APPENDIX- I, II & III
Appendix-I

A-I: SOLAREX MSX-60 and MSX-64 Photovoltaic Modules

The MSX-64 and -60 are among the most powerful of Solarex’s Mega module™ series, a product line which is the culmination of nearly three decades of extensive research in polycrystalline silicon photovoltaic. With over 3 amperes of current at peak power, these modules offer the most cost-effective package in the industry, and charge batteries efficiently in virtually any climate. These modules may be used in single-module arrays or deployed in multiple-module arrays, wired in series/parallel combinations as to meet current and voltage requirements are engineered under Solarex’s Integra System™, integration concept, which ensures compatibility with other Solarex subsystems and components (support hardware, regulators, etc.) and easy system assembly. As single module arrays, they may be mounted on a ety of surfaces using optional kits or by means of user-fabricated support hardware. Solarex also offers hardware for supporting multiple module arrays.

These modules are well-suited for virtually all applications where photovoltaic are a feasible energy source, including telecommunications systems, pumping and irrigation, cathodic protection, remote villages and clinics, and aids to navigation.

Individually Tested, Labeled and Warranted

As part of the final inspection procedure, every MSX module is tested in a solar simulator and labeled with its actual output voltage, current, and power at maximum power (Pmax) at Standard Test Conditions and Standard Operating Conditions. Furthermore, the MSX-64 and -60 are covered by our industry-leading limited warranty, which guarantees:
1. That no module will generate less than its guaranteed minimum Pmax when purchased;

2. At least 80% of the guaranteed minimum Pmax for twenty years.

3. Contact Solarex's Marketing Department for full terms and limitations of this unparalleled warranty.

4. Reliable and Versatile

5. The Megamodule series has proved its reliability at thousands of installations in every climate on Earth. Among the features that contribute to its versatility:

Safety Approved

Typical Electrical Characteristics

MSX-60 and -64 modules are listed by Underwriters Laboratories for electrical and fire safety (Class C fire rating), certified by TUV Rhineland as Class II equipment, and approved by Factory Mutual Research for application in NEC Class 1, Division 2, Group C & D hazardous locations.

Quality Certified

These modules are manufactured in our ISO 9001-certified factories to demanding specifications, and comply with IEC 1215, IEEE 1262 and CEC 503 test requirements, including:

1. Repetitive cycling between -40°C and 85°C at 85% relative humidity;
2. Maximum power (Pmax) Voltage Pmax (Vmp) Current @ Pmax (Imp) Guaranteed minimum Pmax Short-circuit current (Isc) Open-circuit voltage (Voc)
3. Temperature coefficient of open-circuit voltage
4. Temperature coefficient of short-circuit current
5. Temperature coefficient of power NOCT2
<table>
<thead>
<tr>
<th></th>
<th>MSX-64</th>
<th>MSX-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>64W</td>
<td>60W</td>
<td></td>
</tr>
<tr>
<td>17.5V</td>
<td>17.1V</td>
<td></td>
</tr>
<tr>
<td>3.66A</td>
<td>3.5A</td>
<td></td>
</tr>
<tr>
<td>62W</td>
<td>58W</td>
<td></td>
</tr>
<tr>
<td>4.0A</td>
<td>3.8A</td>
<td></td>
</tr>
<tr>
<td>21.3V</td>
<td>21.1V</td>
<td></td>
</tr>
</tbody>
</table>

- simulated impact of one-inch (25mm) hail at terminal velocity;
- 2700 VDC frame/cell string isolation test;
- a "damp heat" test, consisting of 1000 hours of exposure to 85°C and 85% relative humidity;
- a "hot-spot" test, which determines a module's ability to tolerate localized shadowing (which can cause reverse-biased operation and localized heating);

**TYPICAL ELECTRICAL CHARACTERISTICS (1)**
## 12 Volt Configuration(2)

<table>
<thead>
<tr>
<th></th>
<th>MSX-64</th>
<th>MSX-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical peak power (Pp)</td>
<td>64W</td>
<td>60W</td>
</tr>
<tr>
<td>Voltage @ peak power (Vpp)</td>
<td>17.5V</td>
<td>17.1V</td>
</tr>
<tr>
<td>Current @ peak power (Ipp)</td>
<td>3.66A</td>
<td>3.5A</td>
</tr>
<tr>
<td>Guaranteed minimum peak power</td>
<td>62W</td>
<td>58W</td>
</tr>
<tr>
<td>Short-circuit current (Iscc)</td>
<td>4.0A</td>
<td>3.8A</td>
</tr>
<tr>
<td>Open-circuit voltage (Voc)</td>
<td>21.3V</td>
<td>21.1V</td>
</tr>
<tr>
<td>Temperature coefficient of open-circuit voltage</td>
<td>(80±10)mV/ºC</td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient of short-circuit current</td>
<td>(0.065±0.015)%/ºC</td>
<td></td>
</tr>
<tr>
<td>Approximate effect of temperature on power</td>
<td>(0.5±0.05)%/ºC</td>
<td></td>
</tr>
<tr>
<td>NOCT(3)</td>
<td></td>
<td>49ºC</td>
</tr>
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</table>
Shell PowerMax™ is a new range of dependable, high performance solar products – with designs created specifically for grid connected applications. Shell PowerMax™ Ultra 175-PC and 165-PC products contain 72 series connected 125mm x 125mm mono-crystalline solar cells, which can generate a peak power of 175 and 165 watts at 35.4 and 35V respectively.

**Exceptional Performance**

- High efficiency crystalline silicon cell technology; enhanced by TOPS™ and new silicon nitride anti-reflection coatings.
- One of the industry’s leading energy yields in a wide variety of climates.
- Products rated on fully stabilized initial power so you get the power you pay for.

**Safety by Design**

- Suitable for high snow and wind loads.
- UL fire safety class C.

**Easy to Install**

- Pre-assembled cables and Multi- Contact® plugs.
- 12 mounting holes per product; 4 grounding holes.
- 20A series fuse rating

**Qualifications and Certificates**

The Shell PowerMax™ Ultra 175-PC and 165- PC products meet the following requirements:

- IEC 61215
• UL - Listing 1703
• All Shell Solar modules are produced in ISO 9001 certified factories.

**Electrical Specifications**

Rated Power: 175 Watts
Peak Power: 175 Watts
Module Efficiency: 13.3%
Max System Voltage: 600 Volts (UL); 715 Volts (TUV)
Peak Power Voltage: 35.4 Volts
Peak Power Current: 4.95 Amps
Open Circuit Voltage: 44.6 Volts
Short Circuit Current: 5.43 Amps
Series Fuse Rating: 20 Amps
Min Peak Power: 166.25 Watts
Tolerance on Peak Power: +/-5
Appendix-II

IKC85T SOLAR MODULE SPESIFICATIONS

Kyocera solar modules are a reliable, virtually maintenance-free power supply designed to convert sunlight into electricity at the highest possible efficiency. Kyocera began researching photovoltaic’s in 1975 and has installed thousands of systems throughout the world since 1978. These systems are ideal for charging storage batteries to power remote homes, recreational vehicles, boats, telecommunications systems and other consumer and commercial applications.

Kyocera's advanced cell-processing technology and automated production facilities produce highly efficient multi-crystal photovoltaic modules. To protect the cells from the most severe environmental conditions, they are encapsulated between a tempered glass cover and an EVA potent with a PVF back sheet. The entire laminate is installed in an anodized aluminum frame for structural strength and ease of installation. There is a $10 rebox fee for single panels.
<table>
<thead>
<tr>
<th>Model</th>
<th>Watts</th>
<th>Amps</th>
<th>Volts</th>
<th>Size (Inches)</th>
<th>Shipping Weight (lbs.)</th>
<th>Item</th>
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</thead>
<tbody>
<tr>
<td>KC 85T</td>
<td>85</td>
<td>4.75</td>
<td>17.4</td>
<td>39.65x25.67x2.2</td>
<td>18.3</td>
<td>1100850</td>
</tr>
</tbody>
</table>

### Electrical Performance under Standard Test Conditions (*STC)

- **Maximum Power (Pmax)**: 87W (+10%/-5%)
- **Maximum Power Voltage (Vmpp)**: 17.4V
- **Maximum Power Current (Impp)**: 5.02A
- **Open Circuit Voltage (Voc)**: 21.7V
- **Short Circuit Current (Isc)**: 5.34A
- **Max System Voltage**: 600V
- **Temperature Coefficient of Voc**: -8.21x10⁻² V/°C
- **Temperature Coefficient of Isc**: 2.12x10⁻³ A/°C

*STC: Irradiance 1000W/m², AM1.5 spectrum, cell temperature 25°C

### Electrical Performance at 800W/m², *NOCT, AM1.5

- **Maximum Power**: 92W
- **Maximum Power Voltage (Vmpp)**: 15.5V
- **Maximum Power Current (Impp)**: 5.94A
- **Open Circuit Voltage (Voc)**: 19.9V
- **Short Circuit Current (Isc)**: 6.47A

*NOCT (Nominal Operating Cell Temperature): 47.9°C

### Cells

- **Number per Module**: 36

### Module Characteristics

- **Length x Width x Depth**: 39.6in x 25.7in x 2.3in
- **Weight**: 18.3lbs

### Junction Box Characteristics

- **Length x Width x Depth**: 6.7in x 7.5in x 2in
- **IP Code**: IP65

### Reduction of Efficiency under Low Irradiance

- **Reduction**: 6.1%

Reduction of efficiency from an irradiance of 1000W/m² to 200W/m² (module temperature 25°C)
Appendix-III

Shell Solar SP150-PC

Shell SP150-PC Module Benefits

The Shell SP150-PC module contains 72 series

- Tolerance on the peak power output is ±5% connected 125 x 125 mm PowerMax® mono-ensuring that you receive the power that crystalline silicon solar cells.
- PowerMax® mono-crystalline solar cells The Shell SP150-PC can generate a peak deliver maximum power output even under power of 150 watts at 34.0 volts. reduced light conditions providing more The Shell SP150-PC solar module has been power where space is a limitation, designed for grid connected and industrial
- The surface of the PowerMax® cell has a applications. pyramidal textured surface to enable more light absorption and deliver exceptional The SP150-P is the non-cable version of the efficiency. SP150-PC and is available upon special order.
- Highly transparent tempered glass delivers The SP150-P does not include the cable and more power and ensures high impact fitting assembly, resistance and protection against hail, snow, ice, and storms.

Qualifications

- Nearly 300MW of cumulative installed and Certificates experience has been applied to the evolution of our mono-crystalline range to ensure The Shell SP150-PC solar module meets the that our products have a long and reliable following requirements: service life backed by a 25 year warranty.
- UL – Listing 1703
- MultiContact® flying cables as standard to reduce installation time in grid connected Junction Box applications. The junction box provides a high quality; dust protected and splash proof IP44-rated housing.

All Shell Solar modules are produced in the housing contains a rigid connection block EN-ISO 9001 certified factories, with screw terminals and by-pass diodes providing "hot spot" protection for the solar cells.
Limited Warranties
Type of protection: IP44
Number of by-pass diodes: 3

Photovoltaic Solar Module Mechanical

Electrical Characteristics
Typical I/V Characteristics
Specifications Module
Data at Standard Test Conditions (STC) The I/V graph below shows the typical A
torsion and corrosion-resistant anodized performance of the solar module at various
STC: irradiance level 1000W/m2, spectrum aluminum frame ensures dependable.