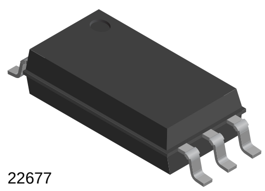
Low Profile, 2.5 A Output Current IGBT and MOSFET Driver



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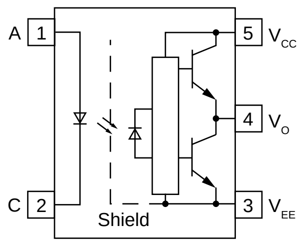

DESIGN SUPPORT TOOLS

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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.

FEATURES

- 2.5 A minimum peak output current
- 48 kV/μs minimum common mode rejection (CMR) at V_{CM} = 1500 V
- Industrial temperature range: -40 °C to +110 °C
- Wide operating V_{CC} range: 15 V to 32 V
- I_{CC} = 2.5 mA maximum supply current
- 0.5 μs maximum propagation delay time
- Under voltage lock-out (UVLO) with hysteresis
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

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

APPLICATIONS

- Isolated IGBT / MOSFET gate driver
- AC and brushless DC motor drives
- Induction stove top
- Industrial inverters
- Switch mode power supplies (SMPS)
- Uninterruptible power supplies (UPS)

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.

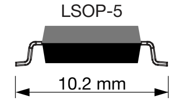
- UL1577
- cUL
- CQC
- DIN EN 60747-5-5 (VDE 0884) and reinforced insulation rating available with option "1"

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



AGENCY CERTIFIED / PACKAGE	CMR (kV/μs)
UL, cUL, CQC	**48**
LSOP-5	VOL3120T
UL, cUL, CQC, VDE	**48**
LSOP-5	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 +110	°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

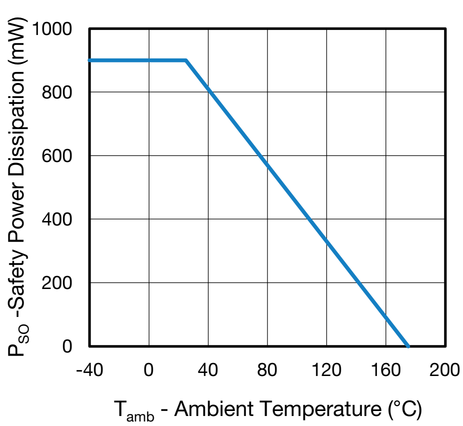


Fig. 1 - Safety Power Dissipation vs. Ambient Temperature

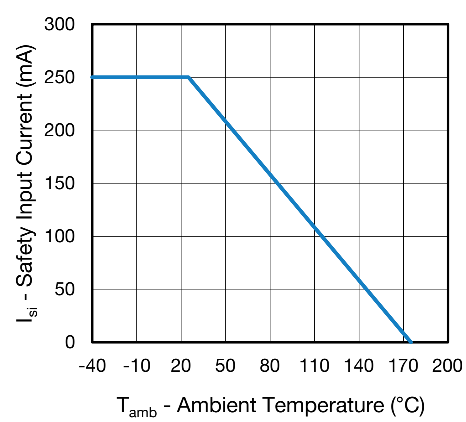


Fig. 2 - Safety Input Current vs. Ambient Temperature

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	+110	°C

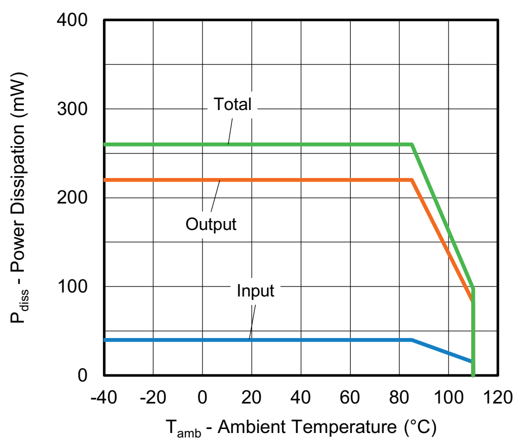


Fig. 3 - Power Dissipation vs. Ambient Temperature

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 +110 °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 +110 °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

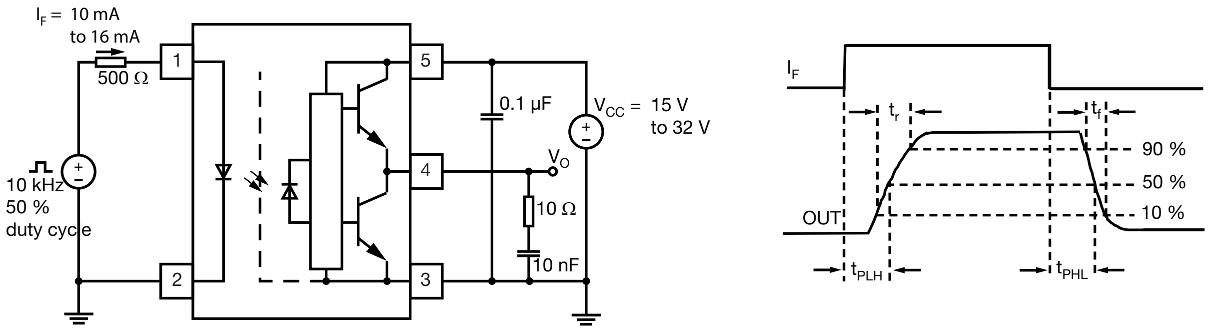


Fig. 4 - t_{PLH}, t_{PHL}, t_r and t_f Test Circuit and Waveforms

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 +110 °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.

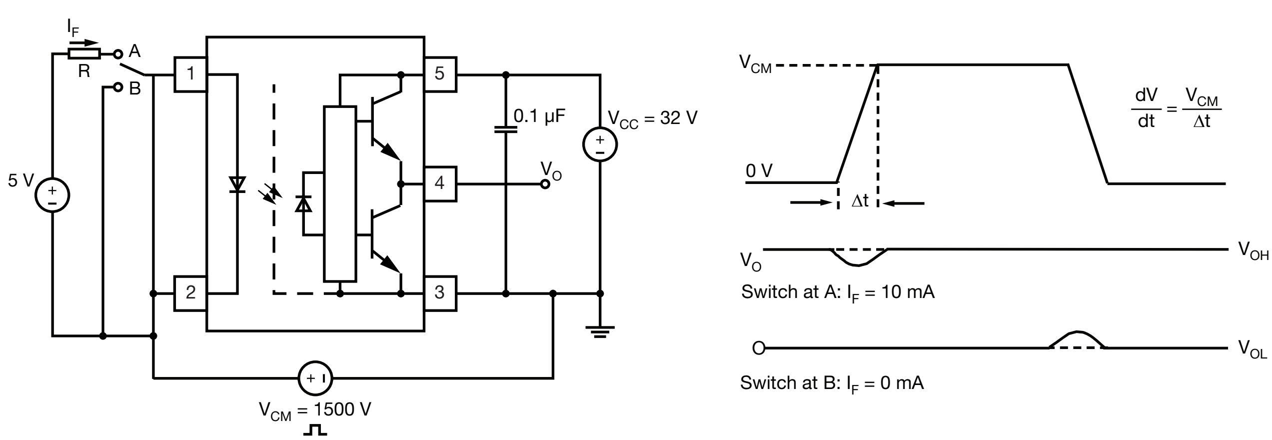


Fig. 5 - CMR Test Circuit and Waveforms

SAFETY AND INSULATION RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Climatic classification	According to IEC 68 part 1		40 / 110 / 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)

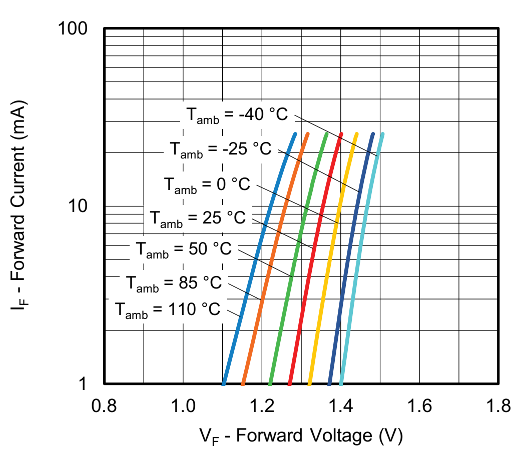


Fig. 6 - Forward Current vs. Forward Voltage

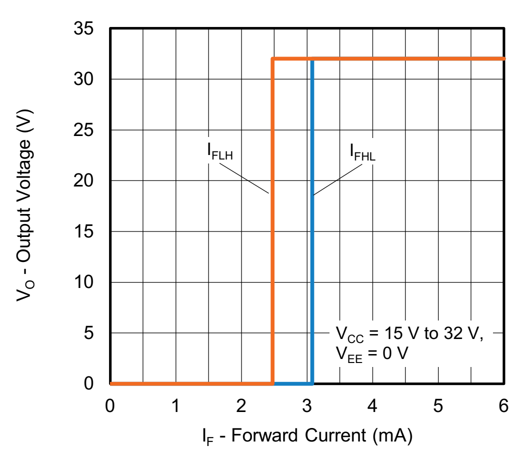


Fig. 7 - Output Voltage vs. Forward Current

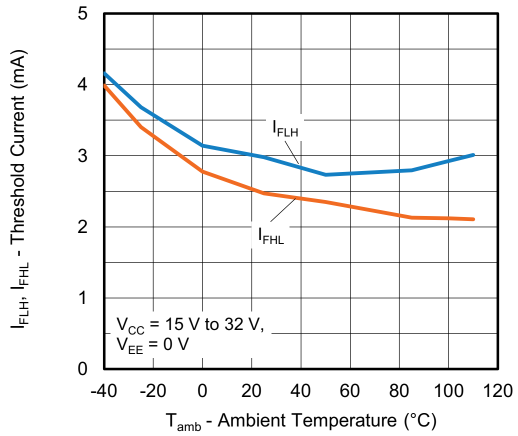


Fig. 8 - Threshold Current vs. Ambient Temperature

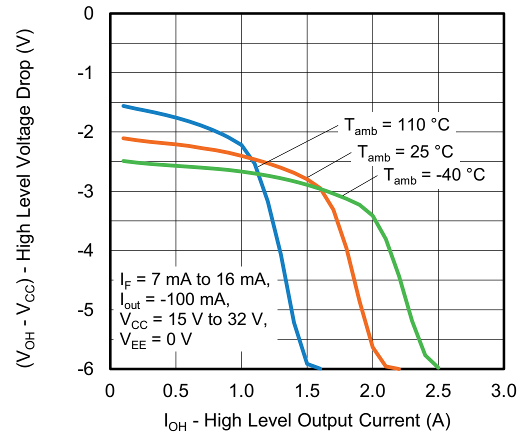


Fig. 11 - High Level Voltage Drop vs. High Level Output Current

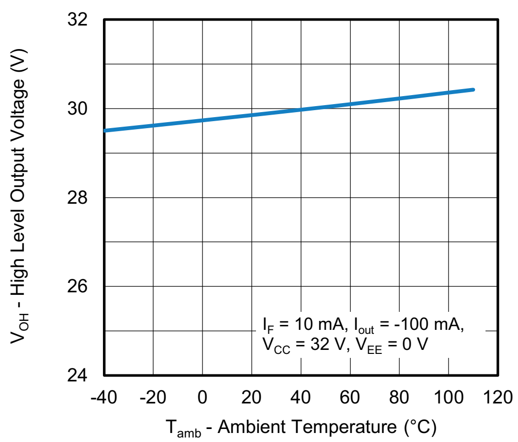


Fig. 9 - High Level Output Voltage vs. Ambient Temperature

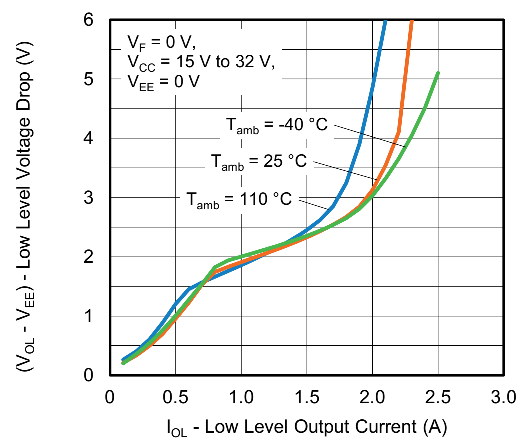


Fig. 12 - Low Level Voltage Drop vs. Low Level Output Current

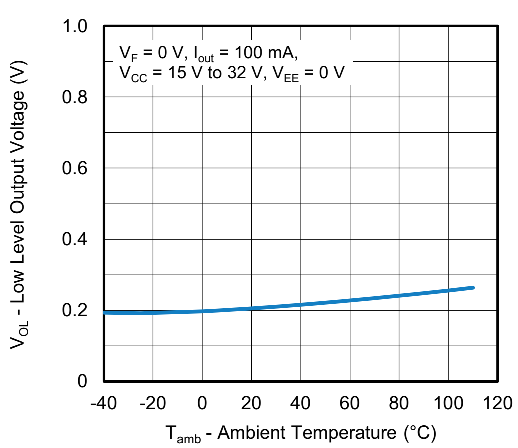


Fig. 10 - Low Level Output Voltage vs. Ambient Temperature

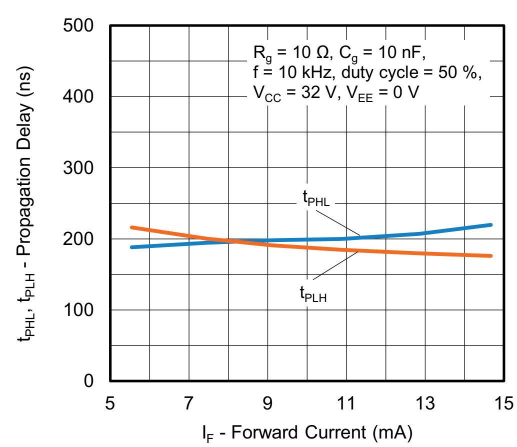


Fig. 13 - Propagation Delay vs. Forward Current

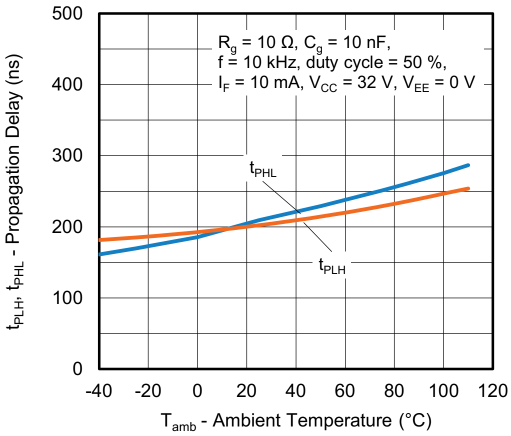


Fig. 14 - Propagation Delay vs. Ambient Temperature

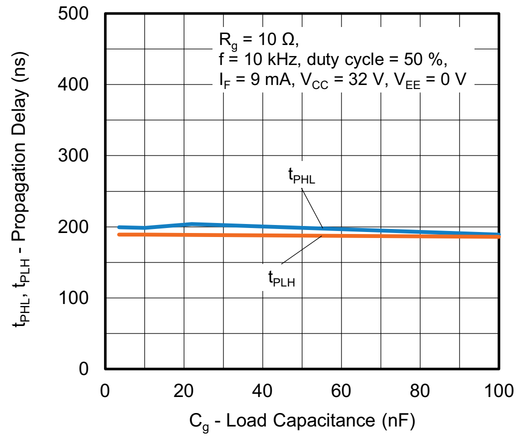


Fig. 17 - Propagation Delay vs. Load Capacitance

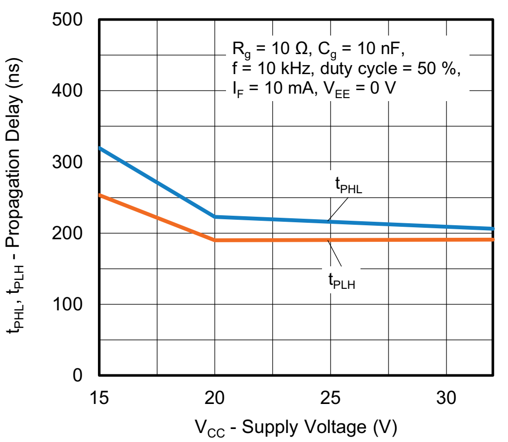


Fig. 15 - Propagation Delay vs. Supply Voltage

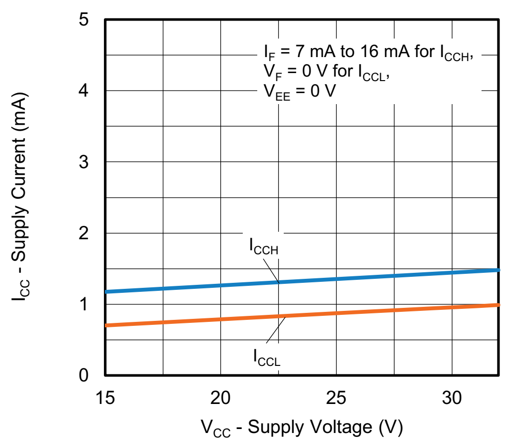


Fig. 18 - Supply Current vs. Supply Voltage

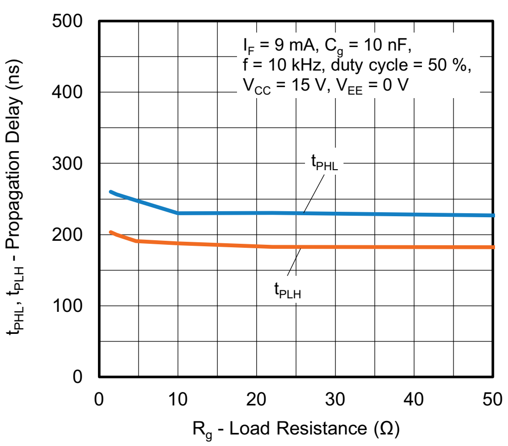


Fig. 16 - Propagation Delay vs. Load Resistance

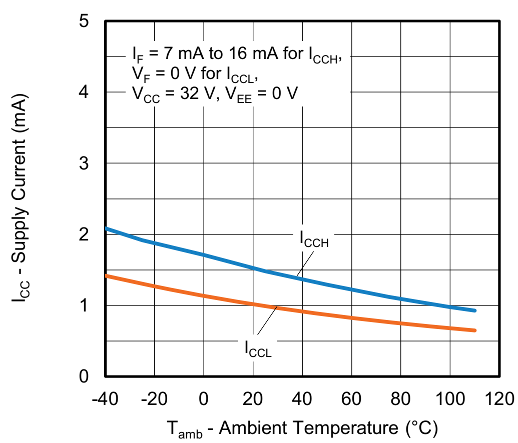


Fig. 19 - Supply Current vs. Ambient Temperature

PACKAGE DIMENSIONS (in millimeters)

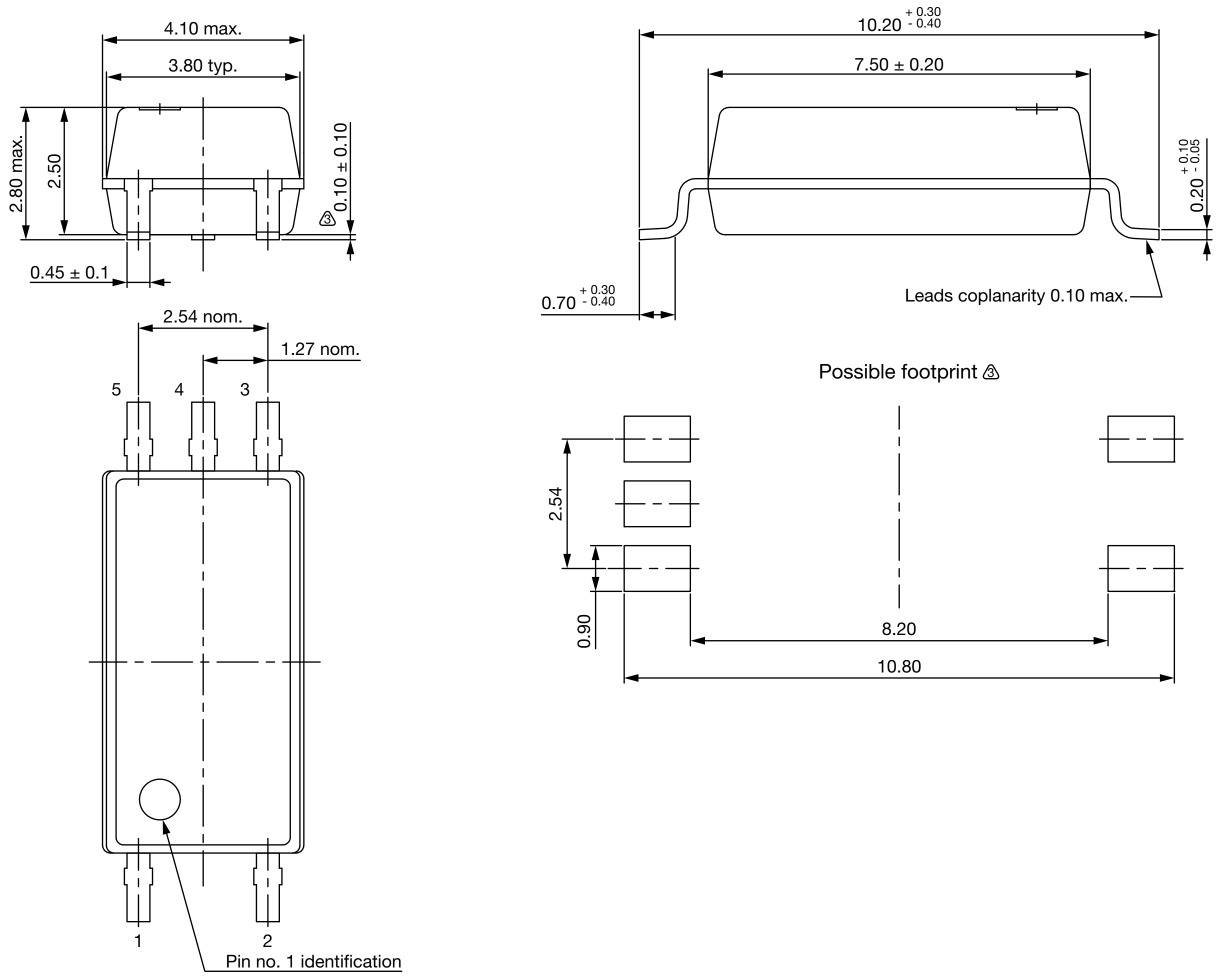


Fig. 20 - Package Drawing

PACKAGE MARKING

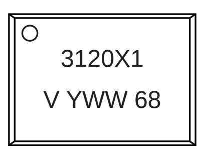


Fig. 21 - Example of VOL3120-X001T

Notes

- "YWW" is the date code marking (Y = year code, WW = week code)
- "X1" is only marked on option "1" parts
- • Tape and reel suffix (T) is not part of the package marking

PACKING INFORMATION (tape and reel)

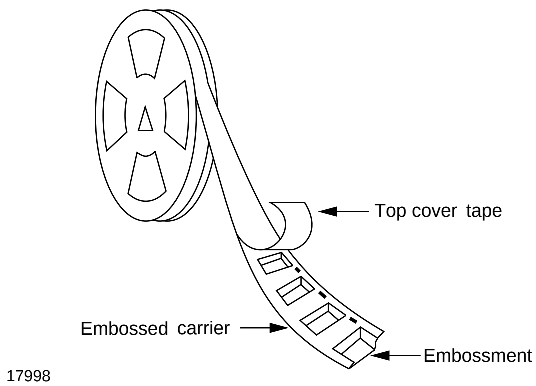
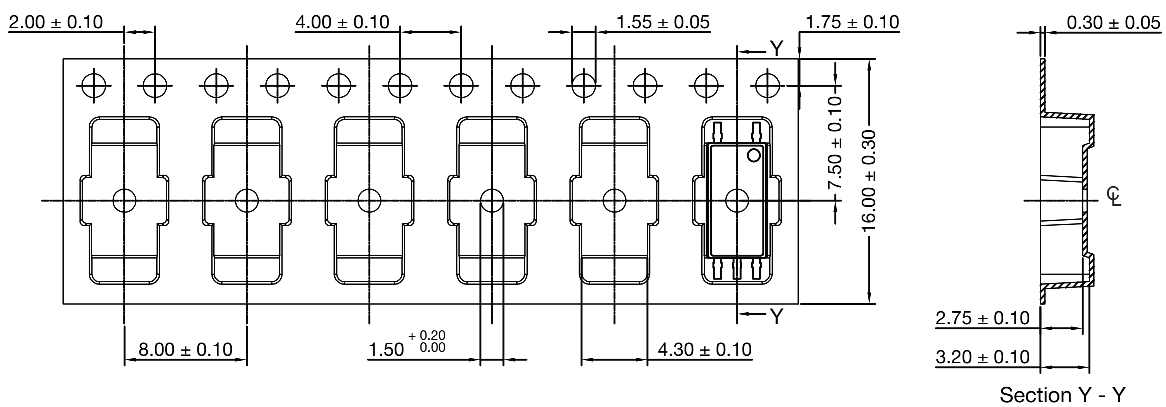


Fig. 22 - Tape and Reel Shipping Medium



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

Fig. 23 - Tape and Reel Packing (2000 pieces on reel)

SOLDER PROFILE

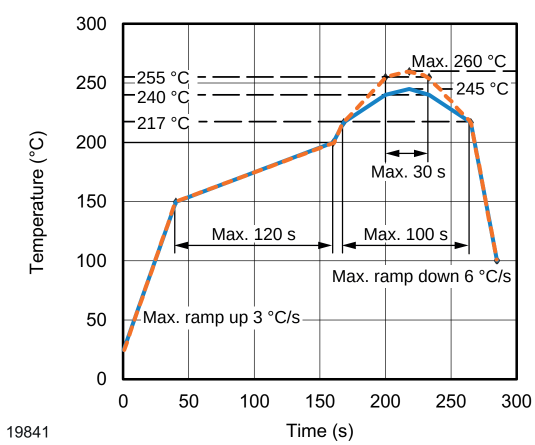


Fig. 24 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020

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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