

# 4N38M, H11D1M, H11D2M, H11D3M, MOC8204M High Voltage Phototransistor Optocouplers

## Features

- High voltage:
  - MOC8204M,  $BV_{CER} = 400V$
  - H11D1M, H11D2M,  $BV_{CER} = 300V$
  - H11D3M,  $BV_{CER} = 200V$
- High isolation voltage:
  - 7500  $V_{AC}$  peak, 1 second
- Underwriters Laboratory (UL) recognized  
File # E90700, Volume 2
- IEC 60747-5-2 approved (ordering option V)

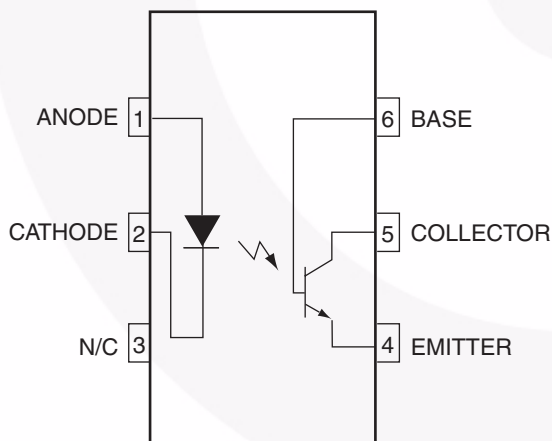
## Applications

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

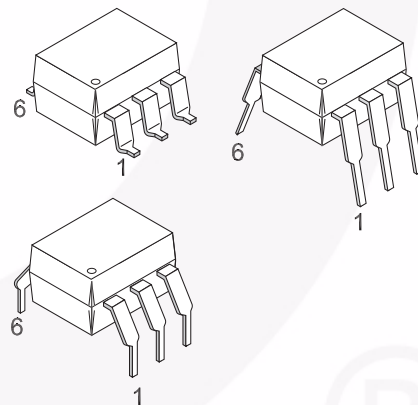
## General Description

The 4N38M, H11DXM and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

## Schematic



## Package Outlines



## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Device	Value	Units
<b>TOTAL DEVICE</b>				
T <sub>STG</sub>	Storage Temperature	All	-40 to +150	°C
T <sub>OPR</sub>	Operating Temperature	All	-40 to +100	°C
T <sub>SOL</sub>	Lead Solder Temperature (Wave Solder)	All	260 for 10 sec	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C Derate Above 25°C	All	260	mW
			3.5	mW/°C
<b>EMITTER</b>				
I <sub>F</sub>	Forward DC Current <sup>(1)</sup>	All	80	mA
V <sub>R</sub>	Reverse Input Voltage <sup>(1)</sup>	All	6.0	V
I <sub>F(pk)</sub>	Forward Current – Peak (1µs pulse, 300pps) <sup>(1)</sup>	All	3.0	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C <sup>(1)</sup> Derate Above 25°C	All	150	mW
			1.41	mW/°C
<b>DETECTOR</b>				
P <sub>D</sub>	Power Dissipation @ T <sub>A</sub> = 25°C Derate linearly above 25°C	All	300	mW
			4.0	mW/°C
V <sub>CER</sub>	Collector to Emitter Voltage <sup>(1)</sup>	MOC8204M	400	V
		H11D1M, H11D2M	300	
		H11D3M	200	
		4N38M	80	
V <sub>CBO</sub>	Collector Base Voltage <sup>(1)</sup>	MOC8204M	400	V
		H11D1M, H11D2M	300	
		H11D3M	200	
		4N38M	80	
V <sub>ECO</sub>	Emitter to Collector Voltage <sup>(1)</sup>	H11D1M, H11D2M, H11D3M, MOC8204M	7	V
I <sub>C</sub>	Collector Current (Continuous)	All	100	mA

### Note:

- Parameters meet or exceed JEDEC registered data (for 4N38M only).

## Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise specified.)

### Individual Component Characteristics

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>							
V <sub>F</sub>	Forward Voltage <sup>(2)</sup>	I <sub>F</sub> = 10mA	All		1.15	1.5	V
$\frac{\Delta V_F}{\Delta T_A}$	Forward Voltage Temp. Coefficient		All		-1.8		mV/°C
BV <sub>R</sub>	Reverse Breakdown Voltage	I <sub>R</sub> = 10μA	All	6	25		V
C <sub>J</sub>	Junction Capacitance	V <sub>F</sub> = 0V, f = 1MHz	All		50		pF
		V <sub>F</sub> = 1V, f = 1MHz			65		pF
I <sub>R</sub>	Reverse Leakage Current <sup>(2)</sup>	V <sub>R</sub> = 6V	All		0.05	10	μA
<b>DETECTOR</b>							
BV <sub>CER</sub>	Breakdown Voltage Collector to Emitter <sup>(2)</sup>	R <sub>BE</sub> = 1MΩ, I <sub>C</sub> = 1.0mA, I <sub>F</sub> = 0	MOC8204M	400			V
			H11D1M/2M	300			
			H11D3M	200			
BV <sub>CEO</sub>		No RBE, I <sub>C</sub> = 1.0mA	4N38M	80			
BV <sub>CBO</sub>	Collector to Base <sup>(2)</sup>	I <sub>C</sub> = 100μA, I <sub>F</sub> = 0	MOC8204M	400			V
			H11D1M/2M	300			
			H11D3M	200			
			4N38M	80			
BV <sub>EBO</sub>	Emitter to Base	I <sub>E</sub> = 100μA, I <sub>F</sub> = 0	4N38M	7			V
BV <sub>ECO</sub>	Emitter to Collector	I <sub>E</sub> = 100μA, I <sub>F</sub> = 0	All	7	10		V
I <sub>CER</sub>	Leakage Current Collector to Emitter <sup>(2)</sup> (R <sub>BE</sub> = 1MΩ)	V <sub>CE</sub> = 300V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	MOC8204M			100	nA
		V <sub>CE</sub> = 300V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C				250	μA
		V <sub>CE</sub> = 200V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	H11D1M/2M			100	nA
		V <sub>CE</sub> = 200V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C				250	μA
		V <sub>CE</sub> = 100V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	H11D3M			100	nA
		V <sub>CE</sub> = 100V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C				250	μA
I <sub>CEO</sub>		No RBE, V <sub>CE</sub> = 60V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	4N38M			50	nA

### Transfer Characteristics (T<sub>A</sub> = 25°C Unless otherwise specified.)

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.*	Max.	Units
<b>EMITTER</b>							
CTR	Current Transfer Ratio, Collector to Emitter	I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V, R <sub>BE</sub> = 1MΩ	H11D1M/2M/3M, MOC8204M	2 (20)			mA (%)
		I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V	4N38M	2 (20)			
V <sub>CE(SAT)</sub>	Saturation Voltage <sup>(2)</sup>	I <sub>F</sub> = 10mA, I <sub>C</sub> = 0.5mA, R <sub>BE</sub> = 1MΩ	H11D1M/2M/3M, MOC8204M		0.1	0.40	V
		I <sub>F</sub> = 20mA, I <sub>C</sub> = 4mA	4N38M			1.0	
<b>SWITCHING TIMES</b>							
t <sub>ON</sub>	Non-Saturated Turn-on Time	V <sub>CE</sub> = 10V, I <sub>CE</sub> = 2mA, R <sub>L</sub> = 100Ω	All		5		μs
t <sub>OFF</sub>	Turn-off Time		All		5		μs

\*All Typical values at T<sub>A</sub> = 25°C

#### Note:

2. Parameters meet or exceed JEDEC registered data (for 4N38M only).

**DC Electrical Characteristics** (Continued) ( $T_A = 25^\circ\text{C}$  unless otherwise specified.)**Isolation Characteristics**

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.*	Max.	Units
$V_{ISO}$	Isolation Voltage	$f = 60\text{Hz}$ , $t = 1 \text{ sec.}$	All	7500			$V_{ACPEAK}$
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500 \text{ VDC}$	All	$10^{11}$			$\Omega$
$C_{ISO}$	Isolation Capacitance	$f = 1\text{MHz}$	All		0.2		pF

\*All Typical values at  $T_A = 25^\circ\text{C}$ **Safety and Insulation Ratings**

As per IEC 60747-5-2, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Main Voltage < 150Vrms		I-IV		
	For Rated Main voltage < 300Vrms		I-IV		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
$V_{PR}$	Input to Output Test Voltage, Method b, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1 \text{ sec}$ , Partial Discharge < 5pC	1594			$V_{peak}$
	Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$ , Type and Sample Test with $t_m = 60 \text{ sec}$ , Partial Discharge < 5pC	1275			$V_{peak}$
$V_{IORM}$	Max. Working Insulation Voltage	850			$V_{peak}$
$V_{IOTM}$	Highest Allowable Over Voltage	6000			$V_{peak}$
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
RIO	Insulation Resistance at $T_s$ , $V_{IO} = 500\text{V}$	$10^9$			$\Omega$

## Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

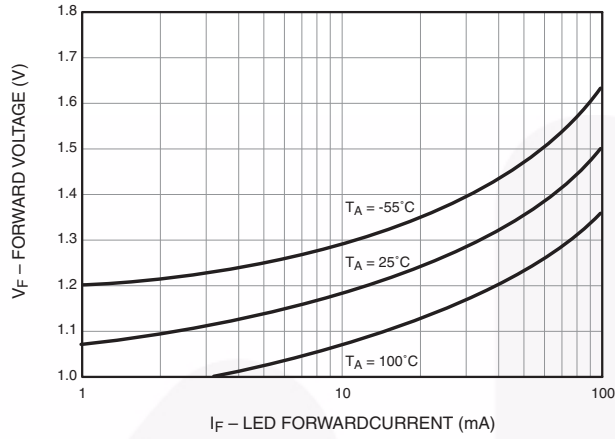


Fig. 2 Normalized Output Characteristics

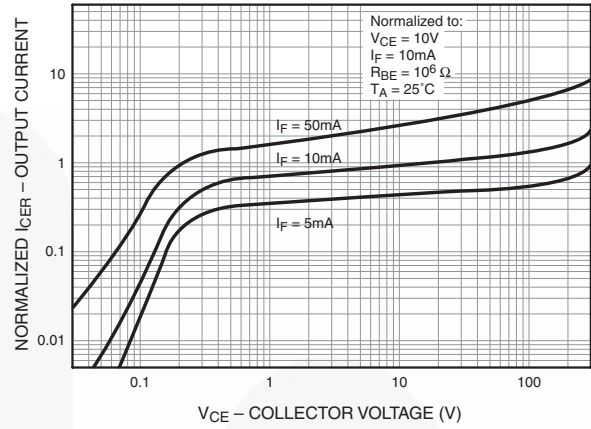


Fig. 3 Normalized Output Current vs. LED Input Current

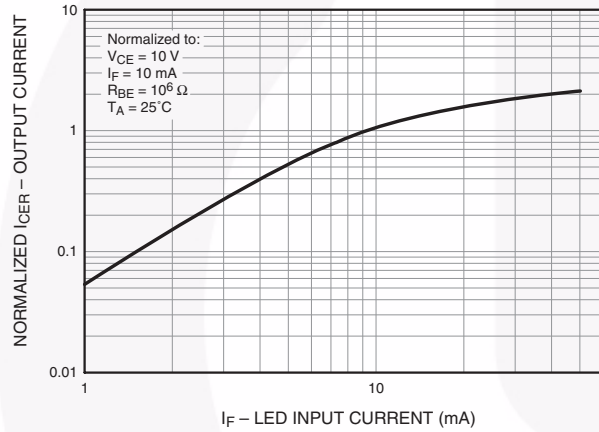


Fig. 4 Normalized Output Current vs. Temperature

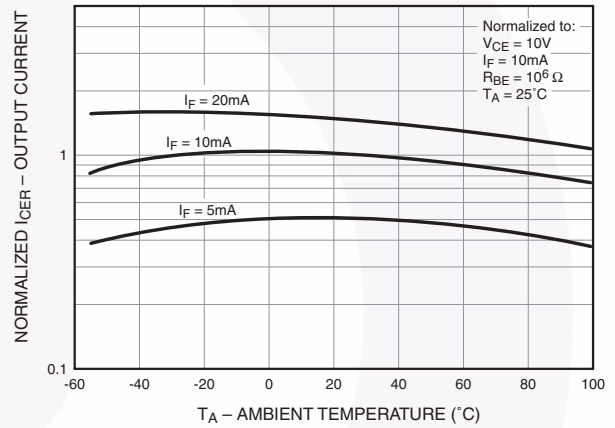


Fig. 5 Normalized Dark Current vs. Ambient Temperature

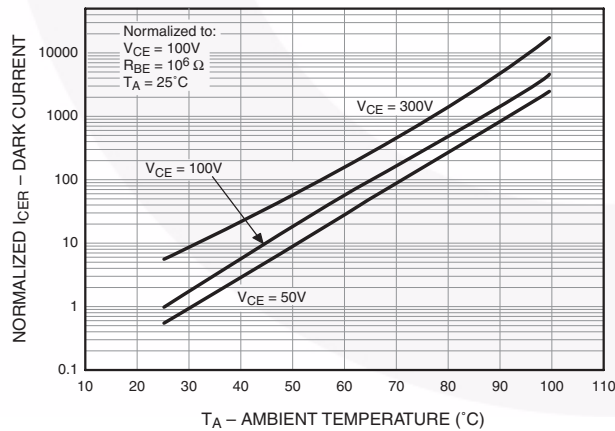
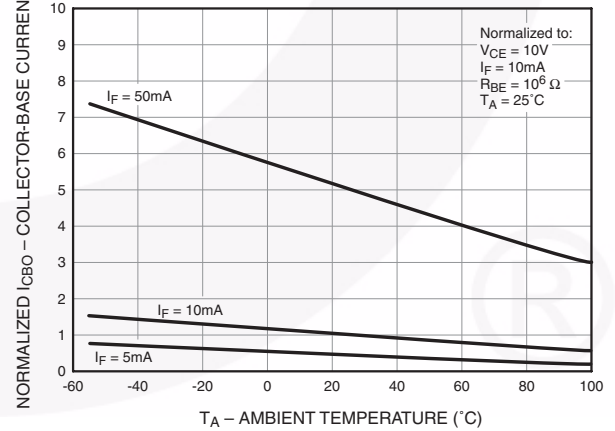
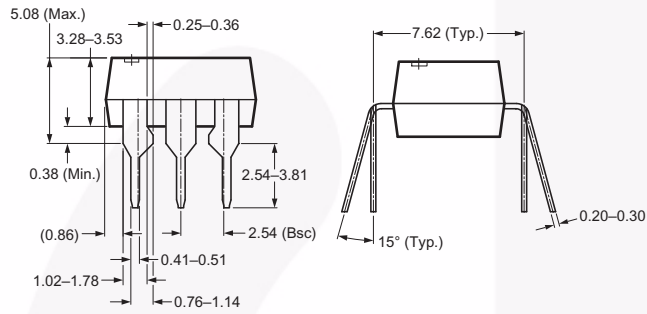
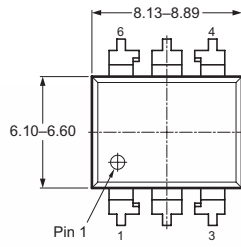


Fig. 6 Normalized Collector-Base Current vs. Temperature

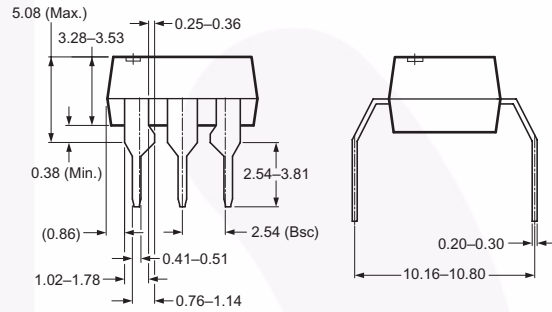
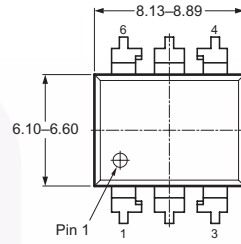


## Package Dimensions

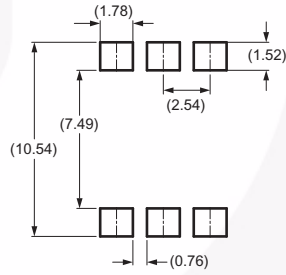
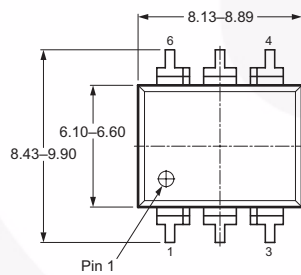
### Through Hole



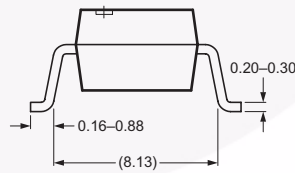
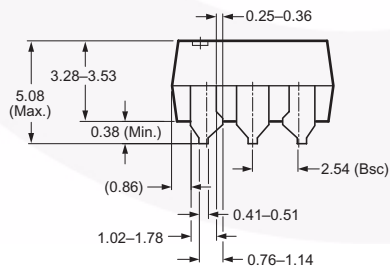
### 0.4" Lead Spacing



### Surface Mount



Recommended Pad Layout

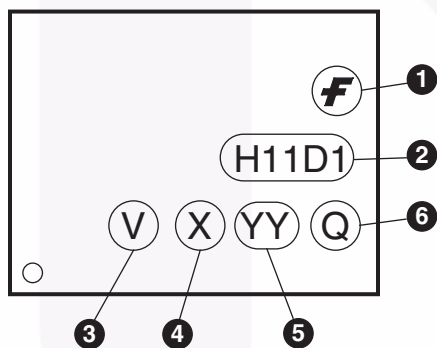


**Note:**  
All dimensions in mm.

## Ordering Information

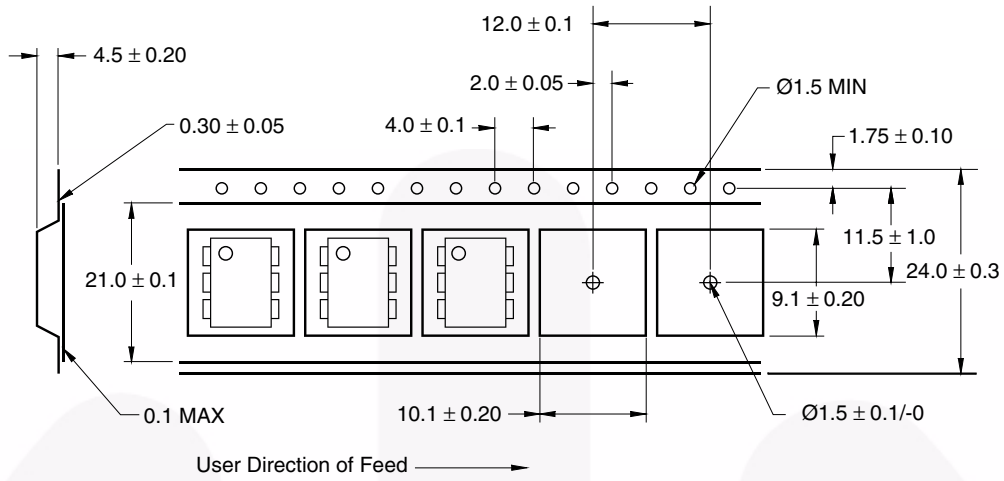
Option	Order Entry Identifier (Example)	Description
No option	H11D1M	Standard Through Hole Device (50 units per tube)
S	H11D1SM	Surface Mount Lead Bend
SR2	H11D1SR2M	Surface Mount; Tape and Reel
T	H11D1TM	0.4" Lead Spacing
V	H11D1VM	VDE 0884
TV	H11D1TVM	VDE 0884, 0.4" Lead Spacing
SV	H11D1SVM	VDE 0884, Surface Mount
SR2V	H11D1SR2VM	VDE 0884, Surface Mount, Tape and Reel

## Marking Information

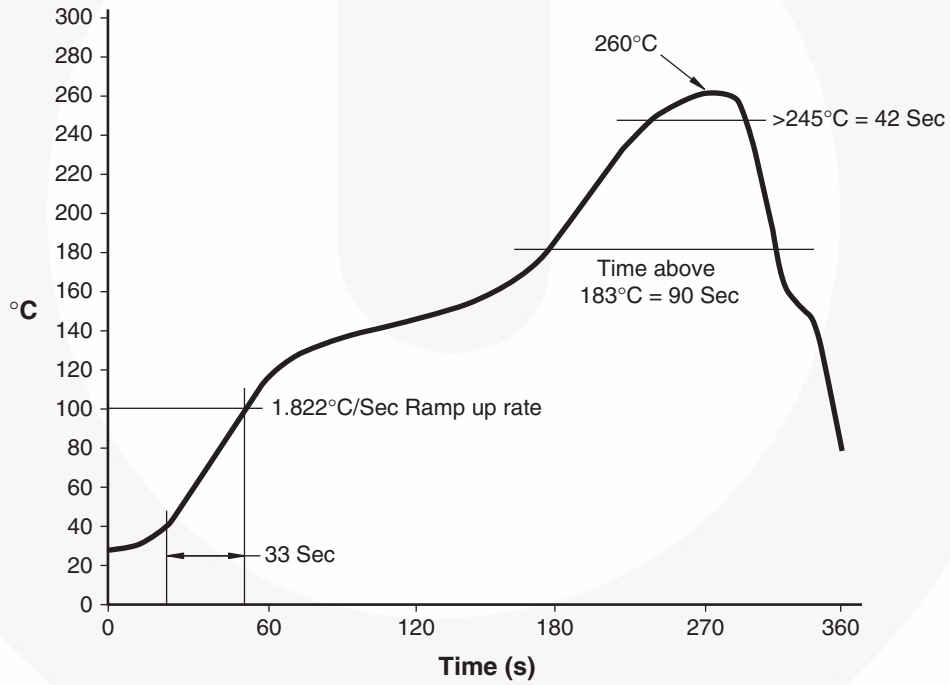


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '7'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

### Carrier Tape Specification



### Reflow Profile











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| FPS™   | Power-SPM™  |  ™* |   |

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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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