

8 PIN DIP LOW INPUT CURRENT HIGH GAIN SPLIT DARLINGTON PHOTOCOUPLER

6N138 6N139

Features:

- High current transfer ratio – 2000% typical
- High isolation voltage between input and output ($V_{iso}=5000 V_{rms}$)
- Guaranteed performance from 0°C to 70°C
- Pb free and RoHS compliant.
- UL approved (No. 214129)
- VDE approved (No. 132249)
- SEMKO approved
- NEMKO approved
- DEMKO approved
- FIMKO approved
- CSA approved (No. 2037145)

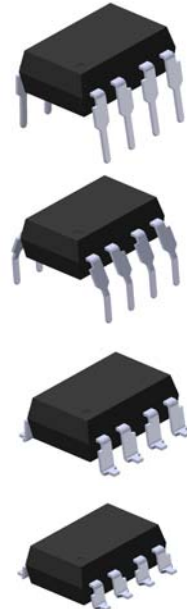
Description

The 6N138 and 6N139 devices each consists of an infrared emitting diode, optically coupled to a high gain split Darlington photo detector. They provide extremely high current transfer ratio between input and output, with access to a base terminal to adjust the gain bandwidth.

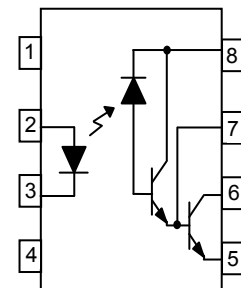
These devices are packaged in an 8-pin DIP package and available in wide-lead spacing and SMD options.

Applications

- Digital logic ground isolation
- RS-232C line receiver
- Low input current line receiver
- Microprocessor bus isolation
- Current loop receiver



Schematic



Pin Configuration

1. No Connection
2. Anode
3. Cathode
4. No Connection
5. Gnd
6. Vout
7. V_B
8. Vcc



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Absolute Maximum Ratings ($T_a=25^{\circ}\text{C}$ unless otherwise specified)

| Parameter | | Symbol | Rating | Unit | |
|-------------------------------------|---|--------------|------------|--------------------|---|
| Input | Forward current | I_F | 20 | mA | |
| | Peak forward current (50% duty, 1ms P.W) | I_{FP} | 40 | mA | |
| | Peak transient current ($\leq 1 \mu\text{s}$ P.W, 300pps) | I_{Ftrans} | 1 | A | |
| | Reverse voltage | V_R | 5 | V | |
| | Power dissipation | P_{IN} | 45 | mW | |
| Output | Power dissipation | P_O | 100 | mW | |
| | Output current | I_O | 60 | mA | |
| | Emitter-Base Reverse Voltage | VER | 0.5 | V | |
| | Output voltage | 6N138 | V_O | -0.5 to 7 | V |
| | | 6N139 | | -0.5 to 18 | V |
| | Supply voltage | 6N138 | V_{CC} | -0.5 to 7 | V |
| 6N139 | | -0.5 to 18 | | V | |
| Isolation voltage ^{*1} | | V_{ISO} | 5000 | V rms | |
| Operating temperature | | T_{OPR} | -40 ~ +85 | $^{\circ}\text{C}$ | |
| Storage temperature | | T_{STG} | -55 ~ +125 | $^{\circ}\text{C}$ | |
| Soldering temperature ^{*2} | | T_{SOL} | 260 | $^{\circ}\text{C}$ | |

Notes

*1 AC for 1 minute, R.H.= 40 ~ 60% R.H. In this test, pins 1, 2, 3, 4 are shorted together, and pins 5, 6, 7, 8 are shorted together.

*2 For 10 seconds.



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Electrical Characteristics ($T_a=0$ to 70°C unless specified otherwise)

Input

| Parameter | Symbol | Min. | Typ.* | Max. | Unit | Condition |
|--|-------------------------|------|-------|------|----------------------|--|
| Forward voltage | V_F | - | 1.3 | 1.7 | V | $I_F = 1.6\text{mA}$ |
| Reverse Voltage | V_R | 5.0 | - | - | V | $I_R = 10\mu\text{A}$, $T_A=25^\circ\text{C}$ |
| Temperature coefficient of forward voltage | $\Delta V_F/\Delta T_A$ | - | -1.8 | - | mV/ $^\circ\text{C}$ | $I_F=1.6\text{mA}$ |

Output

| Parameter | Symbol | Min. | Typ.* | Max. | Unit | Condition | |
|---------------------------|----------------|-----------|-------|------|---------------|--|--|
| Logic High Output Current | 6N139 | - | 0.01 | 100 | μA | $I_F=0\text{mA}$, $V_O=V_{CC}=18\text{V}$ | |
| | 6N138 | - | - | 250 | | | |
| Logic Low Supply Current | 6N138 6N139 | I_{CCL} | - | 0.6 | 1.5 | mA | $I_F=1.6\text{mA}$, $V_O=\text{Open}$, $V_{CC}=18\text{V}$ |
| Logic High Supply Current | 6N138 6N139 | I_{CCH} | - | 0.05 | 10 | μA | $I_F=0\text{mA}$, $V_O=\text{Open}$, $V_{CC}=18\text{V}$ |

Transfer Characteristics ($T_a=0$ to 70°C unless specified otherwise, $V_{CC}=4.5\text{V}$)

| Parameter | Symbol | Min. | Typ.* | Max. | Unit | Condition | |
|--------------------------|--------|----------|-------|------|------|-----------|--|
| Current Transfer Ratio | 6N139 | CTR | 400 | 2500 | - | % | $I_F = 0.5\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC}=4.5\text{V}$ |
| | | | 500 | 2000 | - | | $I_F = 1.6\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC}=4.5\text{V}$ |
| | 6N138 | | 300 | 2000 | - | | |
| Logic Low Output Voltage | 6N139 | V_{OL} | - | 0.05 | 0.4 | V | $I_F = 0.5\text{mA}$, $I_O = 2\text{mA}$, $V_{CC}=4.5\text{V}$ |
| | | | - | 0.09 | 0.4 | | $I_F = 1.6\text{mA}$, $I_O = 8\text{mA}$, $V_{CC}=4.5\text{V}$ |
| | | | - | 0.12 | 0.4 | | $I_F = 5\text{mA}$, $I_O = 15\text{mA}$, $V_{CC}=4.5\text{V}$ |
| | | | - | 0.17 | 0.4 | | $I_F = 12\text{mA}$, $I_O = 24\text{mA}$, $V_{CC}=4.5\text{V}$ |
| | 6N138 | | - | 0.06 | 0.4 | | $I_F = 1.6\text{mA}$, $I_O = 4.8\text{mA}$, $V_{CC}=4.5\text{V}$ |

* Typical values at $T_a = 25^\circ\text{C}$

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Switching Characteristics (T_a=0 to 70°C unless specified otherwise, V_{cc}=5V)

| Parameter | Symbol | Min. | Typ.* | Max. | Unit | Condition | |
|--|-----------------|-------|-------|------|------|---|--|
| Propagation Delay Time to Logic Low (Fig. 13) | 6N139 | TPHL | - | 5 | 25 | μs | I _F = 0.5mA , R _L =4.7kΩ, T _A =25°C |
| | | | - | - | 30 | | I _F = 0.5mA , R _L =4.7kΩ |
| | | | - | 0.2 | 1 | | I _F = 12mA , R _L =270Ω, T _A =25°C |
| | 6N138 | TPHL | - | - | 2 | | I _F = 12mA , R _L =270Ω |
| | | | - | 1.4 | 10 | | I _F = 1.6mA , R _L =2.2kΩ, T _A =25°C |
| | | | - | - | 15 | | I _F = 1.6mA , R _L =2.2kΩ |
| Propagation Delay Time to Logic High (Fig. 13) | 6N139 | TPLH | - | 16 | 60 | μs | I _F = 0.5mA , R _L =4.7kΩ, T _A =25°C |
| | | | - | - | 90 | | I _F = 0.5mA , R _L =4.7kΩ |
| | | | - | 1.7 | 7 | | I _F = 12mA , R _L =270Ω, T _A =25°C |
| | 6N138 | TPLH | - | - | 10 | | I _F = 12mA , R _L =270Ω |
| | | | - | 8 | 35 | | I _F = 1.6mA , R _L =2.2kΩ, T _A =25°C |
| | | | - | - | 50 | | I _F = 1.6mA , R _L =2.2kΩ |
| Common Mode Transient Immunity at Logic High (Fig. 14) ^{*3} | CM _H | 1,000 | - | - | V/μs | I _F = 0mA , V _{CM} =10Vp-p, R _L =2.2KΩ, T _A =25°C | |
| Common Mode Transient Immunity at Logic Low (Fig. 14) ^{*3} | CM _L | 1,000 | - | - | V/μs | I _F = 1.6mA , V _{CM} =10Vp-p, R _L =2.2KΩ, T _A =25°C | |

* Typical values at T_a = 25°C

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Typical Performance Curves

Fig.1 LED Forward Current vs. Forward Voltage

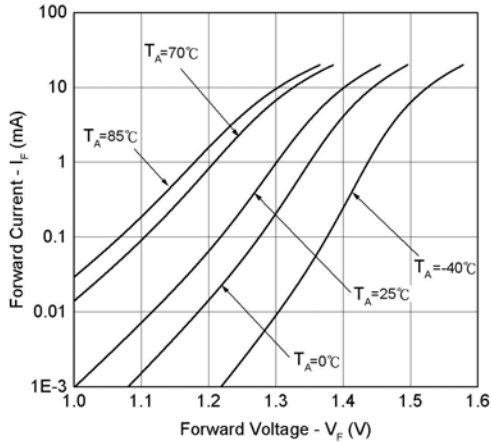


Fig.2 LED Forward Voltage vs. Temperature

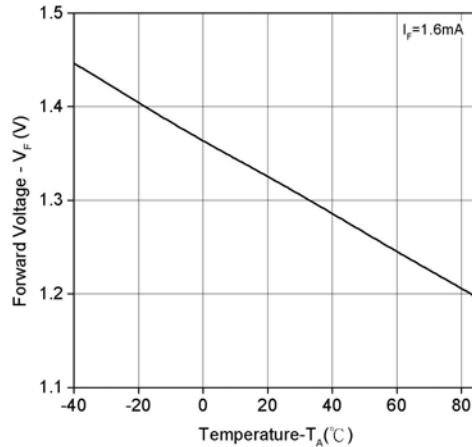


Fig.3 Output Current vs. Output Voltage

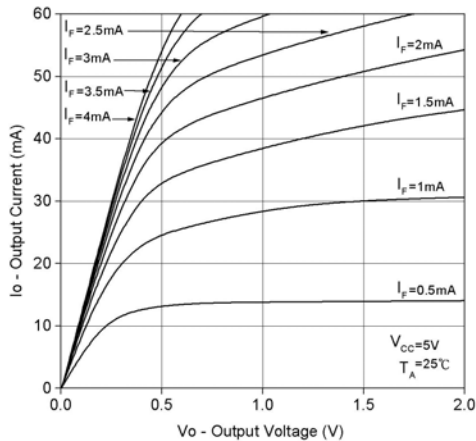


Fig.4 Output Current vs. Input Diode Forward Current

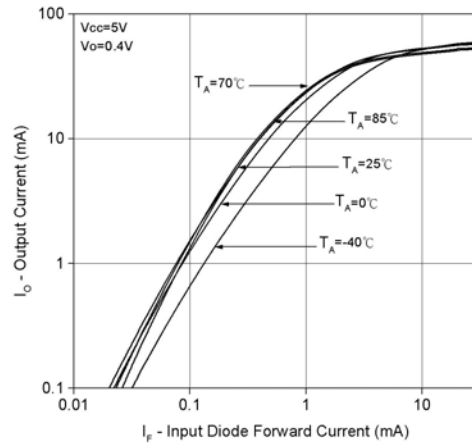


Fig.5 Current Transfer Ratio vs. Forward Current

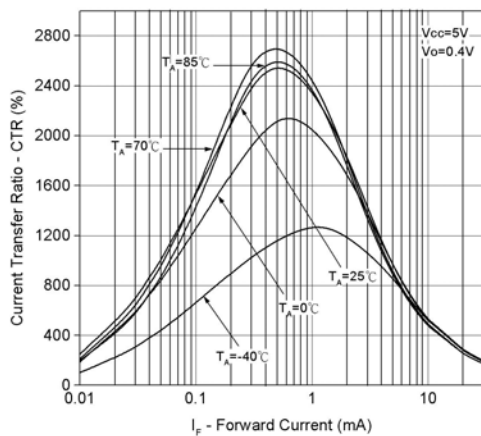
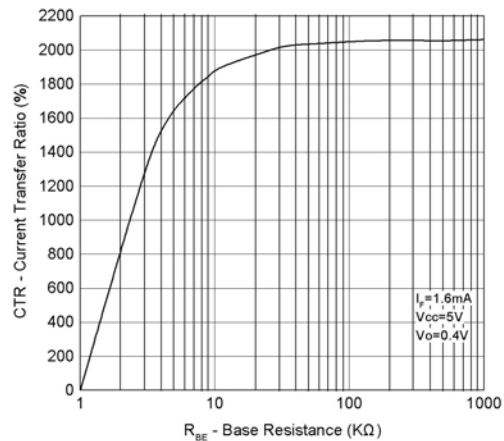


Fig.6 Current Transfer Ratio vs. Base-Emitter Resistance



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Fig.7 Non-saturated Rise and Fall Times vs. Load Resistance

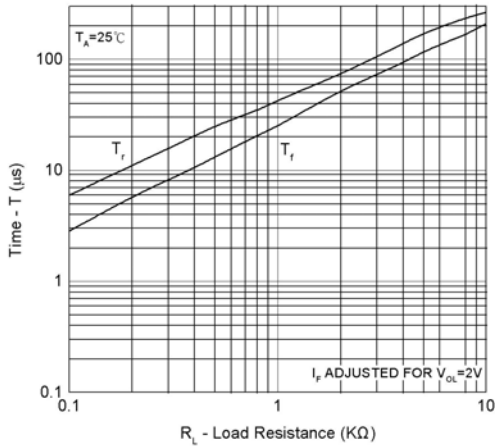


Fig.8 Propagation Delay To Logic Low vs. Base-Emitter Resistance

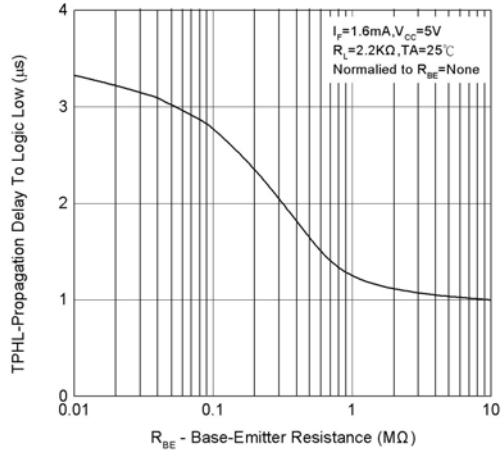


Fig.9 Propagation Delay vs. Input Diode Forward Current

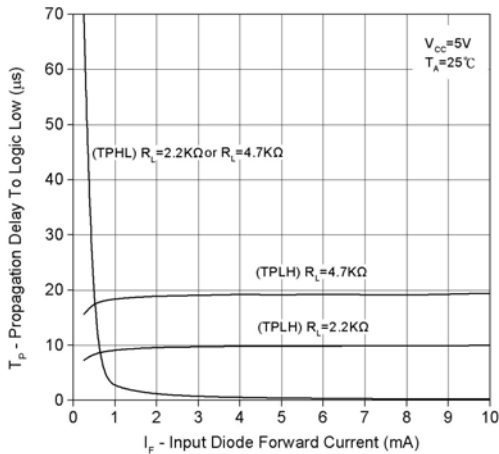


Fig.10 Propagation Delay to Logic Low vs. Pulse Period

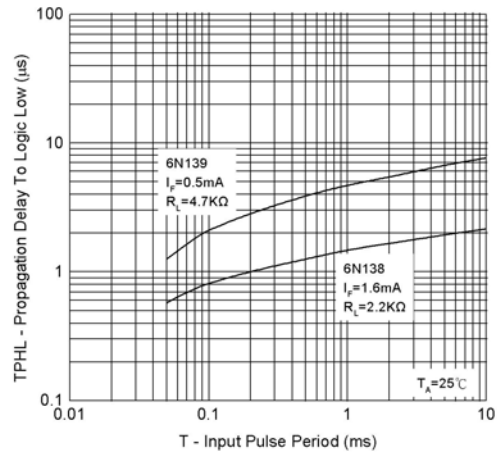


Fig.11 Propagation Delay vs. Temperature

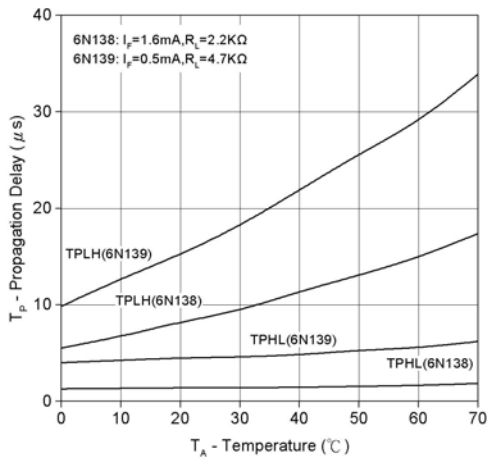
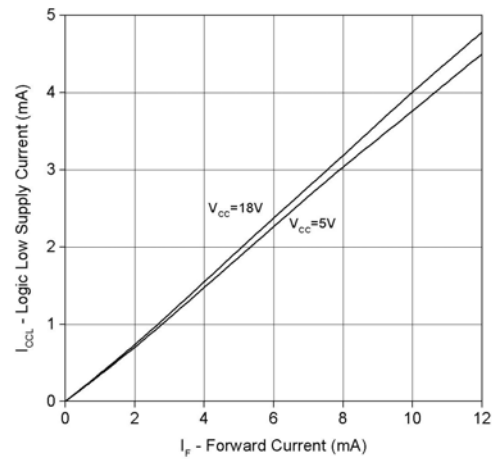


Fig.12 Logic Low Supply Current vs. Input Diode Forward Current



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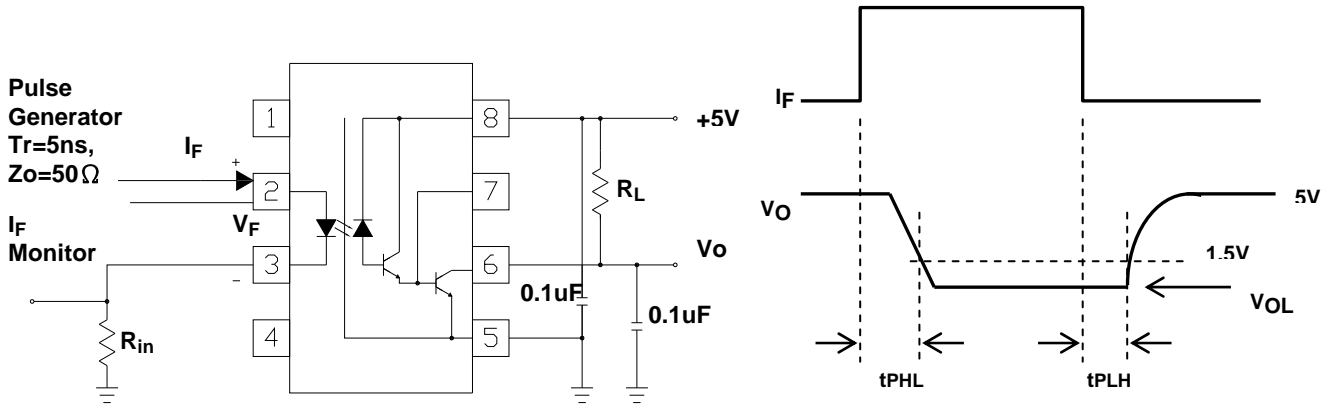


Fig. 13 Switching Time Test Circuit and Waveform

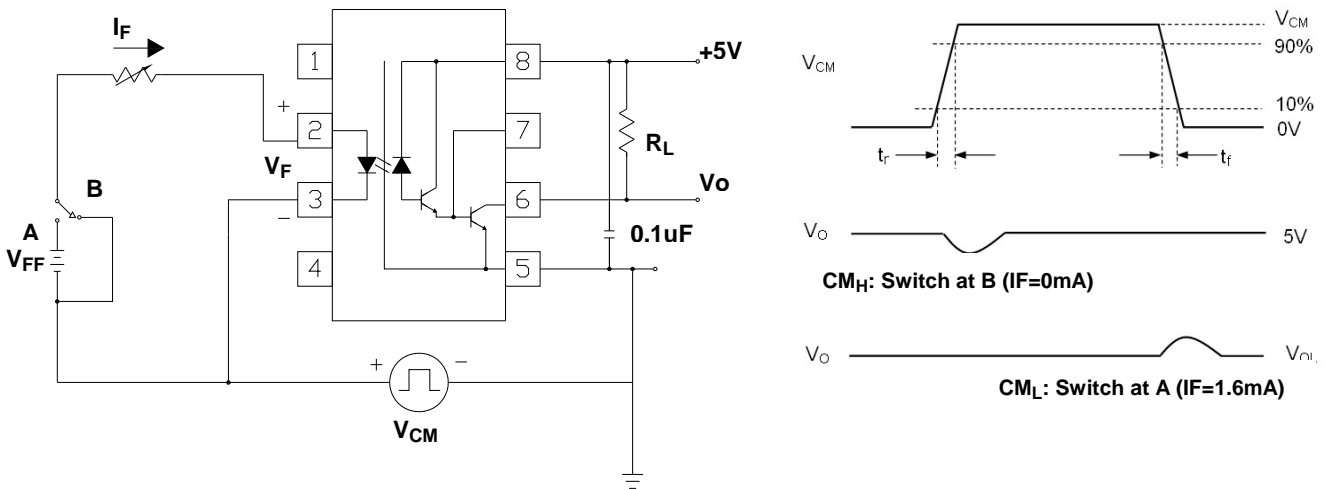


Fig. 14 Common Mode Transient Immunity Test Circuit and Waveform

Note:

*3 Common mode transient immunity in logic high level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse signal V_{cm} , to assure that the output will remain in a logic high state (i.e., $V_O > 2.0V$).

Common mode transient immunity in logic low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm} , to assure that the output will remain in a logic low state (i.e., $V_O < 0.8V$).



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Order Information

Part Number

6N13XY(Z)-V

Note

- X = Part No. (X = 8 or 9)
- Y = Lead form option (S, S1, M or none)
- Z = Tape and reel option (TA, TB or none).
- V = VDE (optional)

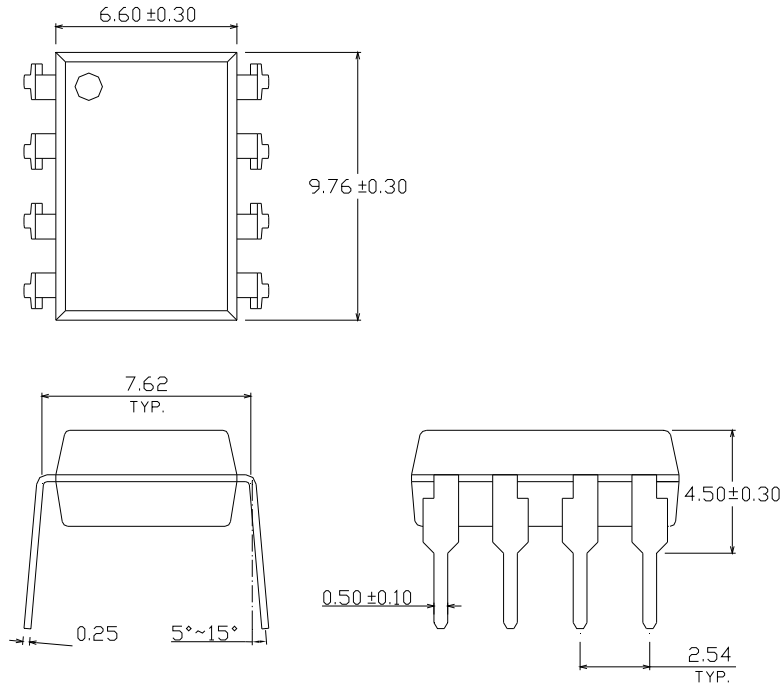
| Option | Description | Packing quantity |
|---------|---|---------------------|
| None | Standard DIP-8 | 45 units per tube |
| M | Wide lead bend (0.4 inch spacing) | 45 units per tube |
| S (TA) | Surface mount lead form + TA tape & reel option | 1000 units per reel |
| S (TB) | Surface mount lead form + TB tape & reel option | 1000 units per reel |
| S1 (TA) | Surface mount lead form (low profile) + TA tape & reel option | 1000 units per reel |
| S1 (TB) | Surface mount lead form (low profile) + TB tape & reel option | 1000 units per reel |

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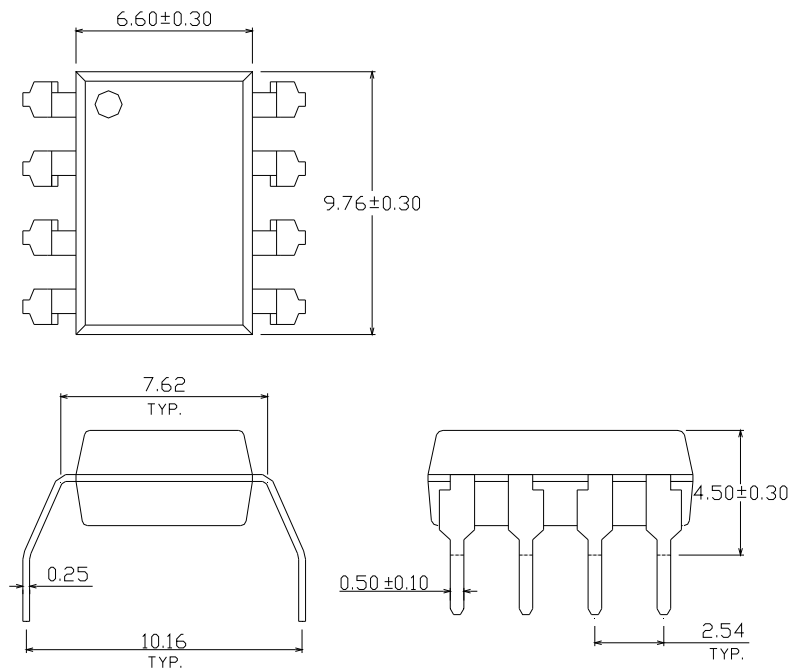
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**Package Drawing
(Dimensions in mm)**

Standard DIP Type



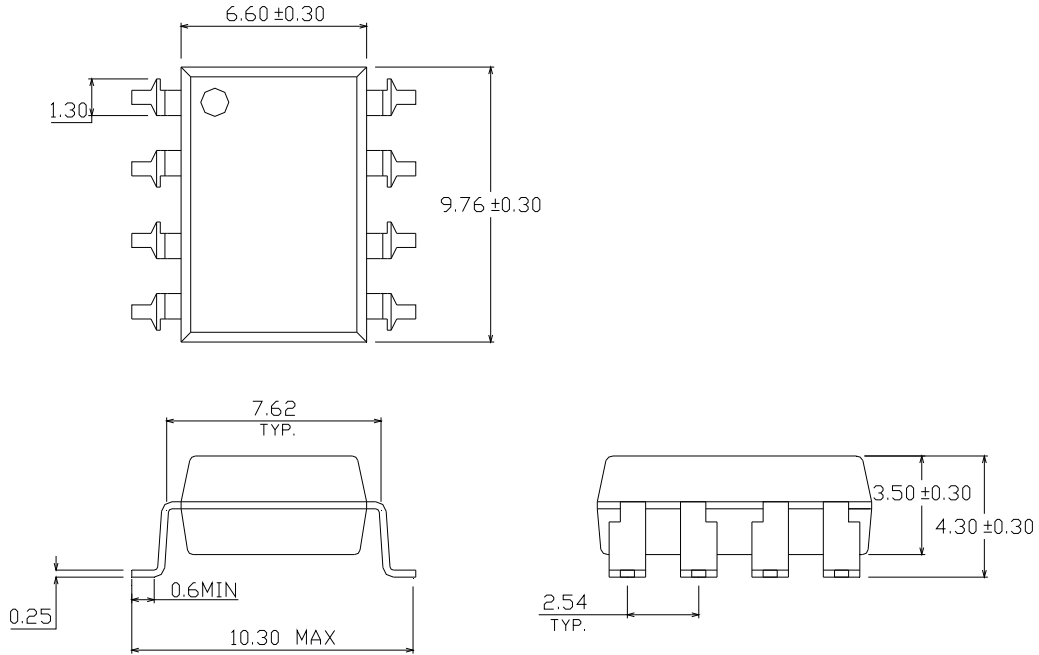
Option M Type



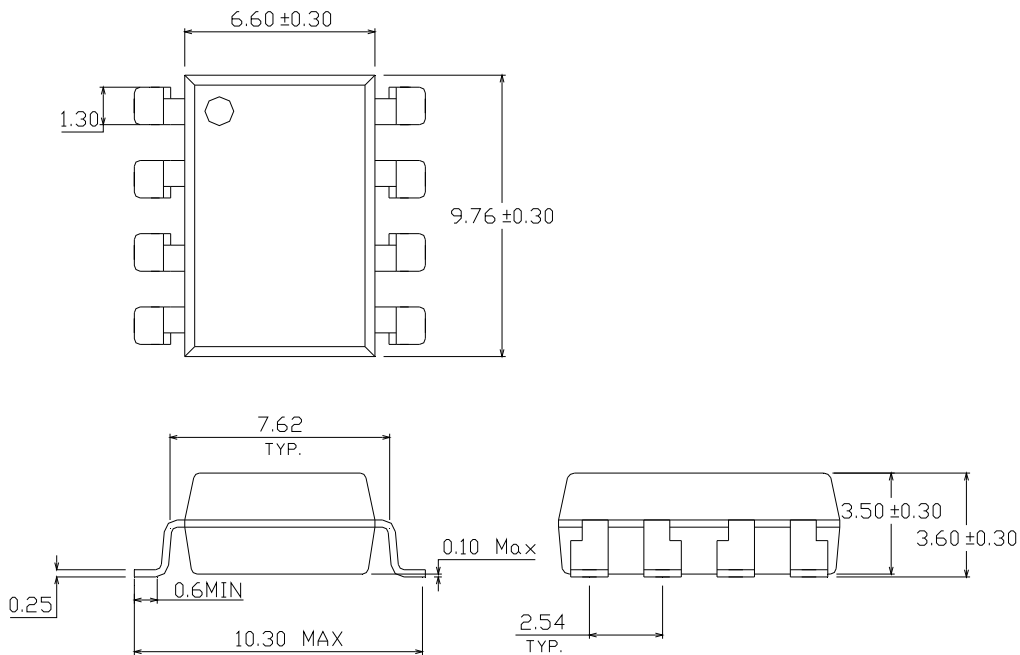
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Option S Type



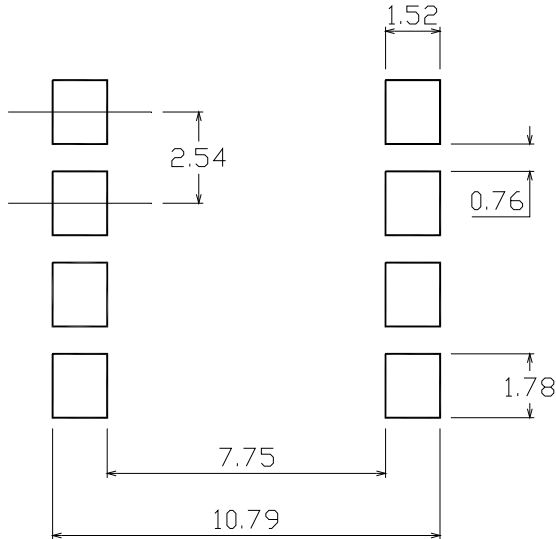
Option S1 Type



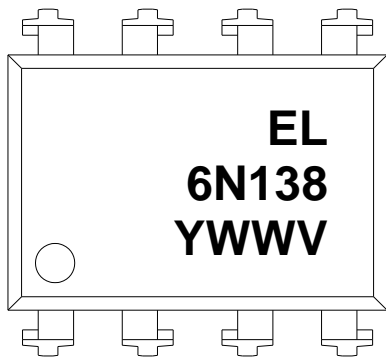
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Recommended pad layout for surface mount leadform



Device Marking



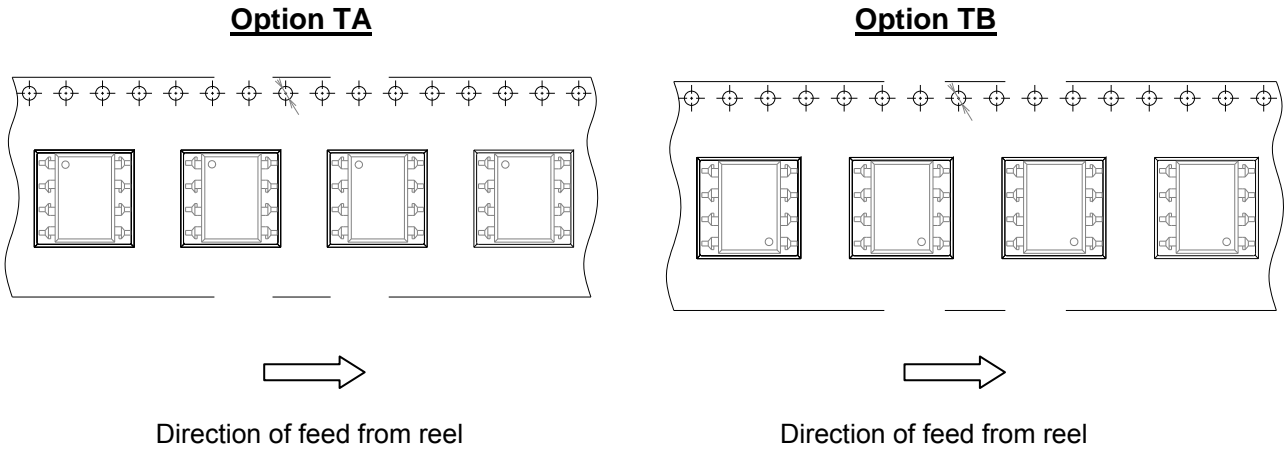
Notes

- 6N138 denotes Device Number
- Y denotes 1 digit Year code
- WW denotes 2 digit Week code
- V denotes VDE (Optional)

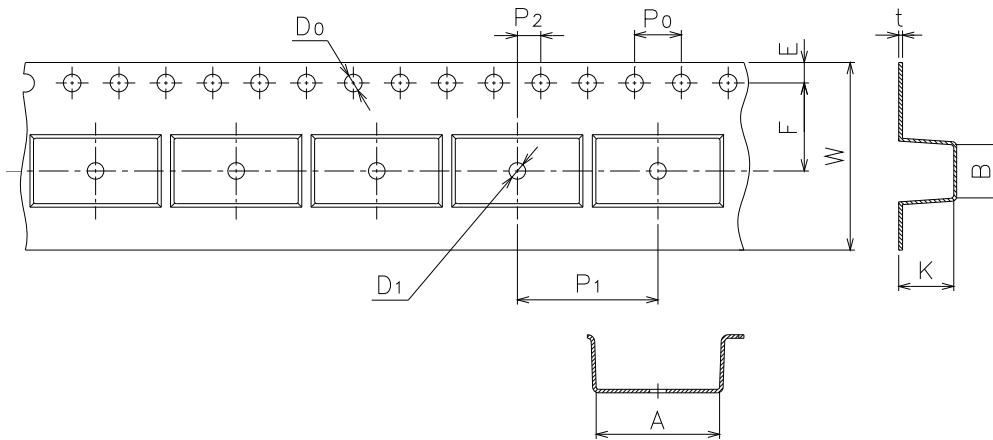
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Tape & Reel Packing Specifications



Tape dimensions

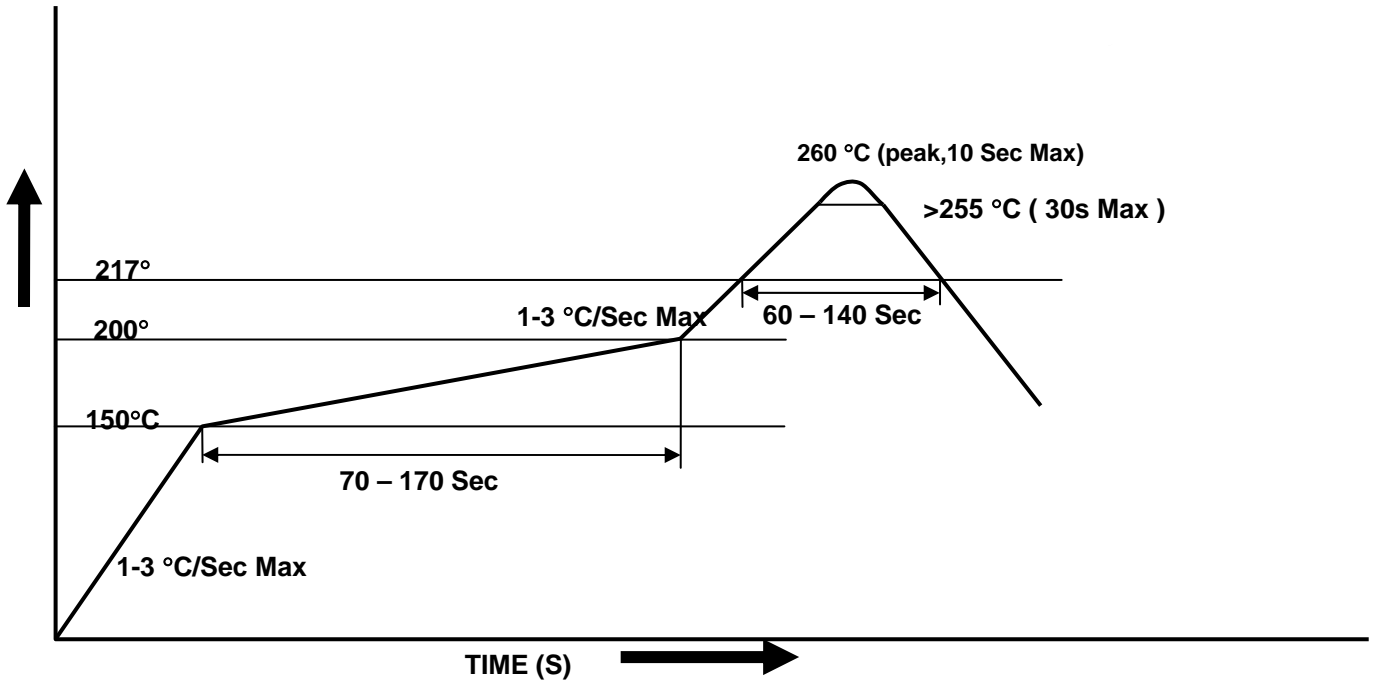


| | | | | | | |
|---------------|-----------|-----------|-----------|-----------|-------------------|----------|
| Dimension No. | A | B | Do | D1 | E | F |
| Dimension(mm) | 10.4±0.1 | 10.0±0.1 | 1.5±0.1 | 1.5±0.1 | 1.75±0.1 | 7.5±0.1 |
| Dimension No. | Po | P1 | P2 | t | W | K |
| Dimension(mm) | 4.0±0.1 | 12.0±0.1 | 2.0±0.1 | 0.4±0.1 | 16.0+0.3/ -0.1 | 4.5±0.1 |

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Solder Reflow Temperature Profile





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