

Cathode Ray Tubes:

Getting Down to Basics

FORWARD

This book was written to serve three major purposes:

1. To understand the interaction and interdependence between the CRT and electronic circuitry in measurement devices having CRTs. The cathode-ray tube (CRT), as the output or display section of oscilloscopes, graphics terminals and other measurement devices, requires understanding in isolating a malfunctioning electronic circuit, the design of circuitry that interfaces with the CRT is dependent upon the requirements of the CRT and before these circuits can be fully analyzed the requirements of the CRT must be known. The proper operation of the various controls and adjustments directly associated with the display requires an understanding of the probable effect upon the CRT.
2. To understand the basic theory or principles of CRT design and operation. In today's world of solid-state devices the principles of operation of vacuum devices is relatively unknown. This book is an attempt to give the engineer, technician or other reader a basic understanding of CRT operation.
3. To consolidate previous CRT-technical documents under one cover. Over the past 30 years there have been a number of CRT theory booklets and technical reports written by Tektronix covering CRT design and theory of operation; some were published and now are out-of-date and no longer in print, others were never published.

I wish to acknowledge those whose publications have been used in this book and whose efforts continue to advance the performance of cathode-ray tubes.

Vernon L. Isaac
CRT Product Assurance Manager
Tektronix, Inc.

APPENDIX B

Types of storage

P	phosphor-target bistable
B	transmission bistable
H	halftone without variable persistence
V	variable persistence
FB	fast (transfer) and bistable
FV	fast (transfer) and variable persistence

Other abbreviations

*	optional feature
Δ	type RM564 only
∇	central 6x8 div only
◦	central 4x5 div only
‡	in reduced scan mode each division is half normal size
†	integration is also a natural property of all halftone and variable persistence tubes
-	not applicable or not available

Product	Y or Z resp. of instrument	CRT			Usable area		Internal graticule illuminated or non-illuminated
		Dual beam	Type of storage	Split screen	cm	div	
D1	Y2	-	P	S	10x12.5	8x10	N
DM53A	Y25	D	V	-	6x10	6x10	-
DM63	Y15	D	V	-	7.2x9	8x10	N
DM64	Y10	-	P	-	8x10	8x10	-
GMA-101A	Z7	-	P	-	26.6x35.5	-	-
GMA-102A	Z7	-	P	-	26.6x35.5	-	-
T912	Y10	-	P	-	8x10	8x10	N
214	Y0.5	-	P	-	3x5	6x10	N
314	Y10	-	P	-	5.1x6.3	8x10	N
434	Y25	-	P	S	7.8x9.8	8x10	N
434 opt 1	Y25	-	P	S	7.8x9.8	8x10	N
464	Y100	-	FV	-	7.2x9	8x10	I
466	Y100	-	FV	-	7.2x9	8x10	I
549	Y30	-	P	S	6x10	6x10	-
564	Y10	-	P	S	8x10	8x10	-
564B	Y10	-	P	S	8x10	8x10	-
564B Mod 08	Y10	-	P	S	8x10	8x10	-
601	Z1	-	P	-	8x10	-	-
603	Z5	-	P	-	10x12.5	8x10*	N*
603 opt 2	Z5	-	P	-	10x12.5	8x10*	N*
605	Z5	-	V	-	7.2x9	8x10*	N*
607	Z5	-	V	-	7.2x9	8x10*	N*
611	Z1.7	-	P	-	16.2x21	-	-
613	Z1.7	-	P	-	15x20	-	-
4501	Z5	-	P	-	7.5x10	-	-
5031	Y1	D	P	S	10x12.5	8x10	I
5111	Y2	-	P	S	10x12.5	8x10	N
5113	Y2	D	P	S	10x12.5	8x10	N
5113 opt 3	Y2	D	P	S	10x12.5	8x10	N
5115	Y2	-	P	S	10x12.5	8x10	N
5441	Y60	-	V	-	7.2x9	8x10	I
5441 opt 5	Y60	-	V	-	7.2x9	8x10	I
7313	Y25	-	P	S	7.8x9.8	8x10	I
7514	Y90	-	P	S	8x10	8x10	I
7613	Y100	-	V	-	7.2x9	8x10	I
7623	Y100	-	FB V	-	7.2x9	8x10	I
7623 opt 12	Y100	-	FB V	-	7.2x9	8x10	I
7623 A	Y100	-	FB FV	-	7.2x9	8x10	I
7633	Y100	-	FB FV	-	7.2x9	8x10	I
7834	Y400	-	FB FV	-	7.2x9	8x10	I

Fastest writing speed		Stored trace brightness FL	Integrate model† (use reduced brightness)	Longest storage time of fastest recording		Longest erase cycle ms	Auto erase	Remote control (Erase only)	Locate zone or Write-through	Dot writing time μs	Resolution paired lines	Product
normal cm/μs	enhanced or reduced scan† cm/μs			normal brightness min	reduced brightness min							
0.025	-	15	R	60	600	250	-	-	-	-	-	D1
0.05	E0.5	100	-	10	60	500	-	R	L	-	-	DM53A
0.045	E0.9	100	-	0.5	5	250	-	-	L	-	-	DM63
0.025	E0.25	6	I	60	-	250	A	E*	L	-	-	DM64
0.01	-	5	-	15	30	1800	-	R	W	5	368x490	GMA-101A
0.015	-	5	-	15	30	1800	-	R	W	5	420x560	GMA-102A
0.025	E0.25	6	I	60	-	600	-	-	-	-	-	T912
0.04	E0.25	8	-	60	-	500	-	-	-	-	-	214
0.05	E0.25	12	I	240	-	300	A	-	-	-	-	314
0.1	E0.4	10	I	240	-	300	-	-	L	-	-	434
0.75	E5	5	I	240	-	300	-	-	L	-	-	434 opt 1
100	-	80	-	0.25	6	1350	A	-	-	-	-	464
135	R1350	80	-	0.25	6	1350	A	-	-	-	-	466
0.5	E5	3.5	I	60	-	150	A	R	L	-	-	549
0.025	E0.25	6	I	60	-	250	-	E∇	L	-	-	564
0.025	E0.25	6	I	60	-	250	A*	R	L	-	-	564B
0.1	E0.5	2	I	60	-	250	A*	R	L	-	-	564B Mod 08
0.01	-	6	-	15	-	200	-	R	-	9	100x125	601
0.025	-	15	-	60	600	250	-	R	-	4	80x100	603
0.25	-	6	-	60	600	250	-	R	-	0.5	80x100	603 opt 2
0.9	-	100	-	5	60	500	-	R	-	-	80x100	605
0.72	-	200	-	1	10	500	-	R	-	-	144x180	607
0.025	-	6	-	15	300	500	-	R	W	5	300x400	611
0.025	-	20	-	15	300	900	-	R	W	5	200x266	613
0.01	-	75	-	15	-	175	-	R	-	8	100x125	4501
0.025	E0.1	6	-	60	-	250	A	R	L	-	-	5031
0.025	-	15	R	60	600	250	A*	E*	-	-	-	5111
0.025	-	15	R	60	600	250	A*	E*	-	-	-	5113
0.25	-	6	R	60	600	250	A*	E*	-	-	-	5113 opt 3
0.25	E1	6	R	60	600	250	A*	E*	-	-	-	5115
4.5	-	100	-	5	60	500	-	-	-	-	-	5441
0.9	-	100	-	5	60	500	-	-	-	-	-	5441 opt 5
0.5	E5	10	I	240	-	300	A	E	L	-	-	7313
0.06	E1	6	I	60	-	1000	A	R	W	-	-	7514
4.5	-	100	-	5	60	500	-	E	-	-	-	7613
90° 0.45	-	100	-	∞ 0.25	∞ 60	1000	A	E	-	-	-	7623
200° 0.45	-	100	-	∞ 0.25	∞ 60	1000	A	E	-	-	-	7623 Opt 12
45Δ 135Δ	-	100	-	∞ 0.5	∞ 15	1300	A	E	-	-	-	7623A
45Δ 135Δ	R180 R1000	100	-	∞ 0.5	∞ 15	1300	A	E	-	-	-	7633
45Δ 270Δ	R350 R2500	135	-	∞ 0.5	∞ 15	1200	A	R	-	-	-	7834