



# Thyristor Module

$V_{RRM} = 1200\text{ V}$

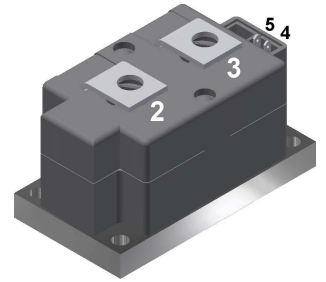
$I_{TAV} = 560\text{ A}$

$V_T = 1.01\text{ V}$

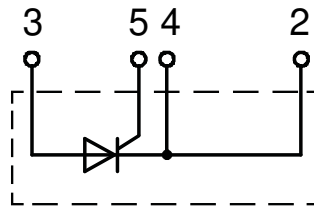
## Single Thyristor

Part number

**MCO500-12io1**



Backside: isolated



### Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al<sub>2</sub>O<sub>3</sub>-ceramic

### Applications:

- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

### Package: Y1

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling

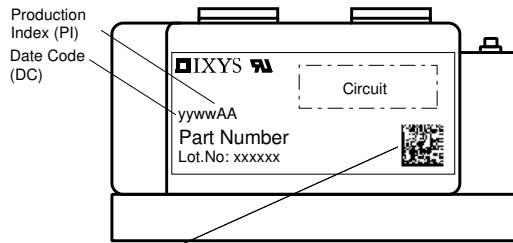
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Thyristor			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1300	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1200	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1200 V$	$T_{VJ} = 25^{\circ}C$		2	mA
		$V_{R/D} = 1200 V$	$T_{VJ} = 125^{\circ}C$		40	mA
$V_T$	forward voltage drop	$I_T = 500 A$	$T_{VJ} = 25^{\circ}C$		1.08	V
		$I_T = 1000 A$			1.27	V
		$I_T = 500 A$	$T_{VJ} = 125^{\circ}C$		1.01	V
		$I_T = 1000 A$			1.24	V
$I_{TAV}$	average forward current	$T_C = 85^{\circ}C$	$T_{VJ} = 140^{\circ}C$		560	A
$I_{T(RMS)}$	RMS forward current	180° sine			880	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 140^{\circ}C$		0.80	V
$r_T$	slope resistance				0.38	mΩ
$R_{thJC}$	thermal resistance junction to case				0.072	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.024		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}C$		1600	W
$I_{TSM}$	max. forward surge current	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		17.0	kA
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		18.4	kA
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		14.5	kA
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		15.6	kA
$I^2t$	value for fusing	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		1.45	MA <sup>2</sup> s
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		1.40	MA <sup>2</sup> s
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		1.04	MA <sup>2</sup> s
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		1.01	MA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400 V \quad f = 1 \text{ MHz}$	$T_{VJ} = 25^{\circ}C$		876	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30 \mu s$	$T_C = 140^{\circ}C$		120	W
		$t_p = 300 \mu s$			60	W
$P_{GAV}$	average gate power dissipation				20	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 140^{\circ}C; f = 50 \text{ Hz}$	repetitive, $I_T = 1500 A$		100	A/μs
		$t_p = 200 \mu s; di_G/dt = 1 A/\mu s;$	non-repet., $I_T = 500 A$		500	A/μs
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$	$T_{VJ} = 140^{\circ}C$		1000	V/μs
		$R_{GK} = \infty; \text{method 1 (linear voltage rise)}$				
$V_{GT}$	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		2	V
			$T_{VJ} = -40^{\circ}C$		3	V
$I_{GT}$	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		300	mA
			$T_{VJ} = -40^{\circ}C$		400	mA
$V_{GD}$	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 140^{\circ}C$		0.25	V
$I_{GD}$	gate non-trigger current				10	mA
$I_L$	latching current	$t_p = 30 \mu s$	$T_{VJ} = 25^{\circ}C$		400	mA
		$I_G = 1 A; di_G/dt = 1 A/\mu s$				
$I_H$	holding current	$V_D = 6 V \quad R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		300	mA
$t_{gd}$	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}C$		2	μs
		$I_G = 1 A; di_G/dt = 1 A/\mu s$				
$t_q$	turn-off time	$V_R = 100 V; I_T = 500 A; V = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}C$		350	μs
		$di/dt = 10 A/\mu s \quad dv/dt = 50 V/\mu s \quad t_p = 200 \mu s$				



Package Y1			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$I_{RMS}$	RMS current	per terminal			600	A
$T_{VJ}$	virtual junction temperature		-40		140	°C
$T_{op}$	operation temperature		-40		125	°C
$T_{stg}$	storage temperature		-40		125	°C
<b>Weight</b>				650		g
$M_D$	mounting torque		4.5		7	Nm
$M_T$	terminal torque		11		13	Nm
$d_{Spp/App}$	creepage distance on surface   striking distance through air	terminal to terminal	16.0			mm
$d_{Spb/Apb}$		terminal to backside	25.0			mm
$V_{ISOL}$	isolation voltage	t = 1 second	3600			V
		t = 1 minute	3000			V



Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCO500-12io1	MCO500-12io1	Box	2	463728

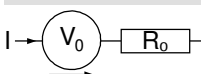
Similar Part	Package	Voltage class
MCO500-14io1	Y1-2-CU	1400
MCO500-16io1	Y1-2-CU	1600
MCO500-18io1	Y1-2-CU	1800
MCO600-20io1	Y1-2-CU	2000

MCO600-22io1	Y1-2-CU	2200
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**Equivalent Circuits for Simulation**

\* on die level

$T_{VJ} = 140^{\circ}C$

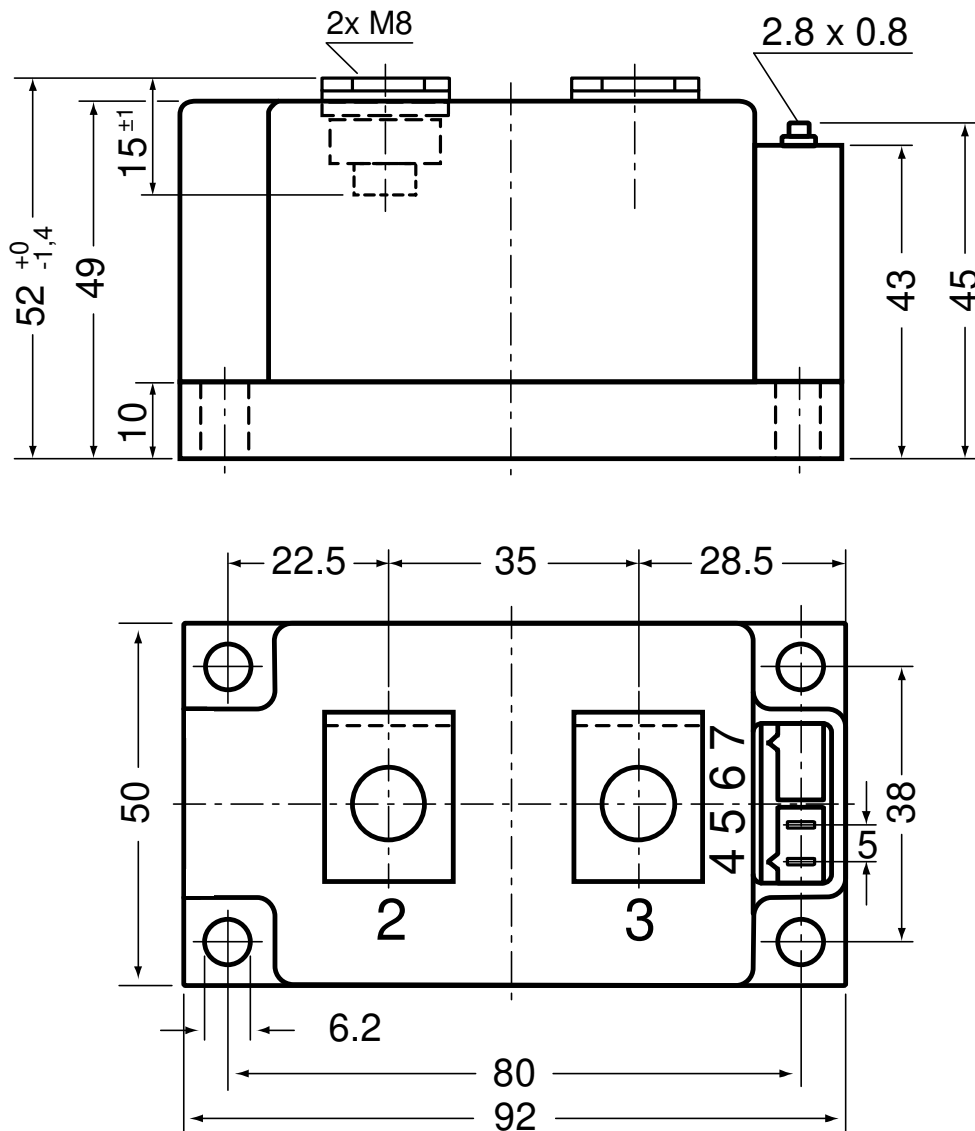


Thyristor

$V_{0\ max}$	threshold voltage	0.8	V
$R_{0\ max}$	slope resistance *	0.22	mΩ

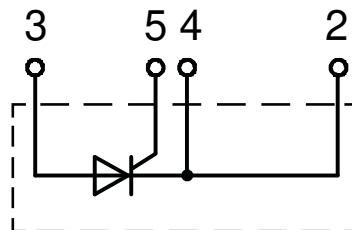


**Outlines Y1**



**Optional accessories for modules**

Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red  
 Type ZY 180L (L = Left for pin pair 4/5) UL 758, style 3751



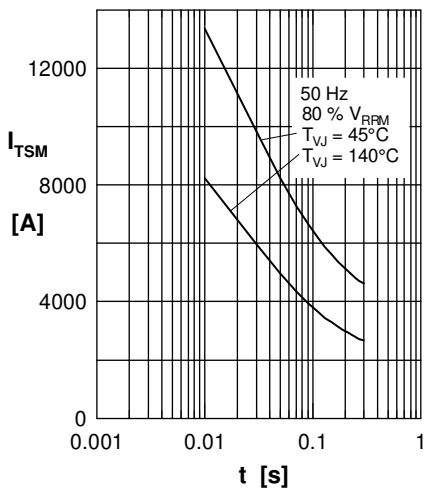
**Thyristor**


Fig. 1 Surge overload current  
 $I_{TSM}$ : Crest value,  $t$ : duration

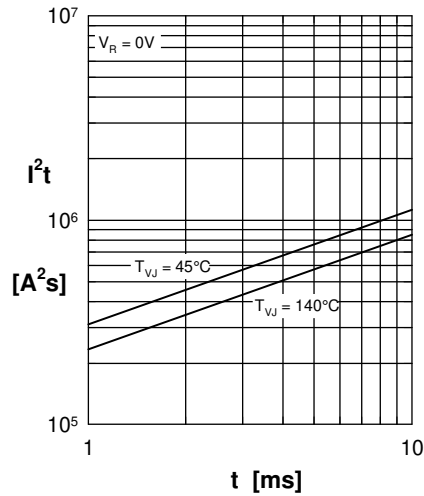


Fig. 2  $I^2t$  versus time (1-10 ms)

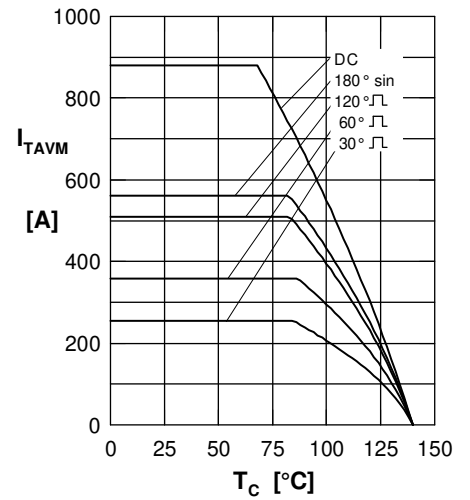


Fig. 3 Maximum forward current at case temperature

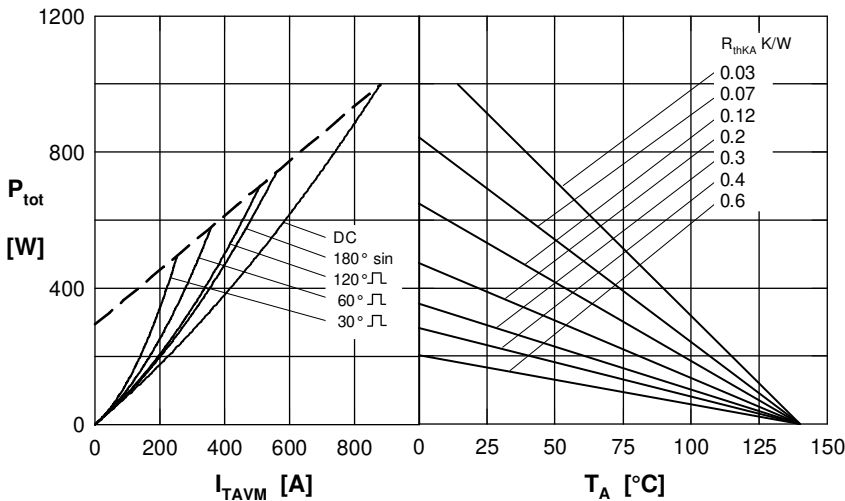


Fig. 4 Power dissipation versus on-state current & ambient temperature

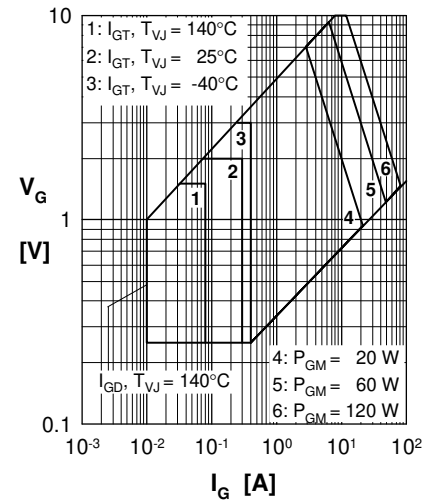


Fig. 5 Gate trigger characteristics

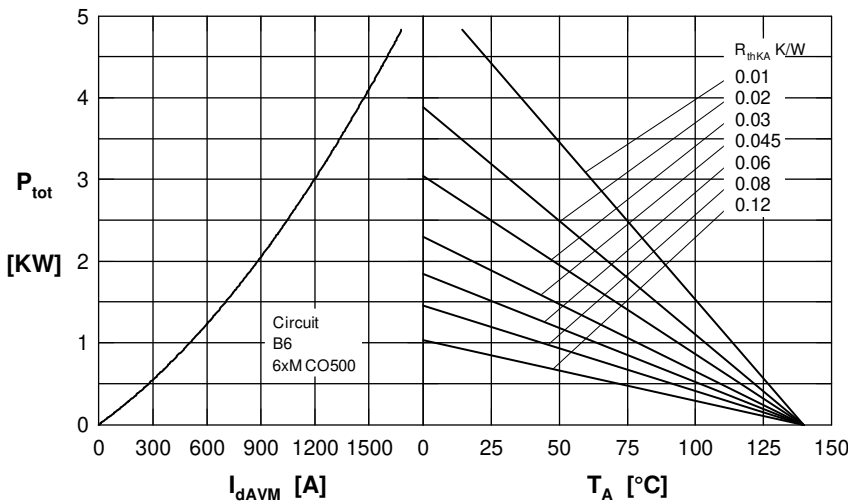


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

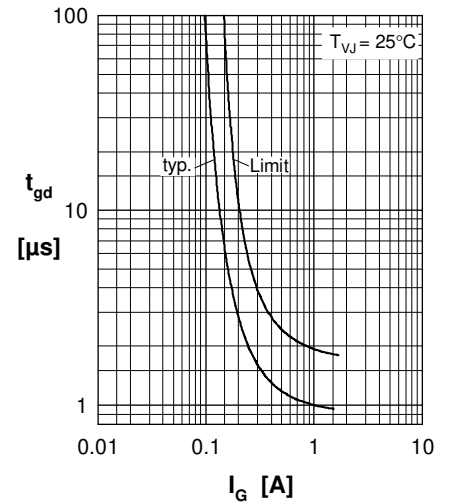


Fig. 7 Gate trigger delay time



**Thyristor**

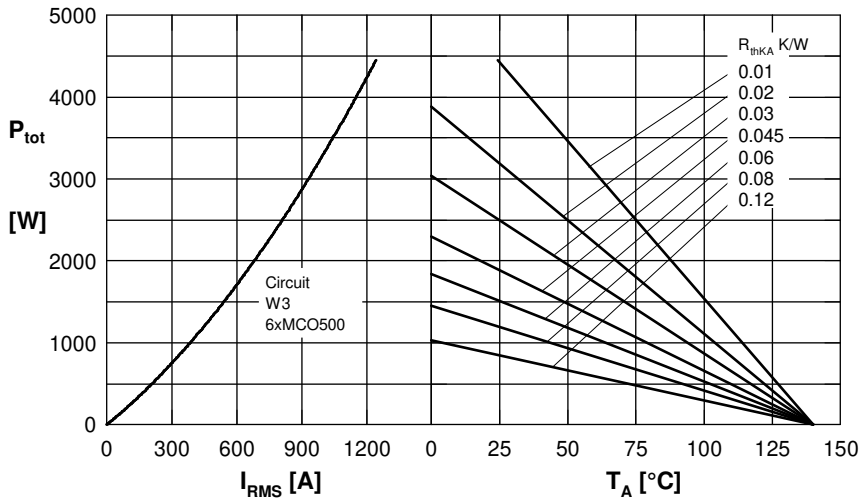


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

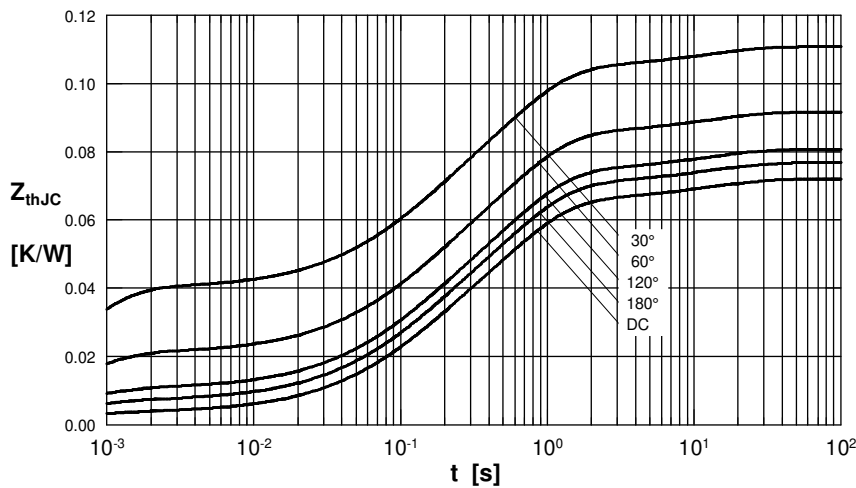


Fig. 9 Transient thermal impedance junction to case

$R_{thJC}$  for various conduction angles d:

d	$R_{thJC}$ (K/W)
DC	0.072
180°	0.0768
120°	0.081
60°	0.092
30°	0.111

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.0035	0.0054
2	0.0186	0.098
3	0.0432	0.54
4	0.0067	12

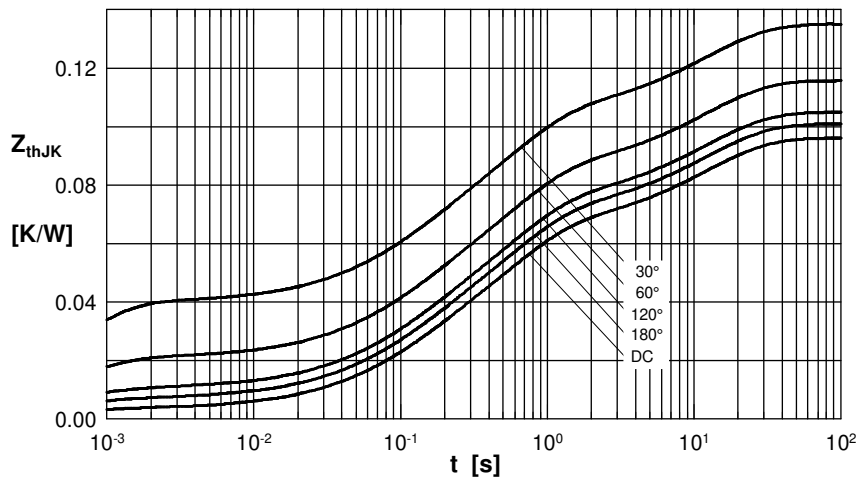


Fig.10 Transient thermal impedance junction to heatsink

$R_{thJK}$  for various conduction angles d:

d	$R_{thJK}$ (K/W)
DC	0.096
180°	0.1
120°	0.105
60°	0.116
30°	0.135

Constants for  $Z_{thJK}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.0035	0.0054
2	0.0186	0.098
3	0.0432	0.54
4	0.0067	12
5	0.024	12