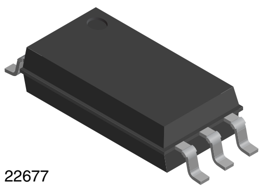
# Low Profile, 2.5 A Output Current IGBT and MOSFET Driver



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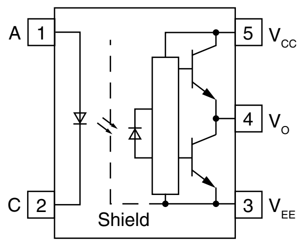



## DESCRIPTION

The VOL3120 consists of an infrared light emitting diode optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control and solar inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving high power IGBTs with ratings up to 1000 V / 100 A. The low profile and small footprint of the VOL3120 makes it an ideal choice for applications where board space and component height are at a premium, while still offering a high degree of isolation performance.

## AGENCY APPROVALS

The safety application model number covering all products in this datasheet is VOL3120. This model number should be used when consulting safety agency documents.

- UL 1577
- cUL
- CQC
- DIN EN 60747-5-5 (VDE 0884-5)

## FEATURES

- Industrial temperature range: -40 °C to +100 °C
- 2.5 mm low profile package
- Rated for reinforced insulation
- 2.5 A minimum peak output current
- 48 kV/μs minimum common mode rejection (CMR) at $V_{CM}$ = 1500 V
- $I_{CC}$ = 2.5 mA maximum supply current
- Under voltage lock-out (UVLO) with hysteresis
- Wide operating $V_{CC}$ range: 15 V to 32 V
- Floor life: unlimited, MSL 1, according to J-STD-020
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
e3
RoHS
COMPLIANT
HALOGEN
FREE
GREEN
(5-2008)

## APPLICATIONS

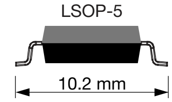
- Domestic appliance motor drives
- Welding equipment
- Variable speed motor drives
- Induction stove top
- Solar inverters
- Switch mode power supplies (SMPS)
- Uninterruptible power supplies (UPS)

## ORDERING INFORMATION

| V | O | L | 3 | 1 | 2 | 0 | - | X | 0 | 0 | # | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

PART NUMBER (V O L 3 1 2 0) — PACKAGE OPTION (X 0 0 #) — TAPE AND REEL (T)

LSOP-5




| PACKAGE | UL, cUL, CQC | UL, cUL, CQC, VDE |
|---|---|---|
| LSOP-5 | VOL3120T | VOL3120-X001T |

| **ABSOLUTE MAXIMUM RATINGS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **CONDITIONS** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Input forward current | | $I_F$ | 25 | mA |
| Peak transient input current | < 1 μs pulse width, 300 pps | $I_{F(TRAN)}$ | 1 | A |
| Reverse input voltage | | $V_R$ | 5 | V |
| Output power dissipation | | $P_{diss}$ | 40 | mW |
| LED junction temperature | | $T_j$ | 125 | °C |
| **OUTPUT** | | | | |
| High peak output current [(1)] | | $I_{OH(PEAK)}$ | 2.5 | A |
| Low peak output current [(1)] | | $I_{OL(PEAK)}$ | 2.5 | A |
| Supply voltage | | $(V_{CC} - V_{EE})$ | 0 to 35 | V |
| Output voltage | | $V_{O(PEAK)}$ | 0 to $V_{CC}$ | V |
| Output power dissipation | | $P_{diss}$ | 220 | mW |
| Output junction temperature | | $T_j$ | 125 | °C |
| **OPTOCOUPLER** | | | | |
| Storage temperature range | | $T_{stg}$ | -55 to +150 | °C |
| Ambient operating temperature range | | $T_{amb}$ | -40 to +100 | °C |
| Total power dissipation | | $P_{tot}$ | 260 | mW |
| Lead solder temperature | For 10 s, 1.6 mm below seating plane | $T_{sld}$ | 260 | °C |

**Notes**

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

(1) Maximum pulse width = 10 μs, maximum duty cycle = 0.2 %. This value is intended to allow for component tolerances for designs with $I_O$ peak minimum = 2.5 A. See applications section for additional details on limiting $I_{OH}$ peak.

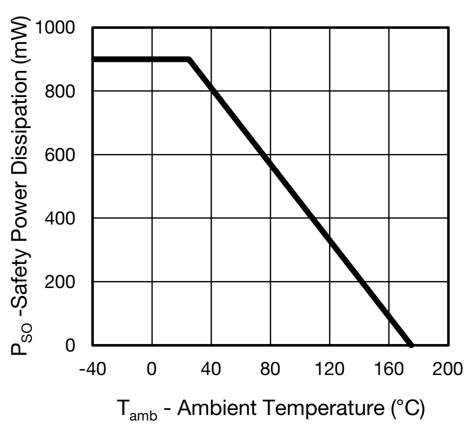



Fig. 1 - Safety Power Dissipation vs. Ambient Temperature

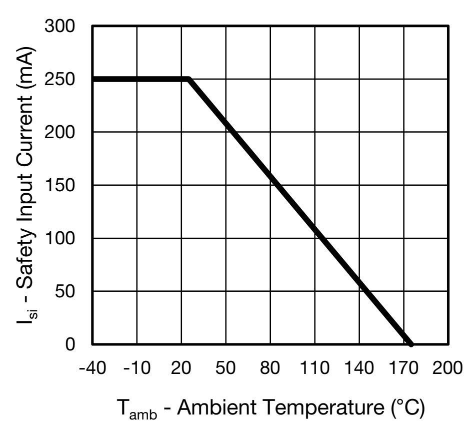



Fig. 2 - Safety Input Current vs. Ambient Temperature

| RECOMMENDED OPERATING CONDITIONS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **MIN.** | **MAX.** | **UNIT** |
| Power supply voltage | $V_{CC}$ - $V_{EE}$ | 15 | 32 | V |
| Input LED current (on) | $I_F$ | 10 | - | mA |
| Input voltage (off) | $V_{F(OFF)}$ | -3 | 0.8 | V |
| Operating temperature | $T_{amb}$ | -40 | +100 | °C |

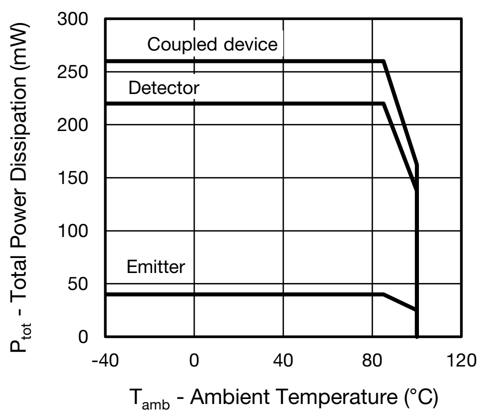



Fig. 3 - Power Dissipation vs. Ambient Temperature

| ELECTRICAL CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| High level output current | $V_O$ = ($V_{CC}$ - 4 V) | $I_{OH}$ | 0.5 | - | - | A |
| | $V_O$ = ($V_{CC}$ - 15 V) | $I_{OH}$ | 2.5 | - | - | A |
| Low level output current | $V_O$ = ($V_{EE}$ + 2.5 V) | $I_{OL}$ | 0.5 | - | - | A |
| | $V_O$ = ($V_{EE}$ + 15 V) | $I_{OL}$ | 2.5 | - | - | A |
| High level output voltage | $I_O$ = -100 mA | $V_{OH}$ | $V_{CC}$ - 4 | - | - | V |
| Low level output voltage | $I_O$ = 100 mA | $V_{OL}$ | - | 0.2 | 0.5 | V |
| High level supply current | Output open, $I_F$ = 10 mA to 16 mA | $I_{CCH}$ | - | - | 2.5 | mA |
| Low level supply current | Output open, $V_F$ = -3 V to +0.8 V | $I_{CCL}$ | - | - | 2.5 | mA |
| Threshold input current low to high | $I_O$ = 0 mA, $V_O$ > 5 V | $I_{FLH}$ | - | 3.4 | 8 | mA |
| Threshold input voltage high to low | | $V_{FHL}$ | 0.8 | - | - | V |
| Input forward voltage | $I_F$ = 10 mA | $V_F$ | 1 | 1.36 | 1.6 | V |
| Temperature coefficient of forward voltage | $I_F$ = 10 mA | $\Delta V_F/\Delta T_{amb}$ | - | -1.4 | - | mV/°C |
| Input reverse breakdown voltage | $I_R$ = 10 μA | $V_{BR}$ | 5 | - | - | V |
| Input capacitance | f = 1 MHz, $V_F$ = 0 V | $C_{IN}$ | - | 45 | - | pF |
| UVLO threshold | $V_O \geq$ 5 V, $I_F$ = 10 mA | $V_{UVLO+}$ | 11 | - | 13.5 | V |
| | | $V_{UVLO-}$ | 9.5 | - | 12 | V |
| UVLO hysteresis | | $UVLO_{HYS}$ | - | 1.6 | - | V |
| Capacitance (Input to Output) | f = 1 MHz, $V_F$ = 0 V | $C_{IO}$ | - | 0.9 | - | pF |

**Note**

- Minimum and maximum values were tested over recommended operating conditions ($T_{amb}$ = -40 °C to +100 °C, $I_{F(ON)}$ = 10 mA to 16 mA, $V_{F(OFF)}$ = -3 V to 0.8 V, $V_{CC}$ = 15 V to 32 V, $V_{EE}$ = ground) unless otherwise specified. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements. All typical values were measured at $T_{amb}$ = 25 °C and with $V_{CC}$ - $V_{EE}$ = 32 V.

| SWITCHING CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Propagation delay time to logic low output | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, duty cycle = 50 % | $t_{PHL}$ | 0.1 | 0.25 | 0.5 | μs |
| Propagation delay time to logic high output | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, duty cycle = 50 % | $t_{PLH}$ | 0.1 | 0.25 | 0.5 | μs |
| Pulse width distortion | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, duty cycle = 50 % | PWD | - | - | 0.3 | μs |
| Rise time | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, duty cycle = 50 % | $t_r$ | - | 0.1 | - | μs |
| Fall time | $R_g$ = 10 Ω, $C_g$ = 10 nF, f = 10 kHz, duty cycle = 50 % | $t_f$ | - | 0.1 | - | μs |
| UVLO turn on delay | $V_O$ > 5 V, $I_F$ = 10 mA | $T_{UVLO-ON}$ | - | 0.8 | - | μs |
| UVLO turn off delay | $V_O$ < 5 V, $I_F$ = 10 mA | $T_{UVLO-OFF}$ | - | 0.6 | - | μs |

**Note**

- Minimum and maximum values were tested over recommended operating conditions ($T_{amb}$ = -40 °C to +100 °C, $I_{F(ON)}$ = 10 mA to 16 mA, $V_{F(OFF)}$ = -3 V to 0.8 V, $V_{CC}$ = 15 V to 32 V, $V_{EE}$ = ground) unless otherwise specified. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements. All typical values were measured at $T_{amb}$ = 25 °C and with $V_{CC}$ - $V_{EE}$ = 32 V.

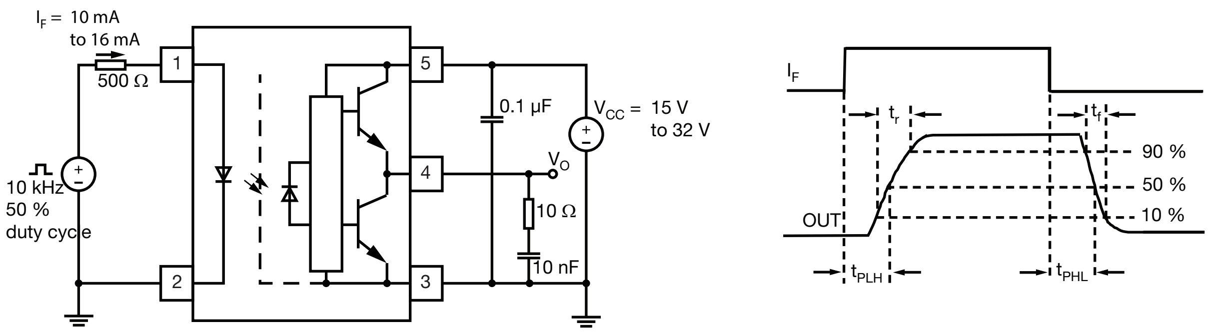



Fig. 4 - $t_{PLH}$, $t_{PHL}$, $t_r$ and $t_f$ Test Circuit and Waveforms

| COMMON MODE TRANSIENT IMMUNITY | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Common mode transient immunity at logic high output | $T_{amb}$ = 25 °C, $I_F$ = 10 mA to 16 mA, $V_{CM}$ = 1500 V, $V_{CC}$ = 32 V | $\|CM_H\|$ | 48 | - | - | kV/μs |
| Common mode transient immunity at logic low output | $T_{amb}$ = 25 °C, $V_{CM}$ = 1500 V, $V_{CC}$ = 32 V, $V_F$ = 0 V | $\|CM_L\|$ | 48 | - | - | kV/μs |

**Note**

- Minimum and maximum values were tested over recommended operating conditions ($T_{amb}$ = -40 °C to +100 °C, $I_{F(ON)}$ = 10 mA to 16 mA, $V_{F(OFF)}$ = -3 V to 0.8 V, $V_{CC}$ = 15 V to 32 V, $V_{EE}$ = ground) unless otherwise specified. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements. All typical values were measured at $T_{amb}$ = 25 °C and with $V_{CC}$ - $V_{EE}$ = 32 V.

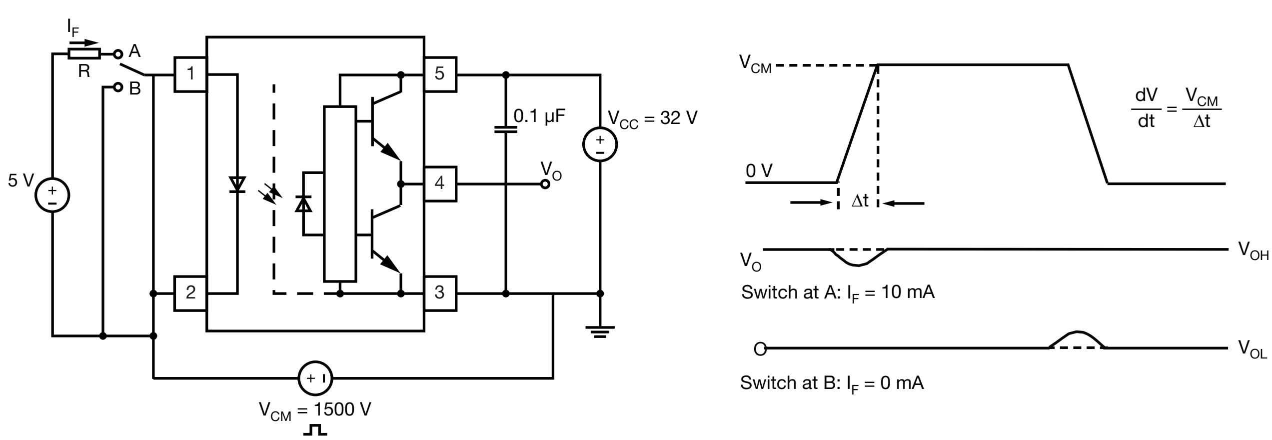



Fig. 5 - CMR Test Circuit and Waveforms

| **SAFETY AND INSULATION RATINGS** | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| Climatic classification | According to IEC 68 part 1 | | 40 / 100 / 21 | |
| Comparative tracking index | | CTI | 175 | |
| Maximum rated withstanding isolation voltage | t = 1 min | $V_{ISO}$ | 5300 | $V_{RMS}$ |
| Maximum transient isolation voltage | | $V_{IOTM}$ | 8000 | V |
| Maximum repetitive peak isolation voltage | | $V_{IORM}$ | 1050 | V |
| Isolation resistance | $T_{amb}$ = 25 °C, $V_{DC}$ = 500 V | $R_{IO}$ | $\geq 10^{12}$ | Ω |
| | $T_{amb}$ = 100 °C, $V_{DC}$ = 500 V | $R_{IO}$ | $\geq 10^{11}$ | Ω |
| Output safety power | | $P_{SO}$ | 900 | mW |
| Input safety current | | $I_{SI}$ | 250 | mA |
| Safety temperature | | $T_S$ | 175 | °C |
| Creepage distance | | | ≥ 8 | mm |
| Clearance distance | | | ≥ 8 | mm |
| Insulation thickness | | DTI | ≥ 0.4 | mm |
| Input to output test voltage, method B | $V_{IORM}$ x 1.875 = $V_{PR}$, 100 % production test with $t_M$ = 1 s, partial discharge < 5 pC | $V_{PR}$ | 1969 | $V_{peak}$ |
| Input to output test voltage, method A | $V_{IORM}$ x 1.6 = $V_{PR}$, 100 % production test with $t_M$ = 10 s, partial discharge < 5 pC | $V_{PR}$ | 1680 | $V_{peak}$ |
| Environment (pollution degree in accordance to DIN VDE 0109) | | | 2 | |

**Note**

- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

## TYPICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified)

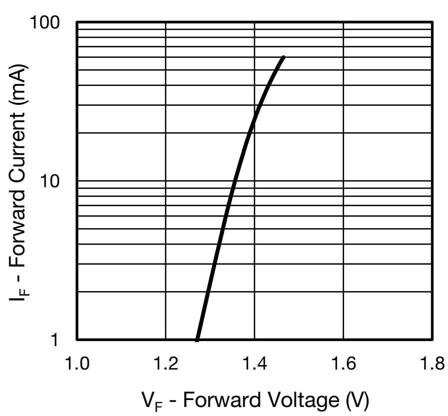



Fig. 6 - Forward Current vs. Forward Voltage

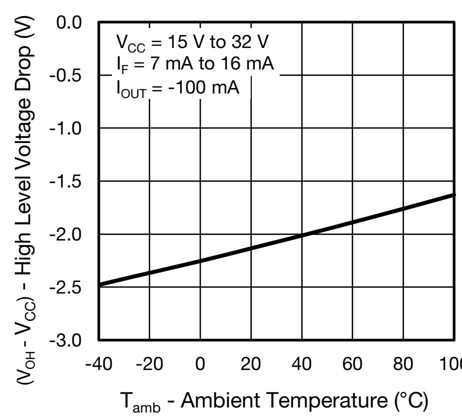



Fig. 7 - High Level Voltage Drop vs. Ambient Temperature

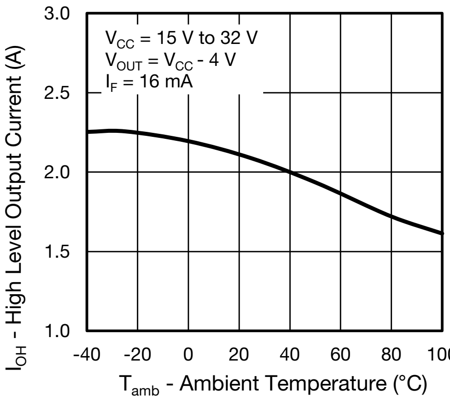



Fig. 8 - High Level Output Current vs. Ambient Temperature

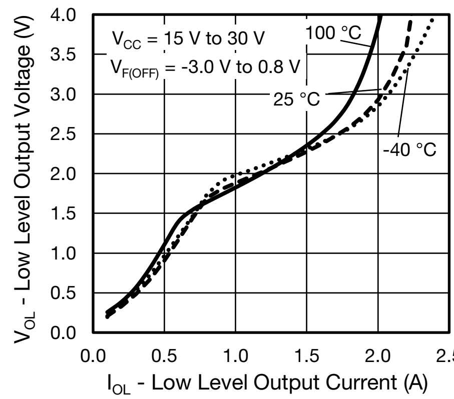



Fig. 11 - Low Level Output Voltage vs. Low Level Output Current

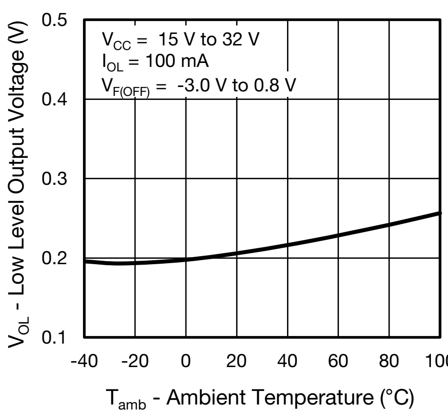



Fig. 9 - Low Level Output Voltage vs. Ambient Temperature

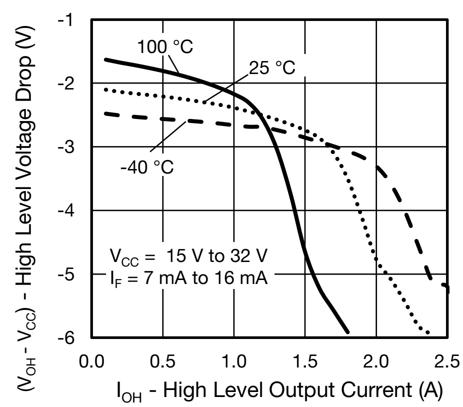



Fig. 12 - High Level Voltage Drop vs. High Level Output Current

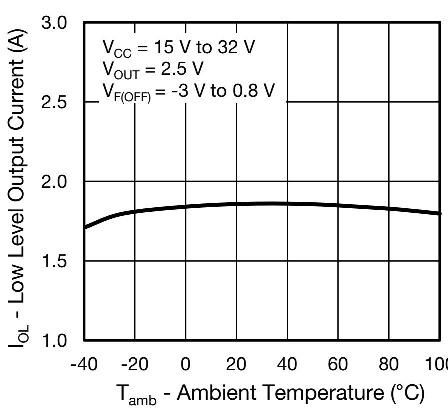



Fig. 10 - Low Level Output Current vs. Ambient Temperature

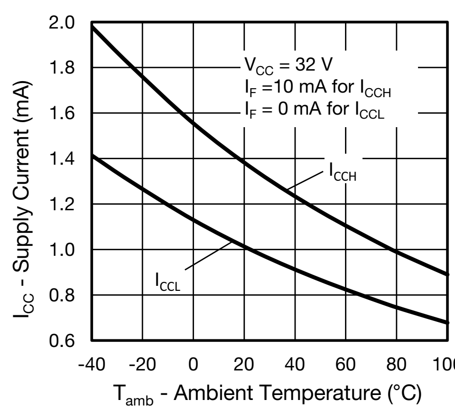



Fig. 13 - Supply Current vs. Ambient Temperature

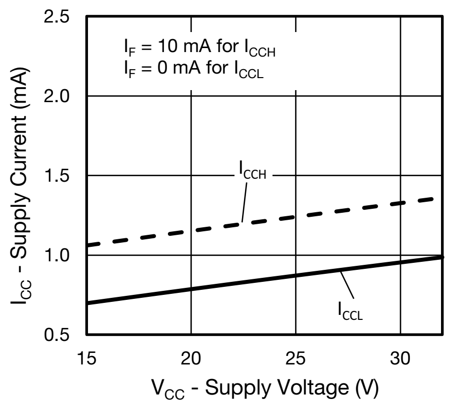



Fig. 14 - Supply Current vs. Supply Voltage

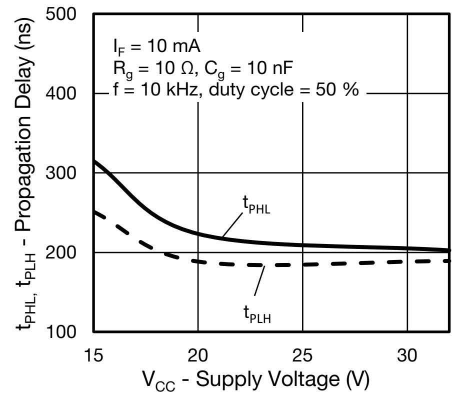



Fig. 17 - Propagation Delay vs. Supply Voltage

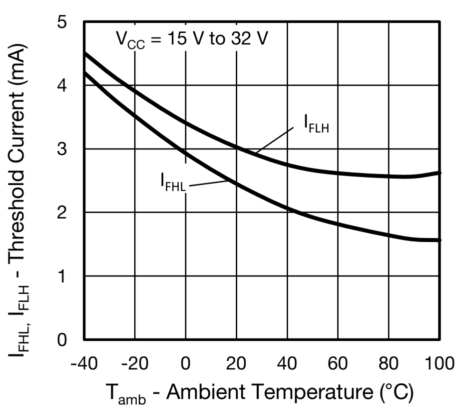



Fig. 15 - Threshold Current vs. Ambient Temperature

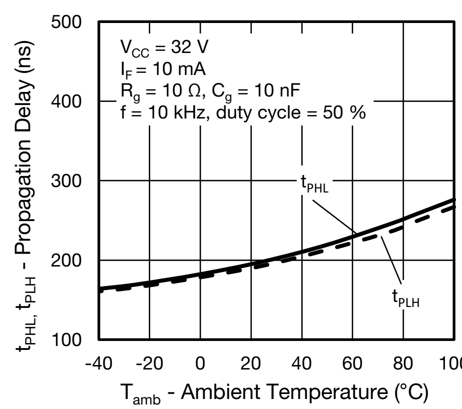



Fig. 18 - Propagation Delay vs. Ambient Temperature

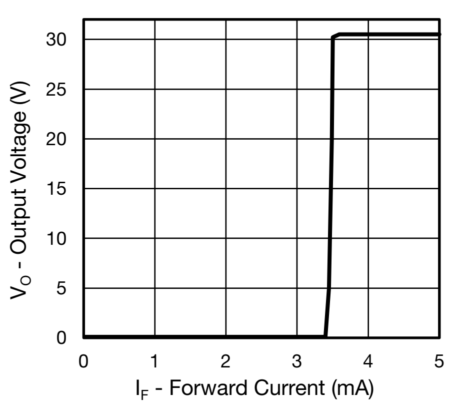



Fig. 16 - Output Voltage vs. Forward Current

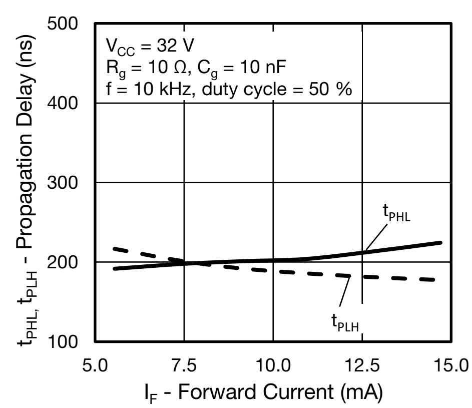



Fig. 19 - Propagation Delay vs. Forward Current

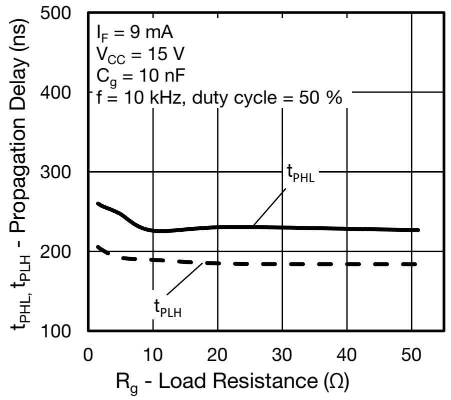



Fig. 20 - Propagation Delay vs. Load Resistance

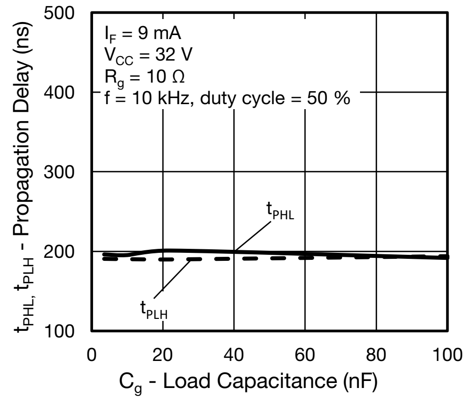



Fig. 21 - Propagation Delay vs. Load Capacitance

## **PACKAGE DIMENSIONS** (in millimeters)

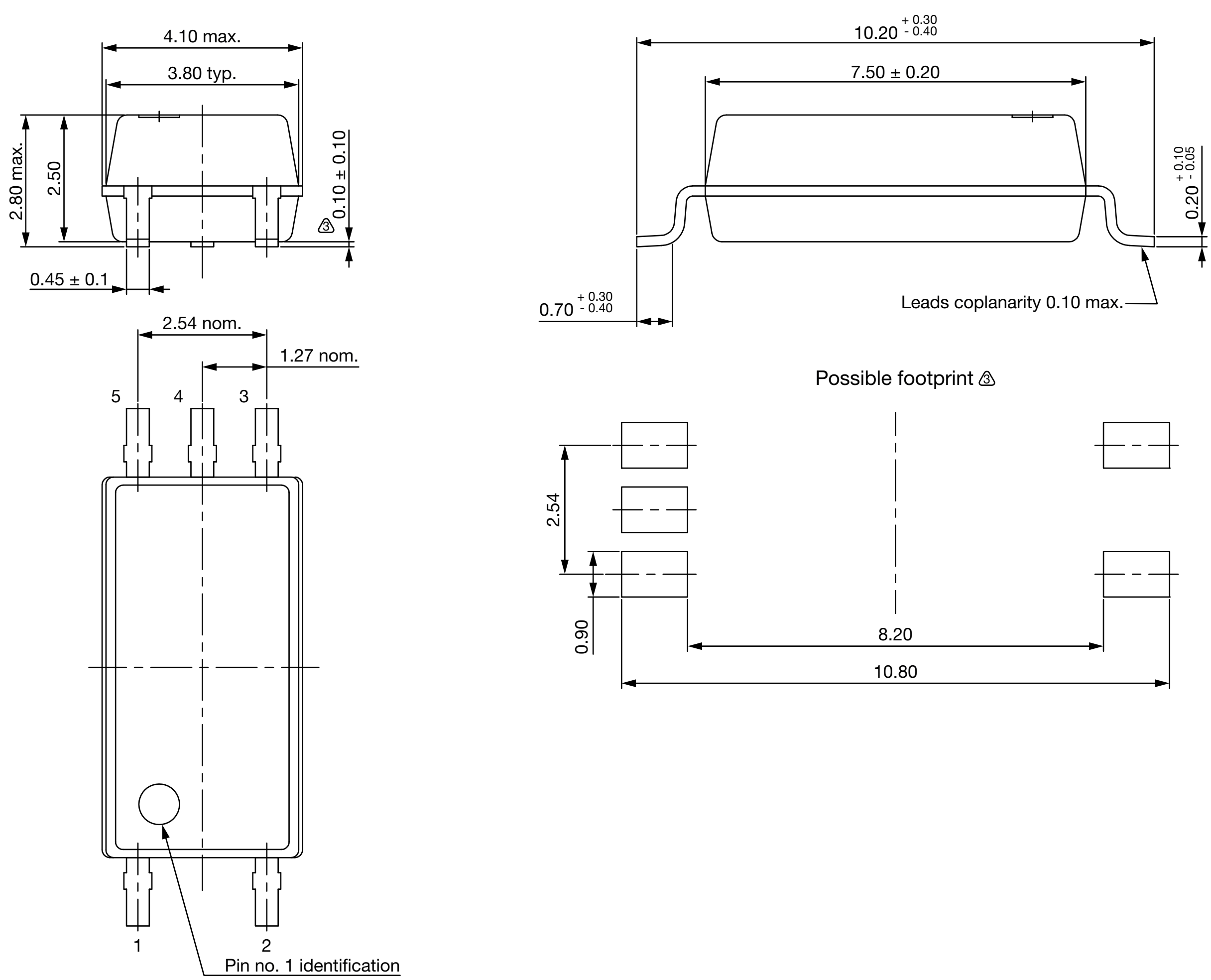



Fig. 22 - Package Drawing

## PACKAGE MARKING

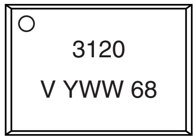



Fig. 23 - VOL3120T

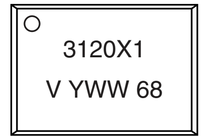



Fig. 24 - VOL3120-X001T

## PACKING INFORMATION (tape and reel)

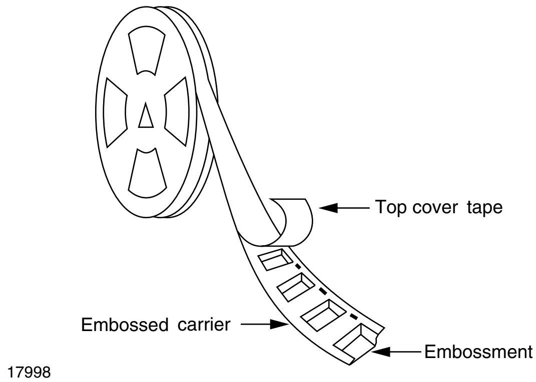
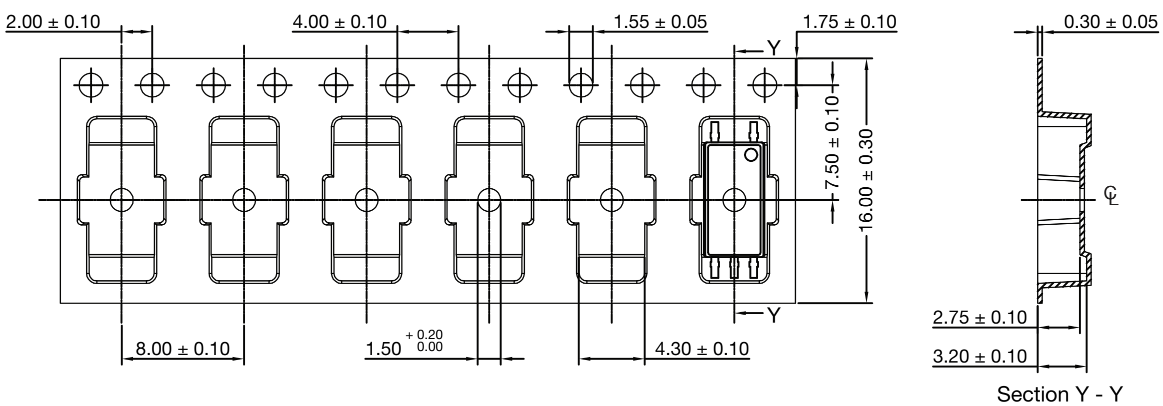



Fig. 25 - Tape and Reel Shipping Medium




**Note:**

1. Cumulative tolerance of 10 spocket holes is ± 0.20.

Fig. 26 - Tape and Reel Packing (2000 pieces on reel)

## SOLDER PROFILE

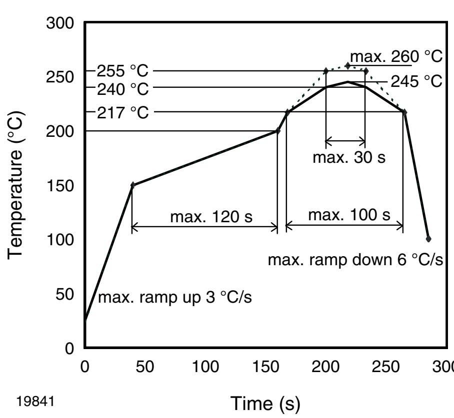



Fig. 27 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions: $T_{amb}$ < 30 °C, RH < 85 %

Moisture sensitivity level 1, according to J-STD-020

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# Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**

Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.


**Как с нами связаться**

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