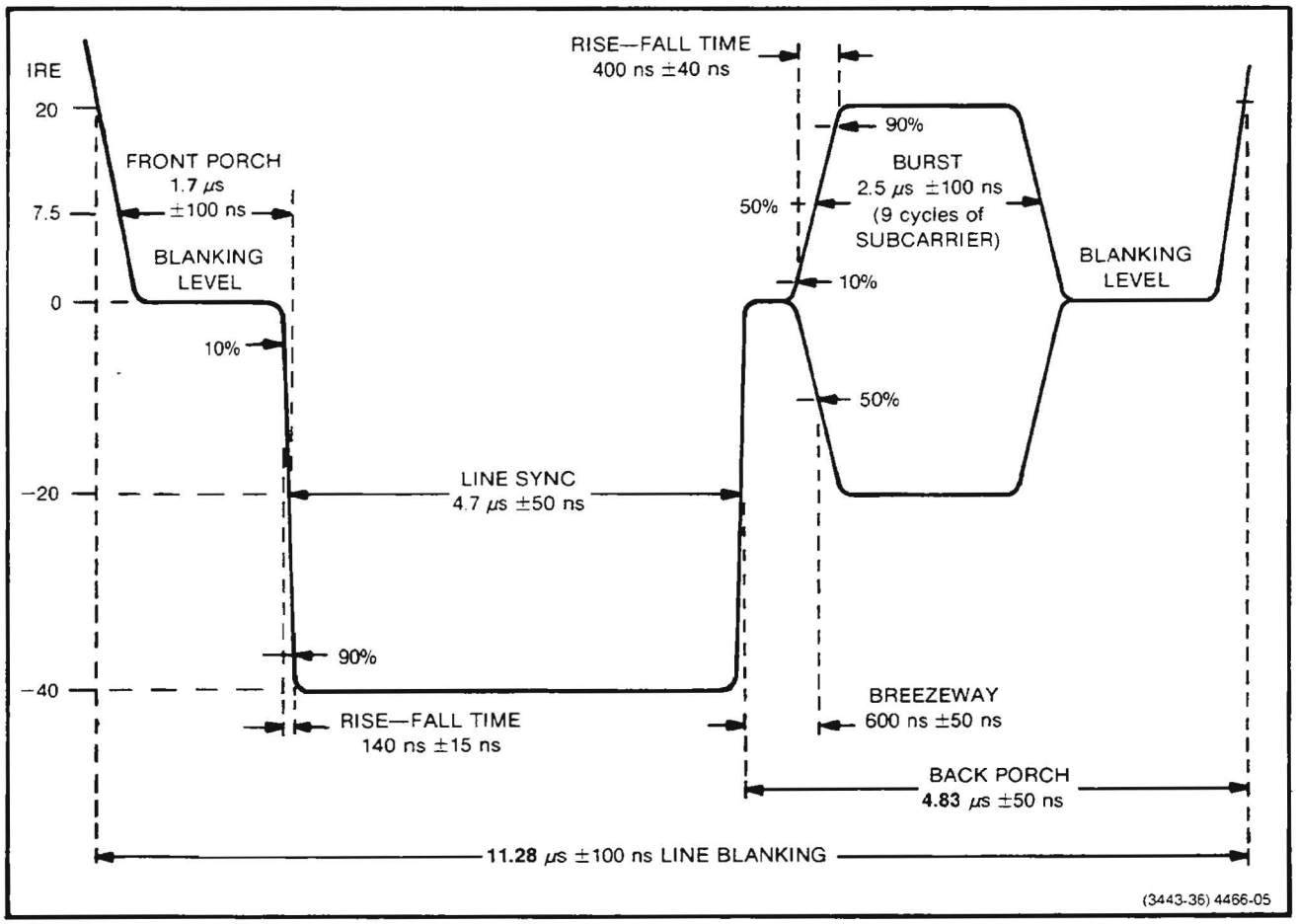


Fig. 1-7. Horizontal Blanking Details.

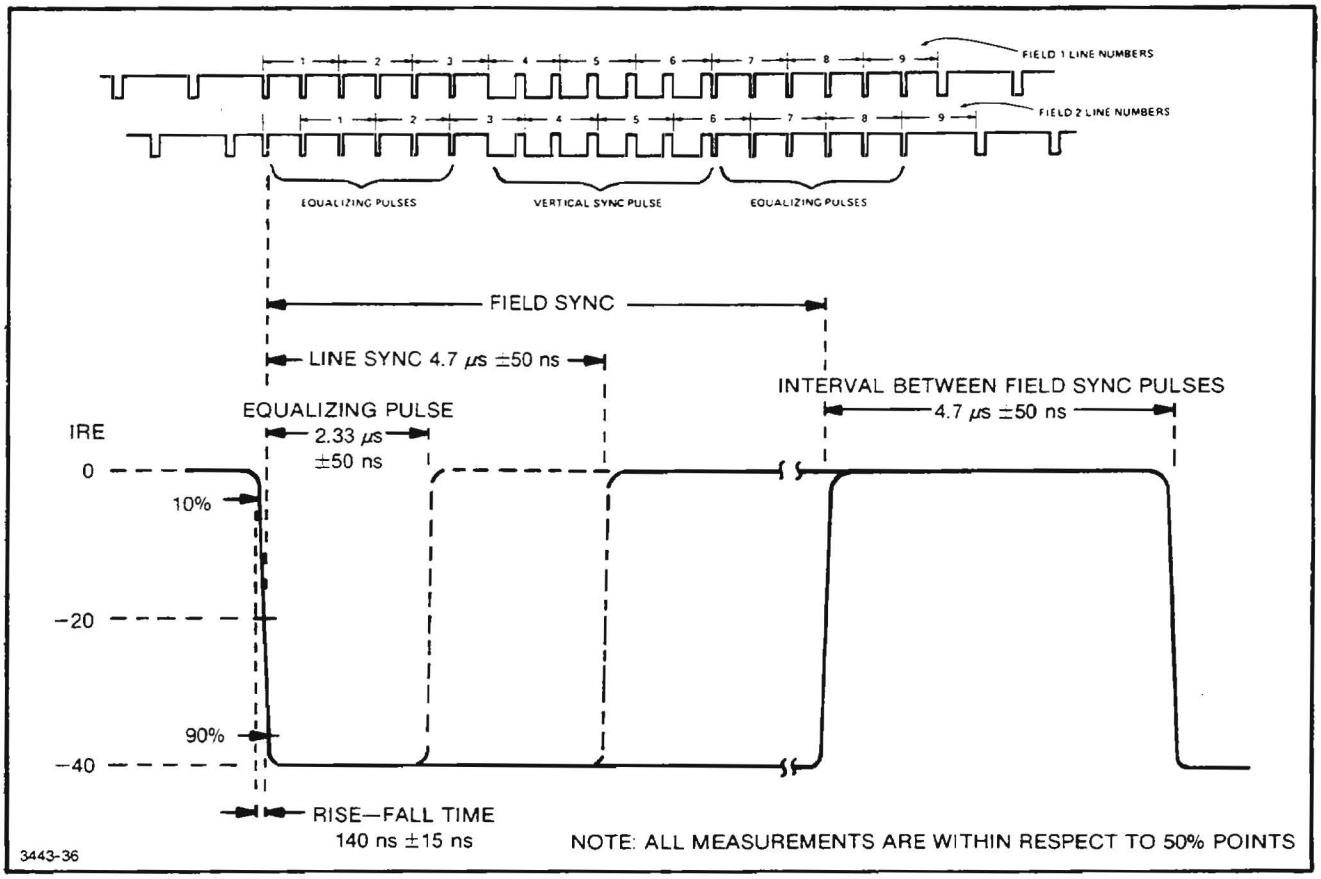


Fig. 1-8. Composite Sync Details.

Table 1-6
SYNC & SUBCARRIER

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
COMPOSITE SYNC			
Amplitude	4 V ±10% p-p, negative going, into 75 Ω		
Rise & Fall Times	140 ns ±20 ns	Measured from 10% to 90% amplitude points.	
Return Loss	At least 30 dB to 3.58 MHz		53
Line Period		Nominal (H) = 63.556 μs $\frac{1}{\frac{\text{Subcarrier X 2}}{455}}$	
Line Sync Duration	4.7 μs ±50 ns	Measured at 50% amplitude point.	
Equalizer Pulse			
Duration	2.3 μs ±50 ns	Measured at 50% amplitude point.	
Sequence Duration		Three lines each.	
Vertical Sync Pulse			
Serration	4.7 μs ±50 ns		
Sequence Duration		Three lines.	
Field Period	262.5 H Lines	16.6835 ms nominal.	
SUBCARRIER			
Amplitude	2 V p-p ±10%	Into 75 Ω.	
Return Loss	At least 30 dB into 5 MHz		53
Frequency		Locked to incoming burst. If burst is not present, locked to leading edge of incoming sync. If sync is not present, determined by an internal oven-controlled oscillator.	25

Table 1-6 (cont)

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Pulse Outputs[a]	H DRIVE, V DRIVE, BURST FLAG, & COMP BLANKING		
Amplitude	4 V ±10% p-p, negative going, into 75 Ω		
Rise & Fall Times	140 ns ±20 ns	Measured from 10% to 90% amplitude points.	
Return Loss	At least 30 dB to 5 MHz		
Timing			
H DRIVE Duration	Start of line blanking to end of line sync ±100 ns		52
V DRIVE Duration	Nine lines	Coincident with beginning of field. Blanking extends nine lines.	52
BURST FLAG			
Delay from Line Sync	5.3 μs ±100 ns		52
Duration	2.5 μs	9 cycles of subcarrier.	52
COMP BLANKING			
Line Blanking Duration	11.1 μs ±100 ns		52
Front Porch	1.5 μs ±100 ns	Leading edge of comp sync to end of line blanking is 9.6 μs ±100 ns.	52
Field Blanking Duration		Field 1 = 21 lines Field 2 = 21 lines Start: 1.5 μs ±100 ns before leading edge of first equalizing pulse.	52

[a]Available when the Pulse Output board, A15 (a standard accessory), is installed in place of the External VITS board, A17.

Table 1-7
RS-232 CONTROL PORT INTERFACE

Characteristics	Performance Requirements	Supplemental Information	
Interface[a]		Supports EIA Standard RS-232-C format to the extent shown below.	
Baud	300, 1200, 2400, and 4800 bits/sec	Selectable through the RS-232 port.	
Input	Serial Asynchronous Data	Full duplex input and output.	
Output	Serial Asynchronous Data		
Data Code	ASCII		
Character Length	Eleven bits per character, including a start and two stop bits.		
Parity			
Input		No parity is required; and, if present, it is ignored.	
Output	No parity is sent.		
Keyboard Syntax		See Section 5 of this manual.	

[a]The control lines used in the 1910 are listed below:

Pin	Function	Input or Output
1	Protective Ground	
2	Receive Data	Input
3	Transmit Data	Output
4	Request to Send	Input
5	Clear to Send	Output
6	Data Set Ready	Output
7	Signal Ground	
8	Received Line Signal Detector (Data Carrier Detect)	Output
20	Data Terminal Ready	Input

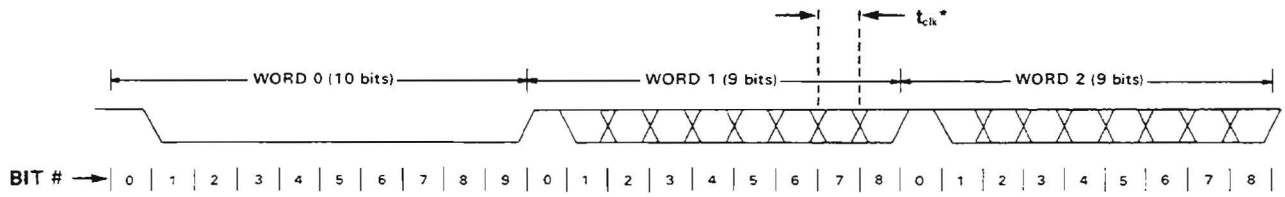
Table 1-8
DIGITAL INPUT INTERFACE

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Digital Format		Parallel, 12 balanced signal pairs consisting of 10 data bits per sample, a clock, and a timing reference signal.	
Encoding Format		Positive binary	
Sampling Frequency	4 times color subcarrier. Nominally 14.31818 MHz		
Sampling Phase Angle		Referenced to I and Q axis.	
Input Logic Levels Terminated in 100 Ω	High: −1.10 to −0.81 V Low: −1.85 to −1.48 V	At 25°C. 10K ECL compatible.	
Dynamic Range 10 bits/sample	Blanking level (0 IRE) is at digital word 240. Reference white (100 IRE) is at digital word 800 (5.6 LSB/IRE).		
Setup Time	Data needs to be valid at least 10 ns before the 50% point of the negative transition of the clock pulse.		
Hold Time	Data needs to be valid for at least 10 ns after the 50% point of the negative transition of the clock pulse.		

Table 1-9
DIGITAL OUTPUT INTERFACE

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Digital Format		Parallel, 12 balanced signal pairs consisting of 10 data bits per sample, a clock, and a timing reference signal.	
Timing Reference Signal		See Fig. 1-9.	
Encoding Format	Positive Binary		
Sampling Frequency	4 times color subcarrier nominal (14.31818 MHz)		
Sampling Phase Angle		Referenced to I and Q axis.	
Output Logic Levels	10K ECL compatible. High: −0.96 to −0.81 V Low: −1.85 to −1.65 V	At 25°C.	
Dynamic Range 10 bits/sample	Blanking level (0 IRE) is at digital word 240. Reference white (100 IRE) is at digital word 800 (5.6 LSB/IRE).		
Clock Timing	The 50% point of the leading edge of the clock pulse precedes the data by 5 ns ±5 ns.		

TIMING REFERENCE SIGNAL



This signal occurs once every 63.56 μs. Field and Frame information change at line number 1.**

Bit 1 of Word 0 occurs 91 Clock cycles after the nominal 50% point of the leading edge of the Horizontal Sync pulse.

WORD 0

Bit 0 — Always High.
Bits 1 through 9 are always Low.

WORD 1

Bit 0 — Always High.
Bit 1 — High for Color Frame B**
Bit 2 — High for Fields 2 and 4**
Bit 3 — 2^6 (MSB) } Horizontal Line Count**
Bit 4 — 2^7 } (straight binary sequence)
Bit 5 — 2^4 }
Bit 6 — 2^5 }
Bit 7 — 2^4 }
Bit 8 — Odd Parity for Word 1.
(Odd parity gives the word, including parity, an odd number of high states.)

WORD 2

Bit 0 — Always High
Bit 1 — 2^3 } Horizontal Line Count**
Bit 2 — 2^2 } (straight binary sequence)
Bit 3 — 2^1 }
Bit 4 — 2^0 (LSB) }
Bit 5 — High when the preceding Frame, Field or Line Count is invalid.
Bit 6 — High for lines with Color Burst.
Bit 7 — High when reference subcarrier is positive-going.**
Bit 8 — Odd Parity for Word 2.
(Odd parity gives the word, including parity, an odd number of high states.)

The remaining time of the Timing Reference Signal is High.

**The clocks repetition rate (t_{clk}) is equivalent to 1/14.31818 MHz.*

***As defined in the EIA Tentative Standard RS 170A for Color Television Studio Picture Line Amplifier Output.*

3443-37B

Fig. 1-9. Timing Reference Signal Details.

Table 1-10
POWER SUPPLY

Characteristics	Performance Requirements	Supplemental Information	Perf. Ck. Step. No.
Supply Accuracy			
+15 V		15 V ±50 mV	
+5 V Analog		5 V ±50 mV	
+5 V Digital		5 V ±50 mV	
−5.2 V ECL		−5.2 V ±50 mV	
−15 V		−15 V ±25 mV	
Current Limit		Nominal	
+15 V		0.7 A	
+5 V Analog		0.5 A	
+5 V Digital		6.5 A	
−5.2 V ECL		2 A	
−15 V		0.8 A	
Supply Ripple		Typical	
+15 V		5 mV	
+5 V Analog		5 mV	
+5 V Digital		5 mV	
−5.2 V ECL		5 mV	
−15 V		5 mV	
Line Voltage Range			
100 Vac	90 Vac to 110 Vac		
110 Vac	99 Vac to 121 Vac		
120 Vac	108 Vac to 132 Vac		
200 Vac	180 Vac to 220 Vac		
220 Vac	198 Vac to 242 Vac		
240 Vac	216 Vac to 250 Vac		
Crest Factor		At least 1.35	
Fuse Data			
100/120 Vac		1.6 A Slow-Blow	
200/240 Vac		0.8 A Slow-Blow	
Maximum Power Consumption		130 W	
Maximum Current at 120 Vac, 60 Hz		1.08 A	
Line Frequency		47 Hz to 63 Hz	

Table 1-11
PHYSICAL CHARACTERISTICS

Characteristics	Information
Dimensions	See Fig. 1-10.
Rackmount	
Height	88 mm (3.470 inches)
Width	486 mm (19.134 inches)
Length	525 mm (20.650 inches)
Cabinet	
Height	96 mm (3.770 inches)
Width	442 mm (17.399 inches)
Length	525 mm (20.650 inches)
Net Weight	
Rackmount	12.2 kg (27 lbs)
Cabinet	11.6 kg (25.5 lbs)
Shipping Weight	16.7 kg (37 lbs)

Table 1-12
ENVIRONMENTAL CHARACTERISTICS

Characteristics	Information
Temperature	
Non-Operating	−40°C to +65°C.
Operating	0°C to +50°C.
Altitude	
Non-Operating	To 50,000 feet.
Operating	To 15,000 feet.
Vibration	
Operating	15 minutes each axis at 0.015 inch, frequency varied from 10-50-10 c/s in 1-minute cycles with instrument secured to vibration platform. Three minutes each axis at any resonant point or at 50 c/s.
Shock	
Non-Operating	30 g's, 1/2 sine, 11 ms duration, 2 guillotine-type shocks per axis.
Transportation	Qualified under NTSC Test Procedure 1A, Category II (24-inch drop).

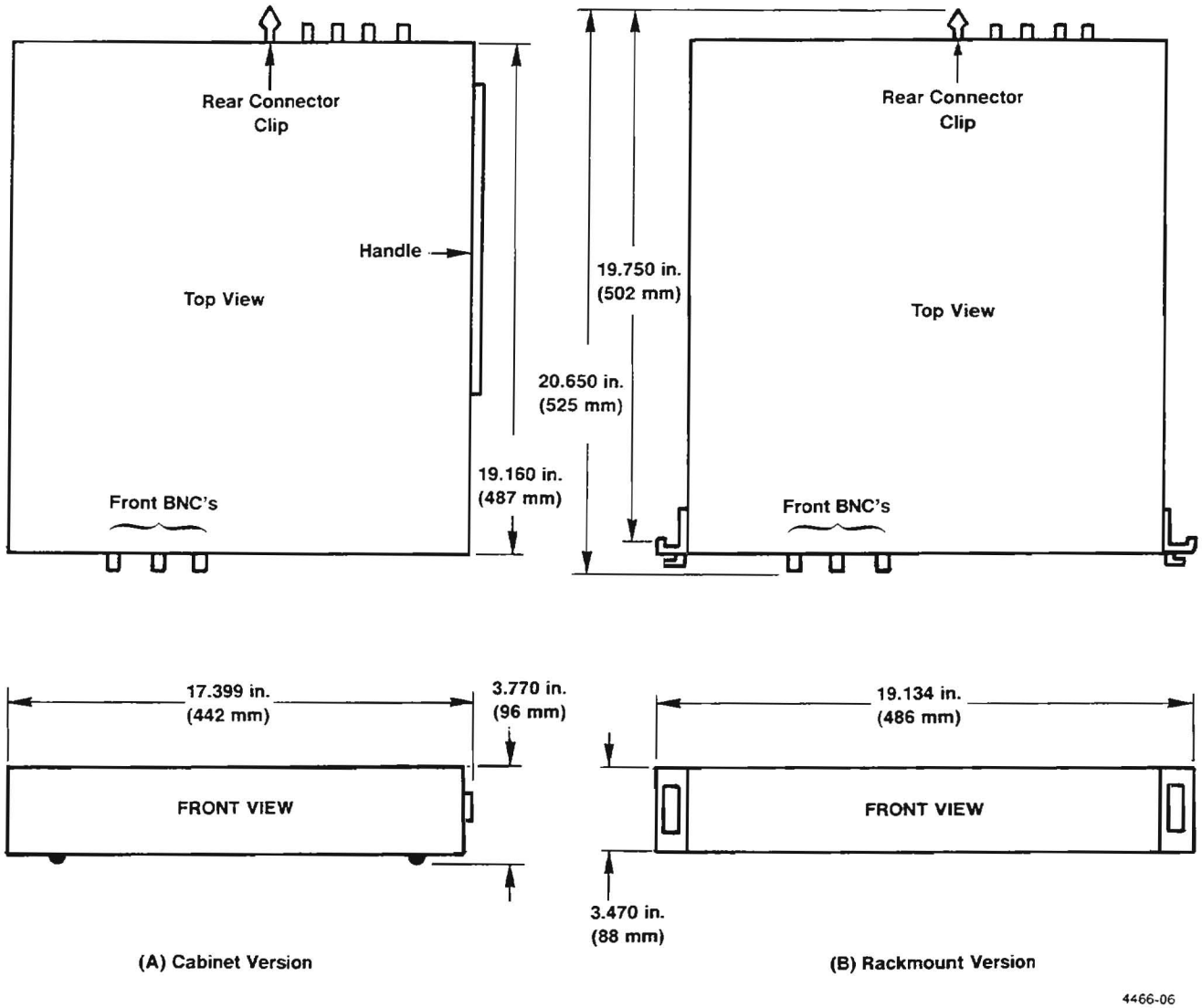


Fig. 1-10. Dimensional Illustrations for the 1910.