

MagnaChip

Analog & Mixed Signal Company

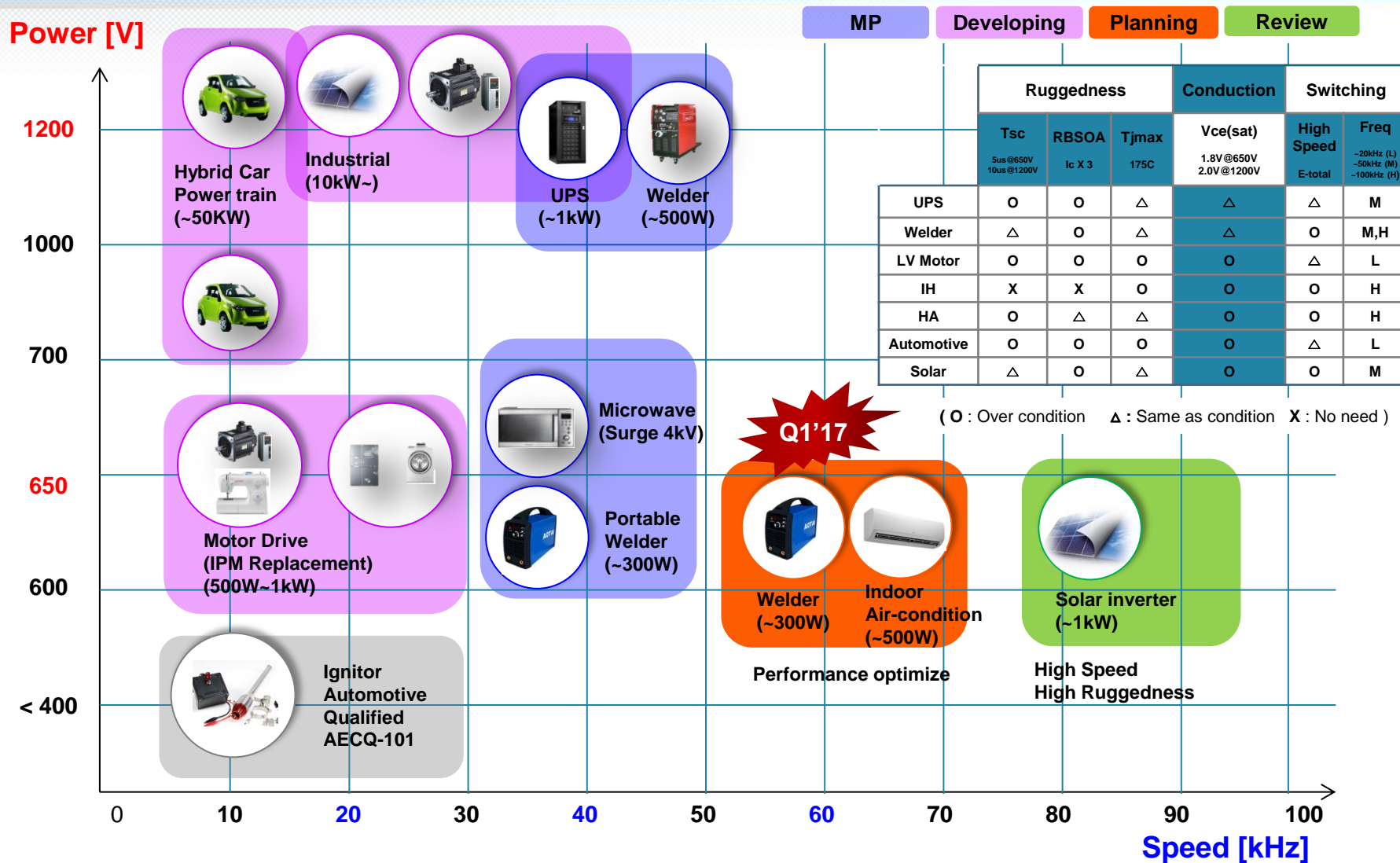
IGBT

SPG Power marketing

Oct. 2016

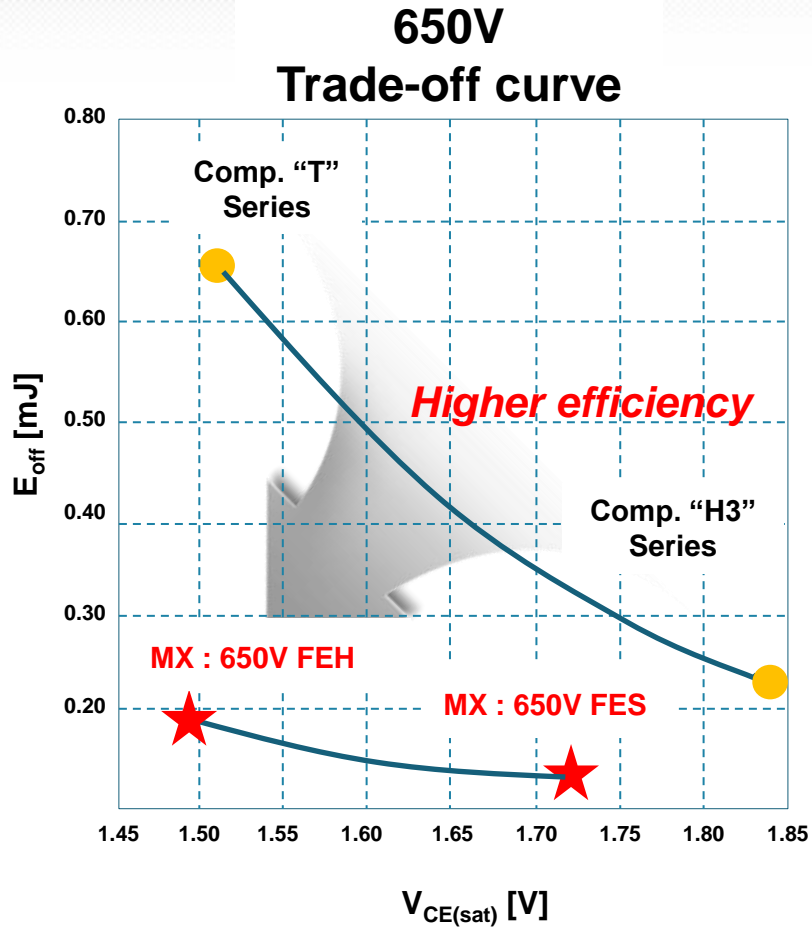


Applications



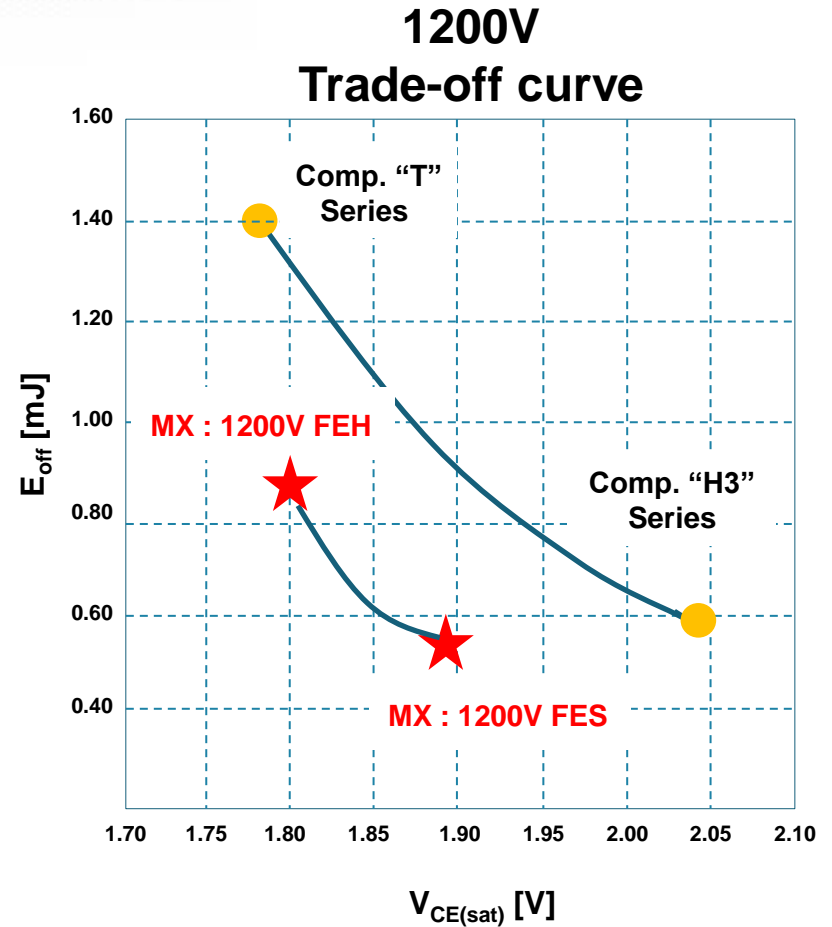
Performance [F Family]

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 "1" |
|---------------|---|----------------------|------------------------|-------------------------|
| $V_{BR(CES)}$ | $I_c=3mA, T_J=25^{\circ}C$ | $>1250V$ | 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 | $T_J=150^{\circ}C$ | cf. ref | 10.9mJ | 10.3mJ |

MX SOA

RBSOA

$V_{CE}=600V$
 $R_{G,on/off}=1.0\Omega$
 $T_J=150^{\circ}C$

SCSOA

$V_{CE}=800V$
 $R_{G,on/off}=1.0\Omega$
 $T_J=150^{\circ}C$

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

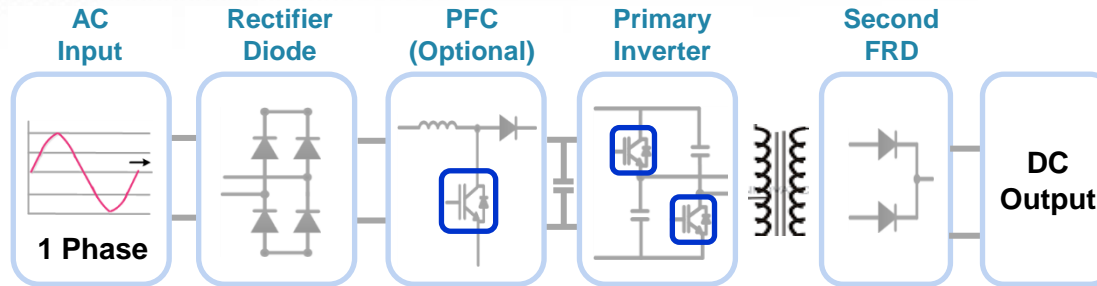
| Part No. | I _c [A] | V _{CE(sat)} [V] | E _{on} [mJ] | E _{off} [mJ] | Package | Description | Status (*E/S) |
|-----------------------------|--------------------|--------------------------|----------------------|-----------------------|--------------|-----------------------------------|---------------|
| 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

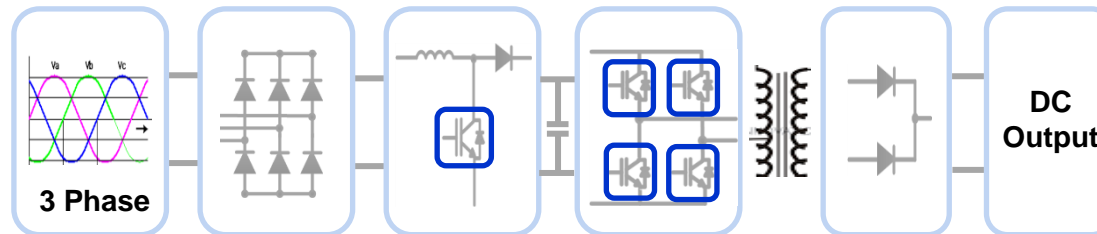

Welder and Motor



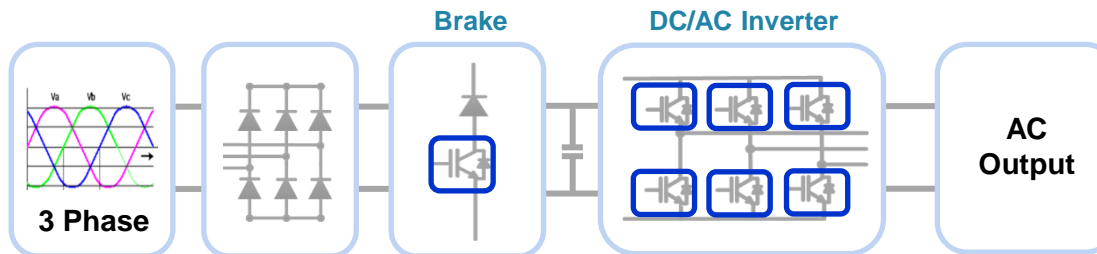
Half Bridge Topology
220V




Full Bridge Topology
380V

3Φ Motor
Low Power



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

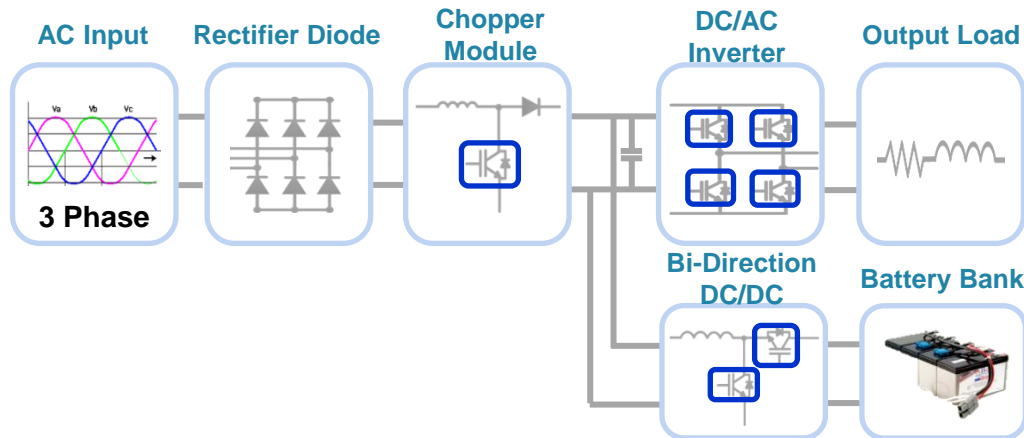
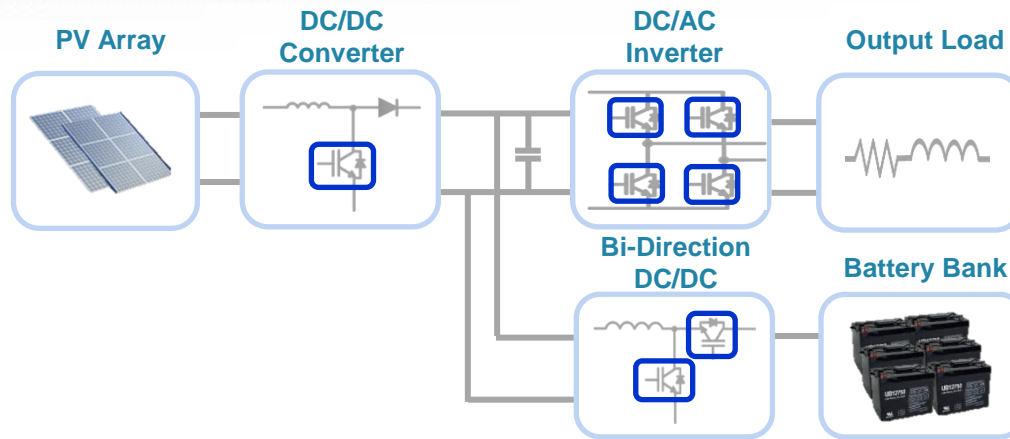
| Discrete IGBT | | |
|---------------|-----------------|-----|
| [V] | Part # | [A] |
| 1200 | MBQ25T120FESCTH | 25 |
| 1200 | MBQ40T120FESTH | 40 |

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

* : Under developing

Applications

Solar and UPS



| 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

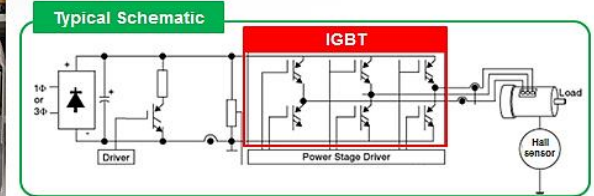


- High ruggedness performance with stable temperature condition at Set level

► 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% |
| | | |

| MBF15T65PEH | STGF15H60DF | IRGIB15B60KD1 |
|--------------------|--------------------|--------------------|
| Temperature : 40°C | Temperature : 40°C | Temperature : 40°C |
| | | |

Performance

650V/40A High Speed Product



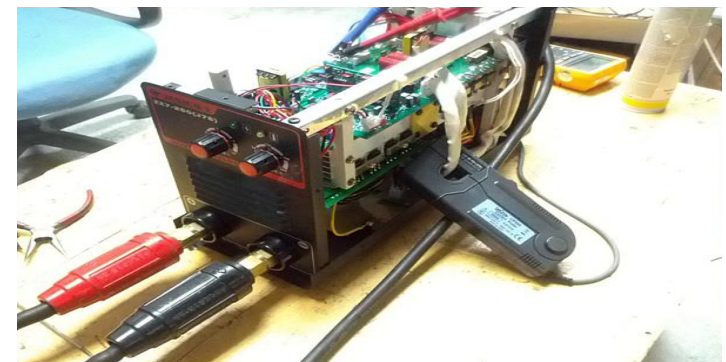
- Better Speed performance with stable temperature condition at Set level

► 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 | $t_{d(on)}$ | $V_{CC}=400V,$ $I_C=40A,$ $V_{GE}=\pm 15V,$ $R_G=7.9\Omega,$ 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} | | $V_{CC}=400V,$ $V_{GE}=15V$ | 23us | 23us |
| Internal R_g | - | 1 Ω | 1 Ω | - | |

► Set evaluation test

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



Performance

650V/50A High Speed Product

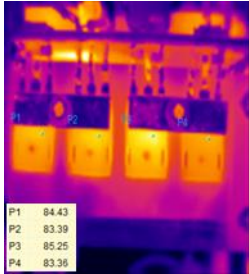



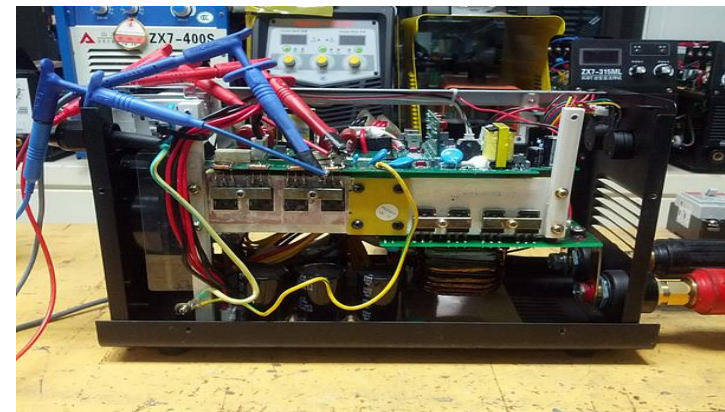
- Better Speed performance with stable temperature condition at Set level

► 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} | | $V_{CC}=400V, V_{GE}=15V$ | 21us | 21us |
| Internal Rg | - | 1Ω | 1Ω | - | |

► Set evaluation test

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



Performance

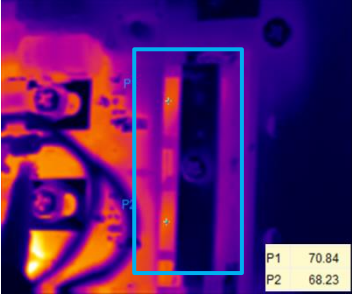
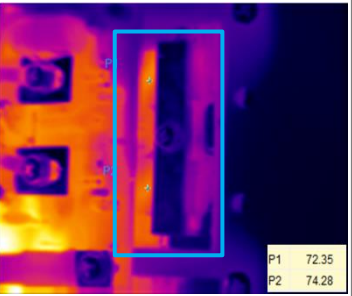
650V/60A High Speed Product

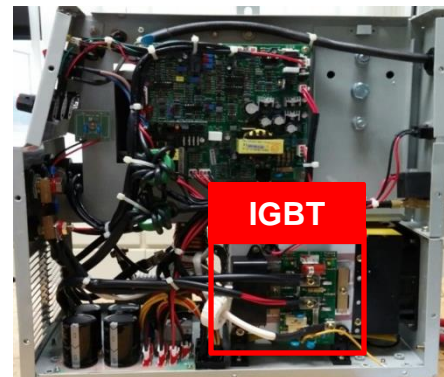
- Better Speed performance with stable temperature condition at Set level

► Electrical characteristics test

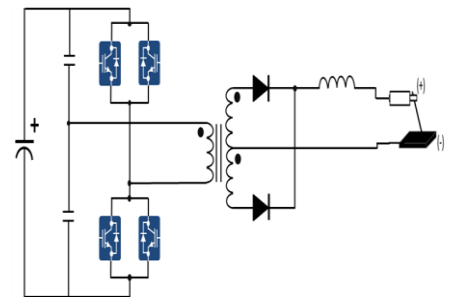
| Item | | Test condition | Magnachip | Competitor |
|------|---------------|---|--------------------------------|-------------|
| | | | MBQ60T65PES | FGH60N60SMD |
| DC | BV_{CES} | $V_{GE}=0V, I_C=1mA$ | 716V | 673V |
| | $V_{CE(SAT)}$ | $V_{GE}=15V, I_C=40A$ | 1.82V | 1.85V |
| | $V_{GE(th)}$ | $V_{CE}=V_{GE}, I_C=1mA$ | 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 |
| | I_{sc} | 291A | | 309A |

► Set evaluation test

| Test condition | Magnachip | Competitor |
|---|---|---|
| | MBQ60T65PES | FGH60N60SMD |
| | 69.5°C | 73.3°C |
| CO ₂ Welder Half-Bridge R _g =22Ω O/P = 16V/190A F _{sw} = 30kHz |  |  |



Typical Half-bridge Inverter Schematic



Performance

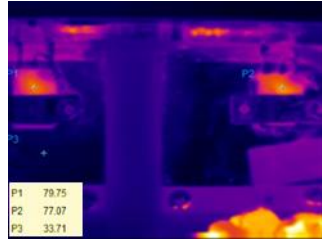
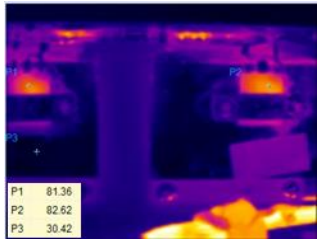
1200V/25A High Speed Product

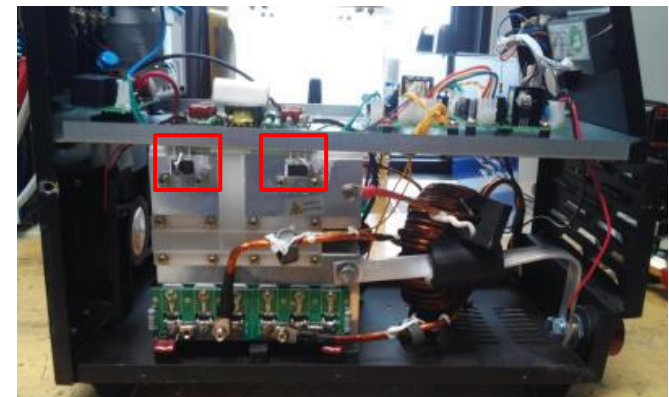
- Better Speed performance with stable temperature condition at Set level

► 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 Rg=20/7.5 Ω 250A 23kHz | 78.4 $^\circ C$ | 82.0 $^\circ C$ |
| |  |  |



Performance

1200V/40A High Speed Product

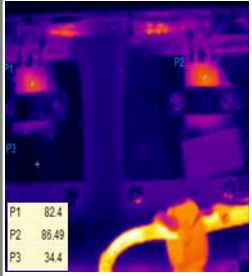




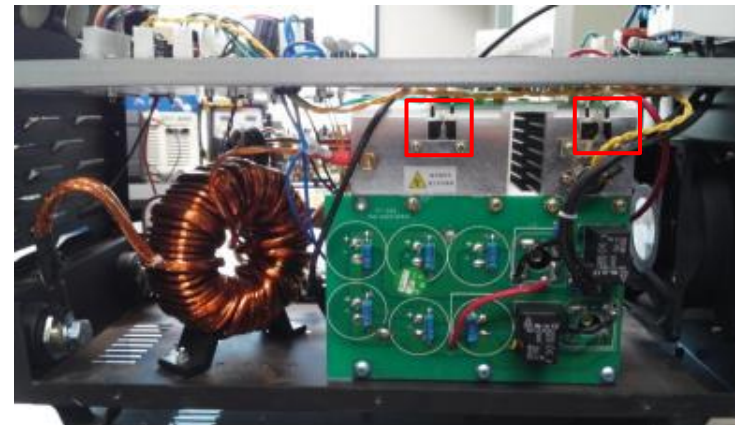
- Better Speed performance with stable temperature condition at Set level

► Electrical characteristics test

► Set evaluation 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} | | $V_{CC}=400V, V_{GE}=15V$ | 27us | 27us |
| Internal R_g | - | 1 Ω | 1 Ω | - | |

| 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 !

Contact information :

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