1. Quality of Install
2. Conductors
3. Install consideration
4. Understand the Power
OutBack Power Technologies

- Premier developer of off-grid and grid hybrid power conversion systems for renewable & energy systems
- Based in Arlington, Washington USA since founding in 2001
- International brand & product quality recognition
Considerations for improved life of an OutBack System


▶ What if my loads are much smaller?
▶ Can I reduce conductor size?
▶ Inrush current
▶ Surge
▶ The human condition
▶ Conductors longer than 3 Meters

<table>
<thead>
<tr>
<th>Inverter</th>
<th>Nominal DC Amps (Derated 125%)</th>
<th>Conductor Size³ (Minimum)</th>
<th>Breaker Size (Minimum)</th>
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</thead>
<tbody>
<tr>
<td>FXR2012E</td>
<td>200</td>
<td>120 mm² (4/0 AWG) or 0.186 in²</td>
<td>250 Adc</td>
</tr>
<tr>
<td>VFXR2612E</td>
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<td>175 Adc</td>
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<tr>
<td>VFXR3024E</td>
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<td>120 mm² (4/0 AWG) or 0.186 in²</td>
<td>250 Adc</td>
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<tr>
<td>FXR2348E</td>
<td>57.5</td>
<td>70 mm² (1/0 AWG) or 0.109 in²</td>
<td>125 Adc</td>
</tr>
<tr>
<td>VFXR3048E</td>
<td>75</td>
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Use Ring terminals with compression fittings to insure proper and lasting connection.
Conductor Sizing and terminal Location

- Proper wiring with DC conductors
  - Sizing for Maximum Current
  - Relationship between breaker and conductor
- Stacking conductors
  - Heaviest towards base

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B: M8-1.25 Hex Bolt
C: DC Disconnect
D: 3/8" Hex Bolt
Proper bussing

► Use top quality products in every project
► Land one conductor per area
► Standoffs protect conductors
► Insolated and Isolated

<table>
<thead>
<tr>
<th>Basbar Size</th>
<th>current capacity A</th>
<th>Weight kg/m CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>10x120</td>
<td>2400</td>
<td>10.68</td>
</tr>
<tr>
<td>10x100</td>
<td>2000</td>
<td>8.9</td>
</tr>
<tr>
<td>10x80</td>
<td>1600</td>
<td>7.12</td>
</tr>
<tr>
<td>10x60</td>
<td>1200</td>
<td>5.34</td>
</tr>
<tr>
<td>10x50</td>
<td>1000</td>
<td>4.45</td>
</tr>
<tr>
<td>10x40</td>
<td>800</td>
<td>3.56</td>
</tr>
<tr>
<td>5x40</td>
<td>400</td>
<td>1.78</td>
</tr>
<tr>
<td>5x30</td>
<td>300</td>
<td>1.335</td>
</tr>
<tr>
<td>5x25</td>
<td>250</td>
<td>1.1125</td>
</tr>
<tr>
<td>6x30</td>
<td>200</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Wiring practices and ‘Looming’

► Organized wiring practices
► Today, tomorrow and years to come
  ► Trouble Shooting
  ► Reduce Damage to wires
  ► Labeling of conductors
A proper crimp use of Ferrules
Proper wire management is so important

Take great care in your preparation and you will be rewarded
Did you take it all into account: Proper materials

**Solar can create some amazing heat when shorted**

Water penetration into the box caused the combiner boxes to incinerate themselves
• The box above was a good example, the others were burned to nothing.
• A concrete roof is what saved this building from burning down
7 Radian System

► Examination of a quality install

► What to look for:
  ► Proper Bussing
  ► Conductor lengths
  ► Circuit Protection
  ► Access to equipment
OutBack Power’s 3 Phase 9 Stack?

3 Phase currently only European 230/50hz

When System size increase, so too does the attention to detail.
Conductors and Protection

- What can be done to protect the copper
- Galvanic Response of metals
- Reducing corrosion
Four ways to protect your conductors

• Liquid Electrical Tape
• Silicone Grease
• Heat Shrink
• Solder

“Hey, where is the electrical tape?”

Tape is short term and does not protect against corrosion!
Using improperly matched conductors

Galvanic reactions will ‘consume’ your conductor

<table>
<thead>
<tr>
<th></th>
<th>Zinc</th>
<th>Galvanized steel</th>
<th>Aluminum</th>
<th>Cast iron</th>
<th>Lead</th>
<th>Mild steel</th>
<th>Tin</th>
<th>Copper</th>
<th>Stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc</td>
<td>None</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Galvanized steel</td>
<td>Low</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Medium</td>
<td>Medium</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>None</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Lead</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>None</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Mild steel</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Tin</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Copper</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>None</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>None</td>
</tr>
</tbody>
</table>
Harsh Environments

Insuring the longest lasing installs

► Best materials are expensive!
► Replacing and damage is more expensive

![Figure 2]

<table>
<thead>
<tr>
<th>ROOFTOP SUPPORT MATERIALS AND FINISHES</th>
<th>GEOGRAPHIC LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low humidity and/or atmospheric impurities</td>
</tr>
<tr>
<td></td>
<td>Moderate humidity and/or atmospheric impurities</td>
</tr>
<tr>
<td></td>
<td>High humidity or aggressive atmosphere</td>
</tr>
<tr>
<td>Exposed wood (e.g. treated pine/redwood/etc.)</td>
<td>Not recommended</td>
</tr>
<tr>
<td>EPDM*</td>
<td>Better</td>
</tr>
<tr>
<td>High-density polyethylene* (HDPE)</td>
<td>Better</td>
</tr>
<tr>
<td>Polypropylene*</td>
<td>Better</td>
</tr>
<tr>
<td>Nylon*</td>
<td>Better</td>
</tr>
<tr>
<td>PVC</td>
<td>Good</td>
</tr>
<tr>
<td>Electro-galvanized (EG)</td>
<td>Good</td>
</tr>
<tr>
<td>Hot-dip galvanized (HD)</td>
<td>Better</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Better</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Best</td>
</tr>
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</table>

*Results in the chart above are based on the assumption these materials have an added ultraviolet (UV) stabilizer to assist with weathering and durability.
May we all aspire to so something great!

OutBack
POWER

member of The Alpha Group™
Large system Bussing
Integrated Systems

SOME GOOD THINGS TO SAY
► A simple install using ‘custom’ racking

► Batteries below inverters

► Open front for venting

► Circuit protection installed
What to look for in an inverter

► Pure or Modified Sine
► Power Factor
► Programmable Set points
► Efficiency
► Surge
► On or off switch
► Conformal Coating
► Accepts an AC input?
  ► Is it a charger too?
► Temp operating Range
Is your inverter full of foam?

A quick analogy for Power factor

- **KVAR**
  - Kilo Volts Amps Reactive
  - Reactive Volt Amps
  - All foam an no coffee

- **KVA**
  - Kilo Volts Amps
  - Measures the cup not the contents

- **KW**
  - Kilo Watts
  - All the Power all the coffee
What makes Quality Power

- Quality of Power
  - Pure Sine vs Modified Sine
- Inductive Loads
  - Pumps
- Power Electronics
- Choosing Sealed or Vented
  - Harsh environment
  - Higher Ambient Temp
  - Insect infestation

Pure Sine Wave from OutBack Power

Modified Sinewave
Lower quality power
FXR Inverter/Chargers:

► Grid-interactive and stand-alone same model
► Preprogrammed operating modes
► Advanced Battery Charging profile
► Stackable in series, parallel, series/parallel, and three-phase configurations – 10 grid tied and 9 three phase
► Passthrough of 30A
► Remote monitoring and programming accuracy with Optics RE via Mate3
► Operating Efficiency at 93%
► Corrosion Resistant Internal Components
► Field upgradable software
► Power Factor corrected battery charging
► 5-year warranty
Protection against the elements

https://youtu.be/VJa8SqiNteg?t=254
OutBack Charge Controller FLEXmax 80

Allows replacement of the cooling fan “on the wall” with only the removal of a single screw for access.
Commercial electrical power & historical preservation: Central Asia

- Historic building converted into the first net-zero office complex in that country
Years of Experience with large systems

System installed in 2002 at an AIDS Research Center in Rakai, Uganda, Africa

Twenty Four 3.0 kW Inverter/Chargers - 72 KW Total 230/400 VAC 50Hz Three Phase
One of Five Systems installed in 2008 in N’Kau Lesotho Africa

Three 3.0 kW Inverter/Chargers - 9.0 kW Total 230/400 VAC Three Phase
Thank You!

John Webber
Arlington, WA USA
Jwebber@Alpha.com

Sales@OutBackpower.com
App notes pertinent to this power point


For addition information please go to http://www.outbackpower.com
Application Notes are available at http://www.outbackpower.com/tech-notes