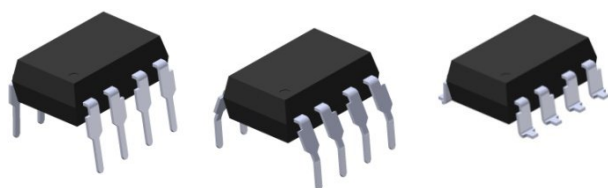


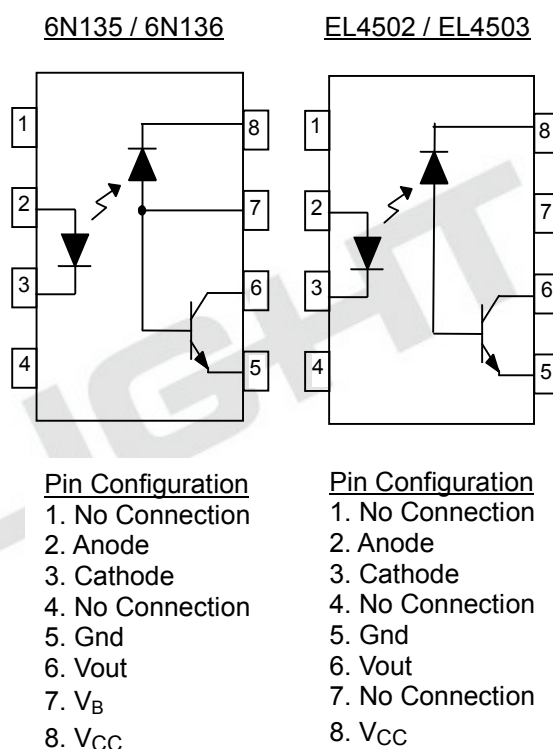
### 8 PIN DIP HIGH SPEED 1Mbit/s TRANSISTOR PHOTOCOUPLER 6N135 6N136 EL450x Series



#### Features

- High speed 1Mbit/s
- High isolation voltage between input and output (Viso=5000 Vrms )
- Guaranteed performance from 0°C to 70°C
- Wide operating temperature range of -55°C to 100°C
- Pb free and RoHS compliant
- UL and cUL approved(No. E214129)
- VDE approved (No. 132249)
- SEMKO approved
- NEMKO approved
- DEMKO approved
- FIMKO approved

#### Schematic



#### Description

The 6N135, 6N136, EL4502 and EL4503 devices each consist of an infrared emitting diode, optically coupled to a high speed photo detector transistor. A separate connection for the photodiode bias and output-transistor collector increase the speed by several orders of magnitude over conventional phototransistor couplers by reducing the base-collector capacitance of the input transistor. The devices are packaged in an 8-pin DIP package and available in wide-lead spacing and SMD option

#### Applications

- Line receivers
- Telecommunication equipments
- Power transistor isolation in motor drives
- Replacement for low speed phototransistor photo couplers
- Feedback loop in switch-mode power supplies
- Home appliances
- High speed logic ground isolation

## Absolute Maximum Ratings (Ta=25°C)

| Parameter               |                                                        | Symbol                      | Rating     | Unit |
|-------------------------|--------------------------------------------------------|-----------------------------|------------|------|
| Input                   | Forward current                                        | $I_F$                       | 25         | mA   |
|                         | Peak forward current<br>(50% duty, 1ms P.W)            | $I_{FP}$                    | 50         | mA   |
|                         | Peak transient current<br>( $\leq 1\mu s$ 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   |
|                         | Emitter-Base reverse voltage                           | 6N135<br>6N136<br>$V_{EBR}$ | 5          | V    |
|                         | Base current                                           | 6N135<br>6N136<br>$I_B$     | 5          | mA   |
|                         | Average Output current                                 | $I_{O(AVG)}$                | 8          | mA   |
|                         | Peak Output current                                    | $I_{O(PK)}$                 | 16         | mA   |
|                         | Output voltage                                         | $V_O$                       | -0.5 to 20 | V    |
|                         | Supply voltage                                         | $V_{CC}$                    | -0.5 to 30 | V    |
|                         | Total Power Dissipation                                | $P_{TOT}$                   | 200        | mW   |
| Isolation Voltage*1     |                                                        | $V_{ISO}$                   | 5000       | Vrms |
| Operating Temperature   |                                                        | $T_{OPR}$                   | -55 to 100 | °C   |
| Storage Temperature     |                                                        | $T_{STG}$                   | -55 to 125 | °C   |
| Soldering Temperature*2 |                                                        | $T_{SOL}$                   | 260        | °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

**Electrical Characteristics ( $T_A=0$  to  $70^\circ\text{C}$  unless specified otherwise)**

**Input**

| Parameter                                  | Symbol                    | Min. | Typ. | Max. | Unit                 | Condition             |
|--------------------------------------------|---------------------------|------|------|------|----------------------|-----------------------|
| Forward Voltage                            | $V_F$                     | -    | 1.45 | 1.8  | V                    | $I_F = 16\text{mA}$   |
| Reverse Voltage                            | $V_R$                     | 5.0  | -    | -    | V                    | $I_R = 10\mu\text{A}$ |
| Temperature coefficient of forward voltage | $\Delta V_F / \Delta T_A$ | -    | -1.9 | -    | mV/ $^\circ\text{C}$ | $I_F = 16\text{mA}$   |

**Output**

| Parameter                 | Symbol    | Min | Typ.  | Max. | Unit          | Condition                                                                           |
|---------------------------|-----------|-----|-------|------|---------------|-------------------------------------------------------------------------------------|
| Logic High Output Current | $I_{OH}$  | -   | 0.001 | 0.5  | $\mu\text{A}$ | $I_F=0\text{mA}$ , $V_O=V_{CC}=5.5\text{V}$ , $T_A=25^\circ\text{C}$                |
|                           |           | -   | 0.01  | 1    |               | $I_F=0\text{mA}$ , $V_O=V_{CC}=15\text{V}$ , $T_A=25^\circ\text{C}$                 |
|                           |           | -   | -     | 50   |               | $I_F=0\text{mA}$ , $V_O=V_{CC}=15\text{V}$                                          |
| Logic Low Supply Current  | $I_{CCL}$ | -   | 140   | 200  | $\mu\text{A}$ | $I_F=16\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$                         |
| Logic High Supply Current | $I_{CCH}$ | -   | 0.01  | 1    | $\mu\text{A}$ | $I_F=0\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$ , $T_A=25^\circ\text{C}$ |
|                           |           | -   | -     | 2    |               | $I_F=0\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$                          |

**Transfer Characteristics ( $T_A=0$  to  $70^\circ\text{C}$  unless specified otherwise)**

| Parameter                | Symbol | Min | Typ. | Max. | Unit | Condition                                                                         |                                                            |
|--------------------------|--------|-----|------|------|------|-----------------------------------------------------------------------------------|------------------------------------------------------------|
| Current Transfer Ratio   | 6N135  | 7   | -    | 50   | %    | $I_F = 16\text{mA}, V_O = 0.4\text{V}, V_{CC}=4.5\text{V}, T_A=25^\circ\text{C}$  |                                                            |
|                          | 6N136  | 19  | -    | 50   |      |                                                                                   |                                                            |
|                          | EL4502 |     |      |      |      |                                                                                   |                                                            |
|                          | EL4503 |     |      |      |      |                                                                                   |                                                            |
|                          | 6N135  |     |      |      |      |                                                                                   | 5                                                          |
|                          | 6N136  | 15  | -    | -    |      |                                                                                   | $I_F = 16\text{mA}, V_O = 0.5\text{V}, V_{CC}=4.5\text{V}$ |
| EL4502                   |        |     |      |      |      |                                                                                   |                                                            |
| EL4503                   |        |     |      |      |      |                                                                                   |                                                            |
| Logic Low Output Voltage | 6N135  | -   | 0.18 | 0.4  | V    | $I_F = 16\text{mA}, I_O = 1.1\text{mA}, V_{CC}=4.5\text{V}, T_A=25^\circ\text{C}$ |                                                            |
|                          | 6N136  | -   | 0.25 | 0.4  |      |                                                                                   |                                                            |
|                          | EL4502 |     |      |      |      |                                                                                   |                                                            |
|                          | EL4503 |     |      |      |      |                                                                                   |                                                            |
|                          | 6N135  |     |      |      |      |                                                                                   | -                                                          |
|                          | 6N136  | -   | -    | 0.5  |      |                                                                                   |                                                            |
| EL4502                   |        |     |      |      |      |                                                                                   |                                                            |
| EL4503                   |        |     |      |      |      |                                                                                   |                                                            |

Switching Characteristics ( $T_A=0$  to  $70^{\circ}\text{C}$  unless specified otherwise,  $I_F=16\text{mA}$ ,  $V_{CC}=5\text{V}$ )

| Parameter                                                          | Symbol                             | Min    | Typ.  | Max.  | Unit | Condition                                                                                         |
|--------------------------------------------------------------------|------------------------------------|--------|-------|-------|------|---------------------------------------------------------------------------------------------------|
| Propagation Delay Time to Logic Low (Fig.8)                        | 6N135<br>6N136<br>EL4502<br>EL4503 | TPHL   | -     | 0.35  | 1.5  | $R_L=4.1\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$                                                |
|                                                                    |                                    |        | -     | -     | 2.0  | $R_L=4.1\text{K}\Omega$                                                                           |
|                                                                    |                                    |        | -     | 0.35  | 0.8  | $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$                                                |
|                                                                    |                                    |        | -     | -     | 1.0  | $R_L=1.9\text{K}\Omega$                                                                           |
| Propagation Delay Time to Logic High (Fig.8)                       | 6N135<br>6N136<br>EL4502<br>EL4503 | TPLH   | -     | 0.5   | 1.5  | $R_L=4.1\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$                                                |
|                                                                    |                                    |        | -     | -     | 2.0  | $R_L=4.1\text{K}\Omega$                                                                           |
|                                                                    |                                    |        | -     | 0.3   | 0.8  | $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$                                                |
|                                                                    |                                    |        | -     | -     | 1.0  | $R_L=1.9\text{K}\Omega$                                                                           |
| Common Mode Transient Immunity at Logic High (Fig.9) <sup>*3</sup> | 6N135                              | $CM_H$ | 1,000 | -     | -    | $I_F=0\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=4.1\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$    |
|                                                                    | 6N136<br>EL4502                    |        | 1,000 | -     | -    | $I_F=0\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$    |
|                                                                    | EL4503                             |        | 15000 | 20000 | -    | $I_F=0\text{mA}$ , $V_{CM}=1500\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$  |
| Common Mode Transient Immunity at Logic Low (Fig.9) <sup>*3</sup>  | 6N135                              | $CM_L$ | 1,000 | -     | -    | $I_F=16\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=4.1\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$   |
|                                                                    | 6N136<br>EL4502                    |        | 1,000 | -     | -    | $I_F=16\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$   |
|                                                                    | EL4503                             |        | 15000 | 20000 | -    | $I_F=16\text{mA}$ , $V_{CM}=1500\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A=25^{\circ}\text{C}$ |

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

## Typical Electro-Optical Characteristics Curves

Fig.1 Forward Current vs. Forward Voltage

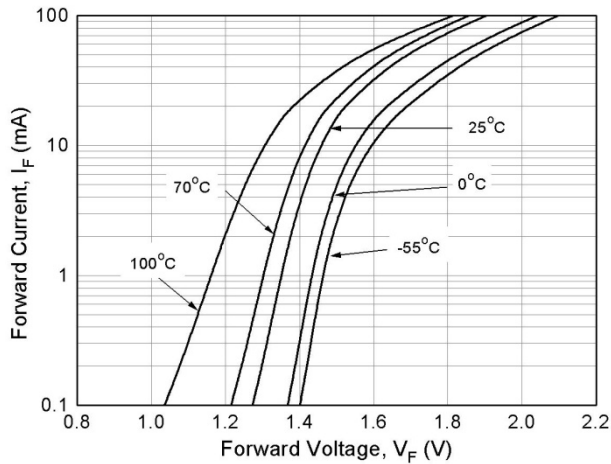


Fig.2 Normalized Current Transfer Ratio vs. Forward Current

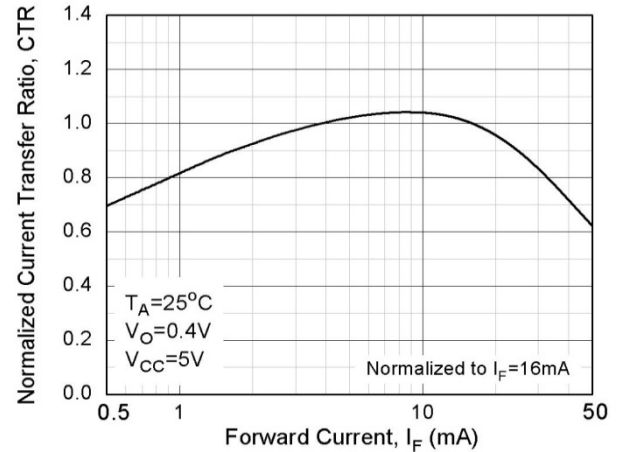


Fig.3 Normalized Current Transfer Ratio vs. Ambient Temperature

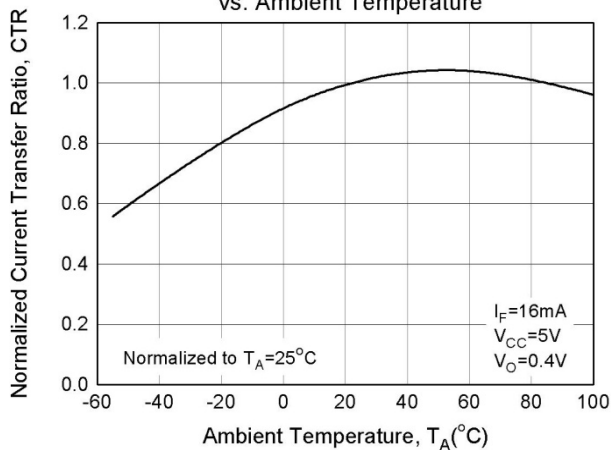


Fig.4 Output Current vs Output Voltage

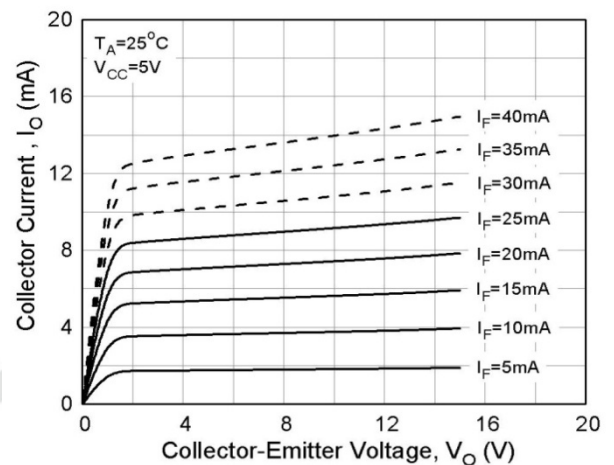


Fig.5 Logic High Output Current vs. Temperature

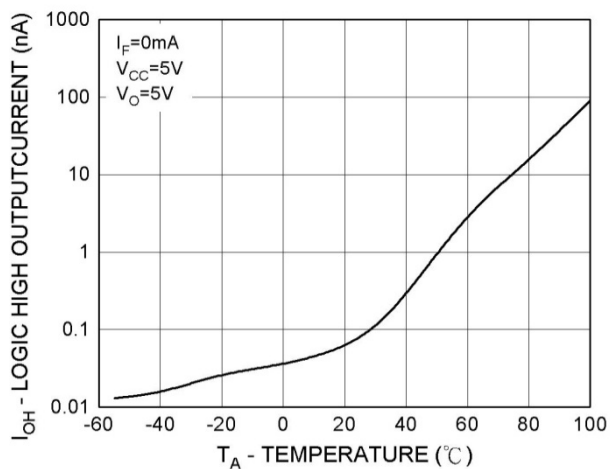


Fig.6 Propagation Delay vs. Load Resistance

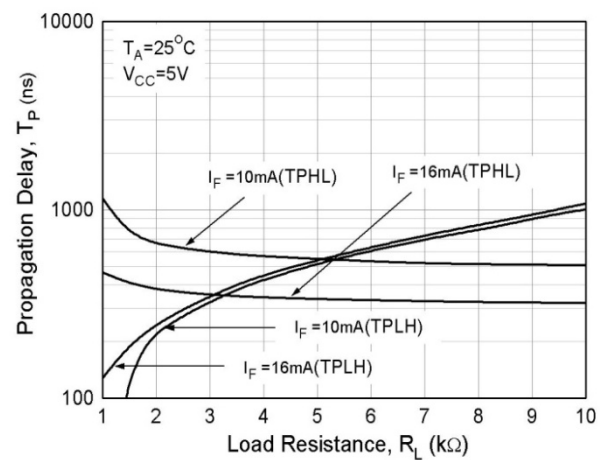


Fig.7 Propagation Delay vs. Temperature

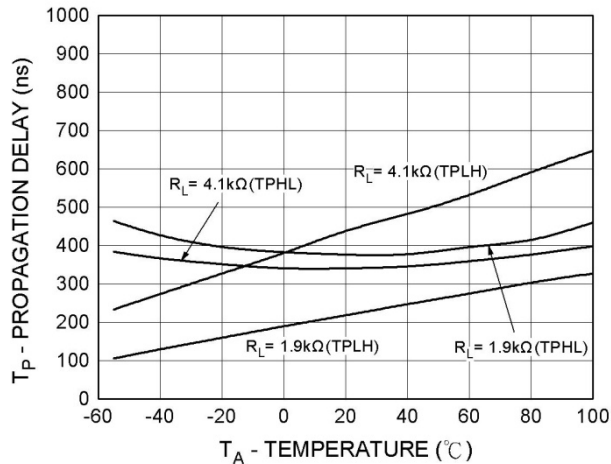


Figure 8 Switching Time Test Circuit & Waveform

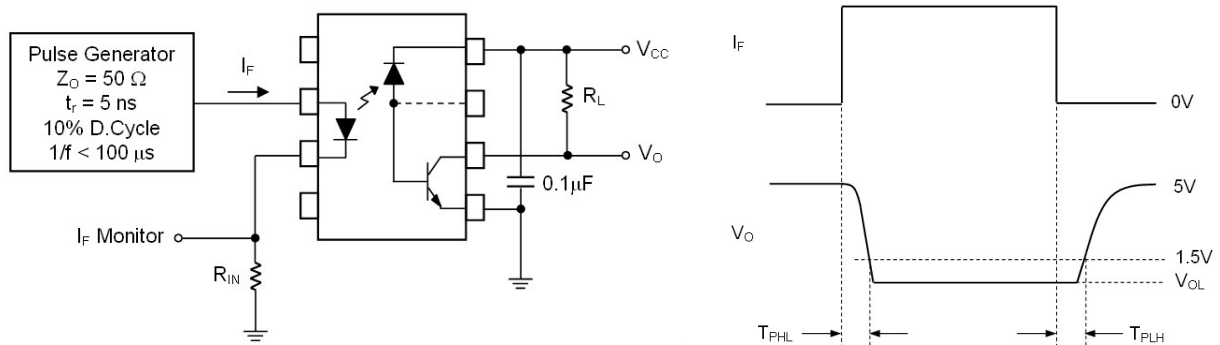
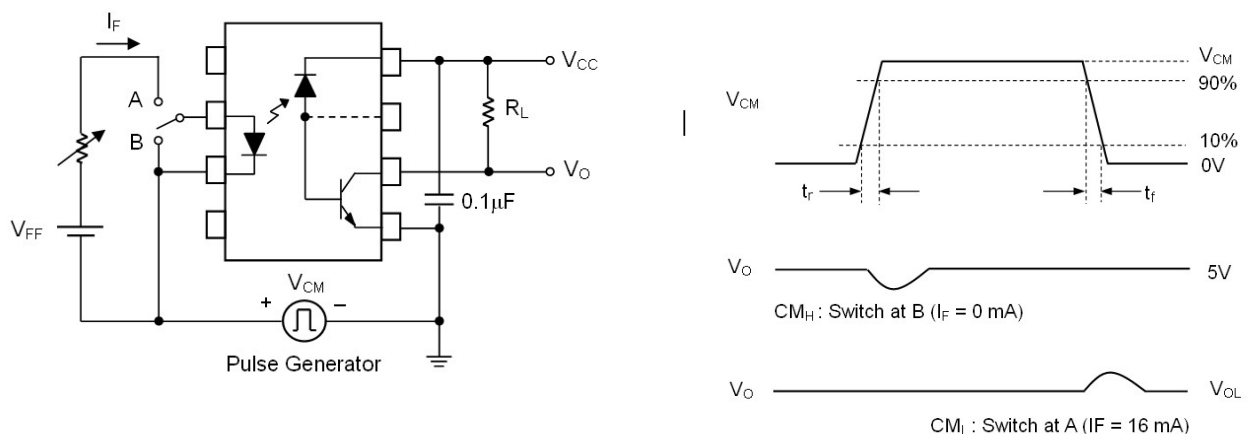


Figure 9 Transient Immunity Test Circuit & Waveform



#### 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.,  $V_O > 2.0\text{V}$ ).

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.,  $V_O < 0.8\text{V}$ ).

## Order Information

### Part Number

**6N13XY(Z)-V**

or

**EL450XY(Z)-V**

### Note

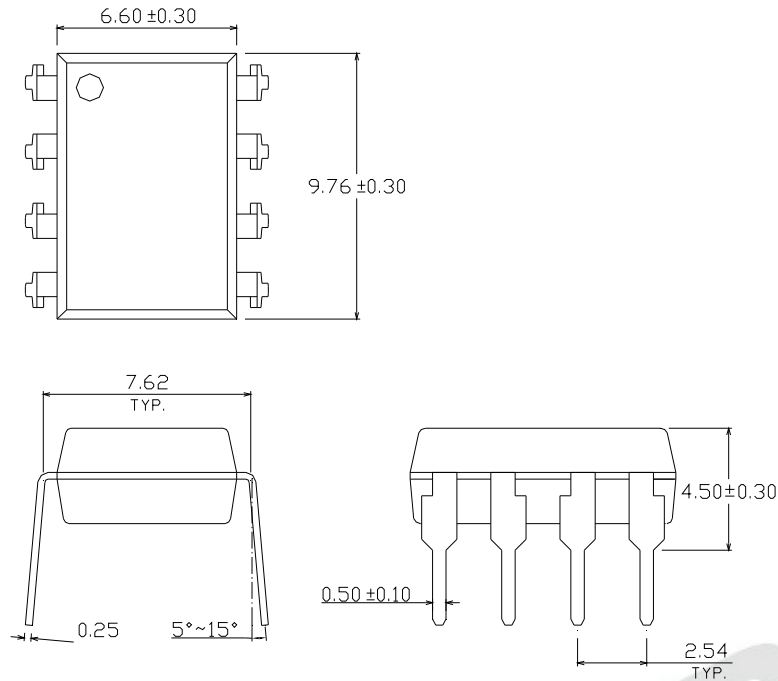
- X = Part No. (X = 5 or 6) for 6N series; (X=2 or 3) for EL45 series  
Y = Lead form option (S, S1, M or none)  
Z = Tape and reel option (TA, TB or none)  
V = VDE (optional)

| 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 |

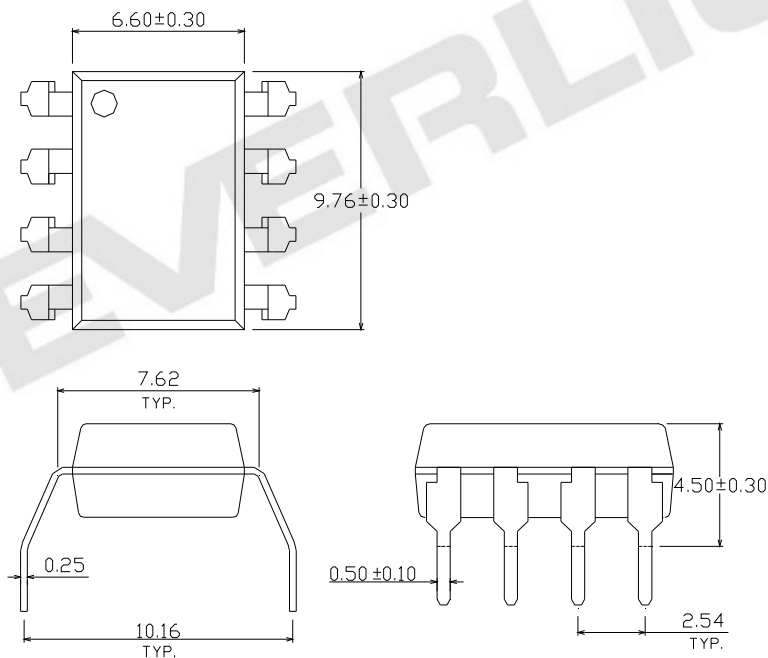


## Package Dimension (Dimensions in mm)

### Standard DIP Type

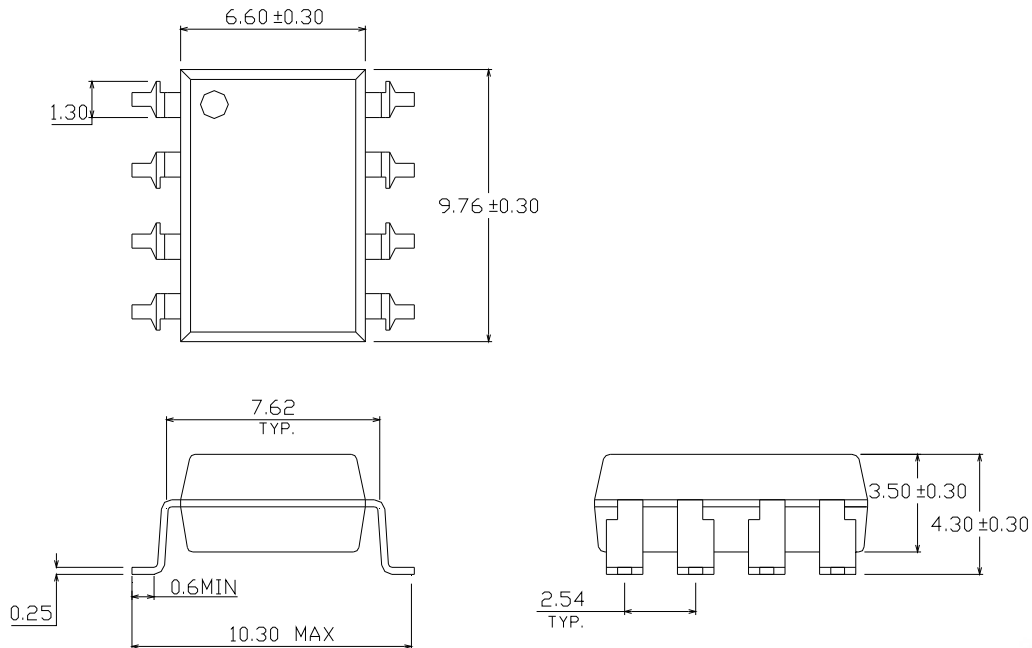


### Option M Type

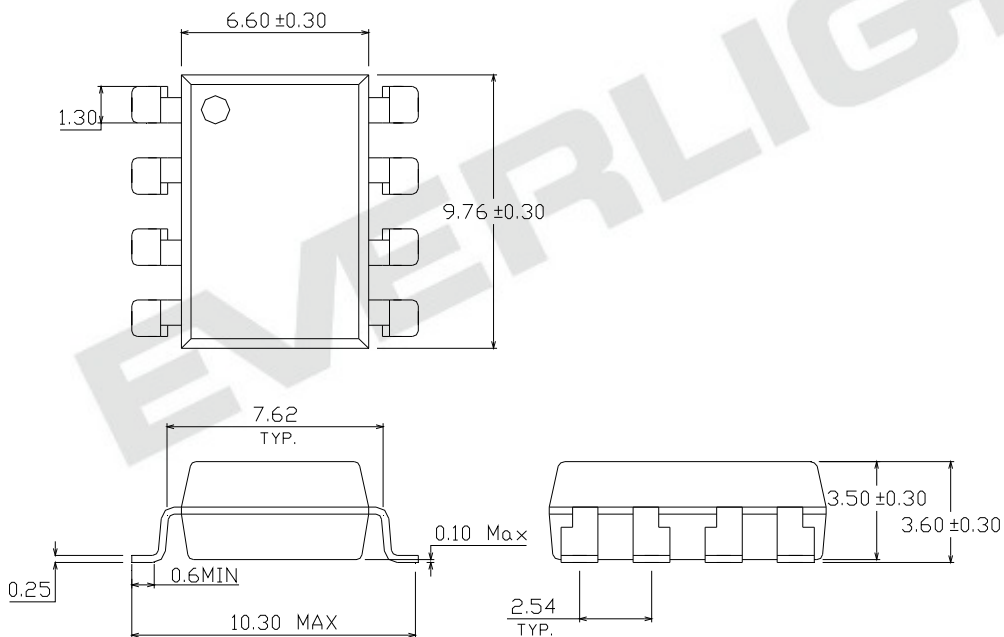




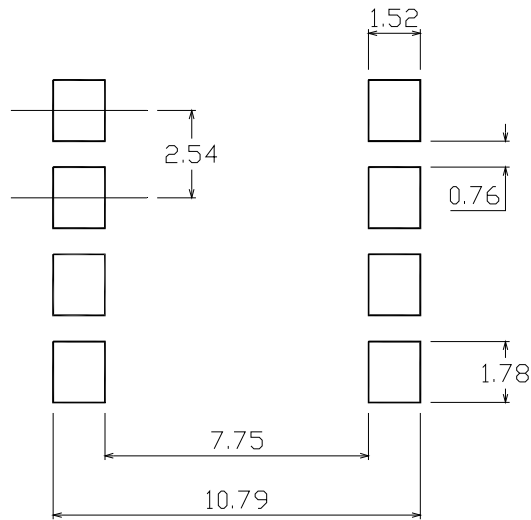
Option S Type



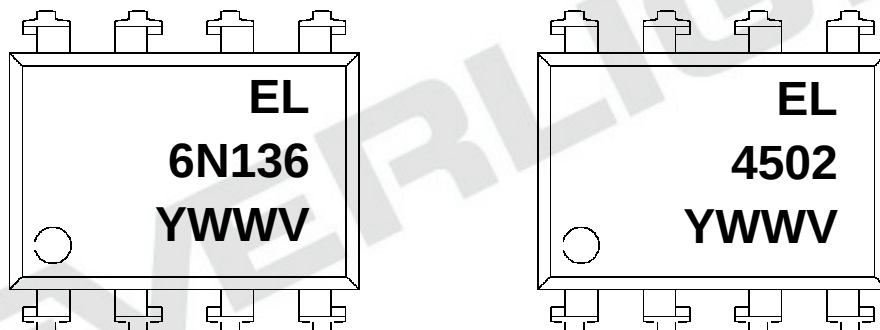
Option S1 Type



## Recommended pad layout for surface mount leadform



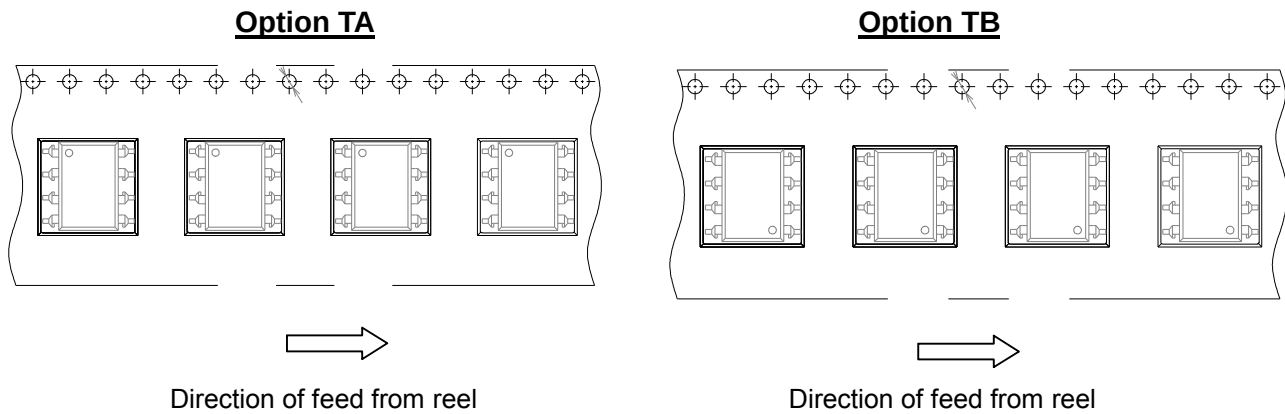
## Device Marking



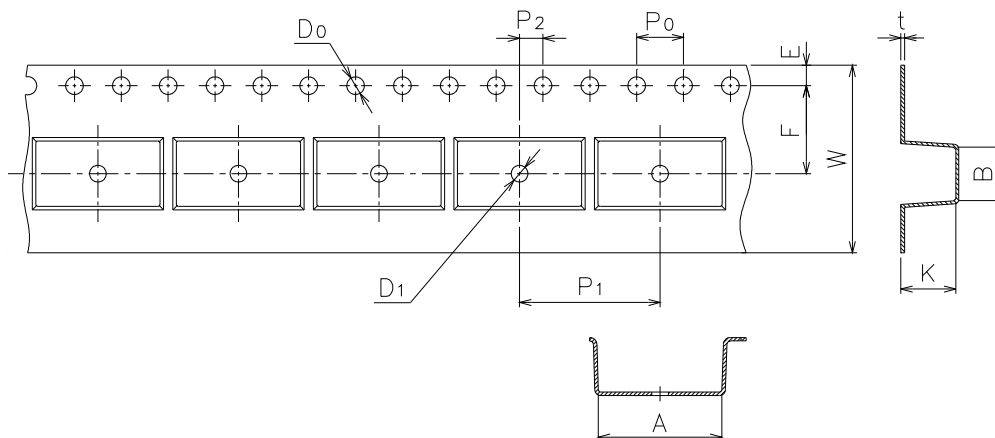
## Notes

|       |                           |
|-------|---------------------------|
| EL    | denotes EVERLIGHT         |
| 4502  | denotes Device Number     |
| 6N136 | denotes Device Number     |
| Y     | denotes 1 digit Year code |
| WW    | denotes 2 digit Week code |
| V     | denotes VDE (optional)    |

## Tape & Reel Packing Specifications



## Tape dimensions

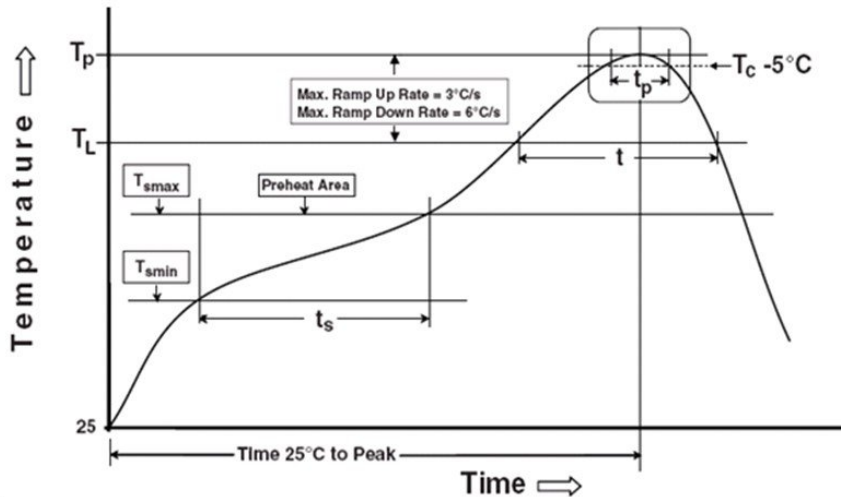


| Dimension No. | A        | B        | D0         | D1          | E         | F       |
|---------------|----------|----------|------------|-------------|-----------|---------|
| Dimension(mm) | 10.4±0.1 | 10.0±0.1 | 1.5+0.1/-0 | 1.5±0.25/-0 | 1.75±0.1  | 7.5±0.1 |
| Dimension No. | P0       | P1       | P2         | t           | W         | K       |
| Dimension(mm) | 4.0±0.1  | 12.0±0.1 | 2.0±0.05   | 0.4±0.05    | 16.0±0.3/ | 4.5±0.1 |

## Precautions for Use

### 1. Soldering Condition

#### 1.1 (A) Maximum Body Case Temperature Profile for evaluation of Reflow Profile



Note:

Reference: IPC/JEDEC J-STD-020D

#### Preheat

|                                              |                 |
|----------------------------------------------|-----------------|
| Temperature min ( $T_{smin}$ )               | 150 °C          |
| Temperature max ( $T_{smax}$ )               | 200°C           |
| Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )  | 60-120 seconds  |
| Average ramp-up rate ( $T_{smax}$ to $T_p$ ) | 3 °C/second max |

#### Other

|                                                                      |                  |
|----------------------------------------------------------------------|------------------|
| Liquidus Temperature ( $T_L$ )                                       | 217 °C           |
| Time above Liquidus Temperature ( $t_L$ )                            | 60-100 sec       |
| Peak Temperature ( $T_p$ )                                           | 260°C            |
| Time within 5 °C of Actual Peak Temperature: $T_p - 5^\circ\text{C}$ | 30 s             |
| Ramp- Down Rate from Peak Temperature                                | 6°C /second max. |
| Time 25°C to peak temperature                                        | 8 minutes max.   |
| Reflow times                                                         | 3 times          |

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