

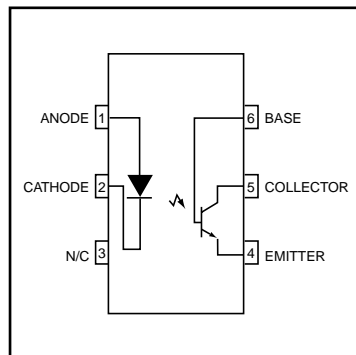
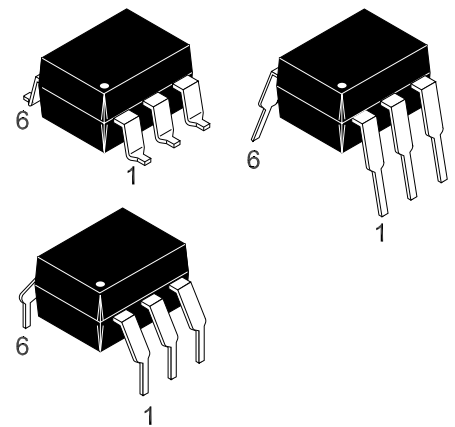
## DESCRIPTION

The H11DX and 4N38 are phototransistor-type optically coupled optoisolators. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

H11D1  
H11D2  
H11D3  
H11D4  
4N38

## FEATURES

- High Voltage
  - H11D1, H11D2,  $BV_{CER} = 300\text{ V}$
  - H11D3, H11D4,  $BV_{CER} = 200\text{ V}$
- High isolation voltage
  - 5300 VAC RMS - 1 minute
  - 7500 VAC PEAK - 1 minute
- Underwriters Laboratory (UL) recognized File# E90700



## APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

## ABSOLUTE MAXIMUM RATINGS

| Parameter   | Symbol    | Value          | Units |
|---|-----------|----------------|-------|
| <b>TOTAL DEVICE</b>                                       |           |                |       |
| Storage Temperature                                       | $T_{STG}$ | -55 to +150    | °C    |
| Operating Temperature                                     | $T_{OPR}$ | -55 to +100    | °C    |
| Lead Solder Temperature                                   | $T_{SOL}$ | 260 for 10 sec | °C    |
| Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$ | $P_D$     | 260            | mW    |
| Derate above $25^\circ\text{C}$                           |           | 3.5            | mW/°C |
| <b>EMITTER</b>  |           |                |       |
| *Forward DC Current                                       | $I_F$     | 80             | mA    |
| *Reverse Input Voltage                                    | $V_R$     | 6.0            | V     |
| *Forward Current - Peak (1 $\mu\text{s}$ pulse, 300pps)   | $I_F(pk)$ | 3.0            | A     |
| *LED Power Dissipation @ $T_A = 25^\circ\text{C}$         | $P_D$     | 150            | mW    |
| Derate above $25^\circ\text{C}$                           |           | 1.41           | mW/°C |

**H11D1, H11D2, H11D3, H11D4, 4N38**

| <b>ABSOLUTE MAXIMUM RATINGS (Cont.)</b>       |           |                      |                      |
|---|-----------|----------------------|----------------------|
| Parameter                                     | Symbol    | Value                | Units                |
| <b>DETECTOR</b>                               |           |                      |                      |
| *Power Dissipation @ $T_A = 25^\circ\text{C}$ | $P_D$     | 300                  | mW                   |
| Derate linearly above $25^\circ\text{C}$      |           | 4.0                  | mW/ $^\circ\text{C}$ |
| *Collector to Emitter Voltage                 | $V_{CER}$ | H11D1 - H11D2<br>300 | V                    |
|   |           | H11D3 - H11D4<br>200 |                      |
|   |           | 4N38<br>80           |                      |
| *Collector Base Voltage                       | $V_{CBO}$ | H11D1 - H11D2<br>300 |                      |
|   |           | H11D3 - H11D4<br>200 |                      |
|   |           | 4N38<br>80           |                      |
| *Emitter to Collector Voltage                 | $V_{ECO}$ | 7                    |                      |
| Collector Current (Continuous)                |           | 100                  | mA                   |

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)

| <b>INDIVIDUAL COMPONENT CHARACTERISTICS</b>                                 |  |                                 |         |           |       |     |                      |
|---|--|---------------------------------|---------|-----------|-------|-----|----------------------|
| Characteristic  | Test Conditions  | Symbol                          | Device  | Min       | Typ** | Max | Unit                 |
| <b>EMITTER</b>  |  |                                 |         |           |       |     |                      |
| *Forward Voltage  | ( $I_F = 10\text{ mA}$ )   | $V_F$                           | ALL     |           | 1.15  | 1.5 | V                    |
| Forward Voltage Temp. Coefficient   |  | $\frac{\Delta V_F}{\Delta T_A}$ | ALL     |           | -1.8  |     | mV/ $^\circ\text{C}$ |
| Reverse Breakdown Voltage   | ( $I_R = 10\ \mu\text{A}$ )  | $BV_R$                          | ALL     | 6         | 25    |     | V                    |
| Junction Capacitance  | ( $V_F = 0\text{ V}, f = 1\text{ MHz}$ )                                   | $C_J$                           | ALL     |           | 50    |     | pF                   |
|   | ( $V_F = 1\text{ V}, f = 1\text{ MHz}$ )                                   |                                 | ALL     |           | 65    |     | pF                   |
| *Reverse Leakage Current  | ( $V_R = 6\text{ V}$ )   | $I_R$                           | ALL     |           | 0.05  | 10  | $\mu\text{A}$        |
| <b>DETECTOR</b>   |  |                                 |         |           |       |     |                      |
| *Breakdown Voltage<br>Collector to Emitter                                  | ( $R_{BE} = 1\text{ M}\Omega$ )  | $BV_{CER}$                      | H11D1/2 | 300       |       |     | V                    |
|   | ( $I_C = 1.0\text{ mA}, I_F = 0$ )   |                                 | H11D3/4 | 200       |       |     |                      |
|   | (No $R_{BE}$ ) ( $I_C = 1.0\text{ mA}$ )                                   | $BV_{CEO}$                      | 4N38    | 80        |       |     |                      |
| *Collector to Base  | ( $I_C = 100\ \mu\text{A}, I_F = 0$ )                                      | $BV_{CBO}$                      | H11D1/2 | 300       |       |     |                      |
|   |  |                                 | H11D3/4 | 200       |       |     |                      |
|   |  |                                 | 4N38    | 80        |       |     |                      |
| Emitter to Base   |  | $BV_{EBO}$                      | 4N38    | 7         |       |     |                      |
| Emitter to Collector  | ( $I_E = 100\ \mu\text{A}, I_F = 0$ )                                      | $BV_{ECO}$                      | ALL     | 7         | 10    |     |                      |
| *Leakage Current<br>Collector to Emitter<br>( $R_{BE} = 1\text{ M}\Omega$ ) | ( $V_{CE} = 200\text{ V}, I_F = 0, T_A = 25^\circ\text{C}$ )               | $I_{CER}$                       | H11D1/2 |           |       | 100 | nA                   |
|   | ( $V_{CE} = 200\text{ V}, I_F = 0, T_A = 100^\circ\text{C}$ )              |                                 |         |           |       | 250 | $\mu\text{A}$        |
|   | ( $V_{CE} = 100\text{ V}, I_F = 0, T_A = 25^\circ\text{C}$ )               |                                 | H11D3/4 |           |       | 100 | nA                   |
|   | ( $V_{CE} = 100\text{ V}, I_F = 0, T_A = 100^\circ\text{C}$ )              |                                 |         |           |       | 250 | $\mu\text{A}$        |
|   | (No $R_{BE}$ ) ( $V_{CE} = 60\text{ V}, I_F = 0, T_A = 25^\circ\text{C}$ ) |                                 |         | $I_{CEO}$ | 4N38  |     |                      |

**Notes**

\* Parameters meet or exceed JEDEC registered data (for 4N38 only)

 \*\* All typical values at  $T_A = 25^\circ\text{C}$

**H11D1, H11D2, H11D3, H11D4, 4N38**

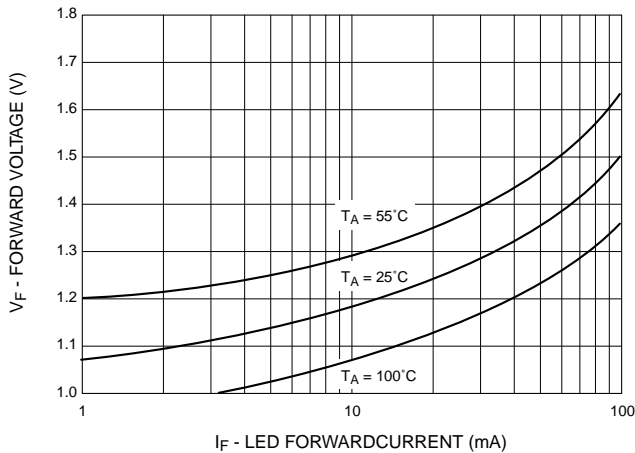
| TRANSFER CHARACTERISTICS                       |  |               |             |        |       |      |        |
|--|--|---------------|-------------|--------|-------|------|--------|
| DC Characteristic                              | Test Conditions  | Symbol        | Device      | Min    | Typ** | Max  | Unit   |
| <b>EMITTER</b>                                 |  |               |             |        |       |      |        |
| Current Transfer Ratio<br>Collector to Emitter | $(I_F = 10 \text{ mA}, V_{CE} = 10 \text{ V})$<br>$(R_{BE} = 1 \text{ M}\Omega)$ | CTR           | H11D1       | 2 (20) |       |      | mA (%) |
|  |  |               | H11D2       |        |       |      |        |
|  |  |               | H11D3       |        |       |      |        |
|  |  |               | H11D4       | 1 (10) |       |      |        |
|  |  |               | 4N38        | 2 (20) |       |      |        |
| *Saturation Voltage                            | $(I_F = 10 \text{ mA}, I_C = 0.5 \text{ mA})$<br>$(R_{BE} = 1 \text{ M}\Omega)$  | $V_{CE(SAT)}$ | H11D1/2/3/4 |        | 0.1   | 0.40 | V      |
|  |  |               | 4N38        |        |       | 1.0  |        |
|  | $(I_F = 20 \text{ mA}, I_C = 4 \text{ mA})$                                      |               |             |        |       |      |        |

| TRANSFER CHARACTERISTICS   |  |           |        |     |       |     |               |
|----------------------------|--|-----------|--------|-----|-------|-----|---------------|
| Characteristic             | Test Conditions                                  | Symbol    | Device | Min | Typ** | Max | Unit          |
| <b>SWITCHING TIMES</b>     |  |           |        |     |       |     |               |
| Non-Saturated Turn-on Time | $(V_{CE} = 10 \text{ V}, I_{CE} = 2 \text{ mA})$ | $t_{on}$  | ALL    |     | 5     |     | $\mu\text{s}$ |
| Turn-off Time              | $(R_L = 100 \Omega)$                             | $t_{off}$ | ALL    |     | 5     |     |               |

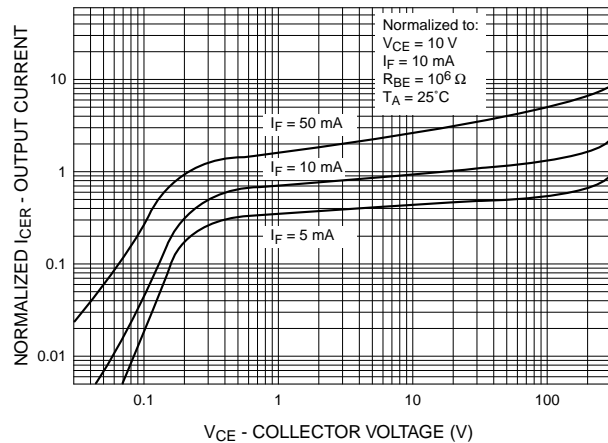
| ISOLATION CHARACTERISTICS |  |           |        |           |       |     |                |
|---------------------------|--|-----------|--------|-----------|-------|-----|----------------|
| Characteristic            | Test Conditions                                | Symbol    | Device | Min       | Typ** | Max | Unit           |
| Isolation Voltage         | $(I_{I-O} \leq 1 \mu\text{A}, 1 \text{ min.})$ | $V_{ISO}$ | ALL    | 5300      |       |     | $(V_{ACRMS})$  |
|                           |  |           |        | 7500      |       |     | $(V_{ACPEAK})$ |
| Isolation Resistance      | $(V_{I-O} = 500 \text{ VDC})$                  | $R_{ISO}$ | ALL    | $10^{11}$ |       |     | $\Omega$       |
| Isolation Capacitance     | $(f = 1 \text{ MHz})$                          | $C_{ISO}$ | ALL    |           | 0.5   |     | pF             |

Notes  
 \* Parameters meet or exceed JEDEC registered data (for 4N38 only)  
 \*\* All typical values at  $T_A = 25^\circ\text{C}$

**Fig.1 LED Forward Voltage vs. Forward Current**

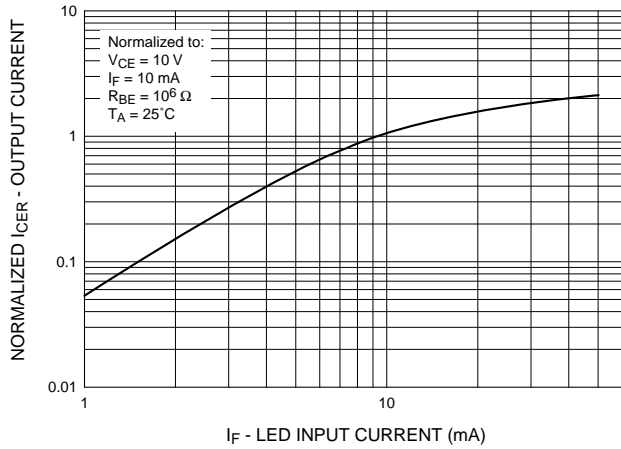


**Fig.2 Normalized Output Characteristics**

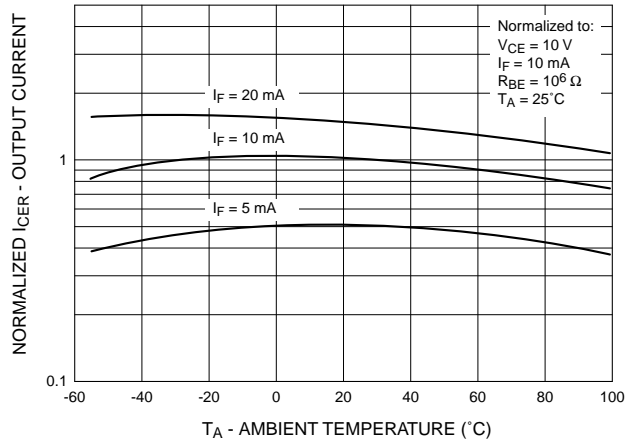


**H11D1, H11D2, H11D3, H11D4, 4N38**

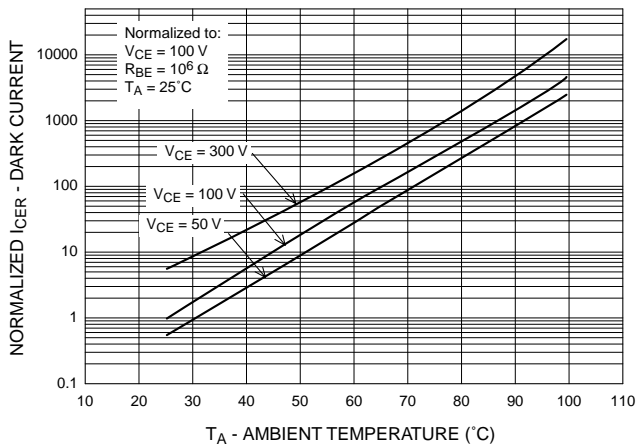
**Fig.3 Normalized Output Current vs. LED Input Current**



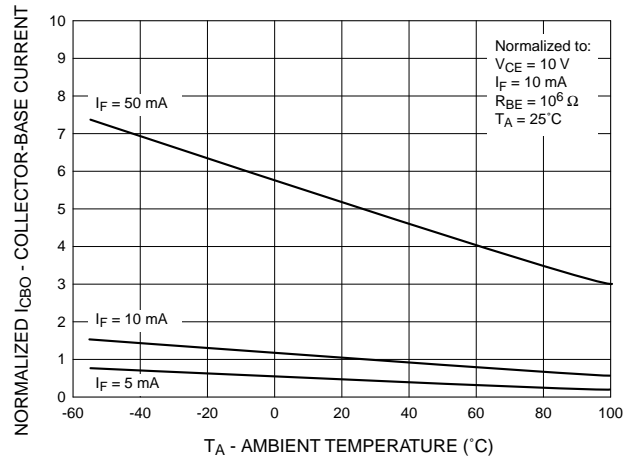
**Fig.4 Normalized Output Current vs. Temperature**



**Fig.5 Normalized Dark Current vs. Ambient Temperature**

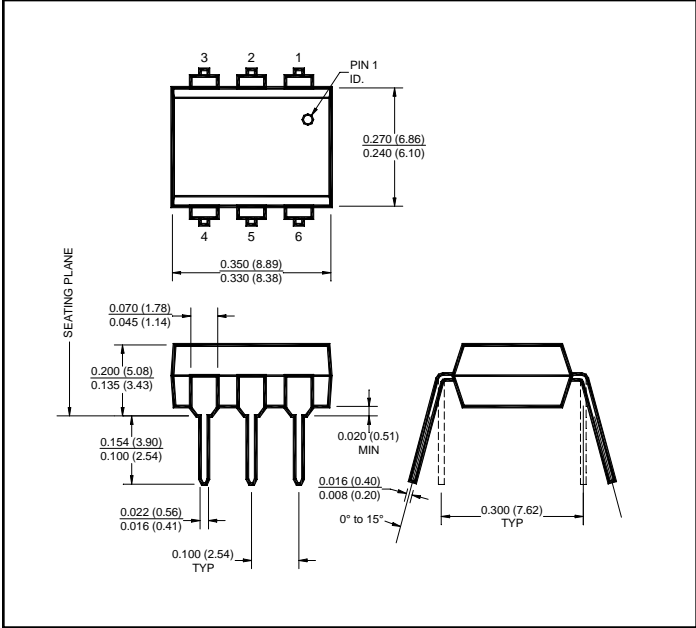


**Normalized Collector-Base Current vs. Temperature**

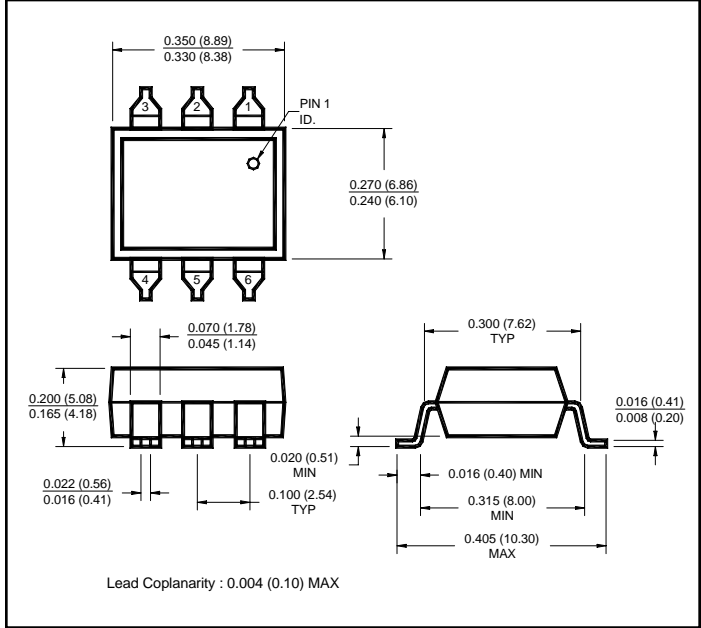


**H11D1, H11D2, H11D3, H11D4, 4N38**

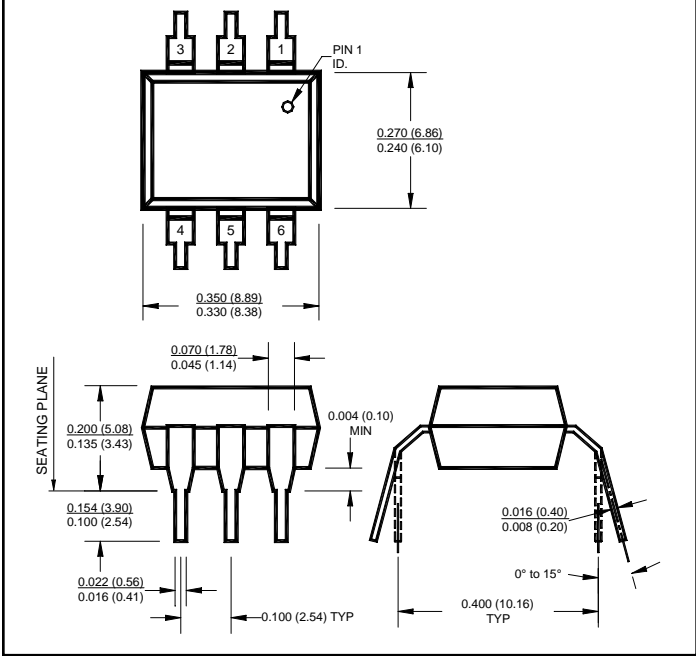
**Package Dimensions (Through Hole)**



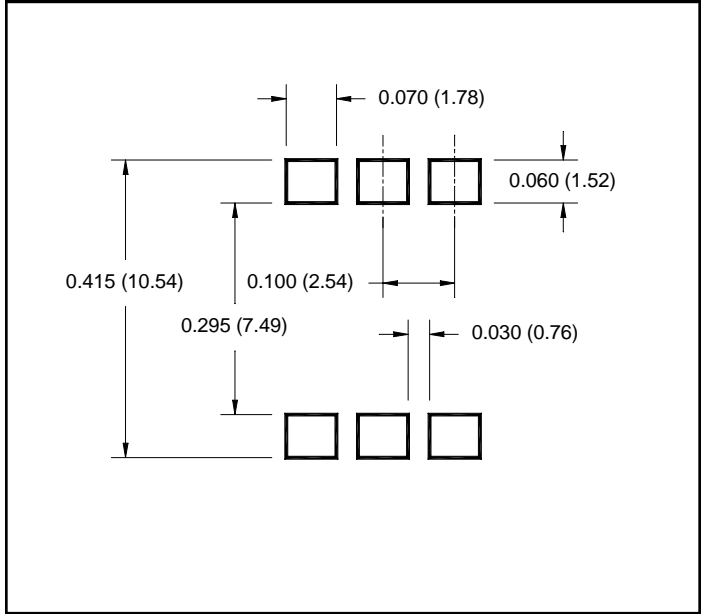
**Package Dimensions (Surface Mount)**



**Package Dimensions (0.4" Lead Spacing)**



**Recommended Pad Layout for Surface Mount Leadform**



**NOTE**

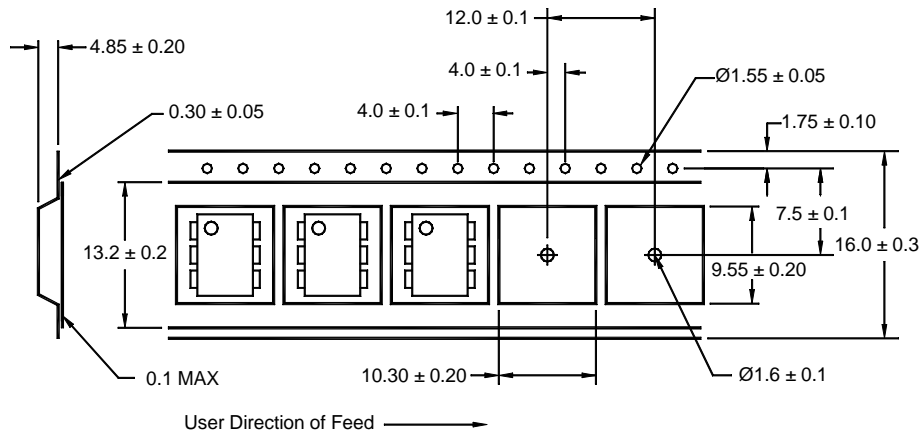
All dimensions are in inches (millimeters)

H11D1, H11D2, H11D3, H11D4, 4N38

## ORDERING INFORMATION

| Option | Order Entry Identifier | Description                          |
|--------|------------------------|--------------------------------------|
| S      | .S                     | Surface Mount Lead Bend              |
| SD     | .SD                    | Surface Mount; Tape and reel         |
| W      | .W                     | 0.4" Lead Spacing                    |
| 300    | .300                   | VDE 0884                             |
| 300W   | .300W                  | VDE 0884, 0.4" Lead Spacing          |
| 3S     | .3S                    | VDE 0884, Surface Mount              |
| 3SD    | .3SD                   | VDE 0884, Surface Mount, Tape & Reel |

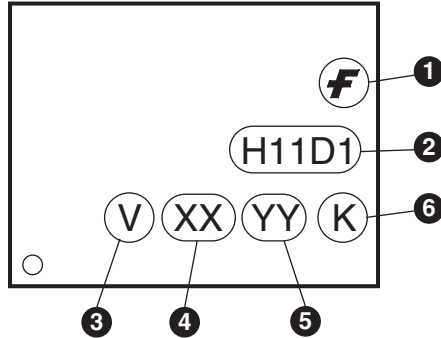
## QT Carrier Tape Specifications ("D" Taping Orientation)



### NOTE

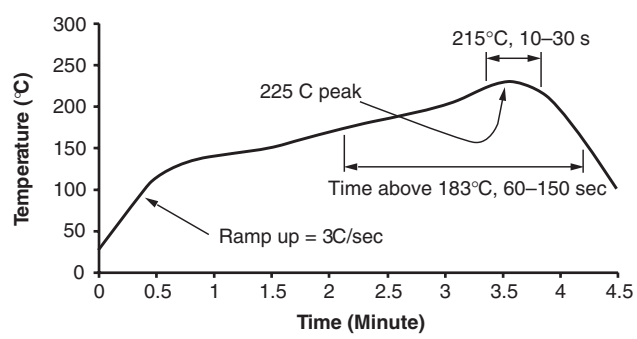
All dimensions are in millimeters

**MARKING INFORMATION**



| Definitions |  |
|-------------|--|
| 1           | Fairchild logo   |
| 2           | Device number  |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | Two digit year code, e.g., '03'  |
| 5           | Two digit work week ranging from '01' to '53'  |
| 6           | Assembly package code  |

**Reflow Profile (Black Package, No Suffix)**



- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60–150 seconds
- One time soldering reflow is recommended

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|--------------------------------------|---------------------|---------------|---------------------|-----------------|
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| ActiveArray™                         | FASTr™              | LittleFET™    | PowerEdge™          | SuperFET™       |
| Bottomless™                          | FPST™               | MICROCOUPLER™ | PowerSaver™         | SuperSOT™-3     |
| CoolFET™                             | FRFET™              | MicroFET™     | PowerTrench®        | SuperSOT™-6     |
| CROSSVOLT™                           | GlobalOptoisolator™ | MicroPak™     | QFET®               | SuperSOT™-8     |
| DOMET™                               | GTO™                | MICROWIRE™    | QS™                 | SyncFET™        |
| EcoSPARK™                            | HiSeC™              | MSX™          | QT Optoelectronics™ | TinyLogic®      |
| E <sup>2</sup> CMOS™                 | μC™                 | MSXPro™       | Quiet Series™       | TINYOPTO™       |
| EnSigna™                             | i-Lo™               | OCX™          | RapidConfigure™     | TruTranslation™ |
| FACT™                                | ImpliedDisconnect™  | OCXPro™       | RapidConnect™       | UHC™            |
| FACT Quiet Series™                   |                     | OPTOLOGIC®    | μSerDes™            | UltraFET®       |
| Across the board. Around the world.™ |                     | OPTOPLANAR™   | SILENT SWITCHER®    | VCX™            |
| The Power Franchise®                 |                     | PACMAN™       | SMART START™        |                 |
| Programmable Active Droop™           |                     | POP™          | SPM™                |                 |

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status         | Definition  |
|--------------------------|------------------------|---|
| Advance Information      | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.  |
| Preliminary              | First Production       | This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design. |
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