

**Key data**

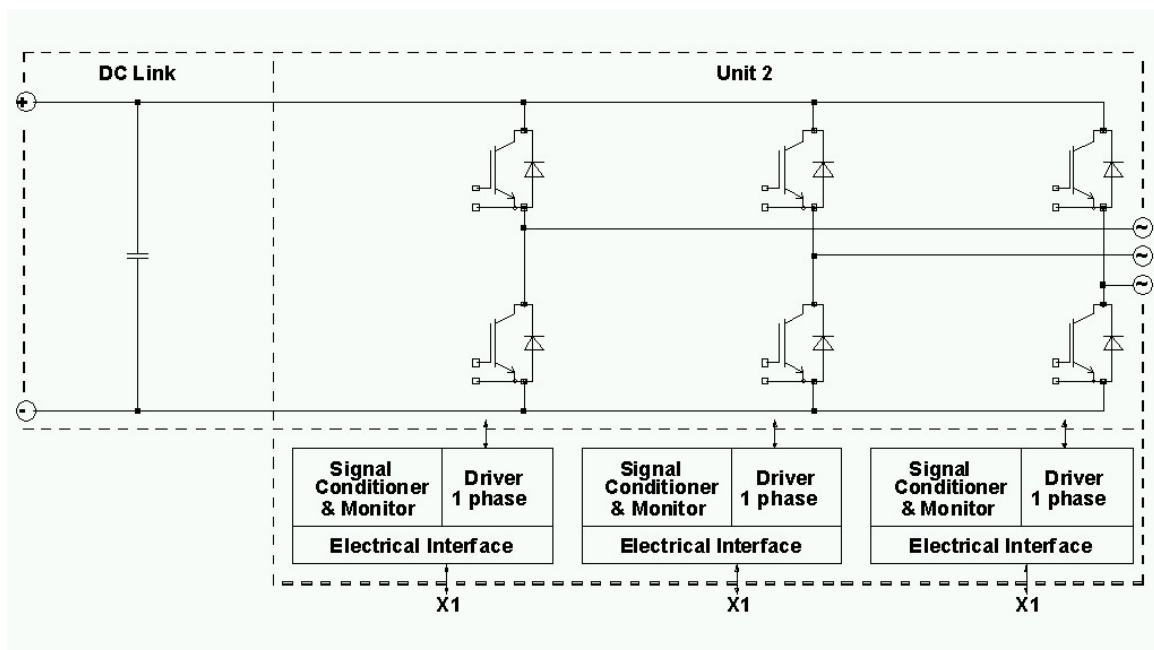
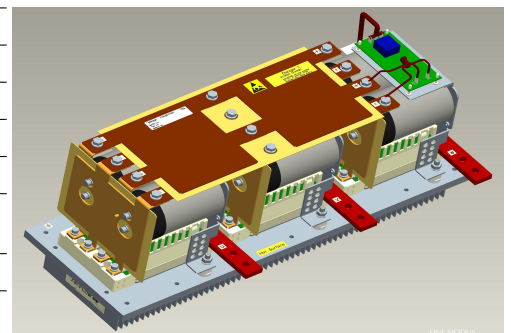
3x 306A rms at 400V rms, forced air (fan not implemented)

**General information**

Stacks for various inverter application. IGBT's, heat sinks, capacitors, drivers and sensors included.

Please read carefully the complete document and maintain the proper design environment!

|                           |                                  |                |
|---------------------------|----------------------------------|----------------|
| Topology                  | B6I                              |                |
| Application / Modulation  | Inverter / Sine                  |                |
| Load type                 | resistive, inductive             |                |
| Cooling                   | forced air (fan not implemented) |                |
| Implemented sensors       | current, voltage, temperature    |                |
| Semicond. (Unit 1)        | none                             |                |
| DC Link                   | 2.4mF                            |                |
| Semicond. (Unit 2)        | IGBT                             | 6x FF200R12KE4 |
| Driver signals IGBT       | electrical CMOS<br>0 .. 15V      |                |
| Standards                 | EN50178, UL94                    |                |
| Sales - name              | 6PS04012E4DG36022                |                |
| Internal ID               | 36022                            |                |
| Mechanical drawing number | 36022_MB                         |                |
| Electrical drawing number | 2PS-CD-V                         |                |



|                 |                                 |
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## Preliminary data

### Notes

Overvoltage sensor is located only in the middle phase.

### Electrical data

| DC Link              |                     |          | min | typ | max | units |
|----------------------|---------------------|----------|-----|-----|-----|-------|
| Voltage              |                     | $V_{DC}$ |     | 650 | 850 | V     |
| Overvoltage shutdown | within 5000 $\mu$ s |          |     | 850 |     | V     |

| Unit 2 AC                        |   |                      | min   | typ  | max   | units      |
|----------------------------------|---|----------------------|-------|------|-------|------------|
| Voltage                          | depending on controller   | $V_{Unit2}$          |       | 400  |       | $V_{RMS}$  |
| Continuous current               | $V_{Unit2} = 400V_{RMS}$ , $V_{DC} = 650V$ , $T_{inlet} = 40^{\circ}C$ ,<br>$T_J \leq 125^{\circ}C$ , $f_{Unit2} = 50Hz$ , $f_{sw2} = 5000Hz$ ,<br>$\cos(\phi) = 0,85$                      | $I_{Unit2}$          |       |      | 306   | $A_{RMS}$  |
| Continuous current overload cap. | $T_{inlet} = 40^{\circ}C$ , for overload capability 150% for 60s  |                      |       | 217  |       | $A_{RMS}$  |
| DC current                       | no rotating field, $T_{inlet} = 40^{\circ}C$  | $I_{Unit2 DC}$       |       |      | 159,0 | $A_{av}$   |
| Overcurrent shutdown             | within 15 $\mu$ s   |                      |       | 640  |       | $A_{peak}$ |
| Switching frequency              |   | $f_{sw2}$            |       |      | 20000 | Hz         |
| Power losses                     | $V_{Unit2} = 400V$ , $V_{DC} = 650V$ , $T_{inlet} = 40^{\circ}C$ ,<br>$T_J \leq 125^{\circ}C$ , $f_{Unit2} = 50Hz$ , $f_{sw2} = 5000Hz$ ,<br>$\cos(\phi) = 0,85$ , $I_{Unit2} = 306A_{RMS}$ | $P_{loss2}$          |       | 3030 |       | W          |
| Power factor                     |   | $\cos(\phi)_{Unit2}$ | -1,00 |      | 1,00  |            |

| General data                          |  |                | min         | typ | max | units      |
|---------------------------------------|--|----------------|-------------|-----|-----|------------|
| Power losses (PCB)                    |  | $P_{loss aux}$ |             |     | 40  | W          |
| EMC test                              | according to IEC61800-3 at named interfaces  | power          | $V_{Burst}$ | 2   |     | kV         |
|                                       |  | control        | $V_{Burst}$ | 1   |     | kV         |
|                                       |  | aux (24V)      | $V_{Surge}$ | 1   |     | kV         |
| Insulation management is designed for |  | $V_{Line}$     |             | 690 |     | $V_{RMS}$  |
| Insulation test voltage               | according to EN50178, $f = 50Hz$ , $t = 60s$ | $V_{isol}$     |             | 2,5 |     | $kV_{RMS}$ |

| Important component data       |                                     |            | min | typ    | max | units       |
|--------------------------------|-------------------------------------|------------|-----|--------|-----|-------------|
| DC Link capacitor              |                                     | $C_{DC}$   |     | 2,40   |     | mF          |
|                                |                                     | type       |     | Foil   |     |             |
| Temperature range              |                                     |            | -40 |        | +85 | $^{\circ}C$ |
| Rated voltage                  | per device                          | $U_R$      |     | 1100   |     | $V_{DC}$    |
| Rated capacitance              | per device                          | $C_R$      |     | 400    |     | $\mu F$     |
| Capacitance tolerance          | per device                          | Tol        | -10 |        | +10 | %           |
| Maximum ripple current         | per device, $T_{amb} = 55^{\circ}C$ | $I_{Rmax}$ |     |        | 45  | $A_{RMS}$   |
| wiring system                  | series, parallel                    |            |     | 1s, 6p |     |             |
| Balance or discharge resistors | per DC Link unit                    | $R_b$      |     | 164,0  |     | $k\Omega$   |

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### Controller interface data

|                               |   |                  | min                       | typ  | max  | units    |
|-------------------------------|---|------------------|---------------------------|------|------|----------|
| Auxiliary voltage             |   | $V_{aux}$        | 13                        | 24   | 30   | $V_{av}$ |
| Auxiliary power requirement   | $V_{aux} = 24V_{av}$  | $P_{aux}$        | 120                       |      |      | W        |
| Driver and interface board    | see separate technical information  |                  | 3 x DR240                 |      |      |          |
| Driver core                   |   |                  | EiceDRIVER<br>2ED300C17-S |      |      |          |
| Digital input level           | resistor to GND 10,0k $\Omega$ , capacitor to GND 1nF, high = on, min 15mA  | $V_{in}$         | 0,0                       |      | 15,0 | V        |
| Digital output level          | open collector, low = ok, max 15mA  | $V_{out}$        | 0,0                       |      | 30,0 | V        |
| Analog current outputs Unit 2 | load max 1mA; at 306A   | $V_{ana\ out}$   | 4,80                      | 4,90 | 5,00 | V        |
| Analog DC Link voltage output | load max 1mA; at 850V   | $V_{DC\ out}$    | 8,33                      | 8,50 | 8,67 | V        |
| Analog temperature output     | load max 1mA; at $T_{NTC} = 75^{\circ}C$ correspond to $T_j = 125^{\circ}C$ | $V_{T\ out}$     |                           | 8,70 |      | V        |
| Overtemperature shutdown      | at $T_{NTC} = 81^{\circ}C$ correspond to $T_j = 135^{\circ}C$               | $V_{T\ out\ OT}$ |                           | 10   |      | V        |

### Heat sink air cooled / Thermal data

|                               |   |                           | min  | typ | max | units             |
|-------------------------------|---|---------------------------|------|-----|-----|-------------------|
| Airflow                       | $T_{Air} = 20^{\circ}C$ , $P_{air} = 1013hPa$ , dry- and dust free, measured on side of heat sink. according to DIN 41882 | $\Delta V/\Delta t_{Air}$ | 1710 |     |     | m <sup>3</sup> /h |
| Air pressure drop             |   | $\Delta p_{Air}$          |      | 135 |     | Pa                |
| Cooling air inlet temperature | heat sink temperature < -25°C   | $T_{inlet}$               | -40  |     | 60  | °C                |

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## Preliminary data

### IGBT data unit 2

|  |  |               | min | typ     | max | units |
|--|--|---------------|-----|---------|-----|-------|
| Type                                     | assumed  |               |     |         |     |       |
| collector-emitter saturation voltage     | $I_c = 200A; V_{ge} = 15V; T_{vj} = 150^\circ C$ | $V_{CE\ sat}$ |     | 2,05    |     | V     |
| parameter for linear model               | $T_{vj} = 25^\circ C$                            | $V_{ce1}$     |     | 0,944   |     | V     |
| parameter for linear model               | $T_{vj} = 25^\circ C$                            | $r_{ce1}$     |     | 4,031   |     | mΩ    |
| parameter for linear model               | $T_{vj} = 150^\circ C$                           | $V_{ce2}$     |     | 0,89    |     | V     |
| parameter for linear model               | $T_{vj} = 150^\circ C$                           | $r_{ce2}$     |     | 5,799   |     | mΩ    |
| turn-on / turn-off energy loss per pulse | $T_{vj} = 25^\circ C$                            | $E_1$         |     | 10 / 17 |     | mJ    |
| turn-on / turn-off energy loss per pulse | $T_{vj} = 150^\circ C$                           | $E_2$         |     | 17 / 29 |     | mJ    |
| thermal resistance, junction to case     | per IGBT   | $R_{thjc}$    |     | 0,135   |     | K/W   |
| thermal resistance, case to heatsink     | per IGBT   | $R_{thch}$    |     | 0,034   |     | K/W   |

### Diode data unit 2

|                                      |   |            | min | typ   | max | units |
|--------------------------------------|---|------------|-----|-------|-----|-------|
| Type                                 | assumed   |            |     |       |     |       |
| forward voltage                      | $I_F = 200A; V_{ge} = 0V; T_{vj} = 150^\circ C$ | $V_F$      |     | 1,65  |     | V     |
| parameter for linear model           | $T_{vj} = 25^\circ C$                           | $V_{F1}$   |     | 1,06  |     | V     |
| parameter for linear model           | $T_{vj} = 25^\circ C$                           | $r_{F1}$   |     | 2,951 |     | mΩ    |
| parameter for linear model           | $T_{vj} = 150^\circ C$                          | $V_{F2}$   |     | 0,833 |     | V     |
| parameter for linear model           | $T_{vj} = 150^\circ C$                          | $r_{F2}$   |     | 4,084 |     | mΩ    |
| reverse recovery energy              | $T_{vj} = 25^\circ C$                           | $E_{rec1}$ |     | 9     |     | mJ    |
| reverse recovery energy              | $T_{vj} = 150^\circ C$                          | $E_{rec2}$ |     | 17,5  |     | mJ    |
| thermal resistance, junction to case | per Diode                                       | $R_{thjc}$ |     | 0,2   |     | K/W   |
| thermal resistance, case to heatsink | per Diode                                       | $R_{thch}$ |     | 0,05  |     | K/W   |

### Environmental conditions

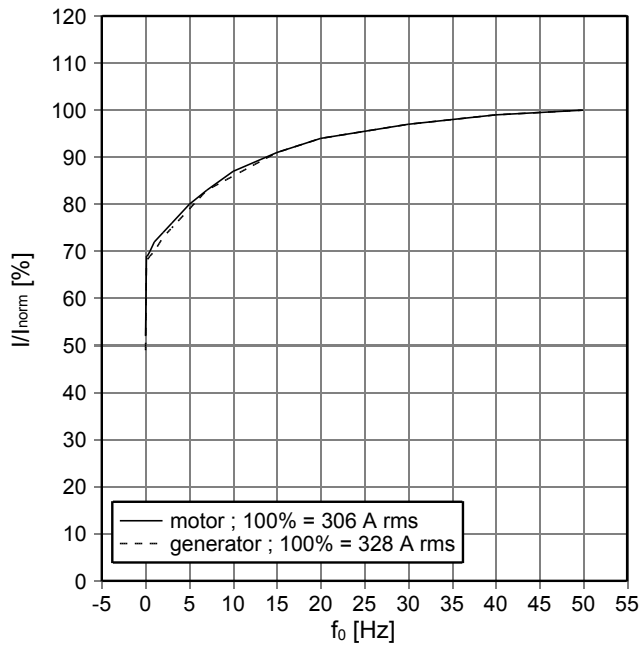
|                            |   |                | min  | typ  | max  | units            |
|----------------------------|---|----------------|------|------|------|------------------|
| Storage temperature        |   | $T_{stor}$     | -40  |      | 80   | °C               |
| Ambient temperature        |   | $T_{amb}$      | -25  |      | 55   | °C               |
| Operating temperature      | see chapter Heat sink air cooled / Thermal data |                |      |      |      |                  |
| Cooling air velocity (PCB) |   | $V_{Air\ PCB}$ | 2,0  |      |      | m/s              |
| Air pressure               | standard atmosphere                             | $p_{Air}$      | 900  |      | 1100 | hPa              |
| Humidity                   | no condensation                                 | Rel. F         | 5    |      | 85   | %                |
| Installation height        |   |                | 0    |      | 1000 | m                |
| Vibration                  | according to IEC60721                           |                |      |      | 5    | m/s <sup>2</sup> |
| Shock                      | according to IEC60721                           |                |      |      | 40   | m/s <sup>2</sup> |
| Protection degree          |   |                |      | IP00 |      |                  |
| Pollution degree           |   |                |      | 2    |      |                  |
| Torque at DC Terminals     |   | $M_{DC}$       | 6,0  |      | 10,0 | Nm               |
| Torque at AC Terminals     |   | $M_{AC}$       | 16,0 |      | 20,0 | Nm               |
| Dimensions                 | width × depth × height                          |                | 645  | 276  | 298  | mm               |
| Weight with heat sink      | approximation                                   |                |      | 35,0 |      | kg               |

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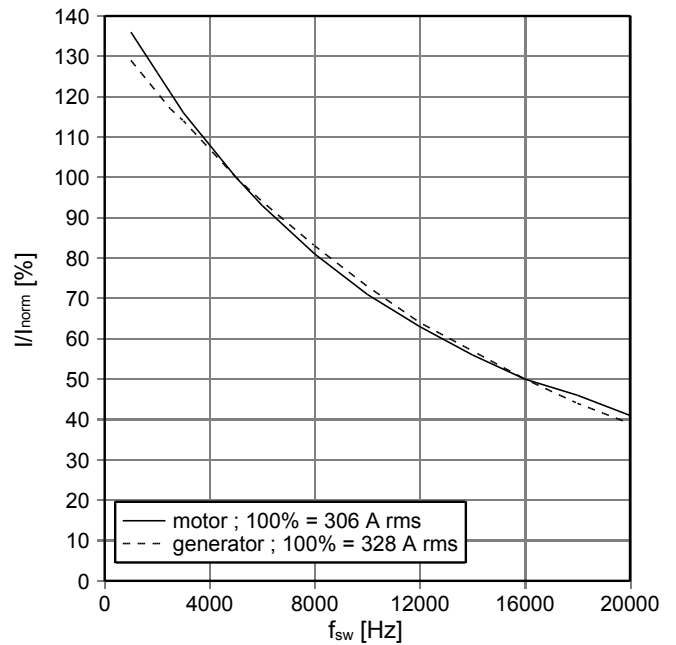


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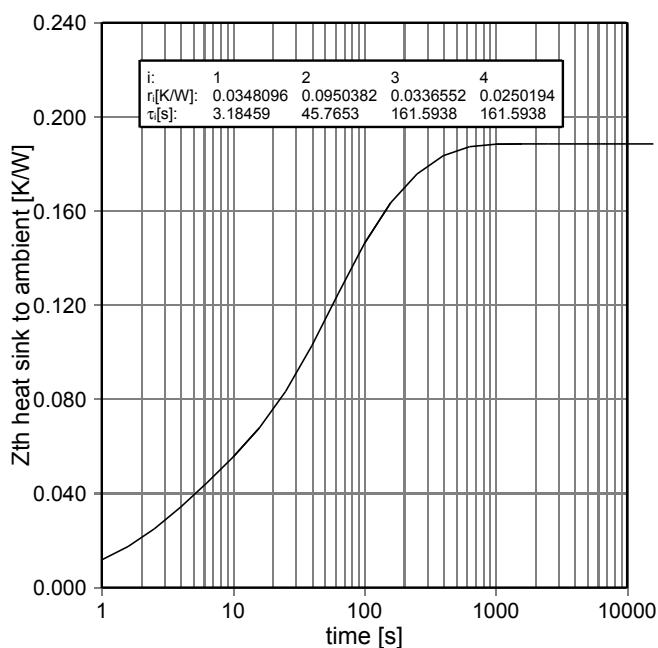
fo - derating curve IGBT (motor), Diode (generator)  
 cos(phi) = ± 0,85  
 T<sub>cool medium</sub> = 40°C



fsw - derating curve IGBT (motor), Diode (generator)  
 cos(phi) = ± 0,85  
 T<sub>cool medium</sub> = 40°C



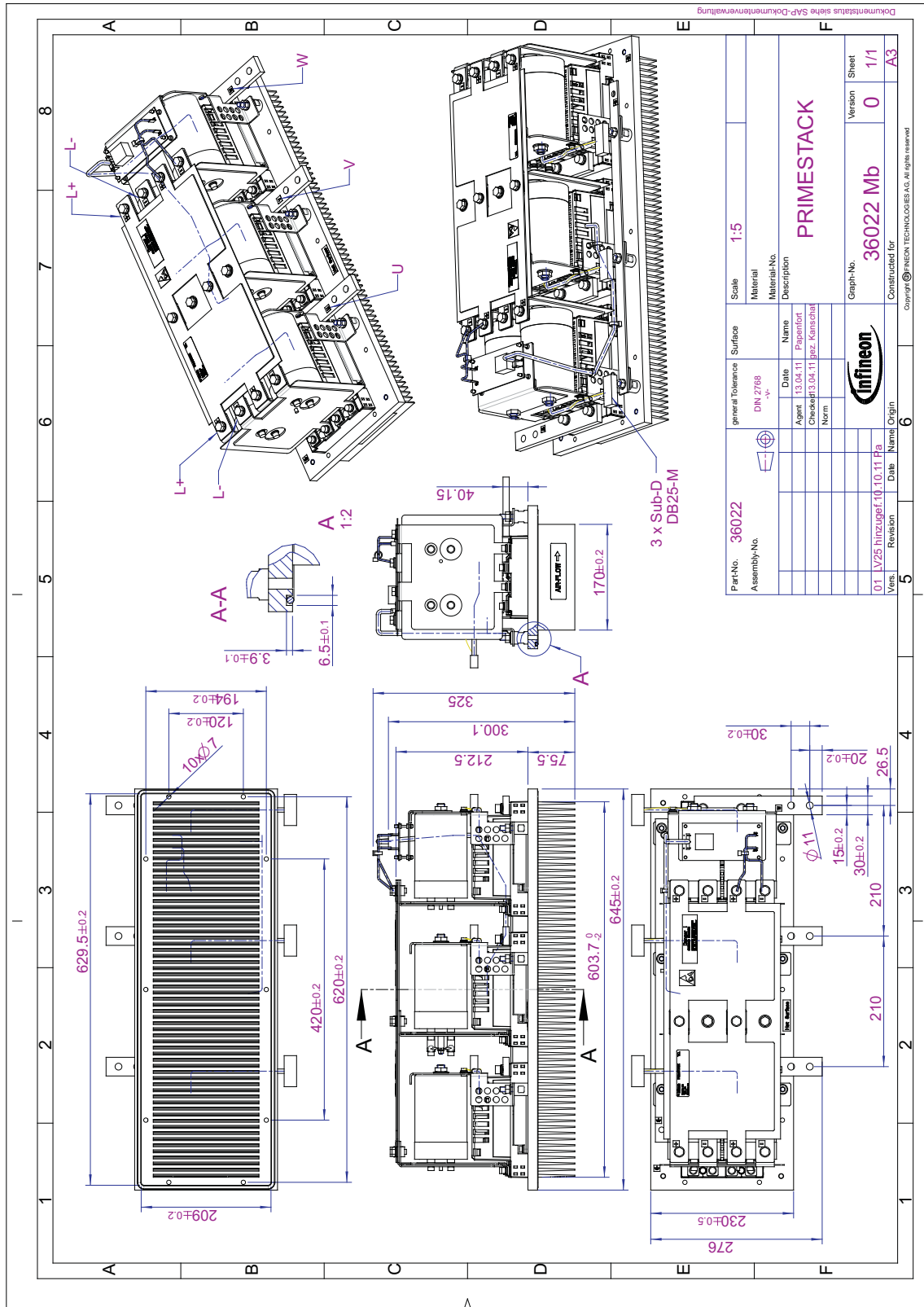
Transient thermal impedance per switch  
 T<sub>cool medium</sub> = 40°C



| i:                    | 1         | 2         | 3         | 4         |
|-----------------------|-----------|-----------|-----------|-----------|
| r <sub>i</sub> [K/W]: | 0.0348096 | 0.0950382 | 0.0336552 | 0.0250194 |
| τ <sub>i</sub> [s]:   | 3.18459   | 45.7653   | 161.5938  | 161.5938  |

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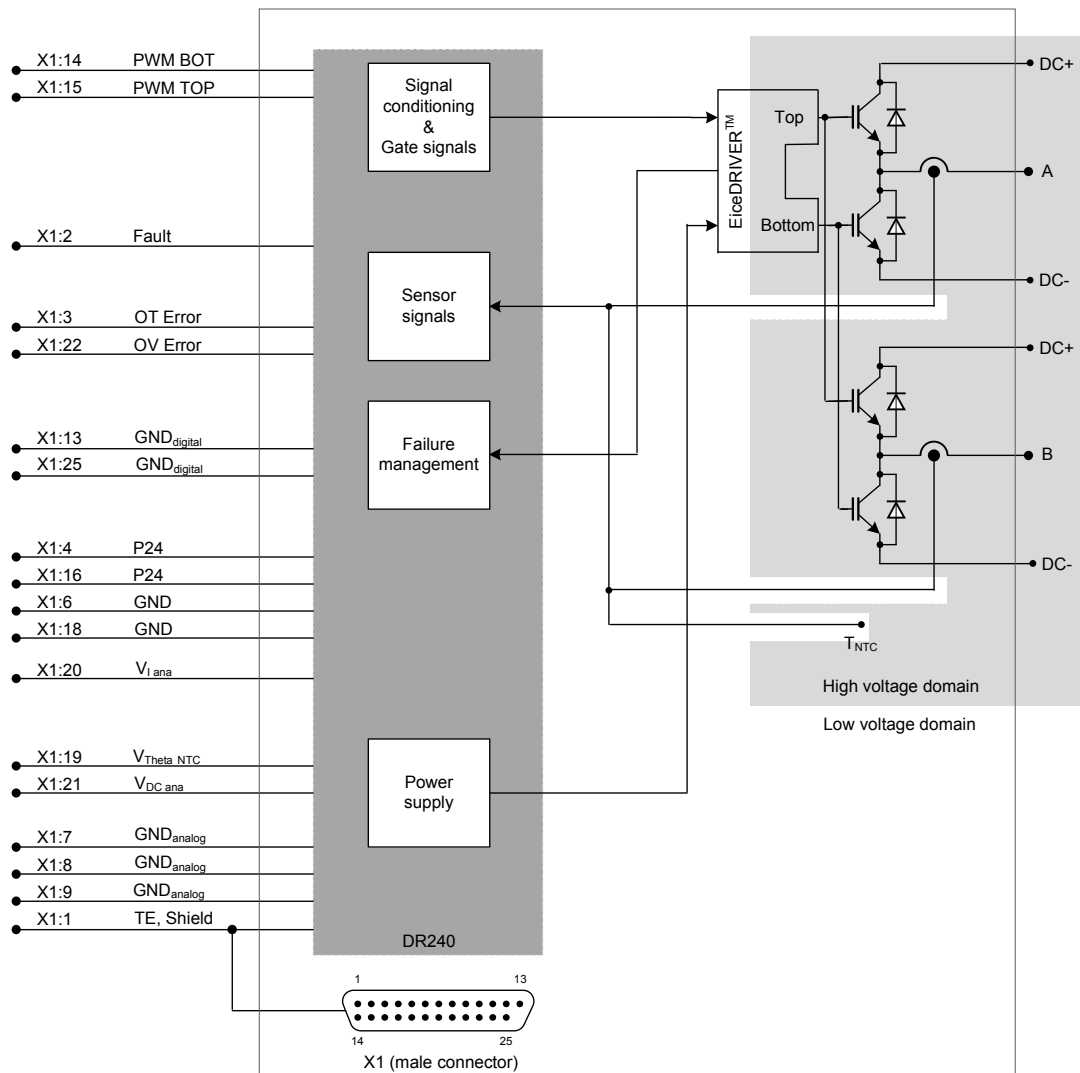
Mechanical drawing



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revision: 2.1

Circuit diagram



|                            | Error outputs (open collector) |      |       |
|----------------------------|--------------------------------|------|-------|
|                            | X1:2                           | X1:3 | X1:22 |
| Error driver core          | X                              |      |       |
| Over current               | X                              |      |       |
| Over temp. output stage    | X                              | X    |       |
| Over temperature PCB       |                                | X    |       |
| Over voltage DC Link       |                                |      |       |
| Under voltage power supply | X                              |      | X     |

X = high level with external pull up resistor

Voltage option only installed in the middle phase v

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**Preliminary data**

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- the conclusion of Quality Agreements;
- to establish joint measures of an ongoing product survey, and that we may make delivery depended on the realization of any such measures.

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**Safety Instructions**

Prior to installation and operation, all safety notices and warnings and all warning signs attached to the equipment have to be carefully read. Make sure that all warning signs remain in a legible condition and that missing or damaged signs are replaced. To installation and operation, all safety notices and warnings and all warning signs attached to the equipment have to be carefully read. Make sure that all warning signs remain in a legible condition and that missing or damaged signs are replaced.

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