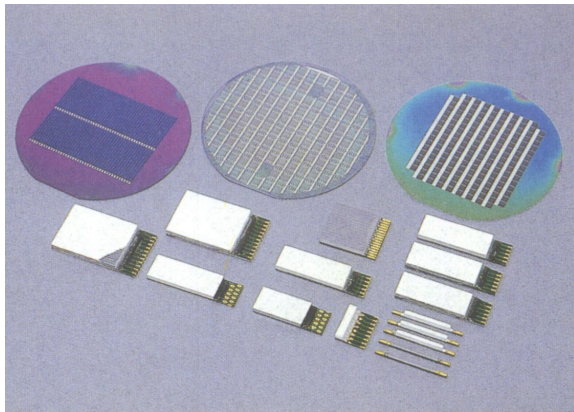


Solid State X-ray Detectors



NK&K DEX Division is one of the largest custom solid-state X-ray detectors suppliers. The main application of these detectors is for baggage and container scanners, non-destructive testing and industrial use. Other applications include Medical X-ray CT. Our X-ray detector consists of a scintillating crystal and photodiode, both of which are produced in our company. NK&K is the only company that produces scintillators, photodiodes and integrated detectors within one company.

This fact is really a big advantage of our company; Not only do we guarantee crystal and photodiode individually but also we test and guarantee the completed detector. Quality, delivery, cost and assembly of individual components will not bother customers anymore.

Mitsui Mining and Smelting is our parent company. NK&K and Mitsui's corporate R&D Center are working closely together toward the improvement of current products and the development of new products.

In addition, we initially acquired qualification for ISO-9001 in March, 1993 and renewed the certificate to ISO-9002 in December, 1995.

" NOTHING IS MORE IMPORTANT THAN QUALITY " is our philosophy.

PHOTODIODES

Our photodiodes are designed and produced in our own facility with a diffusion and ion implantation process. Our photodiodes have been developed based on the lithography technology of Mitsui Mining & Smelting.

The characteristics of our photodiodes are:

- PIN photodiode made by FZ and Epitaxial silicon wafer
- Low dark current
- High output and its linearity
- Lower frequency shifted sensitivity
- Multi-channel photodiodes array with fine pitch
- High separation (low cross talk) array structure

and even more.

These high performance photodiodes are processed under careful quality control. The quality is always monitored during the processes. Every photodiode is inspected before shipping and/or before going to the detector assembly process.

X-ray detectors

Both single-channel and multi-channel detectors are available. In order to produce a state of the art detector, the quality of the single crystals used is critical. Our single crystal scintillators are produced by the Czochralski and Bridgeman methods under strict quality control. They are carefully cut and polished to the designated sizes. Scintillators optimized for high-level output can thus be obtained.

In order to make multi-channel detectors, thin sliced materials are stacked to make an array of crystals. Each scintillator channel is separated from the others by a certain alloy to prevent effects from adjacent channels.

The scintillator or arrays are assembled with the photodiodes to give completed detectors. Each detector is also inspected before shipping. Since the completed detectors are assured for quality, our customers do not need to worry about the individual quality of photodiode, crystals and assembly that would arise in the case of purchasing individual components.

Our detector design gives high output response and low cross talk characteristics, which are optimized from the combination with our photodiodes, resulting in very high performance array-type detectors.

Afterglow measurement at NK&K.

General:

Afterglow is commonly understood as the signal remaining due to a scintillation crystal at a specified time interval after the cessation of an X-ray excitation.

We use a fast, electromechanical, lead shutter to terminate X-ray excitation after which time we measure the remaining signal level. Our shutter has a closing speed of approximately 1 mm per millisecond, therefore we usually measure afterglow several tens of milliseconds after the shutter has closed.

NK&K specification:

X-ray machine type (NK&K):

W-target, continuous 3- phase (6 peaks / 20 msec), 3 kW

X-ray tube voltage: 120 kV

CWO X-ray exposure: 1 second

Calculation:

Afterglow level, A (%) = $100 \times (I_2 - I_0) / (I_1 - I_0)$

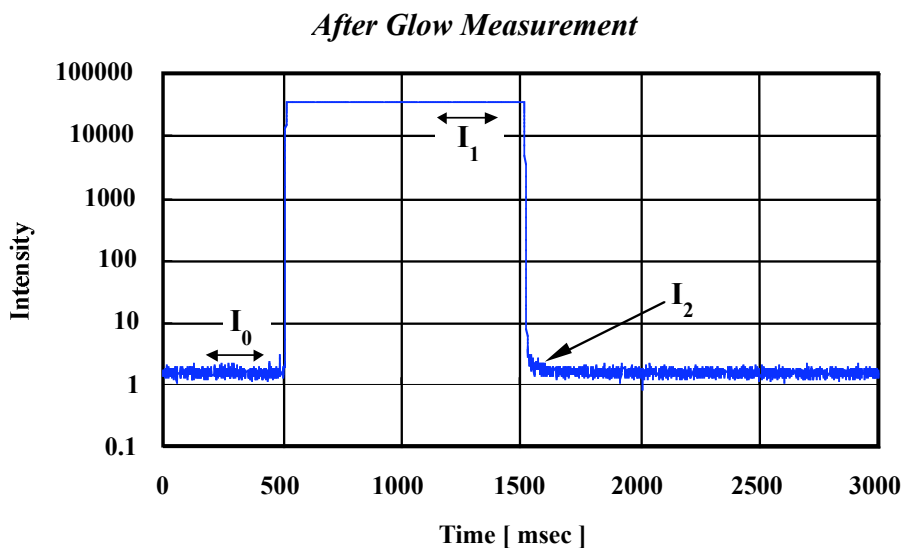
I_0 @ t = 400 msec (Average of 50 points)

I_1 @ t = 1200 msec (Average of 50 points)

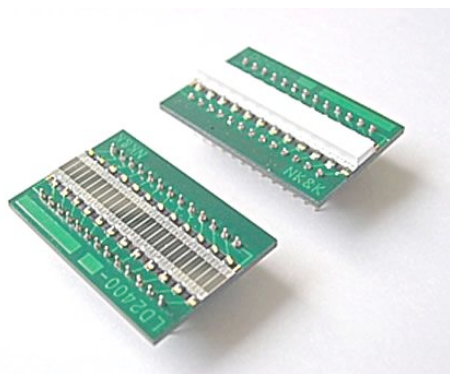
I_2 @ t = t_2 (20 msec^{*1)} after shutter)^{*2)}

*1) 20 msec is our standard. Point of after shutter can be set 20 msec to 1500 msec

*2) Data is smoothing by moving average method.



STD24 - 24 channels Si-PIN Photodiode for X-ray detector



This photodiode is designed for X-ray detector.

We mount linear scintillator array on the photodiode active area.

Customer can chose CWO, CsI, GOS and any other scintillator which fit for the application.

General ratings

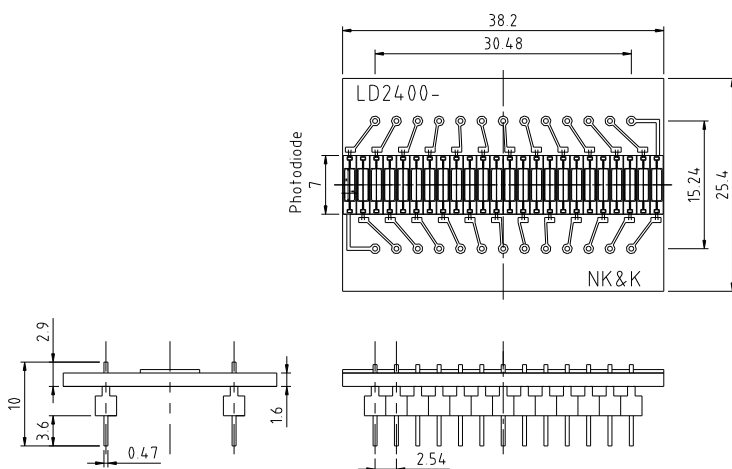
Item	Symbol	General rating	Unit
Active area	A	3.8 × 1.18	mm
Si thickness	-	0.3	mm
Substrate	-	FR4	-
Substrate thickness	-	1.6	mm
Spectral response	Range	-	190~1100
	Peak wave length	lp	960

Absolute maximum ratings

Item	Symbol	Absolute maximum rating	Unit
Reverse Voltage Max.	V_r	20	V
Forward Current Max	I_f	10	mA
Reverse Current Max.	I_r	0.1	mA
Operating Temperature	T_{opr}	0~+50	°C
Storage Temperature	T_{stg}	-20~+80	°C

Electrical and optical characteristics (T=25° C)

Item	Symbol	Condition	typ.	Unit
Leakage Current	I_d	$V_r=1V$	40	pA
Terminal Capacitance	C_t	$V_r=0V, f=10kHz$	90	pF
Shunt Resistance	R_{sh}	$V_r=\pm 10mV$	500	MΩ
Rise Time	tr/tf	$V_r=0V, l=480nm, RL=50W$	10	ms
Photo sensitivity	I_L	$V_r=0V, l=480nm$	0.2	A/W



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