MARK 5 MEMO #069

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To: Mark 5 Development Group

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Subject: Temperature coefficients for LMR-400, LMR-400 ultraflex and LMR-240

Times microwave LMR-400 and LMR-240 were measured at 5 and 10 MHz over a range from 75 to 120 F using the Timing system TSC5115A phase comparator.

The following results were obtained:

Freq MHz	Cable	Temp Co ppm/K	Loss dB/100m	Effect of internal inductance	Expected ppm/K
10	LMR-400	-11±3	1.2	11	-13
10	LMR-240	0±3	2.3	21	-3
5	LMR-400	0.5±3	0.8	15	-9
5	LMR-240	17±6	1.7	32	8
5	LMR-400 UF	9±1	1.1	-	-

I also show the expected temperature coefficient due to the change of internal inductance from the theory of memo #67 plus a correction of -24 ppm/K for the change in dielectric which is assumed to be a constant and not change with frequency. The LMR400 is the "ideal" cable for 5 MHz distribution while LMR240 is best for 10 MHz.

In Nov 2009 the temperature coefficient of LMR-400 Ultraflex was measured at 5 MHz and found to be 9±1 ppm/K of the cable delay. The thermal time constant was found to be about 30 minutes. The delay change which resulted from bending the cable into a loop of 3 inch radius was found to be under 0.5 ps. The larger temperature coefficient of the ultraflex compared with the standard LMR-400 is likely to be due to the effect of the internal inductance which is likely to be larger since the center conductor is made of many smaller conductors stranded together. The theory of the internal inductance of this type of conductor is unclear so I have left the expected temperature coefficient column blank. The temperature coefficient of 9 ppm/K corresponds to about 3 ps/degC in 100 meters of cable.