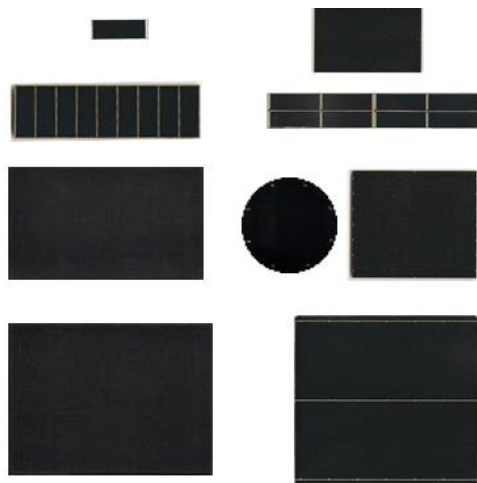


ANYSOLAR

TOTAL SOLAR SYSTEM



Agenda.

- 1. Introduction.**
- 2. Products and Roadmap.**
- 3. Advantages of IXOLAR™.**
- 4. Reliability.**
- 5. Markets.**
- 6. For more information.**

Anysolar is a manufacturer of leading technology in solar products since 2009. We have grown by supplying our products to the global market with innovative and automated production technology with IXYS and Littelfuse.

Anysolar will continue to provide reliable customized products, excellent quality and achieve customer's satisfaction for a solar applications.

Introduction.

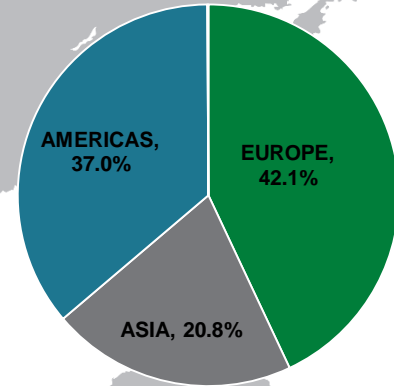
Europe (42.1%)

Americas (37.0%)

Asia (20.8%)

Middle East (0.1%)

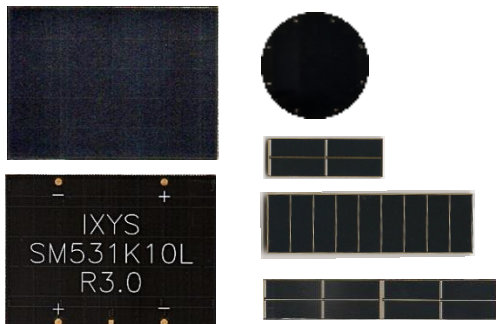
Regional Market Share
IXOLAR™ CY2021



■ AMERICAS ■ ASIA ■ EUROPE ■ Middle East

Anysolar has customers worldwide in Portable Electronics, Industrial, Wireless Communications, Sensors and IOTs markets.

High Efficiency Solar Cell 25% Monocrystalline Silicon



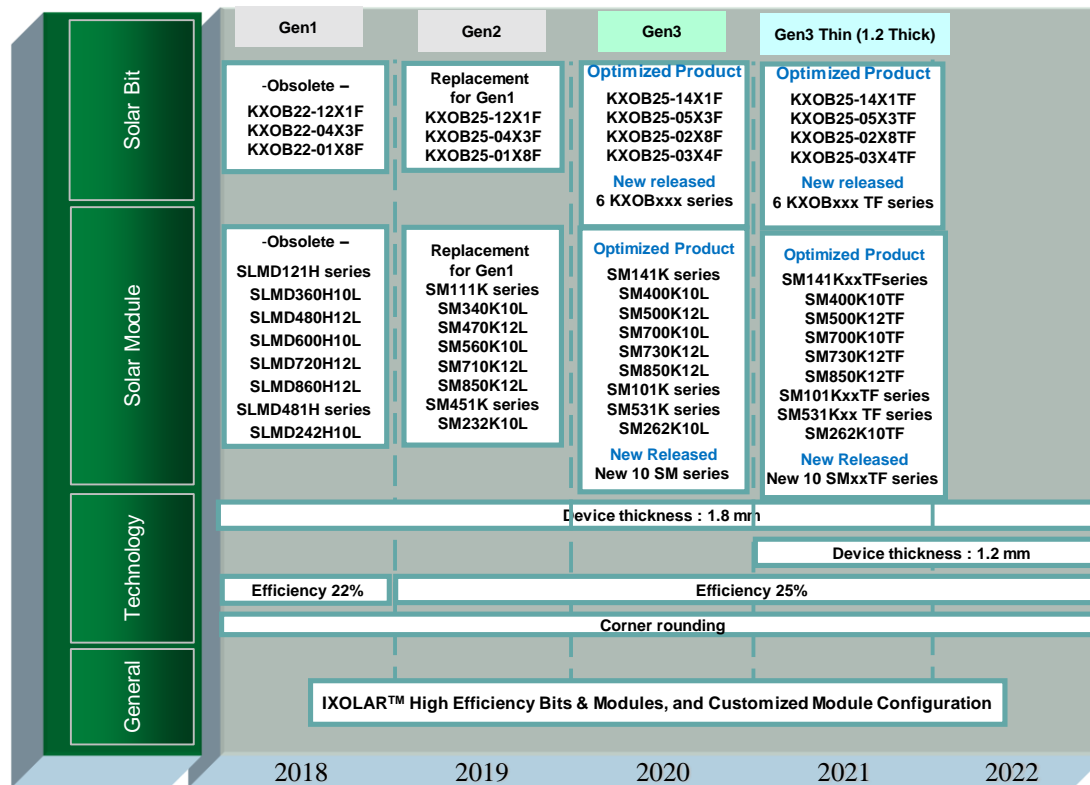
IXOLAR™ SolarBIT

- Surface Mountable
- Reflow Solderable
- Film Laminated Encapsulation
- Form Factor : 23mm x 8mm x 1.8mm

IXOLAR™ SolarMD

- Manual Solderable Mini Solar Modules
- Film Laminated Encapsulation
- Customized Voltage/Current Ratings
- Various Module Sizes

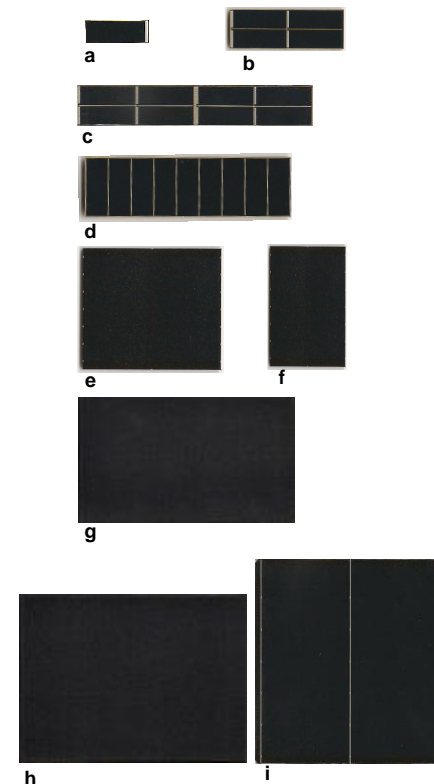
IXOLAR™ BIT/MD Technology Roadmap



IXOLAR™ BIT&MODULE(1)

SYMBOL	Unit	IXOLAR™ High Efficiency SolarBIT			IXOLAR™ High Efficiency SolarMD			
		KXOB25-14X1F	KXOB25-05X3F	KXOB25-02X8F	SM141K04L	SM141K04LV	SM141K06L	SM141K06LV
1.Voc	V	0.69	2.07	5.53	2.76	2.76	4.15	4.15
2.Isc	mA	58.6	19.5	6.3	58.6	58.6	58.6	58.6
3.Pmax	mW	30.7	30.7	26.3	122.9	122.9	184.4	184.4
4.Vmax	V	0.56	1.67	4.46	2.23	2.23	3.35	3.35
5.Imax	mA	55.0	18.4	5.9	55.1	55.1	55.1	55.1
6.Jsc	mA/cm ²	41.4	41.4	41.4	41.4	41.4	41.4	41.4
7.Fill Factor	%	>70	> 70	> 60	> 70	> 70	> 70	> 70
8.Cell Efficiency	%	25.0	25.0	25.0	25.0	25.0	25.0	25.0
9.ΔVOC/ΔT	mV/K	-1.74	-5.22	-13.92	-7.0	-7.0	-10.4	-10.4
10.ΔJSC/ΔT	mA/(cm ² K)	0.0265	0.0088	0.0028	0.0265	0.0265	0.0265	0.0265
11.Dimensions	mm(LxWxH)	23x8x1.8	23x8x1.8	23x8x1.8	29x23x1.8	45x15x1.8	42x23x1.8	45x22x1.8
12.Unit cell size	mm(LxW)	21.5x6.59	7.2x6.59	5.4x2.83	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59
13.Cells in series	cells	1	3	8	4	4	6	6
14.Package	-	a	a	a	b	b	b	b
15.Pack quantity	-	20/tube	20/tube	20/tube	40/blister	50/blister	20/blister	20/blister
16.Weight	grams	0.5	0.5	0.5	2.5	3.5	5.0	5.5
17.Unit cell area	mm ² (LxW)	142.00	47.00	15.28	120.00	120.00	120.00	120.00
18.Datasheet	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes

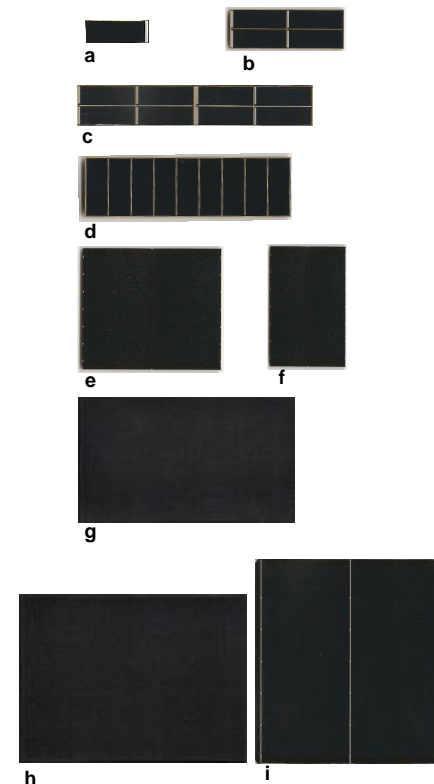
*) Please note, all values measured at Standard Condition: 1 sun (= 100 mW/cm²), Air Mass 1.5, 25°C



IXOLAR™ BIT&MODULE(2)

Symbol	Unit	IXOLAR™ High Efficiency SolarMD							
		SM141K08L	SM141K08LV	SM141K09L	SM141K10L	SM141K10LV	SM400K10L	SM500K12L	SM700K10L
1.Voc	V	5.53	5.53	6.22	6.91	6.91	6.91	8.29	6.91
2.Isc	mA	58.6	58.6	58.6	58.6	58.6	16.4	21.0	29.5
3.Pmax	mW	245.8	245.8	276.5	307.3	307.3	85.7	132.3	154.3
4.Vmax	V	4.46	4.46	5.02	5.58	5.58	5.58	6.70	5.58
5.Imax	mA	55.1	55.1	55.1	55.1	55.1	15.4	19.8	27.7
6.Jsc	mA/cm ²	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4
7.Fill Factor	%	> 70	> 70	> 70	> 70	> 70	> 70	> 70	> 70
8.Cell Efficiency	%	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
9.ΔVOC/ΔT	mV/K	-13.9	-13.9	-15.7	-17.4	-17.4	-17.4	-20.9	-17.4
10.ΔJSC/ΔT	mA/(cm ² K)	0.0265	0.0265	0.0265	0.0265	0.0265	0.0074	0.0095	0.0133
11.Dimensions	mm(LxWxH)	88x15x1.8	45x29x1.8	63x23x1.8	70x23x1.8	45x36x1.8	33x15x1.8	24x32x1.8	24x36x1.8
12.Unit cell size	mm(LxW)	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59	21.5x6.59
13.Cells in series	cells	8	8	9	10	10	6	6	6
14.Package	-	c	b	d	e	e	b	f	f
15.Pack quantity	-	20/blister	20/blister	20/blister	20/blister	25/blister	50/blister	50/blister	50/blister
16.Weight	grams	5.0	5.0	5.0	5.0	5.0	2.0	5.5	5.5
17.Unit cell area	mm ² (LxW)	120.00	47.00	47.00	47.00	47.00	120.00	120.00	120.00
18.Datasheet	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

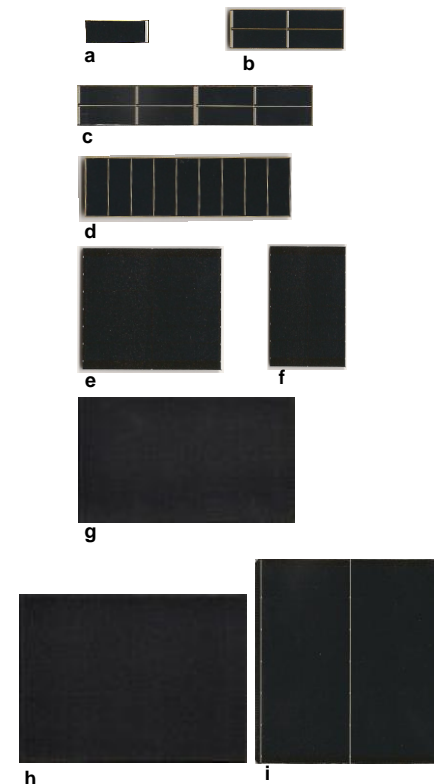
*) Please note, all values measured at Standard Condition: 1 sun (= 100 mW/cm²), Air Mass 1.5, 25°C



IXOLAR™ BIT&MODULE(3)

Symbol	Unit	IXOLAR™ High Efficiency SolarMD							
		SM730K12L	SM850K12L	SM101K09L	SM101K12L	SM351K09L	SM531K08L	SM531K10L	SM531K12L
1.Voc	V	8.29	8.29	6.22	8.29	6.22	5.53	6.91	8.29
2.Isc	mA	30.0	35.1	41.9	41.9	147.3	217.8	217.8	217.8
3.Pmax	mW	188.6	220.5	197.5	263.4	694.6	913.0	1141.3	1369.5
4.Vmax	V	6.70	6.70	5.02	6.70	5.02	4.46	5.58	6.70
5.Imax	mA	28.2	32.9	39.3	39.3	138.3	204.5	204.5	204.5
6.Jsc	mA/cm ²	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4
7.Fill Factor	%	> 70	> 70	> 70	> 70	> 70	> 70	> 70	> 70
8.Cell Efficiency	%	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
9.ΔVOC/ΔT	mV/K	-20.9	-20.9	-15.7	-20.9	-15.7	-13.9	-17.4	-20.9
10.ΔJSC/ΔT	mA/(cm ² K)	0.0136	0.0159	0.0189	0.0189	0.0666	0.0985	0.0985	0.0985
11.Dimensions	mm(LxWxH)	33x32x1.8	38.5x33x1.8	47x23x1.8	45x32x1.8	57x64x1.8	89x52x1.8	89x65x1.8	89x77x1.8
12.Unit cell size	mm(LxW)	15.4x4.71	18.0x4.71	21.5x4.71	21.5x4.71	21.5x6.59	6.0x6.59	10.8x4.71	10.8x6.59
13.Cells in series	cells	12	12	9	12	9	8	10	12
14.Package	-	e	e	d	e	h	g	h	i
15.Pack quantity	-	25/blister	25/blister	20/blister	20/blister	bulk	bulk	bulk	bulk
16.Weight	grams	4.5	4.5	5.5	6.0	12.0	16.0	18.0	20.0
17.Unit cell area	mm ² (LxW)	73.00	85.00	101.00	101.00	142.00	40.00	51.00	71.00
18.Datasheet	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*) Please note, all values measured at Standard Condition : 1 sun (= 100 mW/cm²), Air Mass 1.5, 25°C





SolarBIT

- KXOB25-14X1F : a single cell
- KXOB25-05X3F : 3 cells in series
- KXOB25-02X8F : 8 cells in series

SPECIFICATIONS:

Symbol	Unit	KXOB25-14X1F	KXOB25-05X3F	KXOB25-02X8F
Voc	V	0.69	2.07	5.53
Isc	mA	58.6	19.5	6.3
Pmax	mW	30.7	30.7	26.3
Vmax	V	0.56	1.67	4.46
Imax	mA	55.0	18.4	5.9
Dimensions	mm(LxWxH)	23x8x1.8	23x8x1.8	23x8x1.8
Unit cell area	mm ² (LxW)	141.68	47.45	15.28

APPLICATIONS:

- Battery chargers for various kinds of sensors, Asset trackers, and IoT applications
- Energy harvesting
- Power backup for sensors, wearables, Nanonet, Bluetooth, Wi-Fi etc.



SolarMD (Examples)

- SM141K04LV : 21.5mm x 6.59mm by 4S
- SM141K08L : 21.5mm x 6.59mm by 8S
- SM700K10L : 10.8mm x 6.59mm by 10S
- SM531K12L : 21.5mm x 12.25mm x 2P by 12S

SPECIFICATIONS:

Symbol (unit)	SM141K06L	SM141K08L	SM141K09L	SM141K10L	SM700K10L	SM500K12L	SM101K12L	SM531K08L	SM531K10L	SM531K12L
Voc (V)	4.15	5.53	6.22	6.91	6.91	8.29	8.29	5.53	6.91	8.29
Isc (mA)	58.6	58.6	58.6	58.6	29.5	21.0	41.9	217.8	217.8	217.8
Pmax (mW)	184.4	245.8	276.5	307.3	154.3	132.3	263.4	913.0	1141.3	1369.5
Vmax (V)	3.35	4.46	5.02	5.58	5.58	6.70	6.70	4.46	5.58	6.70
Imax (A)	55.1	55.1	55.1	55.1	27.7	19.8	39.3	204.5	204.5	204.5
Dimensions (mm)	42x23x1.8	88x15x1.8	63x23x1.8	45x36x1.8	24x36x1.8	24x32x1.8	45x32x1.8	89x52x1.8	89x65x1.8	89x77x1.8
Unit cell area (mm ²)	141.68	141.68	141.68	141.68	71.17	50.87	101.26	263.37	263.37	263.37

APPLICATIONS:

- Battery chargers such as sensors, asset trackers, IoTs, ETCs, cell phones, MP3-players, PDAs etc.
- Emergency backup charging, Energy harvesting, Inductive Loop Vehicle Detection
- Power backup for wireless sensors, GPS, wearables

IXOLAR™ SolarBIT

- Can connect as many BITs to match an application
 - Has high mechanical robustness
 - Is surface mount package
 - Makes possible automatic pick & place mounting
 - Requires no hand mounting
 - Reflow soldering compatible
 - Tape & reel packaging
- **Why do IXOLAR™ not degrade over time like other solar technologies?**
- IXOLAR™ cells are made from monocrystalline silicon free from impurities that reduce the output voltage, current and resulting efficiency.
 - In comparison polycrystalline, thin film and amorphous materials contain impurities causing an efficiency reduction of 20% in the first 10 to 100 operating hours, following an exponential function.

Advantages of IXOLAR™

Superior to competition



The strength of the IXOLAR Solar is that it is able to quickly produce and supply uniform quality products that are driven by the new technology and produced in automated process with a single-crystal silicon solar cell which has a highest 25% energy-conversion efficiency per unit area.

In addition, since IXOLAR Solar does not directly operate manufacturing facilities and personnel, it reduces the risk and cost of operating facilities, and provides high-quality service to customers at a low cost through the use of global marketing and sales channels that are already well-organized.

By combining heat dissipation know-how gained from semiconductor manufacturing and operation over a long period of time, we produce the thinnest, SMT-enabled, various powers and sizes solar modules with high performance reliability.

IXOLAR Solar is one of the highest quality products that has been proven performance and reliability for long from many leading customers.

Copper foundation

is nearly impervious to heat and humidity⁴

Durable cell design

flexes in fluctuating temperatures —while other cells break



Unique cell architecture

performs better than conventional panels in cloudy weather and partial shade⁵

Converts more sunlight

starting earlier and lasting later in the day than conventional panels⁶



Annual Reliability Report

Superior to competition



RELIABILITY REPORT KXOB and SM product.

Temperature Cycle

Failure modes: Thermal fatigue of silicon-metal and metal-metal interfaces due to Keating and cooling, causing thermal and electrical performance degradation.

Humidity Test

Failure Modes: Degradation of electrical leakage characteristics due to moisture penetration into plastic packages.

UV Test

Failure Modes: Degradation of encapsulation material integrity due to high energy UV irradiation, causing electrical performance degradation and encapsulation material delamination.

Weather Test

Failure Modes: Sequential degradation of electrical leakage characteristics and encapsulation material integrity due to the weather condition combined with sequential Humidity and UV tests, causing electrical performance degradation and encapsulation material delamination.

Summary of Tables : Temperature Cycle

	Table 1 KXOB & SLMD discrete device
Total Lots Tested	24
Total Devices Tested	480
Total Failures	0
Total Device Cycles	241,920

Summary of Tables : Humidity Test

	Table 2 KXOB & SLMD discrete device
Total Lots Tested	24
Total Devices Tested	480
Total Failures	0
Total Device Cycles	480,000

Summary of Tables: UV Test

	Table 3 KXOB & SM discrete device
Total Lots Tested	24
Total Devices Tested	480
Total Failures	0
Total Device Hours	72,000

Summary of Tables: Weather Test

	Table 4 KXOB & SM discrete device
Total Lots Tested	24
Total Devices Tested	480
Total Failures	0
Total Device Hours Humidity	28,800
Total Device Hours UV A+B	72,000

Weather TEST

UV TEST

TEMPERATURE CYCLE

TABLE 1: KXOB & SLMD

#	Part Number	Test #	Temp [°C]	Rel. H [%]	Time [hrs]	Sample Size	Failures	Device Hours [hrs]	Remark
1	KXOB22-01X4F	1601	85	85	1000	20	0	20000	
2	KXOB22-04X2F	1602	85	85	1000	20	0	20000	
3	KXOB22-12X1F	1603	85	85	1000	20	0	20000	
4	KXOB22-05X3F	1604	85	85	1000	20	0	20000	
5	KXOB22-01X8F	1605	85	85	1000	20	0	20000	
6	SLMD360H04L	1607	85	85	1000	20	0	20000	
7	SLMD360H10L	1608	85	85	1000	20	0	20000	
8	SLMD600H10L	1609	85	85	1000	20	0	20000	
9	SLMD480H12L	1610	85	85	1000	20	0	20000	
10	SLMD720H12L	1611	85	85	1000	20	0	20000	
11	SLMD960H12L	1612	85	85	1000	20	0	20000	
12	SLMD121HD4L	1613	85	85	1000	20	0	20000	
13	SLMD121HD8L	1614	85	85	1000	20	0	20000	
14	SLMD121HD8L	1615	85	85	1000	20	0	20000	
15	SLMD121HD8L	1616	85	85	1000	20	0	20000	
16	SLMD121HI0L	1617	85	85	1000	20	0	20000	
17	SLMD241HD8L	1618	85	85	1000	20	0	20000	
18	SLMD321HD8L	1619	85	85	1000	20	0	20000	
19	SLMD600H09L	1620	85	85	1000	20	0	20000	
20	SLMD960H12L	1621	85	85	1000	20	0	20000	
21	SLMD481HD8L	1622	85	85	1000	20	0	20000	
22	SLMD481HI0L	1623	85	85	1000	20	0	20000	
23	SLMD481HI2L	1624	85	85	1000	20	0	20000	
24	SLMD242HI0L	1625	85	85	1000	20	0	20000	



Typical Application

- **Wireless / Remote Sensors**
 - Blue tooth
 - Wi-Fi
 - NANONET
- **Light Sensors**
 - Light intensity measurement
 - Light spectrum analysis
- **IoTs**
 - Container asset tracking
 - Farm animal eartags : sheeps, cattles etc.
 - Equipment asset tracking
 - RFID tags
- **Portable Electronics such as:**
 - ETCs
 - Cell Phones
 - Automotive Keypads
 - Sport watches
- **Mobile Medical Systems**
- *... any application where extending battery life is a benefit.*

ETC : Electronic Toll Collection

MPEON(a part of SAMSUNG)

ITRONICS



Energy Harvesting, using KXOB25-14X1F

Hybrid Energy Harvesting Chip

No external power supply
Energy sources : Piezoelectric, Electromagnetic, Thermoelectric, Indoor solar cell, Microwave, Electrostatic
Input voltage : 1.1V ~ 1kV , **Consumption current** : under 11uA
Voltage regulation : 3.3V(Fixed)/5.0V(Fixed)/3.0V~5.5V(Adj.)

Power Management / Monitoring

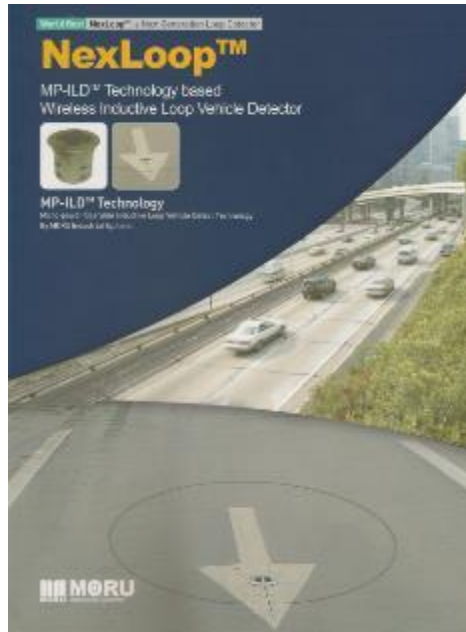
Monitoring : Energy harvesting voltage/current, Stored voltage, Load voltage/current
Input source : AC/DC Energy harvesting
gSensor measurement and analysis
Wireless sensor data display and logging

Energy harvesting

Energy Harvesting Source	Converted Energy (nW)	Frequency (Hz)	Effective Size (cm ²)	Energy Density (mW/cm ²)
Impact Energy	32	2	400	0.08
Vibration Energy	1.7	90	0.08	21.3
Strain Energy (Flexible Piezo Patch)	3.59	6.3	0.22	16.3

Power Management	Specification	Remark	
PowerManagement Chip	입력 전압 : 4.5~5.5V 크기 : 31 X 31 X 3mm Regulating, 음압전 재료, 전선외출	출력 전류 : 2mA 출력 power : 0.5mA@3.0V	GS Celltec / GS Nano Tech 박막전지용 음압전 재료용 새기 지 CD4 개발
Solar Powerchip	Solar 충전 성능 : 10,000 lux 미만 크기 : 31 X 31 X 4.7mm	출력 power : 0.5mA@3.0V	

INDUCTIVE LOOP VEHICLE DETECTOR, using SM531K12L



Why Inductive Loop Vehicle Detector?

We all know why we mostly used inductive loop vehicle detector for traffic signal control during last 100 years.

The typical reasons are known as



- Highly proved vehicle loop technology
- Best stability, detect accuracy and volume
- Free to design the inductive loop detect area
- Long life

What is NexLoop™?

NexLoop™ is upgraded inductive loop vehicle detector for next 100 years.

The main features are

- Works with traditional inductive loop vehicle detect principle
- Installable on the road surface close to the legacy loophead
- Wireless and micro-power operable with solar energy
- Eliminates troublesome lead in cable



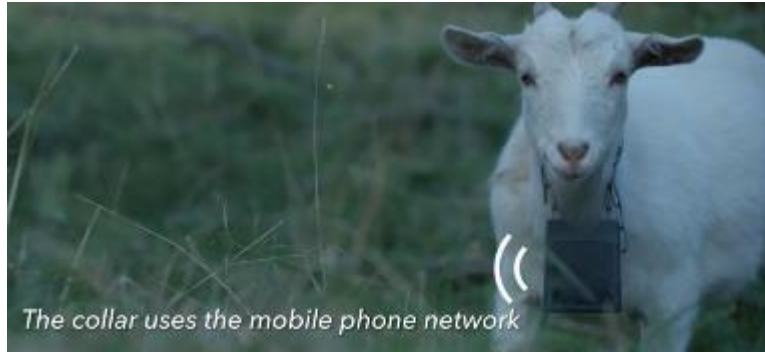
The diagrams show a cross-section of a road with a traditional inductive loop detector (top) and the NexLoop™ detector (bottom). The NexLoop™ detector is shown as a smaller unit installed closer to the road surface.



SMART CROSSWALK LIGHTING SYSTEM



Virtual fence for animal



Container asset tracker



Animal tracker



SOLAR PAPER for York Station



Wireless Sensor Network for TI

Wireless Sensor Network + bq25504 Energy Harvesting BoosterPack for LaunchPad



TEAM MEMBERS:

→ Joey Serikman

EXECUTIVE SUMMARY

A wireless sensor platform with energy harvesting for self-powered operation is presented. A new bq25504 BoosterPack is combined with the LaunchPad. A hub collects data from the nodes and plots it in Excel in real-time.

WHAT'S THE MOTIVATION FOR THIS PROJECT?

Recently, energy harvesting has garnered great interest in order to enable autonomous wireless sensor networks. Continual advances in RF and low-power such that it is feasible to implement small-form factor batteries and energy transducers for powering wireless sensors indefinitely.

- KXOB = SolarBIT
- SM = SolarMD

EXAMPLE:

KXOB25- 14X1F

SolarBIT

25% cell efficiency

14 : 140mm² cell size

1 : one cell

F : A film laminated encapsulation

EXAMPLE:

SM531K10L

SolarMD

531 : 530mm² cell size

K : 25% high cell efficiency

10 : 10 cells in series

L : B film laminated encapsulation



Preliminary

KXOB25-14X1F

IXOLAR™ High Efficiency SolarBIT.

Description

IXOLAR™ SolarBITS are Anysolar' product line of SolarBITS made of monocrystalline, high efficiency solar cells. The IXOLAR™ SolarBITS is an ideal for charging various battery powered and handheld consumer products such as mobile phones, cameras, RF-ID Tag, PDAs, MP3-Players and toys. They are also suitable for industrial applications such as wireless sensors, portable instrumentation and for charging emergency backup batteries.

With a cell efficiency of typically 25% measured at a wafer level, SolarBITS give the ability to extend run time even in "low light" conditions and increase battery life and run time in a small footprint, which can be easily accommodated in the design of Portable Products. The design allows connecting SolarBITS flexibly in series and/or parallel to perfectly meet the application's power requirements.

Product and Ordering Information (Package Level)

Part Number	Open Circuit Voltage [V]	Short Circuit Current [mA]	Typ. Voltage @ P _{max} [V]	Typ. Current @ P _{max} [mA]
KXOB25-14X1F	0.69	58.6	0.56	55.0

(Parameters given are typical values)
 Dimensions (L x W x H): 23 x 8 x 1.8 ± 0.3 [mm]
 SolarBITS Weight: 0.5 grams
 Storage Temperature: -40°C ~ +90°C
 Operation Temperature: -40°C ~ +90°C
 SolarBITS are compliant to the RoHS Norm.

Electrical Characteristics

Symbol	Cell Parameter	Typical Ratings *	Units
V _{oc}	open circuit voltage	690	mV
I _{sc}	short circuit current	58.6	mA
V _{mp}	voltage at max. power point	560	mV
I _{mp}	current at max. power point	55.0	mA
P _{mp}	maximum peak power	30.7	mW
FF	fill factor	> 70	%
η	solar cell efficiency	25	%
ΔV _{oc} /ΔT	open circuit voltage temp. coefficient	-1.7	mV/K
ΔI _{sc} /ΔT	short circuit current temp. coefficient	26.5	uA/K

* All values measured at Standard Condition: 1 sun (= 100 mW/cm²), Air Mass 1.5, 25°C



Features

- Monocrystalline silicon technology
- High efficiency outdoor and indoor
- Long life and stable output
- Sealed Package
- High mechanical robustness
- Surface Mount Package
- Reflow Solderable

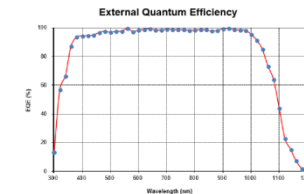
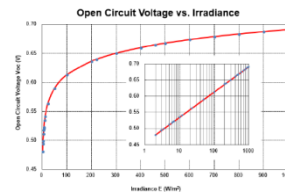
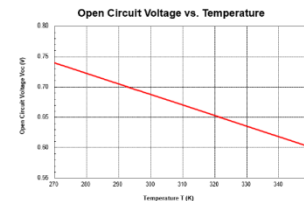
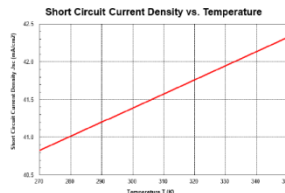
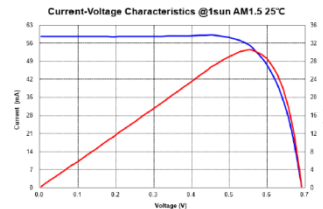
Applications

- Battery chargers for portables such as cell phones, PDAs, GPS-Systems, ...
- "Green" electricity generation
- Power backup for UPS, Sensors, Wearables

Advantages

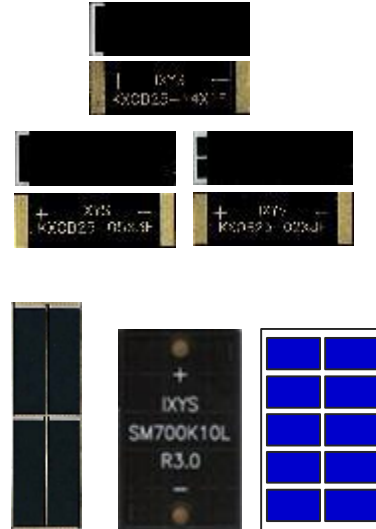
- Automatic Pick & Place Mounting
- One Product for Multiple Applications
- Flexible Integration into the Application

Typical SolarBIT Performance Data



IXOLAR™ Solar Products are Monocrystalline Silicon *resulting in:*

- **Higher Efficiency over Thin Film, Amorphous or Polycrystalline Cells**
 - Typically 20%-40% more efficient and higher current density for same surface area
 - IXOLAR™ is the most efficient in small SolarBIT and SolarMD applications
- **Conversion of a Wider Frequency Range of Light**
 - Provides usability under most lighting conditions
 - Indoors and outdoors
 - Incandescent, fluorescent, etc.
- **Consistent Performance Over Time**
 - No degradation of power output
 - No loss of frequency response
- **Extended Industrial Temperature Range**
- **Higher Reliability / Longer Life**



FOR MORE INFORMATION

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