NICHIA CORPORATION

SPECIFICATIONS FOR WHITE LED

NVSW219BT

- Pb-free Reflow Soldering Application
- Built-in ESD Protection Device
- RoHS Compliant

SPECIFICATIONS

(1) Absolute Maximum Ratings

Item	Symbol	Absolute Maximum Rating	Unit
Forward Current	I_F	1500	mA
Pulse Forward Current	I_{FP}	2000	mA
Allowable Reverse Current	I_R	85	mA
Power Dissipation	P_D	5.4	W
Operating Temperature	T_{opr}	-40~100	°C
Storage Temperature	T_{stg}	-40~100	°C
Junction Temperature	T_J	150	°C

* Absolute Maximum Ratings at T_S=25°C.
* I_{FP} conditions with pulse width ≤10ms and duty cycle ≤10%.

(2) Initial Electrical/Optical Characteristics

Item		Symbol	Condition	Typ	Max	Unit
Forward Voltage		V_F	I_F=700mA	3.13	-	V
			I_F=350mA	2.95	-	
Rnn	Luminous Flux	Φ_v	I_F=700mA	290	-	lm
			I_F=350mA	155	-	
	Luminous Intensity	I_v	I_F=700mA	76	-	cd
			I_F=350mA	41	-	
	Color Rendering	R_a	I_F=700mA	-	-	-
R70	Luminous Flux	Φ_v	I_F=700mA	270	-	lm
			I_F=350mA	145	-	
	Luminous Intensity	I_v	I_F=700mA	72	-	cd
			I_F=350mA	39	-	
	Color Rendering	R_a	I_F=700mA	73	-	-
R8000	Luminous Flux	Φ_v	I_F=700mA	230	-	lm
			I_F=350mA	122	-	
	Luminous Intensity	I_v	I_F=700mA	61	-	cd
			I_F=350mA	32	-	
	Color Rendering	R_a	I_F=700mA	83	-	-
Chromaticity Coordinate	x	-	I_F=700mA	0.344	-	-
	y	-	I_F=700mA	0.355	-	-
Thermal Resistance		$R_{\theta JS}$	-	6	11	°C/W

* Characteristics at T_S=25°C.
* Luminous Flux value as per CIE 127:2007 standard.
* Chromaticity Coordinates as per CIE 1931 Chromaticity Chart.
* $R_{\theta JS}$ is Thermal Resistance from junction to T_S measuring point.

RANKS

Item	Rank		Condition	Min	Max	Unit
Forward Voltage	M2		I_F=700mA	3.4	3.6	V
	M1			3.2	3.4	
	L2			3.0	3.2	
	L1			2.8	3.0	
Luminous Flux	D300		I_F=700mA	300	320	lm
	D280			280	300	
	D260			260	280	
	D240			240	260	
	D220			220	240	
	D200			200	220	
Color Rendering	Rnn	R_a	I_F=700mA	-	-	-
	R70	R_a		70	-	-
	R8000	R_a		80	-	-
		R_9		0	-	-

Color Ranks

	Rank c1			
x	0.3300	0.3300	0.3610	0.3570
y	0.3390	0.3600	0.3850	0.3610

	Rank c2			
x	0.3300	0.3300	0.3570	0.3560
y	0.3180	0.3390	0.3610	0.3510

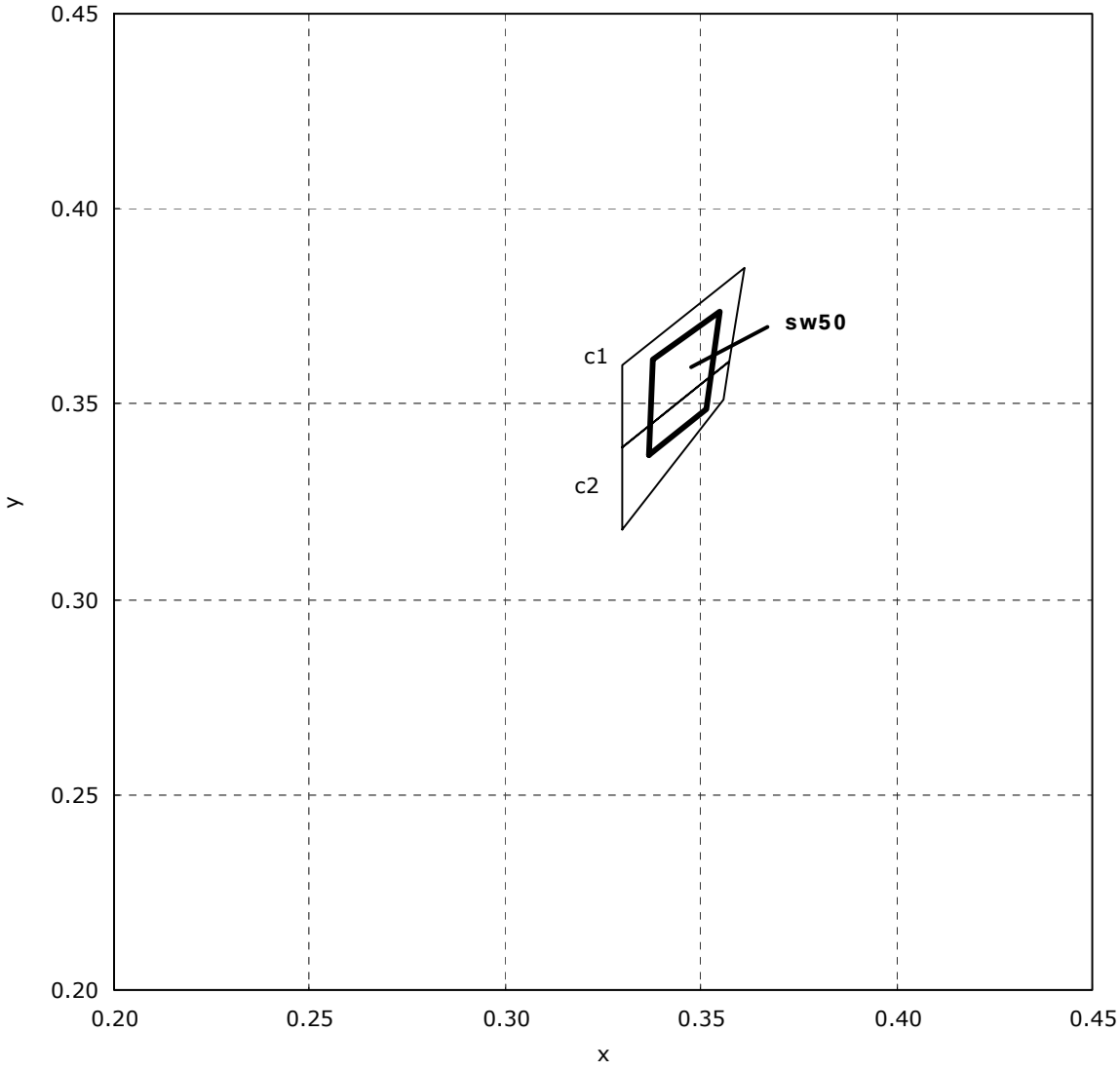
	Rank sw50			
x	0.3366	0.3376	0.3548	0.3515
y	0.3369	0.3616	0.3736	0.3487

* Ranking at T_S=25°C.
* Tolerance of measurements of the Forward Voltage is ±0.05V.
* Tolerance of measurements of the Luminous Flux is ±7%.
* Tolerance of measurements of the Color Rendering R_a is ±2.
* Tolerance of measurements of the Color Rendering R_9 is ±6.5.
* The R_9 value for the above rank shall be greater than 0.
* Tolerance of measurements of the Chromaticity Coordinate is ±0.005.
* A shipment shall consist of LEDs in a combination of the above ranks.
  The percentage of each rank in the shipment shall be determined by Nichia.

Luminous Flux Ranks by Color Rank, Color Rendering Rank

Ranking by Color Coordinates, Color Rendering \ Ranking by Luminous Flux		D200	D220	D240	D260	D280	D300
c1,c2	Rnn						
	R70						
sw50	R8000						

CHROMATICITY DIAGRAM

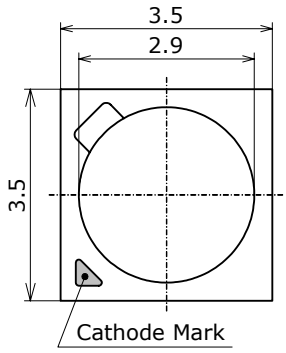


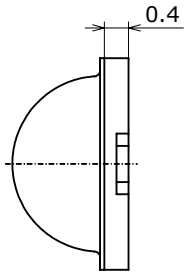
OUTLINE DIMENSIONS

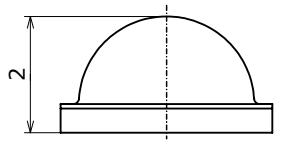
* 本製品はRoHS指令に適合しております。
This product complies with RoHS Directive.

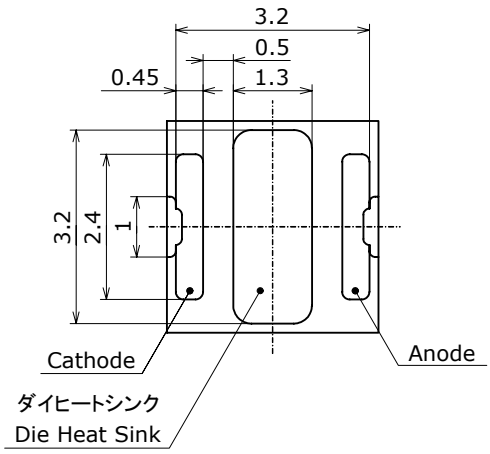
NVSW219B
管理番号 No. STS-DA7-1727

(単位 Unit: mm，公差 Tolerance: ±0.2)

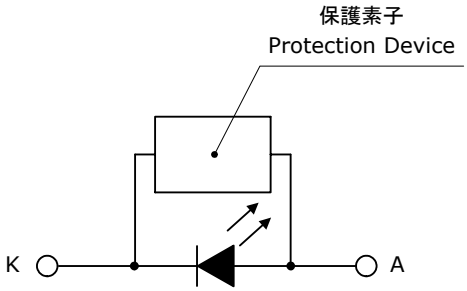






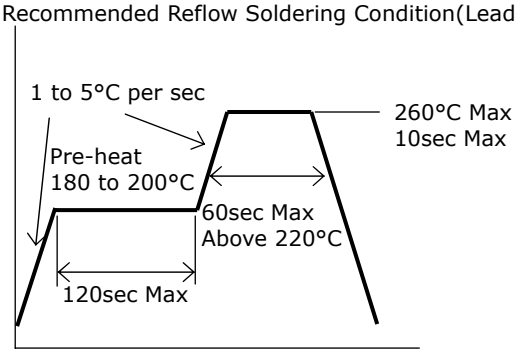


項目 Item	内容 Description
パッケージ材質 Package Materials	セラミックス Ceramics
封止樹脂材質 Encapsulating Resin Materials	シリコーン樹脂（蛍光体入り） Silicone Resin (with phosphor)
電極材質 Electrodes Materials	金メッキ Au-plated
レンズ材質 Lens Materials	シリコーン樹脂 Silicone Resin
ダイヒートシンク材質 Die Heat Sink Materials	金メッキ Au-plated
質量 Weight	0.030g (TYP)

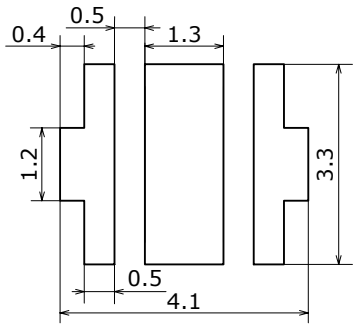


SOLDERING

• Recommended Reflow Soldering Condition(Lead-free Solder)

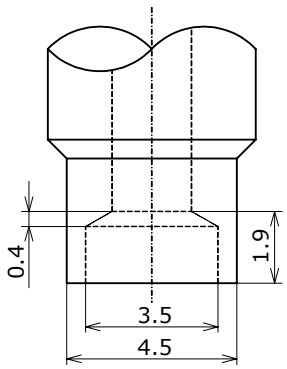


• Recommended Soldering Pad Pattern



(単位 Unit: mm)

* This LED is designed to be reflow soldered on to a PCB. If dip soldered or hand soldered, Nichia cannot guarantee its reliability.
* Reflow soldering must not be performed more than twice.
* Avoid rapid cooling. Ramp down the temperature gradually from the peak temperature.
* Nitrogen reflow soldering is recommended. Air flow soldering conditions can cause optical degradation, caused by heat and/or atmosphere.
* Since the silicone used in the encapsulating resin is soft, do not press on the encapsulant resin. Pressure can cause nicks, chip-outs, encapsulant delamination and deformation, and bump breaks, decreasing reliability. When using automatic pick and place machine, use a pick up nozzle which does not directly apply stress to the encapsulation of the LEDs.
  Recommended conditions:
  It is recommended to use a pick up nozzle designed for the LEDs. (See Figure below.)
  * Avoid direct contact to the resin lens with the picking up nozzle.
    Failure to comply might result in catastrophic failure of the LEDs due to bump damage or breakage.



(単位 Unit: mm)

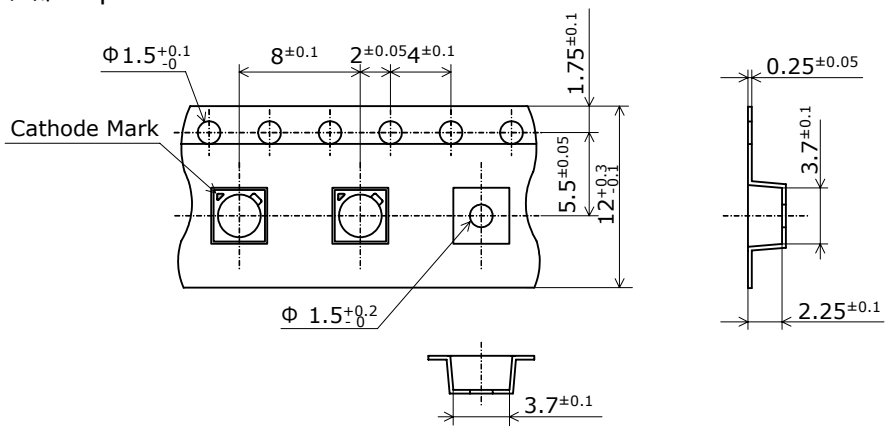
* Repairing should not be done after the LEDs have been soldered. When repairing is unavoidable, a hot plate should be used.
  It should be confirmed beforehand whether the characteristics of the LEDs will or will not be damaged by repairing.
* The Die Heat Sink should be soldered to customer PCB.
  If it is difficult or impossible, use high heat-dissipating adhesive.
* When soldering, do not apply stress to the LED while the LED is hot.
* This product uses an electrode pad design which improves thermal shock resistance.
  After mounting, it is recommended to check if the solder fillets are properly formed on the sides of the pads.

TAPE AND REEL DIMENSIONS

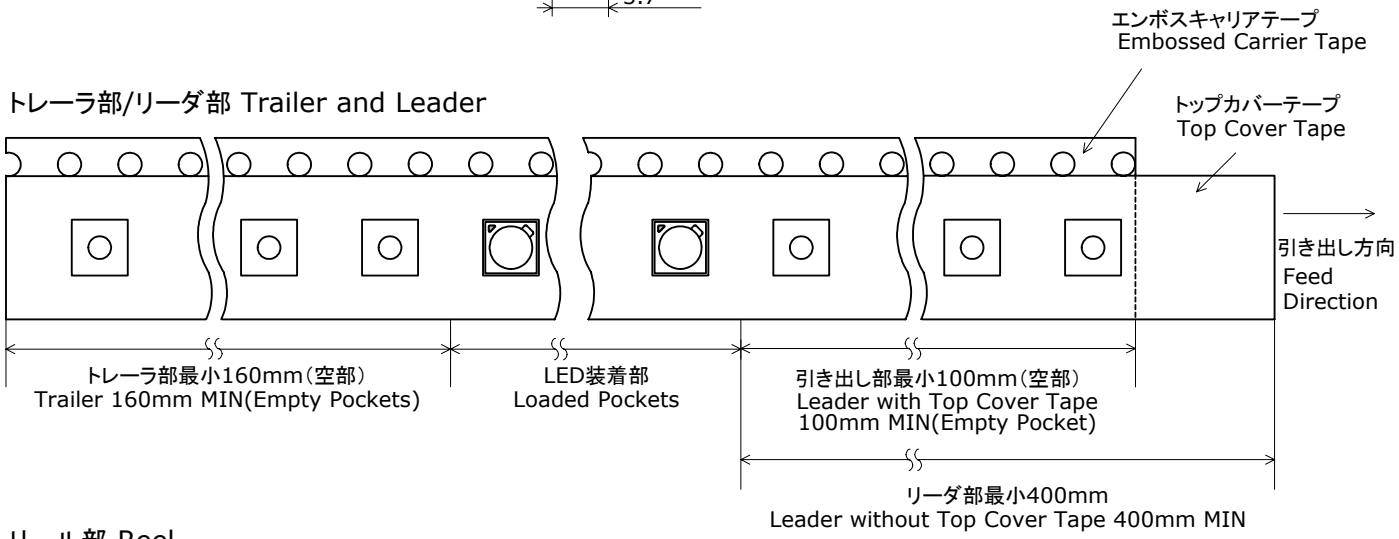
Nxxx219x
管理番号 No. STS-DA7-1728

(単位 Unit: mm)

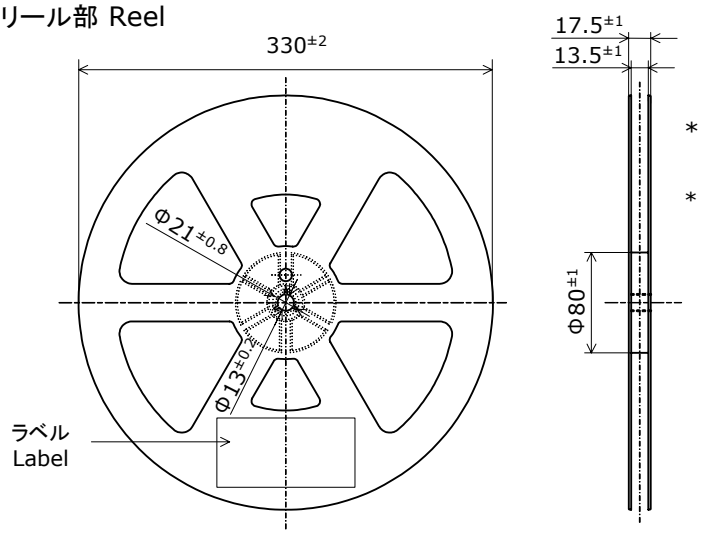
テーピング部 Tape



トレーラ部/リーダ部 Trailer and Leader



リール部 Reel



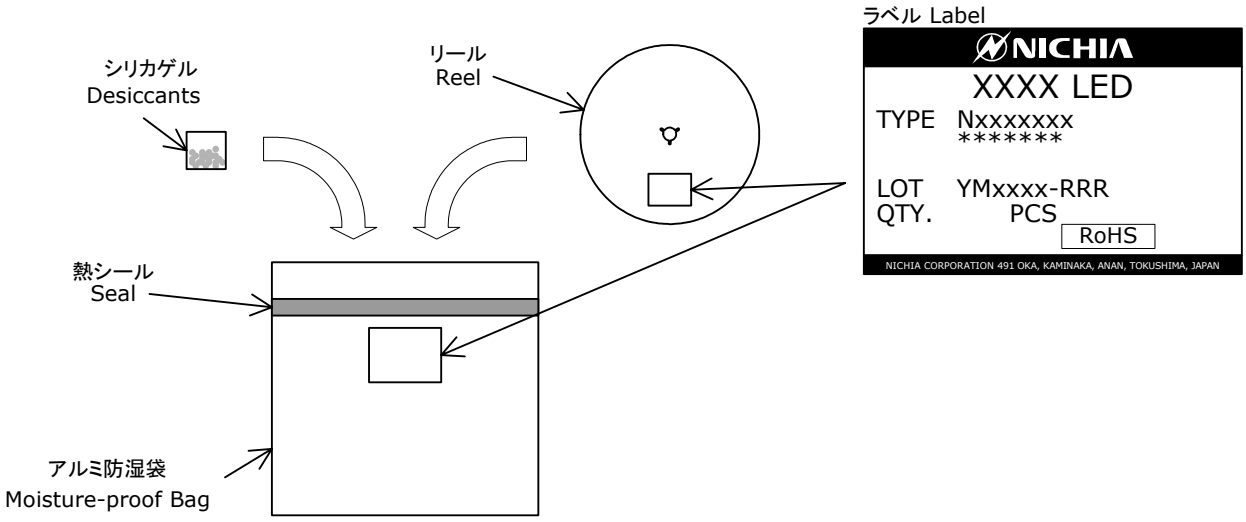
* 数量は1リールにつき 3500個入りです。
Reel Size: 3500pcs

* JIS C 0806電子部品テーピングに準拠しています。
The tape packing method complies with JIS C 0806 (Packaging of Electronic Components on Continuous Tapes).

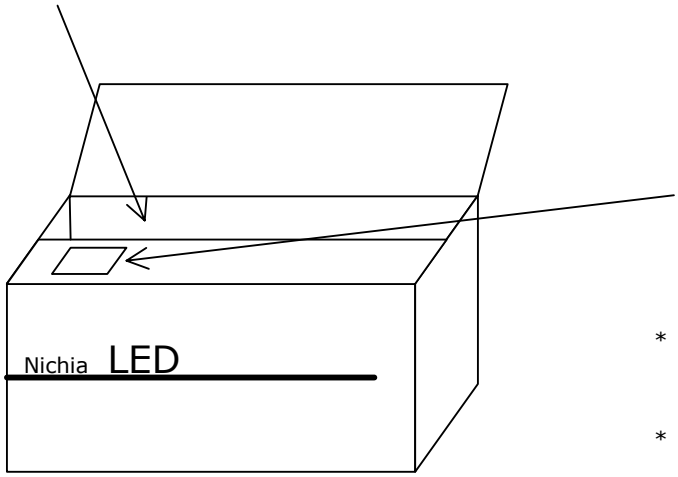
PACKAGING - TAPE & REEL

シリカゲルとともにリールをアルミ防湿袋に入れ、熱シールにより封をします。
Reels are shipped with desiccants in heat-sealed moisture-proof bags.

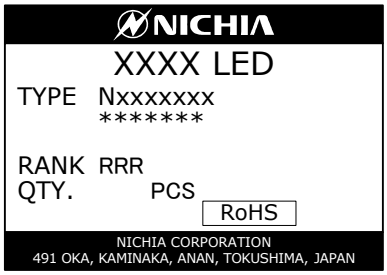
Nxxxxxxx
管理番号 No. STS-DA7-0006B



アルミ防湿袋を並べて入れ、ダンボールで仕切ります。
Moisture-proof bags are packed in cardboard boxes with corrugated partitions.



ラベル Label



* 客先型名を*******で示します。
客先型名が設定されていない場合は空白です。
******* is the customer part number.
If not provided, it is not indicated on the label.
* ロット表記方法についてはロット番号の項を参照して下さい。
For details, see "LOT NUMBERING SCHEME" in this document.
* ランク分けがない場合はランク表記はありません。
The label does not have the RANK field for un-ranked products.

* 本製品はテーピングしたのち、輸送の衝撃から保護するためダンボールで梱包します。
Products shipped on tape and reel are packed in a moisture-proof bag.
They are shipped in cardboard boxes to protect them from external forces during transportation.
* 取り扱いに際して、落下させたり、強い衝撃を与えたりしますと、製品を損傷させる原因になりますので注意して下さい。
Do not drop or shock the box. It may damage the products.
* ダンボールには防水加工がされておりませんので、梱包箱が水に濡れないよう注意して下さい。
Do not expose to water, the box is not water-resistant.
* 輸送、運搬に際して弊社よりの梱包状態あるいは同等の梱包を行って下さい。
Using an original packaging material or equivalent in transit is recommended.

LOT NUMBERING SCHEME

Lot Number is presented by using the following alphanumeric code.

YMxxxx - RRR

Y - Year

Year	Y
2009	9
2010	A
2011	B
2012	C
2013	D
2014	E

M - Month

Month	M	Month	M
1	1	7	7
2	2	8	8
3	3	9	9
4	4	10	A
5	5	11	B
6	6	12	C

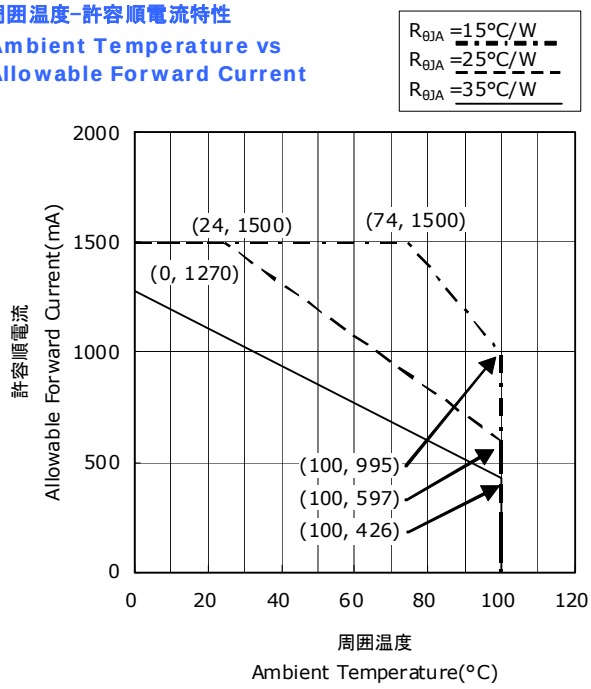
xxxx-Nichia's Product Number

RRR-Ranking by Color Coordinates, Ranking by Luminous Flux, Ranking by Forward Voltage, Ranking by Color Rendering

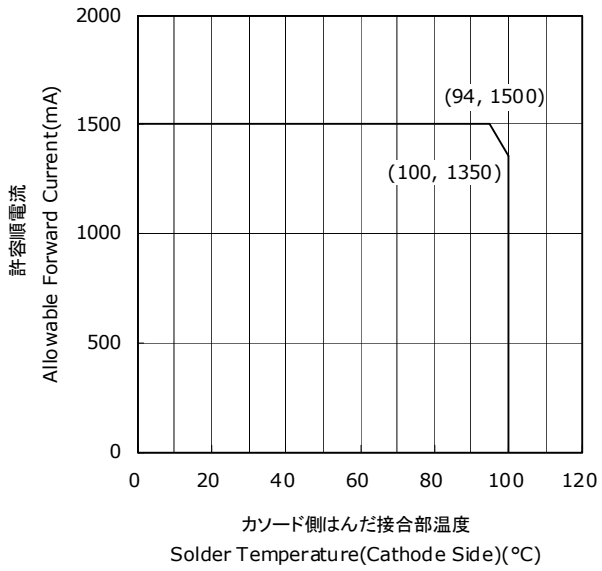
DERATING CHARACTERISTICS

NVSx219B
管理番号 No. STS-DA7-1723

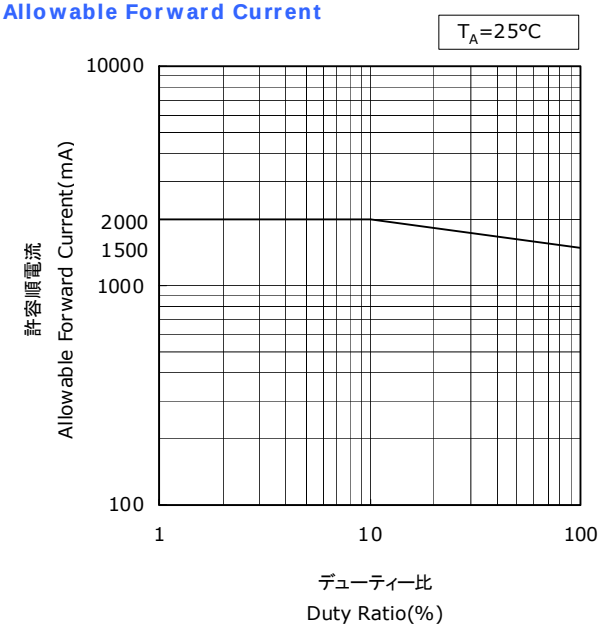
周囲温度−許容順電流特性
Ambient Temperature vs
Allowable Forward Current



カソード側はんだ接合部温度−許容順電流特性
Solder Temperature(Cathode Side) vs
Allowable Forward Current



デューティー比−許容順電流特性
Duty Ratio vs
Allowable Forward Current

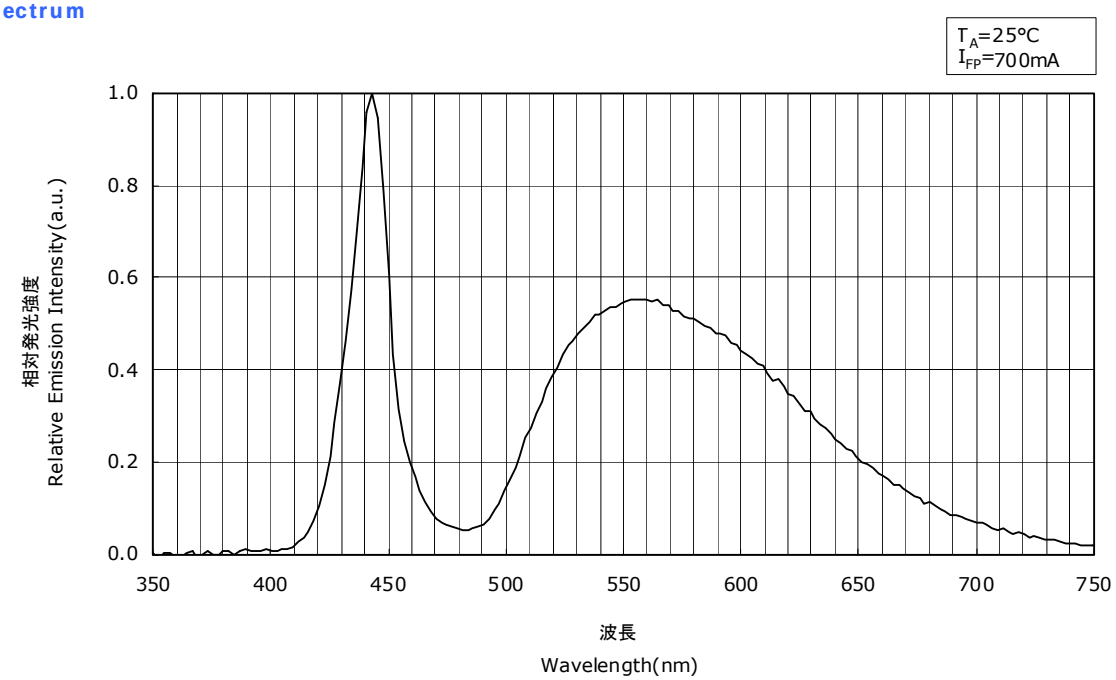


OPTICAL CHARACTERISTICS

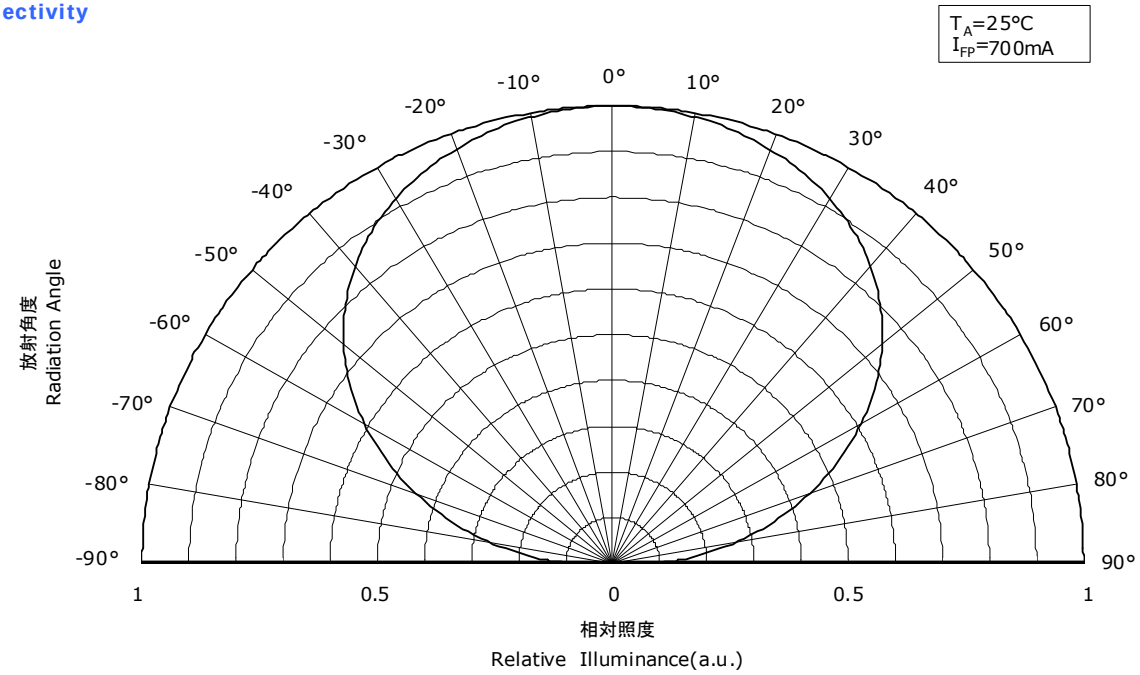
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-1724A

発光スペクトル
Spectrum



指向特性
Directivity



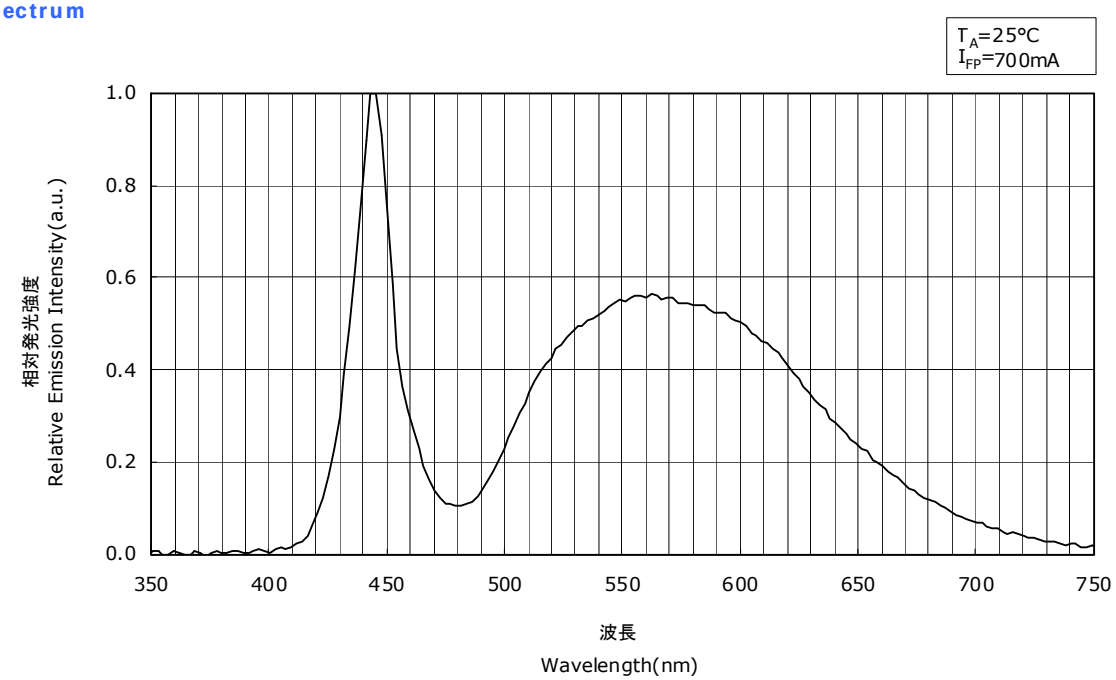
＊ 本特性は演色性ランクRnnに対応しています。
The graphs above show the characteristics for Rnn LEDs of this product.

OPTICAL CHARACTERISTICS

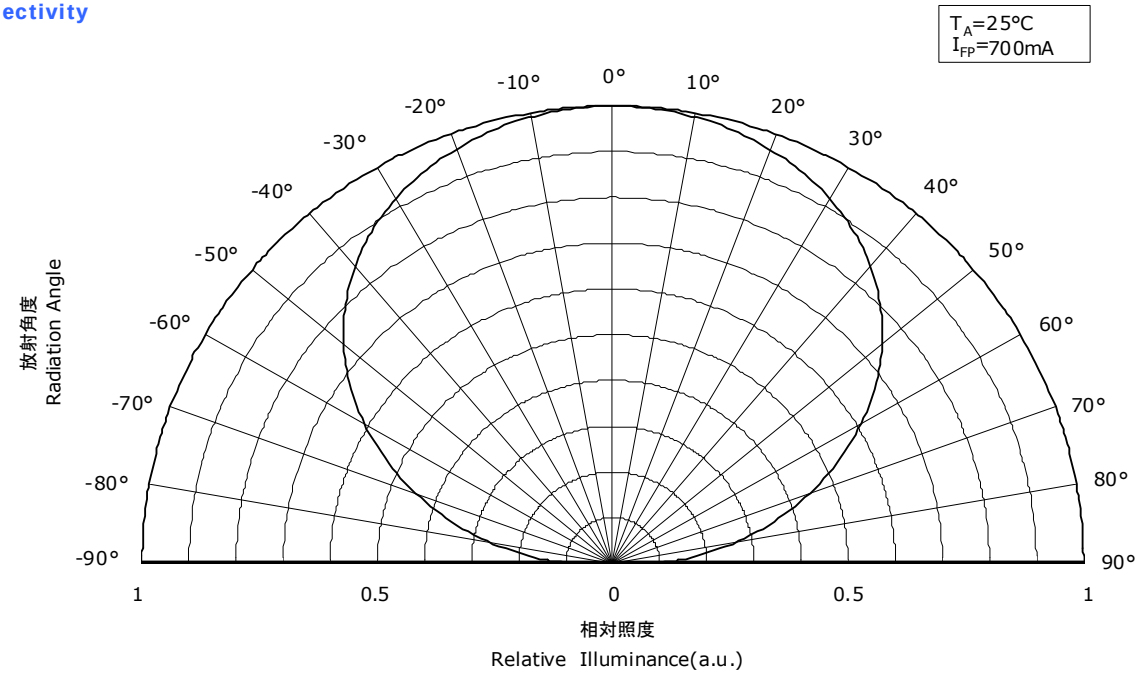
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-2442

発光スペクトル
Spectrum



指向特性
Directivity



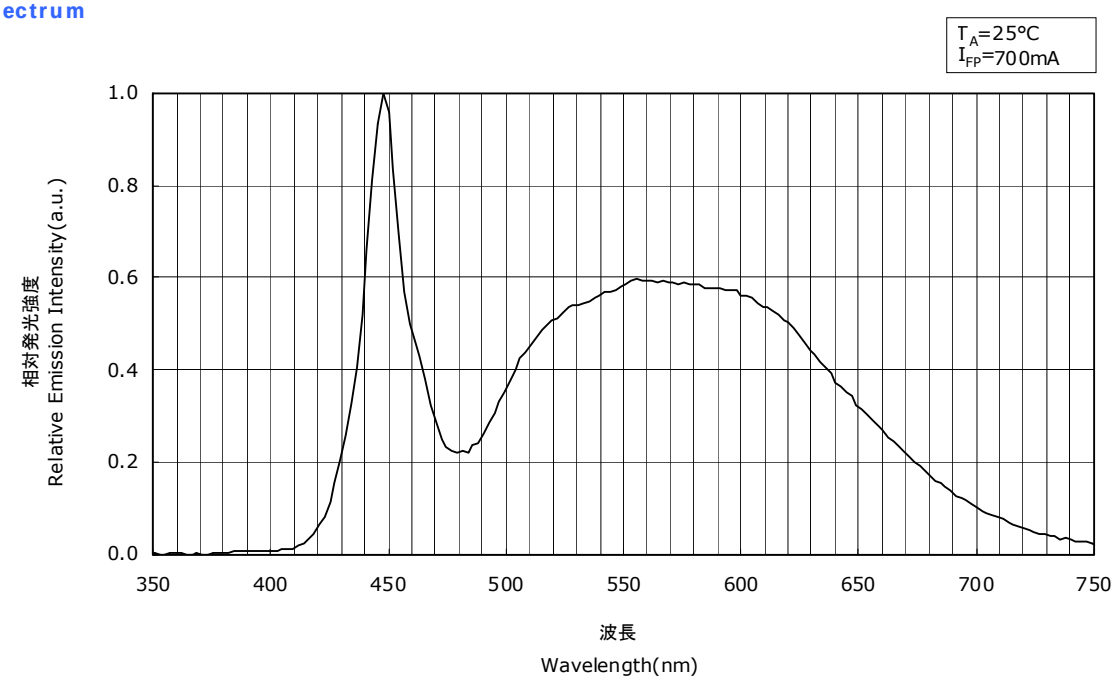
＊ 本特性は演色性ランクR70に対応しています。
The graphs above show the characteristics for R70 LEDs of this product.

OPTICAL CHARACTERISTICS

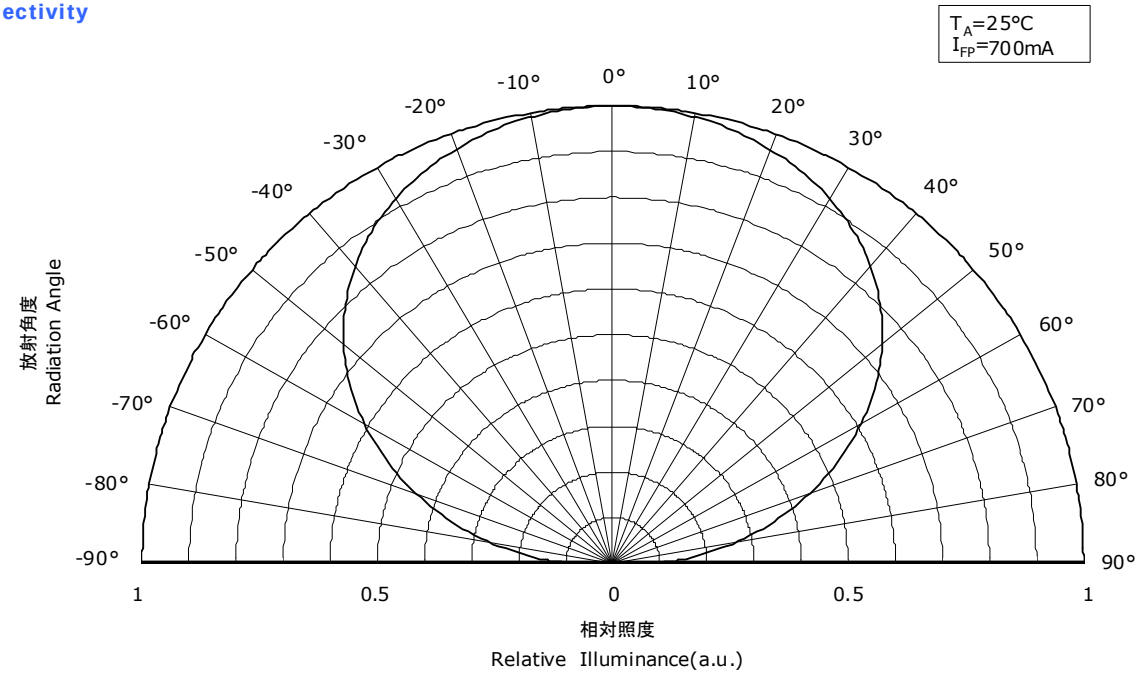
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-3187

発光スペクトル
Spectrum



指向特性
Directivity



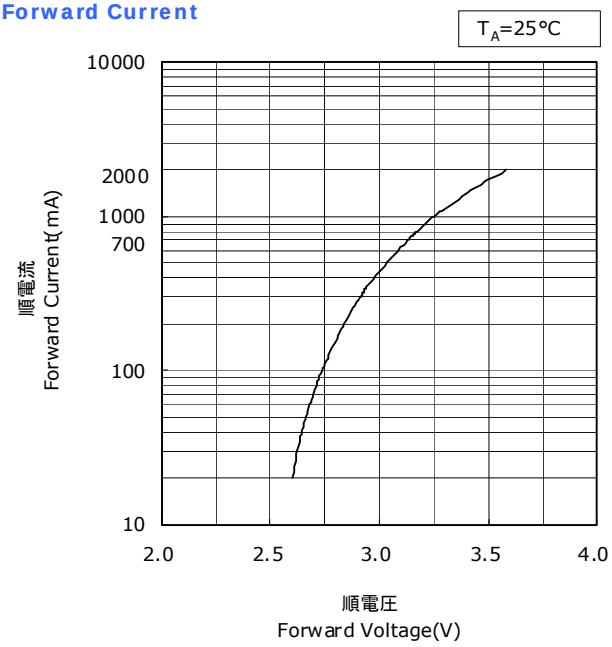
＊ 本特性は演色性ランクR8000に対応しています。
The graphs above show the characteristics for R8000 LEDs of this product.

FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

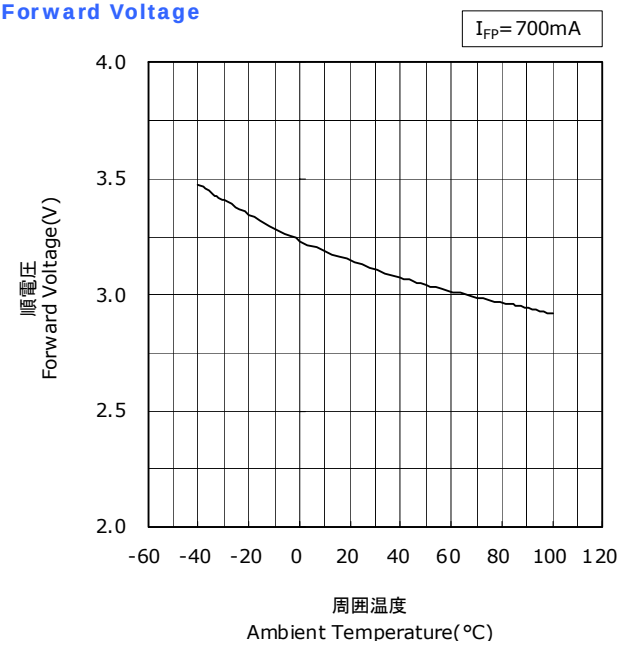
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-1725

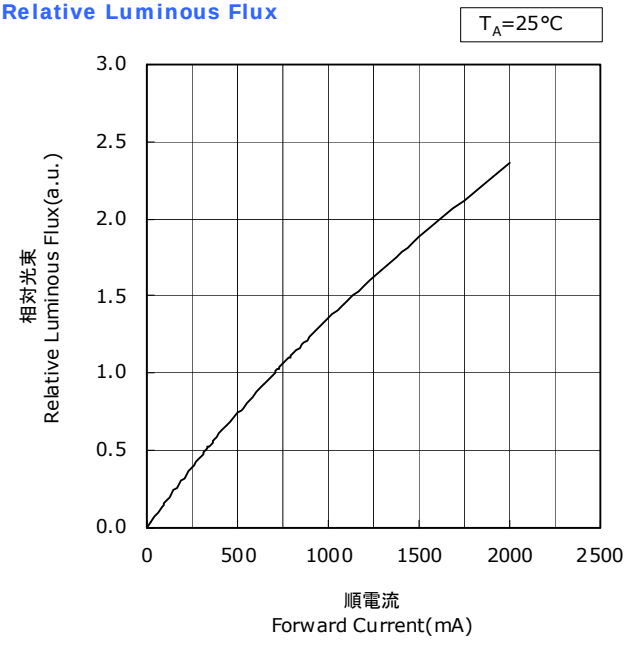
順電圧-順電流特性
Forward Voltage vs Forward Current



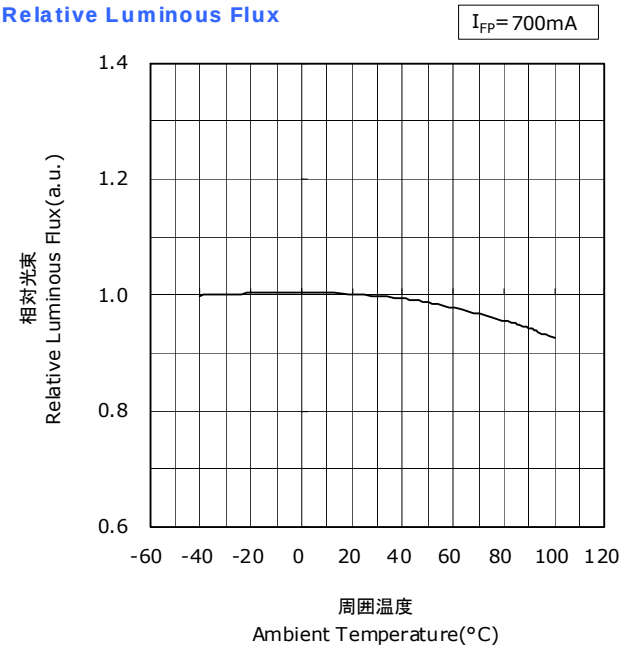
周囲温度-順電圧特性
Ambient Temperature vs Forward Voltage



順電流-相対光束特性
Forward Current vs Relative Luminous Flux



周囲温度-相対光束特性
Ambient Temperature vs Relative Luminous Flux

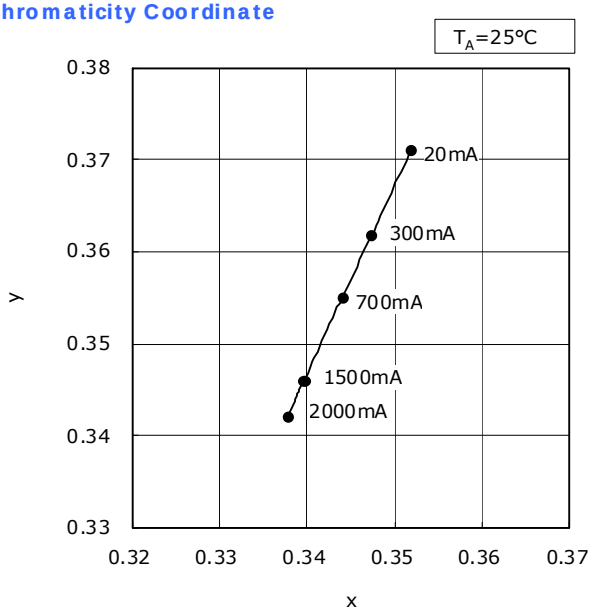


FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

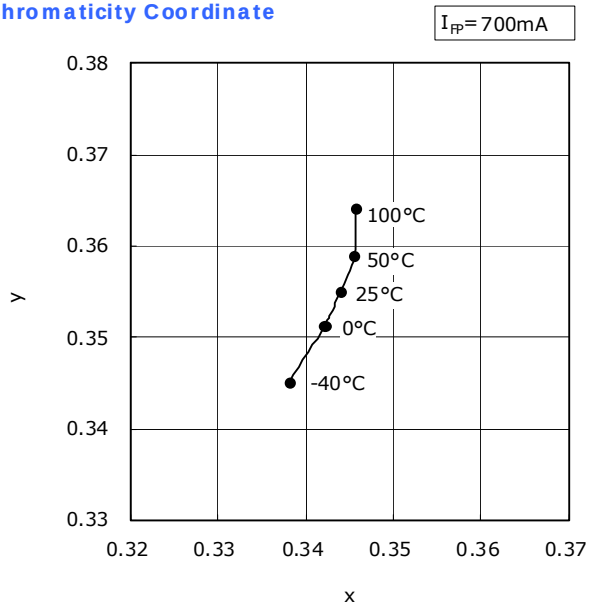
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-1726A

順電流-色度特性
Forward Current vs
Chromaticity Coordinate



周囲温度-色度特性
Ambient Temperature vs
Chromaticity Coordinate



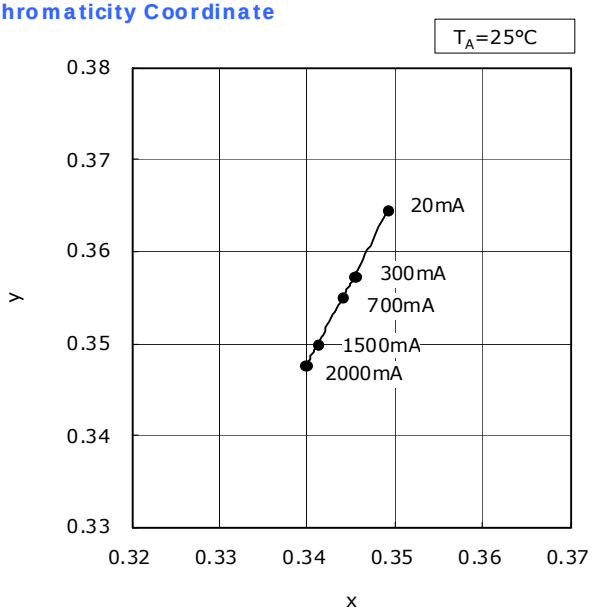
＊ 本特性は演色性ランクRnnに対応しています。
The graphs above show the characteristics for Rnn LEDs of this product.

FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

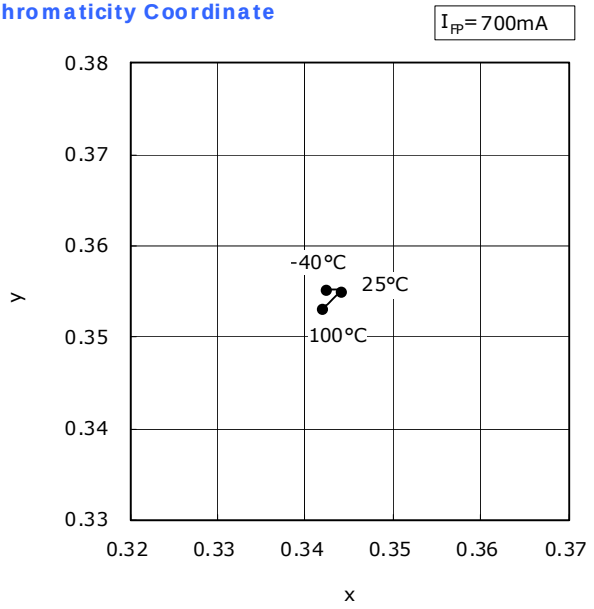
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-2443A

順電流–色度特性
Forward Current vs Chromaticity Coordinate



周囲温度–色度特性
Ambient Temperature vs Chromaticity Coordinate



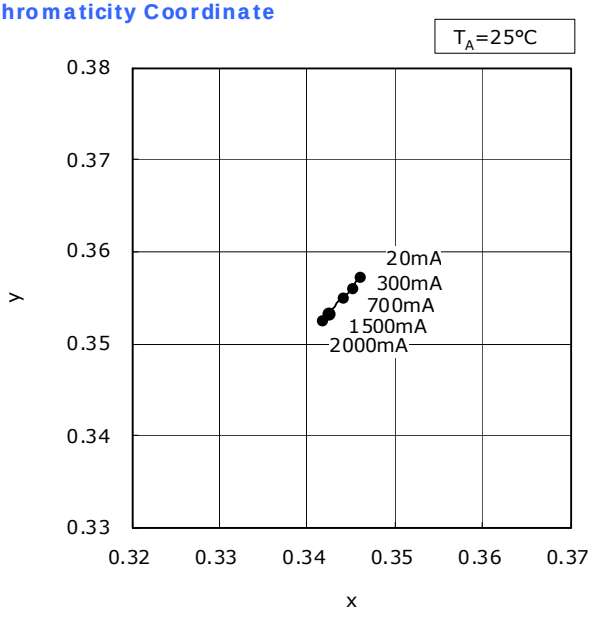
＊ 本特性は演色性ランクR70に対応しています。
The graphs above show the characteristics for R70 LEDs of this product.

FORWARD CURRENT CHARACTERISTICS / TEMPERATURE CHARACTERISTICS

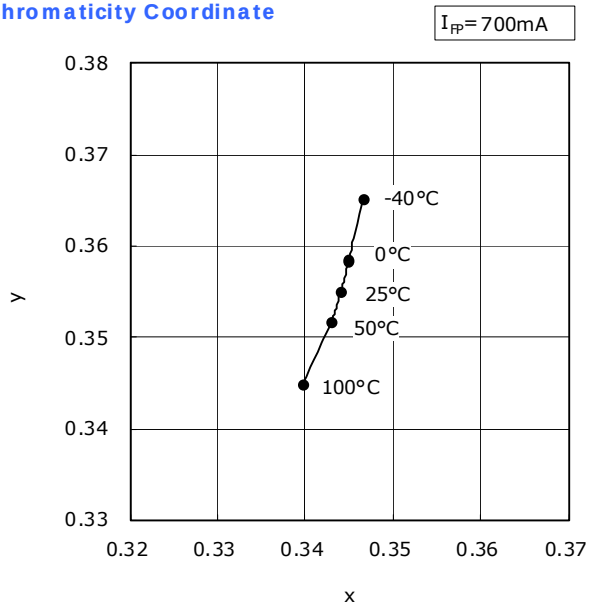
＊ 本特性は参考です。
All characteristics shown are for reference only and are not guaranteed.

NVSW219B
管理番号 No. STS-DA7-3188

順電流-色度特性
Forward Current vs
Chromaticity Coordinate



周囲温度-色度特性
Ambient Temperature vs
Chromaticity Coordinate



＊ 本特性は演色性ランクR8000に対応しています。
The graphs above show the characteristics for R8000 LEDs of this product.

RELIABILITY

(1) Tests and Results

Test	Reference Standard	Test Conditions	Test Duration	Failure Criteria #	Units Failed/Tested
Resistance to Soldering Heat (Reflow Soldering)	JEITA ED-4701 300 301	T_{sld}=260°C, 10sec, 2reflows, Precondition: 30°C, 70%RH, 168hr		#1	0/22
Solderability (Reflow Soldering)	JEITA ED-4701 303 303A	T_{sld}=245±5°C, 5sec, Lead-free Solder(Sn-3.0Ag-0.5Cu)		#2	0/22
Temperature Cycle	JEITA ED-4701 100 105	-40°C(30min)~25°C(5min)~ 100°C(30min)~25°C(5min)	100cycles	#1	0/22
Moisture Resistance (Cyclic)	JEITA ED-4701 200 203	25°C~65°C~-10°C, 90%RH, 24hr per cycle	10cycles	#1	0/22
High Temperature Storage	JEITA ED-4701 200 201	T_A=100°C	1000hours	#1	0/22
Temperature Humidity Storage	JEITA ED-4701 100 103	T_A=60°C, RH=90%	1000hours	#1	0/22
Low Temperature Storage	JEITA ED-4701 200 202	T_A=-40°C	1000hours	#1	0/22
Room Temperature Operating Life		T_A=25°C, I_F=1000mA Test board: See NOTES below	1000hours	#1	0/22
High Temperature Operating Life		T_A=100°C, I_F=400mA Test board: See NOTES below	1000hours	#1	0/22
Temperature Humidity Operating Life		60°C, RH=90%, I_F=700mA Test board: See NOTES below	500hours	#1	0/22
Low Temperature Operating Life		T_A=-40°C, I_F=700mA Test board: See NOTES below	1000hours	#1	0/22
Vibration	JEITA ED-4701 400 403	200m/s^2, 100~2000~100Hz, 4cycles, 4min, each X, Y, Z	48minutes	#1	0/10
Electrostatic Discharges	JEITA ED-4701 300 304	HBM, 2kV, 1.5kΩ, 100pF, 3pulses, alternately positive or negative		#1	0/22

NOTES:

1) Test board: FR4 board thickness=1.6mm, copper layer thickness=0.07mm, $R_{\theta JA}$≈35°C/W

2) Measurements are performed after allowing the LEDs to return to room temperature.

(2) Failure Criteria

Criteria #	Items	Conditions	Failure Criteria
#1	Forward Voltage(V_F)	I_F=700mA	>Initial value×1.1
	Luminous Flux(Φ_V)	I_F=700mA	<Initial value×0.7
#2	Solderability	-	Less than 95% solder coverage

CAUTIONS

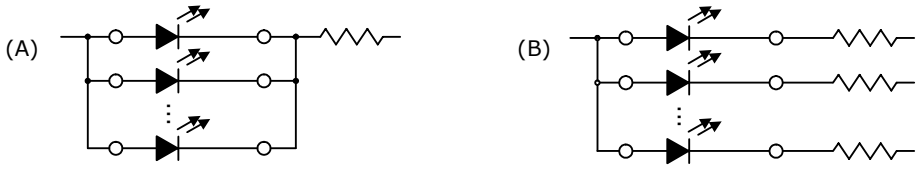
(1) Storage

Conditions		Temperature	Humidity	Time
Storage	Before Opening Aluminum Bag	≤30°C	≤90%RH	Within 1 Year from Delivery Date
	After Opening Aluminum Bag	≤30°C	≤70%RH	≤168hours
Baking		65±5°C	-	≥24hours

- Product complies with JEDEC MSL 3 or equivalent. See IPC/JEDEC STD-020 for moisture-sensitivity details.
- Absorbed moisture in LED packages can vaporize and expand during soldering, which can cause interface delamination and result in optical performance degradation. Products are packed in moisture-proof aluminum bags to minimize moisture absorption during transportation and storage.
  Included silica gel desiccants change from blue to red if moisture had penetrated bags.
- After opening the moisture-proof aluminum bag, the products should go through the soldering process within the range of the conditions stated above. Unused remaining LEDs should be stored with silica gel desiccants in a hermetically sealed container, preferably the original moisture-proof bags for storage.
- After the "Period After Opening" storage time has been exceeded or silica gel desiccants are no longer blue, the products should be baked. Baking should only be done once.
- Although the leads or electrode pads (anode and cathode) of the product are plated with gold, prolonged exposure to a corrosive environment might cause the gold plated the leads or electrode pads to tarnish, and thus leading to difficulties in soldering. If unused LEDs remain, they must be stored in a hermetically sealed container. Nichia recommends using the original moisture-proof bag for storage.
- Do not use sulfur-containing materials in commercial products. Some materials, such as seals and adhesives, may contain sulfur. The contaminated plating of LEDs might cause an open circuit. Silicone rubber is recommended as a material for seals. Bear in mind, the use of silicones may lead to silicone contamination of electrical contacts inside the products, caused by low molecular weight volatile siloxane.
- To prevent water condensation, please avoid large temperature and humidity fluctuations for the storage conditions.

(2) Directions for Use

- When designing a circuit, the current through each LED must not exceed the Absolute Maximum Rating. Operating at a constant current per LED is recommended. In case of operating at a constant voltage, Circuit B is recommended. If the LEDs are operated with constant voltage using Circuit A, the current through the LEDs may vary due to the variation in Forward Voltage characteristics of the LEDs.



- LEDs should be operated in forward bias. Driving circuits must not subject LEDs to either forward or reverse voltage while off. Continuous reverse voltage can cause migration and LED damage.
- For stabilizing the LED characteristics, it is recommended to operate at greater than 10% nominal current.
- For outdoor use, necessary measures should be taken to prevent water, moisture and salt air damage.

(3) Handling Precautions

- Do not handle LEDs with bare hands, it may contaminate the LED surface and affect optical characteristics. In the worst case, catastrophic failure from excess pressure through bump-bond breaks and package damage may result.
- When handling the product with tweezers, be careful not to apply excessive force to the resin. Otherwise, The resin can be cut, chipped, delaminate or deformed, causing bump-bond breaks and catastrophic failures.
- Dropping the product may cause damage.
- Do not stack assembled PCBs together. Failure to comply can cause the resin portion of the product to be cut, chipped, delaminated and/or deformed. It may cause bump to break, leading to catastrophic failures.

(4) Design Consideration

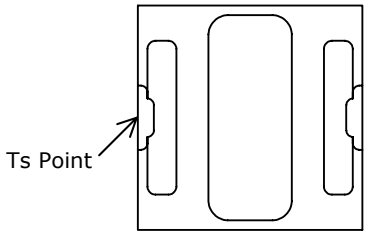
- PCB warpage after mounting the products onto a PCB can cause the package to break.
  The LED should be placed in a way to minimize the stress on the LEDs due to PCB bow and twist.
- The position and orientation of the LEDs affect how much mechanical stress is exerted on the LEDs placed near the score lines.
  The LED should be placed in a way to minimize the stress on the LEDs due to board flexing.
- Board separation must be performed using special jigs, not using hands.
- If an aluminum PCB is used, customer is advised to verity the PCB with the products before use.
  Thermal stress during use can cause the solder joints to crack.

(5) Electrostatic Discharge (ESD)

- The products are sensitive to static electricity or surge voltage. ESD can damage a die and its reliability.
  When handling the products, the following measures against electrostatic discharge are strongly recommended:
  Eliminating the charge
  Grounded wriststrap, ESD footwear, clothes, and floors
  Grounded workstation equipment and tools
  ESD table/shelf mat made of conductive materials
- Proper grounding is required for all devices, equipment, and machinery used in product assembly.
  Surge protection should be considered when designing of commercial products.
- If tools or equipment contain insulating materials such as glass or plastic,
  the following measures against electrostatic discharge are strongly recommended:
  Dissipating static charge with conductive materials
  Preventing charge generation with moisture
  Neutralizing the charge with ionizers
- The customer is advised to check if the LEDs are damaged by ESD
  when performing the characteristics inspection of the LEDs in the application.
  Damage can be detected with a forward voltage measurement or a light-up test at low current (≤1mA).
- ESD damaged LEDs may have current flow at a low voltage or no longer illuminate at a low current.
  Failure Criteria: V_F<2.0V at I_F=0.5mA

(6) Thermal Management

- Proper thermal management is an important when designing products with LEDs. LED die temperature is affected by PCB thermal resistance and LED spacing on the board. Please design products in a way that the LED die temperature does not exceed the maximum Junction Temperature (T_J).
- Drive current should be determined for the surrounding ambient temperature (T_A) to dissipate the heat from the product.
- The following equations can be used to calculate the junction temperature of the products.
  1) $T_J=T_A+R_{\theta JA}\cdot W$ 2) $T_J=T_S+R_{\theta JS}\cdot W$
  *T_J=LED junction temperature: °C
  T_A=Ambient temperature: °C
  T_S=Soldering temperature (cathode side): °C
  $R_{\theta JA}$=Thermal resistance from junction to ambient: °C/W
  $R_{\theta JS}$=Thermal resistance from junction to T_S measuring point: °C/W
  W=Input power($I_F\times V_F$): W



(7) Cleaning

- If required, isopropyl alcohol (IPA) should be used. Other solvents may cause premature failure to the LEDs due to the damage to the resin portion. The effects of such solvents should be verified prior to use. In addition, the use of CFCs such as Freon is heavily regulated.
- Ultrasonic cleaning is not recommended since it may have adverse effects on the LEDs depending on the ultrasonic power and how LED is assembled. If ultrasonic cleaning must be used, the customer is advised to make sure the LEDs will not be damaged prior to cleaning.

(8) Eye Safety

- In 2006, the International Electrical Commission (IEC) published IEC 62471:2006 Photobiological safety of lamps and lamp systems, which added LEDs in its scope. On the other hand, the IEC 60825-1:2007 laser safety standard removed LEDs from its scope. However, please be advised that some countries and regions have adopted standards based on the IEC laser safety standard IEC 60825-1:20112001, which still includes LEDs in its scope. Most of Nichia's LEDs can be classified as belonging into either the Exempt Group or Risk Group 1. High-power LEDs, that emit light containing blue wavelengths, may be classified as Risk Group 2. Please proceed with caution when viewing directly any LEDs driven at high current, or viewing LEDs with optical instruments which may greatly increase the damages to your eyes.
- Viewing a flashing light may cause eye discomfort. When incorporating the LED into your product, please be careful to avoid adverse effects on the human body caused by light stimulation.

(9) Others

- The LEDs described in this brochure are intended to be used for ordinary electronic equipment (such as office equipment, communications equipment, measurement instruments and household appliances). Consult Nichia's sales staff in advance for information on the applications in which exceptional quality and reliability are required, particularly when the failure or malfunction of the LEDs may directly jeopardize life or health (such as for airplanes, aerospace, submersible repeaters, nuclear reactor control system, automobiles, traffic control equipment, life support systems and safety devices).
- The customer shall not reverse engineer by disassembling or analysis of the LEDs without having prior written consent from Nichia. When defective LEDs are found, the customer shall inform Nichia directly before disassembling or analysis.
- Both the customers and Nichia will agree on official specifications of supplied products before a customer's volume production.
- Specifications and appearance subject to change for improvement without notice.

TradeElectronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

О компании

ООО "ТрейдЭлектроникс" - это оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов. Реализуемая нашей компанией продукция насчитывает более полумиллиона наименований.

Благодаря этому наша компания предлагает к поставке практически не ограниченный ассортимент компонентов как оптовыми, мелкооптовыми партиями, так и в розницу.

Наличие собственной эффективной системы логистики обеспечивает надежную поставку продукции по конкурентным ценам в точно указанные сроки.

Срок поставки со стоков в **Европе и Америке – от 3 до 14 дней.**

Срок поставки из **Азии – от 10 дней.**

Благодаря развитой сети поставщиков, помогаем в поиске и приобретении экзотичных или снятых с производства компонентов.

Предоставляем спец цены на элементы для создания инженерных сэмплов.

Упорный труд, качественный результат дают нам право быть уверенными в себе и надежными для наших клиентов.

Наша компания это:

- Гарантия качества поставляемой продукции
- Широкий ассортимент
- Минимальные сроки поставок
- Техническая поддержка
- Подбор комплектации
- Индивидуальный подход
- Гибкое ценообразование

Наша организация особенно сильна в поставках модулей, микросхем, пассивных компонентов, ксайленсах (XC), EPF, EPM и силовой электроники.

Большой выбор предлагаемой продукции, различные виды оплаты и доставки, позволят Вам сэкономить время и получить максимум выгоды от сотрудничества с нами!

Trade Electronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

Перечень производителей, продукцию которых мы поставляем на российский рынок



Trade Electronics.ru

гарантия бесперебойности производства и качества выпускаемой продукции

С удовольствием будем прорабатывать для Вас поставки всех необходимых компонентов по текущим запросам для скорейшего выявления групп элементов, по которым сотрудничество именно с нашей компанией будет для Вас максимально выгодным!

С уважением,

Менеджер отдела продаж ООО

«Трейд Электроникс»

Шишлаков Евгений

8 (495)668-30-28 доб 169

manager28@tradeelectronics.ru

http://www.tradeelectronics.ru/