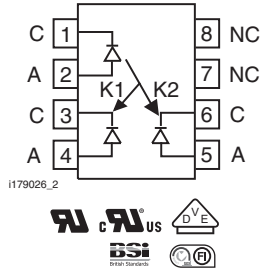


# Linear Optocoupler, High Gain Stability, Wide Bandwidth



## FEATURES

- Couples AC and DC signals
- 0.01 % servo linearity
- Wide bandwidth, > 200 kHz
- High gain stability,  $\pm 0.005 \%/^{\circ}\text{C}$  typically
- Low input-output capacitance
- Low power consumption, < 15 mW
- Isolation rated voltage 4420 V<sub>RMS</sub>
- Internal insulation distance, > 0.4 mm
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## APPLICATIONS

- Power supply feedback voltage / current
- Medical sensor isolation
- Audio signal interfacing
- Isolated process control transducers
- Digital telephone isolation

## AGENCY APPROVALS

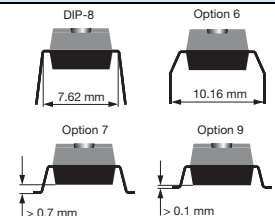
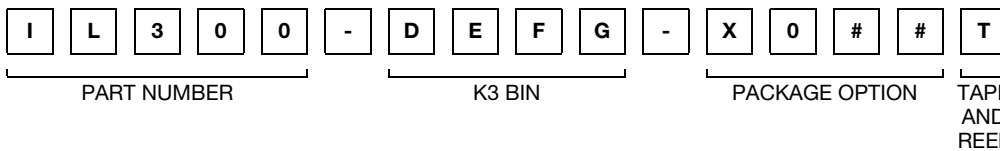
- UL
- cUL
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BSI
- FIMKO
- CQC

## DESCRIPTION

The IL300 linear optocoupler consists of an AlGaAs IRLED irradiating an isolated feedback and an output PIN photodiode in a bifurcated arrangement. The feedback photodiode captures a percentage of the LEDs flux and generates a control signal ( $I_{P1}$ ) that can be used to servo the LED drive current. This technique compensates for the LED's non-linear, time, and temperature characteristics. The output PIN photodiode produces an output signal ( $I_{P2}$ ) that is linearly related to the servo optical flux created by the LED.

The time and temperature stability of the input-output coupler gain ( $K3$ ) is insured by using matched PIN photodiodes that accurately track the output flux of the LED.

## ORDERING INFORMATION



| AGENCY CERTIFIED / PACKAGE | K3 BIN                     |                                 |                       |                       |                               |                       |                       |                              |
|----------------------------|----------------------------|---------------------------------|-----------------------|-----------------------|-------------------------------|-----------------------|-----------------------|------------------------------|
| <b>UL, cUL, BSI, FIMKO</b> | <b>0.557 to 1.618</b>      | <b>0.765 to 1.181</b>           | <b>0.851 to 1.181</b> | <b>0.765 to 0.955</b> | <b>0.851 to 1.061</b>         | <b>0.945 to 1.181</b> | <b>0.851 to 0.955</b> | <b>0.945 to 1.061</b>        |
| DIP-8                      | IL300                      | IL300-DEFG                      | -                     | -                     | IL300-EF                      | -                     | IL300-E               | IL300-F                      |
| DIP-8, 400 mil, option 6   | IL300-X006                 | IL300-DEFG-X006                 | -                     | -                     | IL300-EF-X006                 | IL300-FG-X006         | IL300-E-X006          | IL300-F-X006                 |
| SMD-8, option 7            | IL300-X007T <sup>(1)</sup> | IL300-DEFG-X007T <sup>(1)</sup> | IL300-EFG-X007        | IL300-DE-X007T        | IL300-EF-X007T <sup>(1)</sup> | IL300-FG-X007T        | IL300-E-X007T         | IL300-F-X007T <sup>(1)</sup> |
| SMD-8, option 9            | IL300-X009T <sup>(1)</sup> | IL300-DEFG-X009T <sup>(1)</sup> | -                     | -                     | IL300-EF-X009T <sup>(1)</sup> | -                     | -                     | IL300-F-X009T <sup>(1)</sup> |
| <b>VDE, UL, BSI, FIMKO</b> | <b>0.557 to 1.618</b>      | <b>0.765 to 1.181</b>           | <b>0.851 to 1.181</b> | <b>0.765 to 0.955</b> | <b>0.851 to 1.061</b>         | <b>0.945 to 1.181</b> | <b>0.851 to 0.955</b> | <b>0.945 to 1.061</b>        |
| DIP-8                      | IL300-X001                 | IL300-DEFG-X001                 | -                     | -                     | IL300-EF-X001                 | -                     | IL300-E-X001          | IL300-F-X001                 |
| DIP-8, 400 mil, option 6   | IL300-X016                 | IL300-DEFG-X016                 | IL300-EFG-X016        | -                     | IL300-EF-X016                 | -                     | -                     | IL300-F-X016                 |
| SMD-8, option 7            | IL300-X017                 | IL300-DEFG-X017T <sup>(1)</sup> | -                     | -                     | IL300-EF-X017T <sup>(1)</sup> | -                     | IL300-E-X017T         | IL300-F-X017T <sup>(1)</sup> |
| SMD-8, option 9            | -                          | -                               | -                     | -                     | -                             | -                     | IL300-E-X009T         | IL300-F-X019T <sup>(1)</sup> |

### Note

<sup>(1)</sup> Also available in tubes, do not put "T" on the end



| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                |            |             |       |
|--|----------------|------------|-------------|-------|
| PARAMETER  | TEST CONDITION | SYMBOL     | VALUE       | UNIT  |
| <b>INPUT</b>   |                |            |             |       |
| Power dissipation  |                | $P_{diss}$ | 160         | mW    |
| Derate linearly from 25 °C   |                |            | 2.13        | mW/°C |
| Forward current  |                | $I_F$      | 60          | mA    |
| Surge current (pulse width < 10 μs)  |                | $I_{PK}$   | 250         | mA    |
| Reverse voltage  |                | $V_R$      | 5           | V     |
| Thermal resistance   |                | $R_{th}$   | 470         | K/W   |
| Junction temperature   |                | $T_j$      | 100         | °C    |
| <b>OUTPUT</b>  |                |            |             |       |
| Power dissipation  |                | $P_{diss}$ | 50          | mW    |
| Derate linearly from 25 °C   |                |            | 0.65        | mW/°C |
| Reverse voltage  |                | $V_R$      | 50          | V     |
| Thermal resistance   |                | $R_{th}$   | 1500        | K/W   |
| Junction temperature   |                | $T_j$      | 100         | °C    |
| <b>COUPLER</b>   |                |            |             |       |
| Total package dissipation at 25 °C   |                | $P_{tot}$  | 210         | mW    |
| Derate linearly from 25 °C   |                |            | 2.8         | mW/°C |
| Storage temperature  |                | $T_{stg}$  | -55 to +150 | °C    |
| Operating temperature  |                | $T_{amb}$  | -55 to +100 | °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

| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |                                     |       |                     |        |       |
|--|--|-------------------------------------|-------|---------------------|--------|-------|
| PARAMETER  | TEST CONDITION   | SYMBOL                              | MIN.  | TYP.                | MAX.   | UNIT  |
| <b>INPUT (LED EMITTER)</b>   |  |                                     |       |                     |        |       |
| Forward voltage  | $I_F = 10\text{ mA}$   | $V_F$                               | -     | 1.25                | 1.50   | V     |
| $V_F$ temperature coefficient  |  | $\Delta V_F/\Delta^{\circ}\text{C}$ | -     | -2.2                | -      | mV/°C |
| Reverse current  | $V_R = 5\text{ V}$   | $I_R$                               | -     | 1                   | -      | μA    |
| Junction capacitance   | $V_F = 0\text{ V}, f = 1\text{ MHz}$   | $C_j$                               | -     | 15                  | -      | pF    |
| Dynamic resistance   | $I_F = 10\text{ mA}$   | $\Delta V_F/\Delta I_F$             | -     | 6                   | -      | Ω     |
| <b>OUTPUT</b>  |  |                                     |       |                     |        |       |
| Dark current   | $V_{det} = -15\text{ V}, I_F = 0\text{ A}$   | $I_D$                               | -     | 1                   | 25     | nA    |
| Open circuit voltage   | $I_F = 10\text{ mA}$   | $V_D$                               | -     | 500                 | -      | mV    |
| Short circuit current  | $I_F = 10\text{ mA}$   | $I_{SC}$                            | -     | 120                 | -      | μA    |
| Junction capacitance   | $V_F = 0\text{ V}, f = 1\text{ MHz}$   | $C_j$                               | -     | 12                  | -      | pF    |
| Noise equivalent power   | $V_{det} = 15\text{ V}$  | NEP                                 | -     | $4 \times 10^{-14}$ | -      | W/√Hz |
| <b>COUPLER</b>   |  |                                     |       |                     |        |       |
| Input-output capacitance   | $V_F = 0\text{ V}, f = 1\text{ MHz}$   |                                     | -     | 1                   | -      | pF    |
| K1, servo gain ( $I_{P1}/I_F$ )  | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | K1                                  | 0.006 | 0.012               | 0.017  |       |
| Servo photocurrent <sup>(1)(2)</sup>   | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | $I_{P1}$                            | -     | 120                 | -      | μA    |
| K2, forward gain ( $I_{P2}/I_F$ )  | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | K2                                  | 0.006 | 0.012               | 0.017  |       |
| Forward current  | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | $I_{P2}$                            | -     | 120                 | -      | μA    |
| K3, transfer gain ( $K2/K1$ ) <sup>(1)(2)</sup>  | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | K3                                  | 0.56  | 1                   | 1.65   | K2/K1 |
| Transfer gain stability  | $I_F = 10\text{ mA}, V_{det} = -15\text{ V}$   | $\Delta K3/\Delta T_A$              | -     | ± 0.005             | ± 0.15 | %/°C  |
| Transfer gain linearity  | $I_F = 1\text{ mA to }10\text{ mA}$  | $\Delta K3$                         | -     | ± 0.25              | -      | %     |
|  | $I_F = 1\text{ mA to }10\text{ mA}, T_{amb} = 0\text{ }^{\circ}\text{C to }75\text{ }^{\circ}\text{C}$ |                                     | -     | ± 0.5               | -      | %     |



| ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |            |      |      |      |      |
|---|--|------------|------|------|------|------|
| PARAMETER   | TEST CONDITION   | SYMBOL     | MIN. | TYP. | MAX. | UNIT |
| <b>PHOTOCONDUCTIVE OPERATION</b>  |  |            |      |      |      |      |
| Frequency response  | $I_{Fq} = 10\text{ mA}$ , $MOD = \pm 4\text{ mA}$ , $R_L = 50\text{ }\Omega$ | BW (-3 db) | -    | 200  | -    | kHz  |
| Phase response at 200 kHz   | $V_{det} = -15\text{ V}$   |            | -    | -45  | -    | Deg. |

**Notes**

- Minimum and maximum values were tested 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
- (1) Bin sorting: K3 (transfer gain) is sorted into bins that are  $\pm 6\%$ , as follows:
  - Bin A = 0.557 to 0.626
  - Bin B = 0.620 to 0.696
  - Bin C = 0.690 to 0.773
  - Bin D = 0.765 to 0.859
  - Bin E = 0.851 to 0.955
  - Bin F = 0.945 to 1.061
  - Bin G = 1.051 to 1.181
  - Bin H = 1.169 to 1.311
  - Bin I = 1.297 to 1.456
  - Bin J = 1.442 to 1.618
 K3 = K2/K1. K3 is tested at  $I_F = 10\text{ mA}$ ,  $V_{det} = -15\text{ V}$
- (2) Bin categories: All IL300s are sorted into a K3 bin, indicated by an alpha character that is marked on the part. The bins range from "A" through "J".  
The IL300 is shipped in tubes of 50 each. Each tube contains only one category of K3. The category of the parts in the tube is marked on the tube label as well as on each individual part
- (3) Category options: standard IL300 orders will be shipped from the categories that are available at the time of the order. Any of the ten categories may be shipped. For customers requiring a narrower selection of bins, the bins can be grouped together as follows:  
IL300-DEFG: order this part number to receive categories D, E, F, G only  
IL300-EF: order this part number to receive categories E, F only  
IL300-E: order this part number to receive category E only

| SWITCHING CHARACTERISTICS |  |        |      |      |      |               |
|---------------------------|--|--------|------|------|------|---------------|
| PARAMETER                 | TEST CONDITION                                       | SYMBOL | MIN. | TYP. | MAX. | UNIT          |
| Switching time            | $\Delta I_F = 2\text{ mA}$ , $I_{Fq} = 10\text{ mA}$ | $t_r$  | -    | 1    | -    | $\mu\text{s}$ |
|                           |  | $t_f$  | -    | 1    | -    | $\mu\text{s}$ |
| Rise time                 |  | $t_r$  | -    | 1.75 | -    | $\mu\text{s}$ |
| Fall time                 |  | $t_f$  | -    | 1.75 | -    | $\mu\text{s}$ |

| COMMON MODE TRANSIENT IMMUNITY |   |          |      |      |      |      |
|--------------------------------|---|----------|------|------|------|------|
| PARAMETER                      | TEST CONDITION                                  | SYMBOL   | MIN. | TYP. | MAX. | UNIT |
| Common mode capacitance        | $V_F = 0\text{ V}$ , $f = 1\text{ MHz}$         | $C_{CM}$ | -    | 0.5  | -    | pF   |
| Common mode rejection ratio    | $f = 60\text{ Hz}$ , $R_L = 2.2\text{ k}\Omega$ | CMRR     | -    | 130  | -    | dB   |

| SAFETY AND INSULATION RATINGS                |   |            |                |                    |
|--|---|------------|----------------|--------------------|
| PARAMETER                                    | TEST CONDITION  | SYMBOL     | VALUE          | UNIT               |
| Climatic classification                      | According to IEC 68 part 1  |            | 55 / 100 / 21  |                    |
| Comparative tracking index                   |   | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | $t = 1\text{ min}$  | $V_{ISO}$  | 4420           | $V_{RMS}$          |
| Maximum transient isolation voltage          |   | $V_{IOTM}$ | 10 000         | $V_{peak}$         |
| Maximum repetitive peak isolation voltage    |   | $V_{IORM}$ | 890            | $V_{peak}$         |
| Isolation resistance                         | $V_{IO} = 500\text{ V}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$  | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|  | $V_{IO} = 500\text{ V}$ , $T_{amb} = 100\text{ }^{\circ}\text{C}$ | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
| Output safety power                          |   | $P_{SO}$   | 400            | mW                 |
| Input safety current                         |   | $I_{SI}$   | 275            | mA                 |
| Safety temperature                           |   | $T_S$      | 175            | $^{\circ}\text{C}$ |
| Creepage distance                            |   |            | $\geq 7$       | mm                 |
| Clearance distance                           |   |            | $\geq 7$       | mm                 |
| Insulation thickness                         |   | DTI        | $\geq 0.4$     | 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

**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

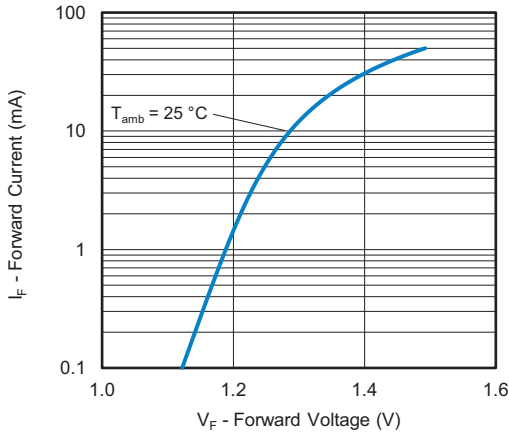


Fig. 1 - Forward Current vs. Forward Voltage

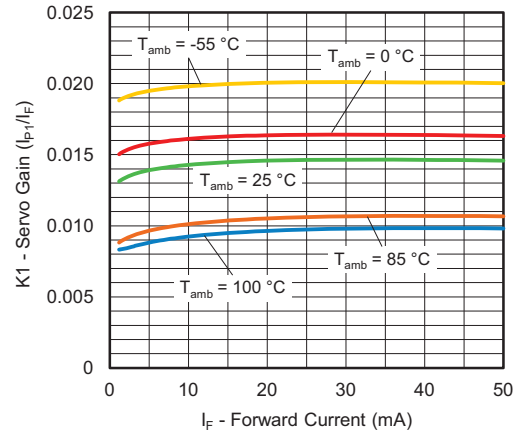


Fig. 4 - Servo Gain vs. Forward Current

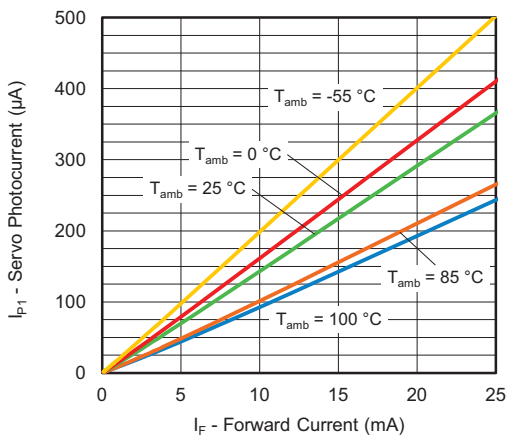


Fig. 2 - Servo Photocurrent vs. Forward Current

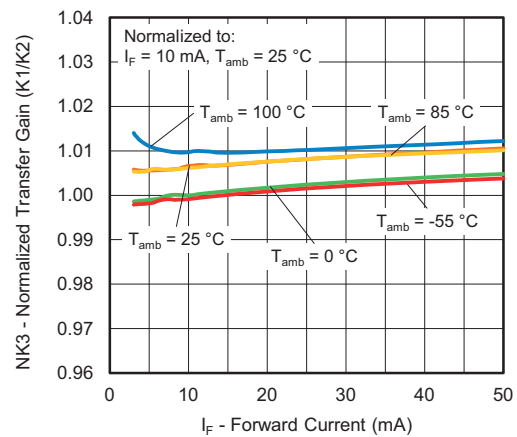


Fig. 5 - Normalized Transfer Gain vs. Forward Current

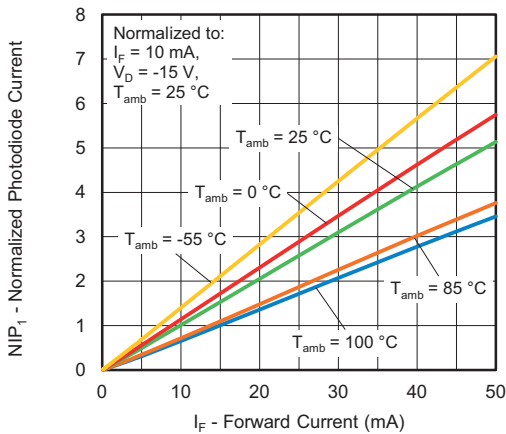


Fig. 3 - Normalized Photodiode Current vs. Forward Current

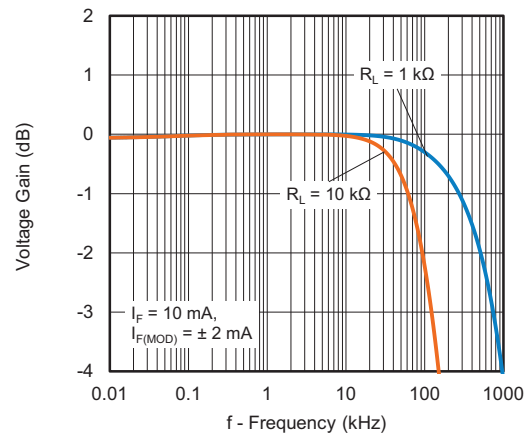


Fig. 6 - Voltage Gain vs. Frequency (2 mA)

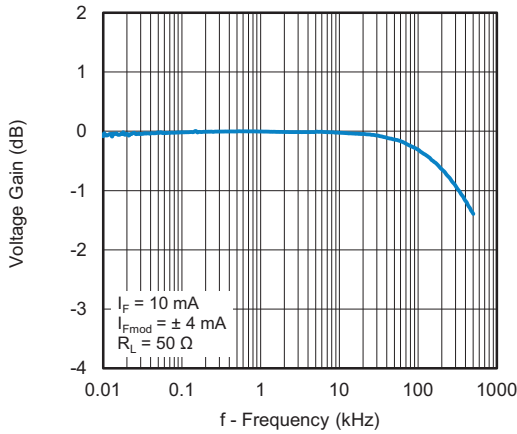


Fig. 7 - Voltage Gain vs. Frequency

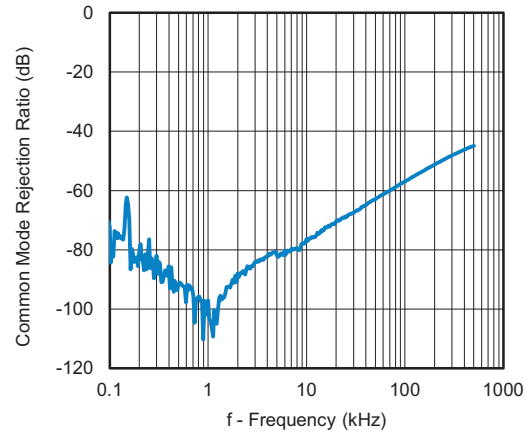


Fig. 9 - Common-Mode Rejection Ratio vs. Frequency

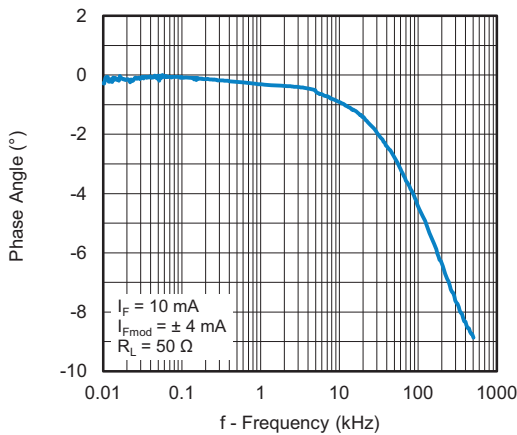


Fig. 8 - Phase Angle vs. Frequency

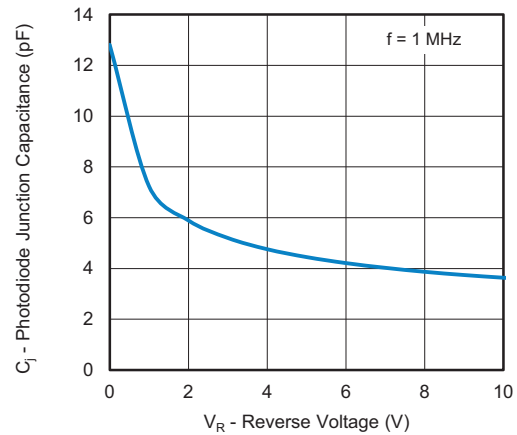
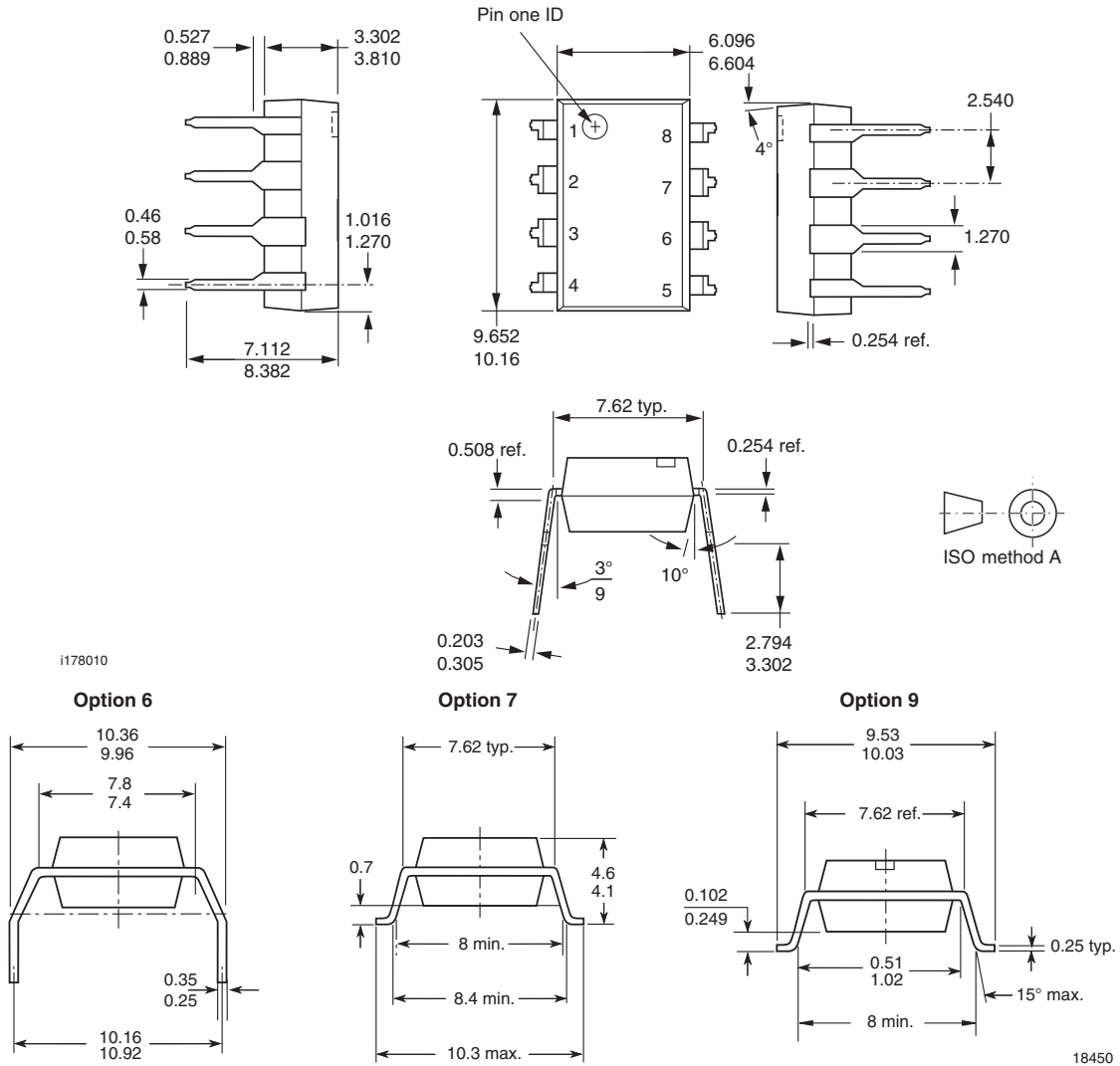


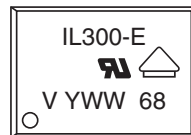
Fig. 10 - Photodiode Junction Capacitance vs. Reverse Voltage



PACKAGE DIMENSIONS (in millimeters)



PACKAGE MARKING (example of IL300-E-X001)





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