

Avalanche Photodiodes

For Industrial & Analytical Applications

AVALANCHE PHOTODIODES ■

Avalanche Photodiodes
Silicon APDs



Avalanche Photodiodes – Silicon APDs

Applications

- Laser range finder
- Scanning video imager
- Confocal microscope
- Free space communication
- Spectrophotometers
- Fluorescence detection
- Luminometer
- DNA sequencer
- Particle sizing

Features and Benefits

- Low noise
- High gain
- High quantum efficiency
- Built-in TE-cooler option
- Various optical input options
- Customization available upon request

Product Description

These rear entry “reach-through” silicon APDs offer the best compromise in terms of cost and performance for applications requiring high speed and low noise photon detection from 400 nm up to 1100 nm. They feature low noise, high quantum efficiency and high gain while maintaining reasonably low operating voltage. The active area varies from 0.5 mm to 3 mm to accommodate a large variety of applications.

The “S” series of the C30902 family of APDs can be used in either their normal linear mode ($V_R < V_{BR}$) or for photon counter in the Geiger mode ($V_R > V_{BR}$). This series is particularly well-suited for ultra-sensitive photon measurements in biomedical and analytical instruments. Precise temperature control can be achieved with a thermo-electric cooler which can be used to improve noise and responsivity or to maintain constant responsivity over a wide range of ambient temperature.

These APDs can also be incorporated into a hermetically-sealed TO-8 package with ultra-low noise preamplifier (C30659 series APD receivers) and thermo-electric cooler (LLAM series receivers) for optimum signal to noise performance.

Technical Specification

Avalanche Photodiodes – Silicon APDs

Unit	Active Diameter mm	Capacitance pF	Rise/Fall Time ns	Dark Current nA	Breakdown Voltage min V	Breakdown Voltage max V	Temp. Coefficient V/°C	Typical Gain	Responsivity 830 nm A/W	Responsivity 900 nm A/W	Responsivity 1060 nm A/W	NEP fW / √Hz	Package
C30817EH	0.8	2	2	50	300	475	2.2	120	-	75	-	13	TO-5
C30884E	0.8	4	1	100	190	290	1.1	100	-	63	8	13	TO-5
C30902BH	0.5	1.6	0.5	15	185	265	0.7	150	77	60	-	3	Ball lens TO-18
C30902EH	0.5	1.6	0.5	15	185	265	0.7	150	77	60	-	3	TO-18, flat window
C30902EH-2	0.5	1.6	0.5	15	185	265	0.7	150	77	60	-	3	TO-18, built-in 905 nm filter
C30902SH	0.5	1.6	0.5	15	185	265	0.7	250	128	108	-	0.9	TO-18, flat window
C30902SH-2	0.5	1.6	0.5	15	185	265	0.7	250	128	108	-	0.9	TO-18, built-in 905 nm filter
C30916EH	1.5	3	3	100	315	490	2.2	80	-	50	12	20	TO-5
C30954EH	0.8	2	2	50	300	475	2.4	120	-	75	36	13	TO-5
C30955EH	1.5	3	2	100	315	490	2.4	100	-	70	34	14	TO-5
C30956EH	3	10	2	100	325	500	2.4	75	-	45	25	25	TO-8

Product Table

Silicon APD – TE-Cooled

Unit	Active Diameter	Active Area	Total Capacitance	Rise/Fall Time	Dark Current	Breakdown Voltage min	Breakdown Voltage max	Temperature Coefficient	Typical Gain	Responsivity 830 nm	Responsivity 900 nm	Responsivity 1060 nm	Noise Current	Package
	mm	mm ²	pF	ns	nA	V	V			A/W	A/W	A/W	pA/sqrt(Hz)	
C30902SH-TC	0.5	0.2	1.6	0.5	2	225	-	0.7	250	128	108	-	0.04	TO-8 flange
C30902SH-DTC	0.5	0.2	1.6	0.5	1	225	-	0.7	250	128	108	-	0.02	TO-8 flange
C30954EH-TC	0.8	0.5	2	2	8	300	475	2.4	120	-	75	-	0.2	TO-8 flange
C30955EH-TC	1.5	1.8	3	2	15	315	490	2.4	100	-	70	-	0.2	TO-8 flange
C30956EH-TC	3	7	10	2	15	325	500	2.4	75	-	45	-	0.2	TO-8 flange

TC stands for single stage cooler, operating temperature 0° C
DTC stands for double stage cooler, operating temperature -20° C

Graph 1

Typical Spectral Responsivity @ 22° C

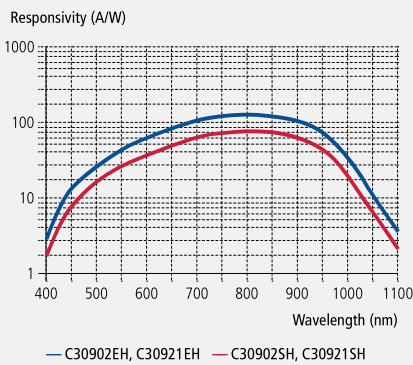


Figure 1

Package Drawing – TO-8 Flange

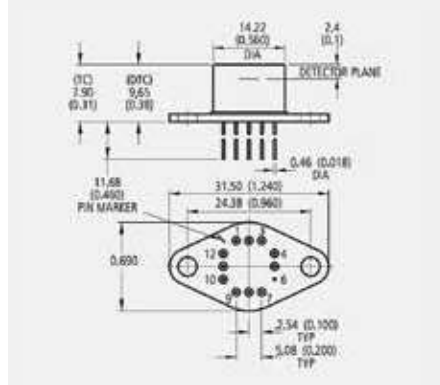


Figure 2

Typical TO-5 Package*

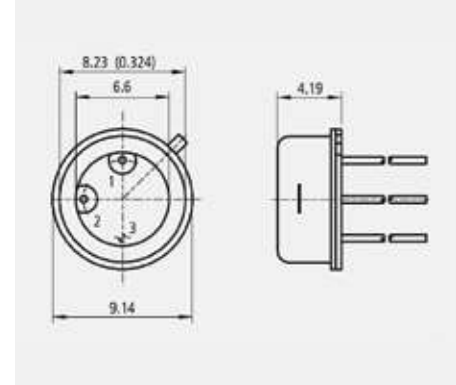


Figure 3

Typical TO-8 Package*

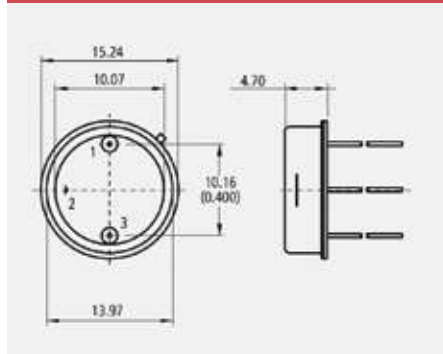
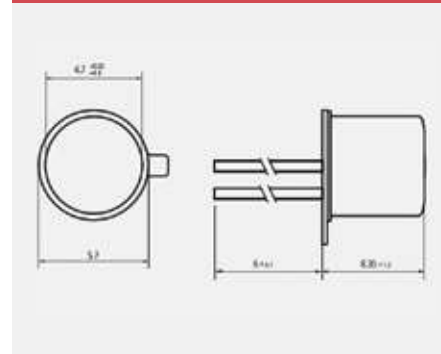


Figure 4

Typical TO-18 Package*



*Note: Package dimensions for indication only. Exact package dimensions can be found on products datasheets.

Avalanche Photodiodes For Analytical Applications

AVALANCHE PHOTODIODES ■

Avalanche Photodiodes Si APD Arrays



Avalanche Photodiodes – Si APD Arrays

Applications

- Spectroscopy
- Particle detection
- Spot tracking and alignment systems
- Adaptive optics
- LiDAR (Light Detection And Ranging)

Features and Benefits

- High quantum efficiency
- Hermetically-sealed packages
- Monolithic chip with minimal dead space between elements
- Specific tailored wavelength response
- RoHS compliant
- Customization available upon request

Product Description

The C30927 series of quadrant Si Avalanche Photodiode utilize the double-diffused “reach-through” structure. This structure provides ultra-high sensitivity at 400-1000 nm. The C30927 quadrant structure has a common avalanche junction, with separation of the quadrants achieved by segmentation of the light entry p+ surface opposite the junction. With this design, there is no dead space between the elements and therefore no loss of response at boresight.

The C30927EH-01, -02 and -03 are optimized for use at wavelengths of 1060, 900, and 800 nm respectively. Each device type will provide high responsivity and excellent performance when operated within about 50 nm of the specified wavelength.

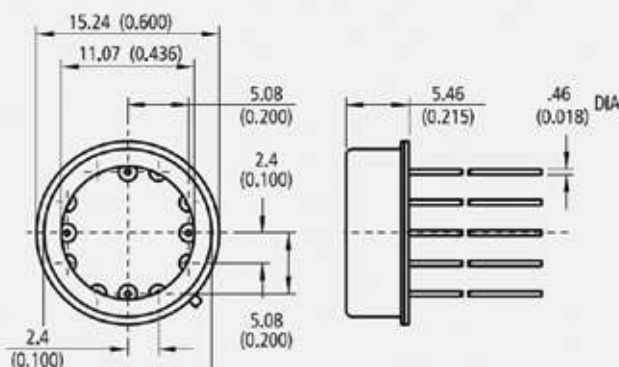
Product Table

Avalanche Photodiodes – Si APD Arrays

Part Number	Number of Elements	Photo Sensitive Diameter	Responsivity	Dark Current per Element	Spectral Noise Current per Element	Capacitance @ 100 KHz per Element	Response Time	NEP	Operating Voltage
Unit	mm	mm	A/W	nA	pA/√Hz	pF	ns	fW/√Hz	V
C30927EH-01	4	1.5	15(@ 1060 nm)	25	0.5	1	3	33(@ 1060 nm)	275 - 425
C30927EH-02	4	1.5	62(@ 900 nm)	25	0.5	1	3	16(@ 900 nm)	275 - 425
C30927EH-03	4	1.5	55(@ 800 nm)	25	0.5	1	3	9(@ 800 nm)	275 - 425

Figure 1

Package Drawing – C30927 Series



Avalanche Photodiodes

For Analytical Applications

■ AVALANCHE PHOTODIODES ■

Avalanche Photodiodes
1060 nm NIR Enhanced Si APDs



1060 nm NIR Enhanced Si APDs

Applications

- Range finding
- LiDAR (Light Detection And Ranging)
- YAG laser detection

Features and Benefits

- High quantum efficiency at 1060 nm
- Fast response time
- Wide operating temperature range
- Low capacitance
- Hermetically-sealed packages
- RoHS compliant
- Customization available upon request

Product Description

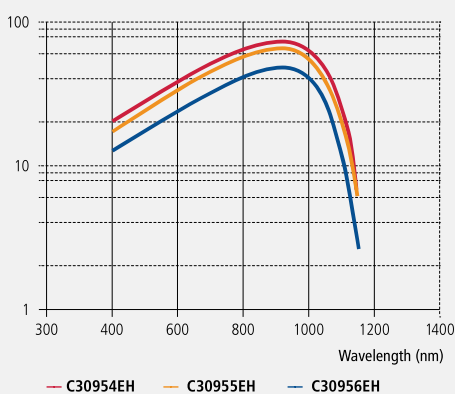
The C30954EH, C30955EH, and C30956EH are general purpose silicon avalanche photodiodes made using a double-diffused "reach-through" structure. The design of these photodiodes are such that their long wave response (i.e. >900 nm) has been enhanced without introducing any undesirable properties.

These APDs have quantum efficiency of up to 40% at 1060 nm. At the same time, the diodes retain the low noise, low capacitance, and fast rise and fall times characteristics.

To help simplify many design needs, these APDs are also available in Excelitas' high-performance hybrid preamplifier module type C30659 series, as well as the preamplifier and TE cooler incorporated module type LLAM series. In addition, these APDs are also available with built-in thermo-electric cooler for easier temperature control. Please refer to the respective sections in this catalog.

Graph 1

Spectral Responsivity Characteristics



Product Table

Si APDs – NIR Enhanced

Part Number	Photo Sensitive Diameter	Responsivity @ 1060 nm	Dark Current	Spectral Noise Current	Capacitance @ 100 KHz	Response Time	NEP @ 1060 nm	Vop Range
Unit	mm	A/W	nA	pA/√Hz	pF	ns	fW/√Hz	V
C30954EH	0.8	36	50	0.5	2	2	14	275 - 425
C30955EH	1.5	34	100	0.5	3	2	15	275 - 425
C30956EH	3.0	25	100	0.5	10	2	20	275 - 425

Figure 1

Package Drawing – C30954EH, C30955EH

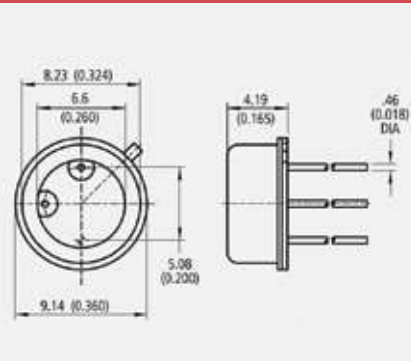
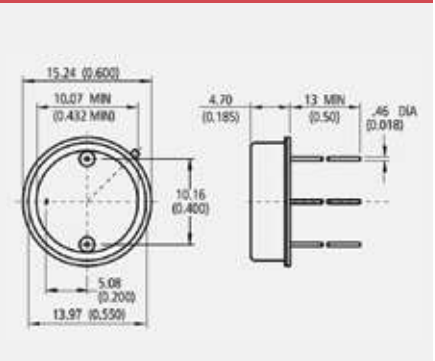


Figure 2

Package Drawing – C30956EH

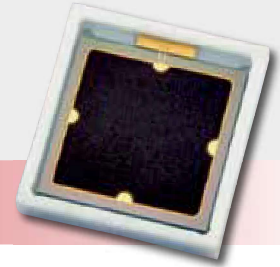


Avalanche Photodiode

For High Energy Radiation Detection Applications, Molecular Imaging

AVALANCHE PHOTODIODES ■

Large Area Si-APDs – UV-Enhanced APDs



Large Area Si-APDs – UV-Enhanced APDs

Applications

- Nuclear medicine
- Fluorescence detection
- High energy physics
- Medical imaging
- Radiation detection
- Particle physics
- Instrumentation
- Environmental monitoring

Features and Benefits

- High quantum efficiency
- Low dark currents
- Easy coupling to scintillator crystals
- Immunity to electromagnetic fields
- Custom packaging available
- Excellent timing resolution
- RoHS compliant
- Customization available upon request

Product Description

The C30739ECERH Silicon Avalanche Photodiode (APD) is intended for use in a wide variety of broadband low light level applications covering the spectral range from below 400 to over 700 nanometers. It has low noise, low capacitance and high gain. It is designed to have an enhanced short wavelength sensitivity, with quantum efficiency of 60 % at 430 nm.

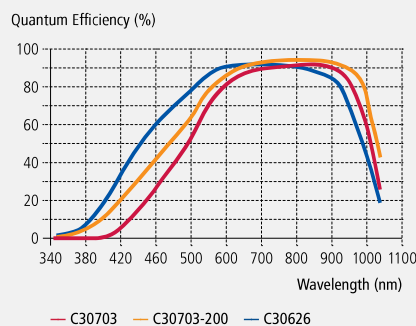
The standard ceramic carrier package allows for easy handling and coupling to scintillating crystals such as LSO and BGO. Combined with the superior short wavelength responsivity, it makes this APD ideal in demanding applications such as Positron Emission Tomography (PET).

The C30626FH and C30703FH series are large area Si APDs in flat pack packages for either direct detection or easy coupling to scintillator crystals.

The C30626 uses a standard reach through structure and has peak detection at about 900 nm. The C30703 is enhanced for blue wavelength response and has peak quantum efficiency at ~ 530 nm. These APDs are packaged in a square flat pack with or without windows or on ceramics. The no-window devices can detect direct radiation of X-rays and electrons at the energies listed, and the windowed packages are best for easy scintillator coupling.

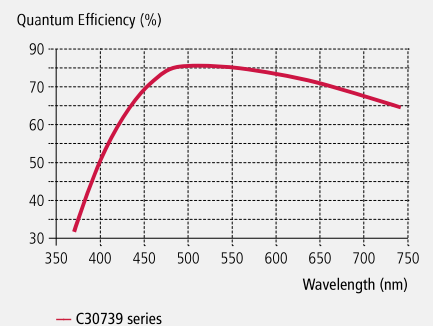
Graph 1

Quantum Efficiency vs. Wavelength



Graph 2

Quantum Efficiency vs. Wavelength



Product Table

Large Area Si-APDs – UV-Enhanced APDs

Part Number	Photo Sensitive Diameter	Responsivity	Dark Current	Spectral Noise Current	Capacitance @ 100 KHz	Response Time	NEP	Vop Range
Unit	mm	A/W	nA	pA/√Hz	pF	ns	fW/√Hz	V
C30626FH	5 x 5	22 (@900 nm)	250	0.5	30	5	23(@900 nm)	275 - 425
C30703FH	10 x 10	16 (@530 nm)	250	0.5	100	5	40(@530 nm)	275 - 425
C30703FH-200	10 x 10	16 (@530 nm)	250	0.7	60	5	40(@530 nm)	275 - 425
C30739ECERH	5.6 x 5.6	20 (@430 nm)	10	1.4	60	2	-	275 - 425
C30739ECERH-2	5.6 x 5.6	52(@430 nm)	10	2	60	2	-	275 - 425

Avalanche Photodiodes

For Range Finding Applications

AVALANCHE PHOTODIODES ■

From Left to Right: C30737MH (Compact, top-looking SMD)
 C30737CH (Top/side-looking SMD)
 C30737LH (Top-looking SMD)
 C30737PH (Through-Hole Package)



C30737 High Speed, Low Voltage APD – C30724 Low Temperature Coefficient APD

Applications

- LiDAR
- Laser range finding for 600 to 950 nm range
- Optical communication
- Analytical instrumentation

Features and Benefits

- Optimized versions for peak responsivity at 900 nm or high bandwidth operation
- Standard versions with 500 and 230 μm active diameter
- Various package types: hermetic TO, plastic TO, SMD top-and side-looking
- High gain at low bias voltage
- Low breakdown voltage
- Fast response, $t_r \sim 300\text{ps}$
- Low noise, in $\sim 0.1\text{pA}/\sqrt{\text{Hz}}$
- RoHS compliant
- Customization including arrays available upon request

Product Description

The Excelitas C30737 series silicon APDs provide high responsivity between 500 nm and 1000 nm as well as extremely fast rise times at all wavelengths, with a frequency response above 1 GHz for bandwidth-optimized versions. The C30724, as a low gain APD, can be operated at a fixed voltage without the need for temperature compensation.

Standard versions of the 737 are available in three active area sizes: 0.23, 0.3 and 0.5 mm diameter. They are offered in the traditional hermetic TO housing ("E"), in cost-effective plastic through-hole T-1 $\frac{3}{4}$ (TO-like, "P") packages, in leadless ceramic carrier (LCC, "L") top-looking package and laminated leadless ceramic (LLC, "C") side-looking package and in a compact surface-mount "top-looking" leadless package (C30737MH). All listed varieties are ideally suited for high-volume, low cost applications.

Customization of these APDs is offered to meet your design challenges. Operating voltage selection and binning or specific wavelength filtering options are among many of the application-specific solutions available.

Please inquire about the availability of arrays based on the C30737 product family to enable your next generation LiDAR systems.

Product Table

C30737 Epitaxial Silicon APD – C30724 Low-Gain APD

Part Number	Package	Optical Bandpass Filter design	Active Area Diam. design	Peak Sensitivity Wavelength	Breakdown Voltage		Temp. Coeff. Of V_{OP} , for Constant M	Gain@ λ_{peak}	Responsivity @ λ_{peak}	Total Dark Current (Bulk + Surface)		Noise Current, ($f = 10\text{ kHz}$, $\Delta f = 1\text{ Hz}$)	Capacitance	Rise & Fall Time, ($R_L = 50\ \Omega$, 10% - 90% - 10% Points)
				typ	min	max	typ	typ	typ	max	typ		typ	
Unit		nm	μm	λ_{peak} nm	V_{BR} V	V_{BR} V	$V/^\circ\text{C}$	M	M	I_D nA	I_D nA	$\text{pA}/\sqrt{\text{Hz}}$	C_D pF	ns
C30737EH-230-80	TO	-	230	800	120	200	0.5	100	50	0.05	0.5	0.1	1.0	0.2
C30737PH-230-80	T-1 $\frac{3}{4}$	-	230	800	120	200	0.5	100	50	0.05	0.5	0.1	1.0	0.2
C30737LH-230-80	LCC	-	230	800	120	200	0.5	100	50	0.05	0.5	0.1	1.0	0.2
C30737CH-230-80	LCC	-	230	800	120	200	0.5	100	50	0.05	0.5	0.1	0.1	0.2
C30737MH-230-80	LCC	-	230	800	120	200	0.5	100	50	0.05	0.5	0.1	0.1	0.2
C30737LH-230-81	LCC	635	230	635	120	200	0.5	100	35	0.05	0.5	0.1	1.0	0.2
C30737LH-230-83	LCC	650	230	650	120	200	0.5	100	35	0.05	0.5	0.1	1.0	0.2
For the remaining 737 family APDs only a generic package and filter part number will be shown, just to show the different APD chip characteristics														
C30737XH-300-7X	LLC, LCC	635, 650	300	800	110	160	-	100	50	0.1	1	0.1	0.7	0.5
C30737XH-500-8X	all	635, 650	500	800	120	200	0.5	100	50	0.1	1	0.1	2.0	0.9
C30737XH-230-9X	all	905	230	900	180	260	1.3	100	60	0.05	0.5	0.1	0.6	0.9
C30737XH-500-9X	all	905	500	900	180	260	1.3	100	60	0.1	1	0.1	1.0	0.9
C30724EH	TO	-	500	920	-	350	-	15	8.5	20	40	0.1	1.0	5
C30724PH	T-1 $\frac{3}{4}$	-	500	920	-	350	-	15	8.5	20	40	0.1	1.0	5

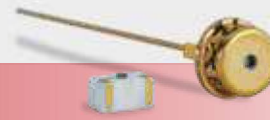
Electrical Characteristics at $T_{Ambient} = 22\ ^\circ\text{C}$; at operating voltage, V_{op}

Avalanche Photodiodes

For Industrial & Analytical Applications

AVALANCHE PHOTODIODES ■

Avalanche Photodiodes
Silicon InGaAs APDs



Avalanche Photodiodes – InGaAs APDs

Applications

- LiDAR
- Laser range finder
- Scanning video imager
- Confocal microscope
- Free space communication
- Spectrophotometers
- Fluorescence detection
- Luminometer
- DNA sequencer
- Particle sizing

Features and Benefits

- Low noise
- High gain
- High quantum efficiency
- Built-in TE-cooler option
- Various optical input options
- Customization available upon request

Product Description

The C30644, C30645 and C30662 Series APDs are high speed, large area InGaAs/InP avalanche photodiodes. These devices provide large quantum efficiency, (QE), high responsivity and low noise in the spectral range between 1100 nm and 1700 nm, with standard active areas up to 200 μm in diameter. They are optimized for use at a wavelength of 1550 nm, ideally suitable for use in eye-safe laser range finding systems.

These APDs are supplied in a hermetically-sealed TO-18 package, with the chip mounted close to the window to allow easy interfacing with the optical system, or on a ceramic carrier. The C30645 and C30662 series APD are offered in the C30659 series of APD receivers with low noise transimpedance amplifier, as well as built-in thermo-electric cooler (the LLAM series). For these modules, refer to page 13 of this catalogue. Other custom package are also available on request.

Product Table

InGaAs APD

Unit	Active Diameter μm	Capacitance pF	Bw MHz	Dark Current nA	Breakdown Voltage min V	Breakdown Voltage max V	Temperature Coefficient V/ $^{\circ}\text{C}$	Typical Gain	Responsivity 1550 nm A/W	NEP fW/sqrt(Hz)	Package
C30662EH	200	2.5	800	70	40	90	0.14	10	9.3	100	TO-18
C30662EH-1	200	2.5	800	70	40	90	0.14	10	9.3	100	TO-18
C30662ECERH	200	2.5	800	70	40	90	0.14	10	9.3	100	Ceramic carrier
C30662ECERH-1	200	2.5	800	70	40	90	0.14	10	9.3	100	Ceramic carrier
C30645EH	80	1.25	1000	35	40	90	0.14	10	9.3	25	TO-18
C30645ECERH	80	1.25	1000	35	40	90	0.14	10	9.3	25	Ceramic carrier
C30644EH	50	0.6	2000	25	40	90	0.14	10	9.3	15	TO-18
C30644ECERH	50	0.6	2000	25	40	90	0.14	10	9.3	15	Ceramic carrier

NOTE: The "-1" version of the C30662 series have a Vbr-Vop of >4V.