



Analog & Mixed Signal Company

IGBT

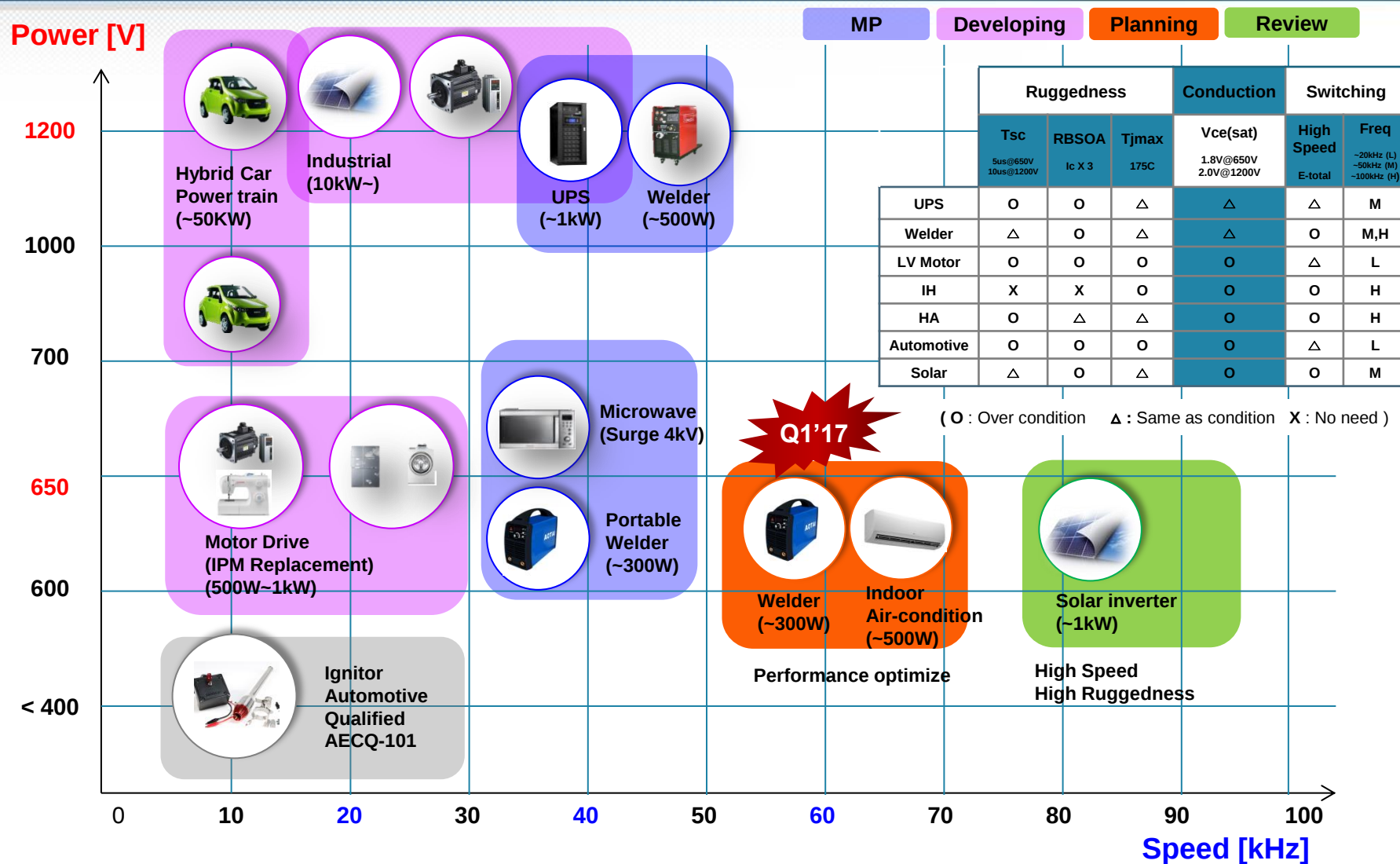
SPG Power marketing

Oct. 2016



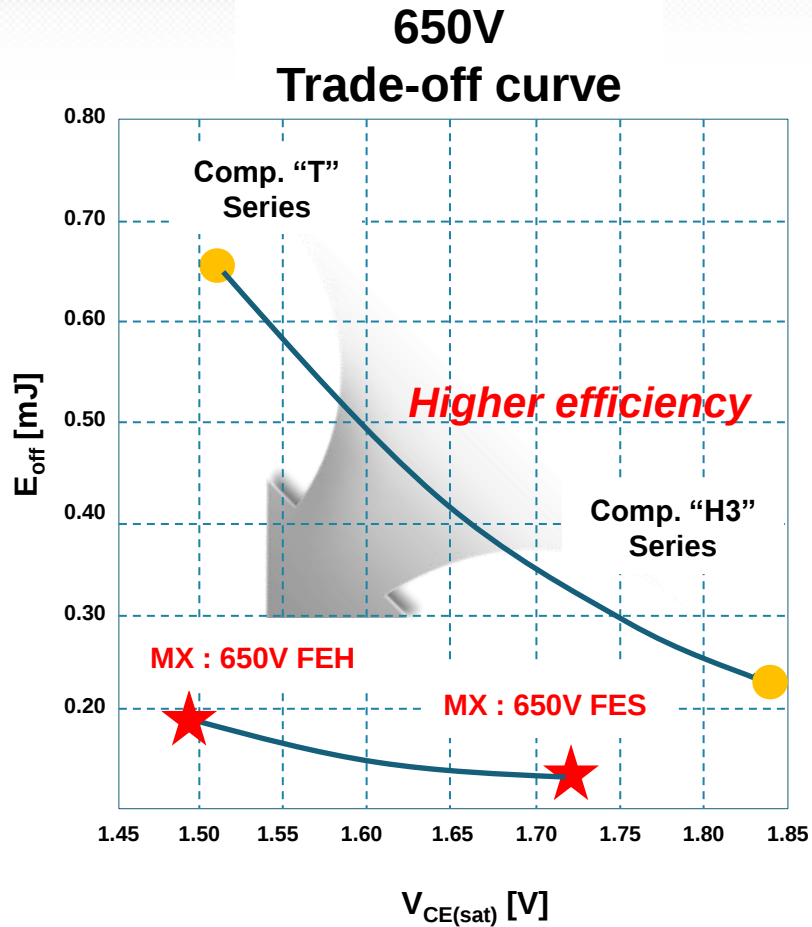
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Applications



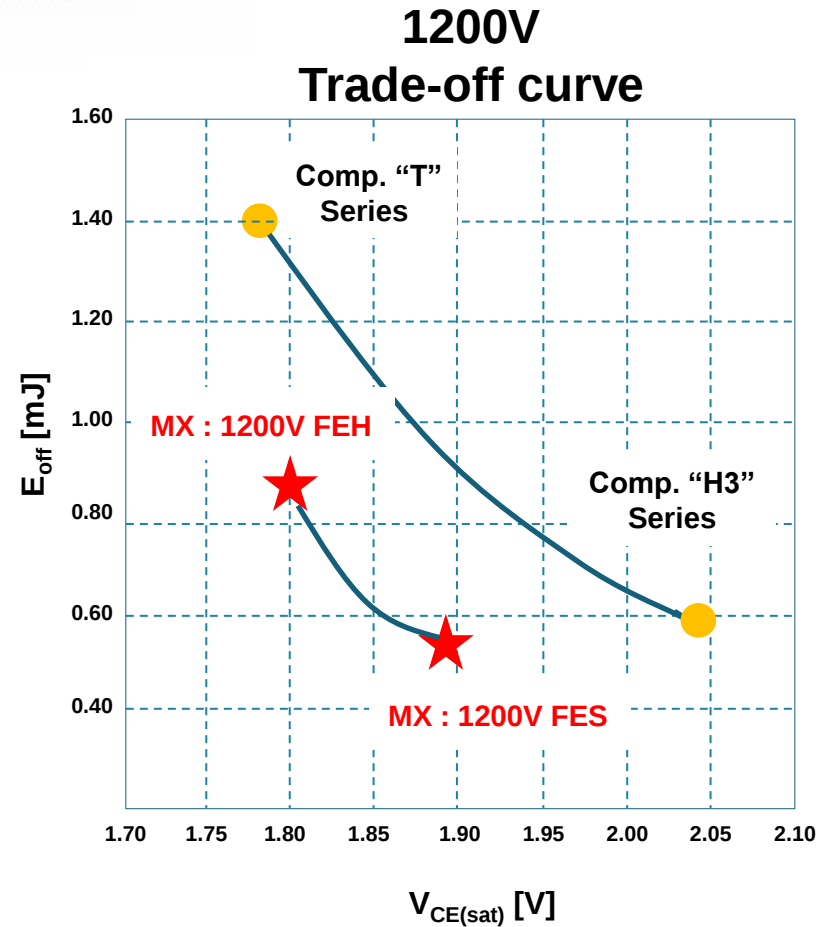
Performance [F Family]

Best in the trade-off curve $V_{CE(sat)}$ vs. E_{off}



Test condition :

$V_{CC}=400V$, $I_C=40A$, $V_{GE}=15V$, $R_G=5\Omega$, $T_j=25^\circ C$



Test condition :

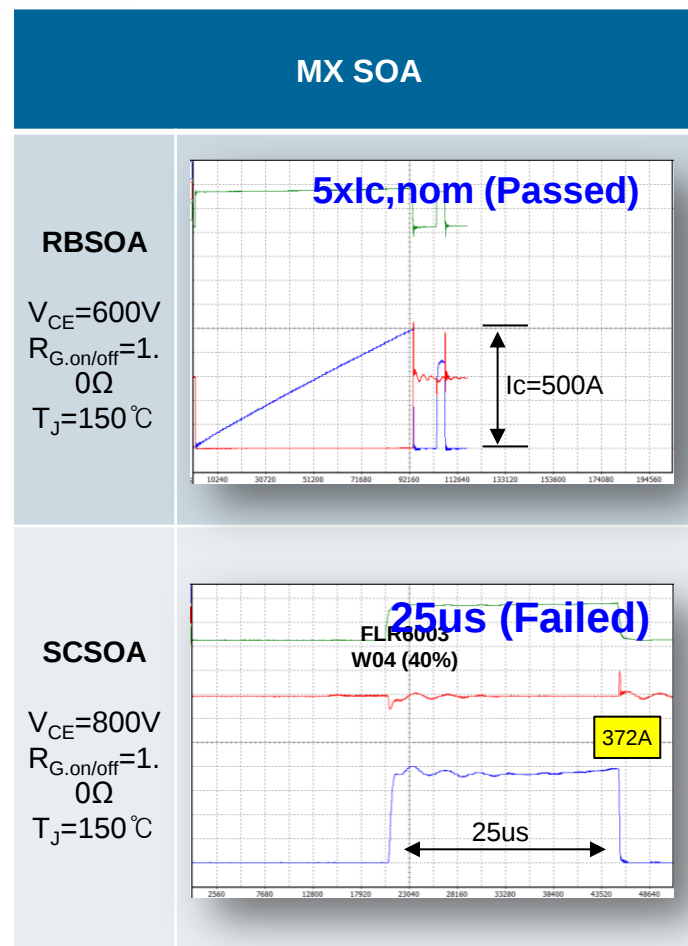
$V_{CC}=600V$, $I_C=40A$, $V_{GE}=15V$, $R_G=10\Omega$, $T_j=25^\circ C$

Performance [P Family]

Best performance 1200V 100A IGBT



	Test conditions	Limit	Magnachip	Competitor "I"
$V_{BR(CES)}$	$I_c=3mA, T_J=25^{\circ}C$	$>1250V$	1410V	1352V
$V_{CE(sat)}$	$I_c=100A, T_J=25^{\circ}C$	$1.8V \pm 0.25V$	1.82V	1.85V
RBSOA	$I_c=300A, V_{ce}=600V$ $R_{g,on/off}=1.0$ $V_{ge}=-15V/+15V$ $T_J=150^{\circ}C$	$3 \times I_{c,nom}$	Passed	Passed
SCSOA	$V_{ce}=800V$ $R_g=1.0\Omega$ $T_J=150^{\circ}C$	$>10\mu s$	Passed	Passed
Eon	$I_c=100A, V_{ce}=600V$ $R_{g,on/off}=1.0\Omega$ $V_{ge}=-15V/+15V$ $T_J=150^{\circ}C$	cf. ref	9.0mJ (Rg=5.5Ω)	12.5mJ (Rg=6.7Ω)
Eoff		cf. ref	10.9mJ	10.3mJ



650V Line-up

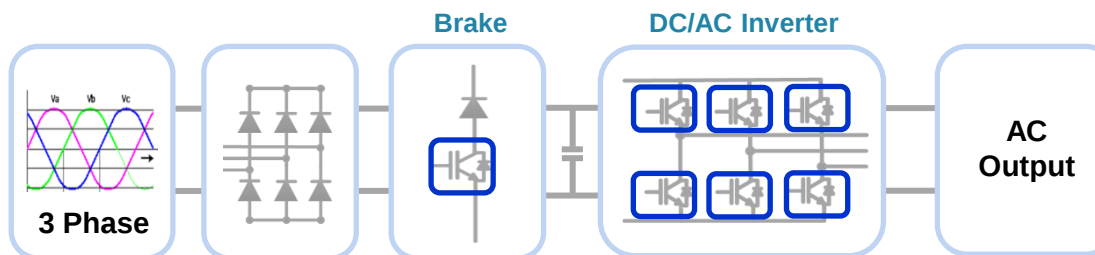
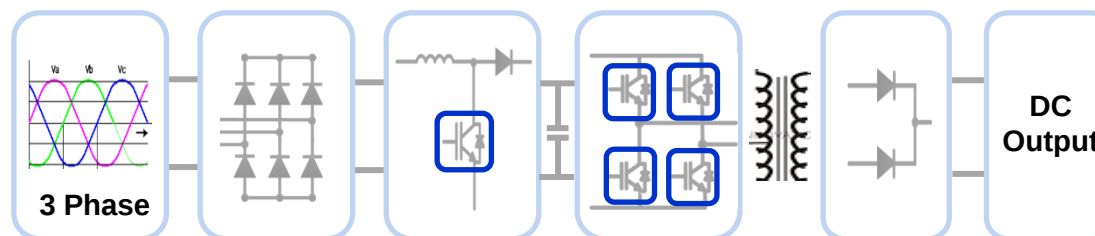
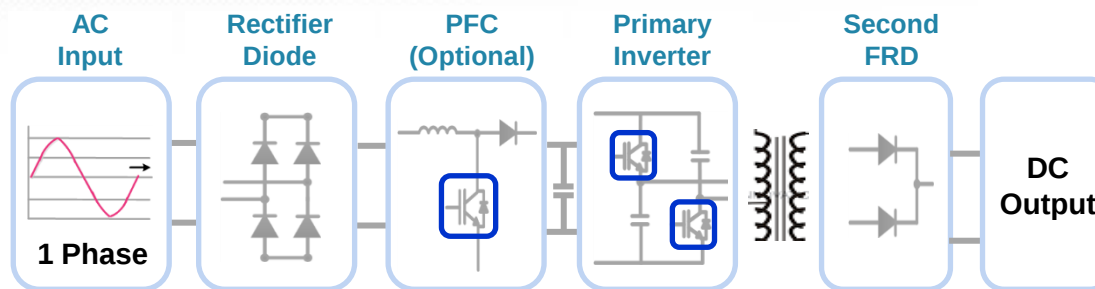
Part No.	I _C [A]	V _{CE(sat)} [V]	E _{on} [mJ]	E _{off} [mJ]	Package	Description	Status (*E/S)
MBF15T65PEH TH	15A	1.8	0.26	0.14	TO220FP	Low Conduction High Ruggedness	*Oct. '16
MBQ40T65FES ^{CTH}	40A	1.95	1.15	0.35	TO247	High speed	MP
MBQ40T65QES TH	40A	1.8	0.85	0.29		Low Conduction Ultra High Speed	* Mar. '17
MBQ50T65FES ^{CTH}	50A	1.95	1.4	0.37		High speed	MP
MBQ60T65PE ^{STH}	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]	E _{on} [mJ]	E _{off} [mJ]	Package	Description	Status (*E/S)
MBQ25T120FES ^{CTH}	25A	2.0	1.44	0.55	TO247	High speed	MP
MBQ40T120FES TH	40A	2.0	1.96	0.54	TO247	High speed	MP
MBQ40T120QES TH	40A	2.0	TBD	TBD	TO247	High speed	* May. '17
MBW50T120PH ^{WH}	50A	1.8@25C	TBD@150C	TBD@150C	Sawn on foil	Low conduction High Ruggedness	* Jan. '17
MBW100T120PH ^{WH}	100A	1.8@25C	9@150C	10.9@150C	Sawn on foil	Low conduction High Ruggedness	* Dec. '16

Applications

Welder and Motor



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

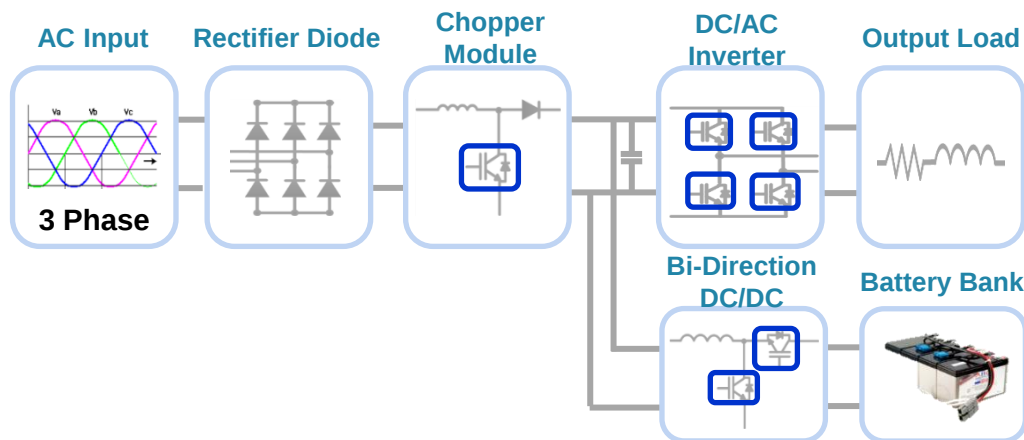
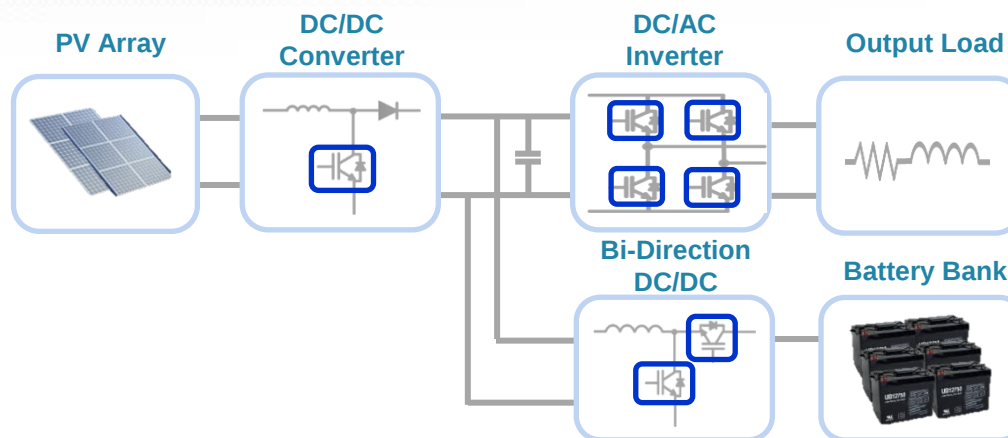
Discrete IGBT		
[V]	Part #	[A]
1200	MBQ25T120FESCTH	25
1200	MBQ40T120FESTH	40

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

* : Under developing

Applications

Solar and UPS



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

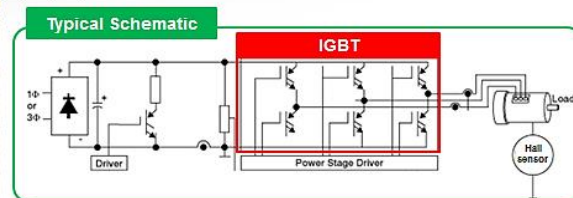


- High ruggedness performance with stable temperature condition at Set level

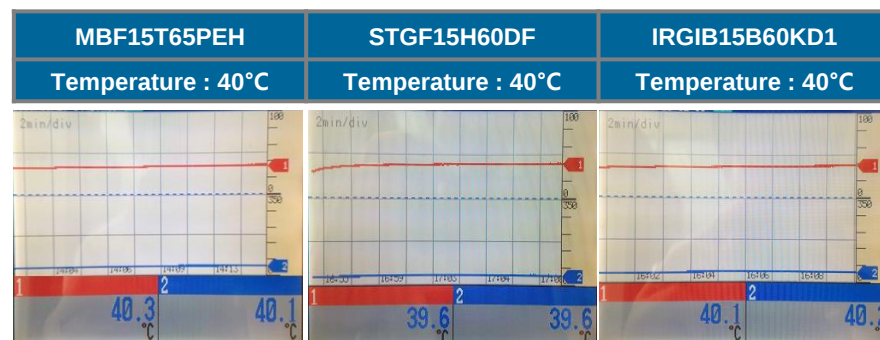
► Electrical characteristics test

Test Item		Magnachip	Competitor	
		MBF15T65PEH	STGF15H60DF	IRGIB15B60KD1
DC	Vsat @15A[V]	1.8	1.55	1.8
	Vth@500uA [V]	6.2	5.9	4.6
	VF@15A [V]	1.8	1.8	1.6
AC	Tr [ns]	23	23	22
	Tf [ns]	103	109	112
	Eon [mJ]	0.26	0.20	0.21
	Eoff [mJ]	0.14	0.16	0.17
	Etot [mJ]	0.40	0.36	0.38
FRD S/W	Trr [ns]	47	41	43
	Irr [A]	14	16	17
Rugged	RBSOA	Icex5 OK	Icex4 OK	Icex4 OK
Short Circuit	Temp=150°C, Vcc=360V	11us	5us	12us

► Set evaluation test



MBF15T65PEH							Company "S"							Company "I"						
Efficiency : 91.1%							Efficiency : 91.5%							Efficiency : 91.3%						
Voltage Current	Element1 200V	Element2 150V	Element3 162.02V	Element4 159.65V	ΣAC(V3A)		Voltage Current	Element1 200V	Element2 150V	Element3 162.02V	Element4 159.65V	ΣAC(V3A)		Voltage Current	Element1 200V	Element2 150V	Element3 162.02V	Element4 159.65V	ΣAC(V3A)	
Urms [V]	220.03	0.1610	162.02	159.78	160.97		Urms [V]	220.03	160.25	162.25	159.65	160.72		Urms [V]	220.05	160.20	159.29	161.25	160.75	
Irms [A]	1.7293	0.9632	0.9187	1.0128	0.9849		Irms [A]	1.7326	0.9212	0.9125	0.9887	0.9628		Irms [A]	1.7153	0.9377	0.8749	0.9850	0.9320	
P [W]	0.18364	80.17	87.04	-3.05	167.21		P [W]	0.17123	74.47	87.60	-2.84	162.07		P [W]	0.17248	80.75	76.58	-7.90	157.39	
S [VA]	0.39373	155.17	158.56	161.83	274.57		S [VA]	0.38126	147.62	157.82	157.84	267.47		S [VA]	0.37926	150.21	163.35	159.02	258.99	
Q [var]	-0.34638	132.85	132.54	161.80	265.39		Q [var]	-0.33758	127.45	131.28	157.82	258.73		Q [var]	-0.33538	126.67	116.43	158.82	243.69	
A [°]	0.4663	0.5167	0.5489	-0.0189	0.6090		A [°]	0.4646	0.5045	0.5551	-0.0180	0.6090		A [°]	0.4572	0.5376	0.5495	-0.0497	0.6070	
φ [°]	0.62.21	0.58.85	0.56.71	0.91.08	52.48		φ [°]	0.62.21	0.59.70	0.56.29	0.91.03	52.70		φ [°]	0.62.79	0.57.48	0.56.67	0.92.85	52.57	
W [Hz]	59.990	15.1306	15.0416	14.8488			W [Hz]	59.994	15.1506	15.1738	15.0003			W [Hz]	59.990	15.1288	15.2638	15.2288		
f1 [Hz]	59.994	2.07758	2.41008	1.80918			f1 [Hz]	60.025	1.95458	2.16648	2.12506			f1 [Hz]	60.012	2.01196	2.16648	1.67696		
Efficiency							Efficiency							Efficiency						
η1	91.089 [%]						η1	91.470 [%]						η1	91.276 [%]					
η2	[%]						η2	[%]						η2	[%]					
η3	[%]						η3	[%]						η3	[%]					
η4	[%]						η4	[%]						η4	[%]					



Performance

650V/40A High Speed Product

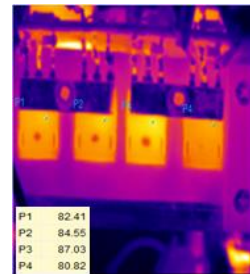
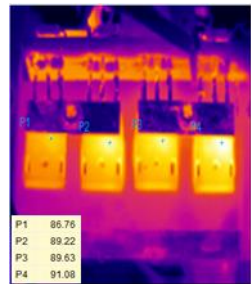


- Better Speed performance with stable temperature condition at Set level

► 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	$t_{d(on)}$	$V_{CC}=400V, I_C=40A, V_{GE}=\pm 15V, R_G=7.9\Omega, \text{Inductive Load}, T_a=25^\circ C$	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
	t_{sc}		23us	23us	21us
Internal R_g		-	1 Ω	1 Ω	-

► Set evaluation test

Test condition	Magnachip	Competitor
	MBQ40T65FESC	IKW40N60H3
ARC Welder	83.7℃	89.2℃
	Full-Bridge $R_g=8.2\Omega$ 200A 30kHz 	



Performance

650V/50A High Speed Product

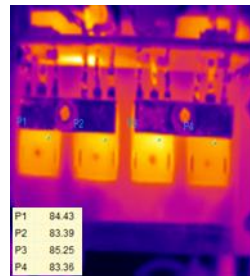


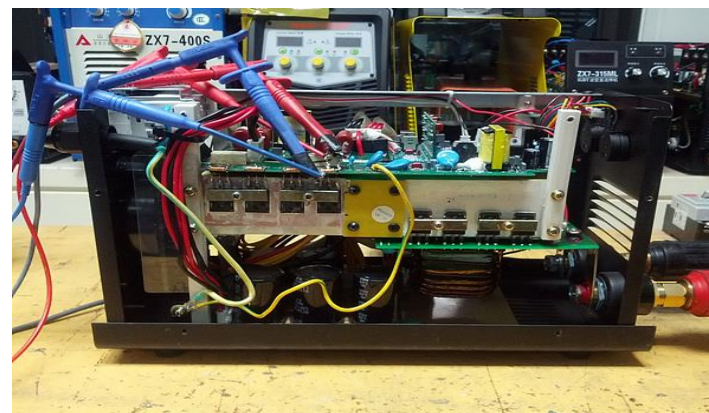
- Better Speed performance with stable temperature condition at Set level

► 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	$t_{d(on)}$	$V_{CC}=400V, I_C=50A, V_{GE}=\pm 15V, R_G=7.9\Omega, \text{Inductive Load}, T_a=25^\circ C$	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
	t_{sc}		21us	21us	23us
Internal R_g		-	1 Ω	1 Ω	-

► Set evaluation test

Test condition	Magnachip	Competitor
	MBQ50T65FESC	IKW50N60H3
ARC Welder Full-Bridge $R_g=8.2\Omega$ 200A 30kHz	84.1 $^\circ C$	86.2 $^\circ C$
		



Performance

650V/60A High Speed Product

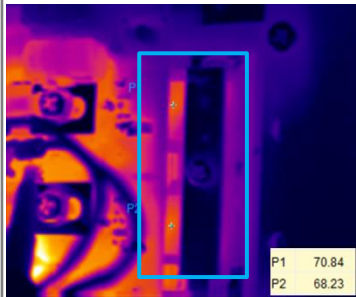
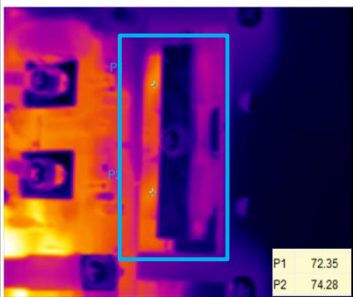


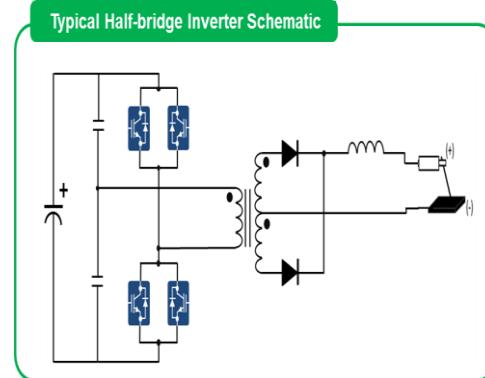
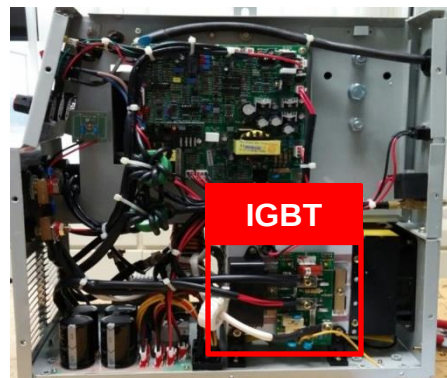
- Better Speed performance with stable temperature condition at Set level

► 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
	$t_{d(on)}$	$V_{CC}=400V,$ $I_C=50A,$ $V_{GE}=\pm 15V,$ $R_G=7.9\Omega,$ Inductive Load $T_a=25^\circ C$	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
	t_{sc}	$V_{CC}=400V,$ $V_{GE}=15V$	12us	20us
	I_{sc}		291A	309A

► Set evaluation test

Test condition	Magnachip	Competitor
	MBQ60T65PES	FGH60N60SMD
CO ₂ Welder Half-Bridge $R_g=22\Omega$ O/P = 16V/190A Fsw = 30kHz	69.5°C	73.3°C
		



Performance

1200V/25A High Speed Product

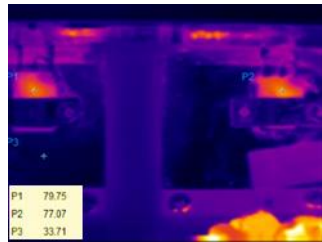
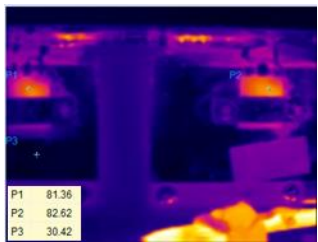


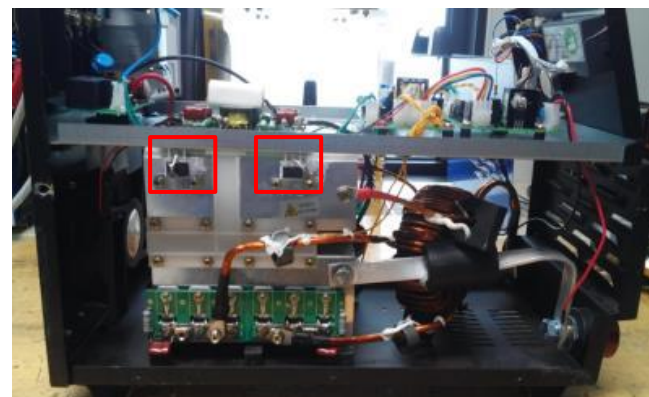
- Better Speed performance with stable temperature condition at Set level

► 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	$t_{d(on)}$	$V_{CC}=600V,$ $I_C=25A,$ $V_{GE}=\pm 15V,$ $R_G=12\Omega,$ Inductive Load $T_c=25^\circ C$	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
	t_{sc}	$V_{CC}=400V,$ $V_{GE}=15V$	27us	68us
	I_{sc}		167A	87A
Internal Rg		-	1 Ω	-

► Set evaluation test

Test condition	Magnachip	Competitor
	MBQ25T120FESC	IKW25N120H3
ARC Welder Full-Bridge $R_g=20/7.5\Omega$ 250A 23kHz	78.4 $^\circ C$	82.0 $^\circ C$
		



Performance

1200V/40A High Speed Product

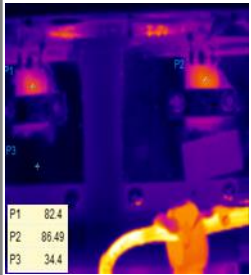


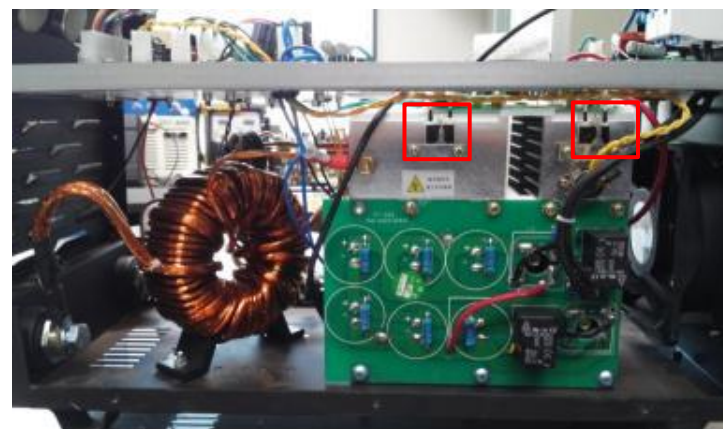
- Better Speed performance with stable temperature condition at Set level

► 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	$t_{d(on)}$	$V_{CC}=600V, I_C=40A, V_{GE}=\pm 15V, R_G=12\Omega, \text{Inductive Load}, T_c=25^\circ C$	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
	t_{sc}		27us	27us	45us
Internal R_g		-	1 Ω	1 Ω	-

► Set evaluation test

Test condition	Magnachip		Competitor
	MBQ40T120FES	MBQ40T120PES	IKW40N120H3
ARC Welder Full-Bridge $R_g=8.2\Omega$ 200A 30kHz	84.4 $^\circ C$	82.4 $^\circ C$	86.7 $^\circ C$
			



Thank you !

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