OPTO DIODE
An ITW Company

EDITION
AN-08

APPLICATION NOTE · VETERINARY DIAGNOSTICS · FLUORESCENCE

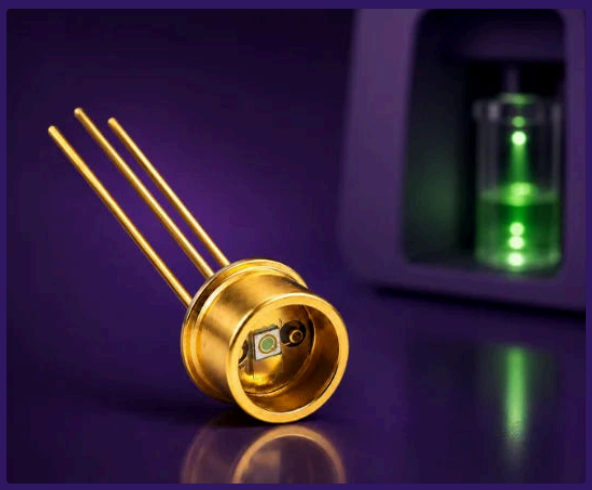
Fluorescence Detection in Veterinary Diagnostic Instruments

How Opto Diode's blue- and red-enhanced silicon photodiodes, low-dark-current detectors, and silicon avalanche photodiodes do the everyday job in veterinary diagnostics: pulling a faint, Stokes-shifted emission off a bright excitation source in fluorescence immunoassay readers, lateral-flow fluorescence analyzers, time-resolved rare-earth assays, and fluorescence flow cytometry — across roughly 350 nm to 900 nm.

FEATURED COMPONENT

Silicon Avalanche Photodiode

Large-area silicon APD for photon-starved fluorescence — internal gain, 500 µm active area, low dark current · hermetically sealed package



WAVELENGTH	400 nm – 1100 nm
ACTIVE AREA	500 µm
RESPONSIVITY	0.55 A/W @ 905 nm
DARK CURRENT	down to 0.2 nA

WHAT YOU'LL LEARN

- L.01 Blue / red-enhanced silicon matched to emission bands
- L.02 Low dark current to resolve a weak emission signal
- L.03 Silicon APDs for photon-starved assays
- L.04 Detector, filter & source pairing for FIA readers

WHO IT'S FOR

- A.01 Veterinary point-of-care analyzer designers
- A.02 Fluorescence immunoassay (FIA) reader teams
- A.03 Lateral-flow fluorescence reader developers
- A.04 Veterinary hematology & cytometry engineers

Overview

Veterinary analyzers run on a clinic bench, read a single drop of whole blood, and have to stay accurate for years. Fluorescence is the sensitive readout behind that promise — and it rests on a detector that can see a faint emission against a bright excitation source. This note maps Opto Diode's silicon photodiodes, blue- and red-enhanced detectors, and avalanche photodiodes onto that job.

01 · APPLICATION CHALLENGE

01 The signal is faint, Stokes-shifted, and buried under the source.

Fluorescence detection is a subtraction problem. A fluorophore is excited by an LED or laser, then re-emits a small number of photons at a longer wavelength. That emission can be orders of magnitude weaker than the excitation that produced it, and it arrives only tens of nanometers away in the spectrum. The detector has to register the faint, Stokes-shifted emission while rejecting everything scattered back from the source.

In a veterinary analyzer the constraint tightens. The instrument lives on a clinic bench, runs from a single drop of whole blood, and has to give the same reading on its first day and its thousandth. A detector that drifts with temperature, leaks dark current, or responds unevenly across channels turns a quantitative assay into a guess.

FIG.01 — BENCH-TOP FLUORESCENCE READ-OUT

02 · DESIGN PRINCIPLE

02 Match the detector to the emission band, then to the photon budget.

Start with the fluorophore, not the catalog. A fluorescein-style green label emits near 520 nm; a europium or rare-earth time-resolved label emits near 615 nm; a near-infrared dye sits past 650 nm. The detector should be most responsive exactly where the assay emits — which is why blue- and red-enhanced silicon, tuned to the short- and long-visible, overperform a flat general-purpose diode on the same signal.

Then weigh the photon budget. A bright lateral-flow or microsphere assay gives a low-dark-current silicon PIN photodiode plenty to work with, and the job becomes linearity and stability. When the label is dim or the analyte is scarce, a silicon avalanche photodiode adds real internal gain that lifts the emission above readout noise — without a photomultiplier's bulk and high-voltage bias.

DESIGN PRINCIPLE · 02

Match the detector to the emission, not the excitation.

The brightest thing in the optical path is the source you are trying to ignore. Specify spectral response at the emission wavelength, dark current, and NEP first; treat responsivity at the excitation line as irrelevant. A blue- or red-enhanced silicon detector aligned to the fluorophore resolves a weak label more reliably than a higher-spec diode tuned to the wrong band.

TBL.00 — GENERIC VS. FIELD-ENGINEERED DETECTORS

PARAMETER	GENERIC DETECTOR	OPTO DIODE FAMILY	WHY IT MATTERS
Emission Sensitivity	Flat general-purpose diode	Blue / red-enhanced silicon	Responsivity peaks where the assay actually emits
Weak-Signal Gain	PIN silicon only	Silicon APD (internal gain)	Lifts dim fluorescence above readout noise
Background Rejection	Bare die, no filter	Filter-integrated hermetic package	Blocks scattered excitation at the detector
Long-Term Stability	Commercial-grade part	Low-dark-current, hermetic, screened	Same reading on day one and year five

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03 · ENGINEERING SELECTION

A practical framework for choosing the right detector.

Begin with the emission wavelength. Most veterinary fluorescence assays read in the visible — green for fluorescein labels, orange-red for rare-earth and time-resolved chemistries — so a blue- or red-enhanced silicon detector, matched to that band, is the starting point. Push past 650 nm into near-infrared dyes and red-enhanced silicon still carries; only true SWIR labels call for InGaAs.

Then set the gain by the photon budget. Bright, high-label assays read cleanly on a low-dark-current silicon PIN photodiode, where linearity and channel matching dominate. Photon-starved assays — early-marker panels, low-titer infectious-disease tests, single-cell cytometry — benefit from a silicon APD's internal gain. When two families both fit, choose the one that simplifies the optical filtering and the calibration you maintain over the instrument's life.

WAVELENGTH	EMISSION	GAIN	NOISE	PACKAGE	CUSTOM
350 – 1100 nm	Blue / green / red	PIN or APD	Low dark current	Hermetic, filtered	Area / filter

TBL.01 — OPTO DIODE FAMILIES FOR VETERINARY FLUORESCENCE

TECHNOLOGY	FAMILY	SPECTRAL RANGE	FORM	TYPICAL USE
Blue Enhanced Si	Silicon photodiode	400 – 1100 nm	Single element	Fluorescein / green-emitting labels
Red Enhanced Si	Silicon photodiode	600 – 1100 nm	Single element	Rare-earth, time-resolved, red labels
Standard Silicon	Silicon PIN photodiode	400 – 1100 nm	Single / multi	Bright lateral-flow & microsphere reads
Silicon APD	Silicon avalanche	400 – 1100 nm	Single (500 µm)	Photon-starved fluorescence, cytometry
InGaAs Photodiode	InGaAs PIN	900 – 1700 nm	Single element	Near-IR / SWIR fluorescent dyes
Red / IR LED Emitter	AlGaAs emitter	Red / 850 – 940 nm	Emitter	Excitation source for red / NIR labels

TBL.02 — COMMON FAILURE MODES IN FLUORESCENCE DETECTION

MODE	ROOT CAUSE	DESIGN RESPONSE
Excitation breakthrough	Scattered source light reaching the detector	Filter-integrated package, emission-matched response
Dark-current drift	Temperature swing, moisture ingress	Low-dark-current silicon, hermetic seal
Weak-label miss	Emission below the readout noise floor	Silicon APD internal gain
Channel mismatch	Unmatched discrete detectors	Matched, screened detector sets

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04 · PRODUCT FIT

Recommended Opto Diode building blocks.

TBL.03 — DETECTOR & EMITTER FAMILIES BY APPLICATION

PART / FAMILY	APPLICATION	FORM / PACKAGE	WHY THIS PART
Blue Enhanced Si	Fluorescein / green-label FIA readers	Single element, low dark current	Responsivity peaks at the green emission line
Red Enhanced Si	Rare-earth & time-resolved assays	Single element, hermetic	Tuned to the orange-red emission band
Silicon APD	Low-titer tests & single-cell cytometry	Single element, 500 µm, hermetic	Internal gain raises weak emission above noise
Standard Silicon	Bright lateral-flow & microsphere reads	Single or multi-element	Proven, low-noise visible workhorse
InGaAs Photodiode	Near-IR / SWIR fluorescent dyes	Single element, hermetic	Extends detection past 900 nm to 1700 nm
Red / IR LED Emitter	Excitation source for red / NIR labels	AlGaAs emitter	Stable source matched to the detector

KEY FEATURES

- Blue- and red-enhanced silicon matched to emission
- Low dark current, down to sub-nanoamp
- Silicon APD internal gain for dim labels
- Filter-integrated hermetic packages
- Custom active area and channel geometry

APPLICATIONS

- Fluorescence immunoassay (FIA) analyzers
- Lateral-flow fluorescence readers
- Time-resolved / rare-earth assays
- Fluorescence flow cytometry & hematology
- Near-infrared fluorescent dye detection

BUILT FOR PRECISION

- Hermetic TO and ceramic packages
- Glass-to-metal seals, no epoxy near die
- Low dark current, tight channel matching
- Matched detector and emitter sets
- ISO 9001:2015 certified

CUSTOM PROGRAMS

Engineered to your assay.

Opto Diode builds detectors around the assay: active areas sized to the read spot, integrated band-pass filters that block the excitation line, blue- or red-enhanced response tuned to the fluorophore, and matched detector-and-emitter sets — all assembled in-house under ISO 9001:2015 with the screening and documentation a diagnostic program needs. Qualification samples typically ship in 8 to 12 weeks.

NEXT STEPS

Talk to Applications Engineering.

Bring your fluorophore and emission band, signal level, channel count, filtering, and the qualification standard you have to meet, and we'll come back with a recommended standard family, or a custom path, within one engineering review cycle.

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