

Photocoupler 4N3X series

1. DESCRIPTION

1.1 Features

- Current transfer ratio (CTR : MIN. 100% at $I_F = 10\text{mA}$, $V_{CE} = 10\text{V}$, $T_a = 25^\circ\text{C}$)
- High input-output isolation voltage
 4N35 series : $V_{iso} = 3,550\text{Vrms}$
 4N37 series : $V_{iso} = 1,500\text{Vrms}$
- Response time (t_r : TYP. $3\mu\text{s}$ at $V_{CC} = 10\text{V}$, $I_C = 2\text{mA}$, $R_L = 100\Omega$)
- Dual-in-line package :
 4N35, 4N37
- Wide lead spacing package :
 4N35M, 4N37M
- Surface mounting package :
 4N35S, 4N37S
- Tape and reel packaging :
 4N35S-TA, 4N37S-TA, 4N35S-TA1, 4N37S-TA1
- Safety approval
 * UL approved (No. E113898)
 * CSA approved (No. CA91533-1)
 * FIMKO approved (No. 193422-01)
 * VDE approved (No. 40015248)
 * BSI approved (No. 9018-9)
 * CQC approved (No. CQC11001061921-2)
- Creepage distance > 8.0 mm ; Clearance > 8.0 mm
- The relevant models are the models Approved by VDE according to DIN EN 60747-5-5
 Approved Model No.: 4N35-V / 4N37-V / 4N35M-V / 4N37M-V / 4N35S-V / 4N37S-V / 4N35STA-V / 4N37STA-V /
 4N35STA1-V / 4N37STA1-V
 VDE approved No.: 40015248 (According to the specification DIN EN 60747-5-5)
- Operating isolation voltage V_{ORM} : 420V (Peak)
- Transient voltage V_{TR} : 6000V (Peak)
- Pollution : 2 (According to VDE 0110-1 : 1997-04)
- Clearances distance (Between input and output) : 7.0mm (MIN.)
- Creepage distance (Between input and output) : 7.0mm (MIN.)
- Isolation thickness between input and output : 0.4mm (MIN.)
- Safety limit values Current (I_{si}) : 400mA (Diode side)
 Power (P_{si}) : 700mW (Phototransistor side)
 Temperature(T_{si}) : 175°C
 In order to keep safety electric isolation of photocoupler, please set the protective
 circuit to keep within safety limit values when the actual application equipment troubled.
- Indication of VDE approval prints " " on sleeve package.

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- RoHS Compliance
All materials be used in device are followed EU RoHS directive (No.2002/95/EC).
- ESD pass HBM 8000V/MM2000V
- MSL class1

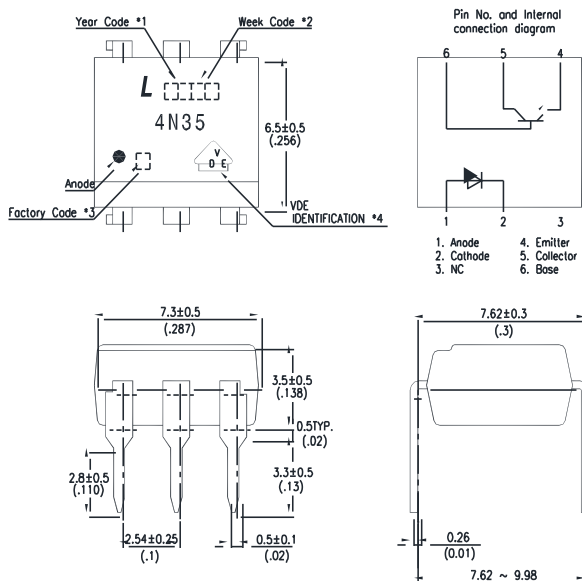
1.2 Applications

- Power Supply regulators
- Digital logic inputs
- Microprocessor inputs

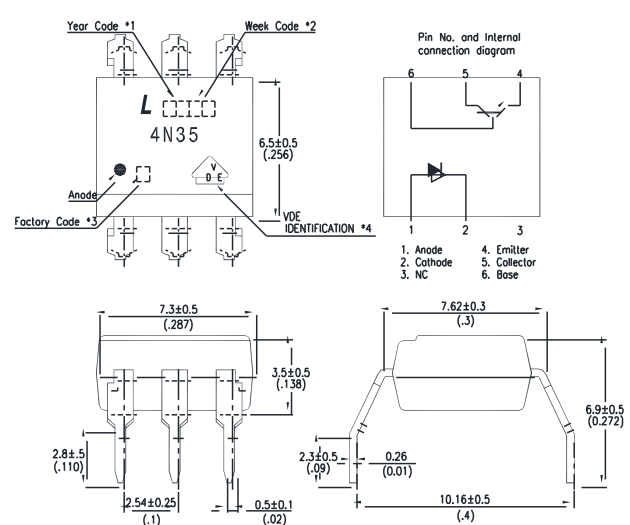
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2. PACKAGE DIMENSIONS

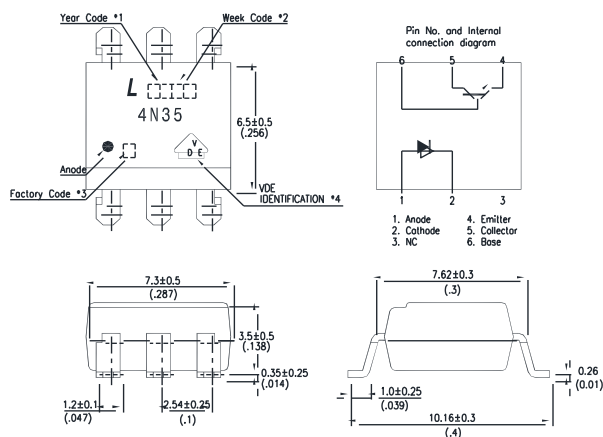
2.1 4N35



2.2 4N35M



2.3 4N35S



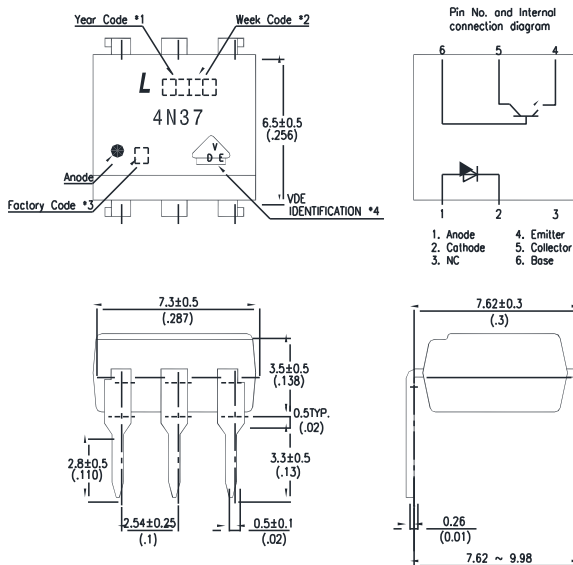
Notes :

1. Year date code.
2. 2-digit work week.
3. Factory identification mark shall be marked (W: China-CZ, Y: Thailand X: China-TJ).
4. VDE option.

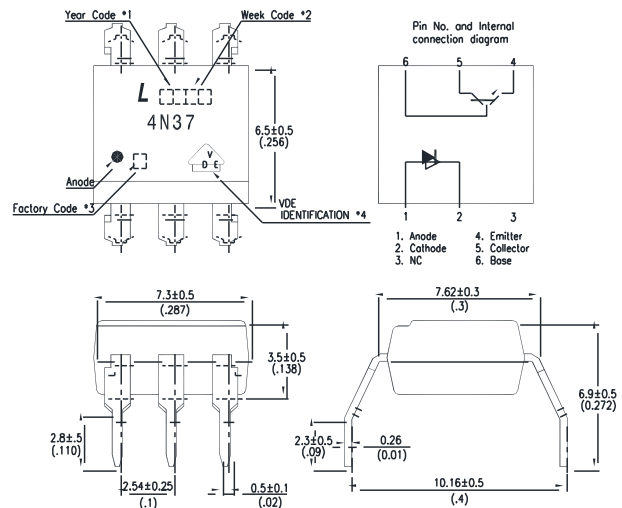
Dimensions in millimeters(inches).

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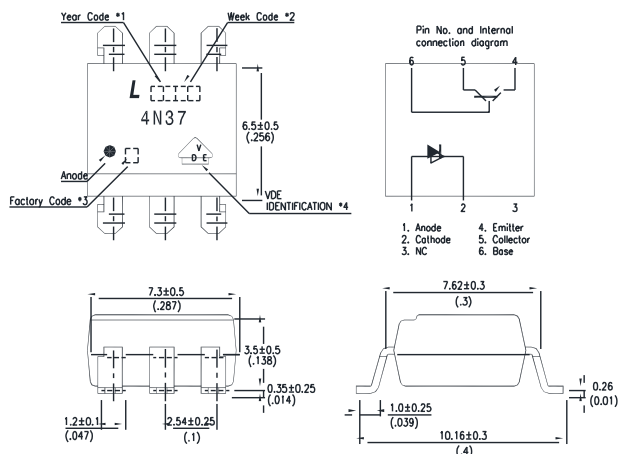
2.4 4N37



2.5 4N37M



2.6 4N37S



Notes :

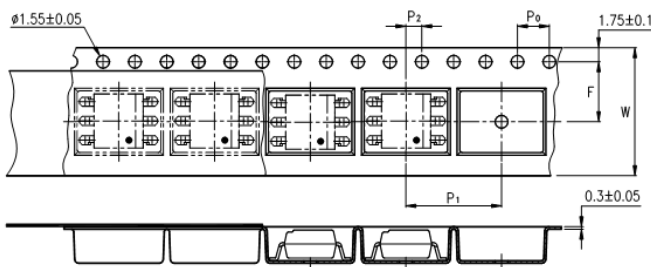
1. Year date code.
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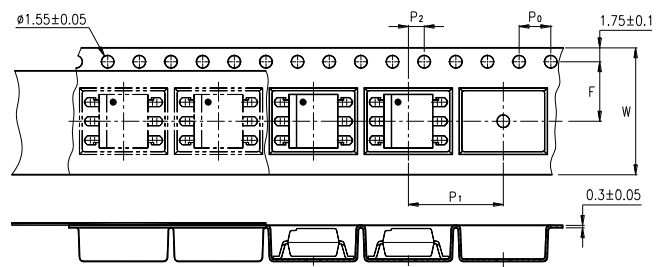
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3. TAPING DIMENSIONS

3.1 4N35S-TA , 4N37S-TA :



3.2 4N35S-TA1 , 4N37S-TA1 :



Description	Symbol	Dimension in mm (inch)
Tape wide	W	16±0.3 (0.63)
Pitch of sprocket holes	P ₀	4±0.1 (0.15)
Distance of compartment	F	7.5±0.1 (0.295)
	P ₂	2±0.1 (0.079)
Distance of compartment to compartment	P ₁	12±0.1 (0.472)

3.3 Quantities Per Reel

Package Type	TA/TA1
Quantities (pcs)	1000

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4. RATING AND CHARACTERISTICS

4.1 Absolute Maximum Ratings at Ta=25°C

Parameter		Symbol	Rating	Unit
Input	Forward Current	I_F	60	mA
	Reverse Voltage	V_R	6	V
	Power Dissipation	P	100	mW
Output	Collector - Emitter Voltage	V_{CEO}	30	V
	Emitter - Collector Voltage	V_{ECO}	7	V
	Collector - Base Voltage	V_{CBO}	70	V
	Collector Current	I_C	100	mA
	Collector Power Dissipation	P_C	300	mW
Total Power Dissipation		P_{tot}	350	mW
*1 Isolation Voltage	4N35 series	V_{iso}	3,550	V_{rms}
	4N37 series		1,500	V_{rms}
Operating Temperature		T_{opr}	-55 ~ +100	°C
Storage Temperature		T_{stg}	-55 ~ +150	°C
*2 Soldering Temperature		T_{sol}	260	°C

*1. AC For 1 Minute, R.H. = 40 ~ 60%

Isolation voltage shall be measured using the following method.

(1) Short between anode and cathode on the primary side and between collector and emitter on the secondary side.

(2) The isolation voltage tester with zero-cross circuit shall be used.

(3) The waveform of applied voltage shall be a sine wave.

*2. For 10 Seconds

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4.2 ELECTRICAL OPTICAL CHARACTERISTICS at Ta=25°C

PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
INPUT	Forward Voltage	VF	—	1.2	1.5	V	IF=10mA
	Reverse Current	IR	—	—	10	μA	VR=4V
	Terminal Capacitance	Ct	—	50	—	pF	V=0, f=1KHz
OUTPUT	Collector Dark Current	ICEO	—	—	50	nA	VCE=10V, IF=0
			—	—	500	μA	VCE=30V, IF=0
	Collector-Emitter Breakdown Voltage	BVCEO	30	—	—	V	IC=0.1mA IF=0
	Emitter-Collector Breakdown Voltage	BVECO	7	—	—	V	IE=10μA IF=0
	Collector-Base Breakdown Voltage	BVCBO	70	—	—	V	IC=0.1mA IF=0
TRANSFER CHARACTERISTICS	Collector Current	IC	10	—	—	mA	IF=10mA
	*Current Transfer Ratio	CTR	100	—	—	%	VCE=10V
	Collector-Emitter Saturation Voltage	VCE(sat)	—	—	0.3	V	IF=50mA IC=2mA
	Isolation Resistance	Riso	5×10 ¹⁰	1×10 ¹¹	—	Ω	DC500V 40 ~ 60% R.H.
	Floating Capacitance	Cf	—	1	2.5	pF	V=0, f=1MHz
	Response Time (Rise)	tr	—	3	10	μs	VCE=10V, IC=2mA
	Response Time (Fall)	tf	—	3	10	μs	RL=100Ω

$$*CTR = \frac{I_C}{I_F} \times 100\%$$

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4.3 ISOLATION SPECIFICATION ACCORDING TO VDE

Parameter		Symbol	Conditions	Rating	Unit	Remark
Class of environmental test		-	DIN IEC68	55/100/21	-	Refer to the Diagram 1, 2
Pollution		-	DIN VDE0110	2	-	
Maximum Operating Isolation Voltage		V_{IORM}	-	420	V_{PEAK}	
Partial Discharge Test Voltage (Between Input and Output)	Diagram 1	V_{pr}	$t_p=60s, q_c<5pC$	630	V_{PEAK}	
	Diagram 2		$t_p=1s, q_c<5pC$	788	V_{PEAK}	
Maximum Over-Voltage		$V_{INITIAL}$	$t_{INI} = 10s$	6000	V_{PEAK}	Refer to the Figure 1, 3
Safety Maximum Ratings						
1) Case Temperature		T_{si}	$I_F = 0, P_c = 0$	175	$^{\circ}C$	
2) Input Current		I_{si}	$P_c=0$	400	mA	
3) Electric Power (Output or Total Power Issipation)		P_{si}	-	700	mW	
Isolation Resistance (Test Voltage Between Input and Output : DC500V)		R_{ISO}	$T_a=T_{si}$	MIN.10 ⁹	Ω	
			$T_a=T_{opr}(MAX.)$	MIN.10 ¹¹		
			$T_a=25^{\circ}C$	MIN.10 ¹²		

Precautions in performing isolation test

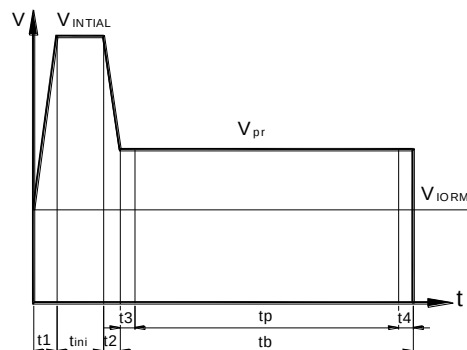
* Partial discharge test methods shall be the ones according to the specifications of DIN EN 60747-5-5

* Please don't carry out isolation test (Viso) over $V_{INITIAL}$, This product deteriorates isolation characteristics by partial discharge due to applying high voltage (ex. $V_{INITIAL}$). And there is possibility that this product occurs partial discharge in operating isolation voltage (V_{IORM})

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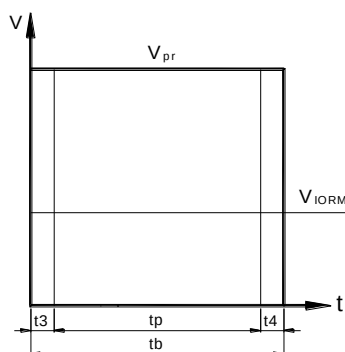
4.4 PARTIAL DISCHARGE TEST METHOD

Method (A) for type testing and random testing.



t_1, t_2 = 1 to 10s
 t_3, t_4 = 1s
 t_p (Partial Discharge Measuring Time) = 60s
 t_b = 62s
 t_{ini} = 10s

Method (B) for routine testing.



t_3, t_4 = 0.1s
 t_p (Partial Discharge Measuring Time) = 1s
 t_b = 1.2s

The partial discharge level shall not exceed 5 pc during the partial discharge measuring time interval t_p under the test conditions shown above.

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5. CHARACTERISTICS CURVES

Fig.1 Forward Current vs. Ambient Temperature

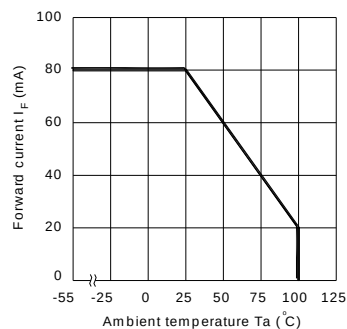


Fig.2 Collector Power Dissipation vs. Ambient Temperature

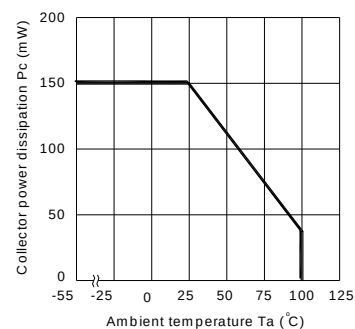


Fig.3 Forward Current vs. Forward Voltage

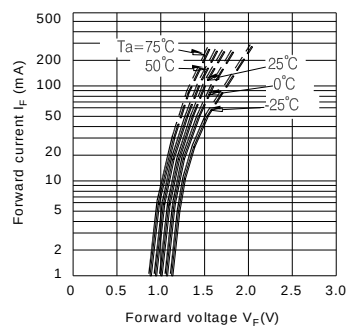


Fig.4 Current Transfer Ratio vs. Forward Current

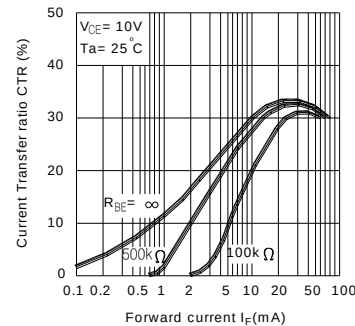


Fig.5 Collector Current vs. Collector-emitter Voltage

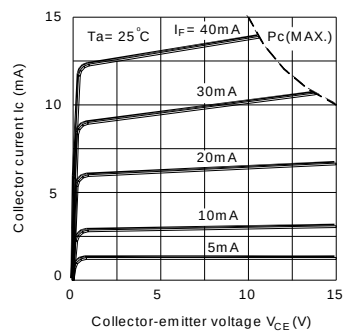
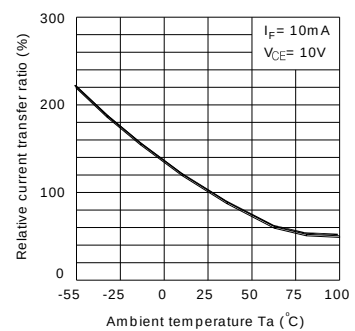


Fig.6 Relative Current Transfer Ratio vs. Ambient Temperature



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Fig.7 Collector-emitter Saturation Voltage vs.
Ambient Temperature

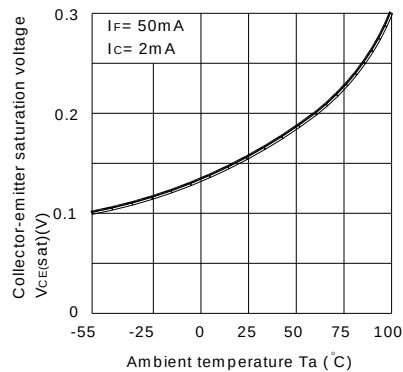


Fig.8 Collector Dark Current vs.
Ambient Temperature

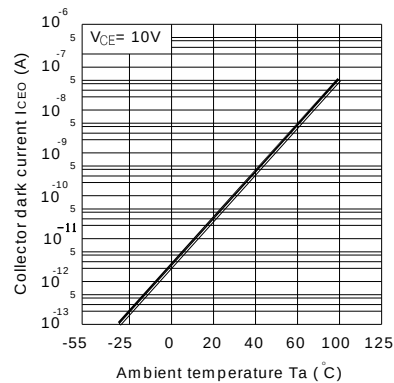


Fig.9 Response Time vs. Load Resistance

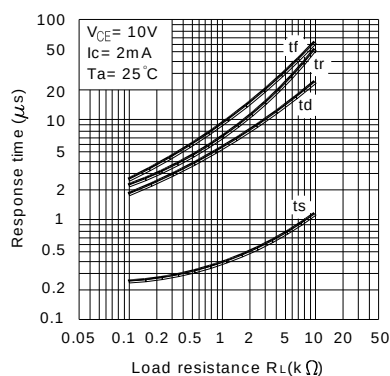


Fig.10 Frequency Response

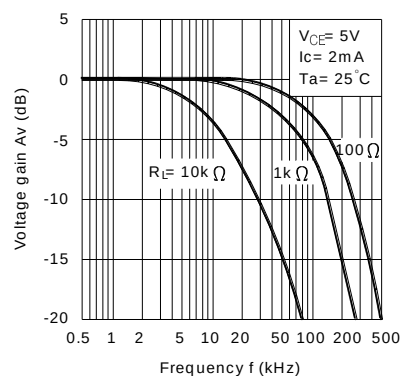
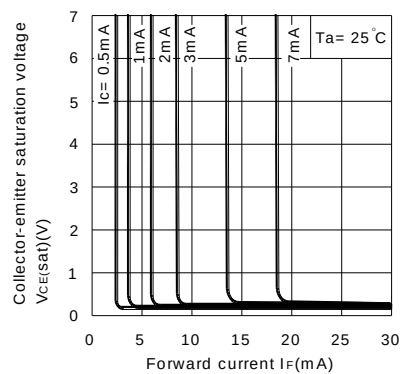
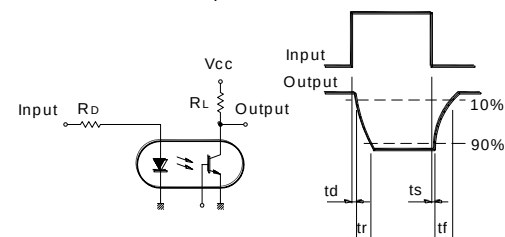


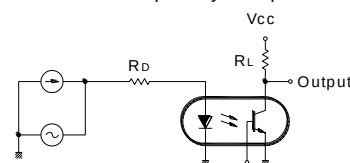
Fig.11 Collector-emitter Saturation
Voltage vs. Forward Current



Test Circuit for Response Time



Test Circuit for Frequency Response



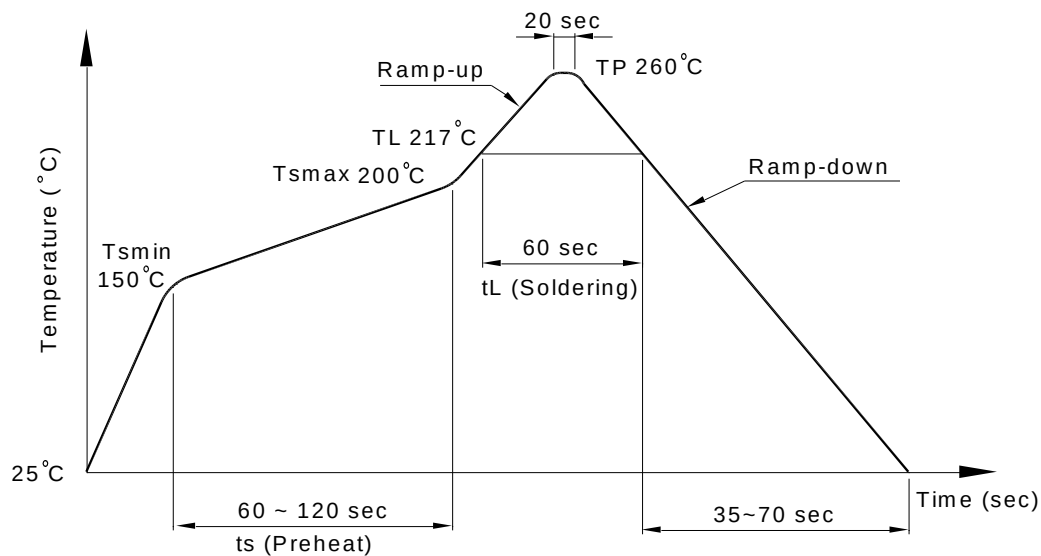
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6. TEMPERATURE PROFILE OF SOLDERING

6.1 IR Reflow soldering (JEDEC-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 Min (T_{Smin})	150°C
- Temperature Max (T_{Smax})	200°C
- Time (min to max) (t_s)	90±30 sec
Soldering zone	
- Temperature (T_L)	217°C
- Time (t_L)	60 sec
Peak Temperature (T_P)	260°C
Ramp-up rate	3°C / sec max.
Ramp-down rate	3~6°C / sec



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6.2 Wave soldering (JEDEC22A111 compliant)

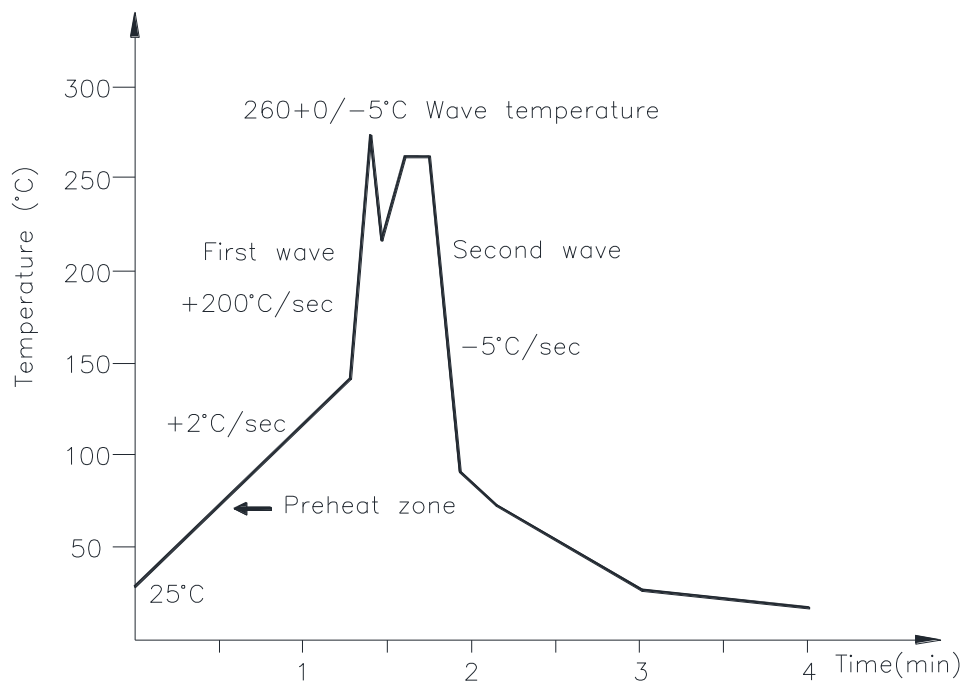
One time soldering is recommended within the condition of temperature.

Temperature: $260 \pm 0/-5^{\circ}\text{C}$

Time: 10 sec.

Preheat temperature: 25 to 140°C

Preheat time: 30 to 80 sec.



6.3 Hand soldering by soldering iron

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

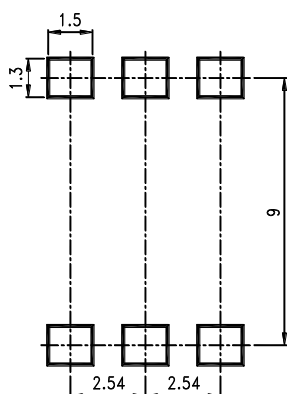
Temperature: $380 \pm 0/-5^{\circ}\text{C}$

Time: 3 sec max.

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7. RRECOMMENDED FOOT PRINT PATTERNS (MOUNT PAD)

Unit: mm



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8. Naming rule

4N3X (1)-(2)

DEVICE PART NUMBER

(1) No suffix = Dual-in-Line package

M = Wide lead spacing package

S = Surface mounting package

(2) TAPING TYPE (TA,TA1 or none)

4N3X series have tape and reel solution.

Please refer to orientation of taping on Page P5

Example : 4N35S-TA1

4N3X(1)(2)-V

DEVICE PART NUMBER

(1) No suffix = Dual-in-Line package

M = Wide lead spacing package

S = Surface mounting package

(2) TAPING TYPE (TA,TA1 or none)

4N3X series have tape and reel solution.

Please refer to orientation of taping on Page P5

(3) VDE order option

Example : 4N35STA1-V-G

9. Notes:

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- The products shown in this publication are designed for the general use in electronic applications such as office automation equipment, communications devices, audio/visual equipment, electrical application and instrumentation.
- For equipment/devices where high reliability or safety is required, such as space applications, nuclear power control equipment, medical equipment, etc, please contact our sales representatives.
- When requiring a device for any "specific" application, please contact our sales in advice.
- If there are any questions about the contents of this publication, please contact us at your convenience.
- The contents described herein are subject to change without prior notice.
- Immerge unit's body in solder paste is not recommended.