Customer Waveforms

I_1 = 42A

V_1 = 8V

I2 = 16A

0V

0A

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SOA Analysis

- Linear approximations for voltage and current:
  - $v_{DS}(t)=V_1\times(1-t/t_2)$
  - $i_{DS1}(t)=I_1\times t/t_1$, $0<t<t_1$
  - $i_{DS2}(t)=I_1-(t_1-t)\times(I_2-I_1)/(t_2-t_1)$, $t_1<t<t_2$
- Power calculations:
  - $p_1(t)=v_{DS}(t)\times i_{DS1}(t)= V_1\times(1-t/t_2)\times I_1\times t/t_1$, $0<t<t_1$
  - $p_2(t)=v_{DS}(t)\times i_{DS2}(t)= V_1\times(1-t/t_2)\times(I_1-(t_1-t)\times(I_2-I_1)/(t_2-t_1))$, $t_1<t<t_2$
- Energy calculations (from Mathcad):

$$E_{.1}=\int_0^{t_{.1}} V_{.1}\cdot\left(1-\frac{t}{t_{.2}}\right)\cdot\left(I_{.1}\cdot\frac{t}{t_{.1}}\right)dt+\int_{t_{.1}}^{t_{.2}} V_{.1}\cdot\left(1-\frac{t}{t_{.2}}\right)\cdot\left[I_{.1}-\left(t_{.1}-t\right)\cdot\frac{\left(I_{.2}-I_{.1}\right)}{t_{.2}-t_{.1}}\right]dt$$

$$E_{.1}=\frac{V_{.1}\cdot\left(t_{.1}-t_{.2}\right)^2\cdot\left(2\cdot I_{.1}+I_{.2}\right)}{6\cdot t_{.2}}-\frac{I_{.1}\cdot V_{.1}\cdot t_{.1}\cdot\left(2\cdot t_{.1}-3\cdot t_{.2}\right)}{6\cdot t_{.2}}$$

$$E_{.1}=0.197$$

$$t_{.EQ}:=\frac{E_{.1}}{V_{.1}\cdot I_{.1}}$$

$$t_{.EQ}=584.921\times 10^{-6}$$

SOA Analysis (cont'd)

- SOA estimates for shorter pulse width and elevated case temperature (from Excel):

Enter application conditions		
PN	CSD18531Q5A	
V_{DS} (V)	8.0	
PW (ms)	0.59	
TC (°C)	75	
Enter datasheet SOA currents		
PW (ms)	ID (A)	
100.00	7.540	
10.00	28.440	
1.00	69.220	t2
0.10	210.480	t1
0.01	400.000	
m	-0.48297924	
a	69.22	
SOA at PW	89.67894238	
SOA at TC	53.80736543