X3T9.2/89-142

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TO: X3T9.2 SCSI Committee Members

c/o John Lohmeyer, Committee Chairman
NCR Corporation
3718 N. Rock Road
Wichita, Kansas 67226

FROM: Wills Xu

DATE: November 2, 1989

SUBJECT: Cable Test Comparisons

The objectives of the tests outlined in the attached report were as follows:

1. Establish cable electrical parameters with specific cable constructions.

2. Compare the electrical characteristics of various similar-type cables.

After comparing the four sample cables, C & M feels there is a limited possibility of manufacturing a cable which meets all of the electrical requirements of the SCSI II specifications as well as the physical restraints of the connectors.

Wills Xu
C & M Product Development Manager

WX:cp:110289WP

cc: Bruce DeBree, C & M Marketing Director
cc: Souky Litthisack, C & M Quality Assurance Engineer

Enc: SCSI II Report

"Our success depends on your satisfaction."

X3T9.2/89-142

SCSI II

CABLE TEST COMPARISON REPORT

OCTOBER 31, 1989

BY

C & M CORPORATION

WILLS XU

SOUKY LITTHISACK

ABSTRACT

The intent of the following tests was to characterize the electrical performance of the cables by varying one parameter at a time during manufacture for SCSI applications.

The test samples were carefully selected to have physical dimensions which fit within the SCSI connector.

To accomplish these goals, C & M Corporation utilized four separate samples. Their physical properties will be described in a separate section. The electrical testing which was performed on these four samples is also outlined in the section covering electrical performance.

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PHYSICAL CHARACTERISTICS OF 25 TWISTED PAIR CABLES

	C & M CAT.# 16400	C & M CAT.# 62286	C & M CAT.# 62327	C & M CAT.# 62523
CONDUCTOR SIZE	#28 AWG	#28 AWG	#28 AWG	#28 AWG & #30 AWG
INSULATION TYPE	HI-DENSITY POLYETHYLENE	FOAM POLYPRO	FOAM POLYPRO	FOAM POLYPRO
OD OVER INSULATION	.035"	.035"	.035"	.035"
BUFFERING TAPE	NO	NO	YES	NO
SHIELDING	BRAID	BRAID	BRAID	BRAID
FINAL OD NOMINAL	.410"	.400"	.420"	.400"
UL LISTED	CL2	CL2	CL2	CL2

NOTE: Color coding of primaries and pair lay-up is outlined in Appendix F, Figure 1.

Catalog #62523, Pair #11 through Pair #25, are #30 AWG conductors.

IMPEDANCE (SINGLE ENDED) TEST RESULT COMPARISON

UNIT OF MEASUREMENT: Ohms

PAIR LOCATION	PAIR #	ALL 28 AWG SOLID POLY W/O BUFFER TAPE CATALOG 16400 COLOR CODE		COLOR CODE	ALL 28 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62286	ALL 28 AWG FOAM POLY W/BUFFER TAPE CATALOG 62327	28 & 30 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62523
CORE	1	Black & Red	92	Black & Red	97	97	93
	2	Blue & Yellow	92	Black & White	100	100	94
	3	Brown & Orange	84	Black & Green	96	95	90
	4	Green & Violet	84	Black & Blue	93	99	92
	5	Gray & White	84	Black & Yellow	93	98	90
MIDDLE	6	White/Blue & Blue/White	84	Black & Brown	93	97	91
LAYER	7	White/Orange & Orange/White	84	Black & Orange	95	97	91
	8	White/Green & Green/White	84	Red & White	98	97	83
	9	White/Brown & Brown/White	84	Red & Green	95	101	90
	10	White/Gray & Gray/White	84	Red & Blue	100	101	92
	11	Red/Blue & Blue/Red	68	Red & Yellow	82	89	87
	12	Red/Orange & Orange/Red	68	Red & Brown	80	89	89
	13	Red/Green & Green/Red	68	Red & Orange	80	81	86
	14	Red/Brown & Brown/Red	68	Green & White	80	85	85
	15	Red/Gray & Gray/Red	69	Green & Blue	80	85	90
	16	Black/Blue & Blue/Black	68	Green & Yellow	77	89	89
OUTER	17	Black/Orange & Orange/Black	67	Green & Brown	77	84	87
LAYER	18	Black/Green & Green/Black	68	Green & Orange	80	84	87
	19	Black/Brown & Brown/Black	66	White & Blue	80	83	91
	20	Black/Gray & Gray/Black	67	White & Yellow	77	90	95
	21	Yellow/Blue & Blue/Yellow	66	White & Brown	77	85	82
	22	Yellow/Orange & Orange/Yellow	68	White & Orange	77	82	87
	23	Yellow/Green & Green/Yellow	67	Blue & Yellow	86	85	86
	24	Yellow/Brown & Brown/Yellow	69	Blue & Brown	80	85	94
	25	Yellow/Gray & Gray/Yellow	70	Blue & Orange	80	83	89
CORE	MIN.		84		93	95	83
AND	MAX.		92		100	101	94
MIDDLE	RANGE		8		7	6	9
	MIN.		66		77	81	82
OUTER	MAX.		68		86	90	95
LAYER	RANGE		2		9	9	13

TEST METHOD: See Appendix E

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IMPEDANCE (DIFFERENTIAL) TEST RESULT COMPARISON

UNIT OF MEASUREMENT: Ohms

PAIR LOCATION	PAIR #	ALL 28 AWG SOLID POLY W/O BUFFER TAPE CATALOG 16400 COLOR CODE		COLOR CODE	ALL 28 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62286	ALL 28 AWG FOAM POLY W/BUFFER TAPE CATALOG 62327	28 & 30 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62523
CORE	1	Black & Red	125	Black & Red	143	128	135
	2	Blue & Yellow	125	Black & White	143	128	140
	3	Brown & Orange	120	Black & Green	135	118	130
	4	Green & Violet	125	Black & Blue	143	128	135
	5	Gray & White	125	Black & Yellow	143	120	133
MIDDLE	6	White/Blue & Blue/White	120	Black & Brown	137	120	137
LAYER	7	White/Orange & Orange/White	120	Black & Orange	137	119	135
	8	White/Green & Green/White	118	Red & White	137	122	129
	9	White/Brown & Brown/White	118	Red & Green	143	128	133
	10	White/Gray & Gray/White	118	Red & Blue	143	128	135
	11	Red/Blue & Blue/Red	111	Red & Yellow	130	120	133
	12	Red/Orange & Orange/Red	110	Red & Brown	130	117	135
	13	Red/Green & Green/Red	112	Red & Orange	125	110	135
	14	Red/Brown & Brown/Red	110	Green & White	125	117	135
	15	Red/Gray & Gray/Red	110	Green & Blue	130	117	143
	16	Black/Blue & Blue/Black.	113	Green & Yellow	120	120	137
OUTER	17	Black/Orange & Orange/Black	109	Green & Brown	120	115	137
LAYER	18	Black/Green & Green/Black	110	Green & Orange	125	115	135
	19	Black/Brown & Brown/Black	111	White & Blue	128	115	143
	20	Black/Gray & Gray/Black	111	White & Yellow	125	118	148
	21	Yellow/Blue & Blue/Yellow	112	White & Brown	125	117	135
	22	Yellow/Orange & Orange/Yellow	113	White & Orange	120	120	135
	23	Yellow/Green & Green/Yellow	113	Blue & Yellow	130	117	135
	24	Yellow/Brown & Brown/Yellow	110	Blue & Brown	120	115	148
	25	Yellow/Gray & Gray/Yellow	109	Blue & Orange	125	114	135
CORE	MIN.		118		135	119	129
AND	MAX.		125		143	128	140
MIDDLE	RANGE		7		8	9	11
	MIN.		109		120	110	135
OUTER	MAX.		113		130	120	148
LAYER	RANGE		4		10	10	13

TEST METHOD: See Appendix E

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CAPACITANCE (SINGLE ENDED) TEST RESULT COMPARISON

UNIT OF MEASUREMENT: pF/Ft.

		ALL 28 AWG SOLID POLY W/O BUFFER TAPE			ALL 28 AWG FOAM POLY W/O BUFFER TAPE	ALL 28 AWG FOAM POLY W/BUFFER TAPE	28 & 30 AWG FOAM POLY W/O BUFFER TAPE
PAIR LOCATION	PAIR #	CATALOG 16400 COLOR CODE		COLOR CODE	CATALOG 62286	CATALOG 62327	CATALOG 62523
CORE	1	Black & Red	18.45	Black & Red	15.74		14.88
	2	Blue & Yellow	18.36	Black & White	15.91		15.11
	3	Brown & Orange	19.04	Black & Green	15.67		17.00
	4	Green & Violet	19.10	Black & Blue	16.15		15.54
	5	Gray & White	18.91	Black & Yellow	15.65		15.17
MIDDLE	6	White/Blue & Blue/White	18.68	Black & Brown	15.80		15.03
LAYER	7	White/Orange & Orange/White	19.27	Black & Orange	16.12		15.08
	8	White/Green & Green/White	18.68	Red & White	15.92		17.34
	9	White/Brown & Brown/White	19.18	Red & Green	15.24		15.54
	10	White/Gray & Gray/White	18.64	Red & Blue	15.98		15.51
	11	Red/Blue & Blue/Red	23.22	Red & Yellow	20.6		16.08
	12	Red/Orange & Orange/Red	23.59	Red & Brown	19.0		16.77
	13	Red/Green & Green/Red	23.05	Red & Orange	19.9		16.60
	14	Red/Brown & Brown/Red	23.41	Green & White	19.7		16.20
	15	Red/Gray & Gray/Red	22.95	Green & Blue	19.5		15.86
	16	Black/Blue & Blue/Black	23.59	Green & Yellow	19.6		15.97
OUTER	17	Black/Orange & Orange/Black	22.95	Green & Brown	19.3		15.94
LAYER	18	Black/Green & Green/Black	23.36	Green & Orange	20.5		16.46
	19	Black/Brown & Brown/Black	23.27	White & Blue	19.4		15.46
	20	Black/Gray & Gray/Black	23.18	White & Yellow	19.9		15.94
	21	Yellow/Blue & Blue/Yellow	23.23	White & Brown	19.7		16.74
	22	Yellow/Orange & Orange/Yellow	23.23	White & Orange	19.0		16.94
	23	Yellow/Green & Green/Yellow	23.27	Blue & Yellow	19.0		16.37
	24	Yellow/Brown & Brown/Yellow	23.18	Blue & Brown	20.0		15.37
	25	Yellow/Gray & Gray/Yellow	23.59	Blue & Orange	19.6		16.57
CORE	MIN.		18.36		15.24		14.88
AND	MAX.		19.27		16.15		17.34
MIDDLE	RANGE		.91		.91		2.46
	MIN.		22.95		19.00		15.37
OUTER	MAX.		23.59		20.60		16.84
LAYER	RANGE		.64		1.60		1.57

TEST METHOD: See Appendix D

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CAPACITANCE (MUTUAL (COND. TO COND.)) TEST RESULT COMPARISON

UNIT OF MEASUREMENT: pF/Ft.

		ALL 28 AWG SOLID POLY W/O BUFFER TAPE			ALL 28 AWG FOAM POLY W/O BUFFER TAPE	ALL 28 AWG FOAM POLY W/BUFFER TAPE	28 & 30 AWG FOAM POLY W/O BUFFER TAPE
PAIR LOCATION	PAIR #	CATALOG 16400 COLOR CODE		COLOR CODE	CATALOG 62286	CATALOG 62327	CATALOG 62523
CORE	1	Black & Red	11.73	Black & Red	9.90	8.92	9.86
	2	Blue & Yellow	11.86	Black & White	10.00	8.88	9.63
	3	Brown & Orange	12.09	Black & Green	10.13	10.20	10.63
	4	Green & Violet	11.91	Black & Blue	9.99	9.20	10.09
	5	Gray & White	11.95	Black & Yellow	9.91	9.32	10.11
MIDDLE	6	White/Blue & Blue/White	12.09	Black & Brown	9.96	9.44	9.89
LAYER	7	White/Orange & Orange/White	12.18	Black & Orange	10.19	9.48	9.89
	8	White/Green & Green/White	11.95	Red & White	9.93	9.56	10.83
	9	White/Brown & Brown/White	12.05	Red & Green	9.62	9.16	9.97
	10	White/Gray & Gray/White	12.14	Red & Blue	9.94	8.64	9.94
	11	Red/Blue & Blue/Red	13.82	Red & Yellow	11.77	10.04	9.91
	12	Red/Orange & Orange/Red	14.14	Red & Brown	11.05	10.60	9.91
	13	Red/Green & Green/Red	13.73	Red & Orange	11.41	11.00	10.03
	14	Red/Brown & Brown/Red	14.00	Green & White	11.36	10.60	9.60
	15	Red/Gray & Gray/Red	13.82	Green & Blue	11.34	10.60	9.57
	16	Black/Blue & Blue/Black	14.00	Green & Yellow	11.29	10.24	9.66
OUTER	17	Black/Orange & Orange/Black	13.82	Green & Brown	11.18	10.84	9.80
LAYER	18	Black/Green & Green/Black	14.10	Green & Orange	11.82	10.16	10.20
	19	Black/Brown & Brown/Black	14.00	White & Blue	11.28	10.76	9.60
	20	Black/Gray & Gray/Black	14.05	White & Yellow	11.60	10.20	9.46
	21	Yellow/Blue & Blue/Yellow	13.82	White & Brown	11.45	10.88	10.34
	22	Yellow/Orange & Orange/Yellow	13.95	White & Orange	11.14	10.92	10.23
	23	Yellow/Green & Green/Yellow	14.10	Blue & Yellow	10.95	10.68	9.74
	24	Yellow/Brown & Brown/Yellow	13.91	Blue & Brown	11.82	10.76	9.31
	25	Yellow/Gray & Gray/Yellow	14.10	Blue & Orange	11.60	10.64	10.03
CORE	MIN.		11.73		9.62	8.64	9.63
AND	MAX.		12.18		10.19	10.20	10.83
MIDDLE	RANGE		.45		.57	1.56	1.20
	MIN.		13.73		10.95	10.04	9.31
OUTER	MAX.		14.14		11.82	11.00	10.34
LAYER	RANGE		.41		.87	.96	1.03

TEST METHOD: See Appendix D

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DCR OF CONDUCTOR TEST RESULT COMPARISON

UNIT OF MEASUREMENT:

		ALL 28 AWG SOLID POLY W/O BUFFER TAPE			ALL 28 AWG FOAM POLY W/O BUFFER TAPE	ALL 28 AWG FOAM POLY W/BUFFER TAPE	28 & 30 AWG FOAM POLY W/O BUFFER TAPE
PAIR LOCATION	PAIR #	CATALOG 16400 COLOR CODE		COLOR CODE	CATALOG 62286	CATALOG 62327	CATALOG 62523
CORE	1	Black & Red	67.00	Black & Red	64.60	65.20	68.86
	2	Blue & Yellow	67.68	Black & White	65.70	64.08	68.86
	3	Brown & Orange	67.45	Black & Green	67.10	65.40	70.86
	4	Green & Violet	66.96	Black & Blue	65.60	64.64	69.71
	5	Gray & White	66.59	Black & Yellow	64.40	64.72	70.28
MIDDLE	6	White/Blue & Blue/White	66.77	Black & Brown	65.60	65.00	68.86
LAYER	7	White/Orange & Orange/White	67.27	Black & Orange	64.90	65.00	68.86
	8	White/Green & Green/White	66.91	Red & White	64.20	65.72	71.14
	9	White/Brown & Brown/White	67.36	Red & Green	65.80	64.52	70.28
	10	White/Gray & Gray/White	67.14	Red & Blue	64.40	65.28	70.28
	11	Red/Blue & Blue/Red	69.14	Red & Yellow	66.00	66.72	110.00
	12	Red/Orange & Orange/Red	68.32	Red & Brown	65.50	65.76	110.57
	13	Red/Green & Green/Red	69.82	Red & Orange	66.10	66.48	110.00
	14	Red/Brown & Brown/Red	69.50	Green & White	64.40	65.48	113.70
	15	Red/Gray & Gray/Red	69.54	Green & Blue	67.10	65.92	113.14
	16	Black/Blue & Blue/Black	70.77	Green & Yellow	67.00	65.80	113.70
OUTER	17	Black/Orange & Orange/Black	68.68	Green & Brown	67.20	66.12	113.14
LAYER	18	Black/Green & Green/Black	69.36	Green & Orange	65.40	66.40	113.70
	19	Black/Brown & Brown/Black	69.81	White & Blue	64.40	66.76	111.43
	20	Black/Gray & Gray/Black	68.27	White & Yellow	66.00	66.24	112.28
	21	Yellow/Blue & Blue/Yellow	68.68	White & Brown	66.00	66.44	113.14
	22	Yellow/Orange & Orange/Yellow	69.00	White & Orange	67.80	65.96	112.57
	23	Yellow/Green & Green/Yellow	69.86	Blue & Yellow	66.60	66.12	113.14
	24	Yellow/Brown & Brown/Yellow	70.15	Blue & Brown	67.00	66.20	113.14
	25	Yellow/Gray & Gray/Yellow	69.50	Blue & Orange	66.70	66.76	113.14
CORE	MIN.		66.59		64.20	64.08	68.86
AND	MAX.		67.68		67.10	65.72	71.14
MIDDLE	RANGE		1.09		2.90	1.64	2.28
	MIN.		68.27		64.40	65.48	110.00
OUTER	MAX.		70.77		67.80	66.76	113.70
LAYER	RANGE		2.50		3.40	1.28	3.70

TEST METHOD: See Appendix B

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ATTENUATION @ 5MHz TEST RESULT COMPARISON

UNIT OF MEASUREMENT: dB/100 FT.

		ALL 28 AWG SOLID POLY W/O BUFFER TAPE			ALL 28 AWG FOAM POLY W/O BUFFER TAPE	ALL 28 AWG FOAM POLY W/BUFFER TAPE	28 & 30 AWG FOAM POLY W/O BUFFER TAPE
PAIR LOCATION	PAIR #	CATALOG 16400 COLOR CODE			CATALOG 62286	CATALOG 62327	CATALOG 62523
CORE	1	Black & Red		Black & Red			
	2	Blue & Yellow		Black & White			4.9
	3	Brown & Orange		Black & Green			
	4	Green & Violet		Black & Blue	7.6		3.7
	5	Gray & White		Black & Yellow			
MIDDLE	6	White/Blue & Blue/White		Black & Brown			
LAYER	7	White/Orange & Orange/White	3.0	Black & Orange	7.04		
	8	White/Green & Green/White	3.2	Red & White	7.2		
	9	White/Brown & Brown/White	3.2	Red & Green			4.6
	10	White/Gray & Gray/White		Red & Blue			
	11	Red/Blue & Blue/Red		Red & Yellow			
	12	Red/Orange & Orange/Red	2.6	Red & Brown	6.56		
	13	Red/Green & Green/Red		Red & Orange			
	14	Red/Brown & Brown/Red		Green & White			
	15	Red/Gray & Gray/Red	2.7	Green & Blue	7.6		
	16	Black/Blue & Blue/Black		Green & Yellow			
OUTER	17	Black/Orange & Orange/Black		Green & Brown			
LAYER	18	Black/Green & Green/Black		Green & Orange			
	19	Black/Brown & Brown/Black		White & Blue			
	20	Black/Gray & Gray/Black		White & Yellow	5.6		5.0
	21	Yellow/Blue & Blue/Yellow		White & Brown			
	22	Yellow/Orange & Orange/Yellow		White & Orange			
	23	Yellow/Green & Green/Yellow		Blue & Yellow			4.6
	24	Yellow/Brown & Brown/Yellow		Blue & Brown			
	25	Yellow/Gray & Gray/Yellow		Blue & Orange	5.88		
CORE AND MIDDLE	MIN.						
	MAX.						
	RANGE						
OUTER LAYER	MIN.						
	MAX.						
	RANGE						

TEST METHOD: See Appendix C

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ATTENUATION @ 10MHz TEST RESULT COMPARISON

UNIT OF MEASUEMENTS: dB/100 FT.

PAIR LOCATION	PAIR #	ALL 28 AWG SOLID POLY W/O BUFFER TAPE CATALOG 16400 COLOR CODE		COLOR CODE	ALL 28 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62286	ALL 28 AWG FOAM POLY W/BUFFER TAPE CATALOG 62327	28 & 30 AWG FOAM POLY W/O BUFFER TAPE CATALOG 62523
CORE	1	Black & Red		Black & Red			
	2	Blue & Yellow		Black & White			2.9
	3	Brown & Orange		Black & Green			
	4	Green & Violet		Black & Blue			3.7
	5	Gray & White		Black & Yellow			
MIDDLE	6	White/Blue & Blue/White		Black & Brown			
LAYER	7	White/Orange & Orange/White	4.1	Black & Orange			
	8	White/Green & Green/White	8.6	Red & White			
	9	White/Brown & Brown/White	6.5	Red & Green			3.3
	10	White/Gray & Gray/White		Red & Blue			
	11	Red/Blue & Blue/Red		Red & Yellow			
	12	Red/Orange & Orange/Red	5.8	Red & Brown			
	13	Red/Green & Green/Red		Red & Orange			
	14	Red/Brown & Brown/Red		Green & White			
	15	Red/Gray & Gray/Red	5.6	Green & Blue			
	16	Black/Blue & Blue/Black		Green & Yellow			
OUTER	17	Black/Orange & Orange/Black		Green & Brown			
LAYER	18	Black/Green & Green/Black		Green & Orange			
	19	Black/Brown & Brown/Black		White & Blue			
	20	Black/Gray & Gray/Black		White & Yellow			4.4
	21	Yellow/Blue & Blue/Yellow		White & Brown			
	22	Yellow/Orange & Orange/Yellow		White & Orange			
	23	Yellow/Green & Green/Yellow		Blue & Yellow			3.7
	24	Yellow/Brown & Brown/Yellow		Blue & Brown			
	25	Yellow/Gray & Gray/Yellow		Blue & Orange			
CORE AND MIDDLE	MIN.						
	MAX.						
	RANGE						
OUTER LAYER	MIN.						
	MAX.						
	RANGE						

TEST METHOD: See Appendix C

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TIME DELAY (SKEW) TEST RESULT COMPARISON

UNIT OF MEASUEMENTS: nanosec/Ft.

		ALL 28 AWG SOLID POLY W/O BUFFER TAPE			ALL 28 AWG FOAM POLY W/O BUFFER TAPE	ALL 28 AWG FOAM POLY W/BUFFER TAPE	28 & 30 AWG FOAM POLY W/O BUFFER TAPE
PAIR LOCATION	PAIR #	CATALOG 16400 COLOR CODE		COLOR CODE	CATALOG 62286	CATALOG 62327	CATALOG 62523
CORE	1	Black & Red	1.542	Black & Red	1.394	1.388	1.388
	2	Blue & Yellow	1.530	Black & White	1.382	1.380	1.380
	3	Brown & Orange	1.546	Black & Green	1.447	1.346	1.346
	4	Green & Violet	1.548	Black & Blue	1.421	1.390	1.390
	5	Gray & White	1.532	Black & Yellow	1.403	1.356	1.356
MIDDLE	6	White/Blue & Blue/White	1.540	Black & Brown	1.425	1.381	1.381
LAYER	7	White/Orange & Orange/White	1.523	Black & Orange	1.393	1.382	1.382
	8	White/Green & Green/White	1.534	Red & White	1.437	1.382	1.382
	9	White/Brown & Brown/White	1.530	Red & Green	1.401	1.370	1.370
	10	White/Gray & Gray/White	1.544	Red & Blue	1.391	1.391	1.391
	11	Red/Blue & Blue/Red	1.544	Red & Yellow	1.456	1.422	1.422
	12	Red/Orange & Orange/Red	1.552	Red & Brown	1.428	1.365	1.365
	13	Red/Green & Green/Red	1.537	Red & Orange	1.443	1.359	1.359
	14	Red/Brown & Brown/Red	1.550	Green & White	1.448	1.350	1.350
	15	Red/Gray & Gray/Red	1.537	Green & Blue	1.441	1.376	1.376
	16	Black/Blue & Blue/Black	1.544	Green & Yellow	1.440	1.370	1.370
OUTER	17	Black/Orange & Orange/Black	1.551	Green & Brown	1.421	1.364	1.364
LAYER	18	Black/Green & Green/Black	1.541	Green & Orange	1.431	1.358	1.358
	19	Black/Brown & Brown/Black	1.548	White & Blue	1.465	1.358	1.358
	20	Black/Gray & Gray/Black	1.555	White & Yellow	1.462	1.368	1.368
	21	Yellow/Blue & Blue/Yellow	1.550	White & Brown	1.454	1.367	1.367
	22	Yellow/Orange & Orange/Yellow	1.543	White & Orange	1.454	1.358	1.358
	23	Yellow/Green & Green/Yellow	1.537	Blue & Yellow	1.421	1.373	1.373
	24	Yellow/Brown & Brown/Yellow	1.539	Blue & Brown	1.424	1.397	1.397
	25	Yellow/Gray & Gray/Yellow	1.548	Blue & Orange	1.463	1.369	1.369
MINIMUM			1.523		1.382	1.346	1.346
MAXIMUM			1.555		1.465	1.422	1.422
RANGE			.032		.083	.076	.076
AVERAGE			1.542		1.430	1.373	1.373

TEST METHOD: See Appendix A

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APPENDIX A

TIME DELAY MEASUREMENT

Equipment: H.P. 8753A Network Analyzer
H.P. 85044A Transmission/Reflection Test Set

Sample Requirement: 10 Feet

Sample Preparation:

1. Remove outer jacket approximately 2 inches from one end. Ihielded, push the shield back and pigtail.

2. Remove 1/2" of insulation from one end of the conductors in the cable.

Test Theory:

Velocity of propagation = The % Vp was determined by finding the half-wave resonant frequency in MHz on a 10 ft. sample and computing the % Vp using the following formula.

% Vp = Half-wave length x 2.032

$$TD = \frac{1.0167 \times 100}{Vp}$$

TD = Time delay in ns/Ft.
Vp = Velocity of propagation

Test Procedure:

1. Proper calibration of equipment is required. Set test frequency from 10MHz to 100MHz.

2. Connect pair being tested to the test fixture. Allow all others to remain open.

3. Use marker knob to read. Phase angle equals zero. Record half-wave frequency at that point.

4. Calculate time delay using formulas above.

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APPENDIX B

DC RESISTANCE MEASUREMENT

Equipment: H.P. 4262A LCR Meter

Sample: 25 Feet

Sample Preparation:

1. From each end of the cable remove 2 inches of outer jacket. If shielded, push the shield back and pigtail.

2. Remove 1/2 inch of insulation from both ends of conductors in the cable.

Test Procedure:

1. Set the switches on the front panel as follows:

   a. Function: R
   b. Loss: D
   c. DC Bias: Off
   d. Circuit Mode: Auto
   e. D/Q Range: Auto
   f. Trigger: Int
   g. Test Signal: 10KHz

2. Connect one end of sample to positive terminal and other end to negative terminal.

4. Take LCR display and divide by length of sample.

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APPENDIX C

ATTENUATION MEASUREMENT

Equipment: H.P. 8753A Network Analyzer
H.P. 85044A Transmission/Reflection Test Set
Transformer

Sample Requirement: 25 Feet

Sample Preparation:

1. Remove outer jacket approximately 2 inches from both ends. If shielded, push the shield back and pigtail.

2. Remove 1/2 inch of insulation from both ends of conductors in the cable.

Test Procedure:

1. Proper calibration of equipment is required. Set range of desired test frequency.

2. Connect pair being tested to the test fixture; allow all others to remain open.

3. Turn frequency knob to required test frequency and read dB per length in upper right corner of screen.

Calculate:
dB/100' = multiply reading by 4.

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APPENDIX D

CAPITANCE MEASUREMENT

Equipment: Model 4262A LCR Meter

Sample Length: 10 Feet

Sample Preparation:

1. From one end, remove 2 inches of outer jacket.
2. Remove 1/2 inch of insulation from one end of conductors in the cable.

Test Procedure:

1. Set the switches on the front panel as follows:

a.	Function:	C
b.	Loss:	D
c.	DC Bias:	Off
d.	Circuit Mode:	Auto
e.	D/Q Range:	Auto
f.	Trigger:	Int
g.	Test Signal:	10KHz

2. Adjust C zero Adj control for 000 counts on LCR display, if necessary.
3. Connect sample to terminal (one conductor of twisted pair to positive terminal and other to negative terminal).
4. Take LCR display and divide by length of sample.

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APPENDIX E

IMPEDANCE MEASUREMENT

Equipment: Tektronix 1502 TDR

Sample Requirement: 10 Feet

Sample Preparation:

1. From one end, remove 2 inches of outer jacket.
2. Remove 1/2" of insulation from one end of conductors in the cable.

Test Procedure:

1. Proper calibration and setting of equipment are required.
2. Connect pair being tested to the test fixture as follows:

   Differential Impedance = One conductor of twisted pair to positive terminal and other to negative terminal. Allow all others to remain open.

   Single Ended Impedance =
   1. Randomly select one conductor of each pair, tie together to overall shield (ground).
   2. Measurement is taken between remaining conductors in the pairs to ground.

3. Record p and calculate impendance as follows:

$$Z = Zo \left(\frac{1-p}{1+p}\right)$$

Where Zo = 50 ohms

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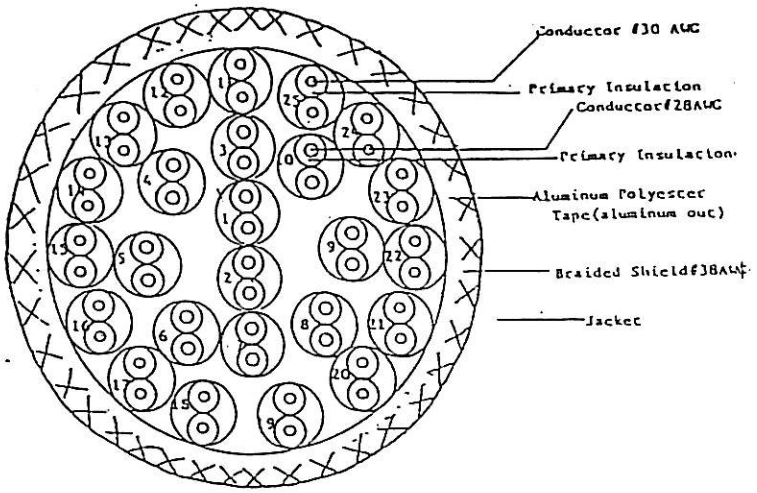
APPENDIX F

FIGURE 1

25 TWISTED PAIRS



COLOR CODE FOR CATALOG #62327, 62323, 62206

1. Black & red
2. Black & white
3. Black & green
4. Black & blue
5. Black & yellow
6. Black & brown
7. Black & orange
8. Red & white
9. Red & green
10. Red & blue
11. Red & yellow
12. Red & brown
13. Red & orange
14. Green & white
15. Green & blue
16. Green & yellow
17. Green & brown
18. Green & orange
19. White & blue
20. White & yellow
21. White & brown
22. White & orange
23. Blue & yellow
24. Blue & brown
25. Blue & orange

COLOR CODE FOR CATALOG 16400

1. Black & red
2. Blue & yellow
3. Brown & orange
4. Green & violet
5. Gray & white
6. White/blue & blue/white
7. White/orange & orange/white
8. White/green & green/white
9. White/brown & brown/white
10. White/gray & gray/white
11. Red/blue & blue/red
12. Red/orange & orange/red
13. Red/green & green/red
14. Red/brown & brown/red
15. Red/gray & gray/red
16. Black/blue & blue/black
17. Black/orange & orange/black
18. Black/green & green/black
19. Black/brown & brown/black
20. Black/gray & gray/black
21. Yellow/blue & blue/yellow
22. Yellow/orange & orange/yellow
23. Yellow/green & green/yellow
24. Yellow/brown & brown/yellow
25. Yellow/gray & gray/yellow

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