

TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: TF FLAT TOP TIME LIMITATIONS

In order to reduce the risk of TF water leaks, it has been decided to limit the operation of the TF system in such a way that the peak current and flat top time are only as high as they need be to satisfy the minimum components of the near term mission. It is been judged that a peak field of 4.5kG and a maximum adiabatic temperature rise of 30°C are appropriate limits to impose at this time.

On this basis the maximum prospective $\int i^2(t)dt$ needs to be limited to $2.64 \times 10^9 \text{A}^2\text{-sec}$. To ensure that this level is not exceeded even at the maximum permitted current, the I2T protective device must be set to trip with anticipation of the L/R decay from that current. Furthermore, to avoid a trip of the protective device during each pulse, the nominal waveform must be design such that, following the current shutdown driven by the power supply, the final $\int i^2(t)dt$ value does not exceed the trip setting.

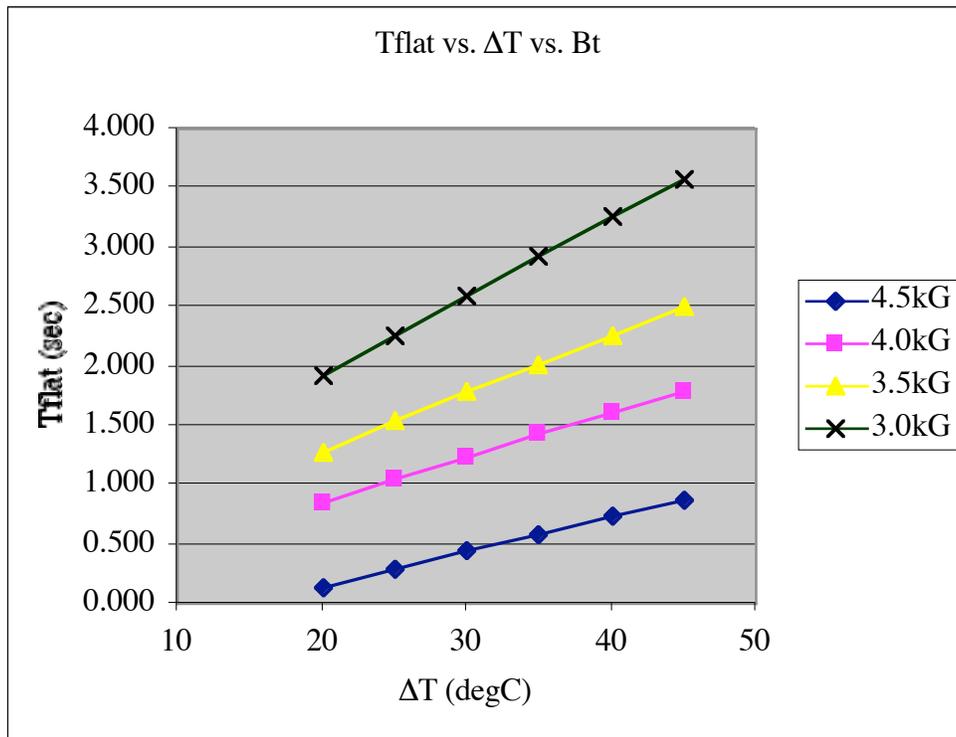
Relevant calculations are given in the following table. It is noted that the RIS I2T setting shall be $1.85 \times 10^9 \text{A}^2\text{-sec}$, and that at 4.5kG the available flat top time is 442mS. This could be increased to approximately 500mS without exceeding the thermal limit but the protective device would then trip every pulse. Furthermore, it is noted that if we do not experience a trip from full current, then the ΔT will only be around 20°C.

Iflat	53400	Amp
Tau	0.369	sec
ΔT_{allow}	30	degC
T0	12	degC
Tallow	42	degC
Gallow	8.3488×10^{15}	$(\text{A/m}^2)^2\text{-sec}$
G0	2.53×10^{15}	$(\text{A/m}^2)^2\text{-sec}$
ΔG_{allow}	5.82×10^{15}	$(\text{A/m}^2)^2\text{-sec}$
I2Tallow	2.64×10^9	$\text{A}^2\text{-sec}$
Trise	0.361	sec
I2T Rise	4.31×10^8	$\text{A}^2\text{-sec}$
I2T L/R	7.98×10^8	$\text{A}^2\text{-sec}$
I2Tflatmax	1.42×10^9	$\text{A}^2\text{-sec}$
Tflatideal	4.96×10^{-1}	sec
I2TEOFT (Trip)	1.85×10^9	$\text{A}^2\text{-sec}$
Tfall	0.246	sec
I2T Fall	1.55×10^8	$\text{A}^2\text{-sec}$
I2Tflat no-trip	1.26×10^9	$\text{A}^2\text{-sec}$
Tflatmax no-trip	0.442	sec
Nominal I2T	1.85×10^9	$\text{A}^2\text{-sec}$
TEOP nominal	3.25×10^1	degC
ΔT nominal	2.05×10^1	degC

Available flat top times at other field levels are given in the following table and figure.

Tflat (sec) vs. Bt vs. ΔT (degC)

ΔTmax (degC)	20	25	30	35	40	45
4.5kG	0.142	0.293	0.442	0.588	0.733	0.875
4.0kG	0.855	1.046	1.234	1.419	1.602	1.782
3.5kG	1.283	1.533	1.779	2.021	2.259	2.494
3.0kG	1.924	2.264	2.598	2.928	3.252	3.572



cc:

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