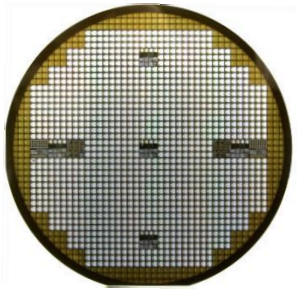
ROHM's High Voltage Power MOSFETs

ROHM's Power Devices (High Breakdown Voltage items)

ROHM has Silicon based Super Junction MOSFETs, FRDs and IGBTs.
SiC devices cover Schottky diodes and MOSFETs

Material	**Si**			**SiC**	
Item	**Super Junction MOSFET**	FRD	IGBT	**SBD**	**MOSFET**
Breakdown Voltage	500V ~800V	300V ~600V, ~1200V*	430V ~650V, ~1200V*	650V, 1200V, 1700V*	650V, 1200V, 1700V*

***Under development**



As of Nov, 2014

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Development Trend - Transistor -

MOSFET
Save energy and High power

Bipolar Transistor
Stable supply and High quality

Digital Transistor
Save space by multi PKG

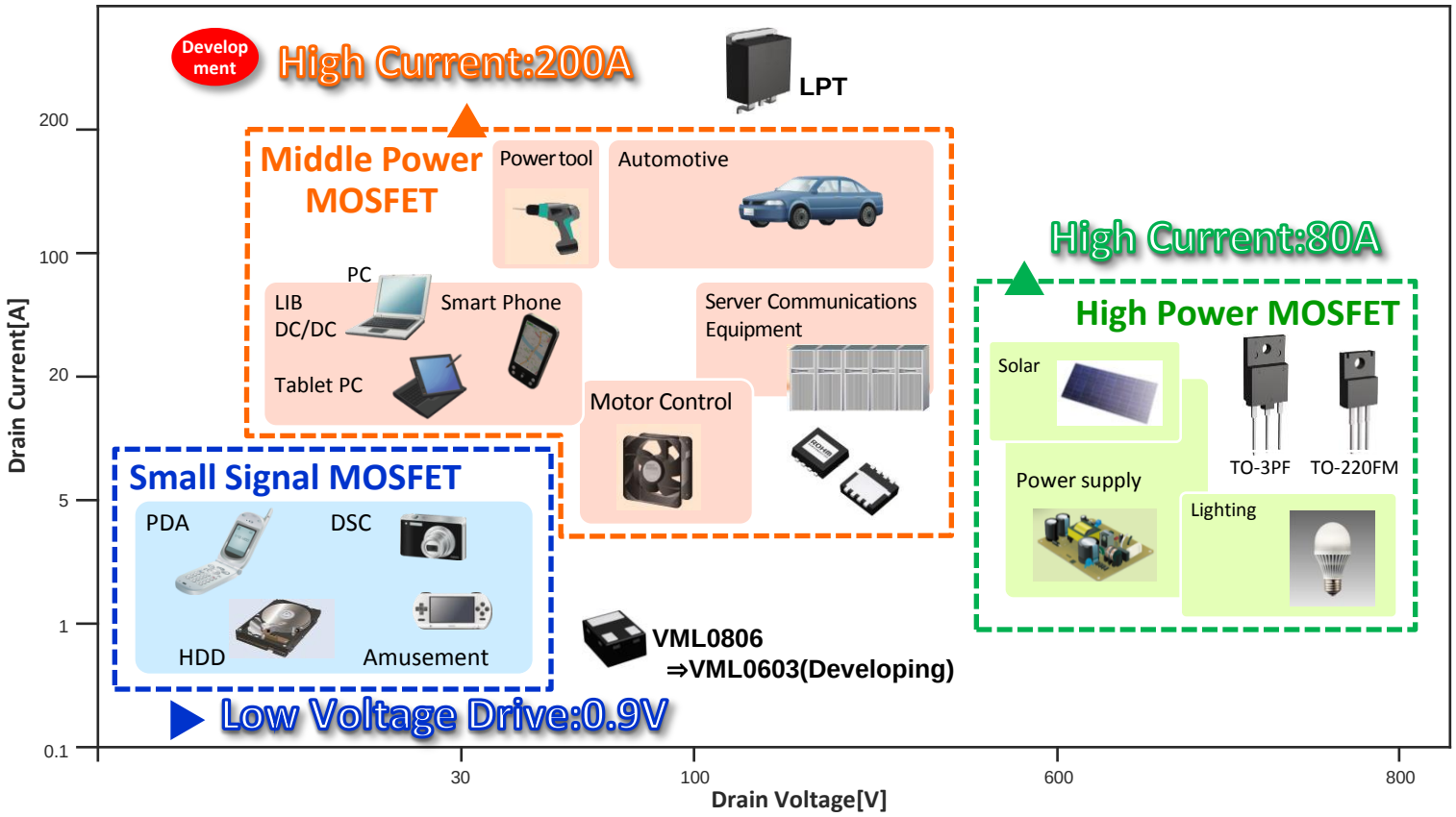
SiC Power Device
High voltage and High efficiency chip
MP started in Dec 2010 that is first in world

Develop ment

Hybrid MOS
Combined characteristics of SJ-MOS and IGBT

Development Strategy

High voltage
High speed
Low RDS

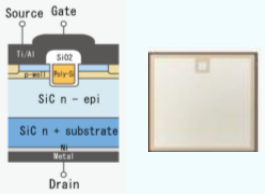


Hybrid MOS

Improvement of Si-Super Junction MOSFET
> High Current / High operating performance
> High speed SW

SiC Device

> Low RDS(on) with Trench structure
RDS(on)1.0mΩcm²
> High Current over 100A



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Recommended Application for using ROHM's Power MOSFETs

	500V	600V					650V	800V
	Planer	SJ-MOS	Planer	SJ-MOS	Hybrid MOS		SJ-MOS	SJ-MOS
	High Speed trr			High Speed trr		High Speed trr		
	D3EB	gen.2	DMOS3	gen.1	gen.1	gen.1	gen.2	gen.1
	RxxWxxxAT (500V only)	R60xxENx	Rx-xAB/C	R60xxFNx Presto MOS	R65xxGNx	R65xxLNx	R65xxENx	R80xxANx
		MP	MP	MP				MP
White goods	Compressor / Motor	PFC		Compressor / Motor	PFC	Compressor / Motor		
Lighting		Compact Lamp PFC / ITTF & TTF					LED Quasi Resonant Flyback	Lamp Ballast Sepic pre converter 3 phase supply / Single switch res.
PC Power		PFC		TTF 80+ / LLC 90+				
Telecom (server)		PFC / ITTF & TTF		ZVS Full-bridge / LLC	PFC			
UPS (, FA)				ZVS Full-bridge	Replace from IGBT			
Adapter		LLC Half-bridge	Flyback/ Quasi resonant	LLC Half-bridge			Flyback / PFC + Flyback	
Consumer (TV, Game, SMPS)	LLC Half-bridge	PFC / LLC Half-bridge		LLC Half-bridge	Replace from IGBT		PFC + Quasi Resonant Flyback	
Solar		Booster			Booster	DC/AC	Booster	DC / AC
EV/HEV				Resonant Full-bridge				

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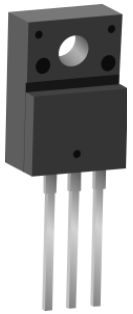
Package Line up - High Voltage MOSFET -

□ THD

TO220FM

29*10

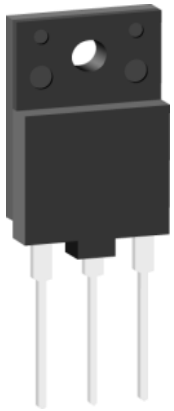
290mm2



TO3PF

26.5*15.5

410mm2



TO247

21.07*15.94

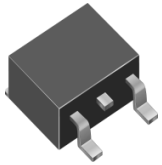
336mm2

□ SMD

D2-Pak(LPT)

13.1*10.1

132mm2



D-Pak(CPT3)

9.5*6.5

62mm2

D-Pak(TO252E)

10.0*6.6

66mm2

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Super Junction MOSFET - Multi Epi 1st gen. AN series -

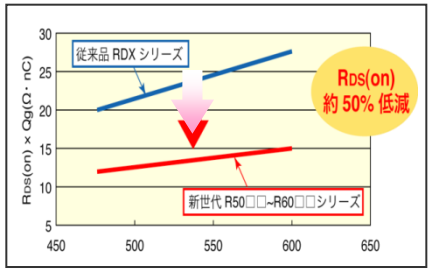
Feature

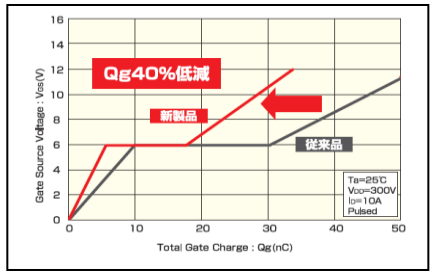
> Super Junction structure

> Line-up of Vds 500V-600V

> Low A*Ron x Qg

> Various Package line-up





500Vシリーズ

Part No.	Package	V_{DSS}[V]	I_D[A]	$R_{DS(on)}$[Ω] at 10V Typ.
R5021ANX	TO220FM	500	21	0.16
R5019ANX			19	0.18
R5016ANX			16	0.21
R5013ANX			13	0.29
R5011ANX			11	0.38
R5009ANX			9	0.55
R5007ANX			7	0.75
R5005CNX			6	0.9
R5021ANJ	LPTS		21	0.16
R5016ANJ			16	0.21
R5013ANJ			13	0.29
R5011ANJ			11	0.38
R5009ANJ			9	0.55
R5007ANJ			7	0.78
R5005CNJ			5	1.2
R5207AND	CPT3	525	7	0.78
R5205CND			5	1.2
SP8K80	SOP8 (Dual)	500	0.5	9

600Vシリーズ

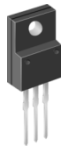
Part No.	Package	V_{DSS}[V]	I_D[A]	$R_{DS(on)}$[Ω] at 10V Typ.
R6046ANZ1	TO247	600	46	0.069
R6046ANZ	TO3PF		46	0.065
R6025ANZ			25	0.12
R6020ANZ			20	0.17
R6015ANZ			15	0.23
R6020ANX	TO220FM		20	0.17
R6015ANX			15	0.23
R6012ANX			12	0.32
R6010ANX			10	0.43
R6008ANX			8	0.6
R6006ANX			6	0.85
R6020ANJ	LPTS		20	0.19
R6015ANJ			15	0.23
R6012ANJ			12	0.32
R6010ANJ			10	0.43
R6008ANJ			8	0.6
R6006AND	CPT3		6	0.9
R6004CND			4	1.4

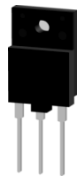
小型PKG. ⟷ High power PKG.


SOP8


CPT3


LPTS


TO220FM


TO3PF


TO247

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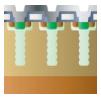
Low Noise Super Junction MOSFET - Multi Epi 2nd gen. EN series -

Feature

Planar MOS

> Low noise

SJ MOS /ANseries

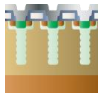


> High speed SW

> Low Ron

Merit of Planar and SJ-MOS are united.

SJ MOS / EN series

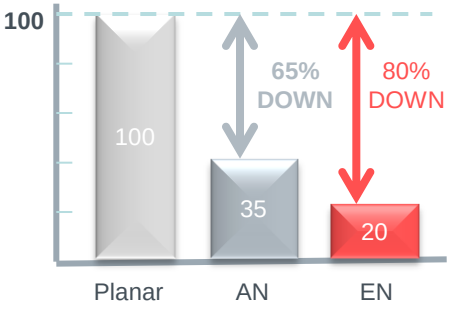


> Low noise

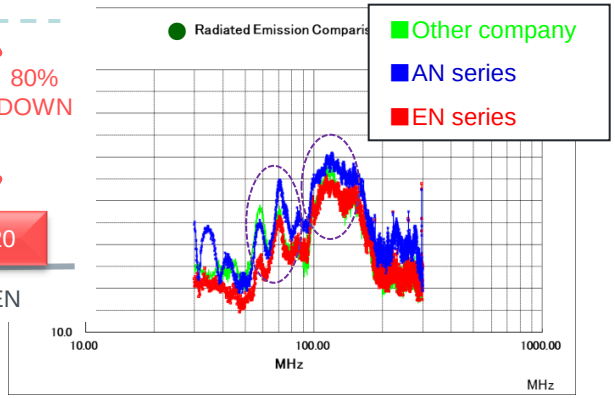
> Low Ron

Advantage

■A*Ron Comparison (TO220)



■Noise Comparison



We are developing Vds 650V(DS Q1/2015) and 800V(DS Q2/2015) gen2 MOSFET line-up.

PKG	Part.No	VDSS (V)	ID (A)	RDS(on) Typ.(Ω) Vgs=10V	Qg Typ.(nC) Vgs=10V
CPT3 D-pak	R6002END	600	1.7	2.8	6.5
	R6004END		4	0.9	15
TO252E D-pak	★R6007END3	600	7	0.57	20
	★R6009END3		9	0.5	23
	★R6011END3		11	0.34	32
LPT D2-pak	R6004ENJ	600	4	0.9	15
	R6007ENJ		7	0.57	20
	R6009ENJ		9	0.5	23
	R6011ENJ		11	0.34	32
	R6015ENJ		15	0.26	40
	R6020ENJ		20	0.17	60
	R6024ENJ		24	0.15	70
TO220FM	R6004ENX	600	4	0.9	15
	R6007ENX		7	0.57	20
	R6009ENX		9	0.5	23
	R6011ENX		11	0.34	32
	R6015ENX		15	0.26	40
	R6020ENX		20	0.17	60
	R6024ENX		24	0.15	70
	R6030ENX		30	0.115	85
TO3PF	R6015ENZ	600	15	0.26	40
	R6020ENZ		20	0.17	60
	R6024ENZ		24	0.15	70
	R6030ENZ		30	0.115	85
	R6035ENZ		35	0.095	110
TO247	R6020ENZ1	600	20	0.17	60
	R6024ENZ1		24	0.15	70
	R6030ENZ1		30	0.115	85
	R6035ENZ1		35	0.095	110
	R6047ENZ1		47	0.07	145
	R6076ENZ1		76	0.04	260

★ Under development: DS Q2/2014 : The development plan may be changed without notice.

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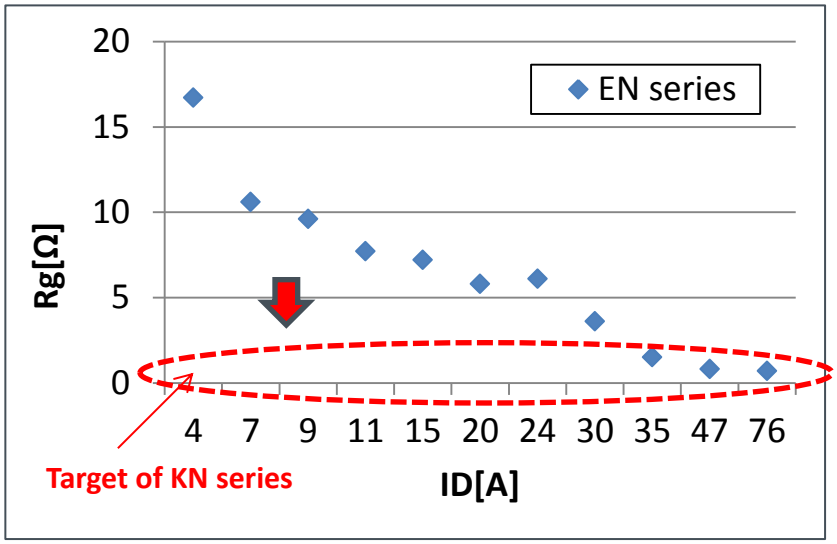
High Speed Super Junction MOSFET - Multi Epi 2nd gen. KN series -

For High Efficiency Set SJ-MOS 2nd gen. High Speed SW type

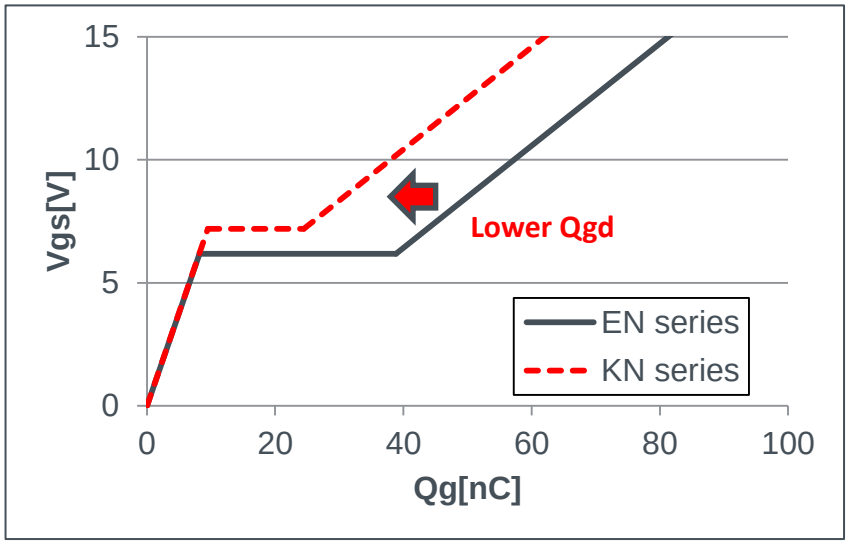
Feature

2nd generation SJ-MOS	2nd generation SJ-MOS
EN series	KN series
> Low A*Ron	> Low A*Ron
> Low Noise	> High Speed / High efficiency

①Lower Rg



②Lower Qgd



ENx series concept : Ease of use (Easy to replace from Planar MOS)

KNx series concept : High efficiency (Low SW Loss)

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1-1. High speed trr SJ MOSFET "PrestoMOS" - Multi Epi 1st gen. FN series -

Presto*: Quick/rapid *(Italian)

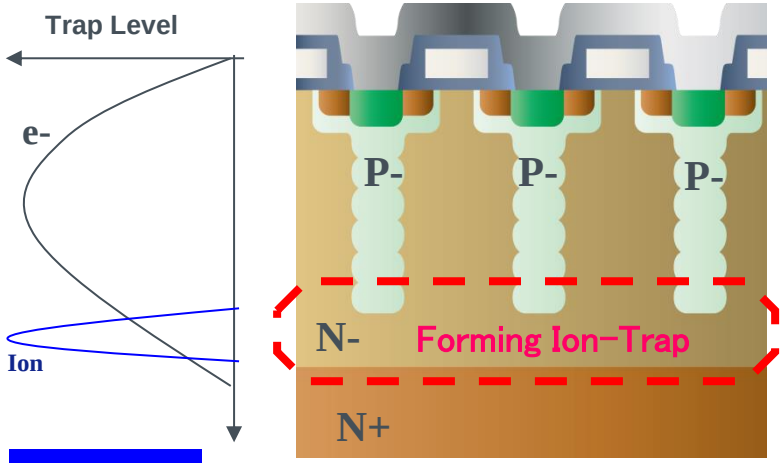
Conventional approach to High Speed trr

Diode ・・・By heavy metal diffusion

Planar MOS

IGBT ・・・By EB irradiation

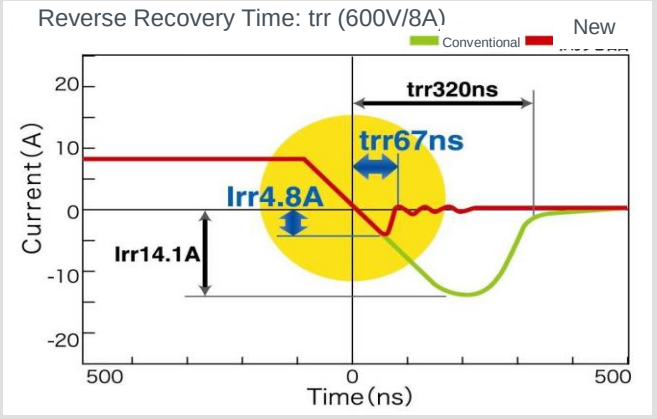
Rohm has developed New technology of creating Trap-Level by using Special Ion (Rohm Patent)



Feature

Reducing Trr by 80% (600V/8A Product)

Trr Dropped from 320ns ⇒ 67ns



(Conditions: di/dt=100A/μs, I_F=8A)

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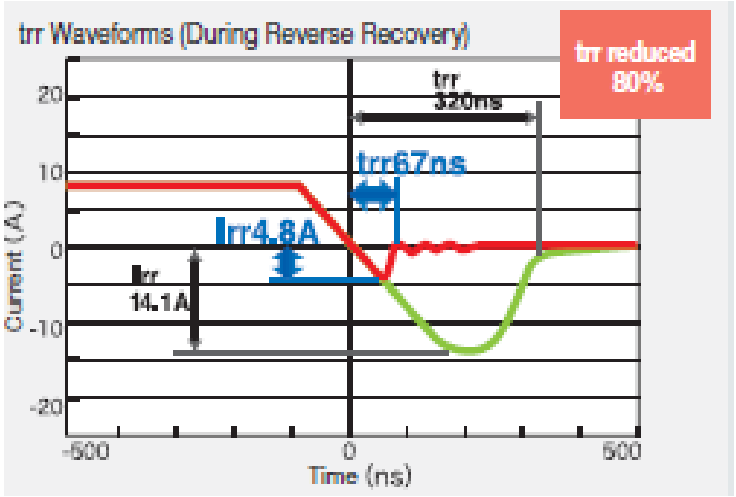
High speed trr Super Junction MOSFET - Multi Epi 1st gen. FN series -

Feature

> High speed trr

> Improves inverter efficiency

> Compact package and low ON-resistance reduces set size (no FRDs connected in parallel required)



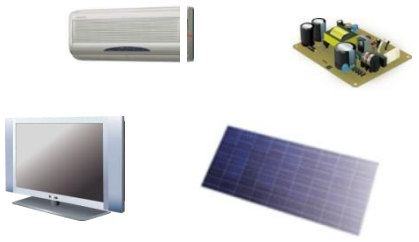
Application

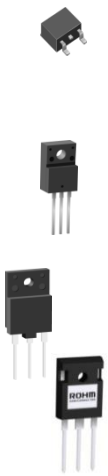
> LCD TV power supplies (with integrated inverter)

> Solar battery power conditioners

> Motor drives

> Home appliances





PKG	Part.No	VDSS (V)	ID (A)	RDS(on) Typ.(Ω) Vgs=10V	Qg Typ.(nC) Vgs=10V	trr Typ. (ns)
LPT D2-pack	R6008FNJ	600	8	0.73	20	67
	R6012FNJ		12	0.39	35	75
TO220FM	R5009FNX	500	9	0.65	18	78
	R5011FNX		11	0.4	30	85
	R5016FNX		16	0.22	45	100
	R6008FNX	600	8	0.73	20	67
	R6012FNX		12	0.39	35	75
	R6015FNX		15	0.27	42	90
	R6020FNX		20	0.2	65	105
TO3PF	R6025FNZ	600	25	0.14	85	120
	R6046FNZ		46	0.075	150	145
TO247	R6025FNZ1	600	25	0.14	85	120
	R6046FNZ1		46	0.075	150	143

We are developing 2nd gen. JN series.
This item's schedule is DS Q4/2014.

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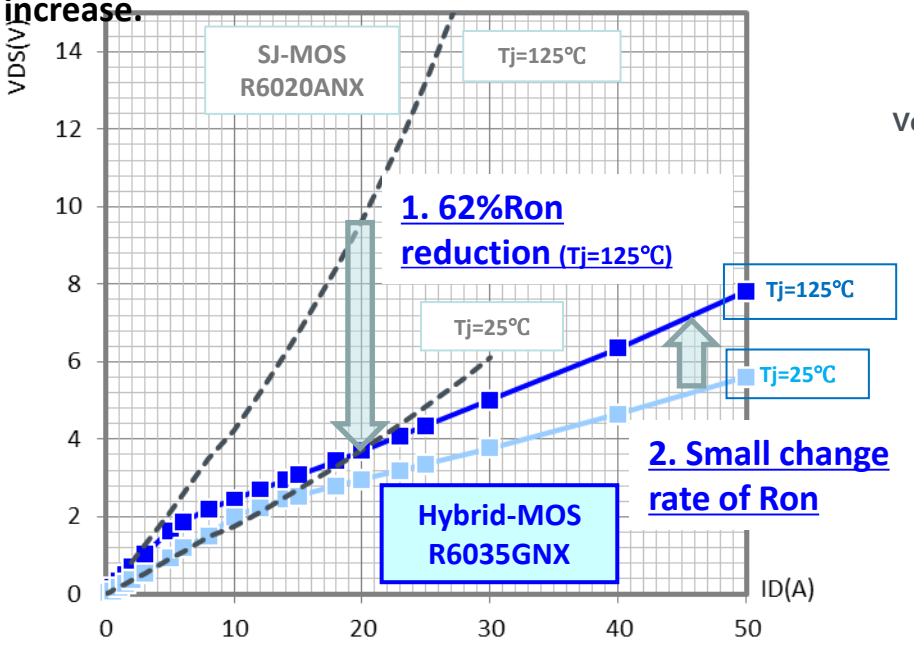
Merit

■ Comparison with Super Junction MOSFET,,,

1. About 62% Ron reduction in High Current operation (Tj=125℃)
2. Smaller change rate of Ron in temperature increase.

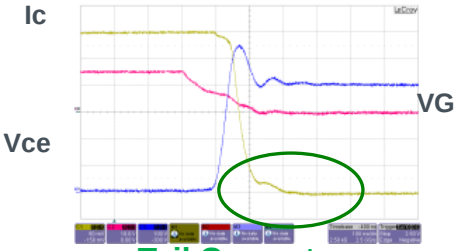


Part.No	VDSS (V)	ID (A)	RDS(on) Typ.(Ω) Vgs=10V				Qg Typ.(nC) Vgs=10V
			Tj=25℃		Tj=125℃		
			ID=10A	ID=20A	ID=10A	ID=20A	
★R6035GNX	600	35	0.17	0.11	0.20	0.14	40

■ Comparison with IGBT,,,

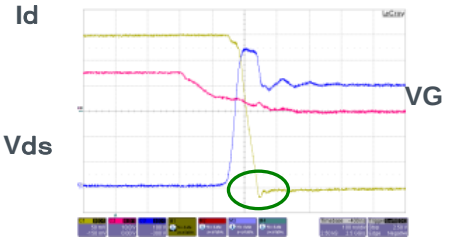
SW speed of Hybrid-MOS is better than IGBT's.

Turn-off waveform of IGBT



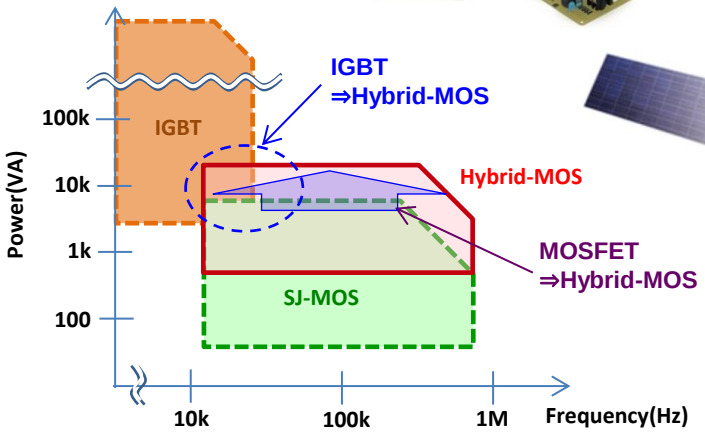
Tail Current

Turn-off waveform of Hybrid-MOS



No Tail Current

Target Application



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3-1. Hybrid-MOS New structure SJ MOSFET - GN series -

●**Fastest in the market !!** ROHM add IGBT function on Super Junction MOSFET.

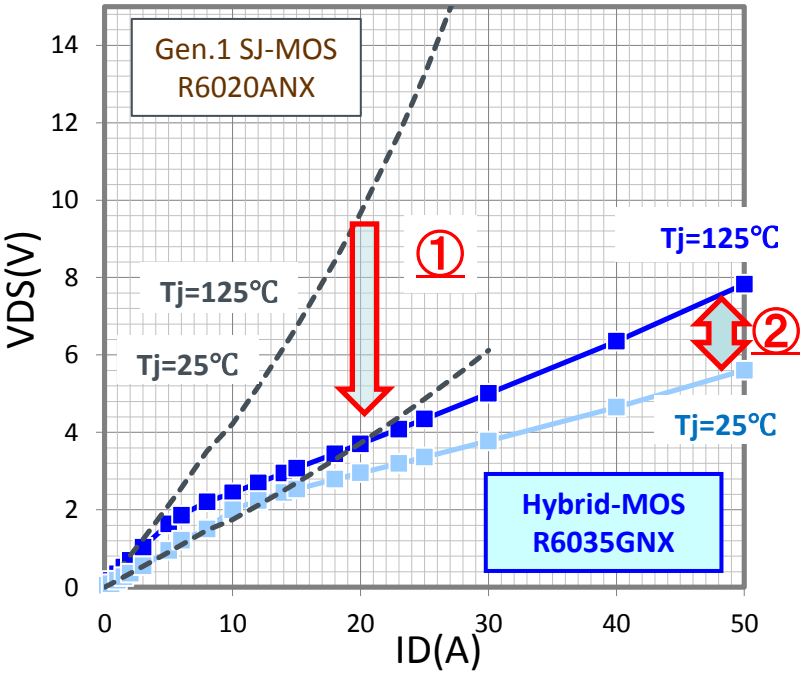
●ROHM has achieved **"Low Rdson at High Temperature condition"** while using Super Junction MOSFET structure.

Merit

■Comparison with Super Junction MOSFET

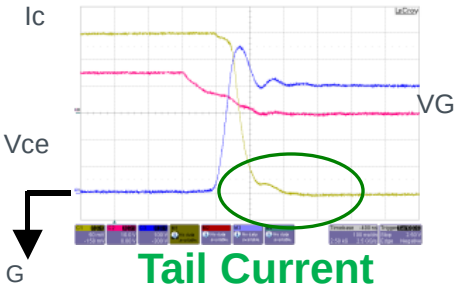
①. About **62%** Ron reduction in High Current operation (Tj=125℃)

②. Smaller change rate of Ron in temperature increase.

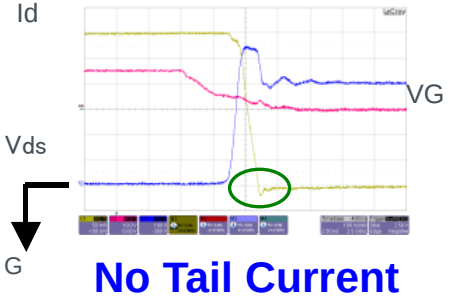


■ Comparison with IGBT,,,

IGBT Turn-off waveform



Hybrid-MOS Turn-off waveform

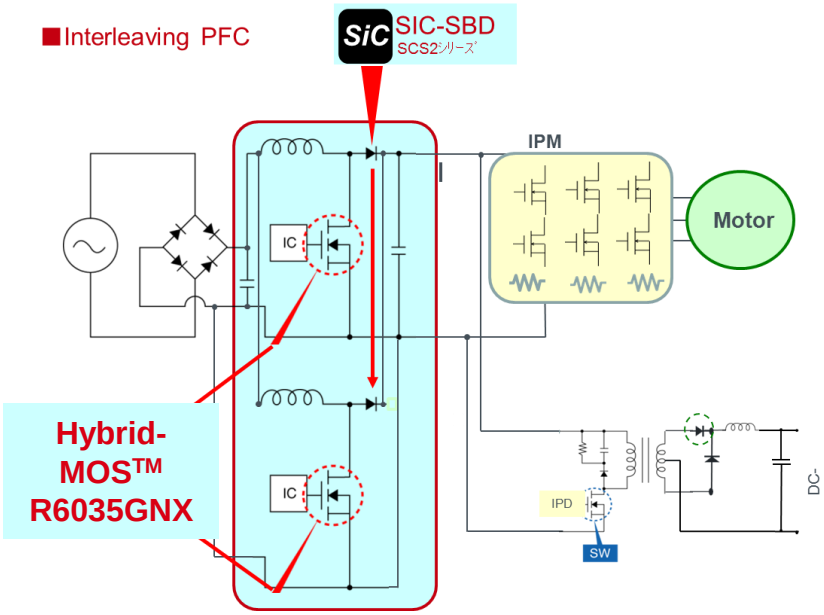


Part.No	VDSS (V)	ID (A)	RDS(on) Typ.(Ω) Vgs=10V				Qg Typ.(nC) Vgs=10V
			Tj=25℃		Tj=125℃		
			ID=5A	ID=10A	ID=5A	ID=10A	
★R6020GNZ	600	20	0.37	0.24	0.45	0.30	20
			ID=10A	ID=20A	ID=10A	ID=20A	
★R6035GNX	600	35	0.17	0.11	0.20	0.14	40

★Under Development

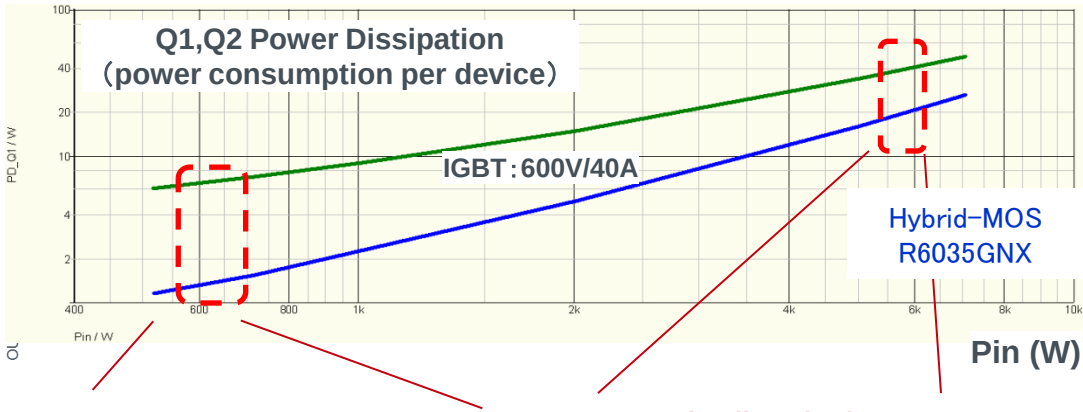
3-2. Hybrid-MOS New structure SJ MOSFET - GN series -

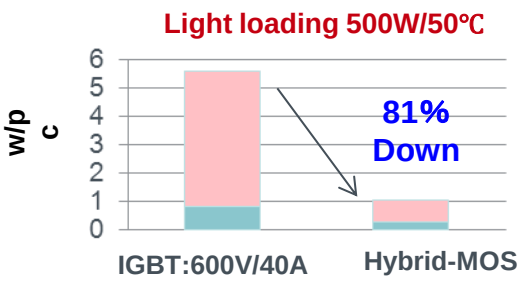
■Circuit Simulation :
PFC circuit for the outdoor unit of the air conditioner

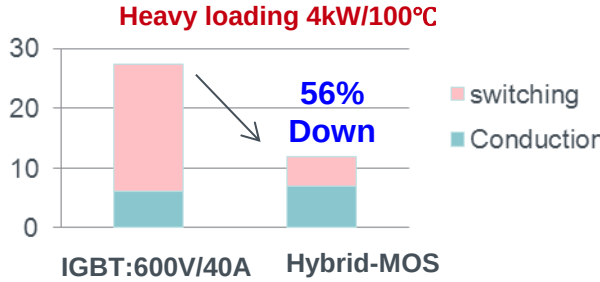


Driving System :
2 Phase Interleave Cont. Current Mode
Conditions :
Vps=200Vac 60Hz
Vout=340Vdc Tj=100℃
Driving Freq: fsw=30kHz

■Improved Power Consumption in whole range







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Super Junction MOSFET - Multi Epi 1st gen. AN series -

Feature

> Super Junction structure

> Line-up of Vds 800V

> Low A*Ron x Qg

> Various Package line-up
(D-pak, D2-pak, TO220FM, TO247, TO3PF)

Application

> LCD TV power supplies

> Lighting (Lamp, LED lamp)

> Solar battery power conditioners

> Adapter

> Game

> Home appliances

> SMPS

Line-up

PKG	Part.No	VDSS (V)	ID (A)	RDS(on) Typ.(Ω) Vgs=10V	Qg Typ.(nC) Vgs=10V
CPT3 D-pack	R8001CND	800	1	6.7	7.2
	★R8002CND		2	3.3	12.7
LPT D2-pack	★R8002ANJ	800	2	3.3	12.7
	★R8005ANJ		5	1.6	21
	★R8008ANJ		8	0.79	39
TO220FM	R8002ANX	800	2	3.3	12.7
	R8005ANX		5	1.6	21
	R8008ANX		8	0.79	39
	R8010ANX		10	0.43	62
TO247	★R8012ANZ1	800	12	0.35	78
	★R8016ANZ1		16	0.23	115

★Under development: DS :OK
The development plan may be changed without notice.
This is reference data. If you design circuit, please refer specification sheet.

⇨ **We are developing Vds 800V(DS Q2/2015) gen2 SJ-MOSFET line-up.**

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High Voltage MOSFET - Planar type -

Feature

> High Eas and Ias

> Wide SOA

> Low Noise

> > We are developing High Speed trr type new line-up

Application




> Power supplies

> LCD TV power supplies

> LED Lighting power supplies

> Home Appliance(Air-Conditioner, etc,,)

Package	VDSS (V)	ID (A)	Part.No	RDS(on) Typ.(Ω) Vgs=10V	Qg Typ.(nC) Vgs=10V
TO220FM 	500	15	RX2W150AB	0.29	46
		13	RX2W130AB	0.45	34
		9	RX2W090AB	0.75	22
TO252 D-pak 		7	★RD3W070AB	1	**
		5	★RD3W050AB	1.3	**
		3	★RD3W030AC	2.3	**
TO220FM	600	12	RX2X120AB	0.45	46
		10	RX2X100AB	0.6	31
		6	RX2X060AB	1	22
TO252 D-pak		4	★RD3X040AB	1.4	**
		2	★RD3X020AC	3.3	**

★Under development: The development plan may be changed without notice. This is reference data. If you design circuit, please refer specification sheet.

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200V/250V Power MOSFET

Feature

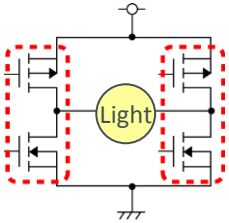
> Low Ron*Qg

> High current products Line-up (Under 51A, MP)

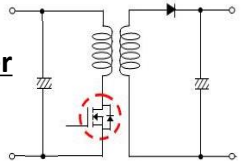
> CPT package, It corresponds to a miniaturization

Application

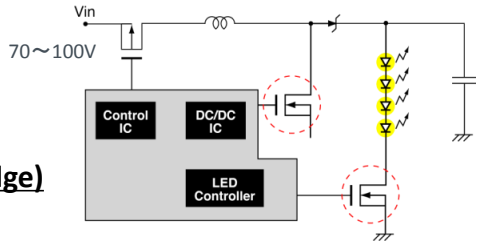
Light source of Projector



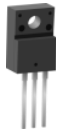
DC/DC converter



LED Back-light (Edge)



PKG	Part. No	VDSS (V)	ID (A)	PD(W) (Ta=25℃)	RDS(on) Typ.(mΩ) Vgs=10V	Qg(nC) Vgs=10V
CPT (D-pack) 	RND030N20	200	3	20	740	7
	RCD051N20		5		470	9
	RCD075N20		7.5		250	15
	RCD100N20		10		140	26
	RCD041N25	250	5		780	9
	RCD060N25		6		410	15
	RCD080N25		8		225	25

PKG	Part. No	VDSS (V)	ID (A)	PD(W) (Ta=25℃)	RDS(on) Typ.(mΩ) Vgs=10V	Qg(nC) Vgs=10V
LPTS (D2-pack) 	RCJ081N20	200	8	40	470	9
	RCJ120N20		12		250	15
	RCJ160N20		16		135	26
	RCJ200N20		20		100	40
	RCJ300N20		30		60	60
	RCJ450N20		45		42	80
	RCJ700N20		70		28	125
	RCJ050N25	250	5	30	850	9
	RCJ080N25		8	35	460	15
	RCJ100N25		10	40	245	26.5
	RCJ120N25		12		180	35
	RCJ220N25		22		105	60
	RCJ330N25		33		77	80
	RCJ510N25		51		48	120
TO220FM 	RCX081N20	200	8	40	470	9
	RCX120N20		12		250	15
	RCX160N20		16		135	26
	RCX200N20		20		100	40
	RCX300N20		30		60	60
	RCX450N20		45		42	80
	RCX700N20		70		28	125
	RCX051N25	250	5	30	850	9
	RCX080N25		8	35	460	15
	RCX100N25		10	40	245	26.5
	RCX120N25		12		180	35
	RCX220N25		22		105	60
	RCX330N25		33		77	80
	RCX511N25		51		48	120

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