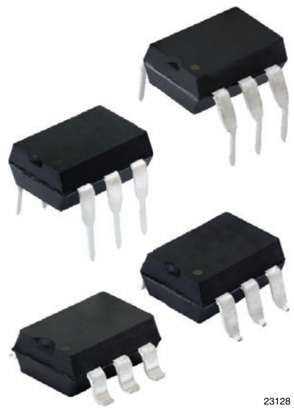
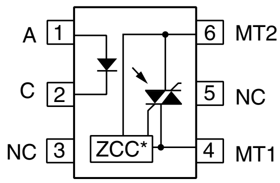
Optocoupler, Phototriac Output, Zero Crossing





*Zero crossing circuit

LINKS TO ADDITIONAL RESOURCES

Related Documents

SPICE Models

DESCRIPTION

The BRT21, BRT22, BRT23 product family consists of an optically coupled GaAs IRLED to a photosensitive thyristor system with integrated noise suppression and zero crossing circuit.

The thyristor system enables low trigger currents of 1.2 mA and features a dV/dt ratio of greater than 10 kV/μs and load voltages up to 800 V.

The BRT21, BRT22, BRT23 product family is a perfect microcontroller friendly solution to isolate low voltage logic from high voltage 120 V_{AC}, 240 V_{AC}, and 380 V_{AC} lines and to control resistive, inductive, or capacitive AC loads like motors, solenoids, high power thyristors, or TRIACs and solid-state relays.

FEATURES

- Low trigger current I_{FT} = 1.2 mA
- I_{TRMS} = 300 mA
- High static dV/dt 10 000 V/μs
- Load voltage = 800 V
- Zero voltage crossing detector
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3 RoHS COMPLIANT

APPLICATIONS

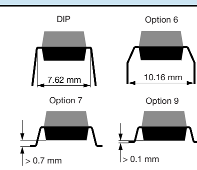
- Industrial controls
- Office equipment
- Consumer appliances

AGENCY APPROVALS

- UL 1577
- cUL 1577
- DIN EN 60747-5-5 (VDE 0884-5), available with option 1

ORDERING INFORMATION

B	R	T	2	#	x	-	X	0	#	#	T
PART NUMBER							PACKAGE OPTION				TAPE AND REEL



AGENCY CERTIFIED / PACKAGE	V_{DRM} (V)				
	≤ 400	≤ 600		≤ 800	
UL, cUL	**I_{FT} = 2 mA**	**I_{FT} = 1.2 mA**	**I_{FT} = 2 mA**	**I_{FT} = 1.2 mA**	**I_{FT} = 2 mA**
DIP-6	BRT21H	BRT22F	BRT22H	BRT23F	BRT23H
DIP-6, 400 mil, option 6	-	-	-	BRT23F-X006	-
SMD-6, option 7	-	BRT22F-X007T	BRT22H-X007T (1)	BRT23F-X007T	BRT23H-X007T (1)
SMD-6, option 9	-	BRT22F-X009T	-	BRT23F-X009T	-
UL, cUL, VDE (Option 1)	**I_{FT} = 2 mA**	**I_{FT} = 1.2 mA**	**I_{FT} = 2 mA**	**I_{FT} = 1.2 mA**	**I_{FT} = 2 mA**
DIP-6	-	BRT22F-X001	-	-	BRT23H-X001
DIP-6, option 6	-	-	BRT22H-X016	-	BRT22H-X016

Note

(1) Also available in tube, do not put T on the end

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**VALUE**	**UNIT**
INPUT					
Reverse voltage	I_R = 10 μA		V_R	6	V
Forward current			I_F	60	mA
Surge current			I_{FSM}	2.5	A
Power dissipation			P_{diss}	100	mW
Derate from 25 °C				1.33	mW/°C
OUTPUT					
Peak off-state voltage		BRT21	V_{DRM}	400	V
		BRT22	V_{DRM}	600	V
		BRT23	V_{DRM}	800	V
On state RMS current			I_{TRM}	300	mA
Single cycle surge current				3	A
Power dissipation			P_{diss}	600	mW
Derate from 25 °C				6.6	mW/°C
COUPLER					
Storage temperature range			T_{stg}	-40 to +150	°C
Ambient temperature range			T_{amb}	-40 to +100	°C
Soldering temperature	Max. ≤ 10 s dip soldering ≥ 0.5 mm from case bottom		T_{sld}	260	°C

Note

- 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.

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
INPUT							
Forward voltage	I_F = 10 mA		V_F	-	1.16	1.35	V
Reverse current	V_R = 6 V		I_R	-	0.1	10	µA
Capacitance	f = 1 MHz, V_F = 0 V		C_O	-	25	-	pF
Thermal resistance, junction to ambient			R_{thJA}	-	750	-	K/W
OUTPUT							
Peak off-state voltage	$I_{D(RMS)}$ = 100 µA	BRT21	V_{DM}	-	400	-	V
		BRT22		-	600	-	
		BRT23		-	800	-	
Off-state current	V_D = V_{DRM}, T_{amb} = 100 °C, I_F = 0 mA		$I_{D(RMS)}$	-	10	100	µA
On-state voltage	I_T = 300 mA		V_{TM}	-	1.7	3	V
On-state current	PF = 1, $V_{T(RMS)}$ = 1.7 V		I_{TM}	-	-	300	mA
Surge (non-repetitive), on-state current	f = 50 Hz		I_{TSM}	-	-	3	A
Trigger current temp. gradient			$\Delta I_{FT1}/\Delta T_j$	-	7	14	µA/K
			$\Delta I_{FT2}/\Delta T_j$	-	7	14	µA/K
Inhibit voltage temp. gradient			$\Delta V_{DINH}/\Delta T_j$	-	-20	-	mV/K
Off-state current in inhibit state	I_F = I_{FT1}, V_{DRM}		I_{DINH}	-	50	200	µA
Holding current			I_H	-	65	500	µA
Latching current	V_T = 2.2 V		I_L	-	5	-	mA
Zero cross inhibit voltage	I_F = rated I_{FT}		V_{IH}	-	15	25	V
OUTPUT (continued)							
Turn-on time	V_{RM} = V_{DM} = $V_{D(RMS)}$		t_{on}	-	35	-	µs
Turn-off time	PF = 1, I_T = 300 mA		t_{off}	-	50	-	µs
Critical rate of rise of off-state voltage	V_D = 0.67 V_{DRM}, T_j = 25 °C		dV/dt_{cr}	10 000	-	-	V/µs
	V_D = 0.67 V_{DRM}, T_j = 80 °C		dV/dt_{cr}	5000	-	-	V/µs
Critical rate of rise of voltage at current commutation	V_D = 230 V_{RMS}, I_D = 300 mA_{RMS}, T_j = 25 °C		dV/dt_{crq}	-	8	-	V/µs
	V_D = 230 V_{RMS}, I_D = 300 mA_{RMS}, T_j = 85 °C		dV/dt_{crq}	-	7	-	V/µs
Critical rate of rise of on-state at current commutation	V_D = 230 V_{RMS}, I_D = 300 mA_{RMS}, T_j = 25 °C		dI/dt_{crq}	-	12	-	A/ms
Thermal resistance, junction-to-ambient			R_{thJA}	-	125	-	K/W
COUPLER							
Critical rate of rise of coupled input / output voltage	I_T = 0 A, V_{RM} = V_{DM} = $V_{D(RMS)}$		dV_{IO}/dt	-	10 000	-	V/µs
Common mode coupling capacitance			C_{CM}	-	0.01	-	pF
Capacitance (input to output)	f = 1 MHz, V_{IO} = 0 V		C_{IO}	-	0.8	-	pF
Trigger current	V_D = 5 V, F - versions		I_{FT}	-	-	1.2	mA
	V_D = 5 V, H - versions		I_{FT}	-	-	2	mA

Note

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

SAFETY AND INSULATION RATINGS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Climatic classification	According to IEC 68 part 1		40 / 100 / 21	
Pollution degree	According to DIN VDE 0109		2	
Comparative tracking index	Insulation group IIIa	CTI	175	
Maximum rated withstanding isolation voltage	According to UL1577, t = 1 min	V_{ISO}	4420	V_{RMS}
Tested withstanding isolation voltage	According to UL1577, t = 1 s	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}	630	V_{peak}
Isolation resistance	V_{IO} = 500 V, T_{amb} = 25 °C	R_{IO}	$\geq 10^{12}$	Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	$\geq 10^{11}$	Ω
Output safety power		P_{SO}	200	mW
Input safety current		I_{SI}	400	mA
Input safety temperature		T_S	175	°C
Creepage distance	DIP-6; SMD-6, option 7; SMD-6 option 9		≥ 7	mm
Clearance distance			≥ 7	mm
Creepage distance	DIP-6, option 6; SMD-6, option 8		≥ 8	mm
Clearance distance			≥ 8	mm
Insulation thickness		DTI	≥ 0.4	mm

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.

POWER FACTOR CONSIDERATIONS

A snubber is not needed to eliminate false operation of the TRIAC driver because of the high static and commutating dV/dt with loads between 1.0 and 0.8 power factors. When inductive loads with power factors less than 0.8 are being driven, include a RC snubber or a single capacitor directly across the device to damp the peak commutating dV/dt spike. Normally a commutating dV/dt causes a turning-off device to stay on due to the stored energy remaining in the turning-off device.

But in the case of a zero voltage crossing optotriac, the commutating dV/dt spikes can inhibit one half of the TRIAC from turning on. If the spike potential exceeds the inhibit voltage of the zero cross detection circuit, half of the TRIAC will be heldoff and not turn-on. This hold-off condition can be eliminated by using a snubber or capacitor placed directly across the optotriac as shown in figure 1. Note that the value of the capacitor increases as a function of the load current.

The hold-off condition also can be eliminated by providing a higher level of LED drive current. The higher LED drive provides a larger photocurrent which causes the phototransistor to turn-on before the commutating spike has activated the zero cross network. Figure 2 shows the relationship of the LED drive for power factors of less than 1.0. The curve shows that if a device requires 1.5 mA for a resistive load, then 1.8 times 2.7 mA) that amount would be required to control an inductive load whose power factor is less than 0.3.

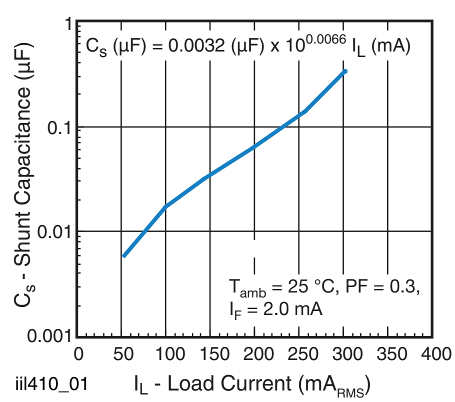


Fig. 1 - Shunt Capacitance vs. Load Current

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

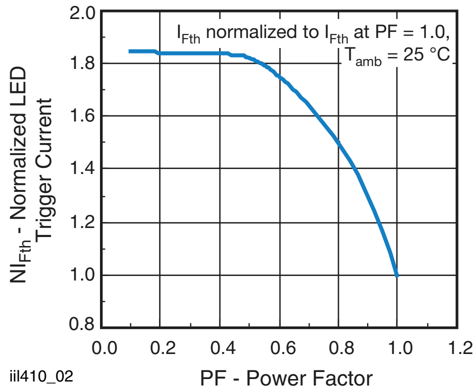


Fig. 2 - Normalized LED Trigger Current vs. Power Factor

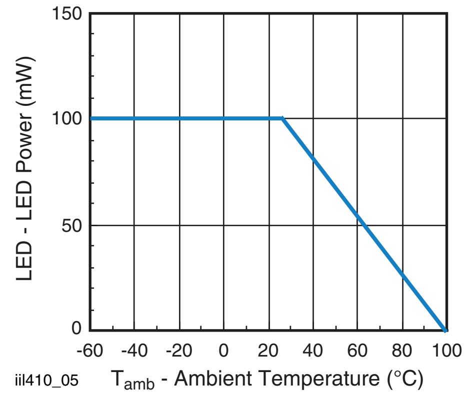


Fig. 5 - Maximum LED Power Dissipation

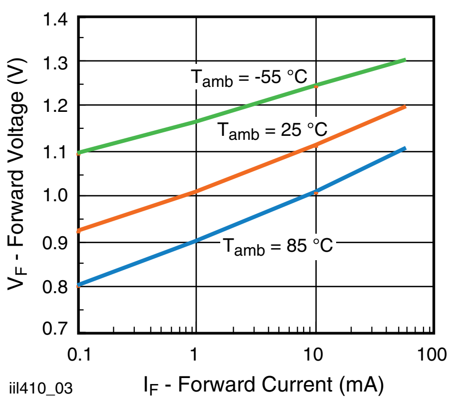


Fig. 3 - Forward Voltage vs. Forward Current

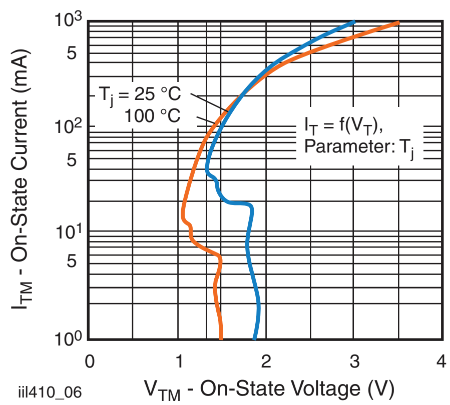


Fig. 6 - Typical Output Characteristics

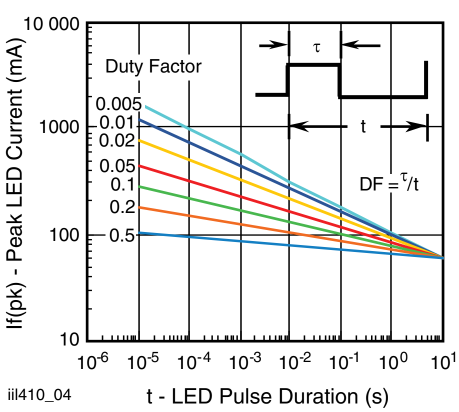


Fig. 4 - Peak LED Current vs. Duty Factor, τ

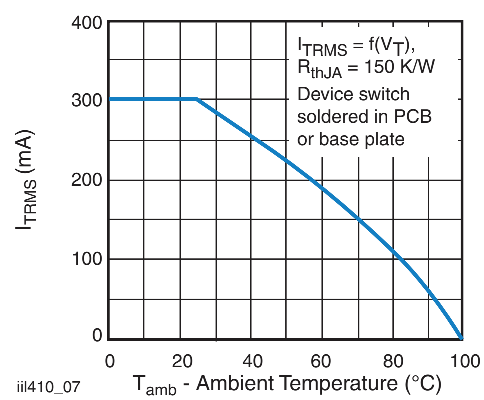


Fig. 7 - Current Reduction

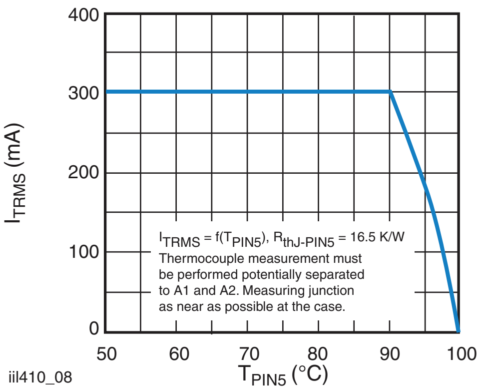


Fig. 8 - Current Reduction

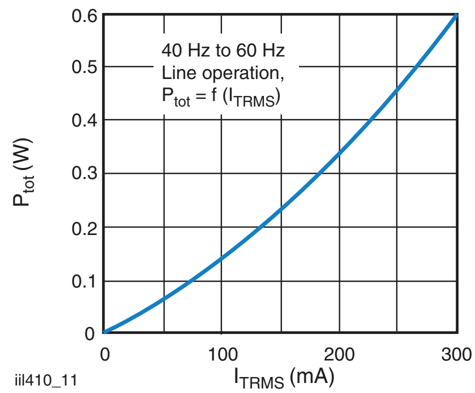


Fig. 11 - Power Dissipation 40 Hz to 60 Hz Line Operation

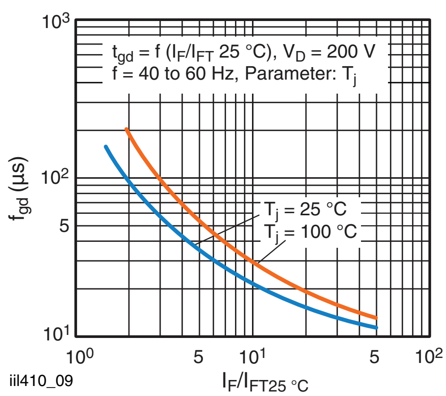


Fig. 9 - Typical Trigger Delay Time

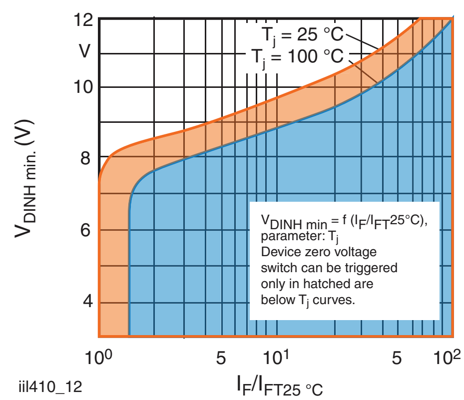


Fig. 12 - Typical Static Inhibit Voltage Limit

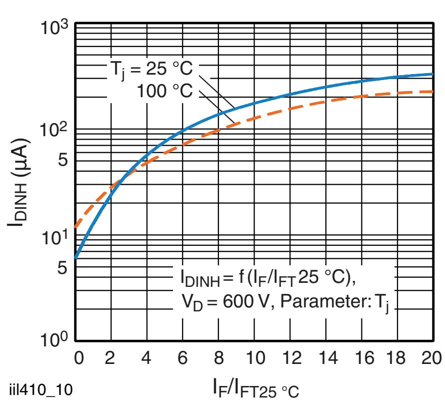


Fig. 10 - Typical Inhibit Current

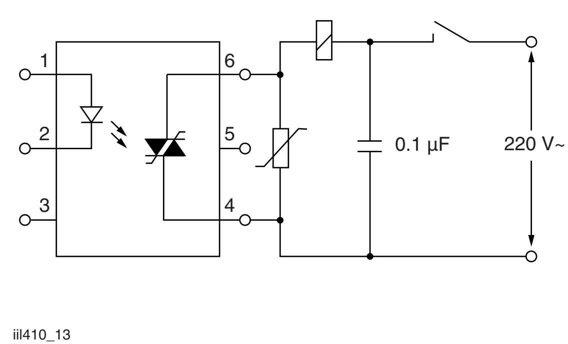


Fig. 13 - Apply a Capacitor to the Supply Pins at the Load-Side

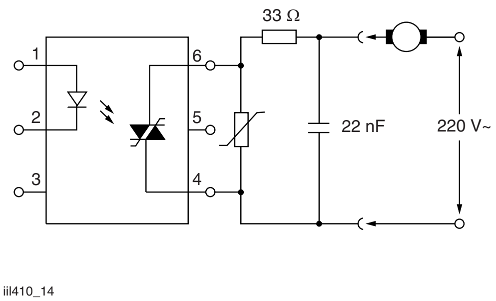


Fig. 14 - Connect a Series Resistor to the Output and Bridge Both by a Capacitor

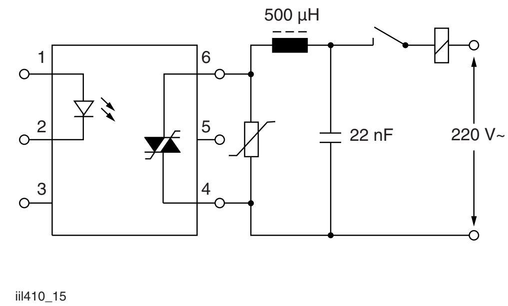
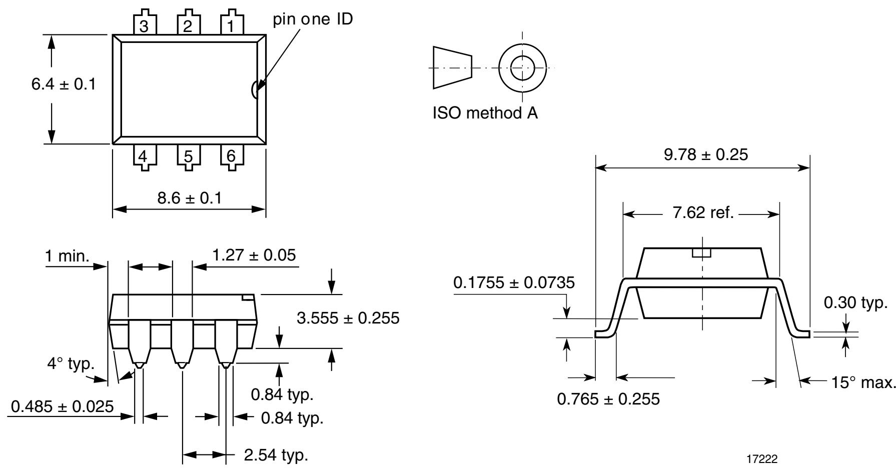


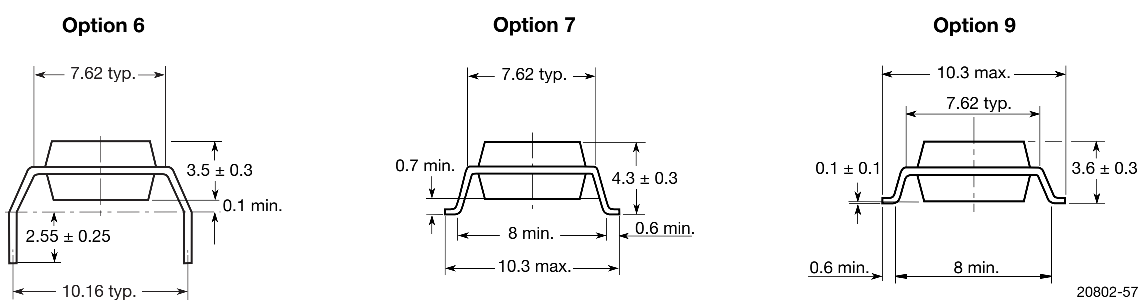
Fig. 15 - Connect a Choke of Low Winding Cap. in Series, e.g., a Ringcore Choke, with Higher Load Currents

TECHNICAL INFORMATION

See Application Note for additional information.

PACKAGE DIMENSIONS in millimeters





PACKAGE MARKING (example)

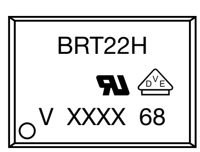


Fig. 16 - Example of BRT22H-X017

Notes

- XXXX = LMC (lot marking code)
- VDE logo is only marked on option 1 parts
- Tape and reel suffix (T) is not part of the package marking

SOLDER PROFILES

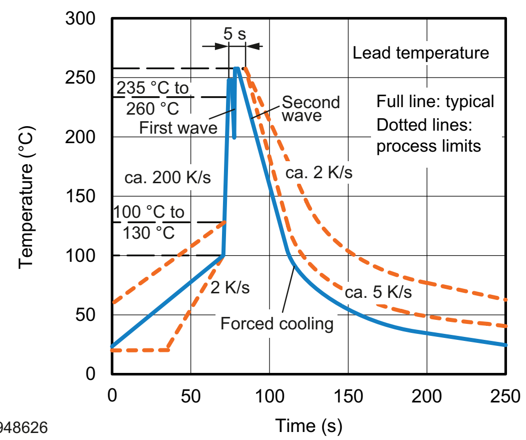


Fig. 17 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP Devices

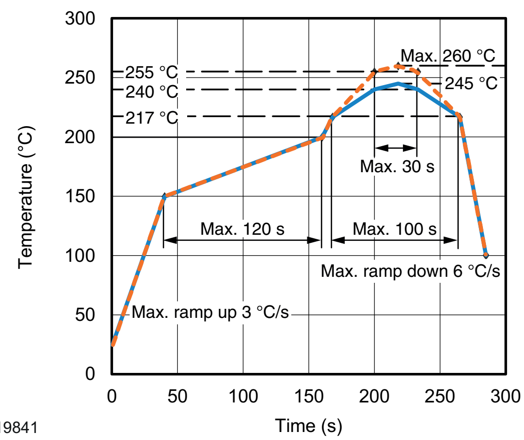


Fig. 18 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

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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