MagnaChip

Analog & Mixed Signal Company

MagnaChip Semiconductor

SPG Power Marketing

2017. 08. 11




MagnaChip Semiconductor

MagnaChip is a Korea-based designer and manufacturer of analog and mixed-signal semiconductor products for high-volume consumer applications. We believe we have one of the broadest and deepest analog and mixed-signal semiconductor technology platforms in the industry, supported by our 30-year operating history, large portfolio of approximately 2,730 novel registered patents and 760 pending novel patent applications, and extensive engineering and manufacturing process expertise




MagnaChip Semiconductor

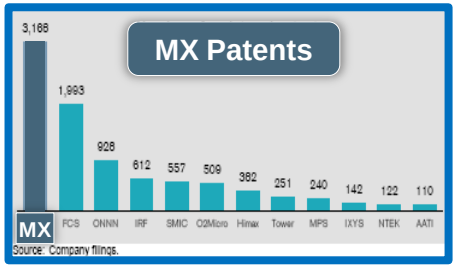
1979
Semiconductor

1984 현대전자

1999
Memory & System IC

2004
Analog & Mixed Signal

Listed NYSE
New York Direct Listing
No.1 Company in Korea
2011



- Monthly 113K wafers capacity
- All fab's – ISO/TS 16949, ISO 14001, OHSAS 18001, REACH
- Proven technology
- Long operating history
- 0.11um to 0.6um technology

MagnaChip Business Scope

MX LISTED NYSE

Display Solutions

Providing flat panel display solutions in several major types of large & small flat panel displays

Power Solutions

Providing power management & signal interface & power discrete, designed to highly maximize efficiency and extremely minimize standby power consumption

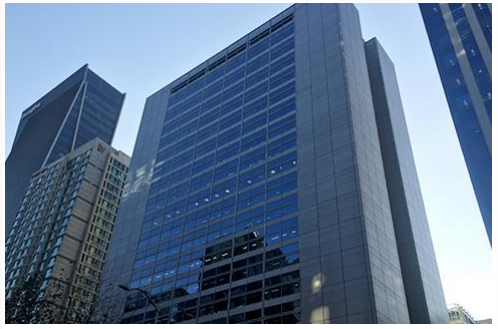
Foundry Service Group

Providing wafer foundry services utilizing CMOS mixed-signal, high voltage, embedded memory & power process technologies for the manufacture of IC's for customer-owned designs

Efficient Asia-based operations

MX LISTED NYSE

Seoul



Cheongju Plant

77 acres : F4 (8″)

- Asia-based supply chain
- Proven technologies
- Fully depreciated fabs
- Long operating history
- 113K wafers / Month - 8” capacity
- 0.11um to 0.5um technology
- All fabs are certified under ISO/TS 16949, ISO 14001, OHSAS 18001

Certificate Number FM 52849

Certificate Number A13220

Certificate Number 2000181 4 TS09

Gumi Plant

27 acres : F3 (8″)

MX Certificate – Overall Summary

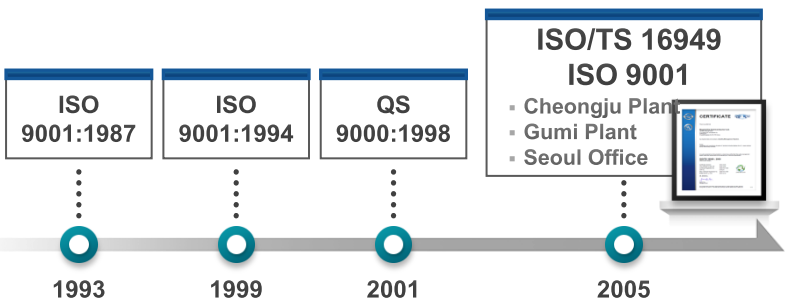
- ISO 14001, OHSAS 18001
- ISO/TS 16949, ISO 9001
- Automotive semiconductor qualification (AEC Q100)
- US DLA QML-V qualification

RoHS Compliant

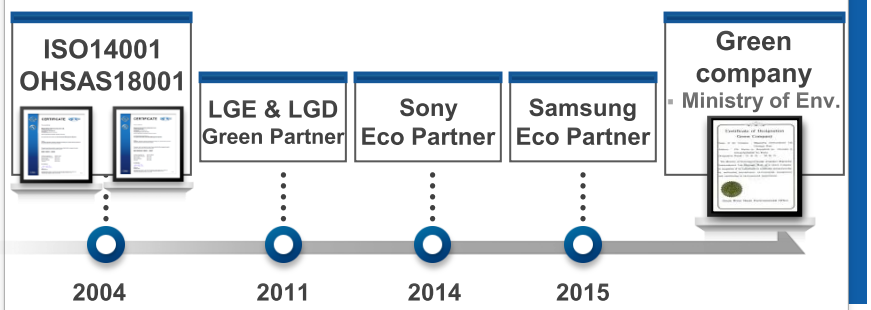
RoHS Compliant
HALOGEN-FREE

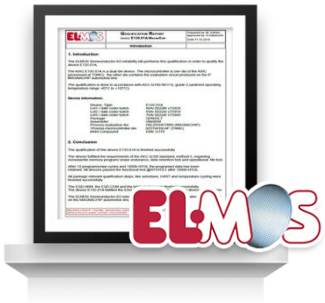
MagnaChip meets RoHS Compliant and HALOGEN-Free

QMS (Quality Management System)



ESH (Environment, Safety and Health)





- **The device fulfilled the requirements of the AEC Q100 standard,** method 5, regarding nonvolatile memory program/ erase endurance, data retention test and operational life test

Automotive Device Qualification

- **Listed as a certified fabrication company**
  Aeroflex received QML-V qualification for mixed-signal products fabricated in MagnaChip

US Defense Logistics Agency QML-V Qualification

MagnaChip Semiconductor

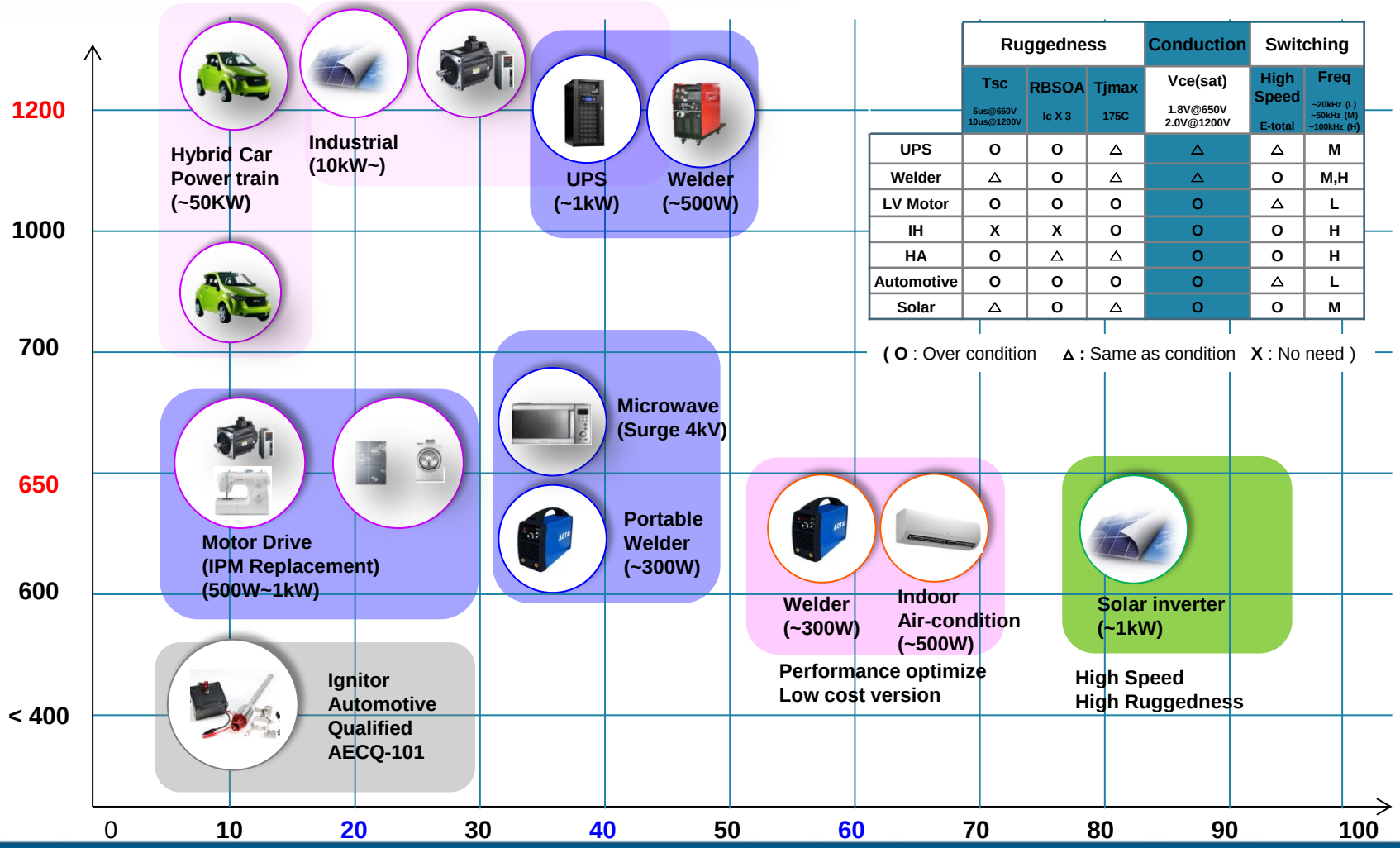
IGBT




Applications

MP | Developing | Planning | Review

Power [V]



	Ruggedness			Conduction	Switching	
	Tsc 5us@650V 10us@1200V	RBSOA Ic X 3	Tjmax 175C	Vce(sat) 1.8V@650V 2.0V@1200V	High Speed E-total	Freq ~20kHz (L) ~50kHz (M) ~100kHz (H)
UPS	O	O	△	△	△	M
Welder	△	O	△	△	O	M,H
LV Motor	O	O	O	O	△	L
IH	X	X	O	O	O	H
HA	O	△	△	O	O	H
Automotive	O	O	O	O	△	L
Solar	△	O	△	O	O	M

(O : Over condition △ : Same as condition X : No need)

IGBT list

650V Line-up

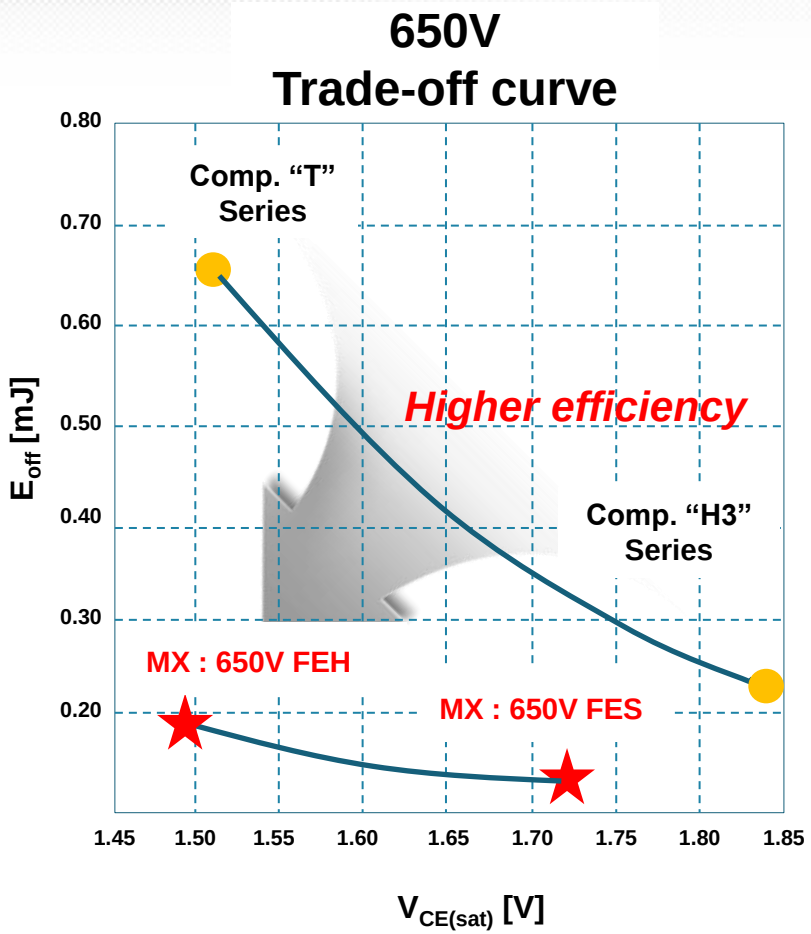
Part No.	I_C [A]	$V_{CE(sat)}$ [V]	Eon [mJ]	Eoff [mJ]	Package	Description	Status (*E/S)
MBF15T65PEHTH	15A	1.65	0.26	0.14	TO220FP	Low Conduction High Ruggedness	Now
MBQ40T65FESCTH	40A	1.95	1.15	0.35	TO247	High speed	MP
MBQ40T65QESTH	40A	1.8	0.85	0.29		Low Conduction Ultra High Speed	* Aug. '17
MBQ50T65FESCTH	50A	1.95	1.4	0.37		High speed	MP
MBQ60T65PESTH	60A	1.8	0.92	0.53		Ultra High speed High Ruggedness	MP

1200V Line-up

Part No.	I_C [A]	$V_{CE(sat)}$ [V]	Eon [mJ]	Eoff [mJ]	Package	Description	Status (*E/S)
MBQ25T120FESCTH	25A	2.0	1.44	0.55	TO247	High speed	MP
MBQ40T120FESTH	40A	2.0	1.96	0.54	TO247	High speed	MP
MBQ40T120QESTH	40A	2.0	TBD	TBD	TO247	High speed	* Sep. '17
MBW50T120PHWH	50A	1.85@25C	8.26@150C	4.80@150C	Sawn on foil	Low conduction High Ruggedness	MP
MBW100T120PHWH	100A	1.70@25C	10.96@150C	10.15@150C	Sawn on foil	Low conduction High Ruggedness	MP

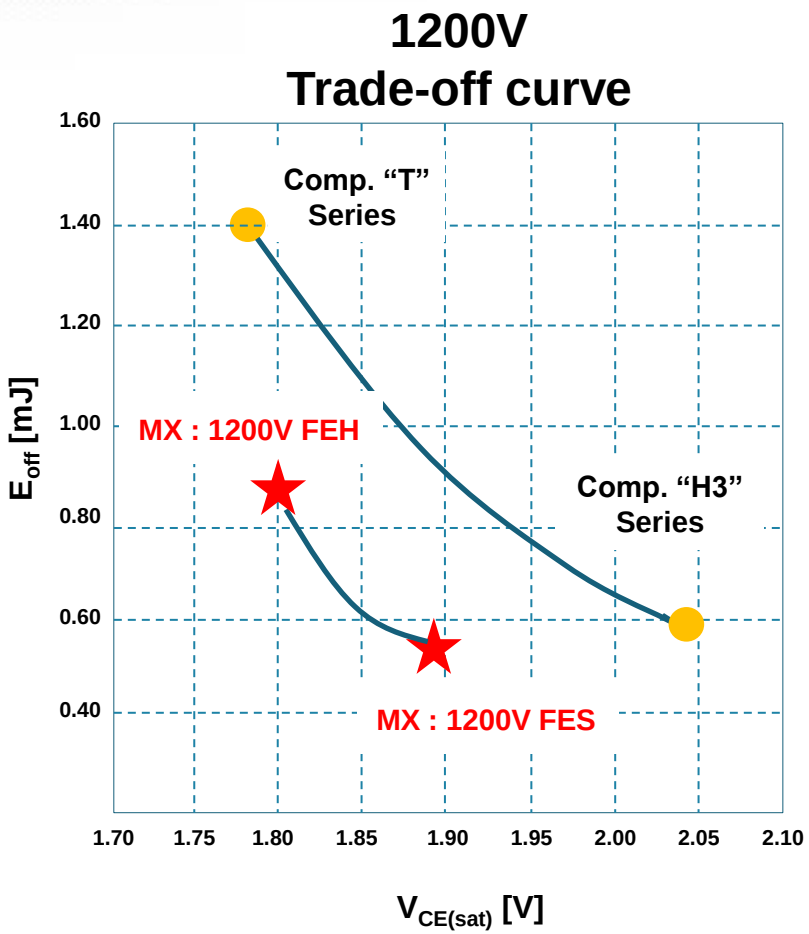
Performance [F Family]

Best in the trade-off curve Vce (sat) vs. Eoff



Test condition :

Vcc=400V, Ic=40A, V_{GE}=15V, Rg=5Ω, Tj=25℃



Test condition :

V_{CC}=600V, I_C=40A, V_{GE}=15V, R_G=10Ω, Tj=25℃

Performance [P Family]

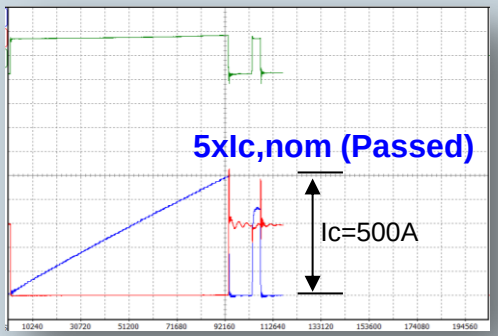
Best performance 1200V 100A IGBT

	Test conditions	Limit	Magnachip	Competitor "I"
$V_{BR(CES)}$	Ic=3mA, T_J=25'C	>1250V	**1410V**	**1352V**
$V_{CE(sat)}$	Ic=100A,T_J=25'C	1.8V ±0.25V	**1.71V (Wafer)**	**1.85V (PKG)**
RBSOA	Ic=300A,Vce=600V Rg,on/off=1.0 Vge=-15V/+15V T_J=150'C	3 x Ic,nom	**X5 ↑**	**X5 ↑**
SCSOA	Vce=800V Rg=1.0Ω T_J=150'C	>10us	**~25us**	**~25us**
Eon	Ic=100A,Vce=600V Rg,on/off=1.0Ω Vge=-15V/+15V T_J=150'C	cf. ref	**10.9mJ (Rg=5.0Ω)**	**12.5mJ (Rg=6.7Ω)**
Eoff		cf. ref	**10.15mJ**	**10.3mJ**

MX SOA

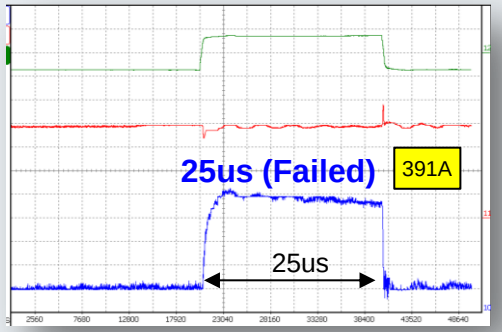
RBSOA

V_{CE}=600V
$R_{G.on/off}$=1.0Ω
T_J=150℃



SCSOA

V_{CE}=800V
$R_{G.on/off}$=1.0Ω
T_J=150℃



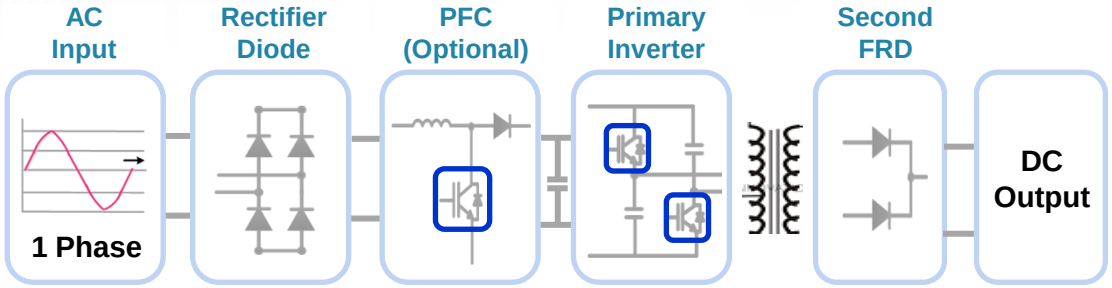
Applications

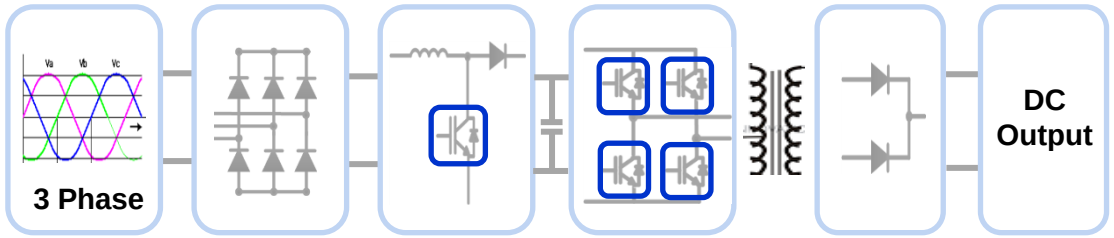
Welder and Motor

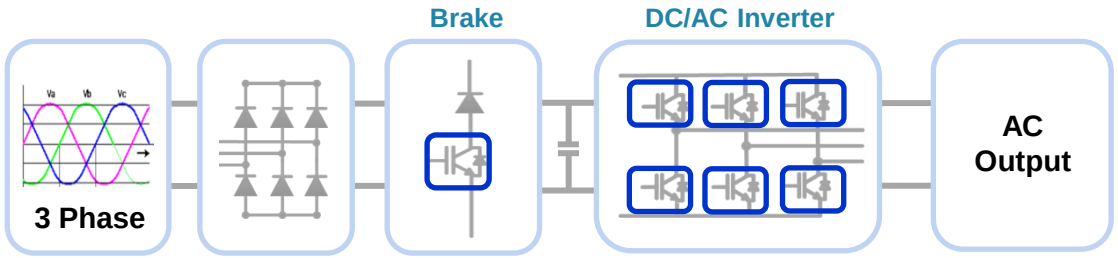
Half Bridge Topology
220V

Full Bridge Topology
380V

3Φ Motor
Low Power







Discrete IGBT		
[V]	Part #	[A]
650	**MBQ40T65FESCTH**	40
650	**MBQ50T65FESCTH**	50
650	**MBQ60T65PESTH**	60

Discrete IGBT		
[V]	Part #	[A]
1200	**MBQ25T120FESCTH**	25
1200	**MBQ40T120FESTH**	40

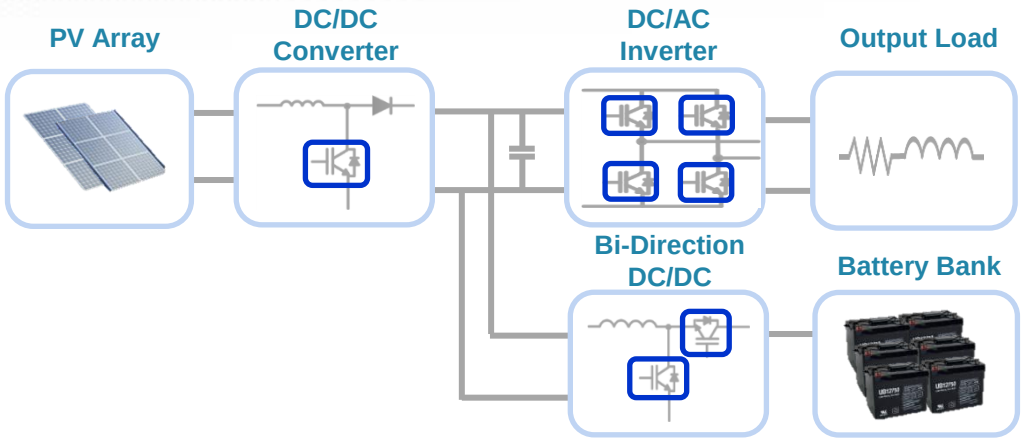
Discrete IGBT		
[V]	Part #	[A]
650	***MBF15T65PEHTH**	15

* : Under developing

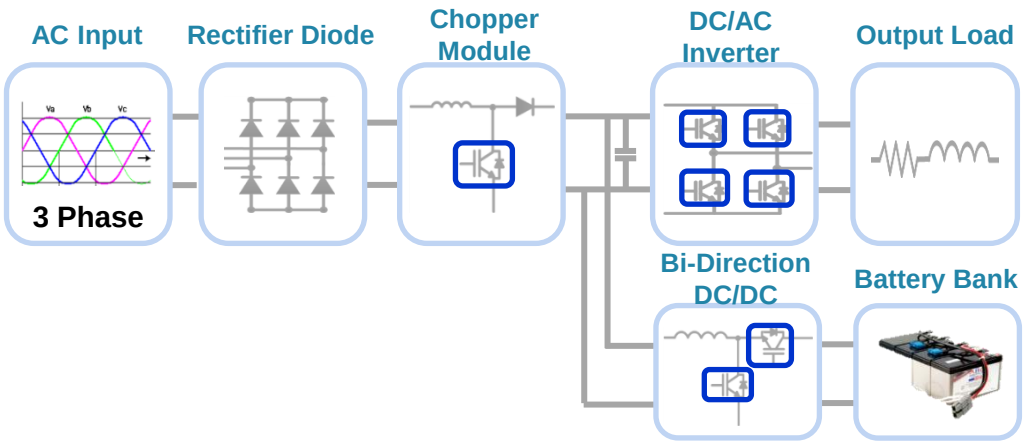
Applications

Solar and UPS

Solar



UPS Inverter



Discrete IGBT		
[V]	Part #	[A]
650	**MBQ40T65FESCTH**	40
650	**MBQ50T65FESCTH**	50
650	**MBQ60T65PESTH**	60
1200	***MBQ40T120PESTH**	40

Discrete IGBT		
[V]	Part #	[A]
1200	**MBQ25T120FESCTH**	25
1200	***MBQ40T120PESTH**	40

* : Under developing

Performance

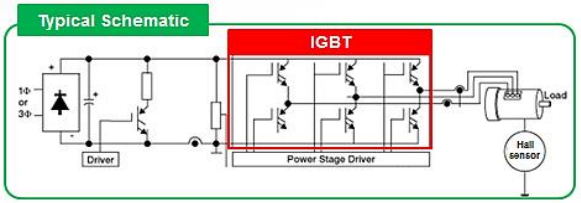
650V/15A Motor IGBT Product

- High ruggedness performance with stable temperature condition at set level

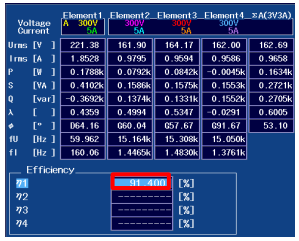
▶ Electrical characteristics test

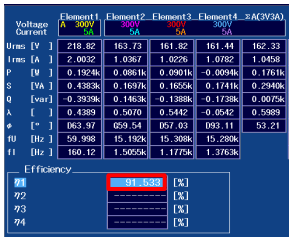
Test Item		Test Condition	Magnachip	Competitor	
			MBF15T65PEH	Company "S"	Company "I"
DC	BV_{CES}	I_C = 2mA, V_{GE} = 0V	650V	600V	600V
	I_C	T_C=100°C	15A	15A	12A
	$V_{CE(sat)}$	I_C = 15A, V_{GE}= 15V	1.65V	1.55V	1.8V
	Vth	V_{CE} = V_{GE}, I_C = 0.5mA	5.5V	5.9V	4.6V
	V_F	V_{GE} = 0V, I_F = 15A	1.8V	1.8V	1.6V
AC	Tr	V_{GE} = 15V, V_{CC} = 400V, I_C = 15A, R_G = 10Ω, Inductive Load	23ns	23ns	22ns
	Tf		103ns	109ns	112ns
	Eon		0.26mJ	0.20mJ	0.21mJ
	Eoff		0.14mJ	0.16mJ	0.17mJ
	Etot		0.40mJ	0.36mJ	0.38mJ
FRD S/W	Trr	I_F = 15A, di_F/dt = 200A/μs,	47ns	41ns	43ns
	Irr		14A	16A	17A
Rugged	RBSOA		Icex5 OK	Icex4 OK	Icex4 OK
Short Circuit	t_{sc}	Temp=150'C, Vcc=360V	10us	5us	15us

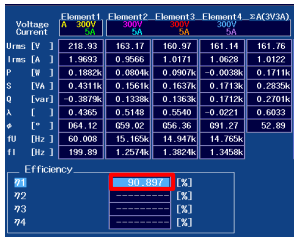
▶ Set evaluation test



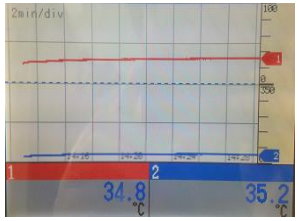
MBF15T65PEH	Company "S"	Company "I"
Efficiency : 91.4%	Efficiency : 91.5%	Efficiency : 90.9%

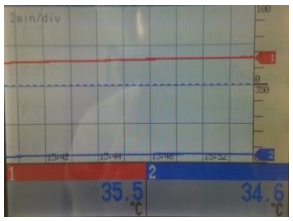


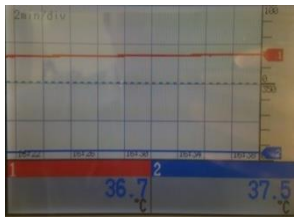




MBF15T65PEH	Company "S"	Company "I"
Temperature : 35°C	Temperature : 35°C	Temperature : 37°C







Performance

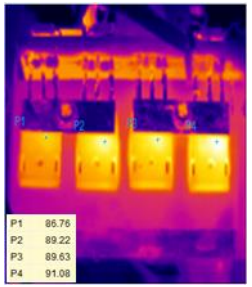
650V/40A High Speed Product

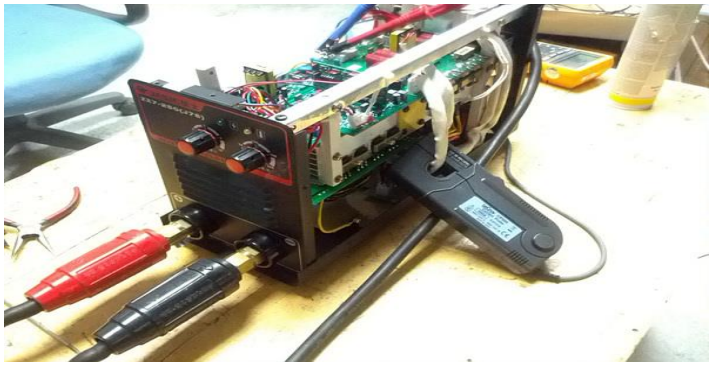
- Better Speed performance with stable temperature condition at Set level

▶ Electrical characteristics test

Item		Test condition	Magnachip		Competitor
			MBQ40T65 FDSC	MBQ40T65 FESC	IKW40N60H3
DC	BV_{CES}	V_{GE}=0V, I_C=1mA	725V	724V	743V
	$V_{CE(SAT)}$	V_{GE}=15V, I_C=40A	1.92V	1.86V	1.85V
	$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1mA	4.63V	5.14V	4.83V
	V_F	I_F=20A	1.39V	1.45V	1.58V
AC	$t_{d(on)}$	V_{CC}=400V, I_C=40A, V_{GE}=±15V, R_G=7.9Ω, Inductive Load Ta=25℃	43ns	46ns	31ns
	t_r		52ns	49ns	63ns
	$t_{d(off)}$		288ns	317ns	318ns
	t_f		39ns	38ns	43ns
	E_{on}		0.64mJ	0.60mJ	0.78mJ
	E_{off}		0.36mJ	0.36mJ	0.50mJ
	tsc	V_{CC}=400V, V_{GE}=15V	23us	23us	21us
Internal Rg		-	1Ω	1Ω	-

▶ Set evaluation test

Test condition	Magnachip	Competitor
	MBQ40T65FESC	IKW40N60H3
ARC Welder Full-Bridge Rg=8.2Ω 200A 30kHz	83.7℃	89.2℃
		



Performance

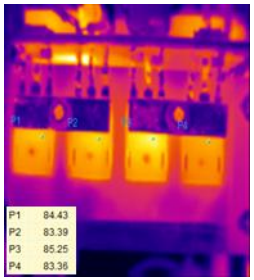
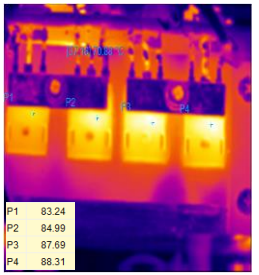
650V/50A High Speed Product

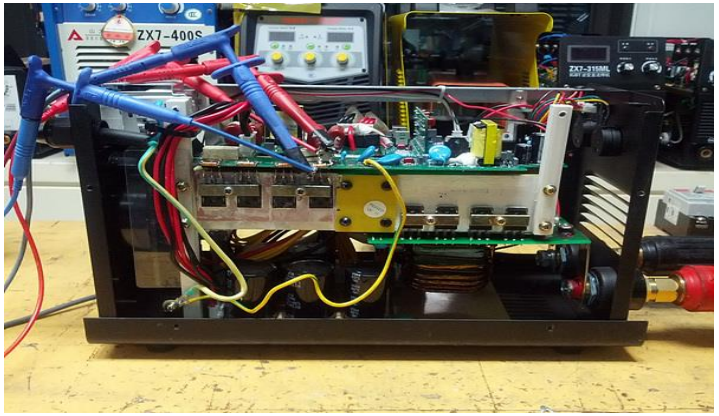
- Better Speed performance with stable temperature condition at Set level

▶ Electrical characteristics test

Item		Test condition	Magnachip		Competitor
			MBQ50T65 FDSC	MBQ50T65 FESC	IKW50N60H3
DC	BV_{CES}	V_{GE}=0V, I_C=1mA	708V	722V	758V
	$V_{CE(SAT)}$	V_{GE}=15V, I_C=40A	1.75V	1.83V	1.82V
	$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1mA	5.49V	5.08V	4.95V
	V_F	I_F=20A	1.39V	1.59V	1.55V
AC	$t_{d(on)}$	V_{CC}=400V, I_C=50A, V_{GE}=±15V, R_G=7.9Ω, Inductive Load	57ns	56ns	42ns
	t_r		63ns	61ns	74ns
	$t_{d(off)}$		321ns	327ns	393ns
	t_f		41ns	43ns	47ns
	E_{on}		0.93mJ	0.84mJ	1.15mJ
	E_{off}		0.58mJ	0.66mJ	0.94mJ
	tsc	V_{CC}=400V, V_{GE}=15V	21us	21us	23us
Internal Rg		-	1Ω	1Ω	-

▶ Set evaluation test

Test condition	Magnachip	Competitor
	MBQ50T65FESC	IKW50N60H3
ARC Welder Full-Bridge Rg=8.2Ω 200A 30kHz	84.1℃	86.2℃
		



Performance

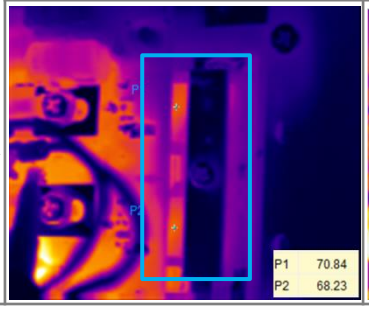
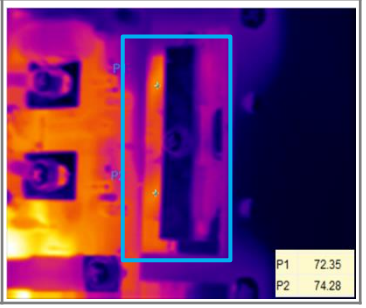
650V/60A High Speed Product

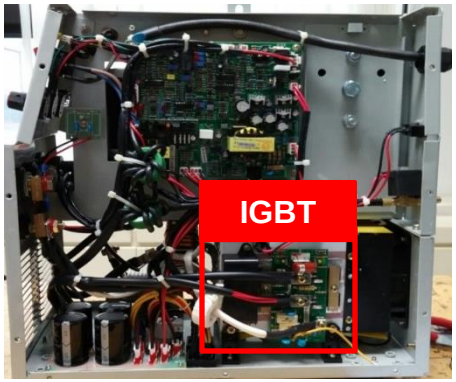
- Better Speed performance with stable temperature condition at Set level

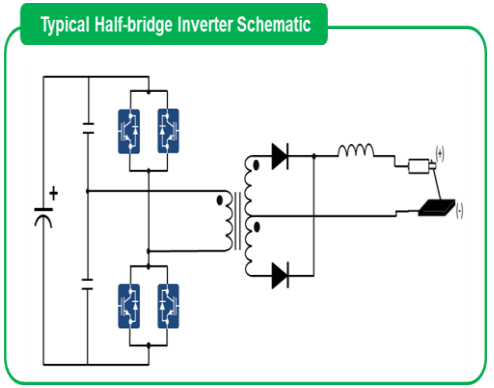
▶ Electrical characteristics test

Item		Test condition	Magnachip	Competitor
			MBQ60T65PES	FGH60N60SMD
DC	BV_{CES}	V_{GE}=0V, I_C=1mA	716V	673V
	$V_{CE(SAT)}$	V_{GE}=15V, I_C=40A	1.82V	1.85V
	$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1mA	4.8V	4.9V
	V_F	I_F=20A	1.6V	2.1V
AC	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	4092pF	5757pF
	C_{res}		837pF	2189pF
	C_{oes}		3663pF	3303pF
	$t_{d(on)}$	V_{CC}=400V, I_C=50A, V_{GE}=±15V, R_G=7.9Ω, Inductive Load Ta=25℃	37ns	41ns
	t_r		44ns	54ns
	$t_{d(off)}$		171ns	285ns
	t_f		50ns	48ns
	E_{on}		0.53mJ	0.61mJ
	E_{off}		0.64mJ	0.75mJ
	tsc	V_{CC}=400V, V_{GE}=15V	12us	20us
	Isc		291A	309A

▶ Set evaluation test

Test condition	Magnachip	Competitor
	MBQ60T65PES	FGH60N60SMD
CO_2 Welder Half-Bridge Rg=22Ω O/P = 16V/190A Fsw = 30kHz	69.5℃	73.3℃
		





Performance

1200V/25A High Speed Product

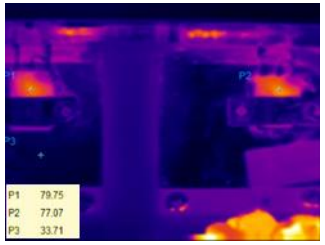
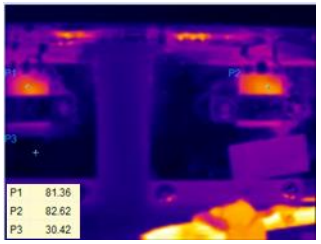
MX LISTED NYSE

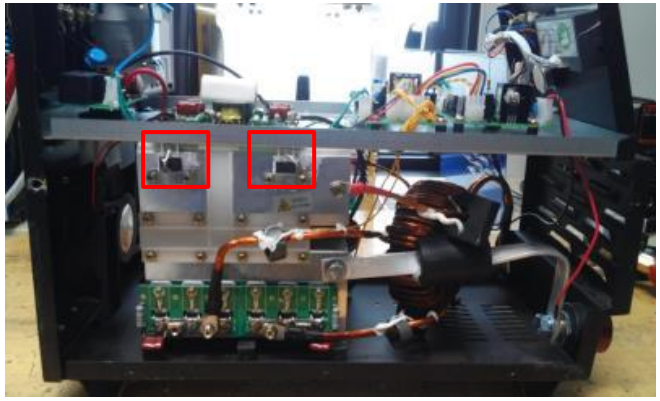
- Better Speed performance with stable temperature condition at Set level

▶ Electrical characteristics test

Item		Test condition	Magnachip	Competitor
			MBQ25T120FESC	IKW25N120H3
DC	BV_{CES}	V_{GE}=0V, I_C=1mA	1329V	1332V
	$V_{CE(SAT)}$	V_{GE}=15V, I_C=40A	1.96V	2.01V
	$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1mA	5.92V	5.98V
	V_F	I_F=25A	3.03V	2.47V
AC	$t_{d(on)}$	V_{CC}=600V, I_C=25A, V_{GE}=±15V, R_G=12Ω, Inductive Load Tc=25℃	74ns	50ns
	t_r		40ns	37ns
	$t_{d(off)}$		319ns	249ns
	t_f		28ns	31ns
	E_{on}		1.15mJ	1.6mJ
	E_{off}		0.81mJ	0.81mJ
	tsc	V_{CC}=400V, V_{GE}=15V	27us	68us
	Isc		167A	87A
Internal Rg		-	1Ω	-

▶ Set evaluation test

Test condition	Magnachip	Competitor
	MBQ25T120FESC	IKW25N120H3
ARC Welder Full-Bridge Rg=20/7.5Ω 250A 23kHz	78.4℃	82.0℃
		



Performance

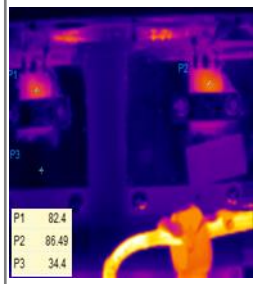
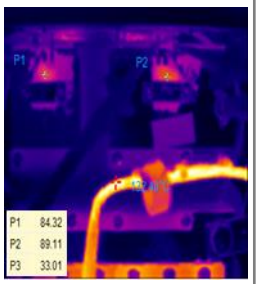
1200V/40A High Speed Product

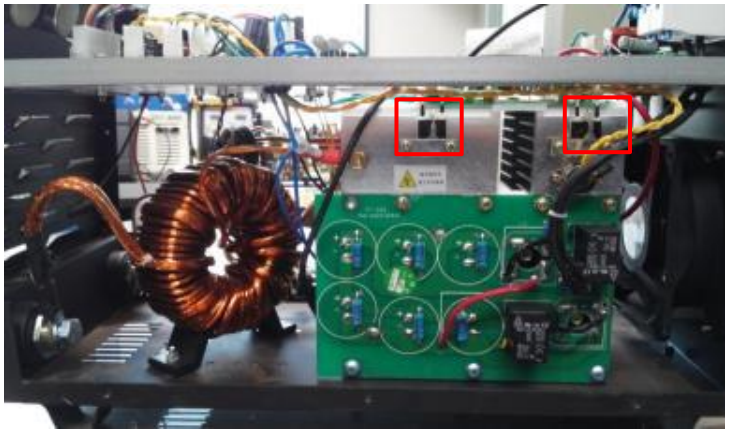
- Better Speed performance with stable temperature condition at Set level

▶ Electrical characteristics test

Item		Test condition	Magnachip		Competitor
			MBQ40T120FDS	MBQ40T120FES	IKW40N120H3
DC	BV_{CES}	V_{GE}=0V, I_C=1mA	1344V	1335	1343V
	$V_{CE(SAT)}$	V_{GE}=15V, I_C=40A	1.90V	1.90V	2.12V
	$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1mA	5.49V	5.49V	5.63V
	V_F	I_F=40A	2.31V	2.16	2.39V
AC	$t_{d(on)}$	V_{CC}=600V, I_C=40A, V_{GE}=±15V, R_G=12Ω, Inductive Load Tc=25℃	84ns	80ns	68ns
	t_r		50ns	38ns	55ns
	$t_{d(off)}$		312ns	348ns	270ns
	t_f		37ns	35ns	40ns
	E_{on}		2.39mJ	1.84	2.81mJ
	E_{off}		0.71mJ	0.71mJ	0.79mJ
	tsc	V_{CC}=400V, V_{GE}=15V	27us	27us	45us
Internal Rg		-	1Ω	1Ω	-

▶ Set evaluation test

Test condition	Magnachip		Competitor
	MBQ40T120FES	MBQ40T120PES	IKW40N120H3
ARC Welder Full-Bridge Rg=8.2Ω 200A 30kHz	84.4℃	82.4℃	86.7℃
			

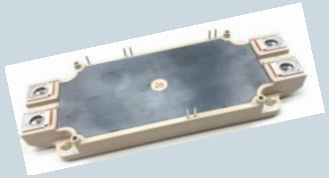


Performance

1200V/100A Module Level Comparison

It seems similar performance which has been applied IFX's IGBT4.

MBW100T120PH Reliability Report

Device	MX (TU Chemnitz test)		IFX (Datasheet) FF300R12ME4		SK (Datasheet) SEMiX303GB12E4p	
$V_{CE(SAT)}$@300A	1.70V		1.75V		1.80V	
Switching Energy Loss	Eon [mJ] (25/150'C)	Eoff [mJ] (25/150'C)	Eon [mJ] (25/150'C)	Eoff [mJ] (25/150'C)	Eon [mJ] (25/150'C)	Eoff [mJ] (25/150'C)
	21/35 *15/28	28/41	10/20	25/42	- /23	- /38
Condition	600V/300A, +/-15V di/dton=2900A/us Rgon/off =1.0Ω *di/dton=3800A/us, *Rgon=0.5Ω		600V/300A, +/-15V di/dton=6050A/us dv/dtoff=3100V/us Rgon/off=1.3Ω		600V/300A, +/-15V di/dton=5600A/us dv/dtoff=3500V/us Rgon/off=1.3Ω	
Module Image						

Performance

1200V/100A Module Chip Comparison

Manufacturer				Magnachip (8”)			IFX (8”)			ABB (6”)			IR (6”)		
Item	**Symbol**	**Condition**	**Unit**	**MBW100T120PH**			**IGC99T120T8RH**			**5SMY12K1280**			**IRGC100B120KB**		
Mechanical parameters	Chip Size		mm	9.588 x 10.49 (100%)			9.5 x 10.39 (98%)			11.9 x 11.2 (133%)			12.396 x 12.396 (153%)		
	Type			FST			FST			SPT			NPT		
	Thickness		um	133 ±5			140			140 ±20			185 ±15		
	Passivation			SiN + Polyimide			Photoimide			SiN + Polyimide					
Maximum ratings	**V_{CES}**	V_{GE}=0V, T_{vj}≥25℃	V	1200			1200			1200			1200		
	I_C		A	100			100			100			100		
	I_{CM}	Limited by T_{vjmax}	A	Depending on thermal properties of assembly			Depending on thermal properties of assembly			200			-		
	V_{GES}		V	±20			±20			±20			±20		
	tsc		us	10			10			10			10		
	T_{vj} ($T_{vj(op)}$)		℃	-40 ~ 175			-40 ~ 175			175 (-40~150)			150		
	Symbol	Condition	Unit	min	typ	max	min	typ	max	min	typ	max	min	typ	max
Static	**BV_{CES}**	I_C=1mA	**V**	1200	-	-	1200	-	-	1200	-	-	1200	-	-
	$V_{CE(sat)}$	V_{GE}=15V, I_C=100A	**V**	1.45	1.70	1.95	1.48	1.70	1.92	-	1.90	2.20	-	2.30	2.60
	$V_{GE(th)}$	I_C=4mA, V_{GE}=V_{CE}	**V**	5.1	5.8	6.5	5.1	5.8	6.4	5.0	-	7.0	4.5	-	6.0
	r_G		**Ω**	-	5.0	-	-	7.5	-	-	2.0	-			

Thank you !

Contact information :

Jason.park@magnachip.com

+82-43-718-4706