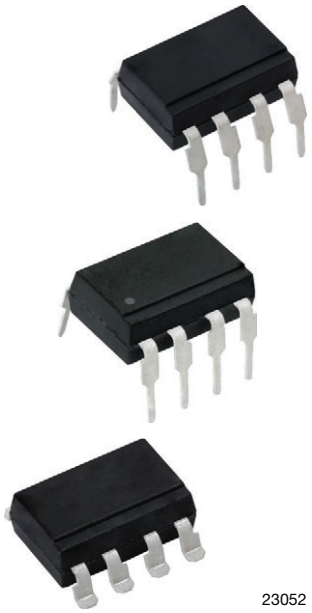
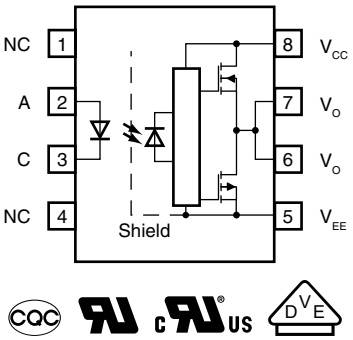
2.5 A Output Current IGBT and MOSFET Driver



23052



DESCRIPTION

The VOD3120A consists of a AlGaAs LED 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 inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The VOD3120A is ideally suited for directly driving IGBTs with ratings up to 1200 V / 100 A. For IGBTs with higher ratings, the VOD3120A can be used to drive a discrete power stage which drives the IGBT gate.

FEATURES

- 2.5 A minimum peak output current
- Rail-to-rail output stage
- 50 kV/µs common mode rejection ratio
- Wide operating range of 15 V to 30 V
- Industrial temperature range of -40 °C to +105 °C
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

APPLICATIONS

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

AGENCY APPROVALS

- UL 1577
- cUL
- DIN EN 60747-5-5 (VDE 0884) and reinforced insulation rating available with option “V”
- CQC

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents | Evaluation Boards

ORDERING INFORMATION

V	O	D	3	1	2	0	A	#	-	V	T	#
PART NUMBER								PACKAGE OPTION		VDE OPTION	TAPE AND REEL	

AGENCY CERTIFIED / PACKAGE	CMR (kV/µs)
UL, cUL, CQC	**35**
DIP-8	VOD3120AD
DIP-8, 400 mil	VOD3120AG
SMD-8	VOD3120AB-T
SMD-8, 180° orientation	VOD3120AB-T2
VDE, UL, cUL, CQC	**35**
DIP-8	VOD3120AD-V
DIP-8, 400 mil	VOD3120AG-V
SMD-8	VOD3120AB-VT
SMD-8, 180° orientation	VOD3120AB-VT2

TRUTH TABLE

LED	HIGH SIDE	LOW SIDE	V_O
Off	Off	On	Low
On	On	Off	High

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT				
Forward current		I_F	20	mA
Peak transient input current	≤ 1 µs pulse width, 300 pps	$I_{F(TRAN)}$	1	A
Reverse input voltage		V_R	5	V
Input current (rise / fall time) (1)		$t_{r(in)}$ / $t_{f(in)}$	500	ns
Output power dissipation		P_{diss}	45	mW
OUTPUT				
High peak output current (2)		$I_{OH(PEAK)}$	2.5	A
Low peak output current (2)		$I_{OL(PEAK)}$	2.5	A
Supply voltage		(V_{CC} - V_{EE})	0 to +35	V
Output voltage		$V_{O(PEAK)}$	35	V
Output power dissipation		P_{diss}	250	mW
Junction temperature		T_j	125	°C
OPTOCOUPLER				
Storage temperature range		T_S	-55 to +125	°C
Ambient operating temperature range		T_{amb}	-40 to +105	°C
Total power dissipation		P_{tot}	295	mW
Soldering temperature		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) The rise and fall times of the forward current should be less than 500 ns

(2) Exponential waveform, pulse width ≤ 0.3 µs, f ≤ 15 kHz

RECOMMENDED OPERATING CONDITION				
PARAMETER	**SYMBOL**	**MIN.**	**MAX.**	**UNIT**
Operating temperature	T_{amb}	-40	+105	°C
Power supply voltage	V_{CC} - V_{EE}	15	30	V
Forward current (V_O in “high” state)	$I_{F(ON)}$	7	16	mA
Forward voltage (V_O in “low” state)	$V_{F(OFF)}$	0	0.8	V

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
INPUT						
Forward voltage	I_F = 10 mA	V_F	1.2	1.37	1.8	V
Temperature coefficient of forward voltage	I_F = 10 mA	$\Delta V_F/\Delta T$	-	-1.237	-	mV/°C
Reverse breakdown voltage	I_R = 10 µA	BV_R	5	-	-	V
Threshold forward current (V_O from “low” to “high”)	V_{CC} = 30 V, V_O < 5 V	I_{FLH}	-	1.8	5	mA
Threshold forward voltage (V_O from “high” to “low”)	V_{CC} = 30 V, V_O > 5 V	V_{FLH}	0.8	-	-	V
Input capacitance	f = 1 MHz, V_F = 0 V	C_{IN}	-	33	-	pF
OUTPUT						
High level supply current	I_F = 10 mA, V_{CC} = 30 V, V_O = open	I_{CCH}	-	1.7	3.0	mA
Low level supply current	I_F = 0 mA, V_{CC} = 30 V, V_O = open	I_{CCL}	-	2.0	3.0	mA
High level output current	V_O = (V_{CC} - 1.5 V)	I_{OH} (1)	-	-	-1.0	A
	V_O = (V_{CC} - 4 V)	I_{OH} (2)	-	-	-2.5	A
Low level output current	V_O = (V_{EE} + 1.5 V)	I_{OL} (1)	1.0	-	-	A
	V_O = (V_{EE} + 4 V)	I_{OL} (2)	2.5	-	-	A
High level output voltage	I_F = 10 mA, I_O = -100 mA	V_{OH}	V_{CC} - 0.3 V	V_{CC} - 0.1 V	-	V
Low level output voltage	I_F = 0 mA, I_O = 100 mA	V_{OL}	-	V_{EE} + 0.1 V	V_{EE} + 0.25 V	V
UVLO threshold	V_O > 5 V, I_F = 10 mA	V_{UVLO+}	11.0	12.7	13.5	V
	V_O < 5 V, I_F = 10 mA	V_{UVLO-}	9.5	11.2	12.0	V
UVLO hysteresis		$UVLO_{HYS}$	-	1.5	-	V
COUPLER						
Coupling capacitance	f = 1 MHz	C_{IO}	-	0.92	-	pF

Notes

- All typical values at T_{amb} = 25°C and V_{CC} - V_{EE} = 30 V, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition

(1) Maximum pulse width = 50 µs

(2) Maximum pulse width = 10 µs

TEST CIRCUITS

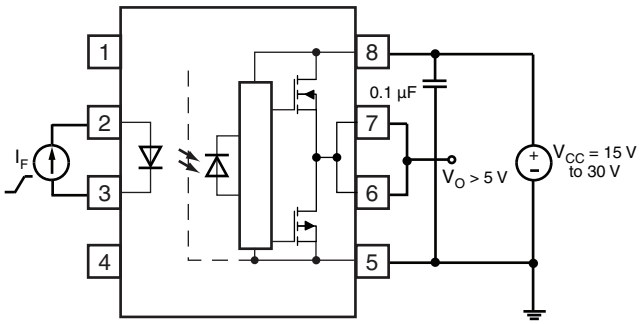


Fig. 1 - I_{FLH} Test Circuit

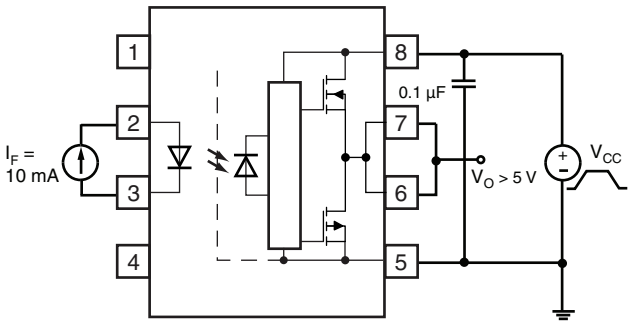


Fig. 2 - UVLO Test Circuit

SWITCHING CHARACTERISTICS (T_{amb} = 25 °C, V_{CC} - V_{EE} = 30 V unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Propagation delay time to V_O = "low"	R_g = 10 Ω, C_g = 25 nF, f = 10 kHz, duty cycle = 50 %, I_F = 7 mA to 16 mA, V_{CC} = 10 V to 30 V, V_{EE} = ground	t_{PHL}	0.05	0.13	0.5	µs
Propagation delay time to V_O = "high"		t_{PLH}	0.05	0.13	0.5	µs
Pulse width distortion		PWD	-	0.005	0.07	µs
Propagation delay difference (1)		PDD	-0.1	-	0.1	µs
Output rise time (10 % to 90 %)		t_r	-	0.035	-	µs
Output fall time (90 % to 10 %)		t_f	-	0.035	-	µs

Note

(1) The difference between t_{PHL} and t_{PLH} between any two parts, series parts, or channels under same test conditions

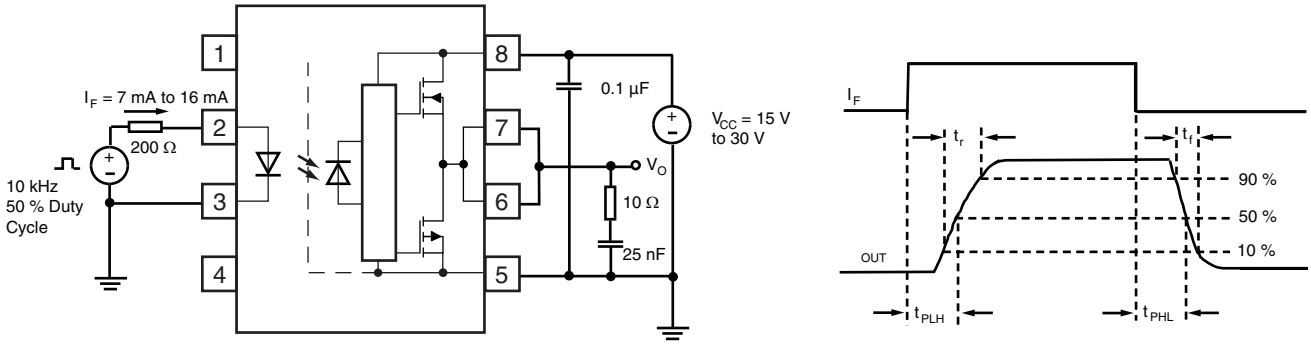


Fig. 3 - t_{PLH}, t_{PHL}, t_r and t_f Test Circuit and Waveforms

COMMON MODE TRANSIENT IMMUNITY (T_{amb} = 25 °C, V_{CC} - V_{EE} = 30 V unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Common mode transient immunity at high level output (V_O = "high") (1)	I_F = 10 mA to 16 mA, V_{CM} = 1500 V, V_{CC} = 30 V	$\|CM_H\|$	35	50	-	kV/µs
Common mode transient immunity at low level output (V_O = "low") (2)	V_F = 0 V, V_{CM} = 1500 V, V_{CC} = 30 V	$\|CM_L\|$	35	50	-	kV/µs

Notes

(1) CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O > 15 V)

(2) CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O < 1 V)

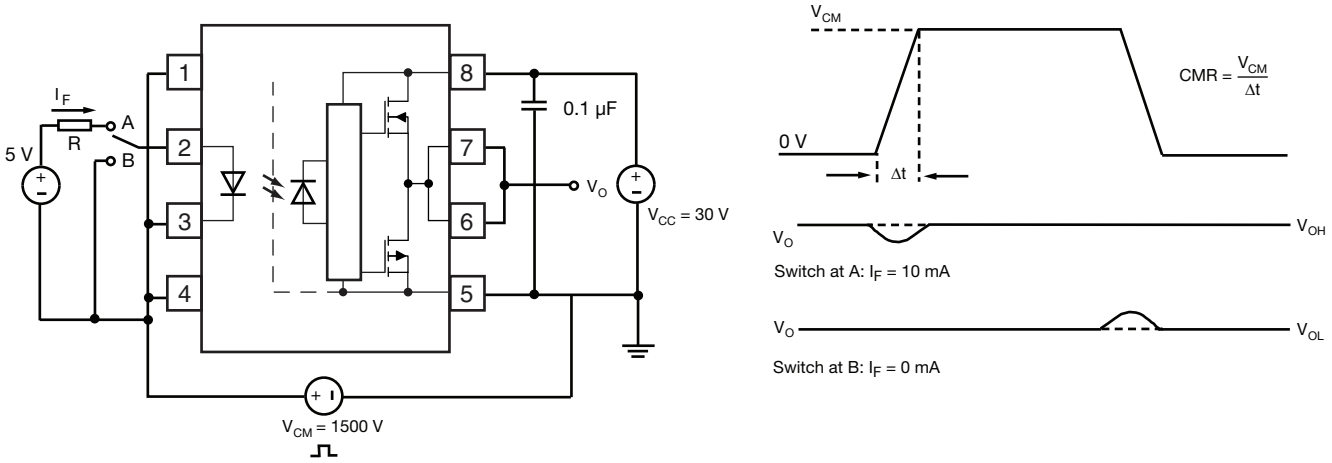


Fig. 4 - CMR Test Circuit and Waveforms

SAFETY AND INSULATION RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Comparative tracking index	Insulation group IIIa	CTI	175	
Maximum rated withstanding isolation voltage	According to UL1577, t = 1 min	V_{ISO}	5300	V_{RMS}
Maximum transient isolation voltage	According to DIN EN 60747-5-5	V_{IOTM}	6000	V_{peak}
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	V_{IORM}	891	V_{peak}
Isolation resistance	T_{amb} = 25 °C, V_{IO} = 500 V	R_{IO}	10^{12}	Ω
	T_{amb} = 100 °C, V_{IO} = 500 V	R_{IO}	10^{11}	Ω
Output safety power		P_{SO}	250	mW
Input safety current		I_{SI}	25	mA
Input safety temperature		T_S	175	°C
Creepage distance	DIP-8, SMD-8		> 7	mm
Clearance distance			> 7	mm
Creepage distance	DIP-8, 400 mil		> 8	mm
Clearance distance			> 8	mm
Insulation thickness		DTI	> 0.4	mm

Note

- As per IEC 60747-5-2, §7.4.3.8.1, this optocoupler is reinforced rated and 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)

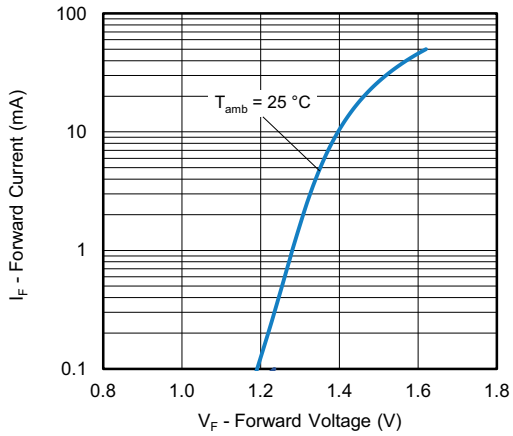


Fig. 5 - Forward Current vs. Forward Voltage

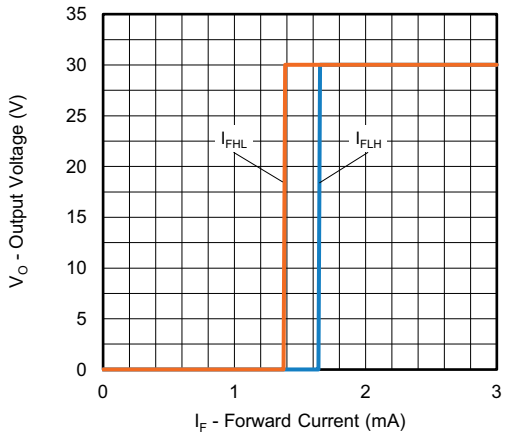


Fig. 6 - Output Voltage vs. Forward Current

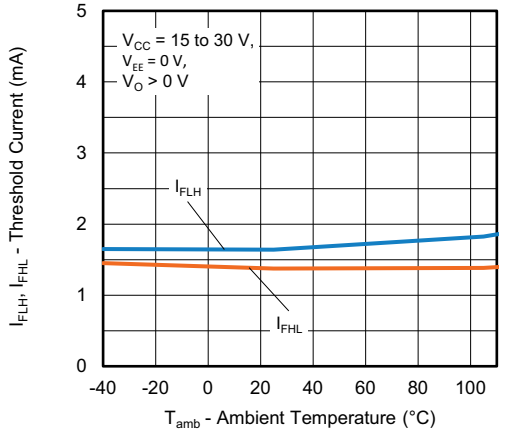


Fig. 7 - Threshold Current vs. Ambient Temperature

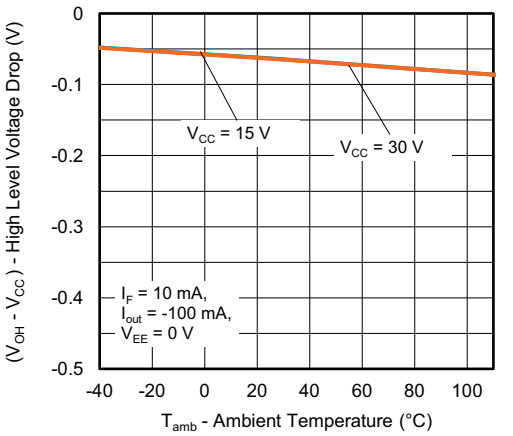


Fig. 8 - High Level Voltage Drop vs. Ambient Temperature

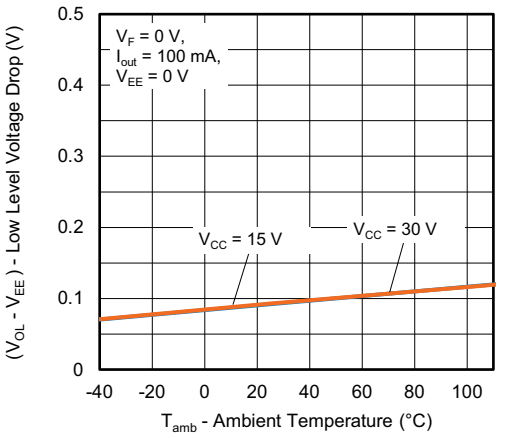


Fig. 9 - Low Level Voltage Drop vs. Ambient Temperature

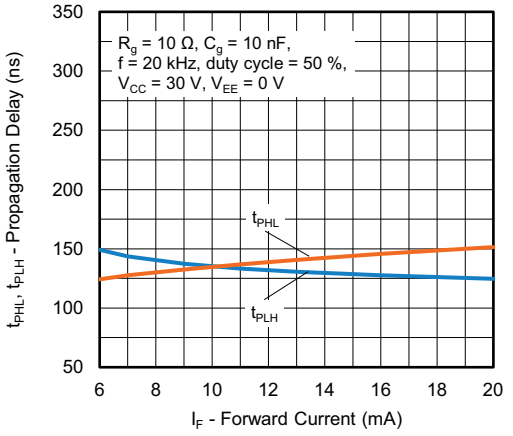


Fig. 10 - Propagation Delay vs. Forward Current

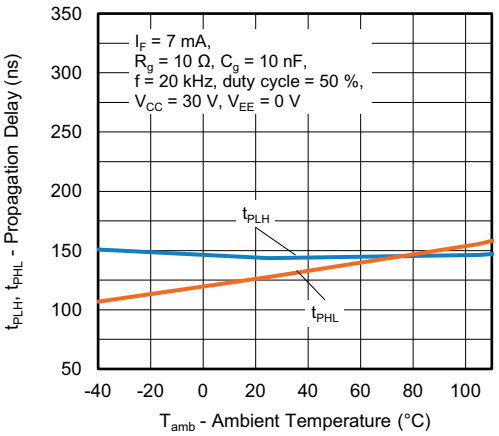


Fig. 11 - Propagation Delay vs. Ambient Temperature

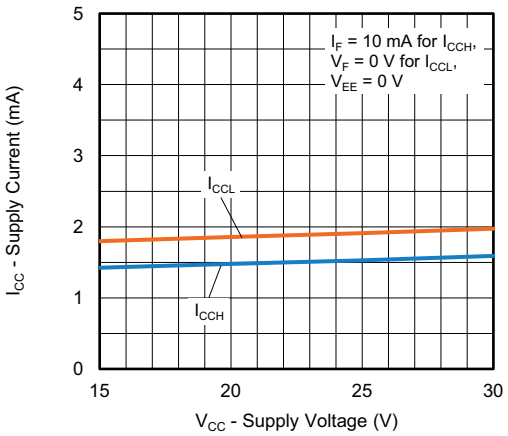


Fig. 13 - Supply Current vs. Supply Voltage

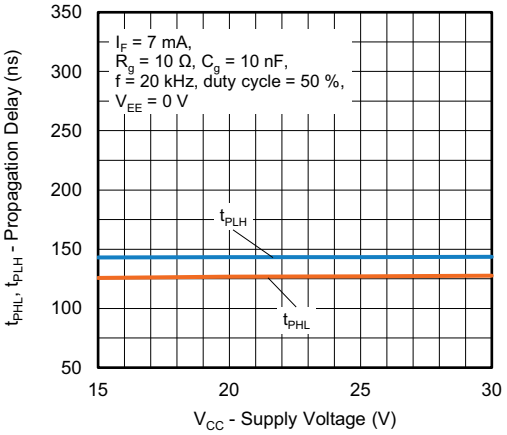


Fig. 12 - Propagation Delay vs. Supply Voltage

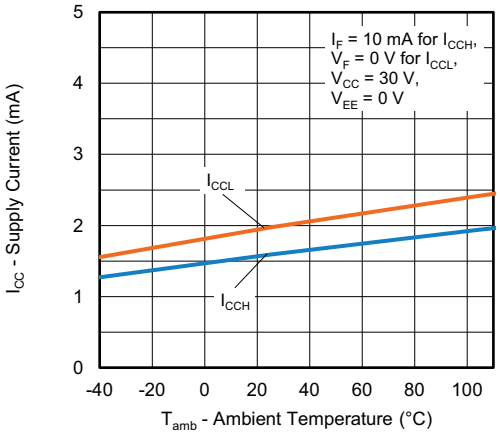


Fig. 14 - Supply Current vs. Ambient Temperature

PACKAGE DIMENSIONS (in millimeters)

DIP-8

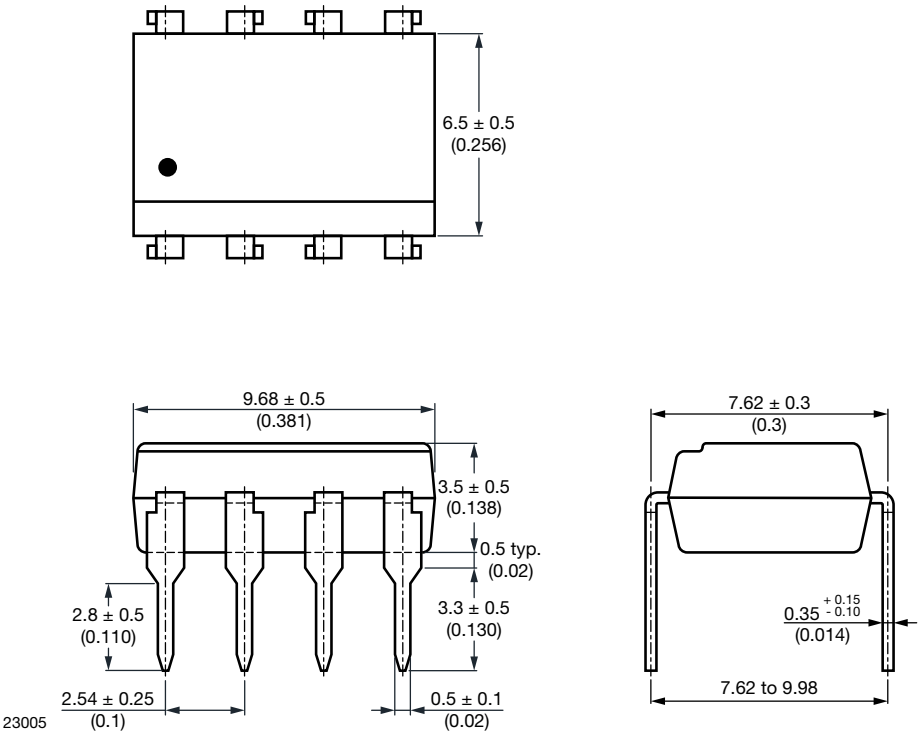


Fig. 15

DIP-8, 400 mil

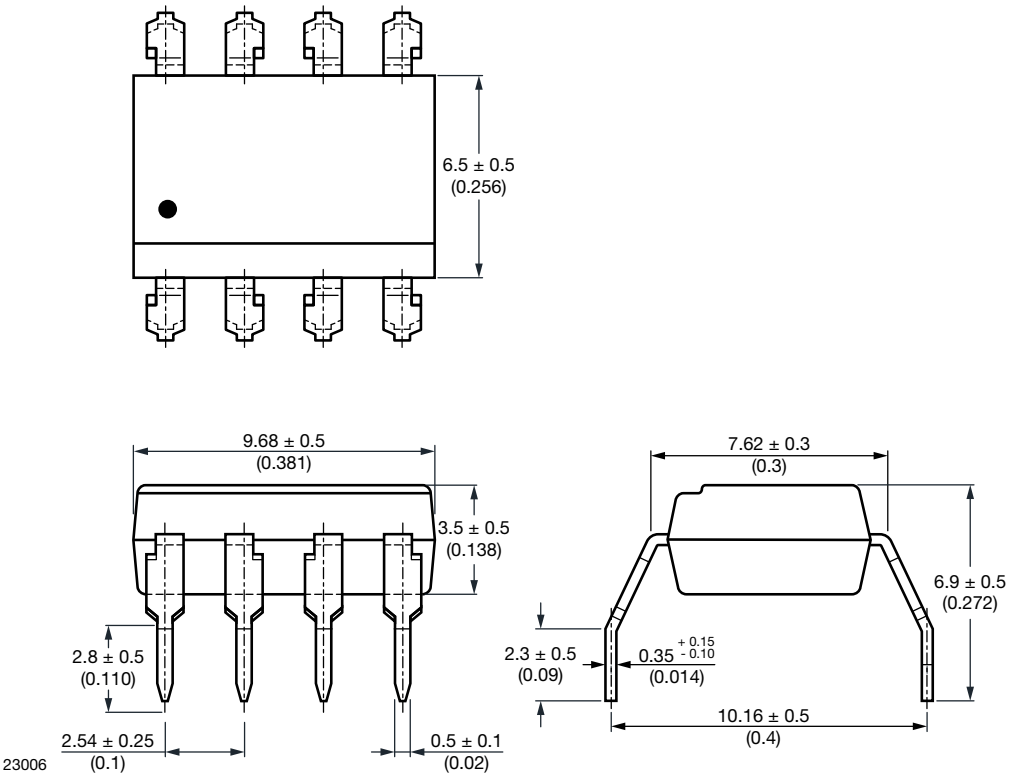


Fig. 16

SMD-8

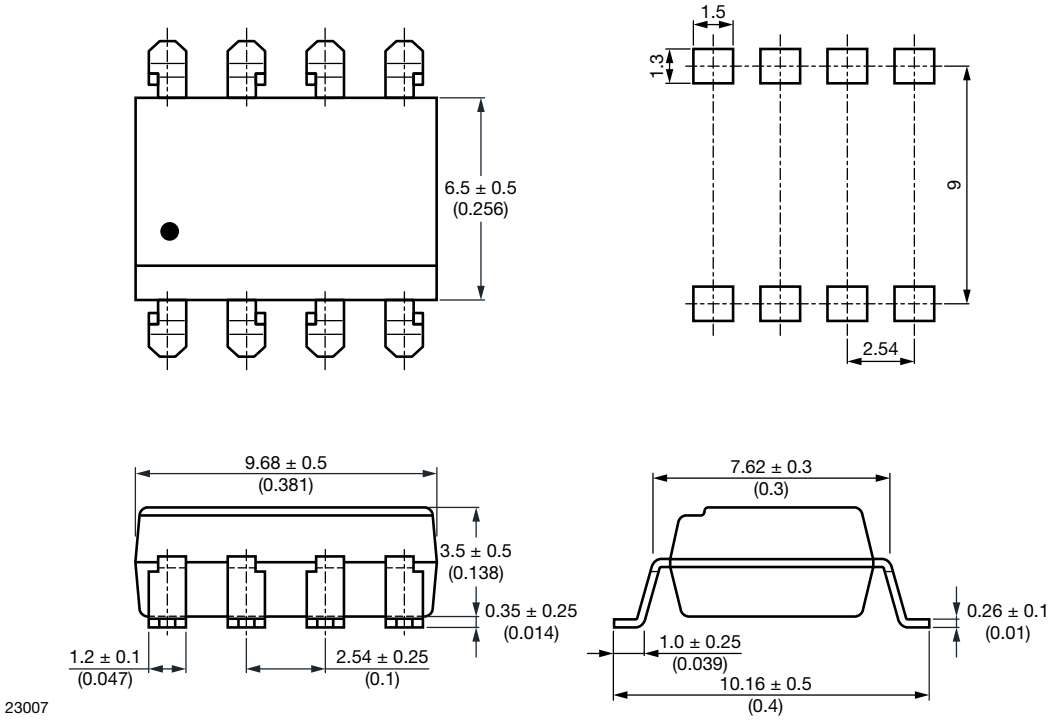


Fig. 17

PACKAGE MARKING

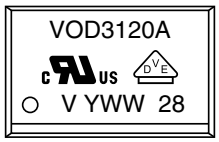


Fig. 18 - Example of VOD3120AB-VT

Notes

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

PACKAGING INFORMATION (in millimeters)

DEVICES PER TUBES			
TYPE	UNITS/TUBE	TUBES/BOX	UNITS/BOX
DIP-8	50	40	2000
DIP-8, 400 mil	50	40	2000

SMD-8 Tape

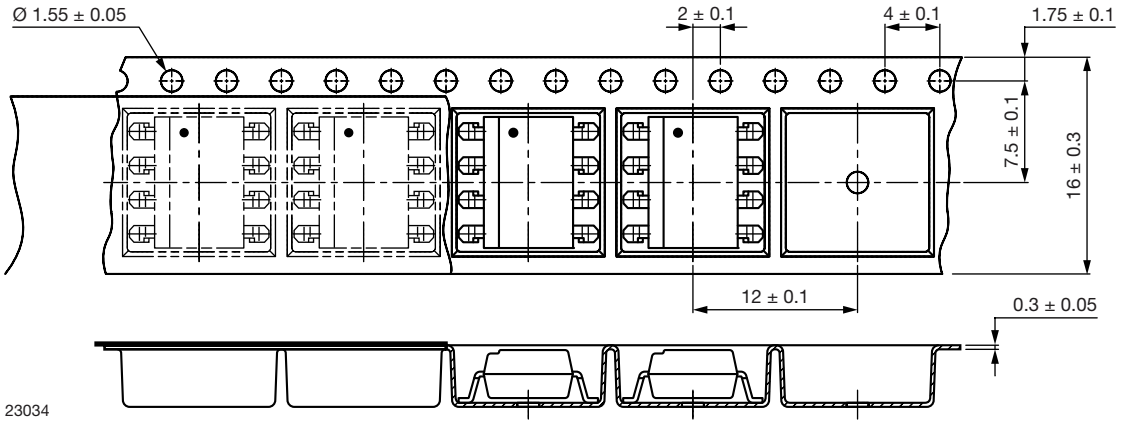


Fig. 19 - Tape and Reel Packaging (1000 pieces on reel)

SMD-8 Tape, 180° Orientation

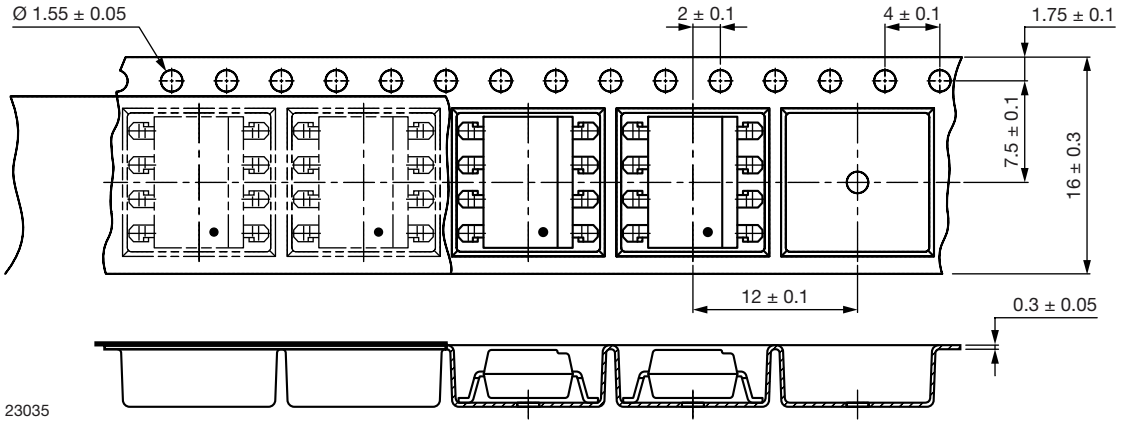


Fig. 20 - Tape and Reel Packaging (1000 pieces on reel)

Reel

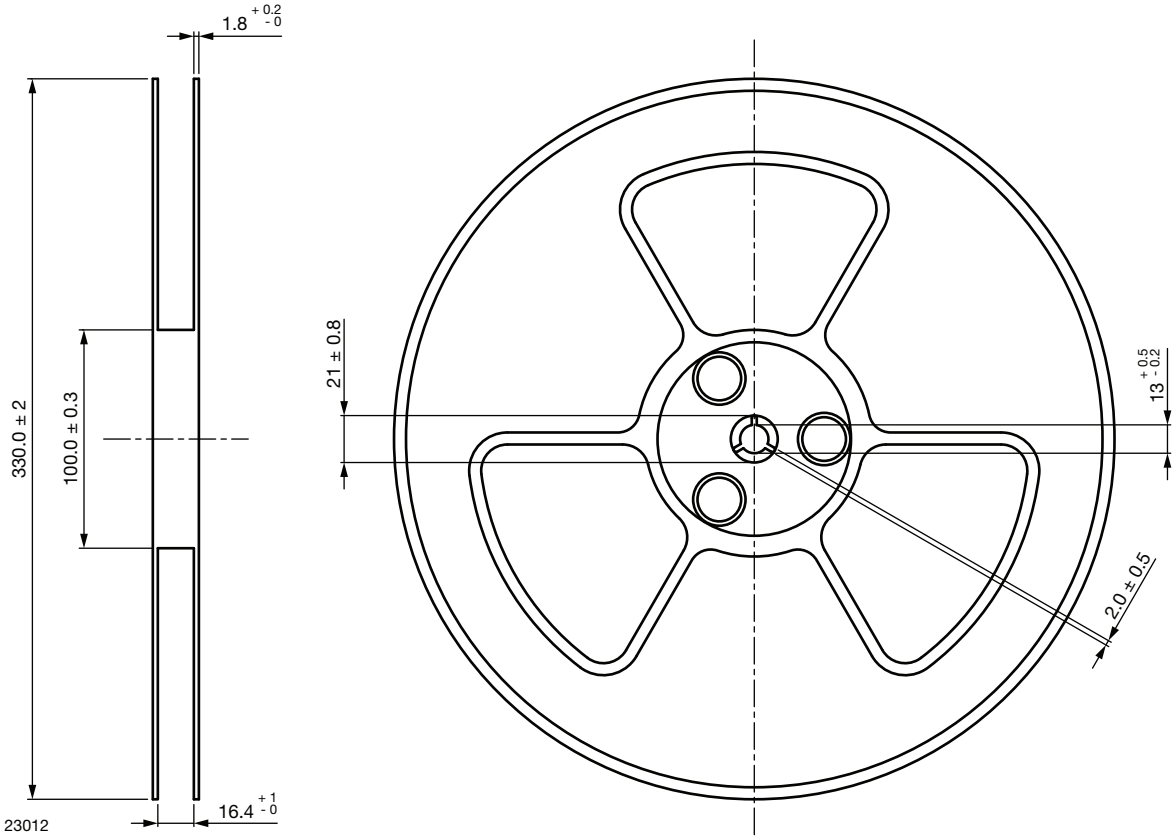


Fig. 21 - Tape and Reel Shipping Medium

SOLDER PROFILES

IR Reflow Soldering (JEDEC® J-STD-020C compliant)

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

PROFILE ITEM	CONDITIONS
Preheat	
- Temperature minimum ($T_{S\ min.}$)	150 °C
- Temperature maximum ($T_{S\ max.}$)	200 °C
- Time (min. to max.) (t_S)	90 s ± 30 s
Soldering zone	
- Temperature (T_L)	217 °C
- Time (t_L)	60 s
Peak temperature (T_p)	260 °C
Ramp-up rate	3 °C/s max.
Ramp-down rate	3 °C/s to 6 °C/s

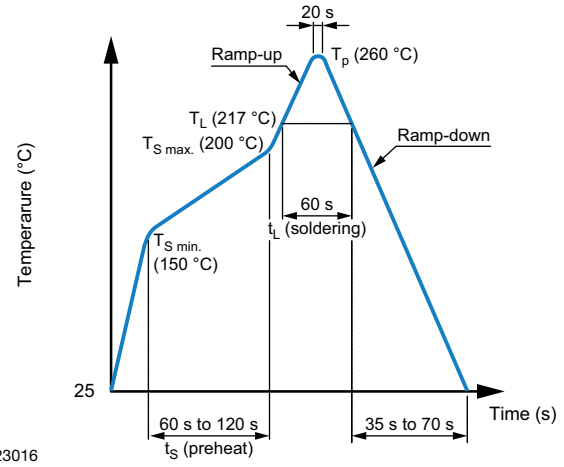


Fig. 1

Wave Soldering (JEDEC JESD22-A111 compliant)

One time soldering is recommended within the condition of temperature.

Temperature: 260 °C + 0 °C / - 5 °C

Time: 10 s

Preheat temperature: 25 °C to 140 °C

Preheat time: 30 s to 80 s

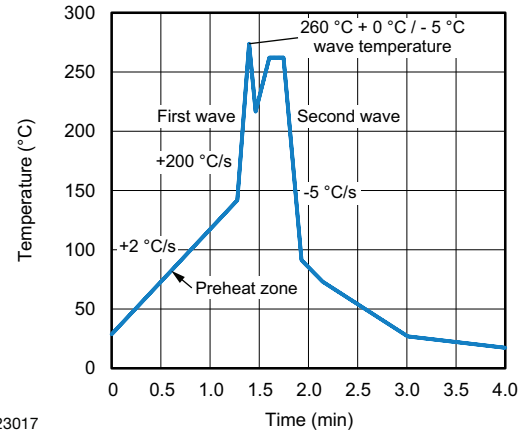


Fig. 2

Hand Soldering by Soldering Iron

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature: 380 °C + 0 °C / - 5 °C

Time: 3 s max.

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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