CALCULATING METHOD FOR THE POWER DISSIPATION OF N5100

INTRODUCTION

This document is introduced the calculating method of the power dissipation. The power dissipation is defined N5100 working at normal operation with fully output load condition, The power dissipation Pd(total) calculation is included a total input power ,a total output power and the sink power dissipation Psink , then the total input power is multiplier of the voltage of supply voltage pin VCC and the current flows into VCC pin. The above powers are calculated with the following equations.

Total input power Pin =VCC x ICC
Total power dissipation Pd(total)= Pin –Pout+Psink
Total output power Pout =PoutA+PoutB+PoutC+PoutD

The outputs of N5100 are driving the power MOSFETs for the CCFL inverter application, as we know, each charge energy will be equal to discharge energy, assume charge period is from 0 to T1, the voltage will be charged from 0 to V during 0 ~T1, discharge period is from T2 to T3, then the voltage will be discharged from V to 0 during T2 ~T3, the period between T1 to T2 is stopping charge and discharge operation, the whole switching period is expressed with T.

$$\triangle Q_{charge} = -\triangle Q_{discharge}$$

$$\triangle Q_{charge} = \int_0^{T1} i_{CHG} * dt = \int_0^{V} C * dv$$

$$\triangle Q_{discharge} = \int_{T2}^{T3} i_{DIS} * dt = \int_V^{0} C * dv = -\triangle Q_{charge}$$

$$= -\int_0^{T1} i_{CHG} * dt = \quad = \int_0^{T1} (-i_{CHG}) * dt$$

$$\text{RMS of } [I_{CHG}] = \sqrt{(1/T) \int_{0}^{T1} (i_{CHG})^2 * dt} = \sqrt{(1/T) \int_{T2}^{T3} (i_{DIS})^2 * dt}$$

$$= \text{RMS of } [I_{DIS}]$$

then ,

PoutA =0.5 xI outA(rms)_a x V outA(rms)
PoutB =0.5 xI outB(rms)_a x V outB(rms)
PoutC =0.5 xI outC(rms)_a x V outC(rms)
PoutD =0.5 xI outD(rms)_a x V outD(rms)

TEST CONNECTION

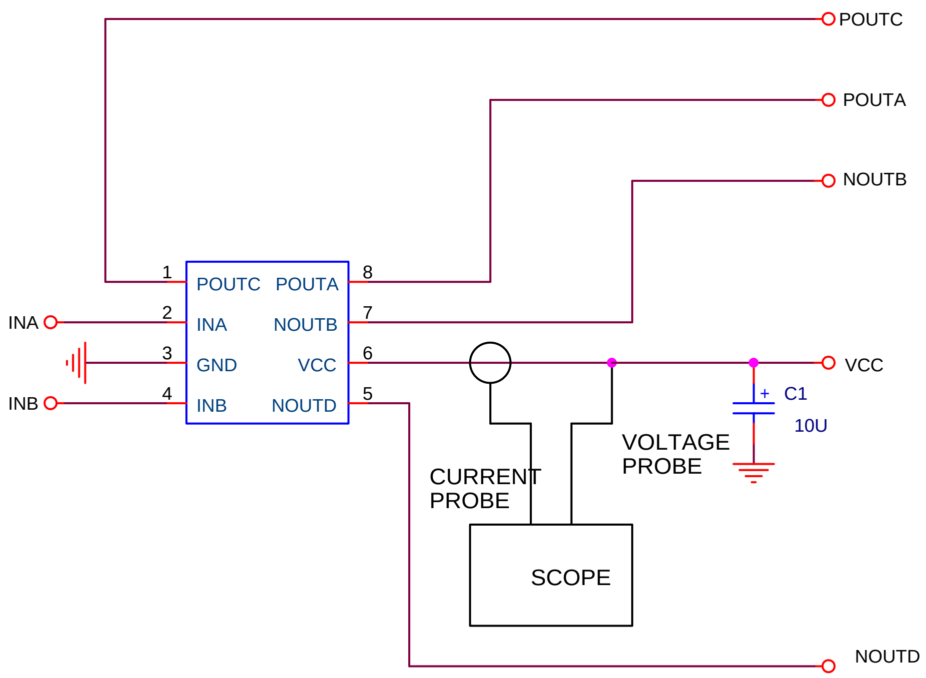

FIG. 1 test connection

CALCULATING METHODE

Refer to FIG.1 test connection, first step is to measure the input current ICC flows into VCC pin and voltage at supply voltage pin VCC with a current probe and voltage probe, the current probe and voltage probe are contented to a scope, set the current and voltage measurement by RMS value and set the third waveform by math result from multiplier of the voltage and the current of RMS, second step is move current probe and voltage probe to each output to measure the voltage and current of each output.

For example, see FIG. 2 are the supply voltage and current waveform that measured from an embodiment application circuit.

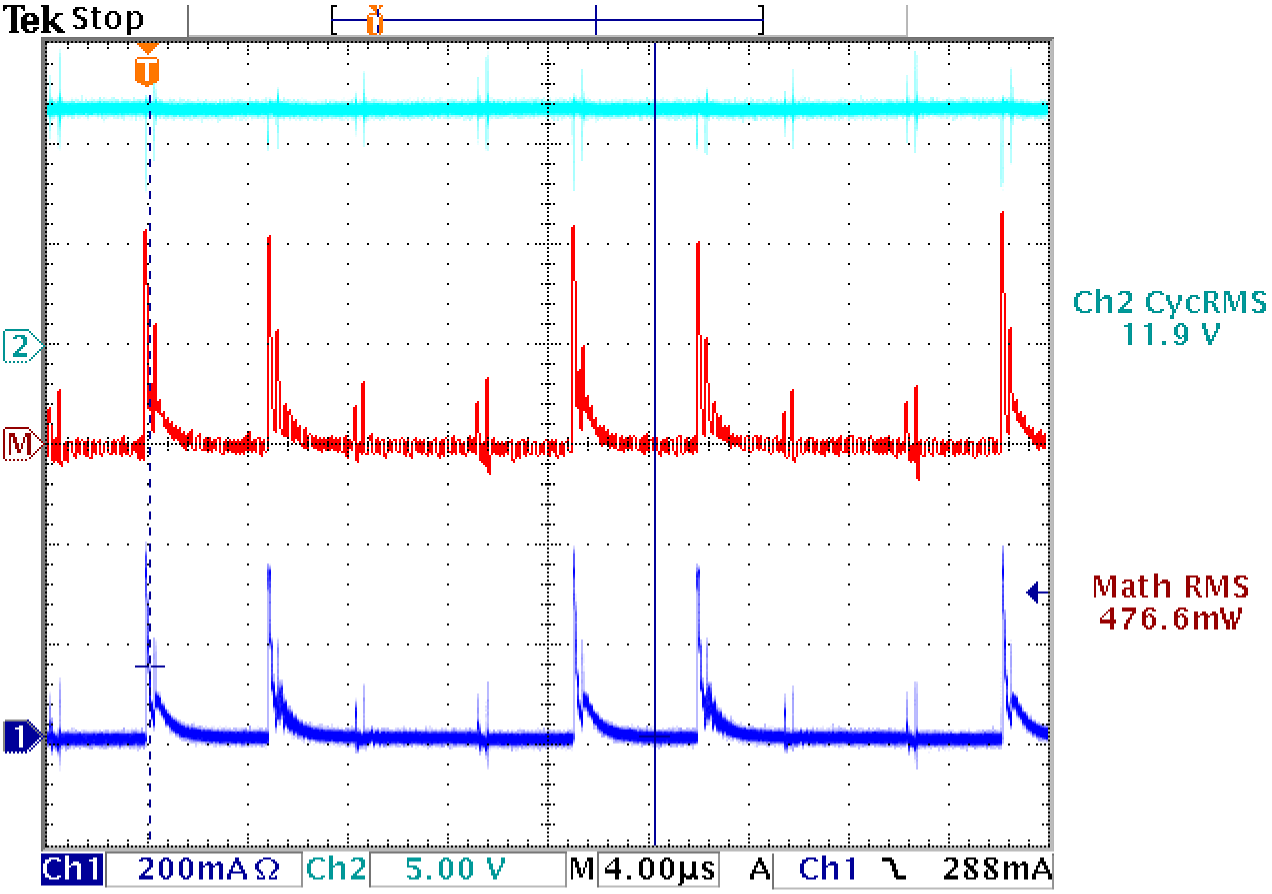

FIG. 2

The total input power Pin =VCC x ICC = 476.6mW

See FIG. 3 are the voltage and current waveform of output A that measured from an embodiment application circuit.

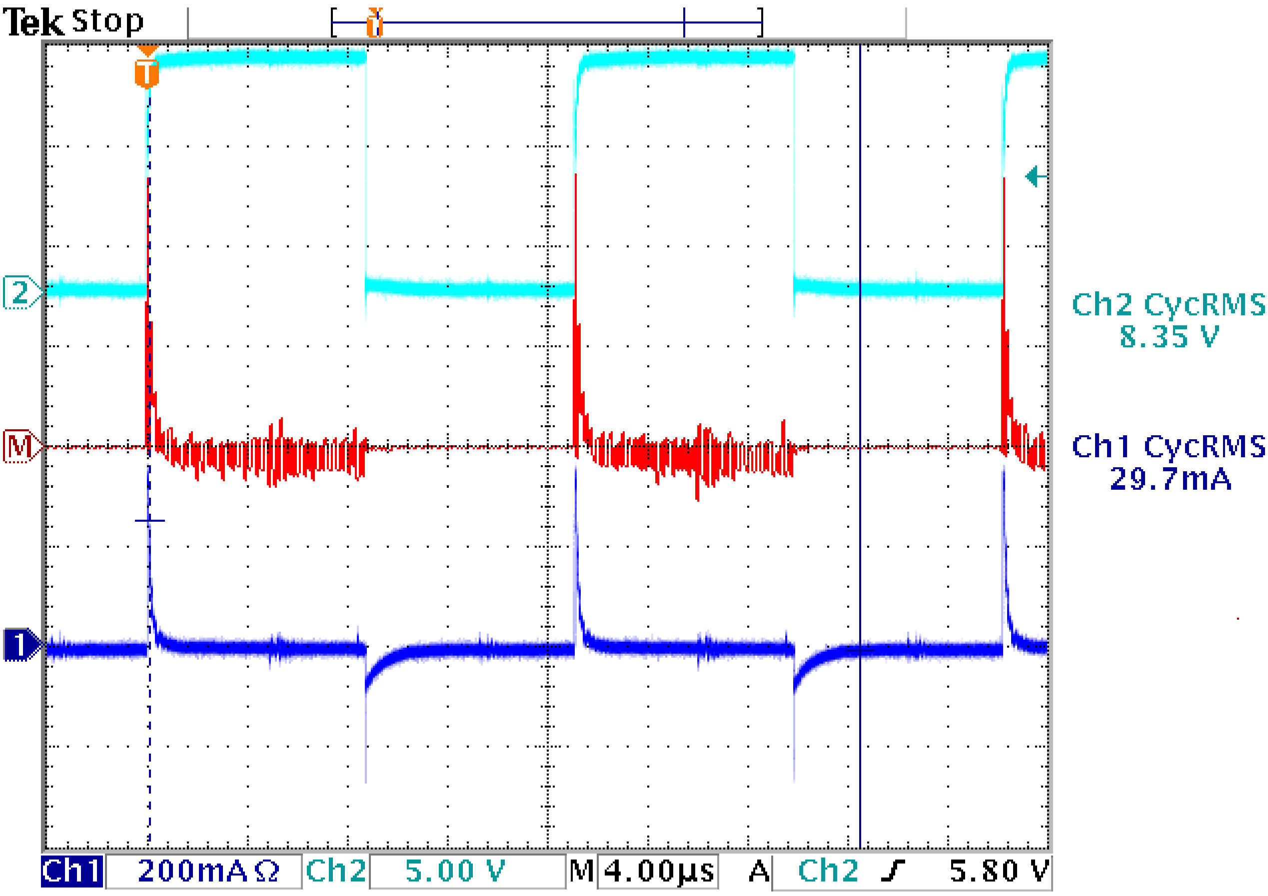

FIG. 3

The PoutA =0.5 xI outA(rms)_a x V outA(rms)
= 0.5x29.7mAx8.35V
=124mW

See FIG. 4 are the voltage and current waveform of output B that measured from an embodiment application circuit.

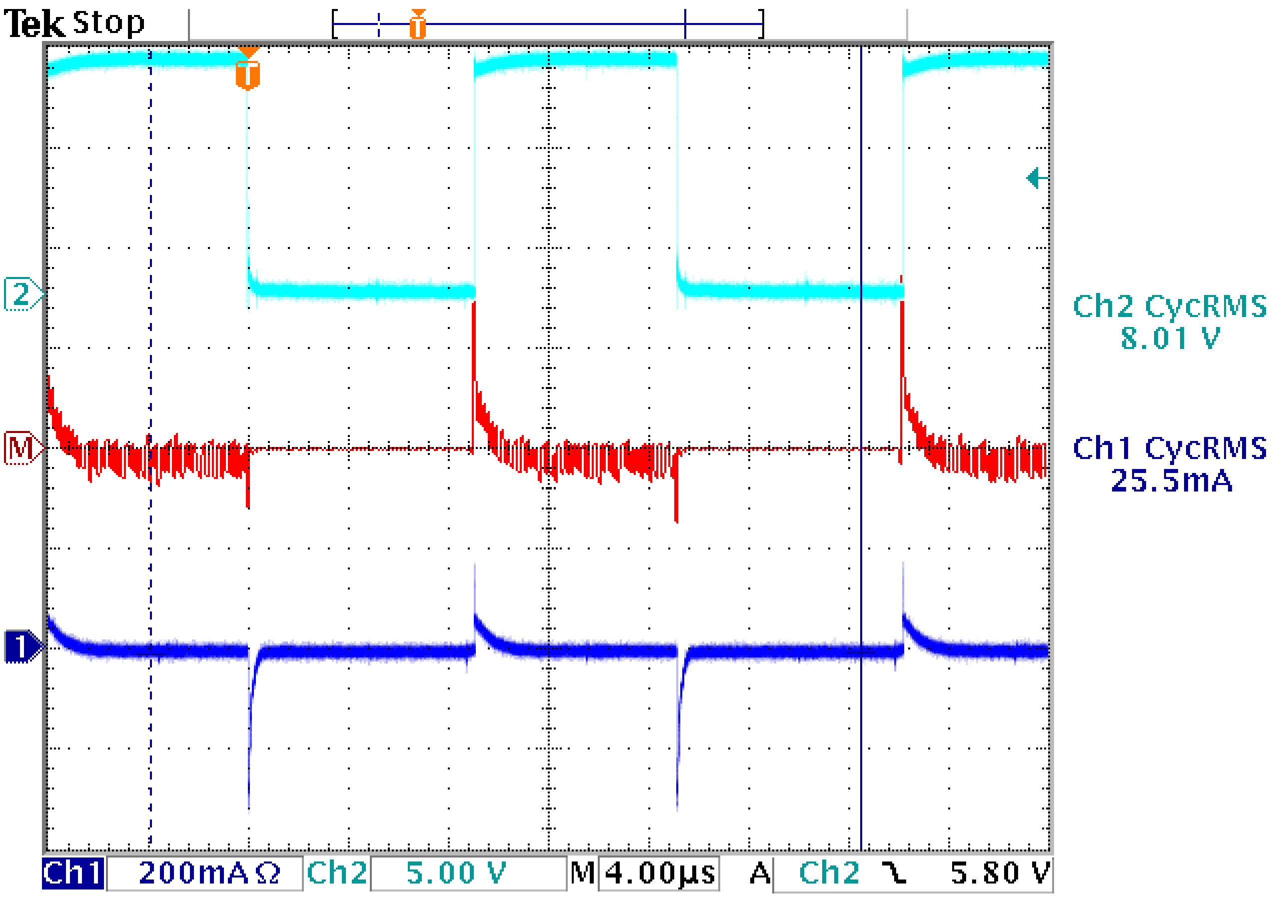

FIG. 4

The PoutB =0.5 xI outB(rms)_a x V outB(rms)

= 0.5x25.5mAx8.01V

=102.1mW

See FIG. 5 are the voltage and current waveform of output C that measured from an embodiment application circuit.

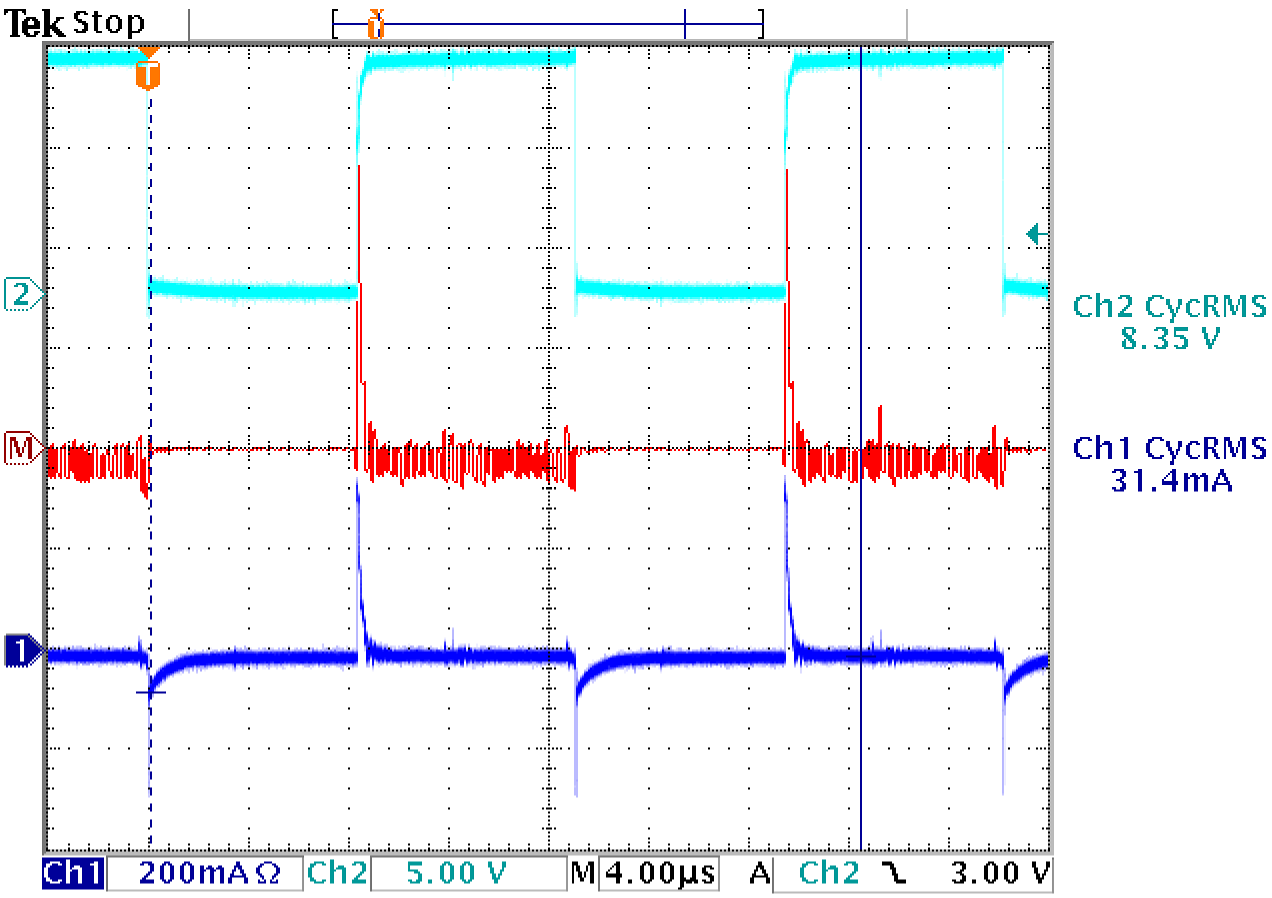

FIG. 5

The PoutC =0.5 xI outC(rms)_a x V outC(rms)

= 0.5x31.4mAx8.35V

=131.1mW

See FIG. 6 are the voltage and current waveform of output D that measured from an embodiment application circuit.

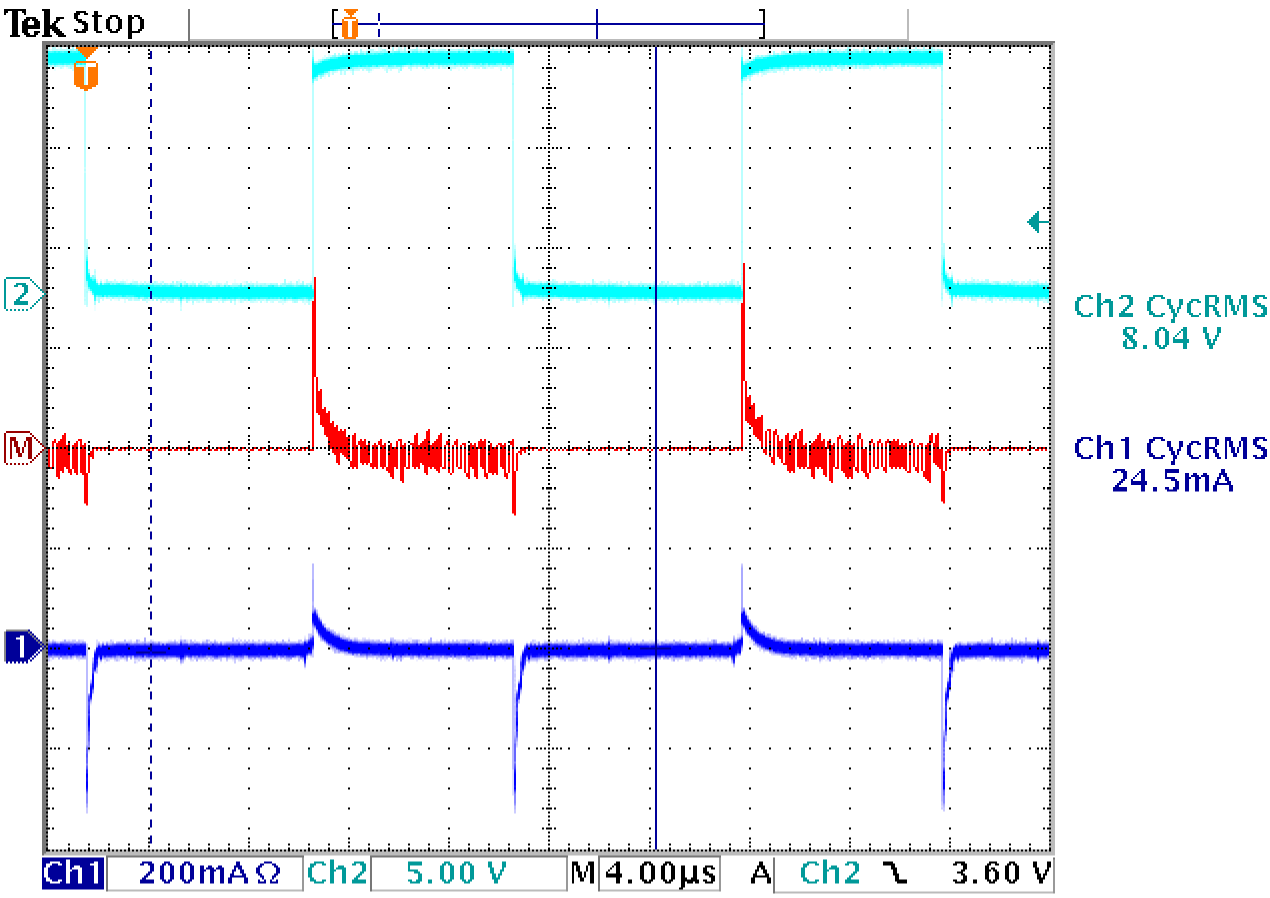

FIG. 6

The PoutD =0.5 xI outD(rms)_a x V outD(rms)

= 0.5x24.5mAx8.04V

=98.5mW

Total output power Pout =PoutA+PoutB+PoutC+PoutD

=124mW+102.1mW+131.1mW+98.5mW

= 455.7mW

Total power dissipation Pd(total)= Pin –Pout –Psink

because △Qcharge = -△Qdischarge

So Psink =Rn/ (Rn+RG) x PoutA,B,C,D = 4/(4+5)x(131.1+124)+4/(4+3)x(102.1+98.5)

=113.4+114.6=228mW

---------- P-channel MOSFET $R_G = 5\Omega$,and N-channel MOSFET $R_G = 3\Omega$,Rn is the internal resistance of N5100

Total power dissipation Pd(total)= Pin –Pout +Psink
= 476.6-455.7+228
= 248.9mW

Otherwise, in accordance with the value of The total power dissipation ($P_{D(TOTAL)}$) ,we also can be calculated the value of derating of power dissipation by:

The derating of power dissipation = Power dissipation ($P_{D(TOTAL)}$ / maximum rating of power dissipation (PD(MAX))
= 248.9/725
=34.3%