ТЕХНИЧЕСКИ УНИВЕРСИТЕТ – СОФИЯ

Част 2. ТЕХНИЧЕСКА СПЕЦИФИКАЦИЯ

Към всяка употреба в текста (заедно с всички форми на членуване, в единствено или множествено число) на стандарт, спецификация, техническа оценка или техническо одобрение, както и на конкретен модел, източник, процес, търговска марка, патент, тип, произход или производство по смисъла на чл. 48, ал. 2 и чл. 49, ал. 2 от ЗОП, следва автоматично да се счита за добавено „или еквивалентно/и".

Обществената поръчка се осъществява в рамките на Проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии", финансиран от Оперативна програма „Наука и образование за интелигентен растеж" 2014-2020, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Целта на проекта е изграждането на научноизследователска инфраструктура за провеждане на върхови изследвания в областта на мехатрониката и чистите технологии - нов тип национален център, който да мобилизира научно-изследователския потенциал, така че да се постигне качествено ново ниво на познанието в няколко взаимосвързани икономически сегмента: механика, роботика,

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енергийна ефективност, устойчиво използване на суровини и ресурси, редуциране на парникови емисии.

Поръчката с предмет: „Доставка на специализирано технологично оборудване за нуждите на Технически университет – София“ по проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии“, финансиран чрез Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020” цели подпомагане на изпълнението на научната програма на проекта, свързана с работата на секция L8S4 „Мехатронни системи в силовата електроника“.

Поръчката цели доставка на Комплекс за изследване и изпитване на електронни преобразуватели . – 1 пакет.

Описание на поръчката

В основата на комплекса е симулатора на микро и нано електрическа мрежа, който позволява синтезирането както на еднофазно, така и на трифазно променливотоково напрежение. Освен това симулатора има и постояннотоков изход. Допълнителните възможности са свързани с цифровото управление на симулатора, като по този начин могат да се генерират различни импулсни поредици за извършване на тестове на електронни преобразуватели с разнообразни приложения като автомобили, системи за децентрализирано производство, съхранение и разпределение на електрическа енергия, индустриални приложения и др. От друга страна в комплекса са предвидени хибридни елементи за съхранение на енергия (класически – оловни акумулатори и иновативни – литиеви батерии и ултракондензатори) със съответните електронни преобразуватели, осигуряващи им работа на обща постояннотокова шина. За да се реализират различни тестове е предвидено и използването на преобразуватели с възможност за работа в автономен и зависим режим. Управлението на енергийните потоци в комплекса се осъществява със система за управление на базата на информацията, получена от системата за събиране, обработка и визуализация на данни от измервания на електрически величини.

Модулната концепция на изграждане на комплекса предполага възможност за бъдещо разширяване на неговите възможности чрез надграждане, добавяне или смяна на отделни модули, което позволява неговото дълготрайно използване, без да се налагат големи инвестиции.

Минимални технически показатели .

Комплексът е съставен от следните компоненти:

1. Симулатор за микро и нано-мрежа:

1.1 Изходна мощност:
- AC режим ≥ 30 kVA;
- DC режим ≥ 35 kW;

1.2 Изходно напрежение:
- AC (p-n): ≥ 3*400 V AC;
- AC (p-p): ≥ 3*690 V AC;
- DC ≥ +/- 1000 V DC;

1.2 Изходен ток:
- Непрекъснат режим: ≥ 30 A (RMS);
- Краткосрочен режим (под 3 сек): ≥ 65 A (RMS);

1.3 Вграден генератор на сигнали с честотна лента на сигнала: мин. DC-5 kHZ;

1.4 Честотна стабилност на генератора : мин. 100 ppm;

1.5 Общо хармонично изкривяване (THD): ≤ 0.5 %;

1.6 Двупосочно ограничение на изходния ток;

1.7 Обхват за ограничаване на тока: мин. 5 – 50 A;

1.8 Стъпка за ограничаване на тока: ≤ 1 A;

1.9 Генериране на сигнали с произволна форма: DC, линейно нарастващ, правоъгълна, триъгълна, трионообразна, стъпка, профил, шум, синусоидална, хармоници или техни еквивалентни;

1.10 Генериране на сигнал чрез импорт от текстов файл : CSV, Excel или еквивалентни;

1.11 Генериране на сигнали на изпитания по следните стандарти или еквиваленти :
- Нискочестотни изпитвания на устойчивост на хармоници и междинни хармоници по IEC/EN 61000-4-13 или еквивалент;
- Изпитване на устойчивост на флуктуации на напрежението по IEC/EN 61000-4-14 или еквивалент;
- Изпитване на устойчивост на пулсации на постоянното напрежение по IEC/EN 61000-4-17 или еквивалент;
- Изпитване за устойчивост на изменение на честотата на захранващата мрежа по IEC/EN 61000-4-28 или еквивалент;
- Изпитване на устойчивост на краткотрайни спадания на напрежението, краткотрайни прекъсвания на напрежението и изменения на напрежението по IEC/EN 61000-4-29 или еквивалент;
- Изпитване на безопасността и електрическите параметри на компонентите с високо напрежение в автомобилите – LV 123 или еквивалент;

1.12 Вграден компютър/контролер за управление;

1.13 Операционна система: Linux Real-Time или еквивалентна;

1.14 Процесор: ≥ 500 MHz;

1.15 RAM памет: ≥ 256 RAM;

1.16 Връщане неизразходената енергия обратно в електрическата мрежа до номиналната AC/DC мощност на източника;

1.17 Удвояване на изходното напрежение в DC режим чрез използване на 2 фази едновременно;

1.18 Интерфейси за връзка с компютър или друга тестова апаратура: GPIB, Ethernet или еквивалентни;

1.19 Интегриран авариен прекъсвач тип „Стоп Бутон" или еквивалентен;

1.20 Вградени защити: при по-висок ток, при висока температура, при пренапрежение или понижено напрежение от захранващата мрежа.

2. Хибридни елементи за съхранение на енергия.

2.1. Оловни за циклична работа:

2.1.1. Номинално напрежение: 12V;

2.1.2. Общ номинален капацитет не по малък от 400Ah;

2.1.3. Експлоатационен срок не по малко от 10 години;

2.2. Литиеви :

2.2.1. Номинално напрежение: 12.8V;

2.2.2. Общ номинален капацитет не по малък от 200Ah;

2.2.3. Максимален брой цикли заряд-разряд не по-малко от 2000;

2.2.4. Работна температура при разряд да покрива поне следния диапазон -20 °C до +55 °C.

2.3. Ултра кондензатори:

2.3.1. Номинално напрежение: 11.4V;

2.3.2. Общ номинален капацитет не по малък от 20Ah;

2.3.3. Максимален брой цикли заряд-разряд не по-малко от 10000;

2.3.4. Работна температура при разряд да покрива поне следния диапазон -20 °C до +55 °C.

3. Заряден регулатор (DC-DC преобразувател)

3.1 Номинално захранващо напрежение – 800Vdc;

3.2 Номинален ток (ефективна стойност) – 24A;

3.3 Максимална работна честота – до 200 kHz;

3.4 Вграден драйвер с галванично изолиране;

3.5 Два оптични входа;

3.6 Два аналогови изхода;

3.7 Вградени сензори за измерване на ток и напрежение;

3.8 Възможност за водно или въздушно охлаждане;

3.9 Полумостова схема, с възможност за включване на много модули за паралелна работа;

3.10 Вградени защити по напрежение и ток.

4. Двупосочен DC-DC преобразувател.

4.1 Номинално захранващо напрежение – 800Vdc;
4.2 Номинален ток (ефективна стойност) – 24A;
4.3 Максимална работна честота – до 200 kHz;
4.4 Вграден драйвер с галванично изолиране;
4.5 Два оптични входа;
4.6 Два аналогови изхода;
4.7 Вградени сензори за измерване на ток и напрежение;
4.8 Възможност за водно или въздушно охлаждане;
4.9 Полумостова схема, с възможност за включване на много модули за паралелна работа;
4.10 Вградени защити по напрежение и ток.

5.AC-DC преобразуватели.

5.1 Номинално захранващо напрежение - 400Vdc;
5.2 Номинален ток (ефективна стойност) – мин. 10A;
5.3 Максимална стойност на токово претоварване за 1s от 230A;
5.3 Максимална работна честота – до 50 kHz;
5.4 Вграден драйвер с галванично изолиране до ± 3kV (1s) и ± 560V (постоянно);
5.5 Два оптични входа;
5.6 Един аналогов изход;
5.7 Вграден препрограмируема логика CPLD;
5.6 Вградени сензори за измерване на ток и напрежение;
5.7 Възможност за водно или въздушно охлаждане;
5.8 Мостова схема, с възможност за включване на много модули за паралелна работа.

6. Система за управление (HIL)

6.1 Процесор – поне 4 ядрен с минимална тактова честота 3Ghz;
6.2 Програмируема логика FPGA;
6.3 Минимална стъпка за изпълнение на модела от 7us в процесора;
6.4 Минимална резолюция на таймера от 10ns и минимални стъпки от 250ns в програмируемата логика за системата;
6.5 Вградени 16 аналогови канали с възможност за до надграждане до 128 за системата;
6.6 Вградени 32 цифрови канали с възможност за до надграждане до 64;
6.7 Интерфейси за връзка – Ethernet, USB, RS232, JTAG, VGA, клавиатура и мишка;
6.8 Възможност за включване на допълнителни модули за разширение през интерфейс RS422 – do 12 канала, енкодер;

6.9 Възможност за допълнителен разширителен модул с оптична връзка - 6 броя до 50Mbps.

7. Система за събиране, обработка и визуализация на данни от измервания на електрически величини.

7.1. Модул за обработка на аналогова информация - 8 диференциални входа с едновременно измерване и скорост от минимум 1.25Msps/ 16bit;

7.2. Контролер за управление с тактова честота минимум 2.4Ghz, минимум 2 ядра;

7.3. Модул за обработка и нормиране на аналогови сигнали от токови и напреженителни сензори;

7.4. Възможност за директни високоволтови измервания – минимум 2000V, минимум 4

1. Изисквания към изпълнение на поръчката:

- Гаранционен срок – минимум 12 месеца, считано от от датата на подписване на Приемо-предавателния протокол, удостоверяващ изпълнението на дейностите, посочени в чл. 1, ал. 2 от договора. В рамките на гаранционния срок, Изпълнителят в срок до 30 календарни дни, считано от датата на двустранно подписан констативен протокол, отстранява със свои сили и средства всички неизправности, несъответствия, повреди, дефекти и/или отклонения на доставеното устройство, съответно доставя резервни части и/или компоненти, подменя дефектирали части и/или компоненти с нови. При невъзможност тези дейности да бъдат извършени в срок до 30 календарни дни, Изпълнителят в срок до 15 календарни дни осигурява на Възложителя оборотно устройство от същия или подобен клас до отстраняването на дефекта/повредата, като гаранционният срок на устройството, в процес на ремонт/поправяне, се удължава със срока, през който е траело отстраняването на повредата/ремонта. Гаранцията на извършен ремонт/вложени части е 6 месеца, считано от датата на двустранно подписан протокол, удостоверяващ извършения ремонт/вложените части. Рекламационното съобщение на Възложителя може да бъде изпратено по факс, електронна поща или обикновена поща. Изпълнителят е длъжен да изпрати свой представител на място за констатиране и идентифициране на повредата/несъответствието в срок до 5 календарни дни, от получаване на рекламационното съобщение на Възложителя. При посещението се съставя констативен протокол в два еднообразни екземпляра, в който се описват вида на съответната повреда/неизправност/несъответствие/дефекти и/или отклонения на доставеното устройство.

- Доставеното оборудване трябва да е ново, неупотребявано, в оригинални фабрични опаковки – декларира се от участника в техническото предложение;
- Доставеното оборудване да е комплектувано с необходимите елементи, така че да е работоспособно и да изпълнява функциите, заложени в спецификацията. Ако се окаже, че оборудването не може да изпълнява дадена функция поради недостиг или липса на съответните елементи, същите трябва да бъдат доставени за сметка на Изпълнителя – декларира се от участника в техническото предложение;
- В случай на спиране на производството на предлаганото оборудване поради внедряване на нови технологии, трябва да се предложи оборудване със същите или по-добри характеристики от актуалната продуктова листа на съответния производител.

2. Съобразно изискванията на Възложителя за изпълнение предмета на поръчката, посочени по-горе, в Техническото си предложение Участникът трябва и да:

- Направи предложение съобразено с Техническата спецификация. Предложеното оборудване трябва напълно да отговаря на изискванията, заложени в техническата спецификация, като варианти на предложенията не се допускат;
- Приложи кратко описание и/или технически материали на български език на предлаганото оборудване, предмет на поръчката.

3. МАКСИМАЛЕН ФИНАНСОВ РЕСУРС. НАЧИН НА ПЛАЩАНЕ

Максимална прогнозна стойност за поръчката: 488333.00 лв. без ДДС.

Горепосочената прогнозна стойност се явява и максимална. Предложената от участника цена не може да надвишава горепосочената максимална стойност за изпълнение предмета на поръчката. Ако участникът е предложил цена за изпълнение на поръчката по-висока от посочените по-горе максимална стойност, офертата на участника се отстранява.

Плащането се извършва съгласно клаузите на договора за изпълнение.

4. СРОК НА ДОГОВОРА. МЯСТО НА ДОСТАВКА

Договорът влиза в сила от датата на регистрирането му в деловодството на Възложителя. Максималният срок за за доставка, монтаж, въвеждане в експлоатация е до 250 календарни дни, от датата на регистрация на договора в деловодната система на възложителя.

Мястото за изпълнение е: Оборудването, предмет на поръчката, ще се доставя на място франко склада на Възложителя - гр. София, бул. „Св. Кл. Охридски“ № 8. Всички разходи по доставката са за сметка на изпълнителя.

ТЕХНИЧЕСКИ УНИВЕРСИТЕТ – СОФИЯ

ОБРАЗЕЦ № 2

Наименование на участника:
Йота Волт

Правно-организационна форма на участника: ЕООД *(търговското дружество или обединения или друга правна форма)*

Седалище по регистрация:
1750 София, бул. Цариградско шосе 40

ЕИК / Булстат: 204912332

www.eufunds.bg

Проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии", финансиран от Оперативна програма „Наука и образование за интелигентен растеж" 2014-2020, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Този документ е създаден с финансовата подкрепа на Оперативна програма „Наука и образование и интелигентен растеж", съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Цялата отговорност за съдържанието на документа се носи от Технически университет – София и никакви обстоятелства не могат да се приемат, че този документ отразява официалното становище на Европейския съюз и Управляващия орган.

До
Технически университет - София
гр. София
Р. България

ТЕХНИЧЕСКО ПРЕДЛОЖЕНИЕ

Наименование на поръчката: **„Доставка на специализирано технологично оборудване за нуждите на Технически университет – София“ по проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии“, финансиран чрез Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020”**

УВАЖАЕМИ ГОСПОДА,

С настоящото представяме нашето техническо предложение за участие за горепосочената поръчка.

Поемаме ангажимент да изпълним предмета на поръчката в съответствие с изискванията Ви, посочени в техническата спецификация, както следва:

Минимални технически показатели на оборудването, предмет на доставката	**Предложение на участника, включително посочване на марка и модел на оборудването**	**Препратка към техническите параметри**
1. Симулатор за микро и нано-мрежа: 1.1 Изходна мощност: - AC режим ≥ 30 kVA; - DC режим ≥ 35 kW;	Симулатор за микро и нано-мрежа: Марка: Ametek CTS/Emtest Модел: NetWave 30.3-400 Технически данни: 1.1 Изходна мощност: - AC режим : 30 kVA; - DC режим : 36 kW;	Технически данни „Netwave“

1.2 Изходно напрежение: - AC (p-n): ≥ 3*400 V AC; - AC (p-p): ≥ 3*690 V AC; - DC ≥ +/- 1000 V DC; 1.2 Изходен ток: - Непрекъснат режим: ≥ 30 A (RMS); - Краткосрочен режим (под 3 сек): ≥ 65 A (RMS); 1.3 Вграден генератор на сигнали с честотна лента на сигнала: мин. DC-5 kHZ; 1.4 Честотна стабилност на генератора : мин. 100 ppm; 1.5 Общо хармонично изкривяване (THD): ≤ 0.5 %; 1.6 Двупосочно ограничение на изходния ток; 1.7 Обхват за ограничаване на тока: мин. 5 – 50 A; 1.8 Стъпка за ограничаване на тока: ≤ 1 A; 1.9 Генериране на сигнали с произволна форма: DC, линейно нарастващ, правоъгълна, триъгълна, трионообразна, стъпка, профил, шум, синусоидална, хармоници или техни еквивалентни; 1.10 Генериране на сигнал чрез импорт от текстов файл : CSV, Excel или еквивалентни; 1.11 Генериране на сигнали на изпитания по следните стандарти или еквиваленти : - Нискочестотни изпитвания на устойчивост на хармоници и междинни хармоници по IEC/EN 61000-4-13 или еквивалент; - Изпитване на устойчивост на флуктуации на напрежението по IEC/EN 61000-4-14 и еквивалент; - Изпитване на устойчивост на пулсации постоянното напрежение по IEC/EN 61000-4-17 или вивалент;	1.2 Изходно напрежение: - AC (p-n): 3*400 V AC; - AC (p-p): 3*690 V AC; - DC ≥ +/- 1120 V DC; 1.2 Изходен ток: - Непрекъснат режим: 33 A (RMS); - Краткосрочен режим (под 3 сек): 66 A (RMS); 1.3 Вграден генератор на сигнали с честотна лента на сигнала: DC-5 kHZ; 1.4 Честотна стабилност на генератора : 100 ppm; 1.5 Общо хармонично изкривяване (THD): ≤ 0.5 %; 1.6 Двупосочно ограничение на изходния ток; 1.7 Обхват за ограничаване на тока: 5 – 66 A; 1.8 Стъпка за ограничаване на тока: 1 A; 1.9 Генериране на сигнали с произволна форма: DC, линейно нарастващ, правоъгълна, триъгълна, трионообразна, стъпка, профил, шум, синусоидална, хармоници 1.10 Генериране на сигнал чрез импорт от текстов файл : CSV, Excel 1.11 Генериране на сигнали на изпитания по следните стандарти : - Нискочестотни изпитвания на устойчивост на хармоници и междинни хармоници по IEC/EN 61000-4-13 - Изпитване на устойчивост на флуктуации на напрежението по IEC/EN 61000-4-14 - Изпитване на устойчивост на пулсации на постоянното напрежение по IEC/EN 61000-4-17	

- Изпитване за устойчивост на изменение на честотата на захранващата мрежа по IEC/EN 61000-4-28 или еквивалент; - Изпитване на устойчивост на краткотрайни спадания на напрежението, краткотрайни прекъсвания на напрежението и изменения на напрежението по IEC/EN 61000-4-29 или еквивалент; - Изпитване на безопасността и електрическите параметри на компонентите с високо напрежение в автомобилите – LV 123 или еквивалент; 1.12 Вграден компютър/контролер за управление; 1.13 Операционна система: Linux Real-Time или еквивалентна; 1.14 Процесор: ≥ 500 MHz; 1.15 RAM памет: ≥ 256 RAM; 1.16 Връщане неизразходената енергия обратно в електрическата мрежа до номиналната AC/DC мощност на източника; 1.17 Удвояване на изходното напрежение в DC режим чрез използване на 2 фази едновременно; 1.18 Интерфейси за връзка с компютър или друга тестова апаратура: GPIB, Ethernet или еквивалентни; 1.19 Интегриран аварийен прекъсвач тип „Стоп Бутон“ или еквивалентен; 1.20 Вградени защити: при по-висок ток, при висока температура, при пренапрежение или понижено напрежение от захранващата мрежа.	- Изпитване за устойчивост на изменение на честотата на захранващата мрежа по IEC/EN 61000-4-28 - Изпитване на устойчивост на краткотрайни спадания на напрежението, краткотрайни прекъсвания на напрежението и изменения на напрежението по IEC/EN 61000-4-29 - Изпитване на безопасността и електрическите параметри на компонентите с високо напрежение в автомобилите – LV 123 1.12 Вграден компютър/контролер за управление; 1.13 Операционна система: Linux Real-Time 1.14 Процесор: 500 MHz; 1.15 RAM памет: 256 RAM; 1.16 Възможност за връщане неизразходената енергия обратно в електрическата мрежа до номиналната AC/DC мощност на източника; 1.17 Възможност за удвояване на изходното напрежение в DC режим чрез използване на 2 фази едновременно; 1.18 Интерфейси за връзка с компютър или друга тестова апаратура: GPIB, Ethernet, RS232, Frame Bus 1.19 Интегриран аварийен прекъсвач тип „Стоп Бутон“ 1.20 Вградени защити: при по-висок ток, при висока температура, при пренапрежение или понижено напрежение от захранващата мрежа.	

2. Хибридни елементи за съхранение на енергия. 2.1. Оловни за циклична работа: 2.1.1. Номинално напрежение: 12V; 2.1.2. Общ номинален капацитет не по малък от 400Ah; 2.1.3. Експлоатационен срок не по малко от 10 години; 2.2. Литиеви : 2.2.1. Номинално напрежение: 12.8V; 2.2.2. Общ номинален капацитет не по малък от 200Ah; 2.2.3. Максимален брой цикли заряд-разряд не по-малко от 2000; 2.2.4. Работна температура при разряд да покрива поне следния диапазон -20 °C до +55 °C. 2.3. Ултра кондензатори: 2.3.1. Номинално напрежение: 11.4V; 2.3.2. Общ номинален капацитет не по малък от 20Ah; 2.3.3. Максимален брой цикли заряд-разряд не по-малко от 10000; 2.3.4. Работна температура при разряд да покрива поне следния диапазон -20 °C до +55 °C.	2. Хибридни елементи за съхранение на енергия 2.1. Оловни за циклична работа **Марка:** Монбат **Модел:** MONOLITH POWER MP6V - 2 броя 2.1.1. Номинално напрежение: 12V със свързване на две батерки 2.1.2. Общ номинален капацитет от 420Ah; 2.1.3. Експлоатационен срок : над 10 години; 2.2. Литиеви : **Марка:** GWL/Power **Модел:** WB-12V200AH-SET 2.2.1. Номинално напрежение: 12.8V (комплект от 4 х Winston LiFeYPO4 клетки) 2.2.2. Общ номинален капацитет: 200Ah (комплект от 4 х Winston LiFeYPO4 клетки) 2.2.3. Максимален брой цикли заряд-разряд: 5000; 2.2.4. Работна температура при разряд : до +65 °C. 2.3. Ултра кондензатори: **Марка:** Maxwell Technologies **Модел:** BMOD0500 P016 B02 **Марка:** PowerStor / Eaton **Модел:** XL60-2R7308T-R – 17 броя 2.3.1. Номинално напрежение: до 16V (BMOD0500 P016 B02)	Технически данни „Хибридни елементи за съхранение на енергия“ Технически данни „Хибридни елементи за съхранение на енергия“ Технически данни „Хибридни елементи за съхранение на енергия“

	Номинално напрежение (5 x XL60-2R7308T-R): до 13.5 V 2.3.2. Общ номинален капацитет: 20Ah (1 x BMOD0500 P016 B02, 17x XL60-2R7308T-R) 2.3.3. Максимален брой цикли заряд-разряд : 1 000 000; 2.3.4. Работна температура при разряд: -40 °C до +65 °C.	
3. Заряден регулатор (DC-DC преобразувател) 3.1 Номинално захранващо напрежение – 800Vdc; 3.2 Номинален ток (ефективна стойност) – 24A; 3.3 Максимална работна честота – до 200 kHz; 3.4 Вграден драйвер с галванично изолиране; 3.5 Два оптични входа; 3.6 Два аналогови изхода; 3.7 Вградени сензори за измерване на ток и напрежение; 3.8 Възможност за водно или въздушно охлаждане; 3.9 Полумостова схема, с възможност за включване на много модули за паралелна работа; 3.10 Вградени защити по напрежение и ток.	3.Заряден регулатор (DC-DC преобразувател) Марка: Imperix Модел: PEB SiC 8024 3.1 Номинално захранващо напрежение – 800Vdc; 3.2 Номинален ток (ефективна стойност) – 24A; 3.3 Максимална работна честота – до 200 kHz; 3.4 Вграден драйвер с галванично изолиране; 3.5 Два оптични входа; 3.6 Два аналогови изхода; 3.7 Вградени сензори за измерване на ток и напрежение; 3.8 Възможност за водно или въздушно охлаждане; 3.9 Полумостова схема, с възможност за включване на много модули за паралелна работа; 3.10 Вградени защити по напрежение и ток.	Технически данни „Система за управление (HIL) със силови преобразуватели“

4. Двупосочен DC-DC преобразувател. 4.1 Номинално захранващо напрежение – 800Vdc; 4.2 Номинален ток (ефективна стойност) – 24A; 4.3 Максимална работна честота – до 200 kHz; 4.4 Вграден драйвер с галванично изолиране; 4.5 Два оптични входа; 4.6 Два аналогови изхода; 4.7 Вградени сензори за измерване на ток и напрежение; 4.8 Възможност за водно или въздушно охлаждане; 4.9 Полумостова схема, с възможност за включване на много модули за паралелна работа; 4.10 Вградени защити по напрежение и ток. 5.AC-DC преобразуватели.	4. Двупосочен DC-DC преобразувател. Марка: Imperix Модел: PEB SiC 8024 4.1 Номинално захранващо напрежение – 800Vdc; 4.2 Номинален ток (ефективна стойност) – 24A; 4.3 Максимална работна честота – до 200 kHz; 4.4 Вграден драйвер с галванично изолиране; 4.5 Два оптични входа; 4.6 Два аналогови изхода; 4.7 Вградени сензори за измерване на ток и напрежение; 4.8 Възможност за водно или въздушно охлаждане; 4.9 Полумостова схема, с възможност за включване на много модули за паралелна работа; 4.1 Вградени защити по напрежение и ток. 5.AC-DC преобразуватели. Марка: Imperix Модел: PEB SiC 8024	Технически данни „Система за управление (HIL) със силови преобразуватели“

5.1 Номинално захранващо напрежение - 400Vdc; 5.2 Номинален ток (ефективна стойност) – мин. 10A; 5.3 Максимална стойност на токово претоварване за 1s от 230A; 5.3 Максимална работна честота – до 50 kHz; 5.4 Вграден драйвер с галванично изолиране до ± 3kV (1s) и ± 560V (постоянно); 5.5 Два оптични входа; 5.6 Един аналогов изход; 5.7 Вграден препрограмируема логика CPLD; 5.6 Вградени сензори за измерване на ток и напрежение; 5.7 Възможност за водно или въздушно охлаждане; 5.8 Мостова схема, с възможност за включване на много модули за паралелна работа.	5.1 Номинално захранващо напрежение – до 800Vdc; 5.2 Номинален ток (ефективна стойност) – до 24A; 5.3 Максимална стойност на токово претоварване за 1s от 240A; (при работа на всички модули) 5.3 Максимална работна честота – до 200 kHz; 5.4 Вграден драйвер с галванично изолиране до ± 3kV (1s) и до ± 3kV (постоянно); 5.5 Два оптични входа; 5.6 Два аналогови изхода; 5.7 Вграден препрограмируема логика CPLD; 5.6 Вградени сензори за измерване на ток и напрежение; 5.7 Възможност за въздушно охлаждане; 5.8 Мостова схема при свързване на два модула в паралел	Технически данни „Система за управление (HIL) със силови преобразуватели“
6. Система за управление (HIL)	6. Система за управление (HIL) Марка: Opal-RT Модел: OP4510	
6.1 Процесор – поне 4 ядрен с минимална тактова честота 3Ghz; 6.2 Програмируема логика FPGA; 6.3 Минимална стъпка за изпълнение на модела от 7us в процесора; 6.4 Минимална резолюция на таймера от 10ns минимални стъпки от 250ns в програмируемата гика за системата; 6.5 Вградени 16 аналогови канали с зможност за до надграждане до 128 за системата;	6.1 Процесор – 4 ядрен, тактова честота 3.5 Ghz; 6.2 Програмируема логика FPGA - Kintex-7 FPGA, 325T 6.3 Минимална стъпка за изпълнение на модела от 7us в процесора; 6.4 Минимална резолюция на таймера от 10ns и минимални стъпки от 250ns в програмируемата логика за системата;	Технически данни „Система за управление (HIL) със силови преобразуватели“

6.6 Вградени 32 цифрови канали с възможност за до надграждане до 64; 6.7 Интерфейси за връзка – Ethernet, USB, RS232, JTAG, VGA, клавиатура и мишка; 6.8 Възможност за включване на допълнителни модули за разширение през интерфейс RS422 – do 12 канала, енкодер; 6.9 Възможност за допълнителен разширителен модул с оптична връзка - 6 броя до 50Mbps.	6.5 Вградени 16 аналогови канали с възможност за до надграждане до 128 за системата; 6.6 Вградени 32 цифрови канали с възможност за до надграждане до 64; 6.7 Интерфейси за връзка – Ethernet, USB, RS232, JTAG, VGA, клавиатура и мишка; 6.8 Възможност за включване на допълнителни модули за разширение през интерфейс RS422 – до 12 канала, енкодер; 6.9 Възможност за допълнителен разширителен модул с оптична връзка - 6 броя до 50Mbps. *Включени допълнителни модули и аксесоари към системата за управление (HIL):* - Imperix B-Box RCP прототипиращ контролер - Imperix 4Ux19" затворено шаси - Imperix интерфейс за връзка с Opal-RT симулатор - Imperix кутия с пасивни филтри - OP8665 контролер интерфейс	
7. Система за събиране, обработка и визуализация на данни от измервания на електрически величини. 7.1. Модул за обработка на аналогова информация - 8 диференциални входа с едновременно измерване и скорост от минимум 1.25Msps/ 16bit;	7. Система за събиране, обработка и визуализация на данни от измервания на електрически величини 7.1. Модул за обработка на аналогова информация - 8 диференциални входа с едновременно измерване и скорост от 1.25Msps/ 16bit; Модел: PXIe-6356 Марка: National Instruments	

7.2. Контролер за управление с тактова честота минимум 2.4Ghz, минимум 2 ядра; 7.3. Модул за обработка и нормиране на аналогови сигнали от токови и напреженителни сензори; 7.4. Възможност за директни високоволтови измервания – минимум 2000V, минимум 4	7.2. Контролер за управление с тактова честота 2.8Ghz, 4 ядра; **Модел:** PXIe-8861 **Марка:** National Instruments 7.3. Модул за обработка и нормиране на аналогови сигнали от токови и напреженителни сензори; **Модел:** RM-26999 **Марка:** National Instruments 7.4. Възможност за директни високоволтови измервания –2000V, 4 *Включени аксесоари към системата:* **Модел:** PXIe-1071 шаси **Марка:** National Instruments	Технически данни „Система за събиране на данни“

В колона „Препратки към техническите параметри“ се посочва номер на страницата от Техническото предложение, на която е приложено кратко описание и/или технически материали на български език на предлаганото оборудване предмет на поръчката. Посочените от участника материали трябва да доказват технически параметри на оборудването, без цени.

1. Срокът за доставка, монтаж и въвеждане в експлоатация е до 250 календарни дни, считано от регистрирането на договора в деловодната система на Възложителя. Предложеният от нас гаранционен срок е 12 месеца, считано от датата на подписване на Приемо-предавателния протокол, удостоверяващ изпълнението на дейностите, посочени в чл. 1, ал. 2 от договора. Гаранционната поддръжка се извършва при условията и сроковете, посочени в Техническата спецификация и проекта на договор.

4. За обезпечаване на задълженията си по договора за възлагане на обществената поръчка, преди подписване на договора ще предоставим на Възложителя гаранция за изпълнение в размер на 3% (три процента) от стойността на договора без ДДС, както и гаранция за авансово предоставените средства, при условията, посочени в проекта на договор към документацията за участие. *Ако Изпълнителят не желае авансово плащане, отпада задължението на последният да осигури гаранция обезпечаваща авансово предоставени средства.*

5. Предлагаме да изпълним поръчката в пълно съответствие с Техническата спецификация на поръчката, изискванията на Възложителя и действащата нормативна уредба. Декларираме, че сме съгласни с поставените от Възложителя условия и ги приемаме без възражения.

6. Декларираме, че:

- Доставеното оборудване ще бъде ново, неупотребявано, в оригинални фабрични опаковки;
- Предложеното оборудване е в съответствие с международните, европейските и на Република България изисквания за радиочестотни смущения, електромагнитна съвместимост, безопасност и нива на шум;
- Доставеното оборудване ще отговоря на всички изисквания в Република България и/или ЕС относно техническа експлоатация, пожаро-безопасност, норми за безопасност и включване към електрическата мрежа;
- Доставеното оборудване ще бъде окомплектовано с всички необходими силови, интерфейсни и други кабели, адаптери и аксесоари, необходими за нормалната му работа;
- Захранването, силовите кабели и кабелните накрайници на силовите кабели са предвидени за експлоатация и отговарят на изискванията в Република България;
- Доставеното оборудване ще бъде комплектувано с необходимите елементи, така че да е работоспособно и да изпълнява функциите, заложени в спецификацията. Ако се окаже, че оборудването не може да изпълнява дадена функция поради недостиг или липса на съответните елементи, същите ще бъдат доставени за сметка на Изпълнителя;
- В случай на спиране на производството на предлаганото оборудване след избирането ми за изпълнител, поради внедряване на нови технологии, ще доставя оборудване със същите или по-добри характеристики от актуалната продуктова листа на съответния производител.

7. Към настоящото техническо предложение прилагам кратко описание и/или технически материали на български език на предлаганото оборудване.

Приложения:

- Технически данни „Netwave"
- Спецификация на производител „Netwave Series (3-Phase)
- Технически данни „Хибридни елементи за съхранение на енергия"
- Спецификация „Monolith Power
- Спецификация на производител „Winston LPF200AHA cell
- Спецификация на производител „BMOD0500 P016 B02
- Спецификация на производител „XL60 Supercapacitors
- Технически данни „Преобразуватели"

- Спецификация на производител „OP4510 Simulator
- Спецификация на производител „OP8665
- Технически данни „Система за управление (HIL) със силови преобразуватели"
- Спецификация на производител „B-Box RCP
- Спецификация на производител „4U Closed Rack
- Спецификация на производител „Passive Filters
- Спецификация на производител „PEB SiC 8024
- Спецификация на производител „Simulator Interface
- Технически данни „Система за събиране на данни"
- Спецификация на производител „PXIe-8861
- Спецификация на производител „NI 6356
- Спецификация на производител „RM-26999

Изброяват се и се прилагат като самостоятелни документи.

Забележка:

При изготвяне на предложението си за изпълнение на поръчката всеки участник следва да се ръководи от всички изисквания на документацията техническата спецификация. Предложението за изпълнение на поръчката следва да е съобразено с насоките, дадени в Указанията за подготовка на офертите и Техническите спецификации. В колона „Препратки към техническите параметри" се посочва номер на страницата от Техническото предложение, на която е приложено кратко описание и/или технически материали на български език на предлаганото оборудване. Приложените от участника материали трябва да доказват техническите параметри, без цени. Ако участник не представи Предложение за изпълнение на поръчката или представеното от него предложение и/или приложенията към него не съответстват на изискванията на Възложителя, той ще бъде отстранен от участие в процедурата. Когато Предложението за изпълнение на поръчката не съответства на Ценовото предложение, участникът се отстранява.

Дата: 21.05.2020

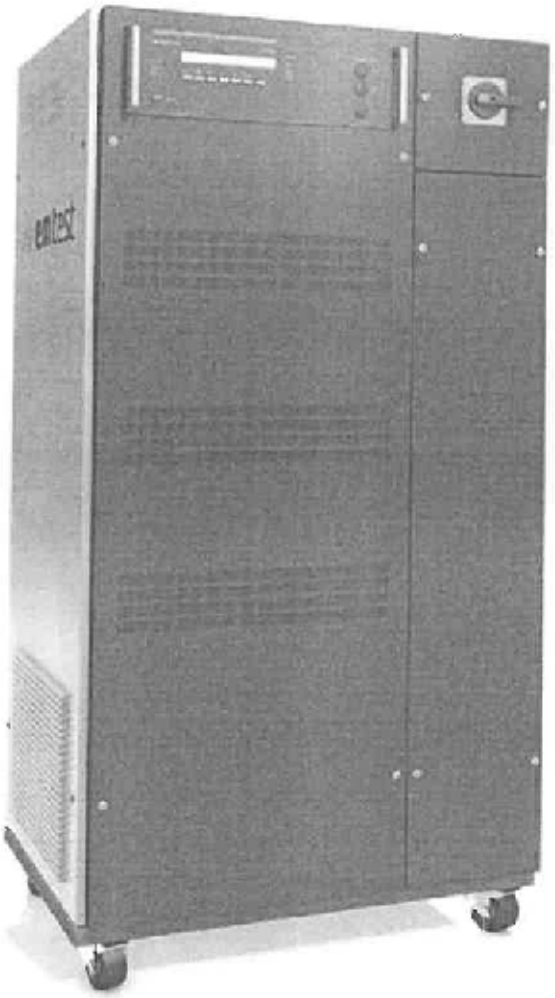
Елиас Кос

Управите

Йота Вент

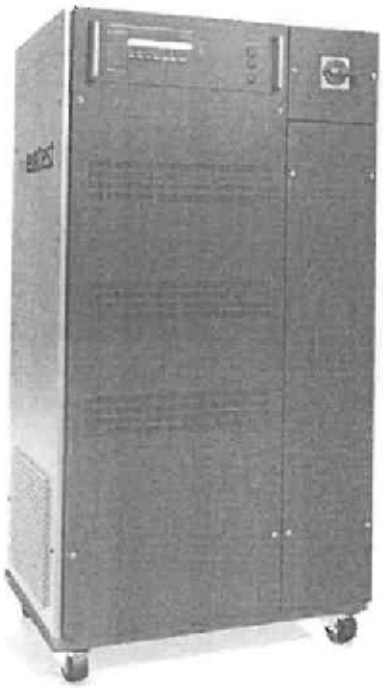
NETWAVE

Технически данни



NETWAVE SERIES (3-PHASE)

ТРИФАЗНИ МУЛТИФУНКЦИОНАЛНИ AC/DC ИЗТОЧНИЦИ



ЗА ТЕСТОВЕ ПО СТАНДАРТИ

> AIRBUS, BOEING
> DO 160 Section 16, Section 18 > LV 123
> BMW GS 95023
> MBN LV 123
> VW 80300
> VW 80303
> PSA B21 7110
> IEC/EN 61000-3-2, -3-12 > IEC/EN 61000-3-3, -3-11 > JIS C 61000-3-2
> IEC/EN 61000-4-11, -4-29, -4-34 > IEC 61000-4-13 > IEC 61000-4-14
> IEC 61000-4-17
> IEC 61000-4-27
> IEC 61000-4-28
> MIL STD 461
> MIL-STD-704

NETWAVE

Серията NetWave (3-фазна) са трифазни източници на захранване с променлив ток, специално проектиран така, че да отговаря напълно на изискванията съгласно стандартите IEC / EN 61000-4-13, -4-14, -4-28 и в допълнение за предварително тестване за съответствие до -4-27. Използва се и като източник на постоянен ток за покриване на изискванията съгласно стандартите IEC / EN 61000-4-17 (Ripple за постоянен ток) и IEC / EN 61000-4-29 за прекъсвания на напрежението и прекъсвания на постояннотокови захранвания. Серията NetWave е много подходяща за тестване на инвертори (например слънчева енергия, вятърна енергия) и електронни превозни средства като LV 123 стандарт. Освен това, серията NetWave (3-фазна) предлага необходимите възможности за тестване на авионика както по DO-160, Airbus ABD0100 и Boeing, така и по MIL-STD-704 и е напълно подходяща като референтен източник за тестване на хармоници и Flicker.
Като опция 3-фазната серия NetWave може да бъде оборудвана с модул за възстановяване на мощността, за да абсорбира захранваната мощност (AC / DC) до номиналната мощност на NetWave.

ХАРАКТЕРИСТИКИ

> Широк честотен диапазон: DC - 5 kHz
> Изходна мощност до 270 kVA AC / 324 kW DC
> Изход до 3*690 VAC (p-p), +/-1120 VDC
> Възможности за висок Inrush Current
> Абсорбиране на мощността до номинал (опция)

ОБЛАСТИ НА ПРИЛОЖЕНИЕ

АВТОМОБИЛНА ИНД. АВИАЦИОННА ИНД.
ИНДУСТРИАЛНИ ПРИЛОЖЕНИЯ ВОЕННА ИНД.
МЕДИЦИНСКА ИНД. ВЪЗОБН

AMETEK
COMPLIANCE TEST SOLUTIONS

ПОЛЗИ

NETWAVE

Програмируемите трифазни AC / DC източници на енергия с широката им честотна лента предлагат мощни възможности за генериране на вълнови форми за различни тестови приложения в областта на EMC и за тестване на авионика. Базирайки се на технологията на Dual-Processor, с интегриран високопроизводителен компютър, цифров процесор за сигнали (DSP) и оборудван с твърд диск, серията NetWave е в състояние да генерира и записва форма на вълни в реално времеcapable to generate and record waveforms in realtime.

Според EMC стандартните е необходимо енвиране на чисто синусоидно напрежение за измерване на хармоници и трептене.
Изходното напрежение на серията NetWave има много ниско изкривяване (THD) - по-малко от 0,1%, независимо от натоварването..

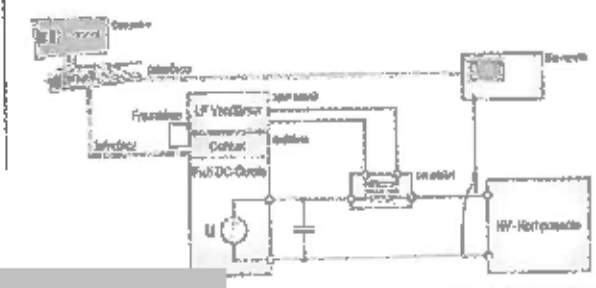
Интерфейсите като GPIB и Ethernet са общи характеристики на серията NetWave

ПЪЛНОТО РЕШЕНИЕ ЗА ИЗПИТВАНЕ НА HV КОМПОНЕНТИ

С NetWave е възможно за първи път да се проверяват HV компоненти до 1120 VDC според LV 123, VW 80300 и други автомобилни стандарти. Включените тестове са бързи и бавни изменения на напрежението, както и тестове за пулсации на напрежението.

Допълнителният LF усилвател AMP 200Nx използва CN 200Nx за свързване на напреженови пулсации до 450 kHz към захранващите линии.

С метода на затворен контур софтуерът net.control измерва пулсацията на напрежението и непрекъснато контролира амплитудата..



СОФТУЕР NET.CONTROL

РЕДАКТИРАНЕ, ДОКУМЕНТИРАНЕ И УПРАВЛЕНИЕ НА ФОРМАТА НА СИГНАЛА И СТАНДАРТНИТЕ ТЕСТОВЕ

net.control е софтуерната платформа „всичко в едно" за лесно и удобно управление на серията NetWave. С помощта на net.control потребителят може да програмира всякакъв вид вълнови форми, съставени от сегменти или точки и да ги изтегли в NetWave. Подобрените графични инструменти са на разположение, за да настроите формата на вълната според индивидуалните изисквания

net.control предоставя библиотека с обширна компилация от предварително дефинирани сегменти, както и десетки хиляди стандартни тестови процедури съгласно EMC и стандартите на авиониката.

net.control също така обработва всяка форма на вълната, записана по друг метод (например засечета с осцилоскоп) или импортирана като Excel или CSV файлове. Всички форми на вълни могат да бъдат изтеглени в NetWave.

net.control предлага подобрен инструмент за отчитане за генериране на тестови и репорти и може да се използва в Windows 7, Windows 8 и Windows 10

РАЗШИРЕТЕ ВЪЗМОЖНОСТИТЕ НА ИЗТОЧНИКА

КОМБИНИРАЙТЕ ДВА ИЛИ ТРИ NETWAVE ИЗТОЧНИКА ЗА ПО-ВИСОКО ИЗХОДНО НАПРЕЖЕНИЕ ИЛИ МОЩНОСТ

Спестете бюджет, купувайки един NetWave днес и разширете възможностите си за тестване утре. Семейството NetWave предлага възможност за разширяване на обхвата на мощност или напрежение чрез комбиниране на няколко единици. Удвоете напрежението с опцията CascadeSource (Opt-3 CS) или образувайте мощен трифазен източник на променлив ток с опцията MultiSource (Opt-3 MS) - и дяте са възможни..

MODEL OVERVIEW

3-ФАЗНИ NETWAVE МОДЕЛИ	
NetWave	3-фазен AC/DC източник
NetWave 20.x	22,5 kVA AC / 27 kW DC
NetWave 30.x	30 kVA AC / 36 kW DC,
NetWave 67.x	67 kVA AC / 77 kW DC,
NetWave 90.x	90 kVA AC / 110 kW DC,
NetWave 108.x	108 kVA AC / 150 kW DC,

ТЕХНИЧЕСКИ ДЕТАЙЛИ

[illegible]	
Изходно напрежение	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Изходен ток	26 A (RMS) непрекъснат 47 A (RMS) краткотраен (макс.. 3 s) 200 A повтарящ пик

NETWAVE 20.2	
Изходно напрежение	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Изходен ток (@ макс.. 300 V AC/360 V DC)	26 A (RMS) непрекъснат 47 A (RMS) краткотраен (макс.. 3 s) 200 A повтарящ пик

[illegible]	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*680 V AC (p-p) 0V-+/-1120VDC изолиран до560 V DC
Изходен ток (@ макс.. 300 V AC/360 V DC)	26 A (RMS) непрекъснат 47 A (RMS) краткотраен (макс.. 3 s) 200 A повтарящ пик
Вкл. опции	Opt-3 Recovery 20/ Opt-3 DC-EVR

NETWAVE 20.5	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 300 V AC/360 V DC)	26 A (RMS) непрекъснат 47 A (RMS) краткотраен (макс.. 3 s) 200 A повтарящ пик
Вкл. опции	Opt-3 Recovery 20/30 Opt-3 DC-EVR Opt-3 Parallel 20/30

ТЕХНИЧЕСКИ ДЕТАЙЛИ

NETWAVE 20.3	
Изходно напрежение	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Изходен ток	33 A (RMS) непрекъснат 66 A (RMS) краткотраен (макс.. 3 s) 250 A повтарящ пик

NETWAVE 20.7	
Изходно напрежение	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	33 A (RMS) непрекъснат 66 A (RMS) краткотраен (макс.. 3 s) 250 A повтарящ пик

NETWAVE 20.3	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC изолиран до660 V DC
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	33 A (RMS) непрекъснат 66 A (RMS) краткотраен (макс.. 3 s) 250 A повтарящ пик
Вкл. опции	Opt-3 Recovery 20/30 Opt-3 DC-EVR

NETWAVE 20.5	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	33 A (RMS) непрекъснат 66 A (RMS) краткотраен (макс.. 3 s) 250 A повтарящ пик
Вкл. опции	Opt-3 Recovery 20/30 Opt-3 DC-EVR Opt-3 Parallel 20/30

NETWAVE 67	
Изходно напрежение	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Изходен ток	75 A (RMS) непрекъснат 100 A (RMS) кратко 400 A повтарящ пи

NETWAVE 67.2	
Изходно напрежение	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	75 A (RMS) непрекъснат 100 A (RMS) краткотраен (макс.. 3 s) 400 A повтарящ пик

OPTION FOR DC EXTENDED VOLTAGE RANGE	
* с опция.	OPT-3 DC-EVR, Double the DC voltage

ТЕХНИЧЕСКИ ДЕТАЙЛИ

NETWAVE 67.3	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC изолиран до660 V DC
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	75 A (RMS) непрекъснат 100 A (RMS) краткотраен (макс.. 3 s) 400 A повтарящ пик
Вкл. опции	Opt-3 Recovery 67 Opt-3 DC-EVR

NETWAVE 67.5	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 300 V AC/ 360 V DC)	75 A (RMS) непрекъснат 100 A (RMS) краткотраен (макс.. 3 s) 400 A повтарящ пик
Вкл. опции	Opt-3 Recovery 67 Opt-3 DC-EVR Opt-3 Parallel 67

NETWAVE 90.2	
Изходно напрежение	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Изходен ток (@ макс.. 300 V AC/360 V DC)	100 A (RMS) непрекъснат 150 A (RMS) краткотраен (макс.. 3 s) 500 A повтарящ пик

NETWAVE 90.3	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC изолиран до 560 V DC
Изходен ток (@ макс.. 300 V AC/360 V DC)	100 A (RMS) непрекъснат 150 A (RMS) краткотраен (макс.. 3 s) 500 A повтарящ пик
Вкл. опции	Opt-3 Recovery 90 Opt-3 DC-EVR

NETWAVE 90.5	
Изходно напрежение	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 300 V AC/360 V DC)	100 A (RMS) непрекъснат 150 A (RMS) краткотраен (макс.. 3 s) 500 A повтарям пик
Вкл. опции	Opt-3 Recovery 90 Opt-3 DC-EVR Opt-3 Parallel 90

NETWAVE 108.5	
Изходно напрежения	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 360 V AC/500 V DC)	100 A (RMS) непрекъснат 150 A (RMS) краткотраен (макс.. 3 s) 500 A повтарям пик
Вкл. опции	Opt-3 Recovery 108 Opt-3 DC-EVR

NETWAVE 108.5	
Изходно напрежения	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0V-+/-1120VDC напълно изолиран до1000 V DC
Изходен ток (@ макс.. 360 V AC/500 V DC)	100 A (RMS) непрекъснат 150 A (RMS) краткотраен (макс.. 3 s) 500 A повтарям пик
Вкл. опции	Opt-3 Recovery 108 Opt-3 DC-EVR Opt-3 Parallel 108

ТЕХНИЧЕСКИ ДЕТАЙЛИ

РАЗШИРЕНИ ВЪЗМОЖНОСТИ ЗА NETWAVE	
Прост режим	Оптимизирано управление за интегриране на Netwave в съществуваща среда за автоматизация (напр. Matlab)
Изходен AC режим	PLL синхронизация с друга източница на напрежение
Тригер канал	Разширени тригер функции
Сегмент "Стъпка"	Ramping of voltage and/or frequency in constant time windows
Външен режим	Управление на NetWave от външен сигнал

NETWAVE XX.3	
Lic-3 NetIndustry	включен
Lic-3 NetAutomotive	включен


AMETEK
COMPLIANCE TEST SOLUTIONS

ОБЩИ ДАННИ (ВСИЧКИ МОДЕЛИ)

[illegible]

Изходна честотна	DC - 6,000 Hz
Честотна стабилност	100 ppm
Фазова точност	резолюция 1°
Изходен шум	< 50 V : 110 mV rms > 50 V : 320 mV rms + 0.02% of set value
Нарастване	8V/µs
Изходно изолационно напрежение	x.5 модели: 1000 VDC линия - земя Всички останали модели: 600 VDC линия - земя
Изходни конектори	Защитени конектори CEE type 32 A (само за NetWave 20.x и NetWave 30.x)
Интерфейси	GPIB Ethernet RS 232 (input from DPA analyser) Frame bus (internal system bus)

РЕГУЛИРАНЕ

Напрежение, запас	Вътрешно или външно, 4 проводно
Изкривяване (THD)	По-малко от 0.5 %, @50/60 Hz
Регулиране на изх. напрежени	По-добро от 0.1 % от зададена стойност
Изходно напрежение Точност	DC: +-0.2 % of set value +-0.15 % of full scale, AC: Add +-0.1 % of set frequency / 1000
Макс. Компенсационен спад на напрежение в проводниците	5 % от V номинално
Токов ограничител	5 A to Iмакс. (peak), Operation: Stop / Continued forward and reverse current
Защита	Over current Over voltage Over temperature Low voltage

ТРИГЕР И OUT МОНИТОРИНГ

Тригер	2 входа, 2 изхода
	хода, конфигурируеми

ОБЩИ ДАННИ (ВСИЧКИ МОДЕЛИ)

ГЕНЕРАТОР НА ФОРМИ НА СИГНАЛ

Постоянен (DC)	Постоянен, наклонен, квадратен, трипъълен, трионообразен, стъпка, синусоида, синусоидална честотна промяна (sweep), синусоидален наклон, намаляваща амплитудата (damp wave) синусоида, синусоидална вълна , профил, квадратна честотна промяна (sweep), шум, синусоиделен Dwell, синхронизия, Хармоници, Експонента ...
Променлив (AC)	Синусоида, модулации, синусоидална честотна промяна (sweep), Честотна промяна (sweep) върху синусоида, синусоида нагоре/надолу, небалансирана синусоида, Overswing, синусоидално отместване, Синусоидален наклон, хармоници, интерхармоници, интерхармонична стъпка, хармонично изкривяване ...

Продължителност на сегмент	Неограничен

[illegible]

Дисплей	2-Line LCD, 40 characters
LED индикатори	Включен Вкл. изходен канал Тригер Статус на хард диск
Бутони	6 функционални бутона, Test On бутон, ON/OFF бутон

РАЗМЕРИ

NetWave 20.x	прибл. 1785 x 930 x 755 mm прибл. 1785 x 1210 x 755 mm (с recovery опция)
NetWave 30.x	прибл. 1785 x 930 x 755 mm прибл. 1785 x 1210 x 755 mm (с recovery опция)
NetWave 67.x	прибл. 2080 x 1205 x 970 mm прибл. 2080 x 1815 x 970 mm (с recovery опция)
NetWave 90.2	прибл. 2080 x 1810 x
NetWave 90.3	прибл. 2080 x 2410 x
NetWave 106.3	прибл. 2080 x 2410 x

ОБЩИ ДАННИ (ВСИЧКИ МОДЕЛИ)

[illegible]	
NetWave 20.x	прибл. 740 kg прибл. 810 kg (с recovery опция)
NetWave 30.x	прибл. 740 kg прибл. 810 kg (с recovery опция)
NetWave 67.x	прибл. 1,180 kg прибл. 1,380 kg (с recovery опция)
NetWave 90.2	прибл. 1,700 kg
NetWave 90.3 / 90.5	прибл. 2,000 kg (с recovery опция)
NetWave 108.3 / 108.5	прибл. 2,000 kg (с recovery опция)

[illegible]	
Захранващо напрежение	3 x 400 V (3P,PE); Опция 3 x 480 V (3P,PE)
Ток на входа	50 A/90 A (NetWave 20.x)* 70 A/140 A (NetWave 30.x)* 160 A/212 A (NetWave 67.x)* 210 A/318 A (NetWave 90.x)* 252 A/381 A (NetWave 108.x)*
Честота на мрежата	45 Hz - 65 Hz
Конектори	Screwed terminals

[illegible]	
Температура	5°C - 35°C
Отн. влажност	10 % - 90 %, non condensing
Атмосферно налягане	96 kPa (960 mbar) to 106 kPa (1,060 mbar)

ОПЦИИ

[illegible]	
Lic-3 NetIndustry	Софтуерен лиценз за индустриални стандарти IEC 61000-4-13, -4-14, -4-17, -4-27, -4-28
Lic-3 NetHarmonics	Софтуерен лиценз за хармоничен анализ спрямо IEC 61000-3-2, -3-12 and ECE-R10
Lic-3 NetFlicker	Софтуерен лиценз за фликер анализ по IEC 61000-3-3 and -3-11
Lic-3 NetAircraft DO	Софтуерен лиценз за DO-160 Стандарт (3-phase)
Lic-3 NetMilitary	Софтуерен лиценз за MIL-STD-704 стандарт за NetWave-серии (3-phase), изисква допълнително F-Box 3 for LDC / HDC 103
Lic-3 NetAircraft Airbus	Софтуерен лиценз за AIRBUS стандарти за NetWave-серии (3-phase)
Lic-3 NetAircraft Boeing	Софтурен лицена за BOEING Стандарти за NetWave-серии (3-phase) Изисква NetWave модел за 360 VAC или по-висок
Lic-3 NetAuomotive	Софтуерен лицена за автомобилни приложения

AC/DC източници

Изходно напрежение	0V÷ 400 V AC (RMS) 0V± 560 V DC				
Изходна честота	DC÷ 5 kHz				
Стабилност на честотата	100 ppm				
NetWave	20.3	30.3	60.3	67.3	
Изходна мощност AC	22.5 kVA	30 kVA	60 kVA	67 kVA	
Изходна мощност	27 kW	36 kW	72 kW	72 kW	
Изходен ток @ макс. 300V AC	26 A 47 A 200 A	33 A 66 A 250 A	66 A 100 A 400 A	75 A 100 A 400 A	(RMS) продължителен (RMS) краткъ (макс.
Изходен конектор	32 A	32 A	63 A	63 A	CEE конектор или Terminal Safety lab plugs (4/6mm banana)

Общи технически данни за всички трифазни NetWave модели

Регулиране

Voltage sense	Вътрешно или външно , 4-проводно
Sense range	Uset ≥ 100 V ac или dc: ± 5% от настойката
Изкривяване (THD)	под 0.5% (50 Hz / 60 Hz) FS
Стабилност на изх. напрежение	по-добра от 0.1%
Точност на изх. напрежение	по-добра от 0.5%
Изходен шум	<50V: 110 mVrms 50 V < 320 mVrms
Макс. компенс. спад в	5% от макс. номинално напрежение
Точност на токовия	<5%
Стъпки на токовия ограничител	1 A

Обхват на токовия ограничител

Устройство	10 Hz 74.99 Hz	75Hz 5 kHz	Изключен
NetWave 20.x:	5 A 47 A	10 A 47 A	47 A
NetWave 30.x:	5 A 66 A	10 A 66 A	66 A
NetWave 60.x:	5 A 100 A	10 A 100 A	100 A
NetWave 90.x:	5 A 150 A	10 A 150 A	150 A

Ограничител при паралелно превключване	Минимален ток: 10 A Текущ обхват: Умножете тази стойност по 3 при използване на паралелно превключване при трифазните модели
Защита	Висок ток Висока темп. Пре-напрежение Ниско напрежение
Нарастване	8 V/µs
Фазова точност	резолюция 1°

Генератор на произволни сигнали

Сегментни видове DC	Постоянен, наклонен, квадратен, триъгълен, трионообразен, стъпка, синусоида, синусоидална честотна промяна (sweep),бсинусоидален наклон, намаляваща амплитудата (damp wave) синусоида, синусоидална вълна , профил, квадратна честотна промяна (sweep), шум, синусоидален Dwell, синхрониция, Хармоници, Експонента ...
Сегментни видове AC	Синусоида, модулации, синусоидална честотна промяна (sweep), Честотна промяна (sweep) върху синусоида, синусоида нагоре/надолу, небалансирана синусоида, Overswing, синусоидално отместване, Синусоидален наклон, хармоници, интерхармоници, интерхармонична стъпка, хармонично изкривяване ...
Сегментни с опция Aircraft	Sine offset (dc offset to sine), Sine Dip, Sine Exponent
Продължителност на сегмент	неограничен
Импорт на данни	CSV or Excel

Дисплей и контрол	
Дисплей	Текстов LCD 2-реда, 40 символа
LED индикатори	Включен
	Активен изходен канала
	Тригер
	Работен статус
	Функционален статус на хард диска
Работа	6 функционални бутона Test Вкл. ; Вкл. / Изкл. бутон за източника

Входове & Изходи	
Тригер	2 входа, 2 изхода
DUT мониторинг	2 входа, конфигурируеми
Сигнален изход	Изходен сигнал на вградения генератор на производни форми
Сигнален вход	Вход за външен или вътрешен генератор на производни форми

Управление	
Компютър	PC 104 компютър AMD Microprocessor 300 MHz 256 MB RAM
Операционна система	Linux, с Real time разширение
DSP сигнален процесор	Motorola DSP 56303

Interfaces	
	GPIB Address 1...30
	Ethernet
	USB (за опции Measure & Analyze NW-Board)
	USB (за памет и външен хард диск) I макс., 500 mA
	RS232 (вход от DPA анализатор)
	Frame bus (вътрешна системна шина)

Околна среда	
Температура	
работна	5°C - 40°C
съхранение	-20°C - 60°C
градиент	20°C / час
Влажност	10% - 90% , без кондензация
Вибрации	
Работен режим	1.0G
Не-работен режим	5.0G
Удър	
Работен режим	225G (2ms)
Не-работен режим	900G (1ms)

Условия		
Защитен дизайн	според IEC 1010, EN 61010	
Захранване	3 x 400 V ± 10%	(3P, PE)
	3 x 208 V ± 10%	(3P, PE) optional
Честота на мрежата	45 Hz 65 Hz	
Макс. входен ток	Непрекъснат	I макс., 3s
- NetWave 20.x	50 A / фаза	90 A
- NetWave 30.x	70 A / фаза	140 A
- NetWave 60.x	140 A / фаза	212 A
- NetWave 67.x	180 A / фаза	212 A
- NetWave 90.2	210 A / фаза	318 A
	Контрол. F1: 3.15 A slow blow	(5 x 20mm)
	AC захрн. F2: 25 A, 600 V >120 kA	(10 x 38mm)
	CEE тип или директно присъединяване	
	60dB A измерен на 1 м пред устройството и на 1.5м	
	0 °C to 35 °C	

Атмосферно налягане	86 kPa (860 mbar) до 106 kPa (1 060 mbar)

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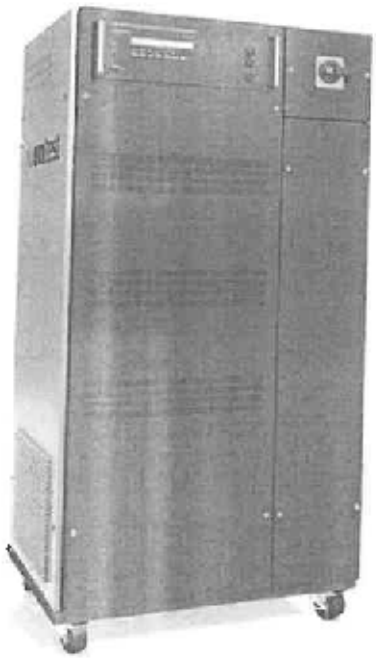
NETWAVE SERIES (3-PHASE)

THREE-PHASE MULTIFUNCTIONAL AC/DC POWER SOURCES



FOR TESTS ACCORDING TO...

- › AIRBUS, BOEING
- › DO 160 Section 16, Section 18
- › LV 123
- › BMW GS 95023
- › MBN LV 123
- › VW 80300
- › VW 80303
- › PSA B21 7110
- › IEC/EN 61000-3-2, -3-12
- › IEC/EN 61000-3-3, -3-11
- › JIS C 61000-3-2
- › IEC/EN 61000-4-11, -4-29, -4-34
- › IEC 61000-4-13
- › IEC 61000-4-14
- › IEC 61000-4-17
- › IEC 61000-4-27
- › IEC 61000-4-28
- › MIL STD 461
- › MIL-STD-704

NETWAVE - SIMULATION OF THE MOST REQUIRED POWER SUPPLY PHENOMENON

The NetWave Series (3-phase) are three-phase AC/DC power source, specifically designed to fully meet the requirements as per the standards IEC/EN 61000-4-13, -4-14, -4-28 and in addition to pre compliance testing to -4-27. It is also used as a DC power source to cover the requirements as per the standards IEC/EN 61000-4-17 (Ripple on DC) and IEC/EN 61000-4-29 for voltage dips and interruptions on DC supplies. The NetWave series is well suited for testing inverters (e.g. solar power, wind power) and e-vehicles like LV 123 standard. Additionally, the NetWave series (3-phase) offers the necessary capabilities for avionics testing as per DO-160, Airbus ABD0100 and Boeing as well as per MIL-STD-704 and is perfectly suited as reference source for Harmonics and Flicker testing.
Optionally the NetWave 3-phase series can be equipped with a power-recovery module to absorb fed-back power (AC/DC) up to nominal power of the NetWave.

HIGHLIGHTS

- › Wide Power Bandwidth: DC - 5 kHz
- › Output Power up to 270 kVA AC / 324 kW DC
- › Output up to 3*690 VAC (p-p), +/-1120 VDC
- › High Inrush Current Capability
- › Power-recovery up to nominal power (optional)

APPLICATION AREAS

- AUTOMOTIVE
- AVIONICS
- INDUSTRY
- MILITARY
- MEDICAL
- RENEWABLE ENERGY

AMETEK
COMPLIANCE TEST SOLUTIONS

TECHNICAL DETAILS

BENEFITS

NETWAVE - THE POWERFUL MULTITALENT FOR AC AND DC SUPPLY SIMULATION

The programmable 3-phase AC/DC power sources with their wide frequency bandwidth offer powerful waveform generation capabilities for various test applications in the EMC area and for avionics testing. Based on a Dual-Processor technology, with an integrated high-performance PC, a digital signal processor (DSP) and equipped with a hard disk, the NetWave Series is capable to generate and record waveforms in realtime.

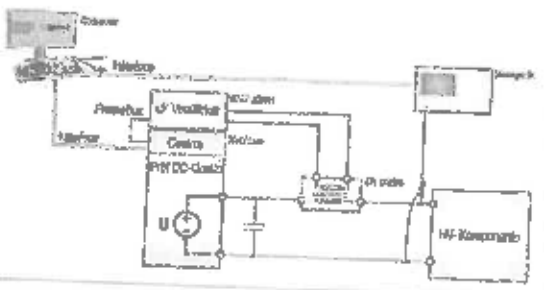
According to standard requirements a pure sinusoidal voltage is needed for harmonics and flicker measurements. The output voltage of the NetWave Series is therefore guaranteed to have a very low distortion (THD) of less than 0.1% regardless of the load. No matter whether waveforms are programmed of segments or of single points (normally resulting in MBs of data) the NetWave masters it all.

Interfaces like GPIB and Ethernet are common features with the NetWave Series.

AUTOMOTIVE APPLICATIONS

THE COMPLETE SOLUTION FOR HV COMPONENTS TESTING

With the NetWave it is possible for the first time to check HV components up to 1120 VDC according to LV 123, VW 80300 and other automotive standards. Tests included are fast and slow voltage variations as well as voltage ripple tests.
The additional LF amplifier AMP 200Nx uses the CN 200Nx to couple voltage ripples up to 450 kHz to the supply lines.
With the closed loop method, the net.control software measures the voltage ripple and continuously controls the amplitude.



SOFTWARE NET.CONTROL

EDITING, DOCUMENTING AND MANAGING YOUR WAVEFORMS AND STANDARD TESTS

net.control is the all-in-one software platform to easily and conveniently control the NetWave Series. By means of net.control the user can program any kind of waveforms either composed from segments or points and download them into the NetWave. Enhanced graphic tools are at hand to adjust the waveform according to individual requirements.

net.control provides a library of an extensive compilation of predefined segments as well as tens of thousands of standard test routines as per EMC and avionics standards.

net.control is also handling any waveform recorded by other method (e.g. captured by an oscilloscope) or imported as Excel or CSV files. All waveforms can be downloaded into the NetWave.

net.control offers an enhanced reporting tool to generate test and measuring reports and can be used under Windows 7, Windows 8 and Windows 10.

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EXPAND YOUR SOURCE

COMBINE TWO OR THREE NETWAVE FOR HIGHER OUTPUT VOLTAGE OR OUTPUT POWER

Save budget by buying one NetWave today and expand your testing capabilities tomorrow. The NetWave family offers the possibility to expand the power or voltage range by combining several units. Double the voltage with the CascadeSource option (Opt-3 CS) or form a powerful three phase AC source with the MultiSource option (Opt-3 MS) - both is possible.

MODEL OVERVIEW

3-PHASE NETWAVE MODELS	
NetWave	3-phase Multifunction AC/DC source
NetWave 20.x	22,5 kVA AC / 27 kW DC support with wheels
NetWave 30.x	30 kVA AC / 36 kW DC, support with wheels
NetWave 67.x	67 kVA AC / 72 kW DC, support with wheels optional
NetWave 90.x	90 kVA AC / 110 kW DC, stationary placement
NetWave 108.x	108 kVA AC / 150 kW DC, stationary placement

TECHNICAL DETAILS

[illegible]	
Output voltage	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Output current	26 A (RMS) continuous 47 A (RMS) short-term (max. 3 s) 200 A repetitive peak

[illegible]	
Output voltage	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Output current (@ max. 300 V AC/360 V DC)	26 A (RMS) continuous 47 A (RMS) short-term (max. 3 s) 200 A repetitive peak

[illegible]	
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC Isolated up to 560 V DC
Output current (@ max. 300 V AC/360 V DC)	26 A (RMS) continuous 47 A (RMS) short-term (max. 3 s) 200 A repetitive peak
Included options	Opt-3 Recovery 20/30 Opt-3 DC-EVR

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TECHNICAL DETAILS

NETWAVE 40	
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC fully isolated up to 1000 V DC
Output current (@ max. 300 V AC/360 V DC)	26 A (RMS) continuous 47 A (RMS) short-term (max. 3 s) 200 A repetitive peak
Included options	Opt-3 Recovery 20/30 Opt-3 DC-EVR Opt-3 Parallel 20/30

TECHNICAL DETAILS

NETWAVE 15	
Output voltage	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Output current	33 A (RMS) continuous 66 A (RMS) short-term (max. 3 s) 250 A repetitive peak

NETWAVE 30	
Output voltage	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Output current (@ max. 300 V AC/ 360 V DC)	33 A (RMS) continuous 66 A (RMS) short-term (max. 3 s) 250 A repetitive peak

NETWAVE 30.3	
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC isolated up to 560 V DC
Output current (@ max. 300 V AC/ 360 V DC)	33 A (RMS) continuous 66 A (RMS) short-term (max. 3 s) 250 A repetitive peak
Included options	Opt-3 Recovery 20/30 Opt-3 DC-EVR

NETWAVE 30.5	
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC fully isolated up to 1000 V DC
Output current (@ max. 300 V AC/ 360 V DC)	33 A (RMS) continuous 66 A (RMS) short-term (max. 3 s) 250 A repetitive peak
Included options	Opt-3 Recovery 20/30 Opt-3 DC-EVR Opt-3 Parallel 20/30

NETWAVE 67	
Output voltage	0 V - 3*300 V AC (p-n) 0 V - +/- 425 V DC, (850 VDC*)
Output current	75 A (RMS) continuous 100 A (RMS) short-term (max. 3 s) 400 A repetitive peak

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TECHNICAL DETAILS

NETWAVE 67
Output voltage	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Output current (@ max. 300 V AC/ 360 V DC)	75 A (RMS) continuous 100 A (RMS) short-term (max. 3 s) 400 A repetitive peak

OPTION FOR DC EXTENDED VOLTAGE RANGE	
*with option	OPT-3 DC-EVR, Double the DC voltage

TECHNICAL DETAILS

NETWAVE 67
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC isolated up to 560 V DC
Output current (@ max. 300 V AC/ 360 V DC)	75 A (RMS) continuous 100 A (RMS) short-term (max. 3 s) 400 A repetitive peak
Included options	Opt-3 Recovery 67 Opt-3 DC-EVR

NETWAVE 67.5
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC Fully isolated up to 1000 V DC
Output current (@ max. 300 V AC/ 360 V DC)	75 A (RMS) continuous 100 A (RMS) short-term (max. 3 s) 400 A repetitive peak
Included options	Opt-3 Recovery 67 Opt-3 DC-EVR Opt-3 Parallel 67

NETWAVE 90.2
Output voltage	0 V - 3*360 V AC (p-n) 0 V - 3*620 V AC (p-p) 0 V - +/- 500 V DC, (1000 VDC*)
Output current (@ max. 300 V AC/360 V DC)	100 A (RMS) continuous 150 A (RMS) short-term (max. 3 s) 500 A repetitive peak

NETWAVE 90.3
Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC isolated up to 560 V DC
Output current (@ max. 300 V AC/360 V DC)	100 A (RMS) continuous 150 A (RMS) short-term (max. 3 s) 500 A repetitive peak
Included options	Opt-3 Recovery 90 Opt-3 DC-EVR

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TECHNICAL DETAILS

NETWAVE 90.3

Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC fully isolated up to 1000 V DC
Output current (@ max. 300 V AC/360 V DC)	100 A (RMS) continuous 150 A (RMS) short-term (max. 3 s) 500 A repetitive peak
Included options	Opt-3 Recovery 90 Opt-3 DC-EVR Opt-3 Parallel 90

NETWAVE 108.3

Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC isolated up to 560 V DC
Output current (@ max. 360 V AC/500 V DC)	100 A (RMS) continuous 150 A (RMS) short-term (max. 3 s) 500 A repetitive peak
Included options	Opt-3 Recovery 108 Opt-3 DC-EVR

NETWAVE [illegible]

Output voltage	0 V - 3*400 V AC (p-n) 0 V - 3*690 V AC (p-p) 0 V - +/- 1120 V DC fully isolated up to 1000 V DC
Output current (@ max. 360 V AC/500 V DC)	100 A (RMS) continuous 150 A (RMS) short-term (max. 3 s) 500 A repetitive peak
Included options	Opt-3 Recovery 108 Opt-3 DC-EVR Opt-3 Parallel 108

TECHNICAL DETAILS

EXTENDED CAPABILITIES FOR NETWAVE

Simple mode	Optimized control for integration of the Netwave into existing automation environments (for example Matlab)
SourceAC mode	PLL synchronization with other voltage sources
Trigger channel	Extended trigger functions
Segment "Step"	Ramping of voltage and/or frequency in constant time windows
Extern mode	Control of the NetWave by an external control signal

NETWAVE OPTIONS

Lic-3 NetIndustry	included
Lic-3 NetAutomotive	included

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TECHNICAL DETAILS

GENERAL DATA (ALL MODELS)

Specifications

Output frequency	DC - 5,000 Hz
Frequency stability	100 ppm
Phase accuracy	Resolution: 1°
Output noise	< 50 V : 110 mV rms > 50 V : 320 mV rms + 0.02% of set value
Slew Rate	8V/µs
Output isolation voltage	x.5 models: 1000 VDC line - earth all other models: 600 VDC line - earth
Output connectors	Safety lab connectors CEE type 32 A (only for NetWave 20.x and NetWave 30.x)
Interfaces	GPIB Ethernet RS 232 (Input from DPA analyser) Frame bus (internal system bus)

Regulation

Voltage sense	Internal or external, 4 wires
Distortion (THD)	Less than 0.5 %, @50/60 Hz
Output voltage regulation	Better than 0.1 % of set value
Output voltage Accuracy	DC: +-0.2 % of set value +-0.15 % of full scale, AC: Add +-0.1 % of set frequency / 1000
Max. compensatable drop on wires	5 % of V nominal
Current limiter	5 A to Imax (peak), Operation: Stop / Continued forward and reverse current
Protection	Over current Over voltage Over temperature Low voltage

TRIGGER AND DUT MONITORING

Trigger	2 inputs, 2 outputs
DUT monitors	2 inputs, configurable

GENERAL DATA (ALL MODELS)

WAVEFORM GENERATOR

Segment types DC	DC, Ramp, Square, Triangle, Sawtooth, Step, Sine, Sine sweep, Sine ramp, Damped sinewave, Sine ripple, Profile, Square sweep, Noise, Sine Dwell, Sinc, Harmonic, Exponent ...
Segment types AC	Sine, Modulation, Sine sweep, Sweep on Sine, Sine up/down, Sine unbalance, Overswing, Sine offset, Sine Dip, Harmonic, Interharmonic, Interharmonic step, Harmonic distortion ...
Segment duration	Unlimited

DISPLAY AND KEYBOARD

Display	2-Line LCD, 40 characters
LED Indicators	Power On Active output channel Trigger Functional status hard disk
Operation	6 function keys, Test On key: ON/OFF key for the power source

DIMENSIONS (ROLLS AND CRANE SUPPORT INCLUDED)

NetWave 20.x	approx. 1785 x 930 x 755 mm approx. 1785 x 1210 x 755 mm (recovery)
NetWave 30.x	approx. 1785 x 930 x 755 mm approx. 1785 x 1210 x 755 mm (recovery)
NetWave 67.x	approx. 2080 x 1205 x 970 mm approx. 2080 x 1615 x 970 mm (recovery)
NetWave 90.2	approx. 2080 x 1810 x 970 mm
NetWave 90.3	approx. 2080 x 2410 x 970 mm
NetWave 108.3	approx. 2080 x 2410 x 970 mm

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TECHNICAL DETAILS

GENERAL DATA (ALL MODELS)

WEIGHT (BOLSTER & CASE SUPPORT INCLUDED)	
NetWave 20.x	approx. 740 kg approx. 810 kg (recovery)
NetWave 30.x	approx. 740 kg approx. 810 kg (recovery)
NetWave 67.x	approx. 1,180 kg approx. 1,380 kg (recovery)
NetWave 90.2	approx. 1,700 kg
NetWave 90.3 / 90.5	approx. 2,000 kg (recovery)
NetWave 108.3 / 108.5	approx. 2,000 kg (recovery)

MAINS	
Supply voltage	3 x 400 V (3P,PE); optional 3 x 480 V (3P,PE)
Input current	50 A/90 A (NetWave 20.x)* 70 A/140 A (NetWave 30.x)* 160 A/212 A (NetWave 67.x)* 210 A/318 A (NetWave 90.x)* 252 A/381 A (NetWave 108.x)* * the higher figure represents the 3s short-term current
Line frequency	45 Hz - 65 Hz
Connectors	Screwed terminals

AMBIENT CONDITIONS	
Temperature	5°C - 35°C
Rel. humidity	10 % - 90 %, non condensing
Atmospheric pressure	86 kPa (860 mbar) to 106 kPa (1,060 mbar)

OPTIONS

OPTIONAL SOFTWARE	
Lic-3 NetIndustry	Software license for industrial standards IEC 61000-4-13, -4-14, -4-17, -4-27, -4-28
Lic-3 NetHarmonics	Software license for harmonics analysis as per IEC 61000-3-2, -3-12 and ECE-R10
Lic-3 NetFlicker	Software license for flicker analysis as per IEC 61000-3-3 and -3-11
Lic-3 NetAircraft DO	Software license for DO-160 standard for NetWave-series (3-phase)
Lic-3 NetMilitary	Software license for MIL-STD-704 standard for NetWave-series (3-phase), requires filter box F-Box 3 for LDC / HDC 103
Lic-3 NetAircraft Airbus	Software license for AIRBUS standards for NetWave-series (3-phase)
Lic-3 NetAircraft Boeing	Software license for BOEING standards for NetWave-series (3-phase) Requires NetWave model for 360 VAC or higher
Lic-3 NetAuomotive	Software license for Automotive application

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TECHNICAL DETAILS

MULTI SOURCE OPTIONS

MULTI SOURCE	
Opt-3 MS xx	Option to connect in parallel three NetWave sources, switched in parallel mode (tripple power), e.g. 3x NW90.2 -> NW90.2MS
Available Options	Opt-3 MS 20/30 Opt-3 MS 67 Opt-3 MS 90
Requirements	Each equipped with Opt-3 Parallel Three identical models only

CASCADE SOURCE OPTIONS

CASCADE SOURCE	
Opt-3 CS	Option to connect in series two NetWave sources, switched in series mode (double voltage), e.g. 2x NW90.2 -> NW90.2CS
Available Options	Opt-3 CS 20/30 Opt-3 CS 67 Opt-3 CS 90
Requirements	Each equipped with Opt-3 Parallel Two identical models only

OPTIONS

NW BOARD MEASURING MODULE	
Channels	Built in 6 channel (3-phase) measurement board for 3* voltage 3* current
Voltage ranges	25 V, 50 V, 100 V, 250 V, 550 V, unipolar or bipolar
Current ranges	10 A, 25 A, 50 A, 100 A, 220 A, unipolar or bipolar
Resolution	16 Bit
Accuracy	Voltage: +-0.05 % of reading +-0.2 % of range Current: +-0.2 % of reading +-0.3 % of range
Frequency range	DC - 100 kHz
Sampling rate	5Hz - 200 kHz, selectable
Memory	Min. 40 GB on hard disk, File size max. 1 GB
PC requirements	Minimum Intel i5 with 8 GB RAM or similar
Measuring Parallel Mode	NetWave 20.x NetWave 30.x

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TECHNICAL DETAILS

OPTIONS

PARALLEL MODE HARDWARE (OPTION PARALLELMODE 20/30, 67, 90, 108)	
Parallel Mode 20/30, 67, 90, 108	Parallels all three phases to one. The common 1-phase output is on a separate terminal block for EUT connection. During parallel mode disconnect the 3-phase terminals from the source.
NetWave 20.x	78 A (RMS) continuous 141 A (RMS) short max. 3s 400 A repetitive peak
NetWave 30.x	99 A (RMS) continuous 198 A (RMS) short max. 3s 500 A repetitive peak
NetWave 67.x	225 A (RMS) continuous 300 A (RMS) short max. 3s 600 A repetitive peak
NetWave 90.x	300 A (RMS) continuous 450 A (RMS) short max. 3s 1,000 A repetitive peak
NetWave 108.x	300 A (RMS) continuous 450 A (RMS) short max. 3s 1,000 A repetitive peak

OPTIONS

POWER RECOVERY (OPTION RECOVERY 20, 30, 67, 90, 108)	
Available for	all 3-phase NetWave models
Mains voltage	400 V +/- 10% (45 Hz - 65 Hz)
Recoverable power	up to nominal AC/DC power of the individual NetWave model
Recovery 20	for NetWave 20.x Max. 22.5 kVA AC / 27 kW DC 26 A (RMS) continuous 47 A (RMS) short max. 3 s 200 A repetitive peak
Recovery 30	for NetWave 30.x Max. 30 kVA AC / 36 kW DC 33 A (RMS) continuous 66 A (RMS) short max. 3 s 250 A repetitive peak
Recovery 67	for NetWave 67.x Max. 67 kVA AC / 72 kW DC 75 A (RMS) continuous 100 A (RMS) short max. 3 s 400 A repetitive peak
Recovery 90	included in Netwave 90.3, Max. 90 kVA AC / 110 kW DC 100 A (RMS) continuous 150 A (RMS) short max. 3 s 500 A repetitive peak
Recovery 108	included in Netwave 108.3, Max. 108 kVA AC / 132 kW DC 100 A (RMS) continuous 150 A (RMS) short max. 3 s 500 A repetitive peak
Power factor	> 0.92 (cos phi) at full load

[illegible]	
OPT-3 DC-EVR	Double DC voltage range, using two phases simultaneously, available only for 3-phase NetWaves
NetWave 20, 30, 67, 90, 108	Extended from 425 VDC to 850 VDC
NetWave x.2 models	Extended from 500 VDC to 1000 VDC
NetWave x.3 models	Extended from 560 VDC to 1120 VDC included

CASTERS FOR NETWAVE 67.X	
Support with wheels	Support with wheels for NetWave 67.x

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TECHNICAL DETAILS

ACCESSORIES

FILTER BOX F-BOX 3-60

Application	Lowpass filter for smoothing the dc voltage for very low ripple application < 500 mV
Standard	MIL-HDBK-704-7 HDC 103 MIL-HDBK-704-8 LDC 103 other applications with low ripple signals
Application MIL-HDBK	Test condition A (10 Hz) Test condition B (25 Hz)
Voltage	AC: 230 V DC: 500 V
Current	60 A
Frequency	max. 60 Hz
Dimension (LxWxH)	200 mm x 150 mm x 60 mm
Weight	1.65 kg

[illegible]

F-BOX 3 Application	Lowpass filter for smoothing the dc voltage for very low ripple application < 500 mV
Standard	MIL-HDBK-704-7 HDC 103 MIL-HDBK-704-8 LDC 103 other applications with low ripple signals
Application MIL-HDBK	Test condition A (10 Hz) Test condition B (25 Hz)
Voltage	AC: 230 V DC: 500 V
Current	100 A
Frequency	max. 60 Hz
Dimension (LxWxH)	255 mm x 180 mm x 80 mm
Weight	3.25 kG

ACCESSORIES

[illegible]

Application	50 µH decoupling coils with integrated 10 µF capacitor for MIL-STD-704 LDC
Max EUT Voltage	500 VDC / 360 VAC
Max EUT current	32 A

[illegible]

Application	50 µH decoupling coils with integrated 10 µF capacitor for MIL-STD-704 LDC
Max EUT Voltage	500 VDC / 360 VAC
Max EUT current	100 A

OTHER SOLUTIONS & OPTIONS

OTHER MODELS

NetWave Series (1-phase)	Single phase Multifunction AC/DC Power sources, up to 7,500 VA AC and 9,000 W DC

TECHNICAL DETAILS

HARMONIC & FLICKER OPTIONS

[illegible]	3-phase Harmonics and Flicker analyzer
AIF 503N16	3-phase flicker impedance, 3x400 V, 16 A 0.24ohm + j0.15ohm (Lines) 0.16ohm + j0.10ohm (Neutral)
AIF 503N16.1	3-phase flicker impedance, 3x400 V, 16 A 0.24ohm + j0.15ohm (Lines) 0.16ohm + j0.10ohm (Neutral) Rackmounted inside a MRAC 25

FLICKER IMPEDANCES WITH ZREF AND ZTEST

General	3-phase dual-impedance, Zref: 0.24 ohm + j0.15 ohm (Lines) 0.16 ohm + j0.10 ohm (Neutral) Ztest: 0.15 ohm + j0.15 ohm (Lines) 0.10 ohm + j0.10 ohm (Neutral)
AIF 503N32.1	3x400 V, 32 A
AIF 503N63.1	3x400 V, 63 A
AIF 503N75.1	3x400 V, 75 A

AUTOMOTIVE OPTIONS

AUDIO AMPLIFIERS

AMP 200N2	LF Signalgenerator & Amplifier, DC to 250 kHz, (500 kHz), 1000 W, Output voltage max. 160 Vp-p, 50 Vrms

COUPLING TRANSFORMERS

	Coupling transformer to couple sinusoidal disturbances to AC and DC lines
CN 200N1	frequency 10 Hz to 250 kHz, sec. current up to 50 A, sec. voltage 400 VAC/600 VDC
CN 200N100	frequency 10 Hz to 500 kHz, sec. current up to 100 A, Isolation voltage 1200 VDC
CN 200N200	frequency 10 Hz to 500 kHz, sec. current up to 200 A, Isolation voltage 1200 VDC
CN 200N300	frequency 10 Hz to 500 kHz, sec. current up to 300 A, Isolation voltage 1200 VDC

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COMPETENCE WHEREVER YOU ARE

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Information about scope of delivery, visual design and technical data correspond with the state of development at time of release. We reserve the right to change without further notice.

AMETEK
COMPLIANCE TEST SOLUTIONS

6.2. 3-phase NetWave

6.2.1. 3-phase NetWave 20, NetWave 30, NetWave 60, NetWave 67

AC / DC Power source					
Output voltage	0V – 300 V AC (RMS) 0V - ±425 V DC				
Output frequency	DC – 5 kHz				
Frequency accuracy, stability	100 ppm				
NetWave	20	30	60	67	
Output power AC	22.5 kVA	30 kVA	60 kVA	67 kVA	
Output power DC	27 kW	36 kW	72 kW	72 kW	
Output current @ max. 300V AC	26 A 47 A 200 A	33 A 66 A 250 A	66 A 100 A 400 A	75 A 100 A 400 A	(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	32 A	32 A	63 A	63 A	CEE con. or Terminal Safety lab plugs (4/6mm banana)

6.2.2. 3-phase NetWave 20.1, NetWave 30.1, NetWave 60.1

AC / DC Power source				
Output voltage	0V – 360 V AC (RMS) 0V - ±500 V DC			
Output frequency	DC – 5 kHz			
Frequency accuracy, stability	100 ppm			
NetWave	20.1	30.1	60.1	
Output power AC	22.5 kVA	30 kVA	60 kVA	
Output power DC	27 kW	36 kW	72 kW	
Output current @ max. 300V AC	26 A 47 A 200 A	33 A 66 A 250 A	66 A 100 A 400 A	(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	32 A	32 A	63 A	CEE con. or Terminal Safety lab plugs (4/6mm banana)

6.2.3. 3-phase NetWave 20.2, NetWave 30.2, NetWave 60.2, NetWave 67.2, NetWave 90.2

AC / DC Power source						
Output voltage	0V – 360 V AC (RMS) 0V - ±500 V DC					
Output frequency	DC – 5 kHz					
Frequency accuracy, stability	100 ppm					
NetWave	20.2	30.2	60.2	67.2	90.2	
Output power AC	22.5 kVA	30 kVA	60 kVA	67 kVA	90 kVA	
Output power DC	27 kW	36 kW	72 kW	72 kW	110 kW	
Output current @ max. 300V AC	26 A 47 A 200 A	33 A 66 A 250 A	66 A 100 A 400 A	75 A 100 A 400 A	100 A 150 A 500 A	(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	32 A	32 A	63 A	63 A	100 A	CEE con. or Terminal Safety lab plugs (4/6mm bana

6.2.4. 3-phase NetWave 20.3, NetWave 30.3, NetWave 60.3, NetWave 67.3

AC / DC Power source					
Output voltage	0V – 400 V AC (RMS) 0V - ±560 V DC				
Output frequency	DC – 5 kHz				
Frequency accuracy, stability	100 ppm				
NetWave	20.3	30.3	60.3	67.3	
Output power AC	22.5 kVA	30 kVA	60 kVA	67 kVA	
Output power DC	27 kW	36 kW	72 kW	72 kW	
Output current @ max. 300V AC	26 A 47 A 200 A	33 A 66 A 250 A	66 A 100 A 400 A	75 A 100 A 400 A	(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	32 A	32 A	63 A	63 A	CEE con. or Terminal Safety lab plugs (4/8mm banana)

6.2.5. 3-phase NetWave 90.3, NetWave 108.3

AC / DC Power source			
Output voltage	0V – 400 V AC (RMS) 0V - ±560 V DC		
Output frequency	DC – 5'000 Hz		
Frequency accuracy, stability	100 ppm		
NetWave	90.3	108.3	
Output power AC	90 kVA	108 kVA	
Output power DC	110 kW	150 kW	
Output current @ max. 300V AC	100 A 150 A 500 A	100 A 150 A 500 A	(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	100 A	100 A	CEE con. or Terminal Safety lab plugs (4/8mm banana)

6.2.6. 3-phase NetWave 30.4 (based on NetWave 30.3)

AC / DC Power source			
Output voltage	0V – 354V AC (RMS) 0V - ±500 V DC Output voltage limited to max. 1000VDC (in HV-DC mode) by hardware.		
Output frequency	DC – 5'000 Hz		
Frequency accuracy, stability	100 ppm		
NetWave	30.4		
Output power AC	30 kVA		
Output power DC	36 kW		
Output current @ max. 300V AC	33 A 66 A 250 A		(RMS) continuous (RMS) short (max. 3s) repetitive peak
Output connector	32 A		CEE con. or Terminal Safety lab plugs (4/8mm banana)

6.2.7. General technical data for all 3-phase NetWave

Regulation				
Voltage sense	Internal or external, 4 wires			
Sense range	Uset ≥ 100 V ac or dc: ± 5% of line setting			
Distortion (THD)	Less than 0.5% (50 Hz / 60 Hz) FS			
Output voltage Stability	Better than 0.1%			
Output voltage Accuracy	Better than 0.5%			
Output Noise	<50V: 110 mVrms; ≥50 V < 320 mVrms			
Max. compen. drop on wires	5% of max. nominal voltage			
Current limiter accuracy	<5%			
Current limiter steps	1 A			
Current limiter range	Device	10 Hz – 74.99 Hz	75Hz – 5 kHz	Disabled
	NetWave 20.x:	5 A – 47 A	10 A – 47 A	47 A
	NetWave 30.x:	5 A – 66 A	10 A – 66 A	66 A
	NetWave 60.x:	5 A – 100 A	10 A – 100 A	100 A
	NetWave 90.x:	5 A – 150 A	10 A – 150 A	150 A
Current limiter in parallel switching	Minimum current : 10 A Current Range: Multiply this value by three when using Parallel Switching on 3 Phases models			
Protection	Over current Over temperature Over voltage mains supply Low voltage mains supply			
Slew Rate	8 V/µs			
Phase accuracy	Resolution 1°			

Waveform generator	
Segment types DC	DC, Ramp, Square, Triangle, Sawtooth, Step, Sine, Sine sweep, Sine ramp, Damped sinewave, Sine ripple, Profile, Square sweep, Noise, Sine Dwell, Sinc, Harmonic, Exponent ...
Segment types AC	Sine (flat curve, flat RMS adapted), Modulation, Sine sweep, Sweep on Sine, Sine up/down, Sine unbalance, Sine Offset, Sine Switching, Over Swing, Harmonic, Interharmonic, Interharmonic step, Harmonic distortion ...
Segments with option Aircraft	Sine offset (dc offset to sine), Sine Dip, Sine Exponent
Segment duration	Unlimited
Data file Import	CSV or Excel

Measurements (option)		
Input channels	6 channels (Opt-3 NWB required)	
Input voltage ranges	25 V, 50 V, 100 V, 250 V and 600V (old systems 550 V) ; unipolar or bipolar	
Input current ranges	10 A, 25 A, 50 A, 100 A and 220 A; unipolar or bipolar	
Resolution	16 Bit	
Accuracy	Voltage better than 0.3%	@50/60 Hz, of selected range
	Current better than 0.5%	@50/60 Hz, of selected range
Frequency range	DC – 100 kHz	
Sampling rate (selectable)	5 S/s – 500 kS/s	
Memory	Min. 40GB on Hard disk File size max. 1 GByte	

Display and Controls	
Display	Text LCD 2 lines, 40 characters
LED indicators	Power On
	Active output channel
	Trigger
	Running status
	Functional status hard disk
Operation	6 function keys
	Test On : ON / OFF key for the power source

Inputs & Outputs	
Trigger	2 inputs, 2 outputs
DUT monitoring	2 inputs, configurable
Signal output	Output Signal of internal arbitrary generator (available only on all 3-phase NetWave models)
Source Input	Input for external or internal arbitrary signal generator (available only on all 3-phase NetWave models)

Control	
Computer	PC 104 computer AMD Microprocessor 500 MHz 256 MB RAM
Operating system	Linux, with Real time extension
DSP Signal processor	Motorola DSP 56303

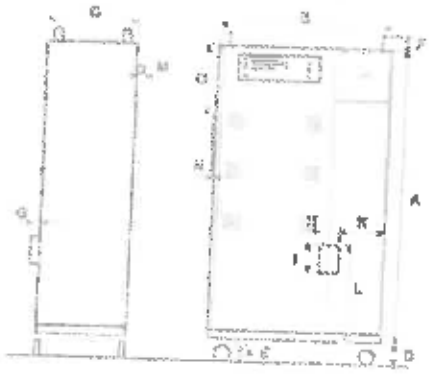
Interfaces	
	GPIB Address 1...30
	Ethernet
	USB (for Measure & Analyze NW-Board option)
	USB (for memory stick and ext. hard disc) I max. 500 mA
	RS232 (Input from DPA analyzer)
	Frame bus (internal system bus)

Environmental Parameter	
Temperature	
operating	5°C - 40°C
storage	-20°C - 60°C
gradient	20°C / hour
Humidity	10% - 90% non-condensing
Vibration	
Operating	1.0G
Non-Operating	5.0G
Shock	
Operating	225G (2ms)
Non-Operating	900G (1ms)

General Data	
Safety design	per IEC 1010, EN 61010
Power supply	3 x 400 V ± 10% (3P, PE) 3 x 208 V ± 10% (3P, PE) optional
line frequency	45 Hz – 65 Hz
Input current max.	Continuous I max. 3s
- NetWave 20.x	60 A / phase 90 A
- NetWave 30.x	70 A / phase 140 A
- NetWave 60.x	140 A / phase 212 A
- NetWave 67.x	160 A / phase 212 A
- NetWave 90.2	210 A / phase 316 A
	Control F1: 3.15 A slow blow (5 x 20mm) AC power F2: 25 A, 500 V >120 kA (10 x 38mm)
Input connector	CEE type or direct cable plugs
Noise (NW 30.2 operates)	SPL –A measured 1m in front of the device 1.5m above ground
Temperature	0 °C to 35 °C
Humidity	10 % to 90 %; non-condensing
Atmospheric pressure	66 kPa (660 mbar) to 106 kPa (1 060 mbar)

NetWave 20.x / 30.x

			recovery
A	height (rolls+crane support)	1560 (1784)	1560 (1784)
B	width	930	1210
C	deep (over all C+G+M)	630 (756)	630 (756)
D	height with rolls	154	154
E	rolls diameter	125	125
F	crane support (removable)	70	80
G	Power IN	85 85	
H	width power IN	130	130
I	height power IN	170	170
K	dist. power IN	345	345
L	dist. power IN	490	490
M	main switch	40	40
N	air IN distance h	na	25
O	air in distance	na	230

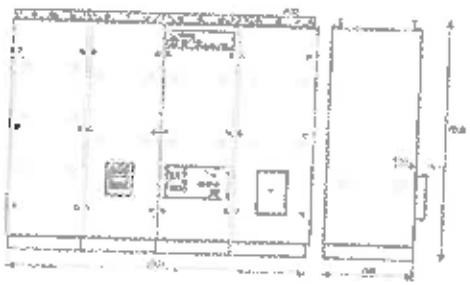


NetWave 60.x / 67.x

			recovery
A	height (rolls+crane support)	1800 (2080)	1800 (2080)
B	width	1205	1615
C	deep (over all C+G+M)	600 (970)	600 (970)
D	height with rolls	200	200
E	rolls diameter	160	160
F	crane support (removable)	80	80
G	Power IN	100	100
H	width power IN	200	200
I	height power IN	300	300
K	dist. power IN	215	215
L	dist. power IN	785	785
M	main switch	70	70
N	air IN distance h	25	25
O	air in distance	430	430

NetWave 90.x / 108.x

			recovery
A	height (crane support)	1800 (1880)	1800 (1880)
B	width	1610	2410
C	deep (over all C+G+M)	970	970
F	crane support (removable)	80	80



= => not relevant data for the standards can be changed by the manufacturer <= =

Хибридни елементи за съхранение на енергия

Технически данни

12V, 2.4kWh LiFePO4 комплект с 200Ah клетки, BMS мобилен мониторинг

Комплектът включва 4 x Winston LiFeYPO4 клетки, 1 x BMS123 , 4 x конектори, 1 x защита от пренапрежение, 4 x капачки (червени), 4 x капачки (черни)

Артикулен номер: WB-12V200AH-SET

Описание:

Технологията Winston LiFeYPO4 превъзхожда конвенционалната AGM, SLA в няколко аспекта.

Те работят по-дълго (живот, цикъл). Нашият 10-годишен опит показва средна продължителност на живота на 5000 цикъла (в зависимост от скоростта на разреждане, минимум 2000, максимално наблюдавани 8000).

По-мощни. С наличната непрекъсната скорост на разреждане при 3C (3 пъти по-голяма от капацитета си), LiFeYPO4 осигурява повече енергия от AGM, SLA.

Никакви киселини. За разлика от AGM, SLA LiFePO4 не съдържа вещества, застрашаващи живота.

Неексплозивност. Li-Pol (Полимерни) и други батерии, често използвани в електронните потребители (Телефони, Таблети), са изключително опасни, когато са физически повреде или неправилно използвани. Всъщност можете да пробиете LiFePO4 с метал и да не предизвикате пожар или експлозия. Пряк път за дълги периоди със същия (малко до нищ ефект.

Технически характеристики

Тегло (кг)	32,4
Височина (mm)	256
Ширина (mm)	362
Дълбочина (mm)	224
Номинално напрежение (V)	12,8
Капацитет (Ah)	200
Максимален ток на разряд (A)	600
Оптимален ток на разряд (A)	100
Максимален ток при заряд (A)	600
Максимален ток при заряд (A)	100

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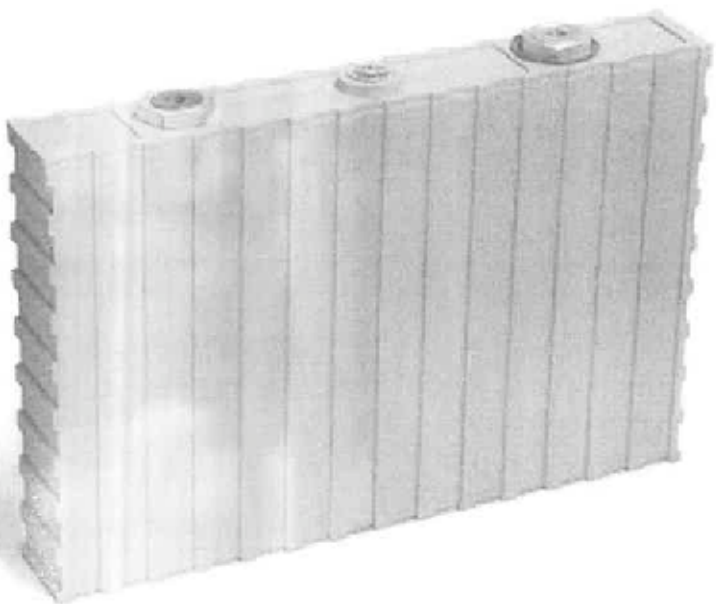
Технически спецификации

Winston LFP200AHA клетка



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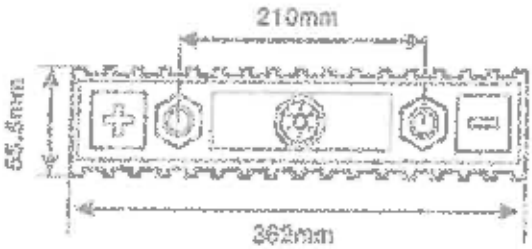
Winston LFP200AHA клетка

Име на модела	LFP200AHA	Алтернативна продуктова марка TS-LFP200AHA, WB-LYP200AHA
Номинално напрежение	3.2 V	Работното напрежение под товар е 3.0 V
Капацитет	200 AH	+/- 5%
Работно напрежение	макс 3,6V - мин 2.5V	При 80% DOD
Напрежение на дълбок разряд	2.5 V	Клетките са повредени, ако напрежението падне под това ниво
Макс. зареждащо напрежение	4 V	Клетките са повредени, ако напрежението покаже това ниво
Оптимален пиков ток на разряд	<100A	0.5 C
Макс. ток на разряд	<600A	3 C, непрекъснато за макс. 15 минути от зареждането на клетка
Макс. пиков ток на разряд	< 2300 A	10 C, макс. 5 секунди за 1 минута
Оптимален зареждащ ток	<100A	0.5 C
Максимален зареждащ ток	<600A	< 3 C с мониторинг на температурата на батерията
Максимална температура за продължителна работа	55 °C	Температурата на батерията не трябва да превишава това ниво при заряд и разряд
Размери	255 X 362 X 55,5	милиметри (толеранс +/- 2 мм)
Тегло	7,5 кг	килограми (толеранс +/- 150гр)
Име на модела	LFP200AHA	Алтернативна продуктова марка TS-LFP200AHA,



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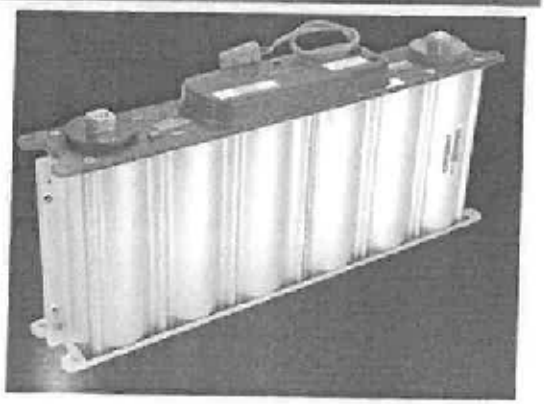


СПЕЦИФИКАЦИИ

ЕЛЕКТРИЧЕСКИ	BMOD0500 P016 B02
Капацитет	
Минимален Капацитет, първоначален	500 F
Максимален Капацитет, първоначален	500F
Максимален ESR DC, първоначален	600 F
Тестов ток за капацитет ESR_{DC}[1]	2.1 mΩ
Напрежение	100 A
Абсолютно макс. напрежение	16 V
Абсолютен макс. ток	17 V
Ток на утечка при 25°C, максимум (B01 Suffix - VMS 2.0)[2]	1,900 A
Ток на утечка при 25°C, maximum (B02 Suffix - Passive Balancing)[2]	N/A
Maximum Series Voltage	170 mA
Капацитет на индивидуални клетки	750 V
Макс. енергия за съхранение, индив. клетки	3,000 F
Брой клетки	3.0 Wh
	8

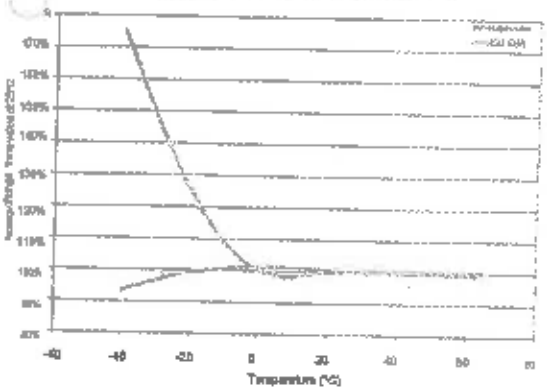
ТЕМПЕРАТУРА	
Работна температура	
Минимум	-40oC
Максимум	65oC
Температура на съхранение	
Минимум	-40oC
Максимум	70oC

СПЕЦИФИКАЦИИ

ТЕРМАЛНИ ХАРАКТЕРСИТИКИ	BMOD0500 P016 B02
Термално съпротивление, типично	0.70°C/W
Термален капацитет (C_{th}), типично	4,300 J/°C
Максимален непрек. ток (ΔT = 15°C):	100 A_{RMS}
Максимален непрек. ток (ΔT = 40°C):	160 A_{RMS}

ЖИВОТ	
DC живот при висока температура	1,500 часа
Промяна в капацитета	20%
ESR промяна	100%
Очакван DC живот при 25°C	10 години
Промяна в капацитета	20%
ESR промяна	100%
Очакван брой цикли при 25°C	1,000,000 цикли
Промяна в капацитета	20%
ESR промяна	100%
Тестов ток	100 A

ESR И КАПАЦИТЕТ VS ТЕМПЕРАТУРА



PowerStor / Eaton XL60-2R7308T-R

Данни

Капацитет	3000 F до 3400 F
Максимално работно напрежение	2.70 V / 2.85 V
Пробивно напрежение	2.85 V / 3.00 V
Капацитетен толеранс	0% до +20%
Работна температура	-40 °C до +65 °C
Разширен температурен обхват	-40 °C до +85 °C (намаление на напр. до 2.30 V / 2.45 V @ +85 °C)

Спецификации

Капацитет (F)	Арт. номер	Максимално работно напрежение (V)	Максимално начално ESR (mΩ)	Номинален ток на утечка (mA)	Енергия Съхран. (Wh)	Пикова Мощност (W)	Импулсен ток (A)	Непрекъснат ток (A)	Типично термално Съпротив. Rth (°C/W)	Ток на късо Съедн. (A)
3000	XL60-2R7308T-R	2.70	0.23	6.0	3.0	7,900	2,400	143	3.2	11,700

Производителност

Параметър	Промяна в капацитет (% от първ. данни)	ESR (% от първ. макс. стойност)
Живот — 1,500 часа при работно напрежение и температура	≤ 20%	≤ 200%
Заряд/разряд цикли — 1 милион при +25 °C	≤ 20%	≤ 200%
Съхранение, незаредени, до +35 °C — 3 години	≤ 5%	≤ 10%

Акумулатор MONBAT MONOLIT POWER DEEP CYCLE 12V/ 110Ah

Описание

MONOLITH POWER

БАТЕРИЯ С ЦИКЛИЧНО ЗАРЯВАНЕ - ЗАЛИТИ

Гамата Monolith Power Deep е специално проектирана за захранване на електрически апарати, които изискват от време на време дълбоко разреждане.

- Висококачествени суровини, осигуряващи изключително висока устойчивост на удари и вибрации
- Повече от 1200 цикъла при 75% дълбочина на разряд (за 12V батерия)
- Повече от 1500 цикъла при 70% дълбочина на разряда (за 6V и 8V)
- Над 2000 цикъла в съответствие с IEC 61427 (PVSS приложения)
- Много добър избор за използване за всеки вид приложение

ТЕХНИЧЕСКИ ПАРАМЕТРИ

Тип	C20, Ah	C5, Ah	Резервен капацитет @ 25A, мин	Размери, мм L	W	H	Полярност	Тип терминали	Полярност
	210	175	450	264	181	276	0	Dual	FLAT
	240	185	500	344	181	274	0	Dual	FLAT
	300	270	615	365	181	288	0	Dual	FLAT
	175	145	362	261	181	278	0	Dual	FLAT
	80	56	180	259	175	190	1	Dual	SMF
	95	75	170	343	173	242	1	Dual	SMF
	105	75	200	343	173	242	1	Dual	SMF
	130	105	230	343	175	242	1	Dual	FLAT

Продуктовата снимка е с илюстративна цел.

Условията за получаване на промоционалната цена е:

Да върнете използвания акумулатор със същият или подобен капацитет, заведен от вашия акумулатор!

- Производител: MONBAT
- Тип: MONOLIT POWER DEEP CYCLE 12V 110Ah

Продуктови детайли

Производител: MONBAT

https://12v.bg/bg/monbat-monolit-power-deep-cycle-12v-110ah.html

12V, 2.4kWh LiFeYPO4 set with 200Ah cells, BMS mobile monitoring

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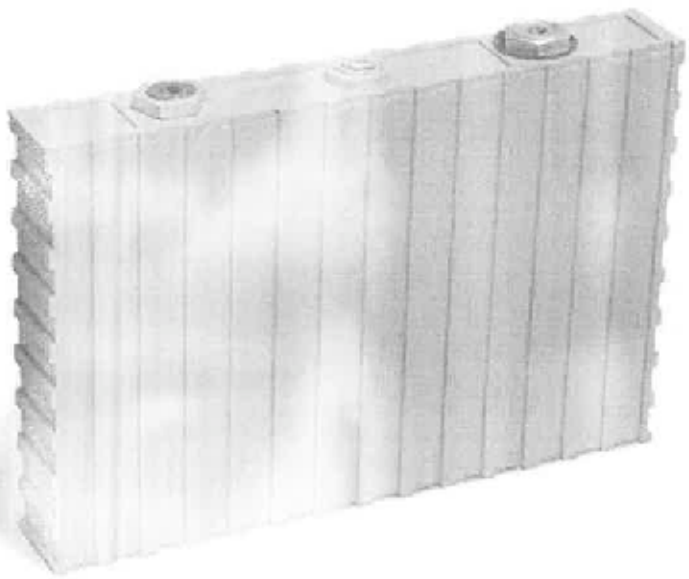
Technical specification

Winston LFP200AHA cell



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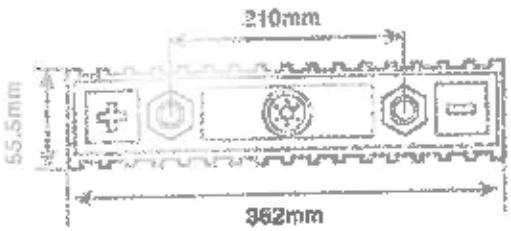
Winston LFP200AHA cell

Specifications		
Model name	LFP200AHA	Alternative product marking TS-LFP200AHA, WB-LYP200AHA
Nominal voltage	3.2 V	Operating voltage under load is 3.6 V
Capacity	200 AH	+/- 5%
Operating voltage	max 3.9V – min 2.8V	At 80% DOD
Deep discharge voltage	2.5 V	The cells is damaged if voltage drops bellow this level
Maximal charge voltage	4 V	The cells is damaged if voltage exceeds this level
Optimal discharge current	< 100 A	0.5 C
Maximal discharge current	< 600 A	3 C, continuous for max 15 minutes from full charge
Max peak discharge current	< 2000 A	10 C, maximal 5 seconds in 1 minute
Optimal charge current	< 100 A	0.5 C
Maximal charge current	< 600 A	< 3 C with battery temperature monitoring
Maximal continuous operating temperature	65 °C	The battery temperature should not increase this level during charge and discharge
Dimensions	216 X 362 X 55,5	Millimeters (tolerance +/- 2 mm)
Weight	7,9 kg	Kilograms (tolerance +/- 150g)
Model name	LFP200AHA	Alternative product marking TS-LFP200AHA, WB-LYP200AHA



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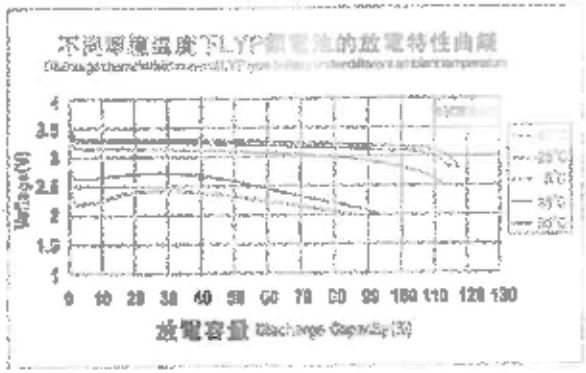
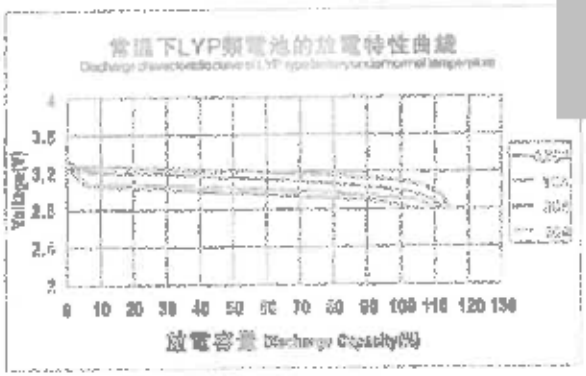
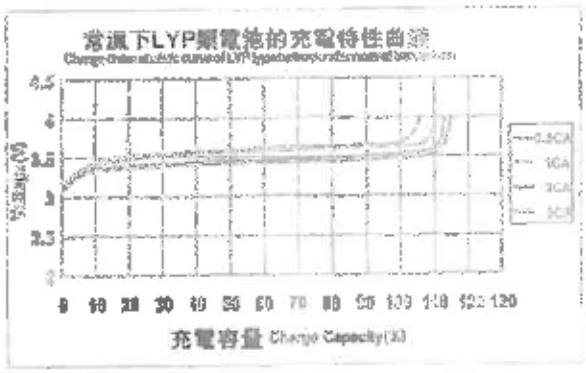
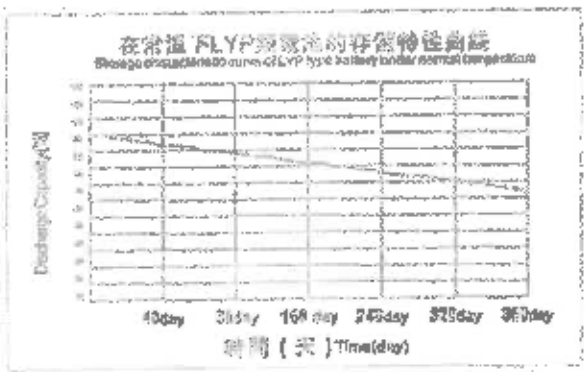








PRODUCT WEBPAGE

GWL Power a.s.
Průmyslová 11, 102 19 Prague 10
Czech Republic, European Union

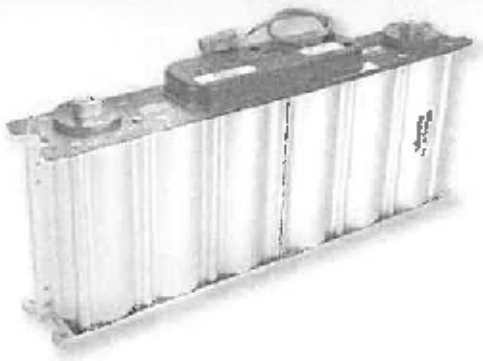
DATASHEET 16V MODULES

FEATURES AND BENEFITS*

- Up to 1,000,000 duty cycles or 10 year DC life
- 16V DC working voltage
- Resistive or active cell balancing available
- Temperature output
- Overvoltage outputs available
- High power density
- Compact, rugged, fully enclosed splash-proof design

TYPICAL APPLICATIONS

- Wind turbine pitch control
- Transportation
- Heavy industrial equipment
- UPS systems



PRODUCT SPECIFICATIONS

ELECTRICAL	BMOD0500 P016 B01	BMOD0500 P016 B02
Rated Capacitance[1]	500 F	500 F
Minimum Capacitance, Initial[1]	500 F	500F
Maximum Capacitance, Initial[1]	600 F	600 F
Maximum ESR_{DC}, Initial[1]	2.1 mΩ	2.1 mΩ
Test Current for Capacitance and ESR_{DC}[1]	100 A	100 A
Rated Voltage	16 V	16 V
Absolute Maximum Voltage[2]	17 V	17 V
Absolute Maximum Current	1,900 A	1,900 A
Leakage Current at 25°C, maximum (B01 Suffix - VMS 2.0)[3]	5.2 mA	N/A
Leakage Current at 25°C, maximum (B02 Suffix - Passive Balancing)[3]	N/A	170 mA
Maximum Series Voltage	750 V	750 V
Capacitance of Individual Cells[11]	3,000 F	3,000 F
Maximum Stored Energy, Individual Cell[11]	3.0 Wh	3.0 Wh
Number of Cells	6	6
TEMPERATURE		
Operating Temperature (Cell Case Temperature)		
Minimum	-40°C	-40°C
Maximum	65°C	65°C
Storage Temperature (Stored Uncharged)		
Minimum	-40°C	-40°C
Maximum	70°C	70°C

*Results may vary. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.

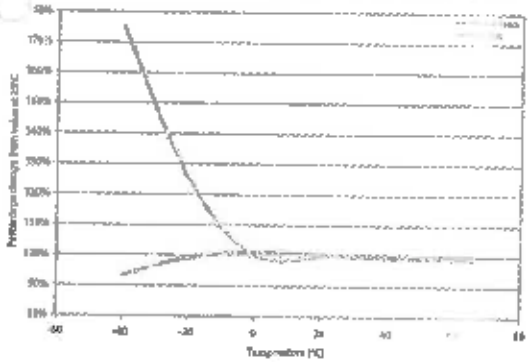
PRODUCT SPECIFICATIONS (Cont'd)

PHYSICAL	BMOD0500 P016 B01	BMOD0500 P016 B02
Mass, typical	5.5 kg	5.5 kg
Power Terminals	M8/M10	M8/M10
Recommended Torque - Terminal	20/30 Nm	20/30 Nm
Vibration Specification	SAE J2380	SAE J2380
Shock Specification	SAE J2464	SAE J2464
Environmental Protection	IP65	IP65
Cooling	Natural Convection	Natural Convection
MONITORING / CELL VOLTAGE MANAGEMENT		
Internal Temperature Sensor	NTC Thermistor	NTC Thermistor
Temperature Interface	Analog	Analog
Cell Voltage Monitoring	Overvoltage Alarm	N/A
Connector	Deutsch DTM	Deutsch DTM
Cell Voltage Management	VMS 2.0	Passive
POWER & ENERGY		
Usable Specific Power, P_4[4]	2,700 W/kg	2,700 W/kg
Impedance Match Specific Power, P_{max}[5]	5,500 W/kg	5,500 W/kg
Specific Energy, E_{max}[6]	3.2 Wh/kg	3.2 Wh/kg
Stored Energy, E_{stored}[7]	18 Wh	18 Wh
SAFETY		
Short Circuit Current, typical (Current possible with short circuit from rated voltage. Do not use as an operating current.)	7,600 A	7,600 A
Certifications	RoHS, UL810a (150 V)	RoHS, UL810a (150 V)
High-Pot Capability[12]	2,500 VDC	2,500 VDC

TYPICAL CHARACTERISTICS

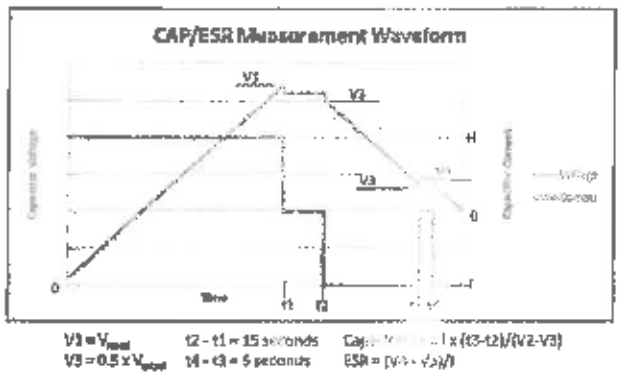
THERMAL CHARACTERISTICS	BMOD0500 P016 B01	BMOD0500 P016 B02
Thermal Resistance (R_{th} All Cell Cases to Ambient), typical[2]	0.70°C/W	0.70°C/W
Thermal Capacitance (C_{th}), typical	4,300 J/°C	4,300 J/°C
Maximum Continuous Current (ΔT = 15°C)[3]	100 A_{RMS}	100 A_{RMS}
Maximum Continuous Current (ΔT = 40°C)[3]	160 A_{RMS}	160 A_{RMS}
LIFE		
DC Life at High Temperature[4] (Held continuously at Rated Voltage & Maximum Operating Temperature)	1,500 hours	1,500 hours
Capacitance Change (% decrease from minimum initial value)	20%	20%
ESR Change (% increase from maximum initial value)	100%	100%
Projected DC Life at 25°C[4] (Held continuously at Rated Voltage)	10 years	10 years
Capacitance Change (% decrease from minimum initial value)	20%	20%
ESR Change (% increase from maximum initial value)	100%	100%
Projected Cycle Life at 25°C[4,5,6]	1,000,000 cycles	1,000,000 cycles
Capacitance Change (% decrease from minimum initial value)	20%	20%
ESR Change (% increase from maximum initial value)	100%	100%
Test Current	100 A	100 A
Shelf Life (Stored uncharged at 25°C)	4 years	4 years

ESR AND CAPACITANCE VS TEMPERATURE

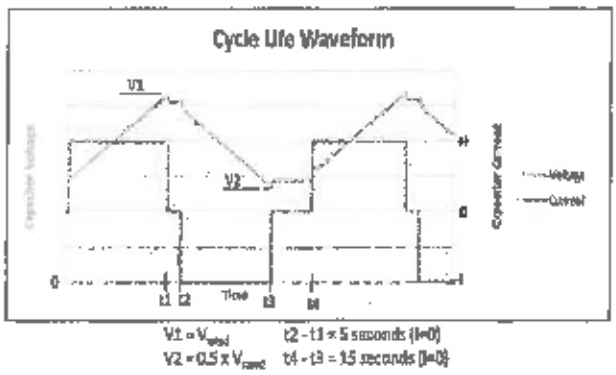


NOTES

1. Capacitance and ESR_{DC} measured at 25°C using specified test current per waveform below.
2. Absolute maximum voltage, non-repetitive. Not to exceed 1 second.
3. After 72 hours at rated voltage. Initial leakage current can be higher.
4. Per IEC 62391-2, $P_d = \frac{0.12V^2}{ESR_{DC} \times mass}$
5. $P_{max} = \frac{V^2}{4 \times ESR_{DC} \times mass}$
6. $E_{cmax} = \frac{\frac{1}{2} CV^2}{3{,}600 \times mass}$
7. $E_{stored} = \frac{\frac{1}{2} CV^2}{3{,}600}$
8. $\Delta T = I_{RMS}^2 \times ESR \times R_{ca}$
9. Cycle using specified test current per waveform below.
10. Cycle life varies depending upon application-specific characteristics. Actual results will vary.
11. Per United Nations material classification UN3499, all Maxwell ultracapacitors have less than 10 Wh capacity to meet the requirements of Special Provisions 361. Both individual ultracapacitors and modules composed of those ultracapacitors shipped by Maxwell can be transported without being treated as dangerous goods (hazardous materials) under transportation regulations.
12. Duration = 60 seconds. Not intended as an operating parameter.



$V1 = V_{rated}$ t2 - t1 = 15 seconds Cap = I x (t3-t2)/(V2-V3)
$V3 = 0.5 \times V_{rated}$ t4 - t3 = 5 seconds ESR = (V1 - V3)/I



$V1 = V_{rated}$ t2 - t1 = 5 seconds (I=0)
$V2 = 0.5 \times V_{rated}$ t4 - t3 = 15 seconds (I=0)

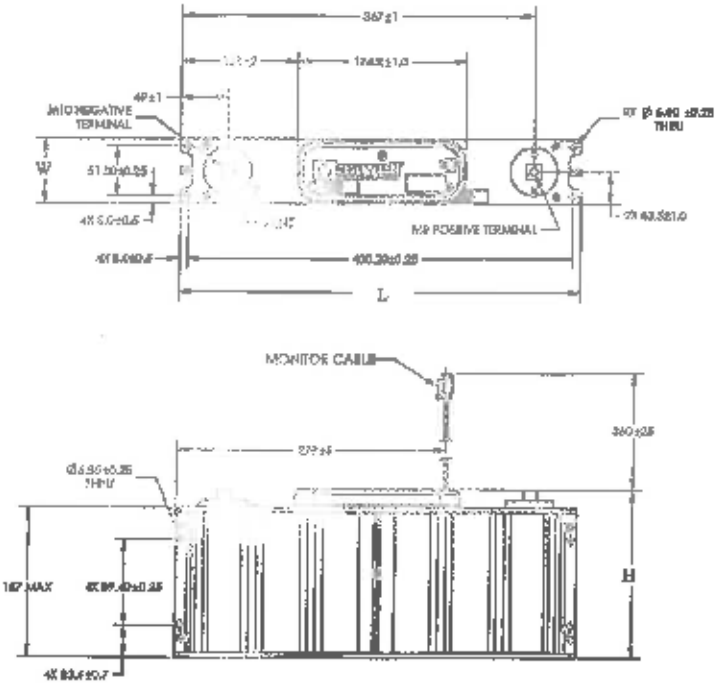
MOUNTING RECOMMENDATIONS

Please refer to the user manual for Installation recommendations.

MARKINGS

Products are marked with the following information: Rated capacitance, rated voltage, product number, name of manufacturer, positive and negative terminal, warning marking, serial number.

BMOD0500 P016 B0X



Part Description	Dimensions (mm) L (max)	W (max)	H (max)	Package Quantity
BMOD0500 P016 B01/B02		68	179	3

Product dimensions are for reference only unless otherwise identified. Product dimensions and specifications may change without notice.
Please contact Maxwell Technologies directly for any technical specifications critical to application. All products featured on this datasheet are covered by the following U.S. patents and their respective foreign counterparts: 6643119, 7295423, 7342770, 7352558, 7384433, 7440258, 7492571, 7508651, 7580243, 7791860, 7791861, 7816891, 7859826, 7883553, 7935155, 8072734, 8098481, 8279580, and patents pending.

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Technical Data 10339

Effective November 2017
Supersedes October 2014

XL60 Supercapacitors
Cylindrical cells

Description

Eaton PowerStor supercapacitors are unique, ultra-high capacitance devices utilizing electrochemical double layer capacitor (EDLC) construction combined with new, high performance materials. This combination of advanced technologies allows Eaton to offer a wide variety of capacitor solutions tailored to specific [illegible] applications. The XL60 supercapacitor [illegible] end power [illegible] applications. Terminal design is optimized for high reliability and low contact resistance.

Features and benefits

- Long life energy storage, up to 20 years
- Ultra low ESR for very high power density
- Wide operating temperature range
- Maintenance free
- Cost effective backup power and large energy recapture
- Low operating costs
- High efficiency (>98%) under broad environmental conditions
- High reliability, green solution
- UL recognized [illegible]

Applications

- Backup power
- Peak power shaving, pulse power
- Engine starting
- Energy capture and re-use (Hybrids) for automotive, trucks, mining and construction, equipment, cranes
- Remote power for sensors, LEDs, switches

EATON
Powering Business Worldwide

Ratings

Capacitance	3000 F to 3400 F
Maximum working voltage	2.70 V / 2.85 V
Surge voltage	2.85 V / 3.00 V
Capacitance tolerance	0% to +20%
Operating temperature range	-40 °C to +65 °C
Extended operating temperature range	-40 °C to +85 °C (with voltage derating to 2.30 V / 2.45 V @ +85 °C)

Specifications

Capacitance[1] (F)	Part Number	Maximum working voltage (V)	Maximum ESR[1] (mΩ)	Nominal leakage current[2] (mA)	Stored energy[3] (Wh)	Peak power[4] (W)	Pulse current[5] (A)	Continuous current[6] (A)	Typical thermal resistance[7] (°C/W)	Short circuit current[8] (A)
3000	XL60-2R7308W-R	2.70	0.23	6.0	3.0	7,900	2,400	143	3.2	11,700
3000	XL60-2R7308T-R	2.70	0.23	6.0	3.0	7,900	2,400	143	3.2	11,700
3400	XL60-2R8348W-R	2.85	0.23	6.0	3.8	8,800	2,700	143	3.2	12,400
3400	XL60-2R8348T-R	2.85	0.23	6.0	3.8	8,800	2,700	143	3.2	12,400

Performance

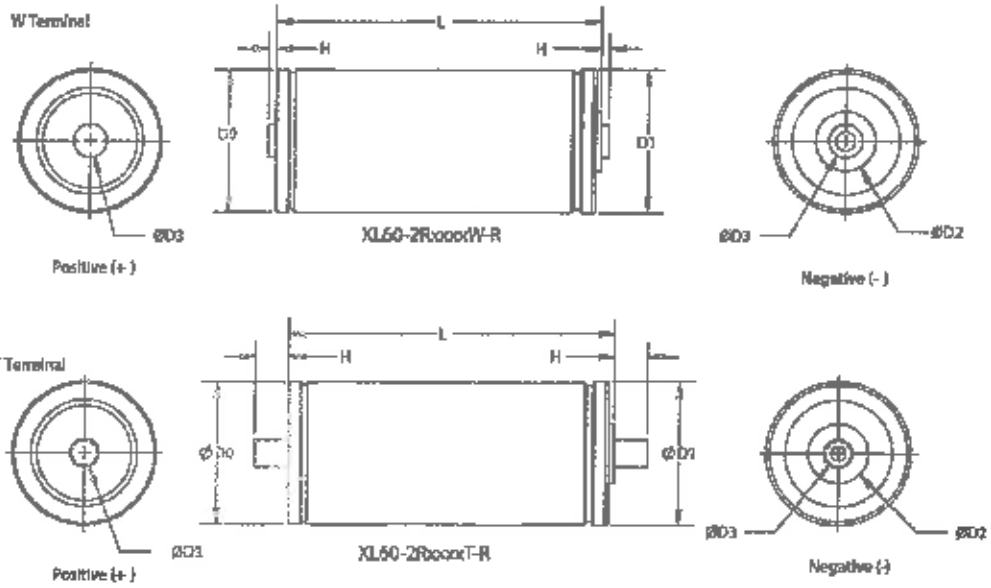
Parameter	Capacitance Change (% of initial value)	ESR (% of initial maximum value)
Lifetime — 1,500 hours at maximum rated voltage and operating temperature	≤ 20%	≤ 200%
Charge/discharge cycling[9] — 1 million at +25 °C	≤ 20%	≤ 200%
Storage, uncharged, up to +35 °C — 3 years	≤ 5%	≤ 10%

1. Capacitance, Equivalent Series Resistance (ESR) and Leakage current measured according to IEC62391-1 with current in milliamps (mA) = 6 x C x V.
2. Leakage current at +20 °C after 72 hour charge and hold.
3. Stored Energy (Wh) = $\frac{0.5 \times C \times V^2}{3600}$
4. Peak Power (W) = $\frac{V^2}{4 \times ESR}$
5. Pulse current for 1 second from full rate voltage to half voltage: I = 2.0 x V x C
6. Continuous current with a 15 °C temperature rise. Continuous current (A) = √(15/ESR)
7. Thermal resistance (with cell body temperature to ambient in open air) in degrees C per Watt (°C/W).
8. Short circuit current is for safety information only. Do not use as operating current.
9. Cycling between maximum working voltage and half voltage at +25 °C, 100 A.

Safety and Certifications

Agency information	UL Recognized (3000 F), Guide EBRG2, File MH46887
Shock and vibration	IEC 61373 Category 1, Class B, IEC 60068-2-6
Safety	UL 810A
Environmental	RoHS compliant, lead free, halogen free
Altitude, Operating	10,000 ft
Altitude, Non-operating	40,000 ft

Dimensions (mm)



Part Number	D0 (±0.2)	D1 (±0.7)	D2 (±0.1)	D3 (±0.1)	H (±0.126)	L (±0.5)	Typical Weight (g)
XL60-2RxxxxW-R	60.3	60.7	25.0	Ø14.0	3.18	136.0	525
XL60-2RxxxxT-R	60.3	60.7	25.0	M12, P1.75	14.0	139.0	515

Part numbering system

XL	C0	-2R7	3R0	S	-R
Family code	Size reference (mm)	Voltage (V) R = Decimal	Capacitance (µF) Value	Multiplier	Standard product
XL = Family Code	Diameter = 60	2R7 = 2.7 V	Example 3R0 = 30 x 10⁰ µF or 3,000 F		

Packaging Information

- Standard packaging: Bulk, 20 parts per box

Part Marking

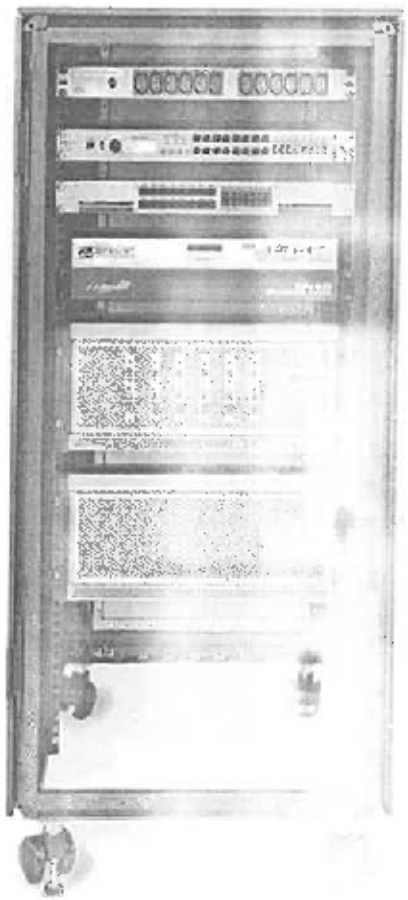
- Manufacturer
- Capacitance (F)
- Maximum working voltage (V)
- Family code or part number

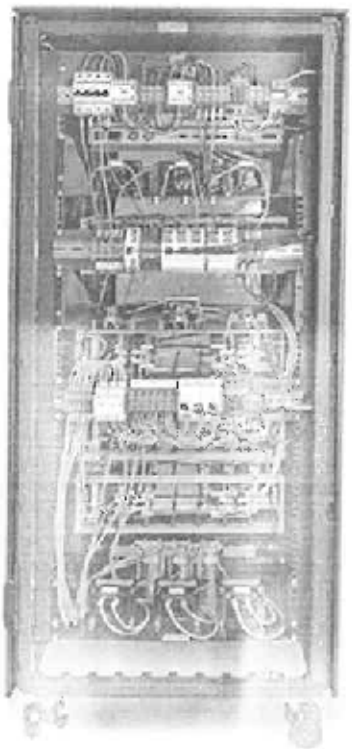
Eaton
Electronics Division
1000 Eaton Boulevard
Cleveland, OH 44122
United States
www.eaton.com/electronics

Powering Business Worldwide

Система за управление (HIL) със силови преобразуватели

Технически данни



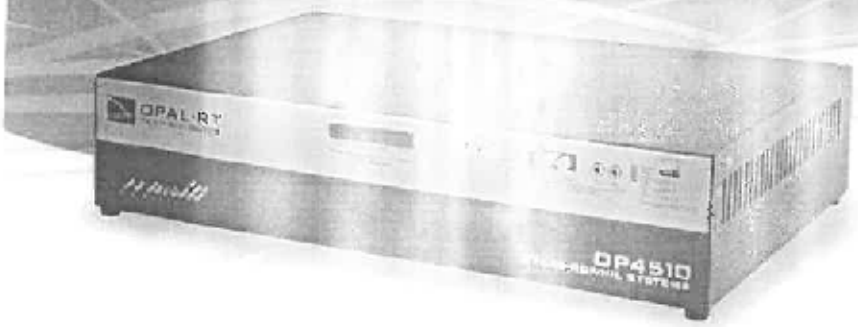


***Забележка:** Снимките имат [illegible] илюстрационен характер. Включените компоненти [illegible] описани в Техническото предложение*

OP4510 Симулатор

RT-LAB / RCP / HIL System

OPAL-RT TECHNOLOGIES



OP4510 е един компактен симулатор за начално-ниво, който ви дава основните предимства на OPAL-RT's високата производителност на RT-LAB при прототипиране на контролни и HIL системи

OPAL-RT представя най-новата версия на **OP4510**, компактен и достъпен цифров симулатор за изпълнение в реално време. **OP4510** (V3) [illegible] на OP4500 и първия **OP4510**, носейки [illegible] ност, разширяемост и гъвкавост на платформата.

OP4510 е естествено продължение на широко-използвания OP4500, включващ:

Мощност

- Мощен [illegible] 3.5 GHZ
- [illegible] 410 K кинетик

Гъвкавост

- Адаптивно на I/O конфигурация към специфичните [illegible] я

Свързаност

- Активни [illegible] CAN bus, GPS
- [illegible] (IEEE 1588)
- [illegible] и SFP модули.
- [illegible] оптични или
- [illegible] ул
- [illegible] OPAL-RT
- [illegible] цифрови модули

КЛЮЧОВИ ХАРАКТЕРИСТИКИ

- Високопроизводителна бърза свързаност в реално време
- Отворена система, оптимизирана на силова електроника
- Ниска цена за система от начално ниво
- Компактност, портативност и голям брой надеждни I/O канали

ПРИЛОЖЕНИЯ

- Прототип на контролни системи (RCP) и (HIL) симулации за R&D и учебни цели
- Стендартни и портативни тестови и измервателни системи
- FPGA разработка

OP4510 Симулатор

Общи спецификации

Захранване	Универсален вход и корекция на фактора на мощността до 350W
FPGA	Kint[illegible] FPGA, 3.5T, [illegible] 840 DSP slice (Multi[illegible])
Компютър	Intel [illegible] E3-1[illegible] CPU [illegible], 8MB cache, [illegible] 3.5GHz), 16G[illegible] RAM, 128 GB [illegible]
Бърз оптичен интерфейс	4 sockets for optical Small Form-Factor Pluggable (SFP&SFP+) 1 to 5 Gbits/s optical cable pairs (Rx/Tx)
Софтуерна съвместимост (CPU)	RT-LAB multi-processors platform, UNIX, Simulink, RTW, SimPowerSystems, SimScape, ARTEMIS, RT-EVENT, HYPERSIM и други софтуери, съвместими с Simulink
FPGA	XILINX System Generator for Simulink, RT-LAB XSG, eHS[illegible] SA
Производителност	Мин[illegible] за модели, които се изпълняват от INTEL CPU и 250 [illegible] за модели, които се изпълняват от FPGA [illegible], 10 наносекунди времева резолюция
Размери & тегло	43.2 [illegible] x 17.46(?) x [illegible]cm (S) (17" x 10.8" x 3.5") 5кг ([illegible])

Налични I/O*

ТИП В МОДУЛИ

Цифрови изходи	32 канала, 5V-30V
Цифрови входове	32 канала, 4V to 50V, 3.8mA мин
Аналогови входове	16 канала, 16 bits,
Аналогови изходи	16 канала, 16 bits
Отвеждане каналите	
RS422	Различни налични опции : RS422 или оптика за цифров I/O или
Оптична синхронизация	комуникационни протоколи или GPS синхронизация

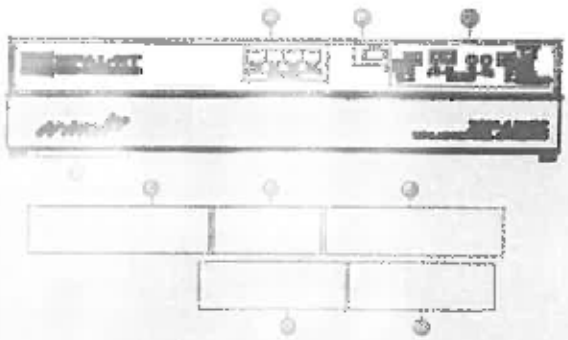
* Стандартната конфигурация включва 32 Dout, 32 Din, 16 Ain, 16 Aout

АРХИТЕКТУРА

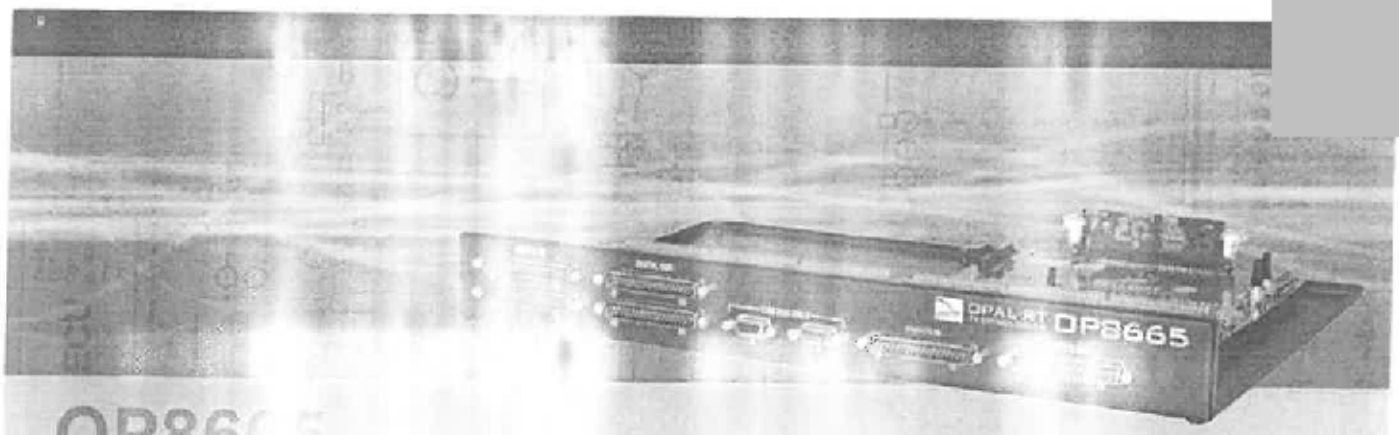
OP4510 интегрира CPU, [illegible] FPGA [illegible] в [illegible] компютър, [illegible] в продуктите с [illegible] Intel [illegible] CPU, както и индустриалния [illegible] архитектура, базирана на [illegible] FPGA, [illegible] опитите от време-пространство [illegible] 7 ns, [illegible] FPGA [illegible] с 250 наносекунди [illegible] контролер на PWM [illegible] на [illegible] метален корпус [illegible] (ROH) с времена [illegible] OP4510 [illegible] да се [illegible] [illegible] електронен контролер с [illegible] електроника.

I/O И КОНЕКТОРИ

- **A** (SFP) 5Gbits/s оптичен интерфейс
- **B** JTAG конектор
- **C** Синхронизиращи конектори и LED за статус
- **D** LED за статус на управляващия компютър



- **E** DB37 конектори за цифрови и аналогови входове или изходи
- **F** Опция RS422, оптични и [illegible] конектори
- **G** Стандартен ATX компютър на конектори за [illegible], USB порт, монитор, [illegible] SATA [illegible]
- **H** Налични разширителни PCIe [illegible] (F): Active[illegible], CANbus, GPS времева синхронизация (IEEE 1[illegible] RJ45



OP8665

Контролер интерфейс с TI контролер

OP8665 се използва като инструмент за разработка за свързване на външен контролер към OPAL-RT HIL. Тази платформа е разработена, за да помогне на инженерите бързо да разработят и тестват софтуера и да се възползва от бъдещите подобрения в производителността. OPAL-RT предоставя и конкретни HIL примери и демонстрации с

Контролер интерфейс

- Директен интерфейс към OPAL-RT (OP4500, OP5600, OP7000)
- Интерфейс към външни разширителни платки
- Свързване към I/O с кабел
- Зона с тестови точки
- Използване на [illegible] ане и на развойния конт
- Комуникация: C [illegible]

TI контролер

- Вкарване на стимули с превключватели, потенциометри, аналогови, цифрови изходи от HIL
- Разделителна верига
- Потребителски конфигурируеми LED за статус
- JTAG интерфейс за [illegible] и програмиране
- Защита на аналоговите [illegible] вход
- Сглобяеми аналогови [illegible] модове
- Сигнали за прекъсване чрез джъмпери
- Вградени 5V и 3.3V регулатор

Ускорете разработката

imperix

B-Box RCP прототипиращ контролер

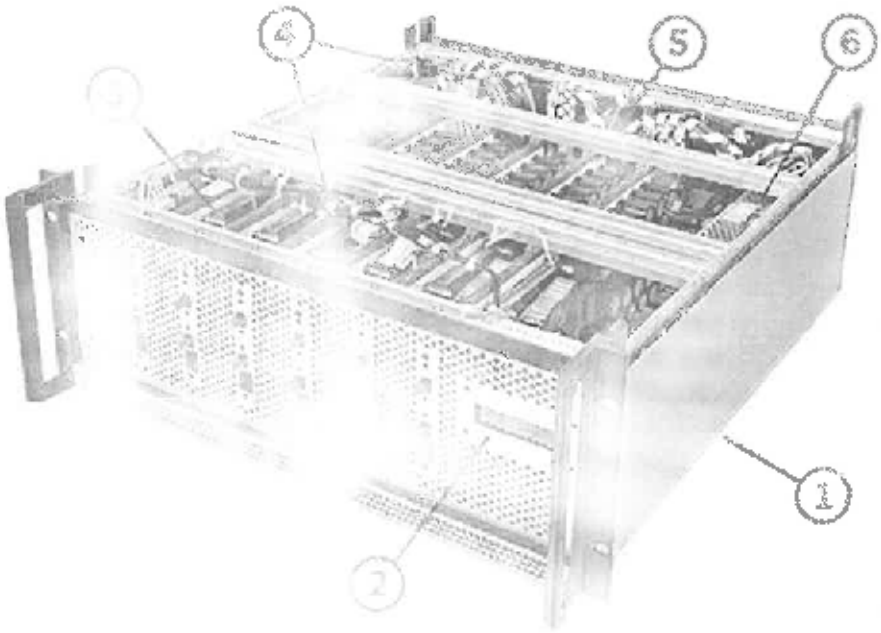
B-Box RCP е система за прототипиране на бъра контрол за силови електронни приложения. Благодарение на високата гъвкавост на своя софтуер и хардуер, той улеснява експерименталното валидиране на техниките за управление на преобразователите на мощност.

Чип	Zynq XC7Z030-3FBG676E	**Цифрови изходи**	16x електрически (3.3V/5.0V)
Процесор	2 x ARM Cortex A9 cores 1GB DDR3	**Цифрови входове**	16x електрическ и (3.3V/5.0V)
FPGA	Kintex 7 125K (програмируем) Artix 7 35T (допълнително)	**Входове за грешки**	16x електрическ и (3.3V) 1x електрически interlock 1x оптически interlock
Аналогови входо	16x [illegible] (3 [illegible]	**Входове за инкрементален декодер**	4x 3-пин (A,B,Z) (споделени с GPI входове)
PWM изходи	16x оптич 3x електрическ и (2.5V)	**Комуникации**	1x CAN 1x Ethernet 1 Gbps 3x SFP+ 5Gbps (RealSync)
Потребителск и бързи I/O	36x електрическ и (3.3V)		

imperix

4U ЗАТВОРЕНО ШАСИ

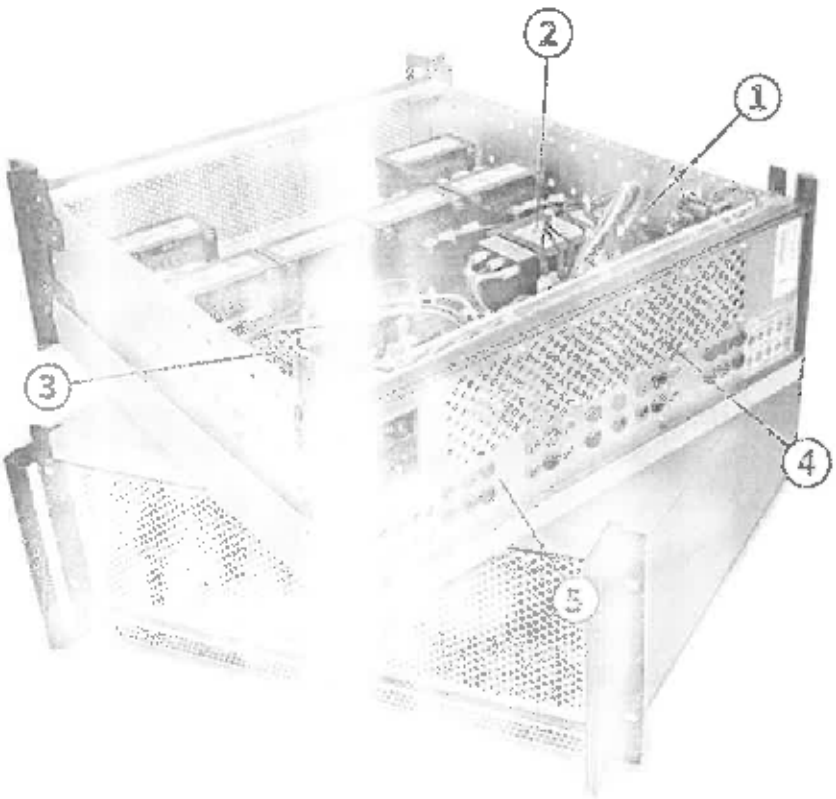
Затворените шасита предлагат по-добра и по-безопасна интеграция на силови модули, при които всички опасни напрежения са недостъпни. Въпреки това те също осигуряват достъп до всички управляващи сигнали на предния панел и всички захранващи клеми отзад за лесно изменение на топологията. Нещо повече, LCD екранът показва полезна информация, като температурата на модула и/или скоростта на вентилатора, а перфорираният корпус с допълнителни вентилатори на корпуса гарантира оптимален въздушен поток.



1 - 4U подвижно шаси
2 - LCD дисплей
3 - Предни панели за сигнали
4 - Задно свързване
5 - Охлаждащи вентилатори
6 - Задно захранване

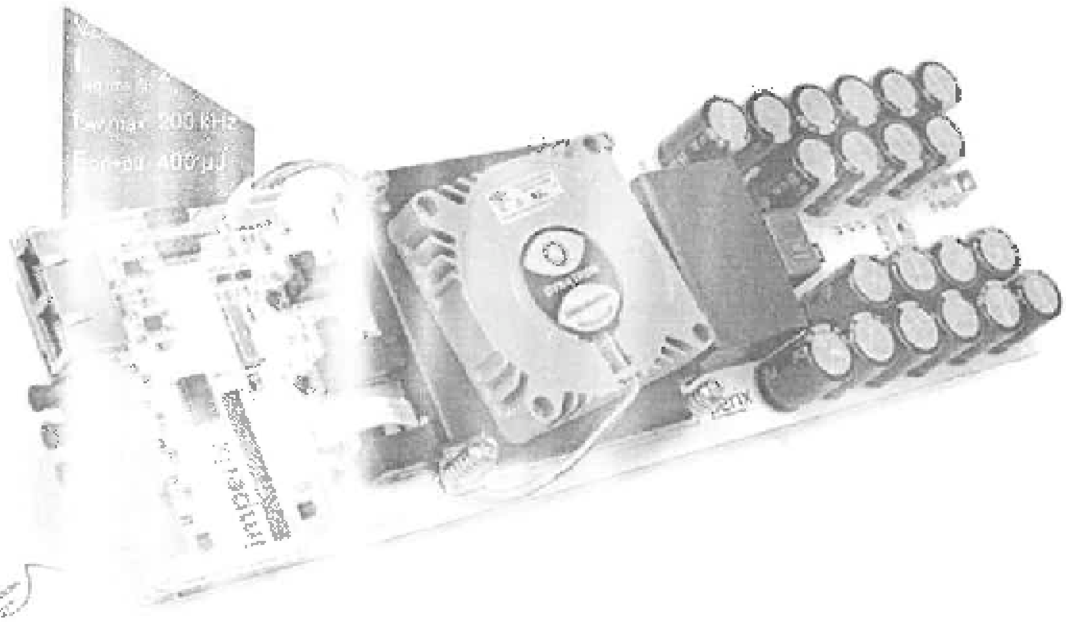
ПАСИВНИ ФИЛТРИ

Готови за използване филтри за различни приложения. Кутията с филтри осигурява лесни за използване и конфигуриране за два комплекта трифазни връзки. Комплектът включва:



1 Трифазен LC-[illegible] (2x)
2 Трифазен EMC [illegible] (2x)
3 Захранване
4 3 охлаждащи вентилатора
5 4мм лабораторни [illegible] тип „Banana"

imperix PEB SiC 8024



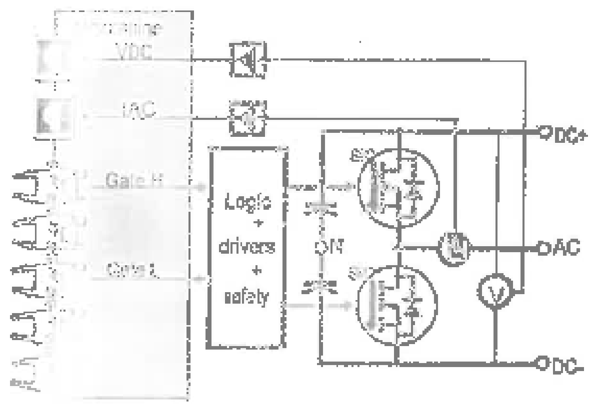
ОБЩО ОПИСАНИЕ

PES модулът се състои от полумостова топология с модерни силициево карбидни (SiC) MOSFET транзистори, които позволяват бързо превключване на честотата и съществено намаляват загуби. Той е предназначен за управление на нисковолтови преобразуватели на енергия с превъзходна производителност и обширни механизми за безопасност за удобно и лесно прототипиране. Осигурява се директен достъп до сигналите чрез оптични входни ... , докато вградените ... за измерване осигуряват директно аналогови ... , свързани с ... напрежения ... на изходния ток, ... изолирани сензори. Механичният дизайн е подходящ за интеграция ... и прости ... и директна ... imperix или ... платформа. ... защити се ... от ... на свръхнапрежение, свръх ток, свръх ... и де-сатурация ... по-безопасна ... приложение ... това ... програмируем от потребителя ... вграден ... CPLD ... използване ... или ... платки ... разработки ... обработка на ...

ТИПИЧНИ ПРИЛОЖЕНИЯ

Модулите са ... проведени за ... амбициозни ... от ... преобразуватели ... ниско напрежение ... от конвенционални ... фазни инвертори ... Типични ... 4-5 kW, в ... на постоянно ...

ЕЛ. СХЕМА



КЛЮЧОВИ ХАРАКТЕРИСТИКИ

— Полумостова топология
— 8... V номин. напрежение
— 1200 V / 30 A SiC MOSFETs
— 2... A непрекъснат RMS ток
— ... макс. импулсен ток (... лимитиран от Tj)
— ...
— ... / 800 V DC шина
— До 200 kHz честота на превключване
— ... 12 V захранване
— Вградени сензори за ток и напрежение
— Защита от пренапрежение, висок ток/напр...
— Конфигурируем CPLD
— 1... x 2... mm Eurocard форм фактор

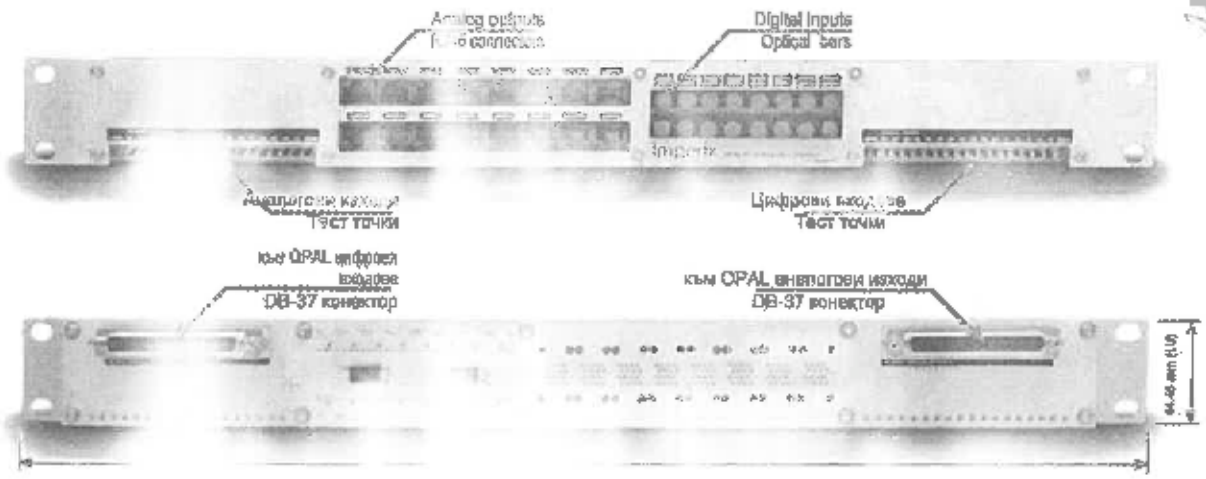
ГЛАВНИ КОМПОНЕНТИ

Компоненти	Устройства	Главни спецификации
Силови прекъсвачи	Cree C2M0080120D or Rohm SCT2080	SiC MOSFET (вместо по-долу)t
Кондензатори	260 µF @ 630 V (2 banks of 11x47µF each)	
Драйвери	Texas Instrument ISO5452-Q1	2.5A, 100 kVµs, V_{DIH} = 1.42 kOhm, V_{ISO} = 5kV$_{rms}$
Изолирани DC/DC конвертори	Murata MGJ2D1220505SC	12 V to 20-8 V, 2 W, V_{ISO} = 5.2 kVDC
	Recom RK-0505S	5 V to 5 V, 1 W, V_{ISO} = 3 kVDC
Токов сензор	LEM CKSR 50-P	±50 A, 300 kHz, ±0.7% точност
Напрежителен ос...	Resistive divider + Avago ACPL-C87B	100 kHz, ±0.1% точност
Радиатори	Dynatron G139	0.33 °C/W @ пълна скорост
CPLD	Xilinx XC9536XL-10VQG44C	10 ns, 36 макроклетки
Микроконтролер	Microchip PIC24FJ64KA101	16 bits, 16 MHz, 9x 10-bit ADC @ 500ksps

ГРАНИЧНИ МОДУЛА

Параметър	Символ	Тестови условия	Мин.	Тип.	Макс.	Ед.
Максимално DC напрежение на шината	V_{max}		-	800	-	V
Максимален непрекъснат ток	I_{max}	T_c = 75°C	-	34	-	A
		T_c = 100°C	-	24	-	A
Максимален импулсен ток	I_{max}	Продължителност на импулса е ограничена от $T_{j(max)}$	-	80	-	A
Максимален DC ток на шината	I_{DC}	F = 0 Hz	-	4.7	-	Arms
	TYPLE	F = 100 kHz	-	13.2	-	Arms
Максимално пиково напрежение	V_{max}		-	1.4	-	V_{PEAK}
Максимално пр... напрежение (1 s)	$V_{...}$		-	2.0	-	V_{PEAK}
Захранващо на...	$V_{...}$		4.2	5.0	5.8	V
	$V_{...}$		10.8	12.0	13.2	V
Над-висока тем...	$T_{...}$		-	170	-	°C

Симулаторен интерфейс – Opal-RT хардуер



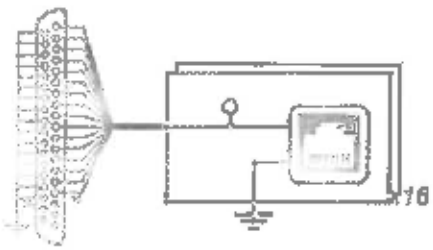
Общо описание

Този интерфейс свързва BoomBox контролера с

Opal-RT HIL симулатор
По този начин контролна реализация може
да бъде тествана - без риск
симулиран потребител,
късно тестване
стъпка ас
сивенни с
истинския
контролна
тествана -
преобразув

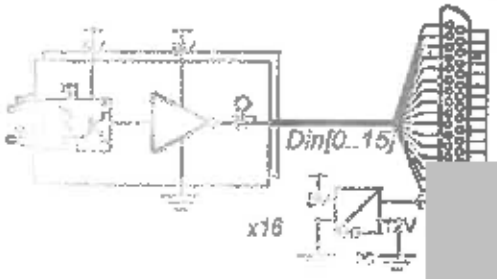
Аналогови изходи

— 16 канала, RJ45 конектори
— За свързване към аналогови входове на BoomBox
— -10 до 10V напреженов обхват



Цифрови входове

— 16 независими канали
— Оптично свързване към цифровите изходи на BoomBox
— Минимално времезакъснение между 2 кан: 60 пс
— 12V захранване, директно от Opal-RT симулатора



OP4510 Simulator

RT-LAB / RCP / HIL System

OPAL-RT TECHNOLOGIES

The OP4510 is a compact entry-level simulator that combines OPAL-RT's core strengths: RT-LAB high-performance Rapid Control Prototyping and Hardware-In-the-Loop systems

OPAL-RT introduces the newest version of the OP4510, compact and affordable real-time power grid digital simulator. The OP4510 (V2) marks a significant evolution of the OP4500 and the first OP4510, bringing a new level of connectivity, expandability, and versatility to the platform.

The OP4510 is the natural evolution of the widely acclaimed OP4500, featuring:

Power

- Faster processor up to 3.5 GHZ
- FPGA Kintex7 able to process up to 410 K Cells

Versatility

- Possibility to adapt the I/O configuration to the targeted application

Connectivity

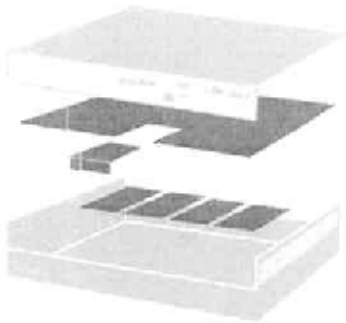
- Active/passive PCIe, CANbus, GPS time synchronization (IEEE 1588)
- Optional optical and SFP modules.
- Optional RS422, fiber optic or synchronization modules.
- Interconnectable with other OPAL-RT simulators or expansion units.

PRODUCT HIGHLIGHTS

- High-Performance Real-time High-Speed Connectivity
- Open and Optimized for Power Electronics
- Low Cost Entry-Level
- Compact, Portable and Large Number of Robust I/O Channels

APPLICATIONS

- Rapid Control Prototyping (RCP) and Hardware-in-the-Loop (HIL) Simulation for R&D and Teaching
- Bench Top and Portable Test and Measurement System
- FPGA Development System



The OP4510 accepts any combination of four different I/O modules such as analog input, analog output, digital input and digital output

OP4510 Simulator

OPAL-RT TECHNOLOGIES

GENERAL SPECIFICATIONS

Power supply	Universal input and active power factor correction 350W
FPGA	Kintex-7 FPGA, 325T, 326,000 logic cells, 840 DSP slice (Multiplier+ added)
Computer	Intel Xeon E3 v5 CPU (4 core, 8MB cache, 2.1 or 3.5GHz), 16G B RAM, 128 GB SSD
Fast optical interface	4 sockets for optional Small Form-Factor Pluggable (SFP&SFP+) 1 to 5 Gbits/s optical cable pairs (Rx/Tx)
Software compatibility (CPU)	RT-LAB multi-processors platform, LINUX, Simulink, RTW, SimPowerSystems, SimScape, ARTEMIS, RT-EVENT, HYPERSIM and several third-party software compatible with Simulink
FPGA	XILINX System Generator for Simulink, RT-LAB XSG, eHS FPGA electrical circuit solvers, library of floating point functions, resolvers and Finite-Element based motor models and converters
Performance	Minimum time step of 7 microseconds for model subsystems executed on the INTEL CPU and 250 nanoseconds for models executed on the FPGA chips, 10 nanosecond timer resolution
Dimensions & weight	43.2 (W) x 27.4(D) x 8.9cm (h) (17" x 10.8" x 3.5") 5Kg (11 lbs) approx. for laboratory use

AVAILABLE I/O SYSTEMS*

TYPE 8 MODULES

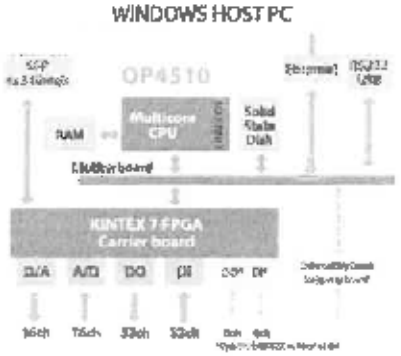
Digital output channels	32 channels, push-pull, 65 nanosecond typical propagation delay, 5V to 30V adjustable by an external voltage supplied by users, 50 mA max, short-circuit protected, Galvanic isolation
Digital input channels	32 channels, 4V to 30V, 3.5mA min, ±10 nanosecond typical propagation delay, galvanic isolation with fast Opto-couplers
Analog input converter	16 channels, 16 bits, 2.5 microsecond conversion time for all channels simultaneously, ± 10V true differential input, 400 kOhms input impedance, conversion time directly controlled by the FPGA chip
Analog output converter	16 channels, 16 bits, 1.0 microsecond update time for all channels simultaneously, ± 10V, 5.5 mA (35 mA with optional fast driver), short-circuit protected, update time directly controlled by the FPGA chip

ON-BOARD CHANNELS

RS422 Fiber optic Synchronization	Various options available: RS422 to transmit differential encoder inputs and outputs or fiber optic for digital I/Os or for low-speed communication protocols or GPS synchronization

* Standard configuration includes 32 Dout, 32 Din, 16 Ain, 16 Aout.

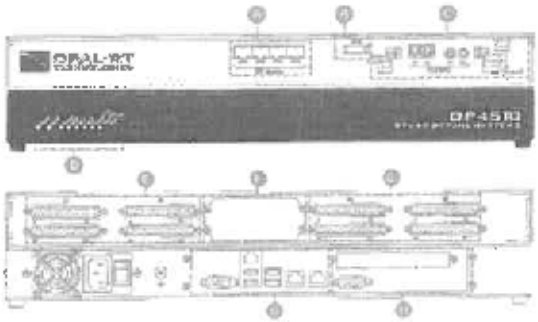
ARCHITECTURE*



The OP4510 integrates OPAL-RT RT-LAB and eFPGAsim real-time platform with the highest performance processors from Intel and FPGA chips as well as with industry standard Simulink and LabVIEW software. This multi-rate FPGA-based architecture enables user to reach time steps below 7 µs for subsystems running on INTEL CPU and less than 250 nanoseconds on the FPGA chip to accurately simulate power converter for HIL applications. An advanced PWM converter controller can then be implemented to control real hardware for Rapid Control Prototyping (RCP) applications with timing resolution better than 20 nanoseconds. The OP4510 can also be delivered as a stand alone power electronic controller test system with pre-defined power electronic models.

I/O AND CONNECTORS

A Small Form Factor (SFP) 5Gbits/s optical interface modules connectors
B JTAG connector
C Synchronization connectors and status LEDs
D Target computer status LEDs



E DB37 connectors for digital and analog inputs and outputs
F Optional RS422 (differential inputs/outputs), fiber optic and synchronization connectors
G Standard ATX computer connectors (left to right): mouse and keyboard, USB ports, monitor, external SATA connector, network ports
H PCIe options available, depending on optional connector selected (i.e. Active/passive PCIe, CANbus, GPS time synchronization (IEEE 1588) SFP or fibers.

About OPAL-RT TECHNOLOGIES

OPAL-RT is the world leader in the development of FPGA Based Real-Time Digital Simulator, Hardware-In-the-Loop (HIL) testing equipment and Rapid Co... (RCP) systems to design, test and optimize control and protection systems used in power grids, power electronics, motor drives, automotive industry, trains, a... various industries, as well as R&D centers and universities.

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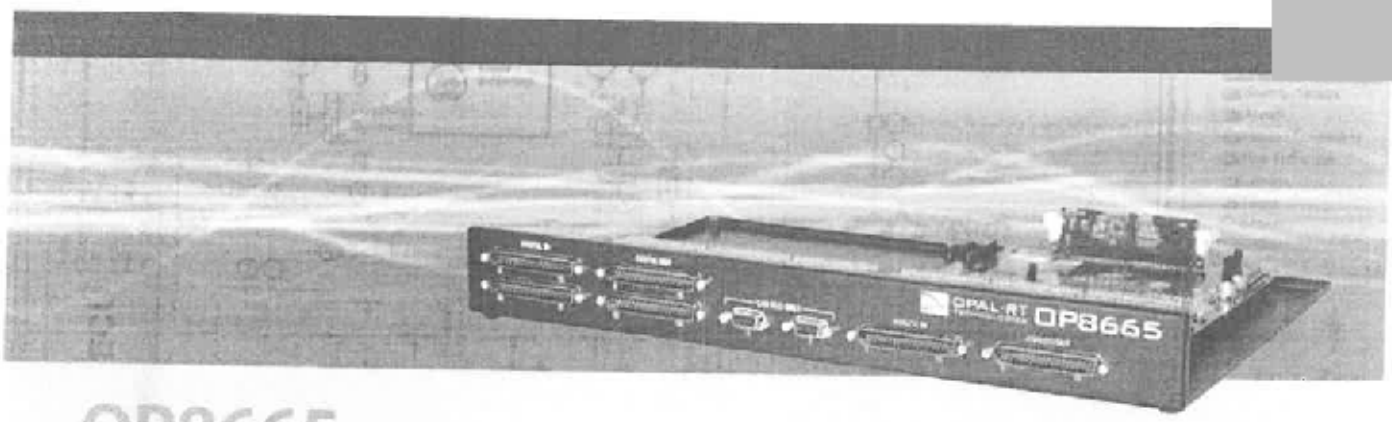


OP8665

Controller Interface with TI Controller Board

The OP8665 is used as a development tool to interface an external controller to an OPAL-RT HIL. This platform allows the user to rapidly develop and test the software and benefit from a quick and easy HIL experience.
OPAL-RT also provides concrete HIL examples and demonstrations with the controller board.

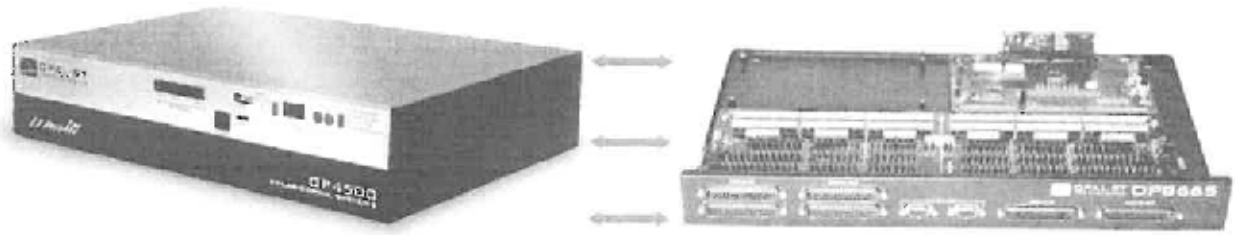
Features Controller Interface

- Direct interface to OPAL-RT simulators (OP4500, OP5600, OP7000)
- Interface to and external development controller board
- Connect to the HIL via cables
- Signal probing area
- Power input used to power the development board
- Communication: CAN, Serial

Features TI Controller Board

- Inject stimulus with switches, potentiometers, analog, digital outputs from HIL
- Resolver Circuit
- User configurable status LED
- JTAG connector interface for programming and debugging
- Analog and Digital Input protection
- Scaled Analog Inputs
- Breakout signals via jumpers
- On board 5V and 3.3V regulator

Accelerate development



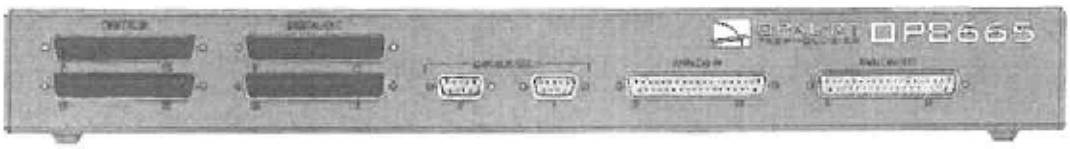
OPAL-RT Controller Interface enables to accelerate the development of power electronic applications without worrying about any interface issues. The HIL interface provides a pin-to-pin compatible interface between OPAL-RT real-time simulator and controller cards, thus eliminating setup time.

OPAL
TECHNOL

From Imagination... to

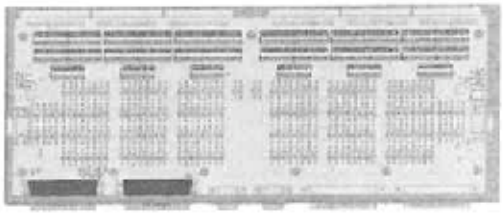
Controller Interface Description

CAN Bus	2 x DB9 female connectors
Digital In	2 x DB37 male connectors to connect to the HIL Digital OUT via a pin to pin DB37 female to male cable
Digital OUT	2 x DB37 male connectors to connect to the HIL Digital IN via a pin to pin DB37 female to male cable
Analog IN	1 x DB37 male connectors to connect to the HIL Analog OUT via a pin to pin DB37 female to male cable
Analog OUT	1 x DB37 male connectors to connect to the HIL Analog IN via a pin to pin DB37 female to male cable



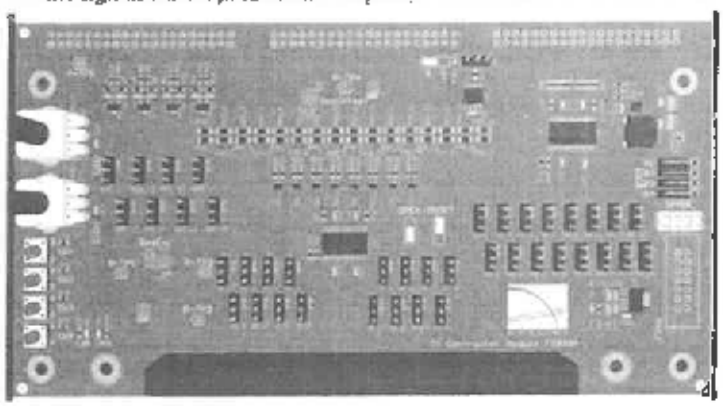
The Controller Interface is divided into Section1 on the right and Section2 on the left, including:

RS232, 1 x DB9 female for each section, USB to UART adaptor, 1 x DB9 female for each section, Power Input, 5VDC to 12VDC, Power On/Off Switch, 1 x for each section, BreakOut Area (Optional), TestPoint Area, Screw Terminals Area, Power On Green LED, 1 x for each section, USB Ready Status LED, 1 x for each section, 40 pin male connectors, 3 x for each section.



TI Controller Board Description

Controller Board Adaptor	Designed with a Texas Instruments TMDSCNCD28335 module
Analog Input	Scaled using a resistor divider circuit
User Switch	SW1, SW2, SW3, SW4
JTAG Connector	Debug or flash the TI controller
BOOT Selector Jumpers	B1, B2, B3, B4
Power Green LED indicator	2 Green LED to indicate the status of the 3.3V & 5V supplies
CAN Bus Termination Jumper	2 Green LED to indicate the status of the 3.3V & 5V supplies
Resolver Circuit	Provided in the controller board, the Resolver Circuit can be calibrated via two potentiometers and the signals can be probed via test points



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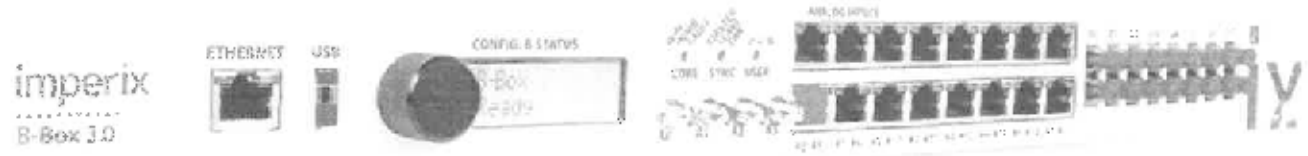
B-Box RCP 3.0

Rapid prototyping controller

The B-Box RCP accelerates the development and experimental validation of power control techniques in a laboratory environment.



GENERAL DESCRIPTION

B-Box RCP is a modular control platform, exclusively tailored for Rapid Control Prototyping (RCP) applications in power electronics. Thanks to its high performance and flexibility, it facilitates the experimental validation of power converters control techniques in R&D environments.

The B-Box notably distinguishes from other RCP solutions by its fully programmable analog front-end, its advanced Pulse-Width Modulation (PWM) capabilities, as well as its numerous and specialized I/Os.

Also, this system has been designed from the start with synchronous sampling applications in mind. It therefore offers a large configurability and guarantees a very strict management of timings and phase shifts, from analog inputs to PWM outputs, including in networked configurations.

Performance is not left on the side either, since its dual-core ARM processor and Kintex-grade FPGA support closed loop control application up to hundreds of kHz! Besides, for the most demanding applications, B-Boxes can be stacked up forming a networked control system of up to 64 units and thousands of I/Os.

Networked B-Box configurations are supported by RealSync, a proprietary technology that guarantees sub-µs communication latency and ns-scale synchronization accuracy. Thanks to this technology, stacked configurations can be used in a totally transparent fashion, as if all FPGA resources and I/Os belonged to one single controller.

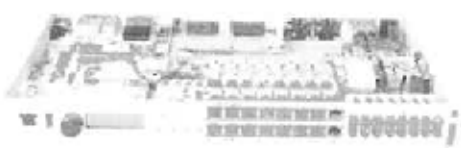
TYPICAL APPLICATIONS

Thanks to its high flexibility, practically any power electronic application can be ideally addressed with B-Box RCP, ranging from grid-tied appliances to electric drives, energy storage systems, renewables, electric mobility, etc.

That said, B-Box RCP is most attractive in very demanding applications, either in terms of I/O count (e.g. multilevel converters), in terms of performance or even both. Notably, systems based on wide band gap devices such as SiC or GaN often simultaneously require high-precision PWM generation as well as a fast closed-loop control speed.

KEY FEATURES AND SPECIFICATIONS

- Stackable up to 64 units
- Dual-core 1 GHz ARM processor
- Kintex-grade FPGA (user programmable)
- Software-independent protections
- Programmable analog front-end
- Up to 250kHz closed loop control frequency
- 134 user I/Os per unit
- Advanced pulse-width modulators (PWM)



FRONT PANEL

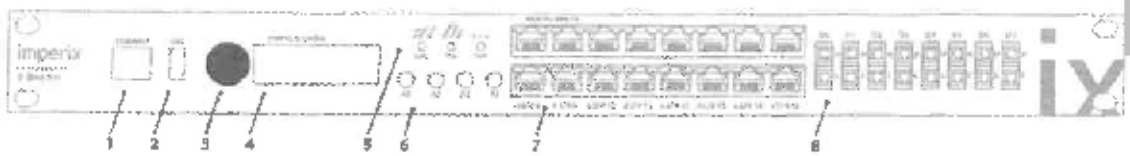


Fig. 1. Front panel view of the B-Box RCP.

1) Gigabit Ethernet port (RJ45)
2) Front panel USB port
3) Rotary and push button
4) LCD screen
5) System and user LEDs
6) Analog outputs (SMA, ±5V)
7) Analog inputs (RJ45, ±10V)
8) Optical PWM outputs (PWM lanes #0-#15)

BACK PANEL

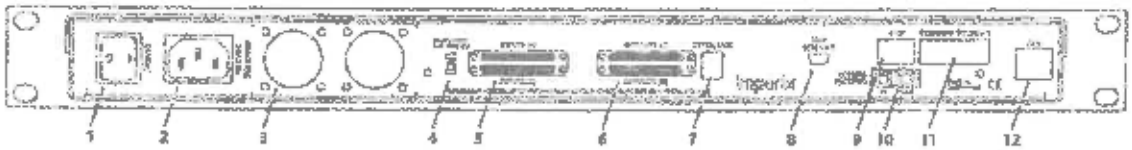


Fig. 2. Back panel view of the B-Box RCP.

1) AC mains switch (ON/OFF)
2) AC mains socket (IEC C14, 110-230V)
3) Fan outlets
4) Selector for GPI/GPO voltage (3.3V or 5.0V)
5) Digital inputs – Connectors A and B (VHDCI HD68)
6) Digital outputs – Connectors C and D (VHDCI HD68)
7) Electrical interlock connector (IN/OUT)
8) Console port (system debug)
9) SFP interconnect – UP link
10) Optical interlock (IN/OUT)
11) SFP interconnect – DOWN links
12) CAN socket (RJ45)

DEVICE CONTENT

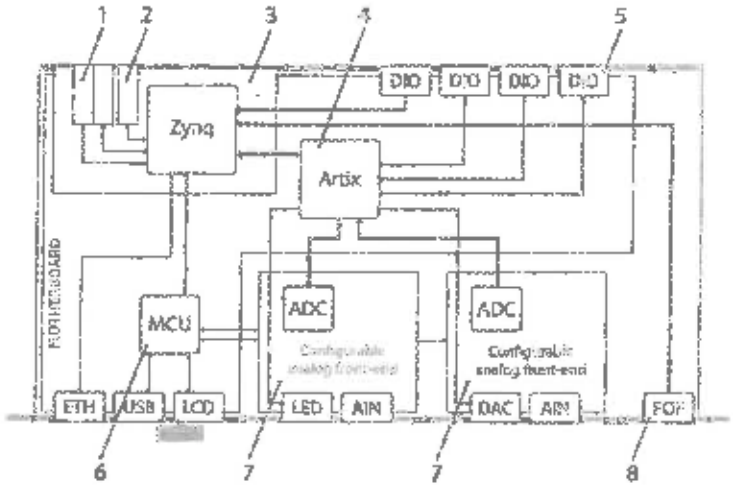


Fig. 3. Simplified system description of the B-Box RCP.

1) SFP Interconnect – DOWN links
2) SFP Interconnect – UP link
3) B-Board processing module
4) Auxiliary FPGA
5) Digital inputs & outputs
6) Frontpanel micro controller
7) Analog front-end board(s)
8) Plastic Optical Fiber (POF) output module

imperix

B-BOARD PROCESSING MODULE DESCRIPTION

1) SFP interconnect – **DOWN links**
2) SFP interconnect – **UP link**
3) USB OTG (on bottom BSH)
4) Gigabit Ethernet (on bottom BSH)
5) Console port
6) Onboard memories:
   - SD card slot
   - 32 MB Flash (program)
   - 8 GB Flash (logging)
7) Wide input range on-board power supply
8) SFP clocks management
9) DDR memory (**1** GB)

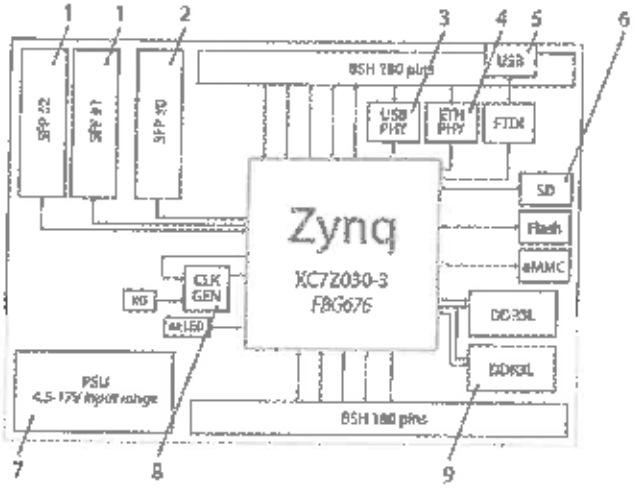


Fig. 4. **Simplified structure of the B-Board processing module.**

MAIN SPECIFICATIONS

Component	Specification	Component	Specification
System on chip	*Xilinx Zynq XC7Z030-3FBG676E Speed grade -3*	*PWM outputs*	*Various topologies 4 ns resolution*
Processing system	*ARM Cortex A9 1 GHz x2 1 GB DDR3*		*Optical 50 Mbps x16 Electrical (3V3) x32*
Programmable logic (FPGA)	*Kintex 7 125K Artix 7 35T (auxiliary)*	*Analog inputs*	*16 bits / 500ksps (simultaneous) x16 Fully configurable front-end*
Storage	*Flash 16Mb x2 micro SD + eMMC 4Gb*	*General-purpose digital outputs (GPO)*	*Electrical (3.3V/5.0V) x16*
		General-purpose digital inputs (GPI)	*Electrical (3.3V/5.0V) x16*
Communication	*USB 2.0 high speed (type A) x1 USB console x1*	*Incremental decoder inputs*	*3-pins (A,B,Z) x4 Shared with GPI inputs*
	Ethernet 1Gbps (RJ45) x1	*User High-speed I/Os*	*FPGA direct (3V3) x36*
	SFP+ 5Gbps x3	*Fault inputs/outputs*	*Digital (3V3) x16 Optical interlock x1 Electrical interlock (5.0V) x1*

Table 1. **Main system specifications for B-Box RCP.**

MAXIMUM I/O CAPABILITIES

Component	Characteristics	Single (1 unit)	Stacked (64 units)
Analog inputs	*Fully configurable (gain, impedance, filter, protection)*	*16*	*1024*
PWM outputs	*Optical, 50 Mbps*	*16*	*1024*
	Electrical, >500 Mbps	*32*	*2048*
General-purpose digital outputs (GPO)	*Electrical, >100 Mbps*	*16*	*1024*
General-purpose digital inputs (GPI)	*Electrical, >100 Mbps*	*16*	*1024*

Table 2. **Maximum I/O count per B-Box RCP unit and in networked configuration.**

LOGICAL STRUCTURE

The 8-Box RCP operates thanks to an association between two CPU core and dedicated peripherals implemented in programmable logic. The distribution of tasks is as follows:

- CPU0: Running on Linux, the first core is responsible for loading the application code, supervising the system execution and managing the data logging.
- CPU1: Running on BBOS (lightweight secured proprietary operating system), the second core executes the application-level control code developed by the user.
- FPGA: The programmable logic area contains all the application-specific peripherals. By default, the corresponding firmware is fixed.

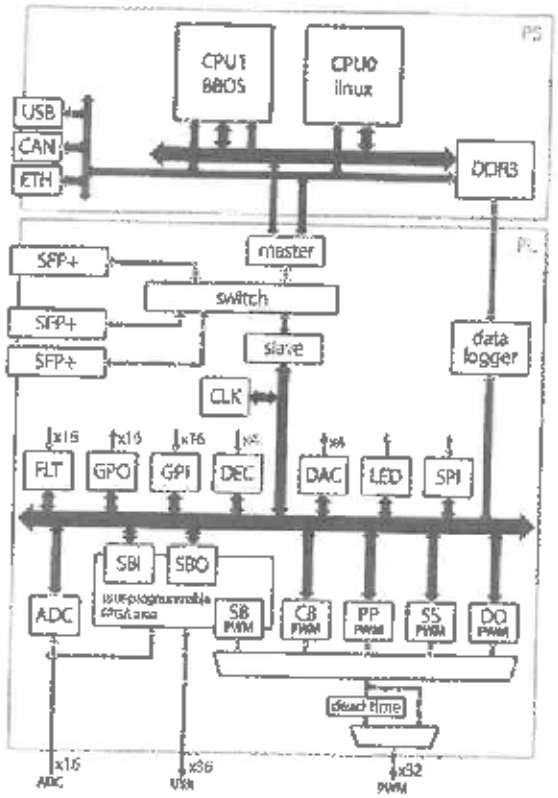


Fig. 5. Functional overview of the 8-Box control platform.

The pre-implemented FPGA peripherals are as follows:

- CLK: Offers clock generators with up to four separate time-bases that can be used with other peripherals.
- ADC: Acquires data from the 16 analog input channels located on the analog front end.
- DAC: Updates the 4 analog output channels (SMA connectors on the front side of the device).
- SBI: Provides easy-to-use access for inbound data traffic from the user-programmable area (sandbox).
- SBO: Provides easy-to-use access for outbound data traffic from the user-programmable area (sandbox).
- CB-PWM: Contains 32 fully-configurable carrier-based modulators (conventional sampled PWM).
- SS-PWM: Implements multilevel modulation for modular converters using a Sort-&-Select voltage balancing technique such as commonly used in Modular Multilevel Converters (MMC). It achieves the balancing of floating capacitors, while maximizing the ration between waveform performance and average switching frequency.
- PP-PWM: Provides hardware support for the generation of Programmed Patterns. It is useful for PWM techniques such as Selective Harmonic Elimination (SHE) or Optimized Pulse Patterns (OPP) in general.
- DO-PWM: Offers a Direct Output operation, allowing to force a specific lane state (0 or 1). This is useful for control techniques such as Model Predictive Control (MPC) or Direct Torque Control (DTC).
- SB-PWM: Provides access to the PWM outputs from the user-programmable area (sandbox).
- GPO: Offers 16 General-Purpose Outputs.
- GPI: Offers 16 General-Purpose Inputs.
- FLT: Offers 16 configurable fault inputs. These inputs can also be used as general-purpose inputs.
- LED: Drives the 3 LEDs available on the front panel.
- DEC: Support the decoding of signals produced by up to four incremental encoders for motor drive applications.
- ETH: Supports data exchanges on Ethernet (TCP/UDP).
- CAN: Provides connectivity with CAN peripherals.
- SPI: Provides SPI connectivity (bidirectional).

ANALOG INPUTS

The B-Box RCP features a fully programmable analog front-end with 16 inputs channels as in Fig. 6. The overall performance specifications are indicated in Table 3. Further analog-to-digital performance specifications are given in Table 7

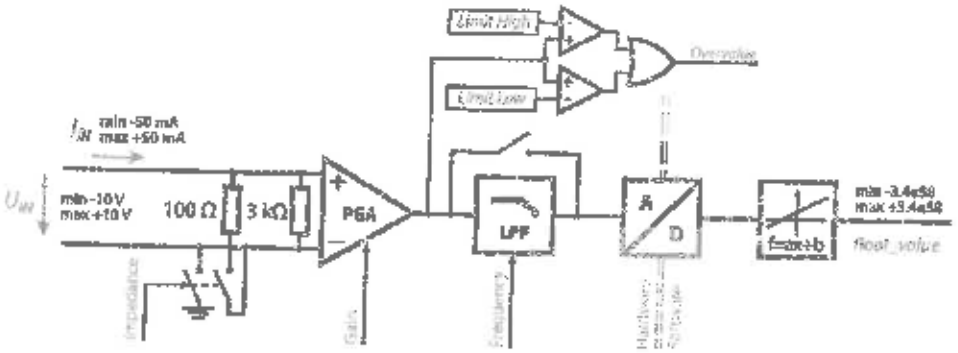


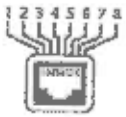
Fig. 6. Block diagram of each channel of the analog input front-end.

Characteristic	Test conditions	Min.	Typ.	Max.	Unit
Input voltage range	Differential mode		±18.0		V
	Common mode		±17.2		V
Absolute maximum tolerable input voltage	On any pin		±56		V
Input impedance	High Z mode / full differential input	2.99	3	3.01	kΩ
			2.2		nF
	Low Z mode / single ended input	99	100	101	Ω
			2.2		nF
Large signal bandwidth	-3 dB, without any filter	400	410		kHz
CMRR (differential input mode only)	G=2, 0 Hz–400 kHz	>65	>72		dB
	G=2, 1.5MHz	>-11	>-65		dB
	G=2, > 10 kHz	>69	>71		dB
Total gain error (uncalibrated)	DC, 3 kΩ differential input mode		±0.8	±1.5	%
	DC, 100 Ω single-ended input mode		±1.4	±1.8	%
Gain stability	0 - 85°C		±0.12	±0.21	%
Offset (uncalibrated)	G= 1, without filter (other gains are better)		±5.6	±15.3	LSB
	G= 1, with filter ON	+16.4	+20.1	+23.6	LSB
Offset stability	0–85°C, without filter		±2.1	±4.3	LSB
	0–85°C, with filter ON		±5.3	±9.3	LSB
Embedded power supply voltage	$I_{OUT} < I_{OUT,max}$ (output protection not triggered)	±14.6	±15.0	±15.4	V
Embedded power supply output current	per channel			150	mA
	all channels			1.5	A

Table 3. Overall performance specifications of the analog front-end (each channel).

ANALOG INPUT CONNECTORS

Analog inputs rely on RJ45 connectors. This allows the use of well shielded twisted pair cables for the connection to sensors, with a good EMI performance.



Pin	Pair	Color	Description
1	2	orange stripe	+15 V
2	2	orange solid	+15 V
3	3	green stripe	0 V
4	1	blue solid	Positive input / current input
5	1	blue stripe	Negative input / ground
6	3	green solid	0 V
7	4	brown stripe	-15 V
8	4	brown solid	-15 V

Table 4. Pinout of the analog inputs.

SELECTABLE INPUT IMPEDANCE

For each channel, the input impedance can be selected so as to implement one of the following configurations:

- High impendance mode: 3 kΩ, full differential mode. This is the default configuration, which is mostly useful when the acquired quantity is a voltage proportional to the measurement.
- Low impedance mode: 100 Ω, single-ended signalling. This is typically useful when the acquired quantity is a current proportional to the measurement.

PROGRAMMABLE-GAIN AMPLIFIER

Each channel features a AD8251 programmable gain amplifier from Analog Devices. The selection of a particular gain typically allows to maximize the ADC input range, notably improving the resolution on the measured value. The possible gain configurations are G=1, G=2, G=4 or G=8.

PROGRAMMABLE LOW-PASS FILTER (WITH BYPASS)

Each channel features a LTC1065 programmable low-pass filter from Linear Technology with the possible cut-off frequencies given in Table 5. The filter is a 5th-order Bessel filter, hence with a practically flat group delay. Attenuation is 80 dB at 8 times the cut-off frequency.

The filter is controlled by a variable-frequency clock that is generated by a local microcontroller. As such, the cut-off frequency can be easily and directly selected from the front panel of the B-Box.

When not used, the filter is physically bypassed by a controllable relay for superior noise and offset performance. When used, the offset of each channel should be properly calibrated with the selected cut-off frequency (as this is indeed a parameter that may significatively vary from part-to-part).

Cut-off frequency	Group delay	Cut-off frequency	Group delay
Filter OFF	0.0 µs		
0.5 kHz	700 µs	8.0 kHz	58 µs
1.0 kHz	400 µs	10 kHz	40 µs
1.6 kHz	250 µs	16 kHz	25 µs
2.5 kHz	160 µs	20 kHz	20 µs
4.0 kHz	100 µs	32 kHz	12.5 µs
6.4 kHz	63.5 µs	40 kHz	10 µs

Table 5. Possible low-pass filter (LPF) configurations.

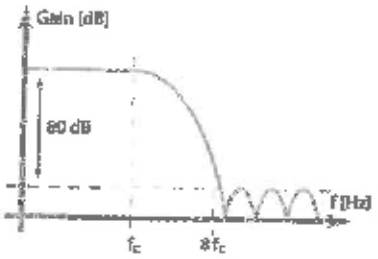


Fig. 7. Frequency response of the low-pass filter.

PROTECTION THRESHOLDS

Each channel features two programmable analog comparators, which can be set to define low and high input voltage thresholds. When either of these thresholds is crossed, the PWM signals (optical and electrical) are instantly blocked and the B-Box set to FAULT state.

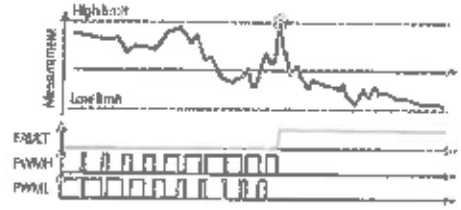


Fig. 8. Operating principle of the protection thresholds.

Characteristic	Min.	Typ.	Max.	Unit
Configurable range		±16.0		V
Setting resolution		0.1		V
Setting accuracy		± 10 % m.v. ± 100 mV		
Response delay to blocking of PWM signals		1.4	1.6	µs

Table 6. Performance specifications of the programmable thresholds.

ANALOG-TO-DIGITAL CONVERTER

A-to-D conversion is achieved with two ADS8568 from TI. The devices guarantee simultaneous sampling on all channels. The sampling clock is freely selectable amount all four CLK sources (see corresponding section on page 11).

Characteristic	Test conditions	Min.	Typ.	Max.	Unit
Resolution			16		bits
Noise floor	G = 1, differential input mode, no filter		0.3	1.7	LSB (rms)
Sampling rate		0.001		500	ksps
Sampling jitter	Same B-Box		±2.1		ns
	Across all B-Boxes		±3.6		ns
Conversion time	All channels			1.98	µs
Data transfer delay		See Fig. 9.			ns

Table 7. Performance specifications of the A/D conversion.

Data retrieval from A/D converters to the processing cores is achieved through FPGA logic and over the RealSync network in case of multi-Bbox operation. Transfer delays vary with the amount of data to be transferred (see Fig. 9). The overall delay from sampling to cache memory is therefore the sum of the ADC conversion time and data transfer delay.

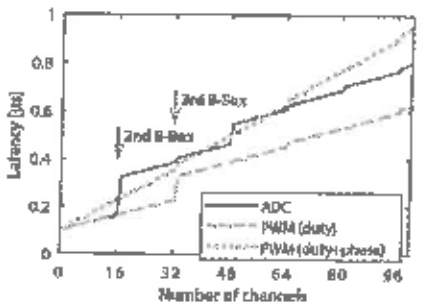


Fig. 9. Data transfert delay as a function of the number of channe

OPTICAL OUTPUTS

PWM lanes #0 to #15 are available on optical fiber outputs. They make use of FTS0MHNR transmitters from Firecomms.[1] By default, two consecutive PWM lanes are associated to form a PWM channel. Several configurations of PWM channels are possible, similarly to electrical PWM outputs:

- PWMH + PWML: high- and low-side signals, i.e. pseudo-complimentary signals with configurable dead time between their '1' states. In this case two PWM lanes form a PWM channel.
- PWM + ACTIVE: PWM and switching authorization signals, i.e. one switching signal and one for blocking / unblocking the operation. In this case, two PWM lanes also form a PWM channel.
- INDEPENDENT: each PWM lane is linked to its own PWM modulator. In this case, no PWM channel is formed and dead time is not enforced.

In pseudo-complimentary operation (PWMH + PWML), a dead time can be freely configured by software.

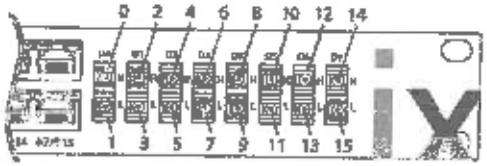


Fig. 10. Physical assignment of PWM lanes.

The overall timing accuracy of the optical outputs is shown in Table 8. These specifications encompass all sources of timing uncertainty up to the optical signals, including the B-Box-to-B-Box synchronization accuracy for networked configurations. Additional details regarding synchronization are given in the section addressing clock generation (page 11).

Characteristic	Test conditions	Min.	Typ.	Max.	Unit
Wavelength		640	650	670	nm
Propagation delay asymmetry	Any two signals, same B-Box, 3σ			±1.3	ns
	Any two signals, across all networked B-Boxes, 3σ			±1.5	ns
Relative jitter (optic)	Any two signals, same B-Box, 3σ			±1.8	ns
	Any two signals across all networked B-Boxes, 3σ			±2.1	ns

Table 8. Performance specifications of the optical PWM outputs.

ANALOG OUTPUTS

The B-Box RCP features 4 analog output channels, available through the 4 SMA connectors present on its front panel. DAC data are updated continuously and successively channel-by-channel.

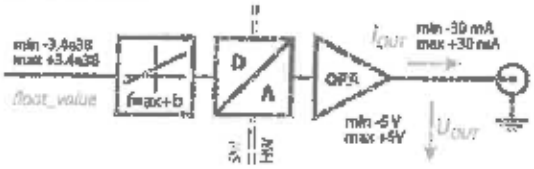


Fig. 11. Block diagram of each channel of the analog output front-end.

Characteristic	Min.	Typ.	Max.	Unit
Resolution		16		bits
Output voltage range		±5.0		V
Maximum achievable output current	±15	±30		mA
Gain error		±1.7		%
Offset		±0.2		mV
Settling time		0.5		µs

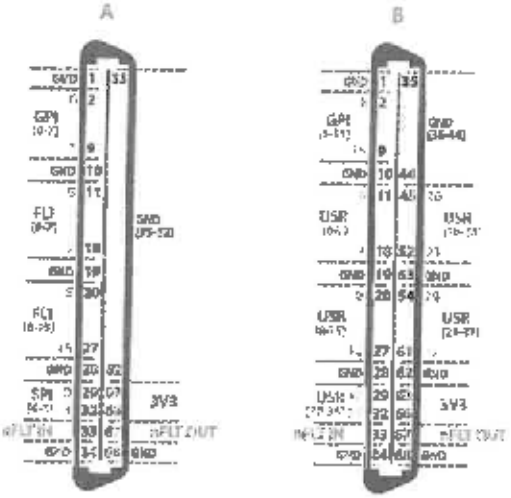
Table 9. Performance specifications of the analog outputs.

[1] ...es are also available on the 3.3V electrical outputs on the rear side of the device.

DIGITAL INPUTS

Electrical digital inputs are grouped on the (A) and (B) high-speed connectors. The following functions are available:

- GPI: General purpose inputs (16 bits)
- FLT: Fault feedback inputs (16 bits)
- SPI: Multi-function acquisition bus (4 bits)
- USR: Fully-configurable input / output bus (32+4 bits)



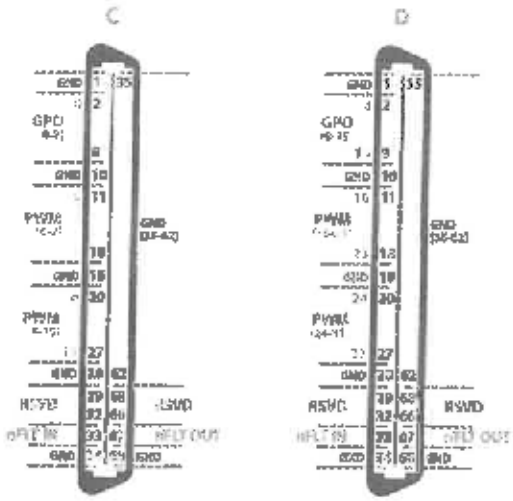
Pins	Signal	Level	Pins	Signal	Level
1, 10, 19, 28, 34, 35-62, 68	GND		1, 10, 19, 28, 34, 35-44, 53, 62, 68	GND	
2-9	GPI0-7	3.3/5V	2-9	GPI8-15	3.3/5V
11-18	FLT0-7	3.3V	11-18, 20-27	USR0-15	3.3V
20-27	FLT8-15	3.3V	45-52, 54-61	USR 16-31	3.3V
29-32	SPI0-3	3.3V	29-32	USR32-35	3.3V
63-66	3V3		63-66	3V3	
33	Fault IN	3.3V	33	Fault IN	3.3V
67	Fault OUT	3.3V	67	Fault OUT	3.3V
	INPUTS (A)			INPUTS (B)	

Table 10. Pinout of the digital inputs (A) and (B).

DIGITAL OUTPUTS

Electrical digital outputs are grouped on the (C) and (D) connectors. The following functions are available:

- GPO: General purpose outputs (16 bits)
- PWM: Pulse-width modulated signals (32 bits)



Pins	Signal	Level	Pins	Signal	Level
1, 10, 19, 28, 34, 35-62, 68	GND		1, 10, 19, 28, 34, 35-42, 68	GND	
2-9	GPO0-7	3.3/5V	2-9	GPO8-15	3.3/5V
11-18	PWM0-7	3.3V	11-18	PWM 16-23	3.3V
20-27	PWM8-15	3.3V	20-27	PWM 24-31	3.3V
29-32, 63-66	RSVD		29-32, 63-66	RSVD	
33	Fault IN	3.3V	33	Fault IN	3.3V
67	Fault OUT	3.3V	67	Fault OUT	3.3V
	OUTPUTS (C)			OUTPUTS (D)	

Table 11. Pinout of the digital outputs (C) and (D).

More information about the different peripherals available on the high-speed connectors is available in Table 12.

Peripheral	Bit lanes	Level	Main functions and bus width	Alternate function	Connector	Internal topology	Typ. speed
GPI	GPI0-7	3.3/5V	General-purpose inputs (16 bits)	Incremental decoder	A	Level shifted to 3.3V	150 Mbps
	GPI8-15	3.3/5V		Incremental decoder	B	Double level shifted to 1.8V	100 Mbps
GPO	GPO0-7	3.3/5V	General-purpose outputs (16 bits)		C	Level shifted to 3.3V	150 Mbps
	GPO8-15	3.3/5V			D	Double level shifted to 1.8V	100 Mbps
PWM	PWM 0-15	3.3V	Pulse-width modulated signals (32 bits)	High-speed DOUT	C	Direct to Zynq	400 Mbps
	PWM 16-31	3.3V		High-speed DOUT	D	Level shifted to 1.8V by Artix 7	250 Mbps
FLT	FLT0-15	3.3V	Fault feedback signals (16 bits)	High-speed DIN	A	Level shifted to 1.8V by Artix 7	250 Mbps
SPI	SPI 0-4	3.3V			A1	Level shifted to 1.5V by Artix 7	
USR	USR 0-35	3.3V			B	Direct to Zynq	400 Mbps

Table 12. General specifications of the digital signals available on the high-speed connectors.

WARNING:
Always make sure to apply and use the appropriate voltage level on each signal. Unexpected behavior or ...may occur in case of inappropriate voltage. The operating logic voltage can be easily selected us... ...responding switch on the rear side of the 6-Box RCP unit. This only applies to GPI and GPO.

3.3V logic
5.0V logic

GENERAL-PURPOSE INPUTS (GPI) AND INCREMENTAL DECODER INPUTS (DEC)

16 inputs are available on connectors (A) and (B). These inputs are statically tied to the GPI block. The logic level can be selected to be 3.3V or 5.0V. The same inputs can also be used as incremental decoder inputs for the DEC peripheral.

Characteristic	Test conditions	Value	Unit
Maximum tolerable input voltage	5.0 V	5.5	V
	3.3 V	3.6	V
Propagation delay asymmetry	Any two signals on same B-Box		ns
	Any two signals across all B-Boxes		ns

Table 13. Performance specifications of the GPI/DEC inputs.

Pin	GPI signal	DEC signal	Pin	GPI signal	DEC signal
A2	GPI0	A0	B2	GPI8	A2
A3	GPI1	B0	B3	GPI9	B2
A4	GPI2	Z0	B4	GPI10	Z2
A5	GPI3	A1 or $\overline{A0}$	B5	GPI11	A3 or $\overline{A2}$
A6	GPI4	B1 or $\overline{B0}$	B6	GPI12	B3 or $\overline{B2}$
A7	GPI5	Z1 or $\overline{Z0}$	B7	GPI13	Z3 or $\overline{Z2}$
A8	GPI6	N/A	B8	GPI14	N/A
A9	GPI7	N/A	B9	GPI15	N/A

Table 14. Signal assignment for the GPI/DEC inputs.

GENERAL-PURPOSE OUTPUTS (GPO)

16 outputs are available, grouped into 2x8 pins on connectors (C) and (D). They are statically tied to the GPO block. The logic level can be freely selected to be 3.3V or 5.0V.

Characteristic	Test conditions	Value	Unit
Max rise/fall time	5.0 V	5	ns
	3.3 V	5	ns
Propagation delay asymmetry	Any two signals on same B-Box	2.5	ns
	Any two signals across all B-Boxes	2.5	ns

Table 15. Performance specifications of the GPO outputs.

FAULT FEEDBACK INPUTS (FLT)

16 digital input lanes are available as fault feedback signals. These signals are tied the fault manager block (FLT). They can also be accessed as digital inputs.

Characteristic	Min.	Typ.	Max.	Unit
Response delay to blocking of PWM signals		55	69	ns
Operating voltage	3.0	3.3	3.6	V

Table 16. Performance specifications of the fault feedback inputs.

MULTI-FUNCTION ACQUISITION BUS (SPI)

A multi-purpose Serial Peripheral Interface (SPI) bus is available on connector (A). It is statically tied to the SPI block.

Characteristic	Min.	Typ.	Max.	Unit
Configurable clock frequency			50	MHz
Operating voltage	3.0	3.3	3.6	V

Table 17. Performance specifications of the SPI bus.

Pin	Name	Direction	Function description
A29	SCLK	Output	Data sampling clock
A30	CS	Output	Chip select strobe
A31	MISO	Input	Master In Slave Out data
A32	MOSI	Output	Master Out Slave In data

Table 18. Signal assignment of the SPI bus.

USER-CONFIGURABLE I/O BUS (USR)

The B-Box RCP features a high-speed bus of 36x bidirectional I/Os that is directly accessible from the user-programmable area (inside the Zynq chip). This area, also designated as sandbox offers easy-to-use access from/to the processing cores through the dedicated SBI and SBO blocks.

Characteristic	Min.	Typ.	Max.	Unit
Operating data bitrate (all lines)			400	Mbps
Operating voltage	3.0	3.3	3.6	V

Table 19. Performance specifications of the USR bus.

Pin	Name	Direction	Function description
B11-B18	USR0-7	I/O	Any (e.g. data / address)
B20-B27	USR8-15	I/O	Any (e.g. data / address)
B45-B52	USR16-23	I/O	Any (e.g. data / address)
B54-B61	USR24-31	I/O	Any (e.g. data / address)
B29-B32	USR32-35	I/O	Any (e.g. data / address / strobes)

Table 20. Signal assignment of the USR bus.

ELECTRICAL PWM OUTPUTS (PWM)

32 PWM lanes are available on connectors (C) and (D). The first 16 lanes (i.e. #0-15) are shared with optical outputs. Two consecutive PWM lanes are by default associated to form a PWM channel with three possible configurations:

- PWM+/-PWM: high- and low-side signals with configurable dead time between their '1' states.
- PWM+ACTIVE: PWM and switching authorization signals, i.e. one switching signal and one for blocking/unblocking the operation.
- INDEPENDENT: each PWM lane is linked to its own PWM modulator. No dead time is enforced.

Table 21 summarizes the timing performance specifications.

Characteristic	Channels	Test conditions	Min.	Typ.	Max.	Unit
Propagation delay asymmetry	PWM 0-15	Any two signals on same B-Box			±1.6	ns
	PWM 16-31				±2.3	ns
	Any	Any two signals on same B-Box			±3.8	ns
		Any two signals across all networked B-Boxes			±5.8	ns
Relative jitter	Any	Any two signals on same B-Box			±0.6	ns
		Any two signals across all networked B-Boxes			±0.7	ns

Table 21. Performance specifications of the 3.3V electrical PWM outputs.

FAULT INTER-LOCKING SIGNALS

Fault inter-locking allows to coordinate emergency mechanisms between B-Box RCP and other appliances, or across several B-Boxes. These mechanisms are bi-directional as they can inform other devices about an internal fault condition or reciprocally receive external trigger signals. In a stacked configuration with multiple networked B-Boxes, fault inter-locking is intrinsically available thanks to the imperix *RealSync* protocol (optical fiber links).[1] Two types of inter-locking mechanisms are available on B-Box RCP:

- Electrical inter-lock: Labeled **INTERLOCK** on the rear side of the device. The connector is part number 1786837 from Phoenix Contact. The mating part is 1790108.
- Optical inter-lock: Labeled **OPTICAL FAULT I/O**. The optical interlock uses standard plastic optical fibers (POF) similar to the Avago HFBR family. The light is ON when no fault condition is active.

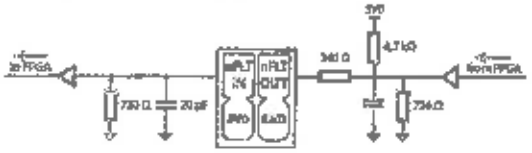


Fig. 12. Electrical circuit for the electrical inter-locking mechanism.

Characteristic	Medium	Min.	Typ.	Max.	Unit
Operating voltage	*Electrical*	*4.5*	*5.0*	*5.5*	*V*
Wavelength	*Optical*	*640*	*650*	*670*	*nm*
Response delay to blocking of PWM signals	*Optical*		*70*	*78*	*ns*
	Electrical		*40*	*50*	*ns*
	RealSync		*0.25*		*µs*

Table 22. Performance specifications of the inter-locking.

Fault input / output flags are also available on the digital connectors (A/B/C/D) located at the rear side of the B-Box. These signals are logically grouped into one fault when entering the fault manager (see Fig. 13). The output directly replicates the nFLT_OUT inter-lock signal.

Pin	Signal	Level	Pin	Signal	Level
A33	*nFLT_A_IN*	*3.3V*	*A67*	*nFLT_OUT*	*3.3V*
B33	*nFLT_B_IN*	*3.3V*	*B67*	*nFLT_OUT*	*3.3V*
C33	*nFLT_C_IN*	*3.3V*	*C67*	*nFLT_OUT*	*3.3V*
D33	*nFLT_D_IN*	*3.3V*	*D67*	*nFLT_OUT*	*3.3V*

Table 23. Signal assignment for the nFLT I/O flags on A/B/C/D slots.

FAULT MANAGER

At the firmware level, all fault signals are grouped inside the fault manager, which manages the overall system execution state and controls the activation of the PWM outputs
The collected fault signals include:

- Dedicated fault input lines FLT0..15 (digital connector A)
- Fault signals on digital I/O connectors (A, B, C and D) (active low signals, inhibited by default)
- Interlocks (optical and electrical)
- Overvalues on analog inputs AIN0..15
- Watchdog counter

BBOS allows to configure the enabling/disabling of each digital fault input line individually through a configuration mask. Reciprocally, interlocks and analog input protections must be configured using the B-Box front panel and the LCD screen. All signal values (fault flags) can be read from the corresponding VALUES register.

The wachdog counter (WDG) is automatically configured with a period of 2.5 times the control processing period. A fault is raised when no data is received by FPGA logic within this interval.

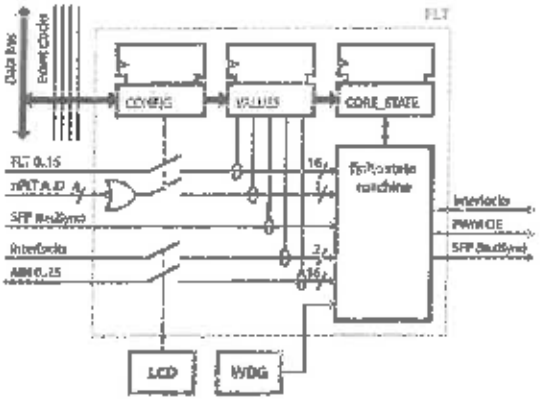


Fig. 13. Internal structure of the FLT peripheral block.

[1] ...y and when relevant, electrical or optical inter-locks can be wired as well, such as to reduce the response time to faults.

CLOCK AND INTERRUPT GENERATORS

Four independent clock generators are available on B-Box. They allow to configure independent time bases that can be allocated to various FPGA peripherals. This guarantees a very strict management of frequencies and phase-shifts between blocks. Clock generators support glitch-less re-configuration during run-time (variable-frequency).

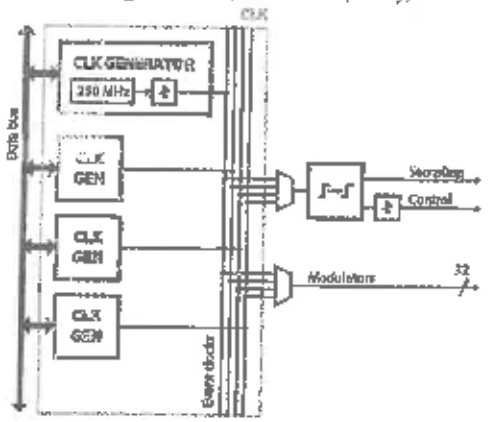


Fig. 14. Internal structure of the CLK peripheral block.

Outputs of clock generators are either interrupt signals or reference clocks for pulse-width modulators. Typical configurations include:

- Basic example: Control, modulation and sampling are at the same frequency. All resources are mapped onto the same clock generator. Measurements are made in the middle of the current ripple.
- Multi-frequency example: Two distinct converters are switching at different frequencies (e.g. 4 kHz and 5 kHz). Sampling is done at a common multiple (e.g. 20 kHz).
- Variable-frequency: One variable-frequency generator is used for modulation. Another frequency generator is used at a constant frequency for sampling and control.

Characteristic	Value
Counter resolution	*4.0 ns*
Counter depth (carrier, prescaler)	*16 bits*
Postscaler value (DAQ subsystem)	*0 – 4095*
Achievable frequency range	*58.2 mHz – 250 MHz*

Table 24. Performance specifications of the CLK peripheral block.

In a multi-device configuration (with stacked B-Boxes), all clock generators are intrinsically syntonized and automatically synchronized. This way, all phase-dependent operations such as sampling (ADC) or modulation (PWM) are guaranteed to have extremely accurate timings. Achievable performance is shown in Table 25 and illustrated in Fig. 15.

Characteristic	Min.	Typ.	Max.	Unit
Mean deviation, any slave B-Box vs. master	*-2.0*	*0*	*2.0*	*ns*
Phase noise (jitter), any B-Box, 3σ		*±250*		*ps*

Table 25. Synchronization performance of CLK peripheral blocks across multiple B-Boxes using *RealSync*.

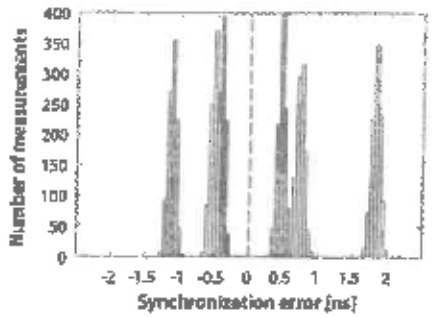


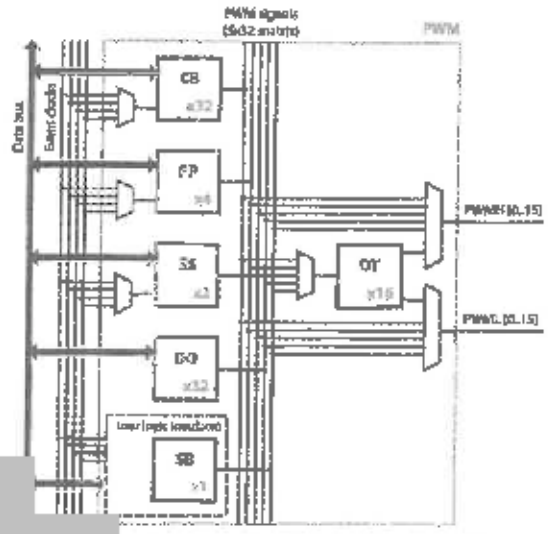
Fig. 15. Relative phase error performance with several B-Boxes in a stacked configuration (example with 6 slaves units).

PULSE WIDTH MODULATORS

The B-Box RCP embeds a full PWM signal generation system, featuring five sub-systems. Each of them generates 32 PWM signals. Fig. 16 depicts the corresponding structure:

- CB-PWM: Carrier-based modulators (32 channels). Various types of carriers are available, with single or double update rate. The CB-PWM block also provide hardware support for space-vector modulation (SV-PWM).
- PP-PWM: Programmed patterns modulators (2x three-phase). They allow the implementation of Selective Harmonic Elimination (SHE) or other types of Optimized Pulse Patterns (OPP).
- DO-PWM: Direct outputs. The direct access to the output state ('1' or '0') typically enables the implementation of software-modulated techniques such as Model Predictive Control (MPC). This also allows to use PWM outputs as standard digital outputs (possibly with dead time).
- SS-PWM: Sort-and-Select modulation and balancing (2 arms of up to 8 modules). This sub-system offers hardware-level support for the operation of Modular Multilevel Converters or similar topologies.
- SB-PWM: This subsystems connects with the user-programmable area (sandbox), which allows for the implementation of fully-customized modulation techniques. Easy-to-use I/O access from the software level is offered by the SBI and SBO blocks (see page 16).

At the output, each of the 32 PWM signals can be directly propagated to the physical outputs (electrical or optical), or to go through a dead time generator.
This results in 32 PWM lanes. By default, lanes are also arranged into 16 pairs of adjacent lanes designated as channels. Within a channel, odd lanes are always low-side signals, while even lanes are always high-side. PWM lanes #0-31 are available from the electrical connectors, while only PWM lanes #0-15 are produced on the optical outputs.
Dead time is obtained by delaying the rising edge of each PWM signal within a given pair. This results in an equivalent propagation delay of half the dead time.



...rnal structure of the PWM signals generation block.

Characteristic	Min.	Typ.	Max.	Unit
Dead time resolution		*4*		*ns*
Dead time value	*0.004*		*262*	*µs*

Table 26. Performance specifications of the dead time generation.

Channel	0	1	2	...	7	8	9	10	...	15
Lane	*0*	*2*	*4*	...	*14*	*16*	*18*	*20*	...	*30*
	1	*3*	*5*	...	*15*	*17*	*19*	*21*	...	*31*

Table 27. Designation of the PWM lanes and channels.

CB-PWM: CARRIER-BASED MODULATION

Carrier-based modulators offer the simplest way to generate pulse-width modulated signals. The corresponding subsystem features 32 independent modulators, which offer independent duty-cycle and phase parameters as well as four different types of carriers. With triangular carriers, modulators can be configured with single or double update rates (once or twice per PWM period).

Characteristic	Value
Counter depth	*16 bits*
Edge resolution (counter resolution)	*4 ns*

Table 28. Performance specifications of the CB-PWM block.

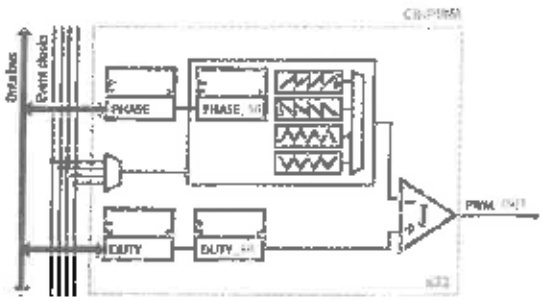


Fig. 17. Internal structure of the CB-PWM peripheral block.

SV-PWM: SPACE VECTOR MODULATION

Space vector modulation (sometimes referred to as SVM) is supported through dedicated software drivers, making use of the same resources as the CB-PWM subsystem. Indeed, once the closed vectors have been identified and the suitable sequence determined, the switching events can be easily produced by suitably-programmed modulators. SV-PWM automatically configures adjacent lanes or channels and supports single or double update rates.

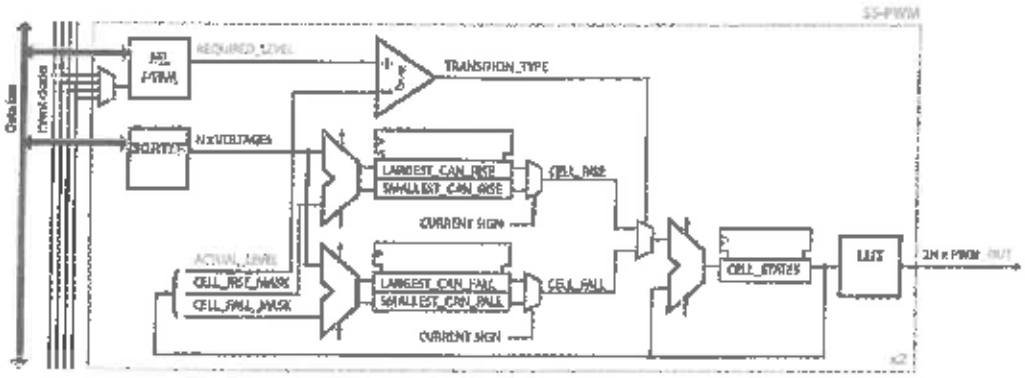


Fig. 25: Internal structure of the SS-PWM peripheral block.

SS-PWM: SORT-AND-SELECT MODULATION FOR MODULAR MULTILEVEL CONVERTERS (MMC)

Modulation with integrated voltage balancing for multilevel converters is supported at the firmware level thanks to the SS-PWM block. It applies to Modular Multilevel Converters as well as similar topologies with floating submodules.

This subsystem accesses the voltages acquired on the analog inputs in order to sort the submodule voltages and allocate the switching events to the suitable submodule as a function of the current polarity.

The SS-PWM block is compatible with half- and full-bridge submodule topologies and hence with both positive and negative arm voltages. The pre-implemented solution also guarantees that only one submodule switches at a given time in order to minimize switching losses and optimize the ratio between apparent and actual switching frequencies. Finally, the firmware also supports the exclusion of one or several submodules from the modulation process, as required by most fault-tolerant operation mechanisms.

Characteristic	Symbol	Value
Number of submodules per converter arm	*N*	*4, 8, 16 (+bypass)*
Number of output voltage levels	*L*	*N+1 or 2N+1*
Switching frequency range	f_{sw}	*3.73 Hz ~ 1 MHz*
PWM edge resolution		*20 ns*

Table 29: Performance specifications of the SS-PWM block.

SB-PWM: PWM ACCESS FROM THE SANDBOX

In addition to existing modulators, the B-Box also features a user-programmable area inside the FPGA. This notably allows to implement special own modulation techniques. In this sandbox, data read and write access from/to the CPU is provides from the the SBI and SBO blocks, respectively (see "User-programmable area (Sandbox)" on page 16).

The SB-PWM subsystem itself allows to connect to the PWM lanes through the dead-time generator block (see Fig. 16) as well as the B-Box's hardware protection mechanisms.

Fig. 18: Internal structure of the SB-PWM block.

DO-PWM: DIRECT OUTPUT ACCESS

Direct access to the PWM outputs is supported by the DO-PWM subsystem. It distinguishes from the SB-PWM in the sense that it is pre-implemented and requires no HDL editing. PWM state values (0 or 1) can be written directly from the CPU cores. This may typically be useful for model-predictive control (MPC) or sliding mode control techniques such as direct torque control (DTC).

Similarly to all PWM subsystems, when used as a channel, output lanes benefit from the dead-time generator block as well as protective mechanisms.

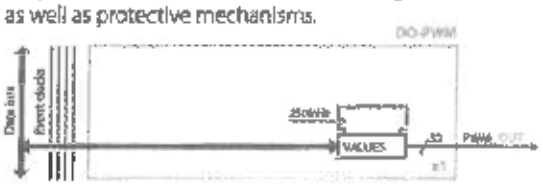


Fig. 19: Internal structure of the DO-PWM block.

PP-PWM: PROGRAMMED PATTERNS MODULATION

The programmed pattern blocks support modulation techniques that rely on pre-defined switching instants such as the generation of firing angles on a thyristor-based converter, the implementation of Selective Harmonic Elimination (SHE) or any Optimized Pulse Pattern (OPP). Three-phase system are supported.

PP-PWM have a fixed counter period (hence angular resolution), but can nevertheless be fed by variable-frequency clocks (see CLK peripheral block), typically aiming to be integrated withing a software PLL.

Each PP-PWM block contains several look up tables (LUT) for switching angles, registers for indicating the direction (up or down) of each switching event, as well as an additional truth table for decoding the output state.

The PP-PWM blocks are meant for accelerating the run time execution of OPP-based modulation and not for supporting the computation of the associated optimization algorithms.

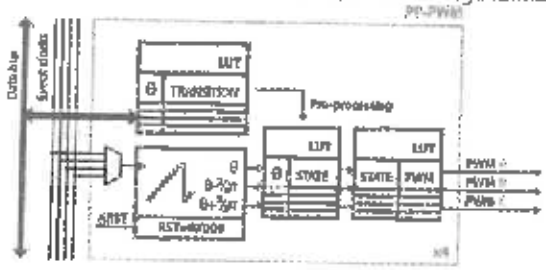


Fig. 20. Internal structure of the SS-PWM block.

Characteristic	Value
Number of angle registers (values 0—65'000)	3x 16 angles x 16 bits
Number of transition direction bits registers (up or down)	3x 16 bits
Size of output LUT	
Edge resolution (respectively to signal period)	0.01°/s

Table 30. Performance specifications of the PP-PWM block.

DEAD TIME GENERATION SUBSYSTEM

As depicted by Fig. 16, the PWM block features a dead time generator at its output. This subsystem can be either used or bypassed by picking-up the signals from the PWM signals matrix directly (outputs of the modulators). Signals from all five PWM subsystems can be routed to the physical outputs (electrical or optical).

The dead time generation relies on a finite state machine operating as depicted in Fig. 21. Essentially, rising edges of the high-side and low-side signals are delayed by a programmable amount of time. This results in an equivalent propagation delay of half the dead time.

Intrinsically, this implementation guarantees that a pulse shorter than the dead time value is not produced.

Characteristic	Min.	Typ.	Max.	Unit
Dead time resolution		4		ns
Dead time value	0.004		262	µs

Table 31. Performance specifications of the dead time generation.

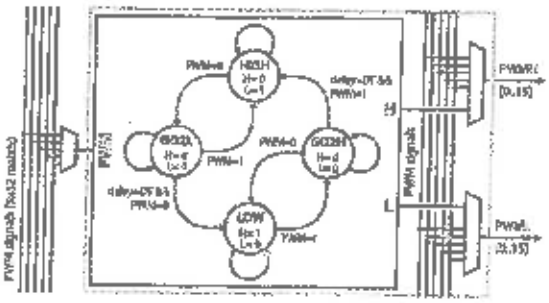


Fig. 21. Internal structure of the dead time generation block.

DATA TRANSFER PERFORMANCE

The transfer of continuously-updated modulation parameters from the processing core to the distributed modulators causes delays, which depend on the amount of data to be transferred. Fig. 22 shows the achieved performance with respect to the update of the CB-PWM block. Other modulators perform similarly.

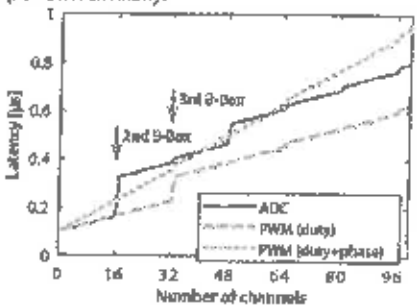


Fig. 22. Data transfer delay, as a function of the number of channels and number of B-Boxes.

INCREMENTAL POSITION DECODERS

The B-Box RCP features decoder inputs for quadrature-encoder speed / position sensor signals (usually called A and B), with or without a reset line (usually called Z). These inputs are either configurable as four independent inputs or two differential inputs.

Each decoder module counts all 4 edges of the A and B inputs, leading to an angular resolution 4 times superior to the PPR value usually specified for a given encoder. The position counter can be reset either at a specified value, or using the Z signal provided by the sensor.

Finally, the position can be latched similarly and simultaneously to the sample and hold feature of the ADC inputs, or simply read at the start of the data transfers to the CPU.

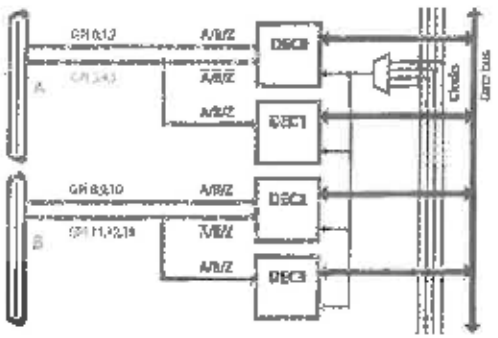


Fig. 23. Device mapping and configuration of the four incremental speed / position sensors decoders.

Characteristic	Test conditions	Min.	Typ.	Max.	Unit
Input signals	*• Single-ended signalling: A, B and Z (Z is optional) • Differential signalling: A, Ā, B, B̄, Z, Z̄ (Z, Z̄ are optional)*				
Sampling options	*Either synchronized with ADC, or independent*				
PWM frequency	*Quadruple rate.*	*0*		*5*	*MHz*

Table 32. Performance specifications of the DEC block.

CAN TRANSCEIVER

An isolated TJA1041 Controller Area Network (CAN) transceiver is available for communication between B-Box and third-party devices. Connectivity is provided through an RJ45 connector on the rear side of the device.

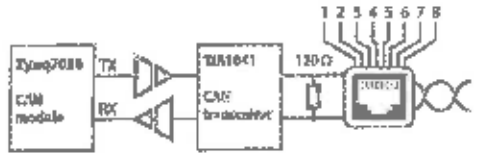


Fig. 24. Block diagram of the Controller Area Network peripheral.

Characteristic	Min.	Typ.	Max.	Unit
Operating baudrate			*1.0*	*Mbd*
Tolerable voltage on CAN+ and CAN- pins	*-27*		*+40*	*V*
Bus impedance	*119*	*120*	*121*	*Ω*

Table 33. Performance specifications for the CAN transceiver.

Pin	Color	Description	Pin	Color	Description
1	*orange stripe*	*CANH*	*5*	*blue stripe*	*NC*
2	*orange solid*	*CANL*	*6*	*green solid*	*GND*
3	*green stripe*	*GND*	*7*	*brown stripe*	*NC*
4	*blue solid*	*NC*	*8*	*brown solid*	*NC*

Table 34. CAN pin/pair assignments.

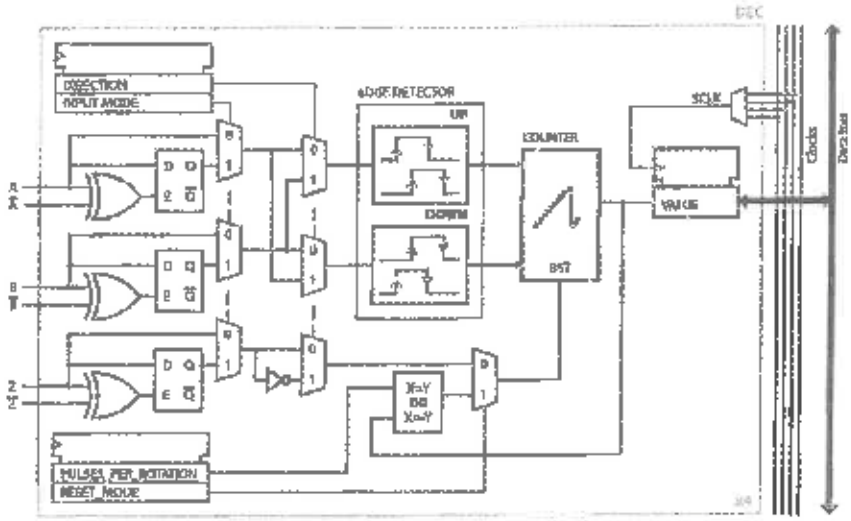


Fig. 26. Internal structure of the DEC block.

USER-PROGRAMMABLE AREA (SANDBOX)

The B-Box RCP is designed such that its programmable logic area (PL) can embed user-defined logic. This may allow for the implementation of special modulation techniques, proprietary communication mechanisms, or interfacing with external hardware and components.

Within this special area, designated as *sandbox*, two peripheral blocks are pre-implemented for easy-to-use I/O access from/to the CPU cores:

- SBI: Input from the sandbox
- SBO: Output to the sandbox

Also, the sandbox offers connectivity to the following I/O:

- ADC values (16x 16 bits signed integers)
- SB-PWM signals (32 bits register)
- Internal clocks
- Physical I/Os (FLT, USR, GPI, GPO)

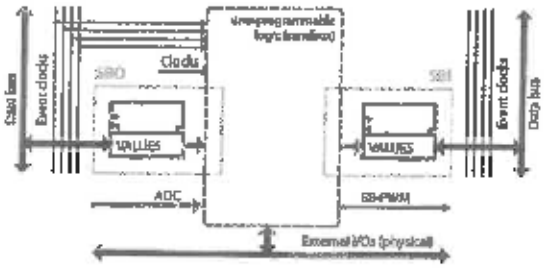


Fig. 27. **Internal structure of the SBI and SBO blocks.**

Thanks to the *RealSync* communication and synchronization protocol, the sandbox can be used indistinctively on the master or a slave B-Box within a control network. The data transfers (read or write) from the CPU core is handled by the SBI or SBO blocks using either the write-through (configuration) or write-back (real-time) data traffic, as with any other peripheral block.

C/C++ drivers (as well as their blockset counterparts) are readily available within the software development kits (SDKs). On the programmable logic side, development templates are provided upon request. In the provided HDL source code, other peripheral blocks are obfuscated.

ENVIRONMENTAL CONDITIONS

The B-Box RCP is designed to be supplied with a 60W 90–240VAC power supply. Other environmental conditions are specified in Table 35.

Characteristic	Test conditions	Min.	Typ.	Max.	Unit
Input voltage		*90*		*240*	*V*
Power consumption		*5*		*60*	*W*
Inrush current				*0.7*	*A*
EMC performance	*IEC61000-3-2 class A*	*pass*			
Burst immunity	*IEC61000-4-4 Level 4*	*pass*			
Conducted immunity	*IEC61201-3 class A*	*pass*			
Operating temperature		*0*		*45*	*°C*
Storage temperature		*-10*		*65*	*°C*
Relative humidity	*Non-condensing*	*5*		*85*	*%*
Absolute humidity		*1*		*25*	*g/m³*

Table 35. **Environmental specifications for the B-Box RCP.**

MECHANICAL DATA

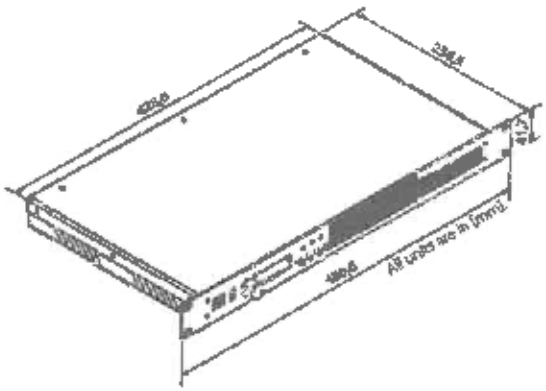
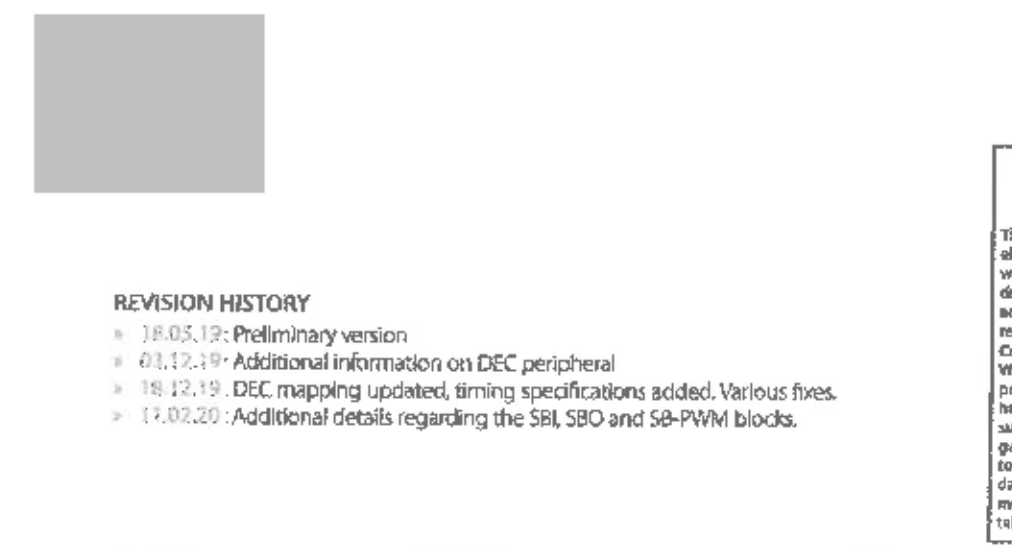


Fig. 28. **Mechanical dimensions of B-Box RCP.**

imperix



This product must be used in electric / electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating instructions.
Caution, risk of electrical shock! When using the devices, certain parts of the modules may carry hazardous voltages (e.g. power supplies, busbars, etc.). Disregarding this warning may lead to injury and / or cause serious damage. All conducting parts must be inaccessible after installation.

REVISION HISTORY

- 18.05.12 : Preliminary version
- 01.12.19 : Additional information on DEC peripheral
- 18.12.19 : DEC mapping updated, timing specifications added. Various fixes.
- 13.02.20 : Additional details regarding the SBI, SBO and SB-PWM blocks.

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ABOUT US

Imperix Ltd is a company established in Sion, Switzerland. Its name is derived form the Latin verb imperare, which stands for controlling and refers to the company's core business: the control of power electronic systems. Imperix commercialises hardware and software solutions related to the fast and secure implementation of pilot systems and plants in the field of power conversion, energy storage and smart grids.

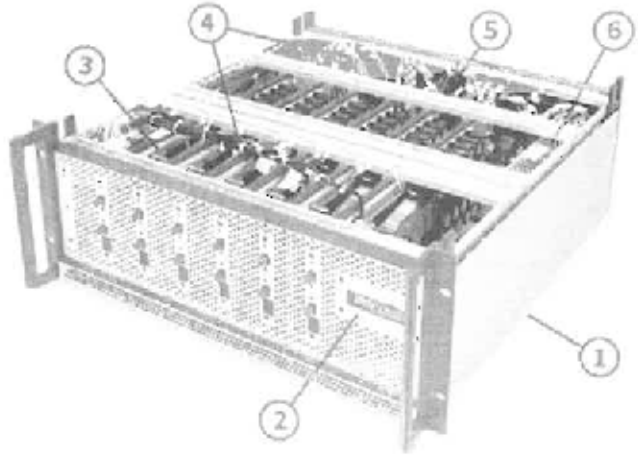
NOTE

While every effort has been made to ensure accuracy in this publication, no responsibility can be accepted for errors or omissions.
Data may change, as well as legislation, and the re is strongly advised to obtain copies of the most rece issued regulations, standards, and guidelines.
This publication is not intended to form the basis contract.

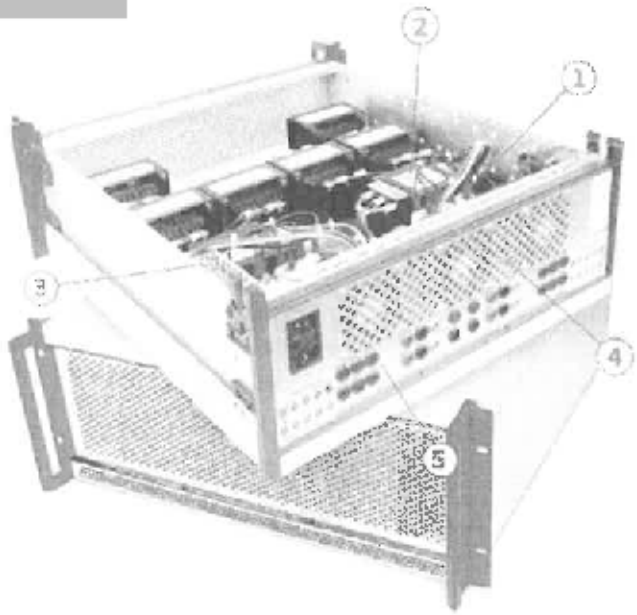
4U CLOSED RACK

Safe and sleek

Closed racks offer a sleeker and safer integration of power modules, where all hazardous voltages are out of reach. Nevertheless, they still give access to all control signals at the font and all power terminals at the rear for easy topology alteration. What's more, an LCD screen displays useful information, such as module temperatures or fan speeds, and a perforated enclosure with additional case fans ensure an optimal airflow.



1- 4U reinforced chassis
2- LCD display
3- 6x power modules
4- Internal wiring for rear safety connectors
5- Cooling fans
6- Auxiliary power supply

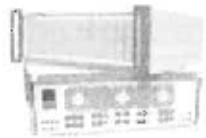


PASSIVE FILTERS

Ready-to-use filters for various applications

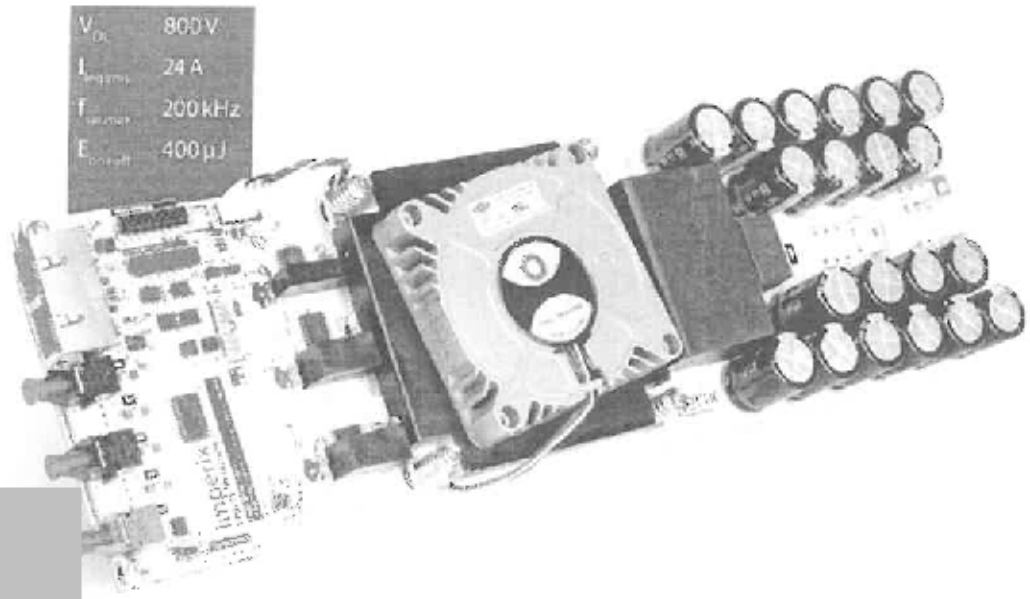
Imperix's filter box provides easy-to-use and configurable filter for two sets of three-phase connections. It contains:

1 – Three-phase LC-type filter (2x)
2 – Three-phase EMC filter (2x)
3 – Power supply
4 – 3 fan cooling
5 – 4mm laboratory banana plugs



imperix PEB SiC 8024 - half-bridge building block

Rev. B / December, 2019



DESCRIPTION

The PES module consists of a **half-bridge** topology with state-of-the-art **Silicon Carbide** (SiC) MOSFETs that enable fast switching frequency while guaranteeing low losses. It is designed for the implementation of low-voltage power converters with superior performance, and provides extensive safety mechanisms for convenient and easy prototyping.

Direct access to the gating signals is offered using optical fiber inputs, while embedded measurement circuits provide direct analog outputs related to the DC link voltages and the AC output current using galvanically-isolated sensors.

The mechanical design is tailored for 19" rack integration with simple interconnections and direct connection to a BoomBox, or any other control platform.

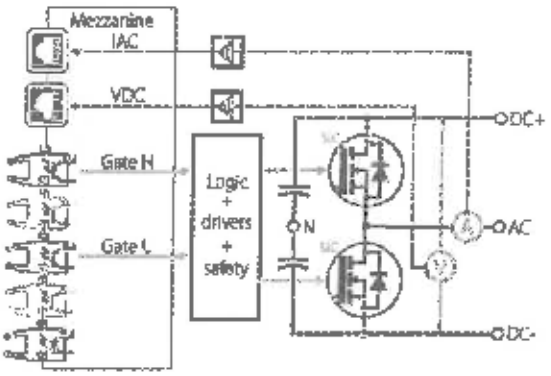
The embedded protections consist of over-voltage, over-current, over-temperature and desaturation detection for safer use in R&D applications. Besides, these protections are user-programmable through a simple onboard microcontroller and a CPLD.

Finally, the possibility to use alternative or customized mezzanine boards enables the compatibility with future developments and onboard data processing.

TYPICAL APPLICATIONS

The modules are ideally suited to build up ambitious prototypes of any type of low-voltage power converters, ranging from conventional three-phase inverters to more complexe multilevel topologies. Typical power ratings [illegible] 4-8 kW, depending on the nominal DC link [illegible] the switching frequency.

ELECTRIC SCHEME



KEY FEATURES AND SPECIFICATIONS

- Half-bridge topology
- 800 V nominal DC link voltage
- 1200 V / 36 A SiC MOSFETs
- 24 A continuous RMS current
- 80 A max pulsed current (t_p limited by T_{Jmax})
- 120 W TDP enveloppe
- 260 µF / 800 V DC bus
- Up to 200 kHz switching frequency
- +5 V and +12 V power supplies
- Embedded voltage and current measurements
- Over voltage/current/temperature and desat protection
- User-configurable CPLD
- 100 x 332 mm Eurocard form factor

MAIN COMPONENTS

Component	Devices	Main specifications
Power switches	2x Cree C2M0080120D or Rohm SCT2080	SiC MOSFET. See below or device datasheet
Capacitors	1x 360 uF @ 600 V (2 banks of 10x68uF each)	
Drivers	2x Texas Instrument ISO5452-Q1	2.5 A, 100 kV/µs, V_{IOTM} = 1.42 kV$_{PEAK}$, V_{IORM} = 0.8 V_{RMS}
Isolated DC/DC Converters	2x Murata MGJ2D122005SC	12 V to 20-5 V, 2 W, V_{ISO} = 5.2 kVDC
	1x Recom RK-0505S	5 V to 5 V, 1 W, V_{ISO} = 3 kVDC
Current sensor	1x LEM CKSR 50-P	±50 A, 300 kHz, ±0.7% accuracy
Voltage sensor	1x Resistive divider + Avago ACPL-C87B	100 kHz, ±0.1% accuracy
Heatsinks	1x Dynatron G199	0.33 °C/W @ full speed
CPLD	1x Xilinx XC9536XL-10VQG44C	10 ns, 36 macrocells
Microcontrollers	2x Microchip PIC24FJ64GA101	16 bits, 16 Mhz, 9x 10-bit ADC @ 500ksps

MODULE RATINGS

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Maximum half DC bus voltage[1]	$V_{DC,max}$		-	900	-	V
Maximum continuous leg current[2]	$I_{leg,max}$	T_c = 25°C	-	30	-	A
		T_c = 100°C	-	24	-	A
Maximum pulsed leg current	$I_{leg,pulse}$	Pulse width limited by $T_{j,max}$	-	60	-	A
Maximum DC bus ripple current[3]	$I_{RMS,C}$	f = 120 Hz	-	4.7	-	Arms
		f = 100 kHz	-	13.2	-	Arms
Maximum repetitive isolation voltage	V_{ISOM}		-	1.6	-	kV_{PEAK}
Maximum transient isolation voltage (1 s)	V_{ISOM}		-	2.0	-	kV_{PEAK}
Supply voltage	5VD		4.2	5.0	5.8	V
	12V		10.8	12.0	13.2	V
Highest allowable junction temperature	$T_{j,max}$		-	150	-	°C

[1] The maximum DC bus voltage is defined by the specifications of the bus capacitors. Therefore, as for any aluminium electrolytic capacitors, few short-term overvoltages can be tolerated, provided that they involve limited amounts of energy.

[2] In cold conditions, the maximum operating current is limited by the power semiconductors. Otherwise, the current rating of the module is limited by the power envelope of the heatsink (about 120 W with airflow).

[3] The maximum ripple current is defined by the equivalent series resistance (ESR) of the capacitors and relates to Joule losses and lifetime considerations. Therefore, this value can be exceeded, provided that the operating temperature of the capacitors remains low.

SEMICONDUCTOR CHARACTERISTICS

Cree C2M0080120D

Parameter	Symbol		Min.	Typ.	Max.	Unit
MOSFET drain-source on-state resistance	$R_{DS(on)}$	I_{DS} = 20 A, T_j = 25°C	-	80	98	mΩ
		I_{DS} = 20 A, T_j = 150°C	-	129	-	mΩ
Diode forward voltage	V_F	I_{SD} = 10 A, T_j = 25°C	-	3.3	-	V
Peak reverse recovery current	I_{rrm}	I_{SD} = 20 A, V_R = 800 V, V_{GS} = -5 V	-	10	-	A
Reverse recovery delay	t_{rr}		-	32	-	ns
Thermal resistance junction-to-case	R_{thJC}		-	0.6	0.65	°C/W
Turn-on losses (inductive load)	E_{on}	I_D = 20 A, V_{DS} = 600 V, $R_{G(ext)}$ = 2.5 Ω	-	265	-	µJ
Turn-off losses (inductive load)	E_{off}	V_{GS} = -5/20 V, L = 142 µH	-	155	-	µJ
External gate resistance	R_g		-	2.51	-	Ω

Rohm SCT2080KE

Parameter	Symbol		Min.	Typ.	Max.	Unit
MOSFET drain-source on-state resistance	$R_{DS(on)}$	I_{DS} = 10A, T_C = 25°C	-	80	117	mΩ
		I_{DS} = 10A, T_C = 125°C	-	125	-	mΩ
Diode forward voltage	V_F	I_{SD} = 10A, T_C = 25°C	-	4.6	-	V
Peak reverse recovery current	I_{RRM}	I_{SD} = 10A, V_R = 400 V	-	23	-	A
Reverse recovery delay	t_{RR}		-	31	-	ns
Thermal resistance junction-to-case	R_{thJC}		-	0.44	0.57	°C/W
Turn-on losses (inductive load)	E_{on}	I_D = 10A, V_{DD} = 400 V, $R_{G(ext)}$ = 0 Ω	-	176	-	µJ
Turn-off losses (inductive load)	E_{off}	V_{GS} = 18/0 V, L = 500 µH	-	57	-	µJ

EMBEDDED SENSORS CHARACTERISTICS

Current measurement

Parameter	Symbol	Note	Min.	Typ.	Max.	Unit
Nominal measured current	I_M		-	±50	-	Arms
Measuring range [1]	I_m		-	±150	-	A
Nominal sensitivity	G	including a x2 gain on the Mezzanine	-	50.0	-	mV/A
Sensitivity error [1]	X		-	-	1.1	%
Bandwidth	f_{-3dB}		-	300	-	kHz
	f_{-1dB}		-	200	-	kHz
Measurable slope	dI/dt		-	50	-	A/µs

Voltage measurement

Parameter	Symbol	Note	Min.	Typ.	Max.	Unit
Measuring range	V_{DIFF}		0.0	-	800	V
Maximum measuring range [1]	V_M		0.0	-	960	V
Nominal sensitivity	G	including a x2 gain on the Mezzanine	-	4.99	-	mV/V
Uncalibrated sensitivity error	G_{ERR}	25°to 125 °C, including resistive divider		±2.0		%
Gain error over temperature	G_{DER}	T_A = 25° to 100 °C		±0.1		%
Bandwidth	f_{-3dB}		-	30	-	kHz
Measurable slope	dV/dt		-	170	-	kV/µs
Maximum working isolation voltage	V_{ISOM}		-	1140	-	V_{DC}

[1] The integrated current and voltage measurements are isolated onboard. The measured values are available as differential signals on the mezzanine connectors, with voltages ranging in the interval between 0 and 3.3V. In case imperix's optical mezzanine is used, the latter features an integrated x2 gain.

[2] When calibrated under stabilized operating temperature conditions, superior performance can be achieved.

Recommended B-Box configuration

For optimal measurements, the use of the following parameters is recommended for configuring the analog front-end (FE) of the B-Box RCP. They allow an optimal utilization of the ADC converter's full scale and ensure that the module capabilities are not exceeded. The values of hardware limits my be reduced, according to the desired operating conditions.

Measurement	Sensitivity	Example operating range	Front-end Gain	Front-end Low-Z	Front-end thresholds
Voltage	4.99 mV/V	[0 V; +820 V]	2.0	No	[-6.2 V; +8.2 V]
Current	50.0 mA/V	[-30A; +30A]	4.0	No	[-6.0 V; +6.0 V]

Table 1. Recommended BoomBox frontpanel configuration

COMPATIBLE MEZZANINES

The modules are compatible with various types of mezzanines, including:

- The **optical** mezzanine (Fig. 1) is meant to provide basic input/output support, featuring optical inputs and analog outputs. Additionally, the error signal is also relayed to the master controller.
- Any custom-made mezzanine that fits the mechanical design and possesses the suitable connectors.

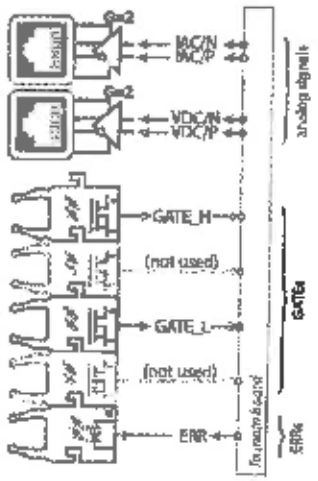


Fig. 1. Functional view of the optical mezzanine.

EMBEDDED LOGIC AND PROTECTION

Main components

The modules embed a digital supervisory system that guarantees their integrity by a continuous monitoring of the measurements given by the voltage and current sensors, as well as the temperature probes and power supply voltage. The main components of this circuit are depicted in Fig. 4 and include the following:

- MCU1 is continuously sampling the voltage and current at approx. 150 ksps. Upon the detection of an overvalue, the MCU triggers the corresponding flag.
- MCU2 is continuously sampling slow variables such as temperature, power supply voltage or other measurements. Upon the detection of an overvalue, the MCU triggers the corresponding error flag.
- The user-programmable CPLD is at the heart of the supervisory system and has three main tasks:
  - Generating the final gating signals based on those received through the optical fibers, possibly involving some decoding of the switching states.
  - Enforcing a specific switching state in case of a fault. This may be a blocked state or a short circuit depending the desired behavior and the cause of the fault.
  - Generating a set of flags based on the faults provided by the microcontrollers.

Default configuration

The modules are provided with a default configuration in which the first and third optical inputs of the optical mezzanine are directly corresponding to the high (H) and low (L) gating signals, respectively. Besides, the safety thresholds are defined as follows:

Event	Flag	Fault-triggering when
Over-current	OC	$\lvert i_d \rvert > 40A$
Over-voltage	OV	$V_{DC} > 900V$
Desaturation	DSAT	$V_{DS} > 6.2V$ on either switch while in on-state (corresp. to $i_D > 60A$) OR « (1,1) state is detected
Bad 5 V power supply	PSU	$V_{5V} < 4.5V$ or $V_{5V} > 5.5V$
Bad 12 V power supply		$V_{12V} < 11V$ or $V_{12V} > 13V$
Over-temperature	TEMP	$T > 90°C$
Fan error	FAN	Fan speed < 600 rpm (for fan connected)

The global error signal transmitted by the mezzanine is turned off upon a fault detection (active low). When a faults is tripped, it is automatically cleared after a power-cycle of the module. If the fault is still present, the module will stay in fault state.

A functional diagram of the CPLD logic is depicted in Fig. 2.

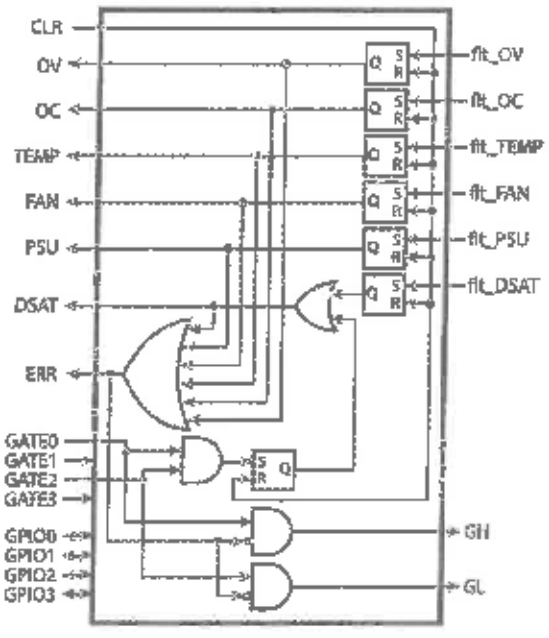


Fig. 2. CPLD functionnal diagram – default configuration

Fault signal sharing

In multi-module setups, it may be useful to share the fault signal among the modules of a converter, in order to safely shut down the converter in case of a fault. This can be done using the 14-pins connector of the mezzanine and daisy-chaining the connection, as shown in Fig. 3.

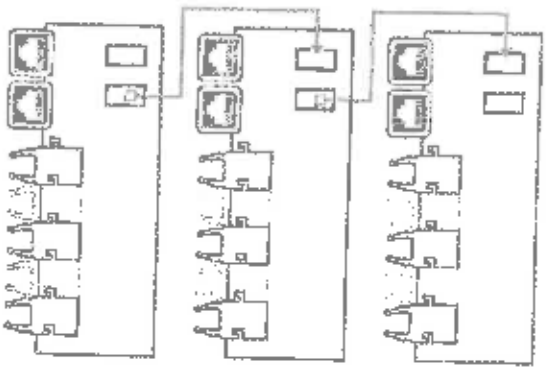


Fig. 3. Fault signal sharing among multiple modules

Custom configuration

Upon demand, imperix provides the CPLD source code so as to allow the user to implement and reprogram the board with custom firmware, in order enable extra features such as :

- A different coding of the gating signals,
- A cell bypass function (i.e. custom gating signal configuration in case of faults),
- Another I/O or safety configuration.

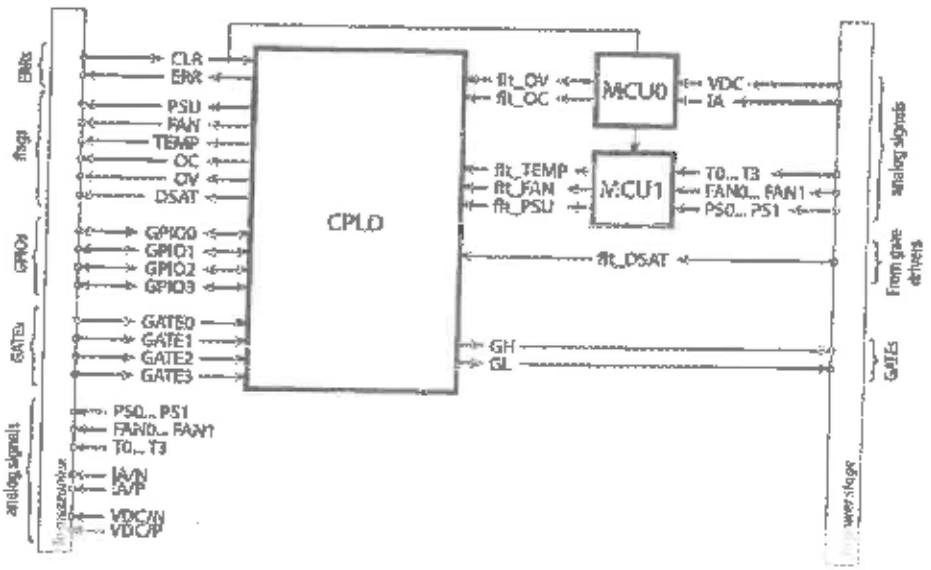


Fig. 4. Onboard protection and logic circuits.

CABLES AND CONNECTORS

Power connectors

All power connectors (X1 to X4 in Fig. 5) have M4 threaded holes. It is recommended to use cable shoes and a wire section of at least 4 mm².

Analog cables

Analog current and voltage measurements are accessible with any standard RJ45 cable. They are available on imperix's website.

Power supply connector

The power supply connector uses a 3 position MTA 100 terminal. A wire section of 0.25 mm² is recommended.

Mezzanine to mezzanine cable

The fault signal can be shared among several mezzanines using a 14-pin flat cable. The recommended reference is TE Connectivity 2205108-2.

Optical fibers

The gating signals are to be wired with plastic optical fibers (POF) with simplex friction plug. They are available on imperix's website.

MECHANICAL DATA

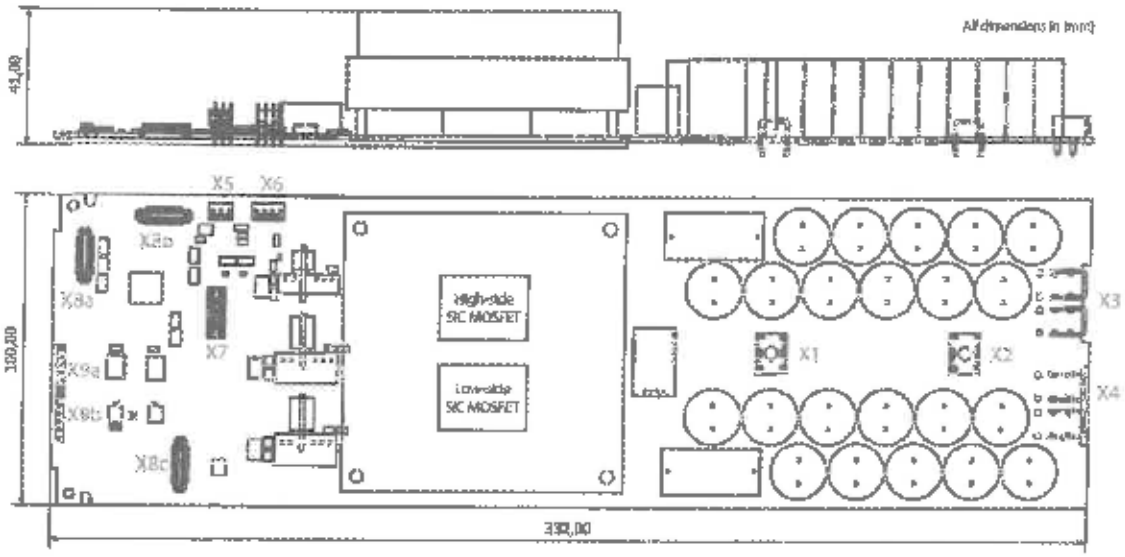


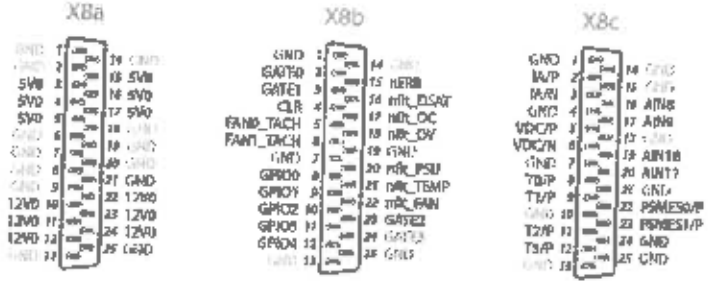
Fig. 5. Mechanical data of PES modules

Label	Role	Label	Role	Label	Role
X1	AC power terminal	X5	Auxiliary 5V-32V power supply connector	X8b	Mezzanine digital signals connector
X2	Neutral point terminal	X6	Fan connector	X8c	Mezzanine analog signals connector
X3	DC+ power terminal	X7	CPLD programming JTAG	X9a	MCU2 ISCP header
X4	DC- power terminal	X8a	Mezzanine power supplies connector	X9b	MCU1 ISCP header

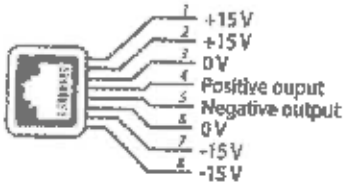
imperix

Mezzanine connectors pinout

Three connectors provide the necessary connectivity between the main board of the module and the mezzanine. Their pinout is given below. Imperix can provide details on the mechanical design or 3D file upon request.

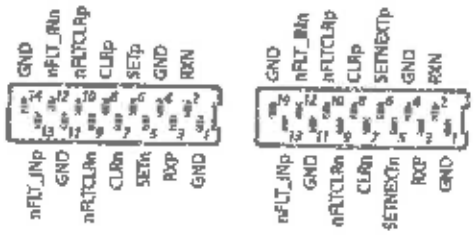


Analog output connectors pinout



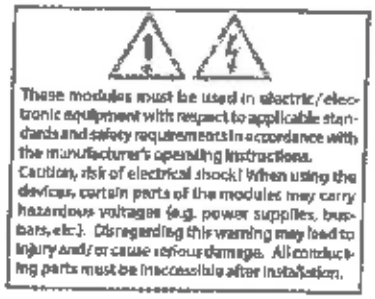
Power supply connector pinout (X5)

Mezzanine to mezzanine connector pinout



P4 - CONTROLLER

P5 - NEXT MODULE



CONTACT

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1950 Sion, Switzerland
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fax: +41 (0)27 552 06 69

www.imperix.ch, sales@imperix.ch

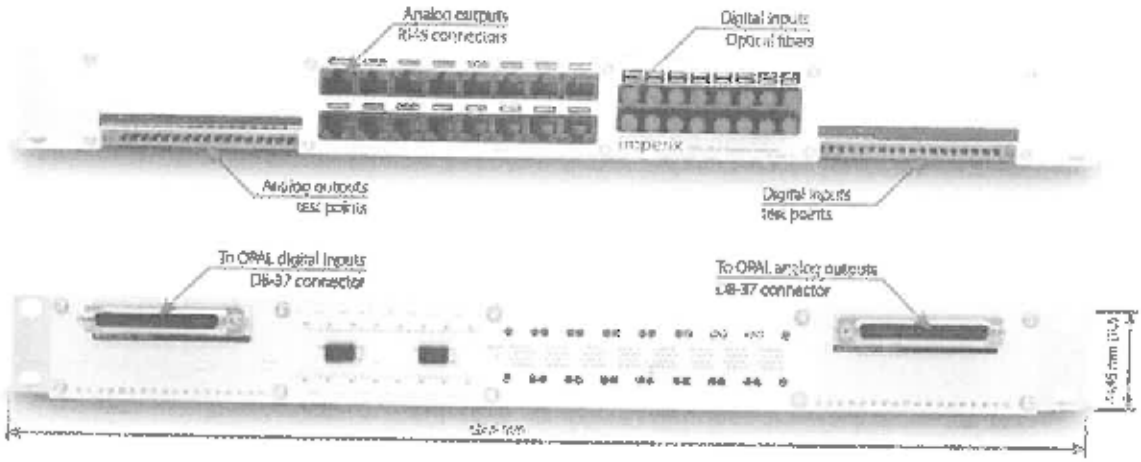
ABOUT US

Imperix Ltd. is a company established in Sion, Switzerland. Its name is derived from the Latin verb *imperare*, which stands for controlling and refers to the company's core business: the control of power electronic systems. Imperix Ltd. is commercializing hardware and software solutions related to the fast and secure implementation of pilot systems and plants in the field of power conversion, energy storage and smart grids.

NOTE

While every effort has been made to ensure accuracy in this publication, no responsibility can be accepted for errors or omissions.
Data may change, as well as legislation, and the reader is strongly advised to obtain copies of t most recently issued regulations, standards, a guidelines.
This publication is not intended to form the basis o contract.

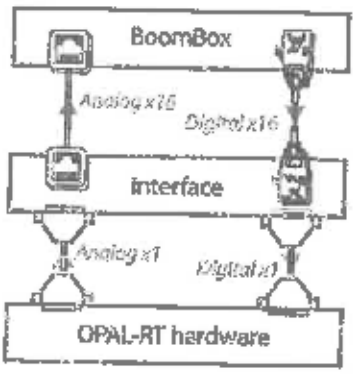
imperix **Simulator interface – For Opal-RT hardware**

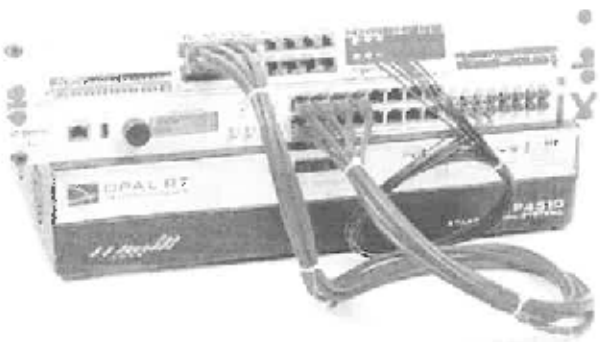


GENERAL DESCRIPTION

This interface interconnects the **BoomBox** controller to an **Opal-RT** HIL simulator.

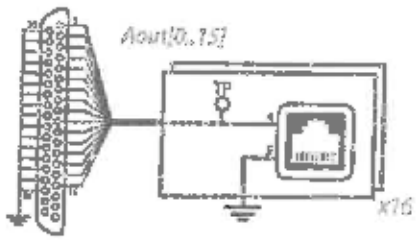
This way, any control implementation can be first tested – without any risk – on a simulated converter; before it is later tested on real hardware. In this second step, all cables can be instantly swapped from the interface to the real converter.





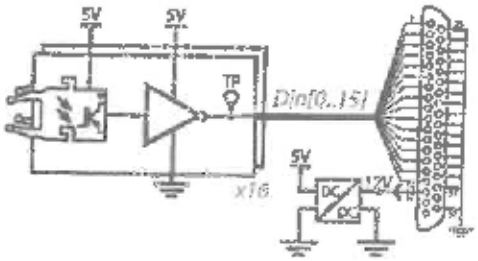
ANALOG OUTPUTS

- 16 channels, RJ45 connectors
- To be wired to analog inputs of the BoomBox
- -10 to 10V voltage range



DIGITAL INPUTS

- 16 independent channels
- Optical fiber wiring to digital outputs of the BoomBox
- Max. prop. delay difference between 2 channels: 80 ns
- 12V supplied directly by the Opal-RT HIL Simulator



CONTACT

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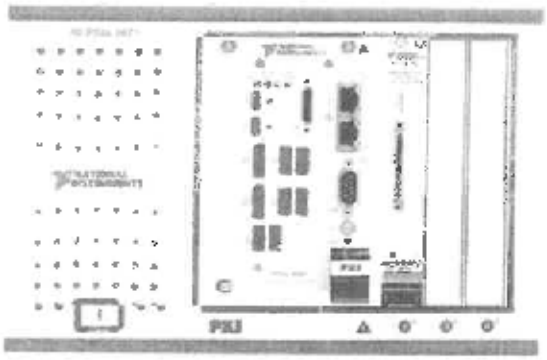
Rue de la Dixence 16, 1950 Sion, Switzerland
sales@imperix.ch

ABOUT US

Imperix develops high-end control equipment and prototyping hardware for power electronics, drives, sm grids and related topics. Its products are designed to accelerate the implementation of laboratory-scale pro converters and facilitate the derivation of high quality experimental results.

Система за събиране на данни

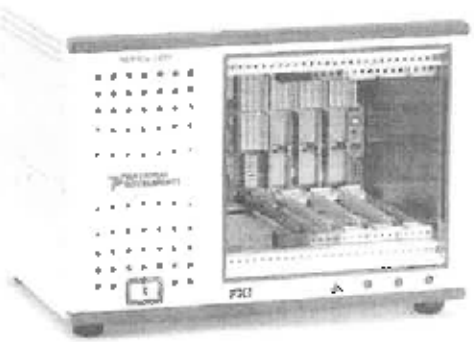
Технически данни



Забележка: Снимките имат само илюстрационен характер. Включените компоненти са описани в Техническото предложение

PXIe-1071

PXI шаси



Описание:

PXIe, 4-слот (3 хибридни слота), до 3 GB / s PXI шаси - PXIe-1071 е проектиран за широк спектър от приложения за изпитване и измервне и осигурява основна лента с висока честотна лента. Неговият компактен и лек форм фактор е идеален за минимизиране на пространството при вашата инсталация, което го прави идеален за десктоп или преносими случаи. PXIe-1071 приема PXI Express модули или стандартни PXI хибридни съвместими модули във всеки периферен слот.

PXIe-8861 Контролер

Характеристики

Процесор	Intel® Xeon® Processor E3-1515M v5
Кеш	8 MB SmartCache
Дву-канални DDR4-2133 (PC-17000)	8 GB standard, 32 GB maximum
Диск	512 GB (or greater) solid-state, NVMe
Видео	1 DisplayPort 1.1, 1 DisplayPort 1.2
Ethernet	1 i219 port 1 i210 port, 1588, 10/100/1000 Base T
PXI Express 4 Link конфигурация	x4, x4, x4, x4
PXI Express 2 Link конфигурация	x8, x8
GPIB (IEEE 488 контролер)	1 mini-GPIB
Сериен порт (RS-232)	1 DB-9
Thunderbolt 3 порт	2 Type-C
Високоскоростен USB (2.0) порт	4 Type-A
USB (3.0) Ports	2 Type-A
PXI тригер шина вход/изход	1 SMB
Инсталирана операционна система	Windows 10 Professional for Embedded Systems

PXI МУЛТИФУНКЦИОНАЛЕН I/O МОДУЛ

PXIe-6356

PXIe, 8 AI (16-Bit, 1.25 MS/s), 2 AO, 24 DIO, PXI Multifunction I/O Module

- Осем диференциални аналогови входни канали; ±10 V до ±1 V входен обхват
- Два 16-bit, 3.33 MSamples/s аналогови изходни; ±10 V изходен обхват
- 24 5 V TTL DIO линии; 8 хардуерно тактувани до 10 MHz
- Четири 32-bit, 100 MHz брояча
- Един 68-pin женски VHDCI конектор

Кабели и Аксесоари

Вижте Модели : DAQ мултифункционален I/O кабел и съвместими аксесоари

СПЕЦИФИКАЦИИ

RM-26999

4 Канален силов преобразувателен терминален блок

Характеристики на напреженовия вход

Максимално входно напрежение	1,000 V, категория II 2,000 V пиково напрежение
Брой кабали	4

Таблица 1. Точност на сигнала

Обхват	Честота на сигнала	Точност	
		Типично-95	Гарантирано
2,000 V	DC	±0.05% of reading	
	1 Hz to 500 Hz	±0.08% от показаното	±0.1% of reading
	>500 Hz to 1 kHz	±0.1% от показаното	±0.2% of reading
	>1 kHz to 5 kHz	±0.25% от показаното	±0.9% of reading
	>5 kHz to 10 kHz	±0.3% от показаното	±1.15% of reading
	>10 kHz to 200 kHz	±0.4% от показаното	±1.35% of reading
	>200 kHz to 1 MHz	±(0.004 × *сигнал честота*)% от показание	±(0.014 × *сигнал честота*)% от показание

Таблица 2. Системен шум

Обхват	Шум (Vrms)
±2,000 V	53 mV
±1,000 V	31 mV
±400 V	22 mV
±200 V	21 mV

Характеристики на токовия вход

Забележка. Характеристиките се определят от свързания DAQ модул.

Брой канали	4
Входни обхвати на DAQ модула	±1 V, ±2 V, ±5 V, ±10 V
Резистори	0.5Ω, 1Ω, 2Ω, 5Ω, 10Ω
Токов вход (макс)	Избираем от DAQ модула
Защита на входа	Определен от DAQ модула
Shunt точност	±0.05%, 2 W, макс
Shunt gain drift	±0.2 ppm/°C

Захранване

Входно напрежение	24VDC±5%
Максимална консумация	150 W, макс
Препоръчителен захранващ адаптер	NI PS-15 (5 A, 120 W) NI PS-16 (10 A, 240 W)

Физически характеристики

Размери	482.6 mm (19.00 in.) × 43.9 mm (1.73 in.) × 156.2 mm (6.15 in.)
Тегло	3,020 g (106.50 oz)

PXIe-1071
PXI Chassis

VIEW PRODUCT DETAILS - https://www.ni.com/en-us/shop/select/pxi-chassis?modelId=123532 Configure A Custom NI System

PXIe, 4-Slot (3 Hybrid Slots), Up to 8 GB/s PXI Chassis—The PXIe-1071 is designed for a wide range of test and measurement applications and provides a high-bandwidth backplane. Its compact and lightweight form factor is ideal for minimizing the footprint of your installation, making it ideal for desktop or portable use cases. The PXIe-1071 accepts PXI Express modules or standard PXI hybrid-compatible modules in every peripheral slot.

upport/model.pxie-1071.html

SPECIFICATIONS

PXIe-8861

Note Specifications are subject to change without notice.

Caution Using the PXIe-8861 controller in a manner not described in this user manual can impair the protection the controller provides.

Features

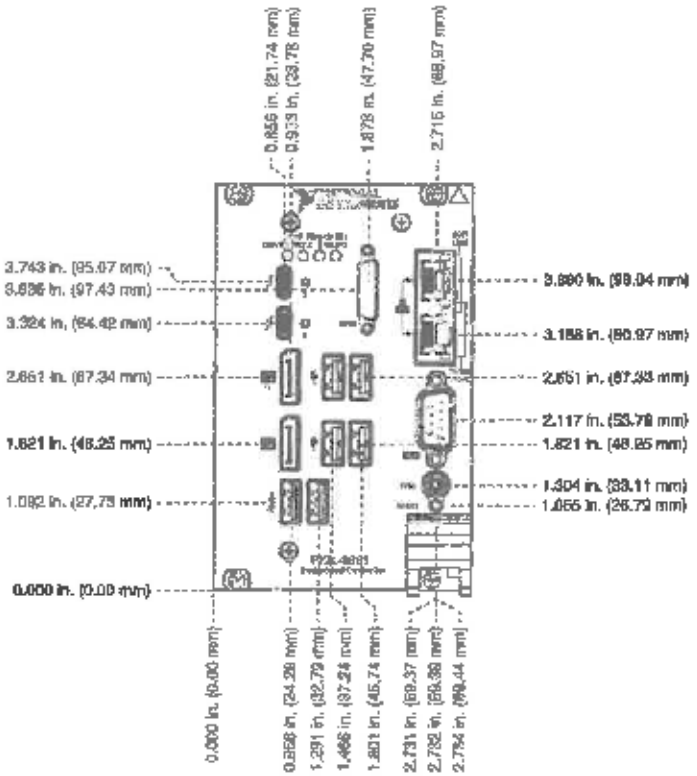
	PXIe-8861
CPU	Intel® Xeon® Processor E3-1515M v5
Cache	8 MB SmartCache
Dual-Channel DDR4-2133 (PC-17000)	8 GB standard, 32 GB maximum
Storage	512 GB (or greater) solid state, NVME
Video	1 DisplayPort 1.1, 1 DisplayPort 1.2
Ethernet	1 I219 port 1 I210 port, 1588, 10/100/1000 Base T
PXI Express 4 Link Configuration	x4, x4, x4, x4
PXI Express 2 Link Configuration	x8, x8
GPIB (IEEE 488 Controller)	1 mini-GPIB
Serial Port (RS-232)	1 DB-9
Thunderbolt 3 Ports	2 Type-C
Hi-Speed USB (2.0) Ports	4 Type-A
SuperSpeed USB (3.0) Ports	2 Type-A
PXI Trigger Bus Input/Output	1 SMB
Installed Operating System	Windows 10 Professional for Embedded Systems

NATIONAL INSTRUMENTS

Front Panel Dimensions

The following figure shows the front panel layout and dimensions of the PXIe-8861. Dimensions are in inches (millimeters).

Figure 1. PXIe-8861 Front Panel Layout and Dimensions



Electrical

Note Does not include any attached devices.

Voltage (V)	Current (Amps) Typical	Current (Amps) Maximum
+3.3 V	3.75 A	4.25 A
+5 V	2.0 A	2.5 A
+12 V	6.0 A	7.6 A
-12 V	0 A	0 A
$+5\ V_{Aux}$	0.75 A	0.8 A

Note Power delivered to external loads through USB or Thunderbolt 3 ports should be included in system power budgets that include this controller module and peripheral modules.

Physical

Board dimensions	Four-wide 3U PXI Express module
Slot requirements	One system slot plus three controller expansion slots
Compatibility	Fully compatible with *PXI Express Specification* 1.0
Weight	1.2 kg (2.6 lb) typical

Environmental

Maximum altitude	4,600 m (570 mbar) (at 25 °C ambient)
Pollution Degree	2

Indoor use only.

Operating Environment

Caution The operating temperature must not be exceeded, even when used in a chassis with a higher temperature range.

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range[1]	-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms} (with solid-state hard drive)
Nonoperating[1]	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

[1] CPU performance may decrease for some workloads if a unit is stored at the extreme ambient temperature range and then subjected to max nonoperating random vibration limits.

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)
- 2014/53/EU; Radio Equipment Directive (RED)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

Battery Replacement and Disposal

Battery Directive This device contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized National Instruments service representative. For more information about compliance with the EU Battery Directive 2006/66/EC about Batteries and Accumulators and Waste Batteries and Accumulators, visit *ni.com/environment/batterydirective*.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

377817B-01 January 14, 2019

DEVICE SPECIFICATIONS

NI 6356

X Series Data Acquisition: 1.25 MS/s/ch, 8 AI, 24 DIO, 2 AO

The following specifications are typical at 25 °C, unless otherwise noted. For more information about the NI 6356, refer to the *X Series User Manual* available from ni.com/manuals.

Analog Input

Number of channels	8 differential
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the *AI Absolute Accuracy* section.
Sample rate	
Single channel maximum	1.25 MS/s
Minimum	No minimum
Timing resolution	10 ns
Timing accuracy	50 ppm of sample rate
Input coupling	DC
Input range	±1 V, ±2 V, ±5 V, ±10 V
Maximum working voltage for all analog inputs	
Positive input (AI+)	±11 V for all ranges, Measurement Category I
Negative input (AI-)	±11 V for all ranges, Measurement Category I

Caution Do not use for measurements within Categories II, III, and IV.

CMRR (at 60 Hz)	75 dB
Bandwidth	1 MHz
THD	-80 dBFS

NATIONAL INSTRUMENTS

Input impedance	
Device on	
AI+ to AI GND	>100 GΩ in parallel with 100 pF
AI- to AI GND	>100 GΩ in parallel with 100 pF
Device off	
AI+ to AI GND	2 kΩ
AI- to AI GND	2 kΩ
Input bias current	±10 pA
Crosstalk (at 100 kHz)	
Adjacent channels	-80 dB
Non-adjacent channels	-100 dB
Input FIFO size	
PXIe	8,182 samples shared among channels used
USB (32 MS)	32 MS shared among channels used
USB (64 MS)	64 MS shared among channels used
Data transfers	
PXIe	DMA (scatter-gather), programmed I/O
USB	USB Signal Stream, programmed I/O
Overvoltage protection for all analog input channels	
Device on	±36 V
Device off	±15 V
Input current during overvoltage conditions	±20 mA max/AI pin

Analog Triggers

Number of triggers	1
Source	AI <0..7>, APFI 0
Functions	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Source level	
AI <0..7>	±Full scale
APFI 0	±10 V
Resolution	16 bits

Modes	Analog edge triggering, analog edge triggering with hysteresis, and analog window triggering
Bandwidth (-3 dB)	
AI <0..7>	3.4 MHz
APFI 0	3.9 MHz
Accuracy	±1% of range
APFI 0 characteristics	
Input impedance	10 kΩ
Coupling	DC
Protection, power on	±30 V
Protection, power off	±15 V

AI Absolute Accuracy

Table 1. AI Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (μVrms)	Absolute Accuracy at Full Scale (μV)
10	-10	114	35	252	2,686
5	-5	120	36	134	1,379
2	-2	120	42	71	564
1	-1	138	50	61	313

Note For more information about absolute accuracy at full scale, refer to the *AI Absolute Accuracy Example* section.

Gain tempco	8 ppm/°C
Reference tempco	5 ppm/°C
Residual offset error	15 ppm of range
INL error	46 ppm of range

Note Accuracies listed are valid for up to two years from the device external calibration.

AI Absolute Accuracy Equation

$AbsoluteAccuracy = Reading \cdot (GainError) + Range \cdot (OffsetError) + NoiseUncertainty$

$GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$

$OffsetError = ResidualOffsetError + OffsetTempco \cdot (TempChangeFromLastInternalCal) + INLError$

$NoiseUncertainty = \frac{\text{Random Noise} \cdot 3}{\sqrt{10,000}}$ for a coverage factor of 3 σ and averaging 10,000 points.

AI Absolute Accuracy Example

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

- $TempChangeFromLastExternalCal = 10\ °C$
- $TempChangeFromLastInternalCal = 1\ °C$
- $number\_of\_readings = 10,000$
- $CoverageFactor = 3\ \sigma$

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

$GainError = 114\ ppm + 8\ ppm \cdot 1 + 5\ ppm \cdot 10 = 172\ ppm$

$OffsetError = 15\ ppm + 35\ ppm \cdot 1 + 46\ ppm = 96\ ppm$

$NoiseUncertainty = \frac{252\ \mu V \cdot 3}{\sqrt{10,000}} = 7.6\ \mu V$

$AbsoluteAccuracy = 10\ V \cdot (GainError) + 10\ V \cdot (OffsetError) + NoiseUncertainty = 2688\ \mu V$

Analog Output

Number of channels	2
DAC resolution	16 bits
DNL	±1 LSB, max
Monotonicity	16 bit guaranteed
Accuracy	Refer to the *AO Absolute Accuracy* section.
Maximum update rate (simultaneous)	
1 channel	3.3 MS/s
2 channels	3.3 MS/s
Minimum update rate	No minimum
Timing accuracy	50 ppm of sample rate

Timing resolution	10 ns
Output range	±10 V, ±5 V, ±external reference on APFI 0
Output coupling	DC
Output impedance	0.4 Ω
Output current drive	±5 mA
Overdrive protection	±25 V
Overdrive current	10 mA
Power-on state	±5 mV
Power on/off glitch	
PXIe	1.5 V peak for 200 ms
USB	1.5 V peak for 200 ms, typical behavior[1]
Output FIFO size	8,191 samples shared among channels used
Data transfers	
PXIe	DMA (scatter-gather), programmed I/O
USB	USB Signal Stream, programmed I/O
AO waveform modes	Non-periodic waveform, periodic waveform regeneration mode from onboard FIFO, periodic waveform regeneration from host buffer including dynamic update
Settling time, full-scale step, 15 ppm (1 LSB)	2 µs
Slew rate	20 V/µs
Glitch energy at midscale transition, ±10 V range	6 nV · s

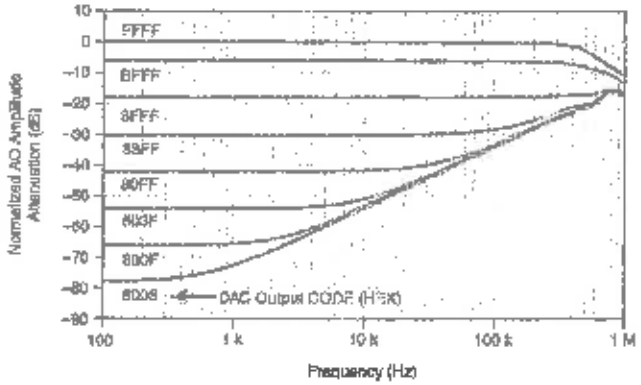
External Reference

APFI 0 characteristics	
Input impedance	10 kΩ
Coupling	DC
Protection, device on	±30 V
Protection, device off	± 15 V

[1] Time period may be longer due to host system USB performance. Time period will be longer during firmware updates.

Range	±11 V
Slew rate	±20 V/µs

Figure 1. Analog Output External Reference Bandwidth



AO Absolute Accuracy

Absolute accuracy at full-scale numbers is valid immediately following self calibration and assumes the device is operating within 10 °C of the last external calibration.

Table 2. AO Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco (ppm/°C)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/ °C)	INL Error (ppm of Range)	Absolute Accuracy at Full Scale (µV)
10	-10	129	17	5	65	1	64	3,256
5	-5	135	8	5	65	1	64	1,616

Note Accuracies listed are valid for up to two years from the device external calibration.

Digital I/O/PFI

Static Characteristics

Number of channels	24 total, 8 (P0.<0..7>), 16 (PFI <0..7>/P1, PFI <8..15>/P2)
Ground reference	D GND
Direction control	Each terminal individually programmable as input or output
Pull-down resistor	50 kΩ typical, 20 kΩ minimum
Input voltage protection	±20 V on up to two pins

Caution Stresses beyond those listed under the *Input voltage protection* specification may cause permanent damage to the device.

Waveform Characteristics (Port 0 Only)

Terminals used	Port 0 (P0.<0..7>)
Port/sample size	Up to 8 bits
Waveform generation (DO) FIFO	2,047 samples
Waveform acquisition (DI) FIFO	255 samples
DI Sample Clock frequency	
PXIe	0 to 10 MHz, system and bus activity dependent
USB	0 to 1 MHz, system and bus activity dependent
DO Sample Clock frequency	
PXIe	
Regenerate from FIFO	0 to 10 MHz
Streaming from memory	0 to 10 MHz, system and bus activity dependent
USB	
Regenerate from FIFO	0 to 10 MHz
Streaming from memory	0 to 1 MHz, system and bus activity dependent
Data transfers	
PXIe	DMA (scatter-gather), programmed I/O
USB	USB Signal Stream, programmed I/O
Digital line filter settings	160 ns, 10.24 µs, 5.12 ms, disable

PFI/Port 1/Port 2 Functionality

Functionality	Static digital input, static digital output, timing input, timing output
Timing output sources	Many AI, AO, counter, DI, DO timing signals
Debounce filter settings	90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Recommended Operating Conditions

Input high voltage (V_{IH})	
Minimum	2.2 V
Maximum	5.25 V
Input low voltage (V_{IL})	
Minimum	0 V
Maximum	0.8 V
Output high current (I_{OH})	
P0.<0..7>	-24 mA maximum
PFI <0..15>/P1/P2	-16 mA maximum
Output low current (I_{OL})	
P0.<0..7>	24 mA maximum
PFI <0..15>/P1/P2	16 mA maximum

Digital I/O Characteristics

Positive-going threshold (VT+)	2.2 V maximum
Negative-going threshold (VT-)	0.8 V minimum
Delta VT hysteresis (VT+ - VT-)	0.2 V minimum
I_{IL} input low current (V_{IN} = 0 V)	-10 µA maximum
I_{IH} input high current (V_{IN} = 5 V)	250 µA maximum

Figure 2. P0.<0..7>: I_{OH} versus V_{OH}

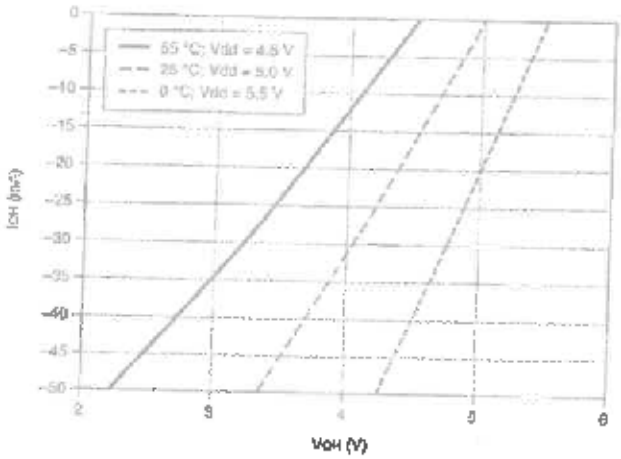


Figure 3. P0.<0..7>: I_{OL} versus V_{OL}

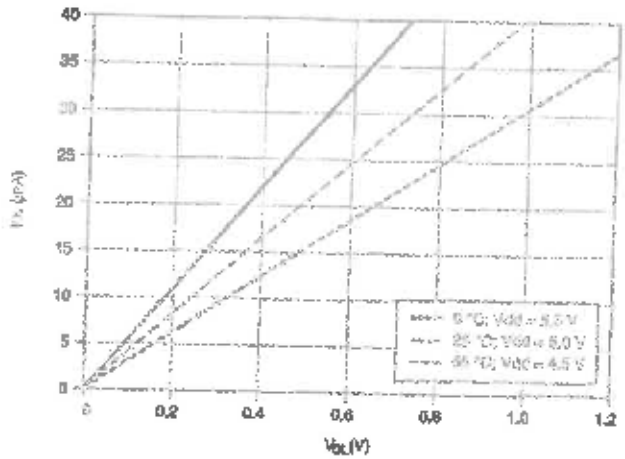


Figure 4. PFI <0..15>/P1/P2: I_{OH} versus V_{OH}

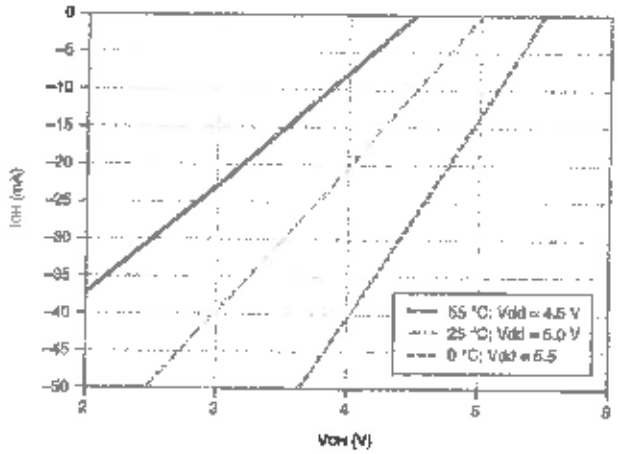
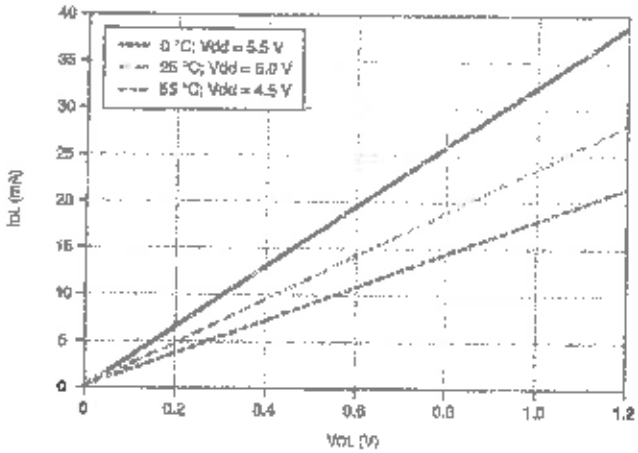


Figure 5. PFI <0..15>/P1/P2: I_{OL} versus V_{OL}



General-Purpose Counters

Number of counter/timers	4
Resolution	32 bits

Counter measurements	Edge counting, pulse, pulse width, semi-period, period, two-edge separation
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
Output applications	Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling
Internal base clocks	100 MHz, 20 MHz, 100 kHz
External base clock frequency	
PXIe	0 MHz to 25 MHz; 0 MHz to 100 MHz on PXIe_DSTAR<A,B>
USB	0 MHz to 25 MHz
Base clock accuracy	50 ppm
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Routing options for inputs	
PXIe	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR, analog trigger, many internal signals
USB	Any PFI, analog trigger, many internal signals
FIFO	127 samples per counter
Data transfers	
PXIe	Dedicated scatter-gather DMA controller for each counter/timer, programmed I/O
USB	USB Signal Stream, programmed I/O

Frequency Generator

Number of channels	1
Base clocks	20 MHz, 10 MHz, 100 kHz
Divisors	1 to 16
Base clock accuracy	50 ppm

Output can be available on any PFI terminal.

Phase-Locked Loop (PLL)

Number of PLLs	1

Table 3. Reference Clock Locking Frequencies

Reference Signal	PXI Express Locking Input Frequency (MHz)	USB Locking Input Frequency (MHz)
PXIe_DSTAR<A,B>	10, 20, 100	—
PXI_STAR	10, 20	—
PXIe_CLK100	100	—
PXI_TRIG <0..7>	10, 20	—
PFI <0..15>	10, 20	10

Output of PLL	100 MHz Timebase; other signals derived from 100 MHz Timebase including 20 MHz and 100 kHz Timebases

External Digital Triggers

Source	
PXIe	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR
USB	Any PFI
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Counter/timer functions	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Digital waveform generation (DO) function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Digital waveform acquisition (DI) function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Device-to-Device Trigger Bus

Input source	
PXIe	PXI_TRIG <0..7>, PXI_STAR, PXIe_DSTAR<A,B>
USB	None
Output destination	
PXIe	PXI_TRIG <0..7>, PXIe_DSTARC
USB	None
Output selections	10 MHz Clock, frequency generator output, many internal signals
Debounce filter settings	90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Bus Interface

PXIe

Form factor	x1 PXI Express peripheral module, specification rev 1.0 compliant
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots
DMA channels	8, can be used for analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3

All PXIe devices may be installed in PXI Express slots or PXI Express hybrid slots.

USB

USB compatibility	USB 2.0 Hi-Speed or full-speed[2]
USB Signal Stream	8, can be used for analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3

[2] Operating on a full-speed bus results in lower performance and you might not be able to achieve maximum sampling/update rates.

Power Requirements

Caution The protection provided by the device can be impaired if the device is used in a manner not described in the *X Series User Manual*.

PXIe

+3.3 V	4.7 W
+12 V	15.4 W

USB

Power supply requirements	11 to 30 VDC, 30 W, 2 positions 3.5 mm pitch pluggable screw terminal with screw locks similar to Phoenix Contact MC 1,5/2-STF-3,5 BK
Power input mating connector	Phoenix Contact MC 1,5/2-GF-3,5 BK or equivalent

Caution The USB device must be powered with an NI offered AC adapter or a National Electric Code (NEC) Class 2 DC source that meets the power requirements for the device and has the appropriate safety certification marks for country of use.

Current Limits

Note Exceeding the current limits may cause unpredictable device behavior.

PXIe, +5 V terminal (connector 0)	1 A max[3]
USB, +5 V terminal	1 A max[3]

Physical Characteristics

PXIe printed circuit board dimensions	Standard 3U PXI
USB enclosure dimensions (includes connectors)	
Screw terminal	26.4 × 17.3 × 3.6 cm (10.4 × 6.8 × 1.4 in.)
BNC	20.3 × 18.5 × 6.8 cm (8.0 × 7.3 × 2.7 in.)

[3] Has a self-resetting fuse that opens when current exceeds this specification.

Weight	
PXIe	168 g (5.9 oz)
USB Screw Terminal	1.428 kg (3 lb 3.4 oz)
USB BNC	1.536 kg (3 lb 6.2 oz)
I/O connector	
PXIe	1 68-pin VHDCI
USB Screw Terminal	64 screw terminals
USB BNC	20 BNCs and 30 screw terminals

Table 4. PXIe Mating Connectors

Manufacturer, Part Number	Description
MOLEX 71430-0011	68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle)
MOLEX 74337-0016	68-Pos Right Angle Dual Stack PCB-Mount VHDCI (Receptacle)
MOLEX 71425-3001	68-Pos Offset IDC Cable Connector (Plug) (SHC68-*)

USB screw terminal/BNC screw terminal wiring	16-24 AWG

Calibration

Recommended warm-up time	15 minutes
Calibration interval	2 years

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel to earth	11 V, Measurement Category I

Caution Do not use for measurements within Categories II, III, or IV.

Shock and Vibration

Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)
Random vibration	
Operating	5 to 500 Hz, 0.3 g_{rms}
Nonoperating	5 to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Environmental

Operating temperature	
PXIe	0 to 55 °C
USB	0 to 45 °C
Storage temperature	-40 to 70 °C
Operating humidity	10 to 90% RH, noncondensing
Storage humidity	5 to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

Device Pinouts

Figure 3. NI PXIe-6368 Pinout

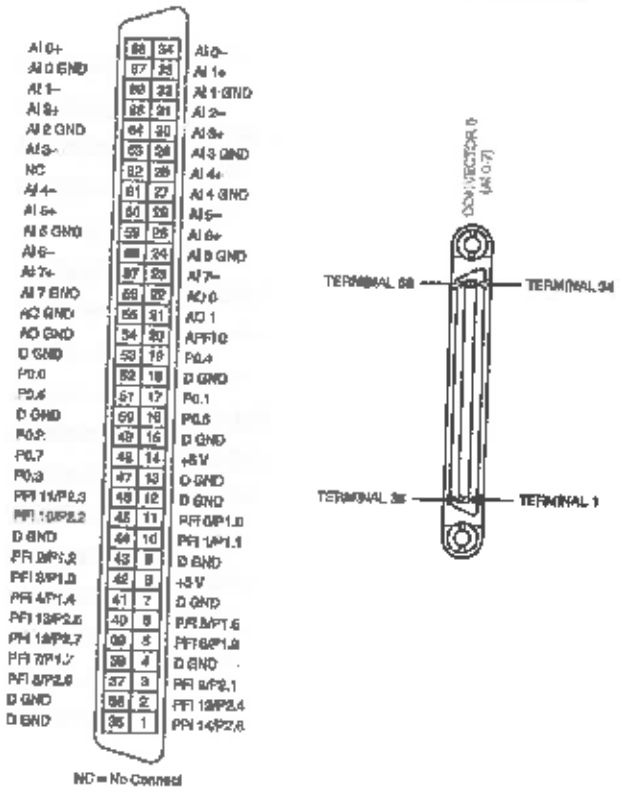
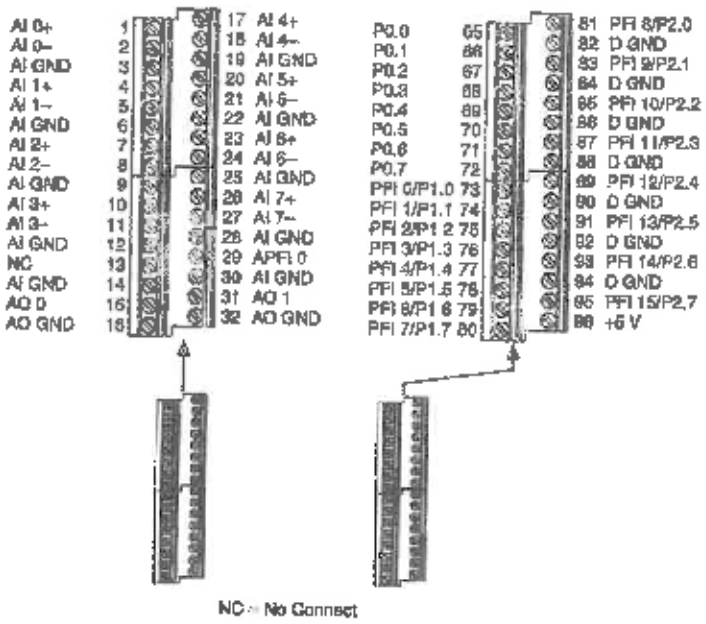
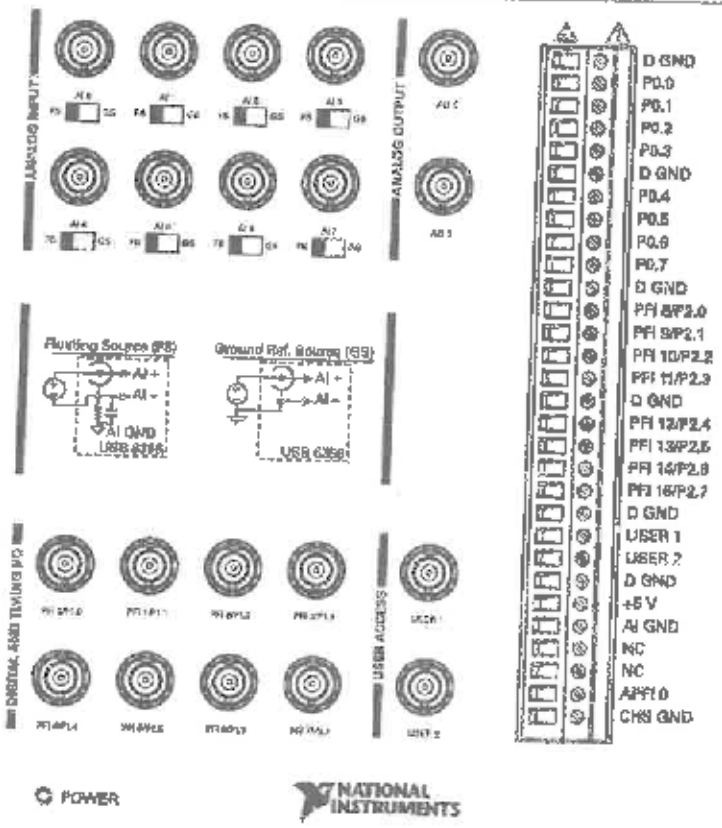


Figura 7. NI USB-6356 Screw Terminal Pinout



NC = No Connect

Figure 4. NI USB-6356 BNC Front Panel and Pinout



374682C-01 Jun16

SPECIFICATIONS

PXIe-8861

Note Specifications are subject to change without notice.

Caution Using the PXIe-8861 controller in a manner not described in this user manual can impair the protection the controller provides.

Features

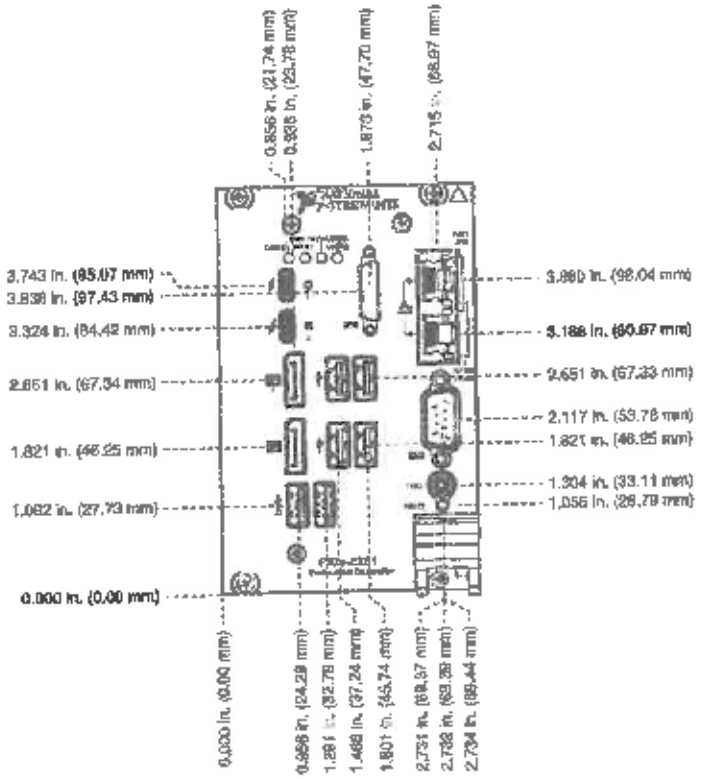
	PXIe-8861
CPU	Intel® Xeon® Processor E3-1515M v5
Cache	8 MB SmartCache
Dual-Channel DDR4-2133 (PC-17000)	8 GB standard, 32 GB maximum
Storage	512 GB (or greater) solid-state, NVMe
Video	1 DisplayPort 1.1, 1 DisplayPort 1.2
Ethernet	1 i219 port 1 i210 port, 1588, 10/100/1000 Base T
PXI Express 4 Link Configuration	x4, x4, x4, x4
PXI Express 2 Link Configuration	x8, x8
GPIB (IEEE 488 Controller)	1 mini-GPIB
Serial Port (RS-232)	1 DB-9
Thunderbolt 3 Ports	2 Type-C
Hi-Speed USB (2.0) Ports	4 Type-A
SuperSpeed USB (3.0) Ports	2 Type-A
PXI Trigger Bus Input/Output	1 SMB
Installed Operating System	Windows 10 Professional for Embedded Systems

NATIONAL INSTRUMENTS

Front Panel Dimensions

The following figure shows the front panel layout and dimensions of the PXIe-8861. Dimensions are in inches (millimeters).

Figure 1. PXIe-8861 Front Panel Layout and Dimensions



Electrical

Note Does not include any attached devices.

Voltage (V)	Current (Amps) Typical	Current (Amps) Maximum
+3.3 V	3.75 A	4.25 A
+5 V	2.0 A	2.5 A
+12 V	6.0 A	7.6 A
-12 V	0 A	0 A
+5 V_{Aux}	0.75 A	0.8 A

Note Power delivered to external loads through USB or Thunderbolt 3 ports should be included in system power budgets that include this controller module and peripheral modules.

Physical

Board dimensions	Four-wide 3U PXI Express module
Slot requirements	One system slot plus three controller expansion slots
Compatibility	Fully compatible with *PXI Express Specification* 1.0
Weight	1.2 kg (2.6 lb) typical

Environmental

Maximum altitude	4,600 m (570 mbar) (at 25 °C ambient)
Pollution Degree	2

Indoor use only.

Operating Environment

Caution The operating temperature must not be exceeded, even when used in a chassis with a higher temperature range.

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range[1]	-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms} (with solid-state hard drive)
Nonoperating[1]	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

[1] CPU performance may decrease for some workloads if a unit is stored at the extreme ambient temperature range and then subjected to max nonoperating random vibration limits.

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)
- 2014/53/EU; Radio Equipment Directive (RED)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

Battery Replacement and Disposal

Battery Directive This device contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized National Instruments service representative. For more information about compliance with the EU Battery Directive 2006/66/EC about Batteries and Accumulators and Waste Batteries and Accumulators, visit *ni.com/environment/batterydirective*.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

377617B-01 January 14, 2019

SPECIFICATIONS

RM-26999

4 Channel, Power Measurements Conditioning Rackmount Terminal Block

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- *Typical* specifications describe the performance met by a majority of models.
- *Typical-95* specifications describe the performance met by 95% (≈2σ) of models with a 95% confidence.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Typical* unless otherwise noted.

Conditions

Specifications are valid for the range 0 °C to 55 °C unless otherwise noted.

These specifications are for the RM-26999. Accuracy for the entire system must be calculated including both the RM-26999 accuracy and the DAQ device accuracy.

Voltage Input Characteristics

Input voltage, maximum	1,000 V, Category II 2,000 V peak, other, non-MAINs circuits
Number of channels	4

NATIONAL INSTRUMENTS

Table 1. Signal Accuracy

Range	Signal Frequency	Accuracy[1]	
		Typical-95	Warranted
2,000 V	DC	±0.05% of reading	
	1 Hz to 500 Hz	±0.08% of reading	±0.1% of reading
	>500 Hz to 1 kHz	±0.1% of reading	±0.2% of reading
	>1 kHz to 5 kHz	±0.25% of reading	±0.9% of reading
	>5 kHz to 10 kHz	±0.3% of reading	±1.15% of reading
	>10 kHz to 200 kHz	±0.4% of reading	±1.35% of reading
	>200 kHz to 1 MHz	±(0.004 × *signal frequency*)% of reading	±(0.014 × *signal frequency*)% of reading

Table 2. System Noise

Range	Noise (V_{rms})
±2,000 V	33 mV
±1,000 V	31 mV
±400 V	22 mV
±200 V	21 mV

Note The system noise specifications above are representative values to help understand the expected quality of the measurement. A PXIe-6366 and RM-26999 were used to create this representative table.

T_{cal}[2]	23 °C ± 5 °C
Gain drift	±25 ppm/°C
Attenuation	200:1
Long-term stability	125 ppm/$\sqrt{1,000\ hrs}$
Input impedance, single-ended to earth	10 MΩ ‖ 4.7 pF
-3 dB bandwidth	1 MHz
Output impedance	50 Ω

[1] T_{cal} ±5 °C. Accuracy is valid after offset compensation.
[2] T_{cal} = temperature at which last external calibration was performed.

Current Input Characteristics

Note Current input characteristics are determined by the connected DAQ devices. For more information about device input characteristics, refer to the device documentation on *ni.com/manuals*.

Note If you connect a current transducer with current output to the RM-26999, install a shunt to convert the current signal to a voltage signal. Refer to the *RM-26999 User Manual* on *ni.com/manuals* for more information about connecting current transducers with current output.

Number of channels	4
DAQ device measurement voltage ranges	±1 V, ±2 V, ±5 V, ±10 V
Burden resistors	0.5 Ω, 1 Ω, 2 Ω, 5 Ω, 10 Ω
Maximum current input	Selectable on the DAQ device
Input protection	Determined by the DAQ device
Shunt accuracy	±0.05%, metal foil, 2 W, maximum
Shunt gain drift	±0.2 ppm/°C

Power Requirements

Voltage input range	24 V DC ± 5%
Maximum power consumption	150 W, maximum
Recommended power supply	NI PS-15 (5 A, 120 W) NI PS-16 (10 A, 240 W)

Physical Characteristics

Dimensions	482.6 mm (19.00 in.) × 43.9 mm (1.73 in.) × 156.2 mm (6.15 in.)
Weight	3,020 g (106.50 oz)

Safety Voltages

Connect only voltages that are below these limits.

Input voltage range	1,000 V, Category II 2,000 V peak, other, non-MAINs circuits

Channel-to-channel, channel-to-earth

Continuous working voltage	1,000 V, Category II 2,000 V peak, other, non-MAINs circuits
Transient overvoltage	6,000 V peak

Caution Do not connect the RM-26999 to signals or use for measurements within Measurement Categories III or IV. Do not connect to signals or use for measurements above 1,000 V RMS within Measurement Category II.

Attention Ne connectez pas le RM-26999 à des signaux et ne l'utilisez pas pour effectuer des mesures dans les catégories de mesure III ou IV. Ne le connectez pas à des signaux et ne l'utilisez pas pour effectuer des mesures supérieures à 1000 Veff dans la catégorie de mesure II.

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe. Above 1,000 V RMS, these test and measurement circuits are not rated for measurements performed on circuits directly connected to the electrical distribution system referred to as MAINs. MAINs is a hazardous, live electrical supply system to which equipment is designed to be connected to for the purpose of powering equipment. Above 1,000 V RMS, this product is rated for measurements of voltages from specially protected secondary circuits, up to 2,000 V peak. Such voltage measurements include signal levels, special equipment, limited energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Connect the PE terminal to protective earth ground in the rack installation or electrical cabinet.

Attention Connectez le terminal de mise à la terre à la borne correspondante (masse) dans l'installation en rack ou dans l'armoire électrique.

Environmental Characteristics

Temperature and Humidity

Temperature	
Operating	0 °C to 55 °C
Storage	-40 °C to 71 °C
Humidity	
Operating	10% RH to 90% RH, noncondensing
Storage	5% RH to 95% RH, noncondensing

Pollution Degree	2
Maximum altitude	2,000 m

Shock and Vibration

Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g RMS
Non-operating	5 Hz to 500 Hz, 2.4 g RMS
Operating shock	30 g, half-sine, 11 ms pulse

377888A-02 January 22, 2019

ЕВРОПЕЙСКИ СЪЮЗ
ЕВРОПЕЙСКИ ФОНД ЗА РЕГИОНАЛНО РАЗВИТИЕ

ЗАЕДНО СЪЗДАВАМЕ

НАУКА И ОБРАЗОВАНИЕ ЗА ИНТЕЛИГЕНТЕН РАСТ

ТЕХНИЧЕСКИ УНИВЕРСИТЕТ – СОФИЯ

ОБРАЗЕЦ № 3

Наименование на участника: Йота Волт

Правно-организационна форма на участника:	ЕООД
Седалище по регистрация:	1750 София, бул. Цариградско шосе 40
ЕИК / Булстат:	204912332

До
Технически университет - София
гр. София
Р. България

ЦЕНОВО ПРЕДЛОЖЕНИЕ

Наименование на поръчката: **„Доставка на специализирано технологично оборудване за нуждите на Технически университет – София“ по проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии“, финансиран чрез Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020“**

УВАЖАЕМИ ГОСПОДА,

Проект BG05M2OP001-1.001-0008 „Национален център по мехатроника и чисти технологии“, финансиран от Оперативна програма „Наука и образование за интелигентен растеж“ 2014-2020, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Този документ е създаден с финансовата подкрепа на Оперативна програма „Наука и образование за интелигентен растеж“, съфинансирана от Европейския съюз чрез Европейския фонд за регионално развитие. Цялата отговорност за съдържанието на документа се носи от Технически университет - София и при никакви обстоятелства не може да се приема, че този документ отразява официалното становище на Европейския съюз и Управляващия орган.

С настоящото представяме нашето ценово предложение за изпълнение предмета на горепосочената поръчка, както следва:

Потвърждаваме, че сме запознати с всички условия на изпълнение на поръчката, които произтичат от изискванията на Възложителя в документацията и в предложената цена сме отчели всички разходи за изпълнение на поръчката в съответствие с посочените изисквания, както и всякакви други изисквания в нормативната уредба, които са задължителни за спазване при изпълнение на поръчката.

П Р Е Д Л А Г А М Е :

Общата стойност за изпълнение на поръчката възлиза на:

488 250 лева без ДДС

Словом: четири стотин осемдесет и осем хиляди двеста и петдесет лева без ДДС,

посочва се цифром и словом стойността в лева без ДДС

представляваща крайна фиксирана цена за изпълнение на всички дейности, включени в предмета на поръчката.

Заявяваме, че:

1. Посочената цена включва всички разходи за точното и качествено изпълнение на поръчката. Цената е посочена в български лева, без ДДС.

2. Предложените цени са определени при пълно съответствие с условията от документацията и техническата спецификация.

3. Задължаваме се, ако нашата оферта бъде приета и сме определени за изпълнители, да изпълним поръчката в сроковете и условията, залегнали в договора.

4. Съгласни сме заплащането да става съгласно клаузите, залегнали в проекта на договора, като всички наши действия подлежат на проверка и съгласуване от страна на Възложителя.

5. За обезпечаване на задълженията си по договора за възлагане на обществената поръчка, преди подписване на договора ще предоставим на Възложителя гаранция за изпълнение в размер на 3% (три процента) от стойността на договора без ДДС, както и гаранция за авансово предоставените средства, при условията, посочени в проекта на договор към документацията за участие. *Ако Изпълнителят не желае авансово плащане, отпада задължението на последният да осигури гаранция обезпечаваща авансово предоставени средства.*

6. Запознати сме, че ако участник включи елементи от ценовото си предложение извън плика с надпис „Предлагани ценови параметри", ще бъде отстранен от участие в процедурата.

ЗАБЕЛЕЖКА: Този документ задължително се поставя от участника в отделен запечатан непрозрачен плик с надпис „Предлагани ценови параметри" и наименованието на участника. Участниците задължително изготвят ценовото си предложение при съобразяване с максималната прогнозна стойност, определена в документацията за участие. При изготвяне на ценовото предложение, участниците задължително следва да включат пълния обем дейности по техническата спецификация. Ценовото предложение на участниците не може да надхвърля максималната обща стойност на поръчката. Оферти надхвърлящи максимално заложената стойност ще бъдат предложени за отстраняване, поради несъответствие с това предварително обявено условие. Ценовото предложение трябва да съответства на предложението за изпълнение на поръчката по отношение на дейностите за изпълнение на поръчката. В противен случай, участникът се отстранява. Участникът е единствено отговорен за евентуално допуснати грешки и пропуски в изчисленията на предложените от него цени. При всяка допусната от участника грешка спрямо посочените по-горе условия, когато грешката е установена от комисията за оценка и класиране на офертите на участниците, ще се счита че ценовото предложение на участника не отговаря на предварително обявените условия на възложителя и такъв участник ще бъде отстранен от по-нататъшно участие.

Запознати сме, че ако участник включи елементи от ценовото си предложение извън съответния плик, ще бъде отстранен от участие в процедурата.

Дата: 21.05.2020

Елин

Упр

Йотв