

# PD69208M and PD69200 Datasheet 8-Port PSE PoE Manager and PSE PoE Controller



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# 1 Revision History

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The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

## 1.1 Revision 5.0

Revision 5.0 of this document was published in November 2018. The following was a summary of the changes made in this revision:

- Updated the Features and Applications details. For more information, see [Features](#), page 4 and [Applications](#), page 4.
- Port real time protection details are updated for  $I_{PORT}$ ,  $I_{LIM}$ ,  $I_{CUT}$ ,  $I_{UDL}$ ,  $P_{PWR}$ , and  $T_{MPS}$ . For more information, see [Table 10](#), page 14.
- Port current monitoring information is updated for accuracy. For more information, see [Table 11](#), page 14.
- Main voltage information is updated for accuracy. For more information, see [Table 13](#), page 15.
- The PD69200 pin diagram is updated. For more information, see [Figure 4](#), page 18.
- The Top-Layer Pin Geometry measurement is updated. For more information, see [Figure 12](#), page 28.
- The PD692000 Thermal Specifications table is added. For more information, see [Table 23](#), page 31.
- The company name Freescale is replaced with NXP across the document.
- Updated Figures 8 - 12. For more information, see [Figure 8](#), page 25, [Figure 9](#), page 26, [Figure 10](#), page 27, [Figure 11](#), page 27, and [Figure 12](#), page 28.
- Added table footnotes for D, VVVV, and SS. For more information, see the [Ordering Information](#), page 41.

## 1.2 Revision 4.0

Revision 4.0 of this document was published in February 2018. The following was a summary of the changes:

- Preliminary designation was removed.
- Thermal specifications were updated. For more information, see [PD69200 Thermal Specifications](#), page 31.
- The tape specification was updated. For more information, see [Figure 19](#), page 35.
- Tape mechanical data was added. For more information, see [Table 28](#), page 35.
- Ordering part numbers were updated. For more information, see [Ordering Information](#), page 41.

## 1.3 Revision 3.0

Revision 3.0 of this document was published in November 2017. The following was a summary of the changes:

- Maximum storage temperature value is no longer preliminary.
- The link to stencil and via plug recommendations was updated.
- Application information was updated.
- Maximum slew rate requirement of 100 mS was added.
- Manufacturing and ordering part number information was updated.
- Updated revision 2.0 history to include entry for the redefinition of quiescent current in terms of port threshold.

## 1.4 Revision 2.0

Revision 2.0 of this document was published in September 2017. The following was a summary of the changes:

- Updated the recommended PCB layout for better manufacturability.
- Redefined quiescent current in terms of port threshold.
- Added the PD69208M Manufacturing and Ordering Part Numbers table.

- Added a note about I<sup>2</sup>C communication configuration.
- Added table footnotes for ESD (HBM and CDM).
- Updated the main voltage monitoring table for accuracy data.
- Updated the Peak Classification Temperature (TP).
- Updated the description for pin 24 for PD69200.
- Updated the description for pin 19 for PD69208M.
- Updated the thermal specifications table.
- Changed the notation from  $V_{PORT\_NEGx}$  to  $V_{PORT}$ .
- Added a footnote for Absolute Storage Temperature in the table.
- Updated the accuracy values in the Port Current Monitoring table.
- Updated the  $R_{SIG\_LOW}$  and  $R_{SIG\_HIGH}$  values in the Detection table.
- Updated the LSB value in the Temperature Monitoring table.
- Updated the values for D11, D12, D15, D16, and D17 in the SPI Timing Diagram Description table.

## 1.5 Revision 1.2

Revision 1.2 of this document was published in August 2016. The following is a summary of the changes:

- According to PCN155881, qualification of UTAC Thailand assembly for PD6920X. Parts from UTAC will be identified by different marking that was added.
- Match 802.3af ILIM and  $I_{INRUSH}$  levels to IEEE standard levels.
- Match 802.3at ILIM low level to IEEE standard levels.

## 1.6 Revision 1.1

Revision 1.1 of this document was published in July 2016. The following is a summary of the changes:

- Updated the feature's list. Changed MSL1 of PD69208 to MSL3.
- Updated ordering information. Changed MSL1 of PD69208 to MSL3.

## 1.7 Revision 1.0

Revision 1.0 of this document was published in December 2015. This was the first publication.



## 2 Overview

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Microsemi's PD69208M Power over Ethernet (PoE) manager IC integrates power, analog, and state-of-the-art logic into a single 56-pin, plastic QFN package. The device is used in Ethernet switches and Midspans to allow network devices to share power and data over the same cable. The PD69208M device is an 8-port, mixed-signal, and high-voltage PoE driver. Together with the PD69200 external MCU, it performs as a PSE system. Microsemi's PoE controller, PD69200, is a cost-effective, pre-programmed MCU designed to implement enhanced mode.

PD69208M/PD69200 chip-set supports PoE Powered Device (PD) detection, power-up, and protection according to IEEE standards, as well as legacy/pre-standard PD detection. It provides PD real-time protection through the following mechanisms: overload, under-load, over-voltage, over-temperature, and short-circuit, and enables operation in a standalone mode. It also executes all real-time functions as specified in IEEE802.3at and IEEE802.3bt Class 3.

PD69208M supports supply voltages between 32 V and 57 V without additional power supply sources. A system that powers over four pairs can be implemented by combining two ports of PD69208M, enabling an extra feature for a simple and low-cost, high-power PD device. An on-going monitoring of system parameters for the host software is available via communication. Internal thermal protection is implemented in the chip. PD69208M is a low-power dissipation device that uses internal MOSFETs and internal 100 m $\Omega$  sense resistors.

PD69200 features an ESPI bus for all PD69208M. It is developed based on NXP Kinetis\_L family, MKL15Z128VFM4, that is embedded with the ARM Cortex™-M0+ core. It also uses I<sup>2</sup>C or UART interface to the host CPU, and is designed to support software field upgradable through the communication interface.

PD69208M is available in a 56 pin, 8 mm x 8 mm QFN package. PD69200 is available in 32 pin, 5 mm x 5 mm QFN package.

## 2.1 Features

- 8 independent channels
- Complies with IEEE802.3af-2003, IEEE802.3at-2009 (including two-event classification), and IEEE802.3bt
- Drives 2-pair power ports or 4-pair ports
- Supports pre-standard PD detection
- Single DC voltage input (32 V to 57 V)
- Built in 3.3 V and 5 V regulators
- Input voltage out of range protection
- Wide ambient temperature range: -40 °C to +85 °C
- On-chip Over-temperature thermal protection and monitoring
- Low power dissipation (0.1  $\Omega$  sense resistor and 0.2  $\Omega$  MOSFET R<sub>dson</sub> per channel)
- Includes Reset command pin
- 4 x direct address configuration pins
- Continuous port monitoring and system data
- Configurable load current setting
- Configurable PSE AT/AF/BT-Type3 modes
- Power soft start mechanism
- Voltage monitoring/protection
- Internal power on reset
- Emergency power management supporting four configurable power bank I/Os
- Advance System Power Management algorithm supports up to 96 physical ports
- Can be cascaded to up to 12 PoE devices (96 ports)
- Supports both UART and I<sup>2</sup>C interfaces to host CPU
- Backwards compatible with Microsemi communication protocol used at prior generations
- LED stream support
- System OK indication
- Software download via I<sup>2</sup>C or UART
- Detailed port status
- Programmable threshold temperature alarm limit
- Interrupt out pin for system and port events
- Forced port power ON function
- Port power limit setting
- Port matrix and priority
- Automatic PoE device type detection
- MSL3, RoHS compliant

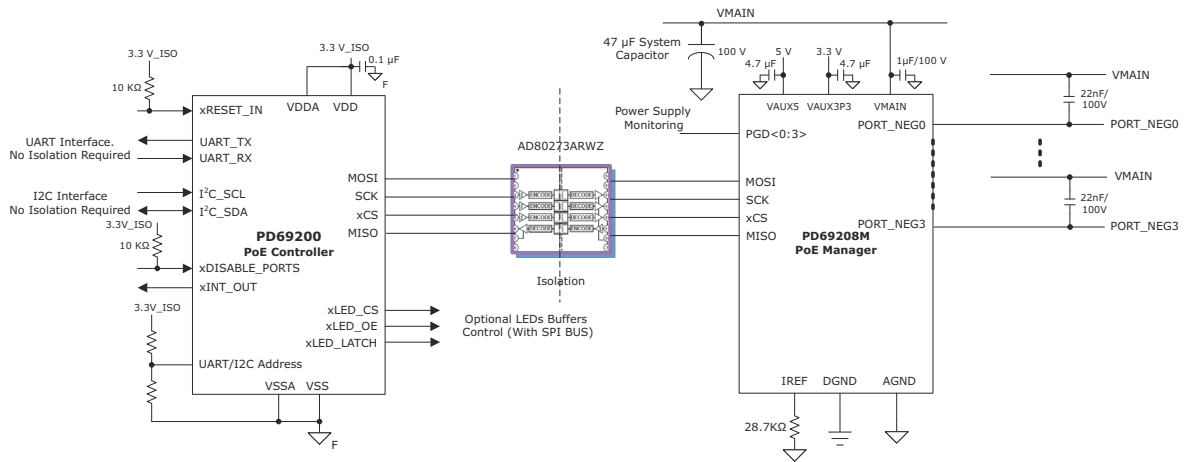
## 2.2 Applications

- Power over Ethernet (all IEEE compliant 2-pair modes)
- Supports 4-pair and IEEE802.3bt PSE Type 3
- Switches/Routers/Midspans
- Industrial automation
- PoE for LED lighting

## 2.3 Typical PoE Application

The following figure illustrates the typical PoE application of PD69208M and PD69200 devices.

**Figure 1 • Typical PoE Application**

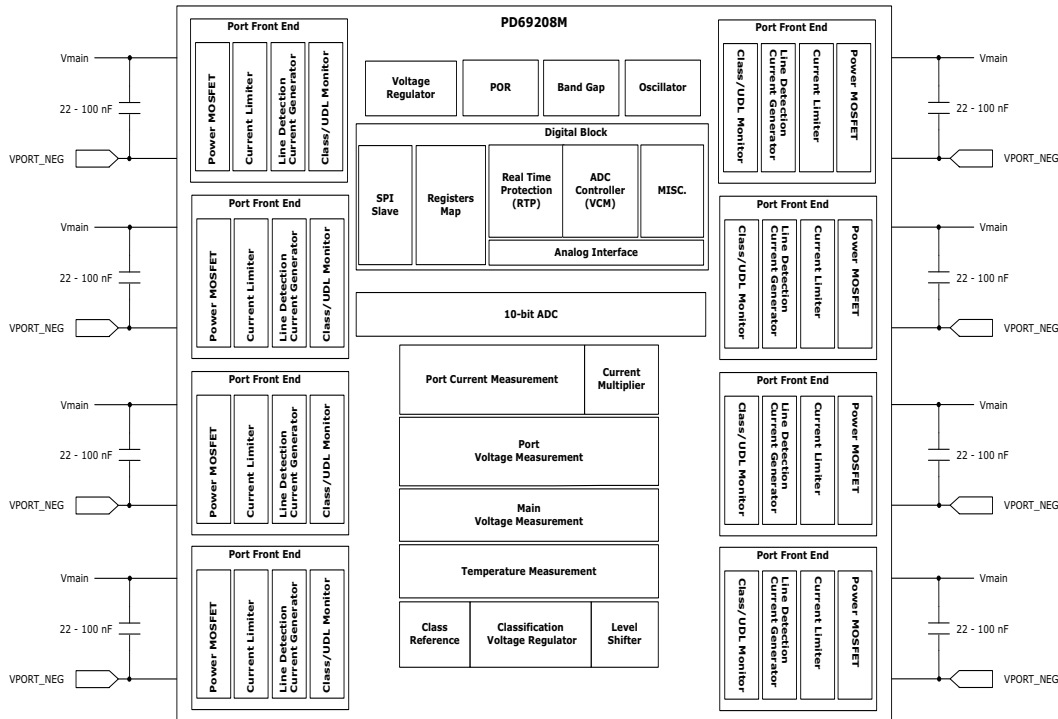


**Note:** Fuses per port are not required for use in circuits with total power level of up to 3kW as the PD69208M designed to fulfill limited power source (LPS) requirements per the latest editions of IEC60950-1 and EN60950-1.

## 3 Functional Descriptions

The following illustration shows the functional blocks of PD69208M.

**Figure 2 • PD69208M Block Diagram**



The following sections describe the functional blocks of PD69208M.

### 3.1 Digital Block Module

The logic main control block includes digital timing mechanisms and state machines synchronizing and activating PoE functions according to PD69200 control commands, such as:

- Real Time Protection (RTP)
- Start Up Macro (DVDT)
- Load Signature Detection (RES DET)
- Classification Macro (CLASS)
- Voltage and Current Monitoring (VCM)
- ADC Interfacing
- Direct Digital Signals with Analog Block
- SPI Communication Block
- Registers

### 3.2 PD Detection Generator

Upon request from PD69200 to the main control module, the PD detection generator generates four different voltage levels to ensure a robust AF/AT/BT PD detection functionality.

### 3.3 Classification Generator

Upon request from PD69200 to the main control module, state machine applies a regulated class event and mark event voltage to ports, as required by IEEE standards.

### 3.4 Current Limiter

This circuit continuously monitors the current of powered ports and limits the current to a pre-defined value set by AF/AT. When the current value exceeds this specific value, the system starts measuring the elapsed timing. If this interval is greater than a preset threshold, the port is disconnected.

### 3.5 Main Power MOSFET

The main power switching FET is used to control PoE current into load.

### 3.6 Analog to Digital Converter

A 10-bit analog to digital converter (ADC) is used to convert analog signals into digital registers for the logic control module.

### 3.7 Power on Reset

Power on Reset (PoR) monitors the internal 3.3 V and 5 V DC levels. If this voltage drops below specific thresholds, a reset signal is generated, and PD69208M is reset.

### 3.8 Voltage Regulator

The voltage regulator generates 3.3 V and 5 V for internal circuitry. These voltages are derived from  $V_{MAIN}$  supply. To use internal voltage regulator connect:

- $V_{AUX5}$  to DRV\_VAUX5
- $V_{AUX3P3}$  to  $V_{AUX3P3\_INT}$

There are three options to reduce PD69208M power dissipation by regulating voltage outside the chip:

- Use an external NPN transistor to regulate the 5 V. In this setup, the configuration of regulators pins should be as follows:
  - DRV\_VAUX5 is connected to NPN BASE
  - $V_{AUX5}$  is connected to NPN EMITTER (Connect Collector to  $V_{MAIN}$ )
  - $V_{AUX3P3}$  is connected to  $V_{AUX3P3\_INT}$
- Supply PD69208M with an external 5 V voltage regulator. In this setup, regulators pins configuration should be as follows:
  - $V_{AUX3P3}$  is connected to  $V_{AUX3P3\_INT}$
  - DRV\_VAUX5 is not connected (left open)
  - $V_{AUX5}$  is connected to external 5 V
- Supply PD69208M with an external 3.3 V voltage regulator. In this setup, regulators pins configuration should be as follows:
  - $V_{AUX5}$  is connected to DRV\_VAUX5
  - $V_{AUX3P3\_INT}$  is not connected (left open)
  - $V_{AUX3P3}$  is connected to external 3.3 V

These options can be implemented simultaneously to reduce PD69208M power dissipation.

### 3.9 Clock

PD69208M clock (CLK) is an internal 8 MHz clock oscillator.

## 3.10 SPI Communication

PD69208M uses SPI communication in SPI slave mode to communicate with PD69200 MCU. Each PD69208M has an address determined by ADDR0-ADDR3 pins. The PD69200 can support up to 12 ICs. The actual frequency between PD69200 and PD69208M ICs is 1 MHz.

The following table lists the SPI communication packet structure.

**Table 1 • SPI Communication – Packet Structure**

Control byte Selects PD69208M According to the address	R/W Bit	Internal Register Address	Number of words (only in read access)	Data Written to IC (in write access) Read from IC (in read access)
8 bits	R(0)/W(1)	8 bits	8 bits	16 bits

### 3.10.1 PD69208M SPI Addressing

PD69208M operates in 8-bit address and 16-bit data. It responds to SPI transaction if the first SPI byte (IC address byte bits[7:1]) complies with the following:

**Table 2 • PD69208M SPI Addressing**

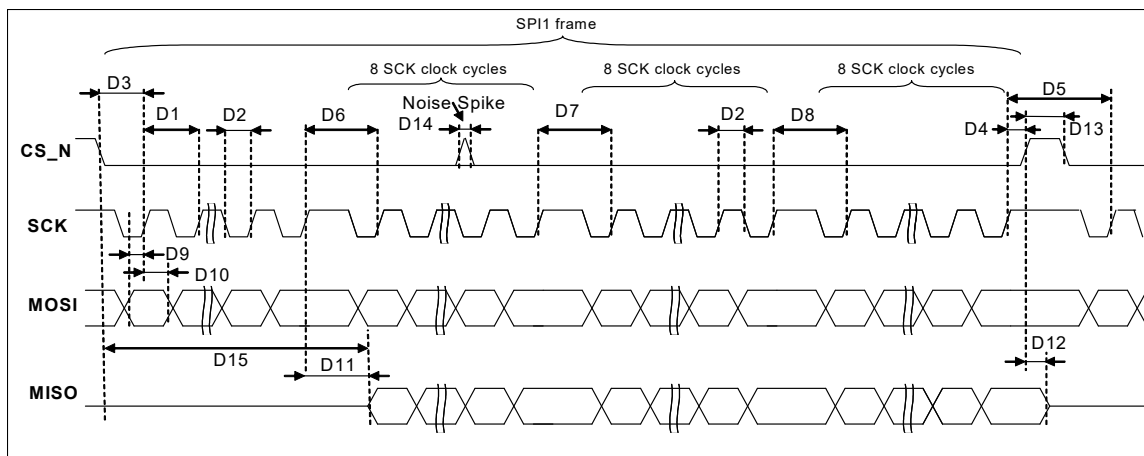
3 Bits (bit 7:5)	4 Bits (bit 4:1)	1 Bit (bit 0)
000	Address Input Pin	Read/Write

### 3.10.2 Broadcast

- A broadcast command is intended to instruct all connected PD69208M ICs to perform a specific operation.
- The broadcast command is a write command with the standard packet structure. In a broadcast read operation, the read data is not valid and the read operation has no impact.

**Table 3 • PD69208M Broadcast**

3 Bits (bit 7:5)	4 Bits (bit 4:1)	1 Bit (bit 0)
001	0000	Write

**Figure 3 • SPI Detailed Timing Diagram**

The following table lists the SPI timing diagram description.

**Table 4 • SPI Timing Description**

Name	Min Delay	Max Delay	Description
D1	910 nS		SPI clock period
D2	45 %	55%	SPI duty cycle
D3	340 nS		SPI_CS setup to SPI clock positive edge (delay after SPI_CS active signal)
D4	340 nS		SPI_CS hold to SPI clock positive edge (delay before SPI_CS inactive signal)
D5	2 SPI clock cycles		Delay between last SCK in eSPI1 frame and first SCK at adjacent eSPI1 frame
D6	1 SPI clock cycles		Between byte 0 (IC address) and byte 1 (address)
D7	1 SPI clock cycles		Between byte 1 (address) and byte 2 (data).
D8	1 SPI clock cycles		Between byte 2 (MS data byte) and byte 3 (LS data byte).
D9	340 nS		MOSI setup time
D10	340 nS		MOSI hold time
D11		700 nS	MISO tri-state to valid data from clock positive edge
D12		700 nS	MISO valid data to tri-state from SPI_CS positive edge
D13	1 SPI clock cycles		SPI_CS width (Delay eSPI1 frame to adjacent eSPI1 frame)
D14		60 nS	Filtered glitch width
D15		D3 + D11 + 24 SPI clock cycles	MISO tri-state from SPI_CS negative edge to valid data cycles
D16	200 nS		MISO setup to SCK positive edge
D17	200 nS		MISO hold to SCK positive edge

### 3.10.3 PD69200 I<sup>2</sup>C Address Selection

The I<sup>2</sup>C interface between the host CPU and a specific PD69200 requires setting the PD69200 address. This is done by applying a specific voltage level to pin #22 (I2C\_ADDR\_MEAS) as listed in the following table:

**Table 5 • I<sup>2</sup>C Address Selection**

I2C_ADDR Voltage Level	I <sup>2</sup> C Address (Hexadecimal)
0.00 to 0.21 VDC	UART
0.21 to 0.41 VDC	0x4
0.41 to 0.62 VDC	0x8
0.62 to 0.83 VDC	0xC
0.83 to 1.03 VDC	0x10
1.03 to 1.24 VDC	0x14
1.24 to 1.44 VDC	0x18
1.44 to 1.65 VDC	0x1C
1.65 to 1.86 VDC	0x20
1.86 to 2.06 VDC	0x24
2.06 to 2.27 VDC	0x28
2.27 to 2.48 VDC	0x2C
2.48 to 2.68 VDC	0x30
2.68 to 2.89 VDC	0x34
2.89 to 3.09 VDC	0x38
3.09 to 3.30 VDC	0x3C

**Note:** UART communications configuration:

- Bits per second: 19,200 bps
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

**Note:** I<sup>2</sup>C communication configuration:

- Address: 7 bits
- Clock stretch: host should support
- Transaction: 15 bytes or 1 byte



## 4 Electrical Specifications

The following sections describes the electrical characteristics of PD69200 and PD69208M devices.

### 4.1 PD69200 Electrical Characteristics

In this application, PD69200 consumption is ~20mA.

- Manufacturer: NXP
- Manufacturer part number: MKL15Z128VFM4
- Maximum pull-ups consumption based on PD69200 application is 2mA. See the hardware application note document: catalog number PD69208\_AN\_211

### 4.2 PD69200 Features Description

The following table lists the main features of PD69200.

**Table 6 • PD69200 Features Description**

Features	Description
Supports up to 12 PoE devices - 96 physical ports (48 logical)	Up to 12 PoE devices can be cascaded, fitting into a 96-physical-port PoE system that uses one PoE controller (PD69200). PD69200 can support up to 48 logical ports. A logical port can be built from 2×Physical ports or 1×Physical port.
Power Management	The system supports three power management modes: Class (LLDP), Dynamic and Static.
Threshold Configuration	Over-voltage and under-voltage thresholds can be configured for disconnection purposes.
High Power Ports (2 pairs or 4 pairs)	PoE devices can be configured (both hardware and software) to enable higher current through ports (up to ~627 mA) or double power at the RJ in case of 4 pairs.
Communication	Supports both I <sup>2</sup> C and UART interfaces with the host CPU.
Legacy (reduced capacitance) Detection	Enables detection and powering of pre-standard devices (PDs) up to 30 μF.
LED Stream	Provides a direct SPI interface to an external LED stream circuitry. Enables designers to implement a simple LED circuit that does not require a software code. (LED stream clock frequency is 1 MHz).
System OK Indication	Provides a digital output pin to host. System validity indication, when the system OK pin state is low. The output behavior is controlled by software mask register settings (Mask 0×28). The mask default settings is 0, meaning that this pin indicates valid software and V <sub>main</sub> is within the range. This pin is active low. For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT).
System and Port Measurements	Measurements of the following parameters: Current (mA), Power Consumption (W), V <sub>main</sub> (V), Port Voltage (V), and PD Class (0-4).
Detailed Port Status	Port statuses are received from PoE managers. Statuses such as port on and port off due to disconnection or overload.
Interrupt Pin	Interrupt out from PoE controller, PD69200, indicating events such as: port on, port off, port fault, PoE device fault, voltage out of range, and more. For a full list of interrupt events, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT.

**Table 6 • PD69200 Features Description (continued)**

Features	Description
Port Power Limit	Configurable port power limit; when a port exceeds the limit, it is automatically disconnected.
Port Matrix Control	Enables layout designers to connect any physical port to any logical port as required.
'Power Good' Interrupt from Power Supply directly to PoE Drivers.	For systems comprising more than a single power supply, when one power supply fails, a fast port disconnection mechanism is executed to maintain operation and prevent collapse of other power supplies.

## 4.3 PD69208M Electrical Characteristics

Unless otherwise specified under conditions, the Min and Max ratings stated in the following table apply to the entire specified operating ratings of the device. Typ values stated are either by design or by production testing at 25 °C ambient.

**Table 7 • PD69208M Electrical Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>MAIN</sub>	Main Supply Voltage	Supports Full IEEE802.3AF and AT functionality	32		57	V
V <sub>PORT</sub>	Port Output	V <sub>MAIN</sub> - V <sub>PORT_NEGx</sub>	0		57	V
V <sub>TH</sub>	POR Threshold	Internal or External 3.3 V supply		8		V
I <sub>MAIN</sub>		Main Power Supply Current @ Operating Mode. V <sub>MAIN</sub> = 55 V		14		mA
V <sub>AUX5</sub>	5 V Output Voltage	V <sub>AUX5</sub> -AGND	4.5	5	5.5	V
V <sub>AUX3P3</sub>	3.3 V Output Voltage	V <sub>AUX3P3</sub> -AGND	3	3.3	3.6	V
I <sub>AUX3P3</sub>	3.3 V Output Current for application use	Without external NPN			5	mA
		With external NPN transistor on V <sub>AUX5</sub>			30	mA
V <sub>AUX3P3_IN</sub>	3.3 V Input Voltage	V <sub>AUX3P3</sub> -AGND	3	3.3	3.6	V
DV <sub>DD</sub>	Digital 3.3 V Input Voltage	DV <sub>DD</sub> -DGND	3	3.3	3.6	V
POR <sub>TP</sub>	Power On Reset DV <sub>DD</sub> Trip Point	DV <sub>DD</sub> -DGND	2.575	2.775	2.975	V
POR <sub>HYS</sub>	Power On Reset DV <sub>DD</sub> Hysteresis	POR <sub>TP</sub> -DGND	0.2	0.25	0.3	V
R <sub>CH_ON</sub>	Total Channel Resistance	R <sub>ds_on</sub> + R <sub>sense</sub> + R <sub>bonding</sub>		0.34		Ω

### 4.3.1 Detection

**Table 8 • PD69208M Detection**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{OC}$	Pre-detection Voltage, Open-circuit Voltage	$V_{MAIN} - V_{PORT\_NEGx}$ , open port			7.8	V
$V_{VALID}$	Detection Voltage	$V_{MAIN} - V_{PORT\_NEGx}$ , for IEEE802.3 compliant signature resistance ( $R_{SIG} < 33\text{ K}$ )			9.3	V
$I_{SC}$	Short Circuit Current	$V_{MAIN} - V_{PORT\_NEGx} = 0\text{ V}$		388	408	$\mu\text{A}$
$R_{SIG\_LOW}$	Minimum Valid Detection Resistance		15		19	$\text{K}\Omega$
$R_{SIG\_HIGH}$	Maximum Valid Detection Resistance		26.5		33	$\text{K}\Omega$

### 4.3.2 Classification

**Table 9 • PD69208M Classification**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{CLASS}$	Class Event Output Voltage	$V_{MAIN} - V_{PORT\_NEGx}$ ; $0\text{ mA} \leq I_{PORT} \leq 50\text{ mA}$	15.5	18	20.5	V
$V_{MARK}$	Mark Event Output Voltage	$V_{MAIN} - V_{PORT\_NEGx}$ ; $0.1\text{ mA} \leq I_{PORT} \leq 5\text{ mA}$	7	8.5	10	V
$I_{CLASS\_LIM}$	Class event current limitation	$V_{MAIN} - V_{PORT\_NEGx} = 0\text{ V}$	51	70	100	mA
$I_{MARK\_LIM}$	Mark event current limitation	$V_{MAIN} - V_{PORT\_NEGx} = 0\text{ V}$	51	70	100	mA
	Classification Current Thresholds	Class 0	0		5	mA
		Class 1	8		13	mA
		Class 2	16		21	mA
		Class 3	25		31	mA
		Class 4	35		45	mA
		Class Error	51		100	mA

### 4.3.3 Port Real Time Protection

**Table 10 • PD69208M Port Real Time Protection**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$T_{RISE}$	Turn on rise time	From 10% to 90% of the voltage difference at the $V_{PORT\_NEGx}$ in POWER_ON state from the beginning of POWER_UP	15			$\mu$ S
$I_{INRUSH}$	Output current in POWER_UP state	$C_{LOAD} \leq 180 \mu F^1$	400	425	450	mA
$T_{INRUSH}$	Inrush Time				65	mS
$I_{PORT}$	Output Operating Current	802.3af	10		360	mA
		802.3at	10		627	mA
		802.3bt class 5	10		560	mA
		802.3bt class 6	10		692	mA
$I_{CUT}$	Overload Current	802.3af		375		mA
		802.3at		645		mA
		802.3bt class 5		589		mA
		802.3bt class 6		709		mA
$T_{CUT}$	Overload Time Limit		62	64	66	mS
$I_{LIM}$	Port Current Limit	802.3af	400	425	450	mA
		802.3bt class 1-3	670	720	770	mA
		802.3at, 802.3bt class 4-6	790	850	892	
$T_{LIM}$	Port Current Limit Time	$V_{MAIN} - V_{PORT\_NEGx} < 30 V$	1	2	3	mS
$P_{PWR}$	Port power accuracy	> 90 W			2	%
$I_{UDL}$	DC Disconnect Under-load Current	2 Pairs	6	7.5	9	mA
		4 Pairs (for each pairset)	2	2.5	3	mA
$T_{MPDO}$	PD Maintain Power Signature Dropout Time Limit		322	324	326	mS
$T_{MPS}$	PD Maintain Power Signature Time For Validity	802.3bt PSE Type 1, 2	46	48	50	mS
		802.3bt PSE Type 3, 4	3	4	5	mS
$T_{OFF}$	Turn Off Time	From $V_{MAIN}$ to 2.8V			500	mS

1. Can be overridden by communication command.

### 4.3.4 Port Current Monitoring

**Table 11 • PD69208M Port Current Monitoring**

Parameter	Conditions	Typ	Max	Units
Resolution	Reported as 14 Bits	10		Bits
LSB		122.07		$\mu$ A
Measurement Period		16		mS

**Table 11 • PD69208M Port Current Monitoring (continued)**

Parameter	Conditions	Typ	Max	Units
Accuracy	$50 \text{ mA} < I_{\text{PORT}} < 150 \text{ mA}$		9	%
	$150 \text{ mA} < I_{\text{PORT}} < 350 \text{ mA}$		4.5	%
	$350 \text{ mA} < I_{\text{PORT}} < 600 \text{ mA}$		3.5	%
	$I_{\text{PORT}} > 600 \text{ mA}$		3.0	%

### 4.3.5 Port Voltage Monitoring

**Table 12 • PD69208M Port Voltage Monitoring**

Parameter	Typ	Max	Units
Resolution	10		Bits
LSB	58.6		mV
Measurement Period	3		mS
Accuracy		3.3	%

### 4.3.6 Main Voltage Monitoring

**Table 13 • PD69208M Main Voltage Monitoring**

Parameter	Conditions	Typ	Max	Units
Resolution		10		Bits
LSB		58.6		mV
Measurement Period		3		mS
Accuracy	$42 \text{ V} < V_{\text{MAIN}} < 50 \text{ V}$		2	%
	$50 \text{ V} < V_{\text{MAIN}} < 57 \text{ V}$		1.5	%
	$50 \text{ V} < V_{\text{MAIN}} < 57 \text{ V}^1$		0.6	%

1. 0-70 °C

### 4.3.7 Temperature Monitoring

**Table 14 • PD69208M Temperature Monitoring**

Parameter	Conditions	Min	Typ	Max	Units
Resolution			8		Bits
LSB	Temperature = (DATA x 1.9384) - 273		1.9384		°C
Measurement Period			3		mS
Accuracy		-3		3	°C

### 4.3.8 Digital Interface

**Table 15 • PD69208M Digital Interface**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>IH</sub>	Input Logic High Voltage	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3]	2.2			V
V <sub>IL</sub>	Input Logic Low Voltage	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3]			0.8	V
Hyst	Input Logic Hysteresis Voltage	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3]	0.4	0.6	0.8	V
I <sub>IH</sub>	Input Logic High Current	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3]	-10		10	μA
I <sub>IL</sub>	Input Logic Low Current	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3]	-10		10	μA
V <sub>OH</sub>	Output Logic High Voltage	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3] IOH = -1mA	2.4			V
V <sub>OL</sub>	Output Logic Low Voltage	RESET_N, MOSI, MISO, SCK, CS_N, PGD[0..3], ADDR[0..3] IOH = 1mA			0.4	V

### 4.3.9 Immunity

**Table 16 • PD69208M Immunity**

Symbol	Parameter	Conditions	Min	Typ	Max	Units
ESD	ESD rating	HBM <sup>1</sup>				
	ESD rating	CDM <sup>2</sup>				
Surge	Lightning surge <sup>3</sup>	EN61000 4-5	-1		1	KV

1. ESD HBM complies with JESD22 Class 2 standard.
2. ESD CDM complies with JESD22 Class 1 standard.
3. System level common mode 10/700 μS according to IEC61000-4-5.

## 4.4 PD69208M Absolute Maximum Ratings

PoE performance is not guaranteed when exceeding the recommended rating. Exposure to any stress in the range between the recommended rating, as listed in the following table, and the absolute maximum rating should be limited to a short time. Exceeding these ratings may impact long-term operating reliability.

**Table 17 • Absolute Maximum Ratings**

Parameters	Min	Max	Units
Supply Input Voltage ( $V_{MAIN}$ ) <sup>1, 2</sup>	-0.3	72	V
PORT_NEG[0..7] pins	-0.3	$V_{MAIN}+0.5$	V
$V_{AUX5}$	-0.3	6	V
$V_{AUX3P3}$ , $DV_{DD}$	-0.3	4	V
Digital pins: MISO, MOSI, SCK, CS_N, ADDR[3:0], PGD[3:0], RESET_N, TRIM	-0.3	$DV_{DD} + 0.3$ and $< 4.0$	V
Junction Temperature		150	°C
Lead Soldering Temperature (40s, reflow)		260	°C
Storage Temperature	-65	150	°C

1. Power Sequence Requirement:  $V_{main} > V_{AUX5} > V_{AUX3P3} = T_{RIM}; DV_{DD}$ .
2. PD69208M EPAD is connected by copper plane on PCB to AGND. AGND is ground for IC.

**Note:** DRV\_VAUX5 and  $I_{REF}$  are output pins and should not apply voltage or current. DRV\_VAUX5 can be left open when not used.

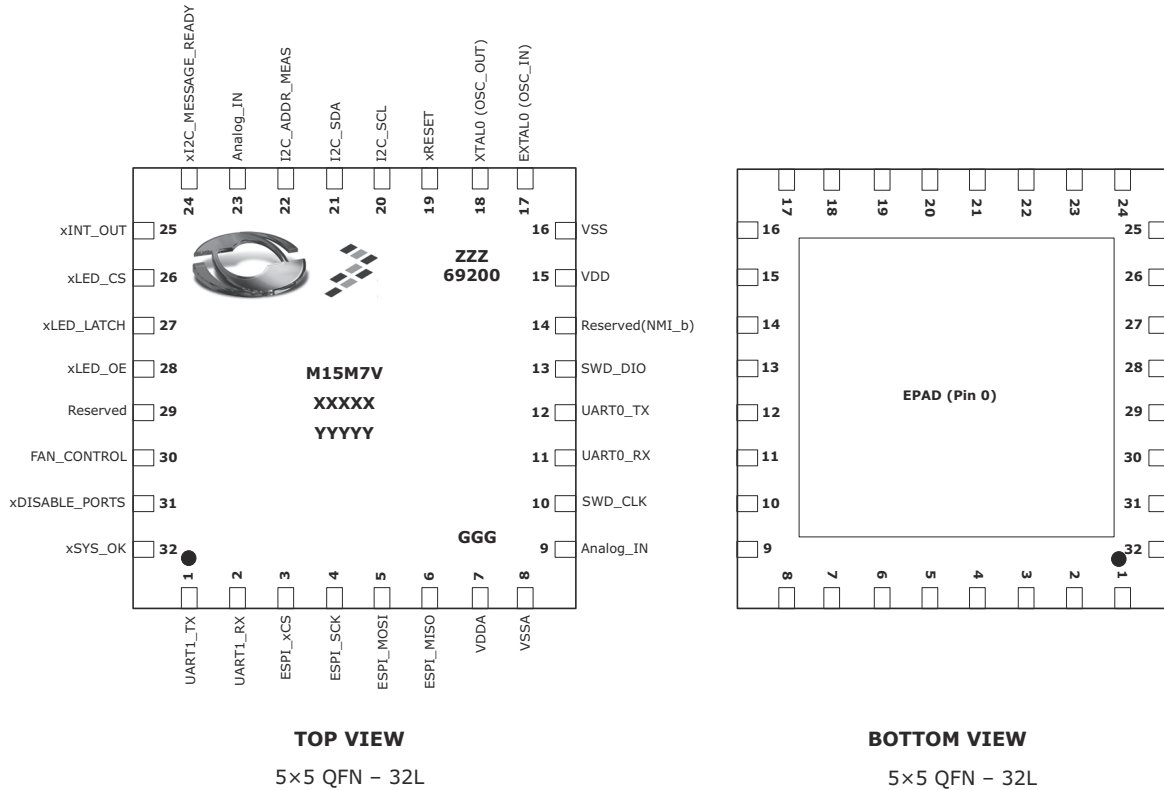
# 5 Pin Descriptions

The PD69200 device has 32 pins and PD69208M device has 56 pins, which are described in this section.

## 5.1 Pin Configuration and Pinout

The following figures represent the top- and bottom-view of PD69200 and PD69208M devices.

Figure 4 • PD69200 Pin Diagram

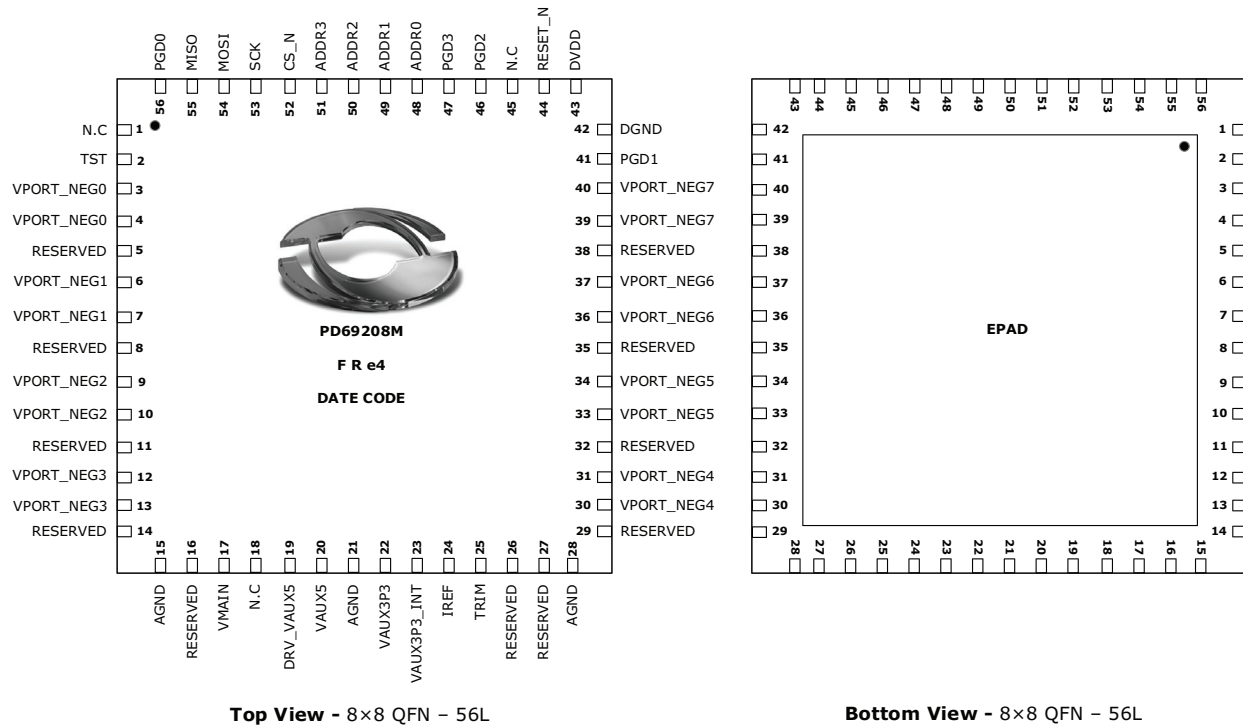


**Note:** The marking position of PD69200 may change subject to NXP practice.

**Note:** For definitions about markings in the PD69200 pinout diagram, see the ordering information table (Table 30, page 41).



**Figure 5 • PD69208M Pin Diagram**



**Note:** For definitions about markings in the PD69208M pinout diagram, see the ordering information table (Table 30, page 41).

## 5.2 Pin Descriptions

The following sections describe the functional pin descriptions of PD69200 and PD69208M devices.

### 5.2.1 PD69200

The following table lists the functional pin descriptions of the PD69200 device.

**Table 18 • PD69200 Pin Description**

Number	Designator	Type	Description
	EPAD	Thermal	Isolated Thermal PAD, recommended to tie to GND.
1	UART1_TX <sup>1</sup>	OUT	Reserved UART.
2	UART1_RX <sup>1</sup>	IN	Reserved UART.
3	ESPI_xCS	OUT	ESPI Bus to PoE Manager. SPI chip select (Active Low). CS is asserted during all SPI frame.
4	ESPI_SCK	OUT	ESPI Bus to PoE Manager. SPI clock output to PD6920x, and LED stream clock output, set to 1 MHz.
5	ESPI_MOSI	OUT	SPI packets are transmitted on this line.
6	ESPI_MISO	IN	ESPI Bus to PoE Manager. SPI Master In Slave Out. SPI packets are received on this line.
7	VDDA	Supply	Main Supply 3.3 V.
8	VSSA	GND	Analog ground.
9	Analog_IN	Analog_IN	Analog input. Should be connected to 3.3 V.
10	SWD_CLK	DEBUG	Serial Debug Data Bus Clock.

**Table 18 • PD69200 Pin Description (continued)**

Number	Designator	Type	Description
11	UART0_RX <sup>1</sup>	IN	UART receive from host. 15 byte protocol commands are received on this line. The baud rate is set to 19,200 bps. For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT.
12	UART0_TX <sup>1</sup>	OUT	UART transmit to host. 15 byte protocol reply/telemetry are transmitted on this line. The baud rate is set to 19,200 bps. For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT.
13	SWD_DIO	DEBUG	Serial Debug Data Bus.
14	Reserved (NMI_b)	IRQ_Input	Spare, an external pull-up must be connected.
15	VDD	Supply	Main Supply 3.3 V.
16	VSS	GND	Digital ground.
17	EXTAL0 (OSC_IN) <sup>2</sup>	Oscillator	Oscillator input - Reserved.
18	XTAL0 (OSC_OUT) <sup>2</sup>	Oscillator	Oscillator output - Reserved.
19	xRESET <sup>(3,4)</sup>	IN/OUT	<p>Host Reset input (Active Low). The shortest reset pulse from the host that is required for the PD69200 application is 150 <math>\mu</math>Sec. PD69200 can generate self-reset. In this case, the xRESET pin is driven low by the PD69200 for about 100 <math>\mu</math>Sec. It is recommended to connect this pin to a host open drain output with 10 K<math>\Omega</math> pull-up. An 47 nF filter capacitor should be connected between this pin to GND, close to the PD69200 device. If this pin is connected to a push/pull driver, a serial resistor of 1.5 K<math>\Omega</math> must be connected instead of the pull-up. The required shortest reset pulse in this case is 300 <math>\mu</math>Sec.</p> <p>For more information about this pin connectivity, see the Hardware Application Note, Catalog Number: PD69208_AN_211.</p>
20	I2C0_SCL <sup>4</sup>	IN/OUT	I <sup>2</sup> C clock from the host master. Speed is limited to 400 KHz and clock stretching functionality must be implemented in the host master. If PD69200 is busy, it holds the clock line.
21	I2C0_SDA <sup>4</sup>	IN/OUT	<p>I<sup>2</sup>C bidirectional data. 15 byte protocol messages are transmitted on this line.</p> <p>For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT.</p>
22	I2C_ADDR_MEAS	Analog_IN	I <sup>2</sup> C address of PD69200. Analog input to determine I <sup>2</sup> C address or UART operation. See I <sup>2</sup> C address selection in Table 5, page 10.
23	Analog_IN	Analog_IN	Reserved analog input. connect to GND.
24	xI2C_MESSAGE_READY <sup>3</sup>	OUT	<p>I<sup>2</sup>C message ready for read by the host. PD69200 asserts this line low when it has an answer to the host. Therefore, the host can poll this line and initiate I<sup>2</sup>C read cycle only when the message is ready. This pin is active low.</p> <p>After the host reads the data from PD69200, this pin is asserted to high.</p>

**Table 18 • PD69200 Pin Description (continued)**

Number	Designator	Type	Description
25	xINT_OUT <sup>(3, 4)</sup>	OUT	Interrupt output indication. This line is asserted low when a pre-configured event is in progress. The host configures the event that should generate an interrupt through 15 bytes protocol. When this event occurs, the xINT_OUT pin is asserted. This pin is active low.
26	xLED_CS <sup>3</sup>	OUT	Chip select signal for LED stream. This pin is active low.
27	xLED_LATCH <sup>3</sup>	OUT	Latch signal for LED stream. This pin is active low.
28	xLED_OE <sup>3</sup>	OUT	Output enable signal for LED stream. This pin is active low.
29	Reserved	IN	Reserved for MPRPD counter for future support. If not used, connect to VDD.
30	FAN_CONTROL	OUT	Optional. Fan control operates a fan, when the PD69208M device temperature is above the temperature alarm threshold. This pin is active high.
31	xDISABLE_PORTS <sup>3</sup>	IN	Disable all PoE ports. When this input is asserted low, the PD69200 device shuts down all of the PoE ports in the system. This pin contains software filter of 480 mSec to reject noise and false disable scenarios.
32	xSys_OK/LED System OK <sup>3</sup>	OUT	System validity indication. When the system is in OK state, the pin state is low. The behavior of this output is controlled by software mask register settings (Mask 0x28). The mask default settings is 0, meaning that this pin indicates valid software, and V <sub>main</sub> is in range. This pin is active low. For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200_UG_COMM_PROT.

1. Weak pull-up is recommended. See the PD69208\_AN\_211 document.
2. The oscillator pins are reserved and unused. The MCU uses internal clock source set to 47.972MHz +/- 1.5% (max).
3. The initial x indicates that the pin is active low.
4. Open drain output requires an external pull-up. See the Hardware Application Note: PD69208\_AN\_211 document.

**Note:** All I/Os in this application can sink or source 3 mA maximum.

## 5.2.2 PD69208M

The following table lists the functional pin descriptions of PD69208M devices

**Table 19 • PD69208M Pin Description**

Number	Designator	Type	Description
	EPAD		Exposed PAD. Connect to analog ground. A decent ground plane should be deployed around this pin as required. See the PD69208M Layout Design Guidelines section in the Hardware Application Note, Catalog Number: PD69208M_AN_211.
1	N.C	N/A	Not connected; do not connect externally (leave floating).
2	TST	Digital Input	Test pin for production use only. Keep connected to DGND.
3	VPORT_NEG0	Analog I/O	Negative port 0 output.
4	VPORT_NEG0	Analog I/O	Negative port 0 output.
5	RESERVED	N/A	Reserved pin. Do not connect externally.
6	VPORT_NEG1	Analog I/O	Negative port1 output.

**Table 19 • PD69208M Pin Description (continued)**

Number	Designator	Type	Description
7	VPORT_NEG1	Analog I/O	Negative port1 output.
8	RESERVED	N/A	Reserved pin. Do not connect externally.
9	VPORT_NEG2	Analog I/O	Negative port 2 output.
10	VPORT_NEG2	Analog I/O	Negative port 2 output.
11	RESERVED	N/A	Reserved pin. Do not connect externally.
12	VPORT_NEG3	Analog I/O	Negative port 3 output.
13	VPORT_NEG3	Analog I/O	Negative port 3 output.
14	RESERVED	N/A	Reserved pin. Do not connect externally.
15	AGND	Power	Analog ground.
16	RESERVED	N/A	Reserved pin. Do not connect externally.
17	V <sub>MAIN</sub>	Power	Main high-voltage supply voltage. A low ESR 1 $\mu$ F (or higher) bypass capacitor, connected to AGND, should be placed as close as possible to this pin through low-resistance traces.
18	N.C	N/A	Not connected. Do not connect externally.
19	DRV_VAUX5	Power	Driven outputs for 5 V external regulation; if internal regulation is used, connect to pin 20. If an external NPN is used to regulate the voltage, connect this pin to Base. If an NPN is used, a 4.7 $\mu$ F capacitor should be connected between this pin and AGND.
20	VAUX5	Power	Regulated 5 V output voltage source; A 4.7 $\mu$ F or higher filtering capacitor should be connected between this pin and AGND. If an external NPN is used to regulate the voltage, connect this pin to the emitter. Or the collector should be connected to V <sub>main</sub> .
21	AGND	Power	Analog ground.
22	V <sub>AUX3P3</sub>	Power	Regulated 3.3 V output voltage source. A 4.7 $\mu$ F or higher filtering capacitor should be connected between this pin and AGND. When an external 3.3 V regulator is used, connect it to this pin to supply the chip.
23	V <sub>AUX3P3_INT</sub>	Power	Connected to V <sub>AUX3P3</sub> (pin 22) if internal 3.3 V regulator is used. Leave unconnected (Floating) if external 3.3 V regulator is used.
24	I <sub>REF</sub>	Analog Input	Reference resistor pin. Connect a 28.7 k $\Omega$ 1% resistor to AGND.
25	TRIM	Test Input	Test Input pin; Keep connected to V <sub>AUX3P3</sub> .
26	RESERVED	N/A	Reserved pin. Do not connect externally.
27	RESERVED	N/A	Reserved pin. Do not connect externally.
28	AGND	Power	Analog ground.
29	RESERVED	N/A	Reserved pin. Do not connect externally.
30	VPORT_NEG4	Analog I/O	Negative port 4 output.
31	VPORT_NEG4	Analog I/O	Negative port 4 output.
32	RESERVED	N/A	Reserved pin. Do not connect externally.
33	VPORT_NEG5	Analog I/O	Negative port 5 output.
34	VPORT_NEG5	Analog I/O	Negative port 5 output.
35	RESERVED	N/A	Reserved pin. Do not connect externally.

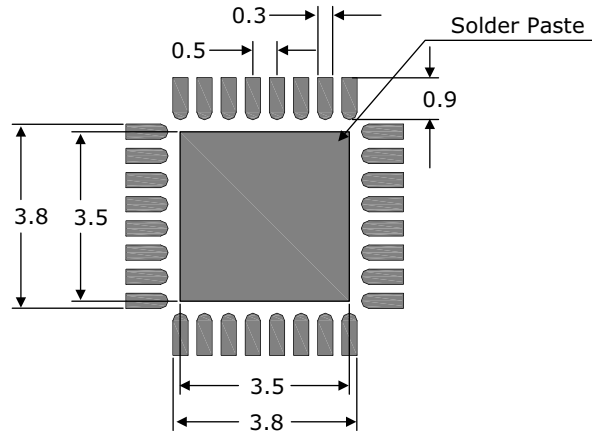
**Table 19 • PD69208M Pin Description (continued)**

Number	Designator	Type	Description
36	VPORT_NEG6	Analog I/O	Negative port 6 output.
37	VPORT_NEG6	Analog I/O	Negative port 6 output.
38	RESERVED	N/A	Reserved pin. Do not connect externally.
39	VPORT_NEG7	Analog I/O	Negative port 7 output.
40	VPORT_NEG7	Analog I/O	Negative port 7 output.
41	PGD1	Digital I/O	Power good input from system power supply.
42	DGND	Power	Digital ground.
43	DV <sub>DD</sub>	Power In	Regulated 3.3 V for digital circuitry. Connect voltage from pin V <sub>AUX3P3</sub> or from external power supply source if used. A 1 $\mu$ F or higher filtering capacitor should be connected between this pin and DGND.
44	RESET_N	Digital Input	Reset input - active low (0 = reset). An external 10 K pull-up resistor should be connected between this pin and DV <sub>DD</sub> .
45	N.C	N/A	Not connected. Do not connect externally.
46	PGD2	Digital Input	Power good input from system power supply.
47	PGD3	Digital Input	Power good input from system power supply.
48	ADDR0	Digital Input	SPI address bit 0 to set chip address.
49	ADDR1	Digital Input	SPI address bit 1 to set chip address.
50	ADDR2	Digital Input	SPI address bit 2 to set chip address.
51	ADDR3	Digital Input	SPI address bit 3 to set chip address.
52	CS_N	Digital Input	SPI bus and chip select.
53	SCK	Digital Input	SPI bus and serial clock input.
54	MOSI	Digital Input	SPI bus and Master Data Out/slave In.
55	MISO	Digital Output	SPI bus and Master Data In/slave Out.
56	PGD0	Digital Input	Power good input from system power supply.

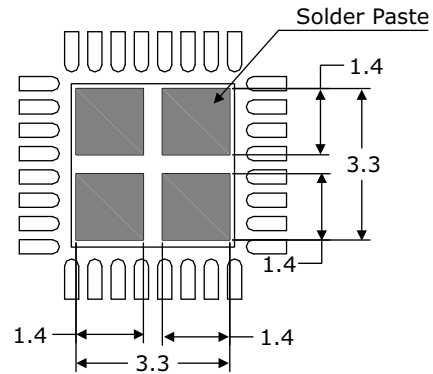
## 5.3 PD69200 Recommended PCB Layout for 32 Pin QFN 5mm x 5mm

The following figures illustrate the PCB layout pattern for PD69200. Units are in mm.

**Figure 6 • PD69200 Top-Layer Copper PCB Layout**



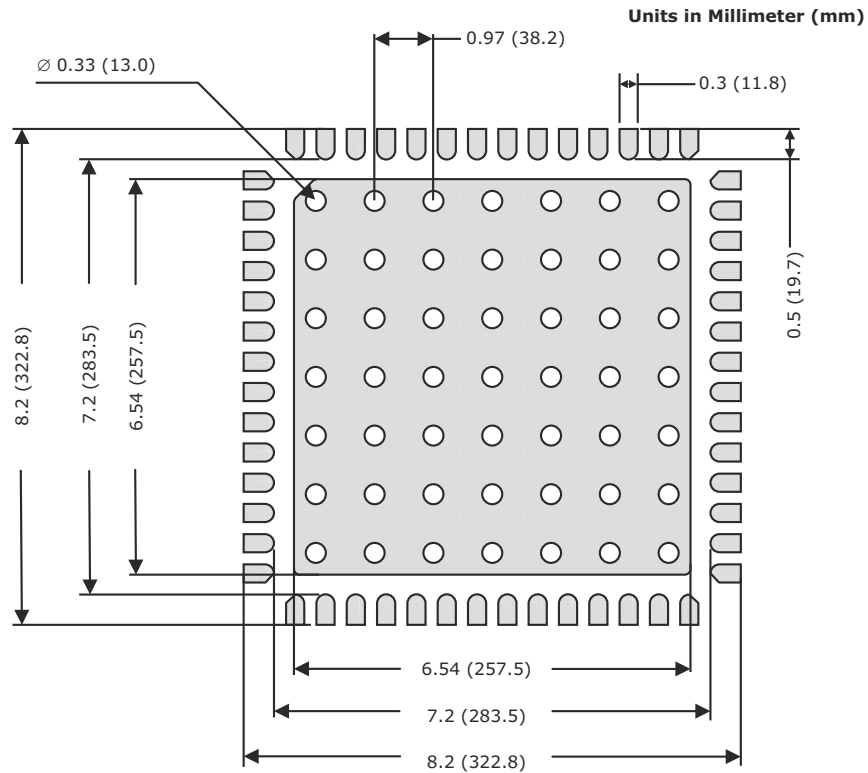
**Figure 7 • PD69200 Top-Layer Solder Paste and Vias PCB Layout for Thermal Pad Array**



## 5.4 PD69208M Recommended PCB Layout for 56-Pin QFN 8mm x 8mm

The following figures illustrate the PCB layout pattern for PD69208M. Units are in mm.

**Figure 8 • Top-Copper Layer**



**Figure 9 • Top-Solder Paste Layer**

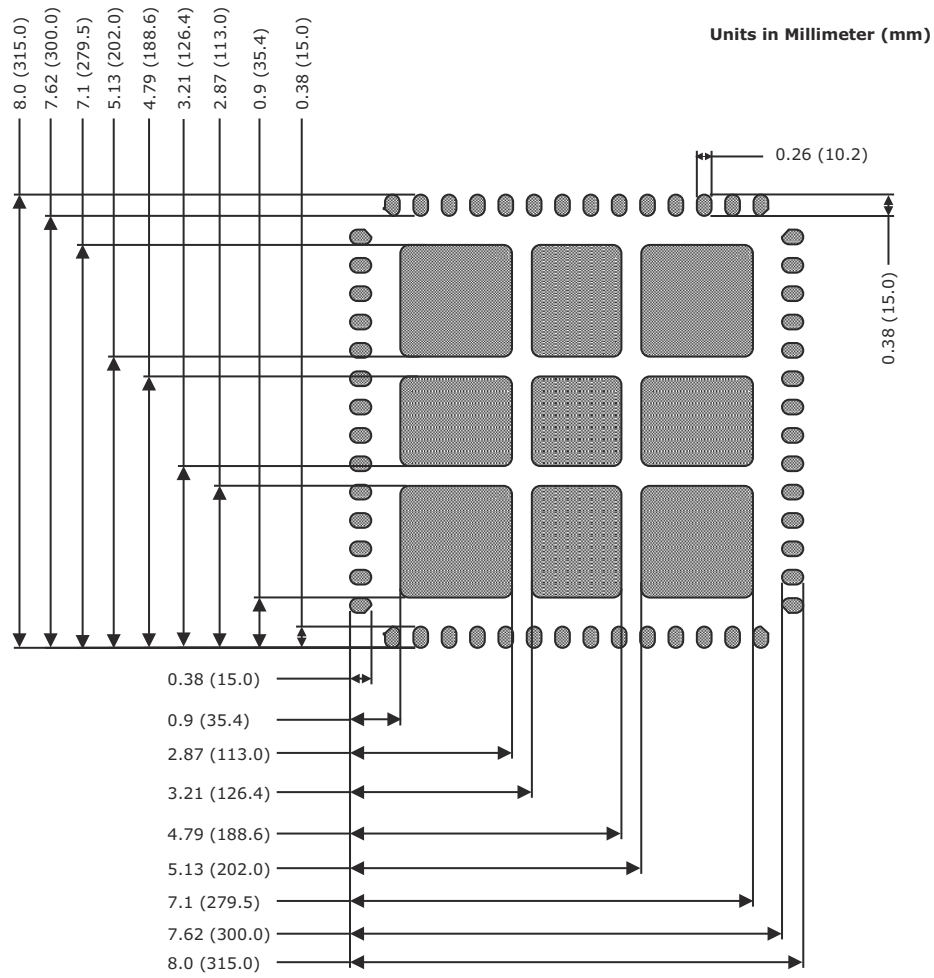




Figure 10 • Top-Layer Mask

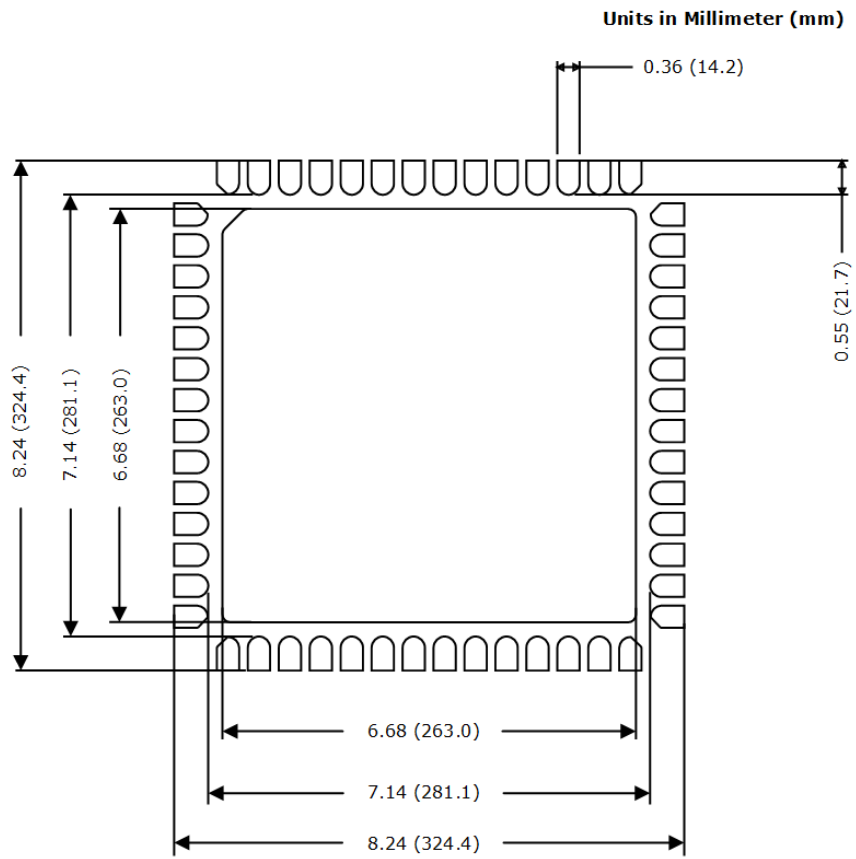
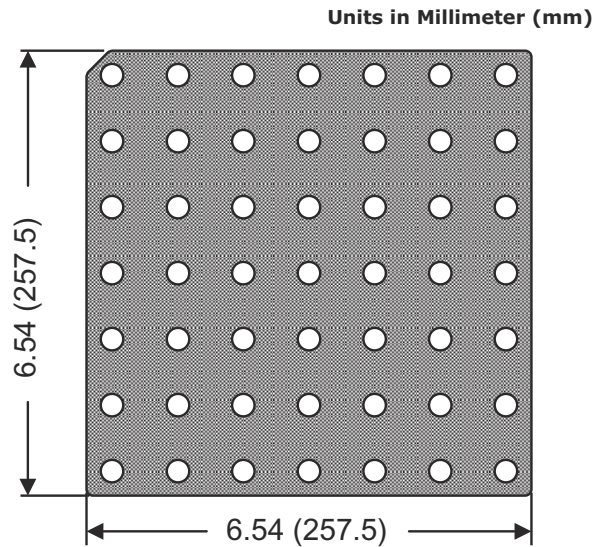
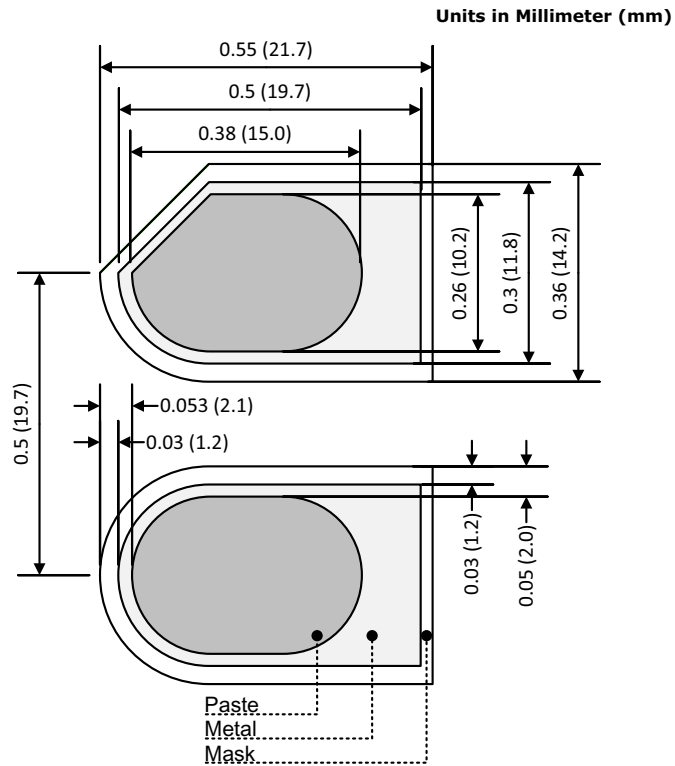


Figure 11 • BOT and Internal Layers Copper Plane



**Figure 12 • Top-Layer Pin Geometry**


**Note:** The CM has latitude to modify the solder paste stencil for manufacturability reasons. The solder paste stencil shall cover 65% to 80% of the thermal pad and must not allow solder to be applied to the thermal vias under the QFN package using any method they deem appropriate. Any design should be subject to system validation and qualification prior to commitment to mass production of field deployment. Use a 5 mil stencil.

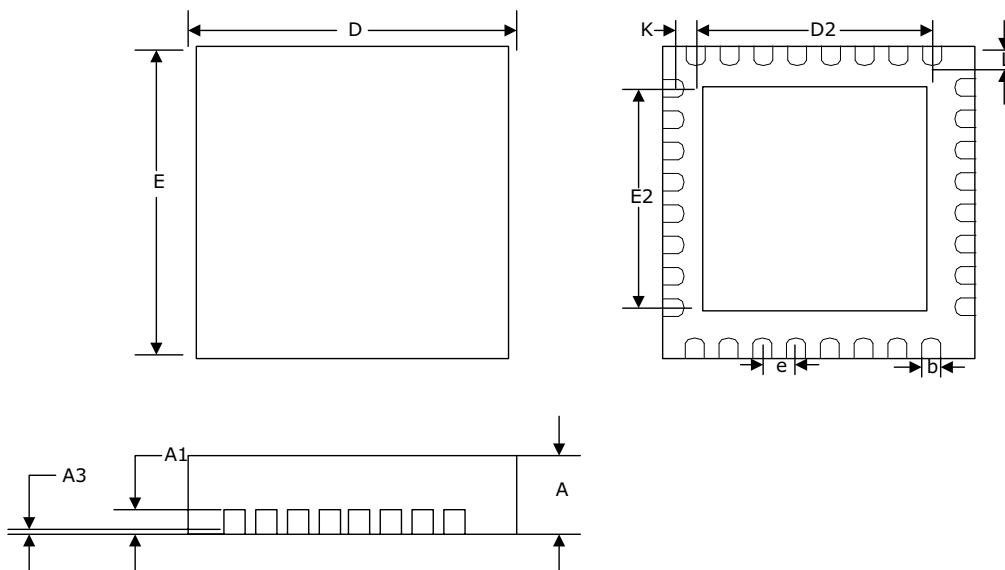
## 6 Package Information

This chapter describes package drawings of PD69200 and PD69208M devices.

### 6.1 PD69200 Package Outline Drawing

The following figure illustrates the package drawing of PD69200 device.

**Figure 13 • PD69200 Package Outline Drawing (32 Pin QFN 5 mm x 5 mm)**



The following table lists the dimensions and measurements of the PD69200 package.

**Table 20 • PD69200 Package Outline Dimensions and Measurements**

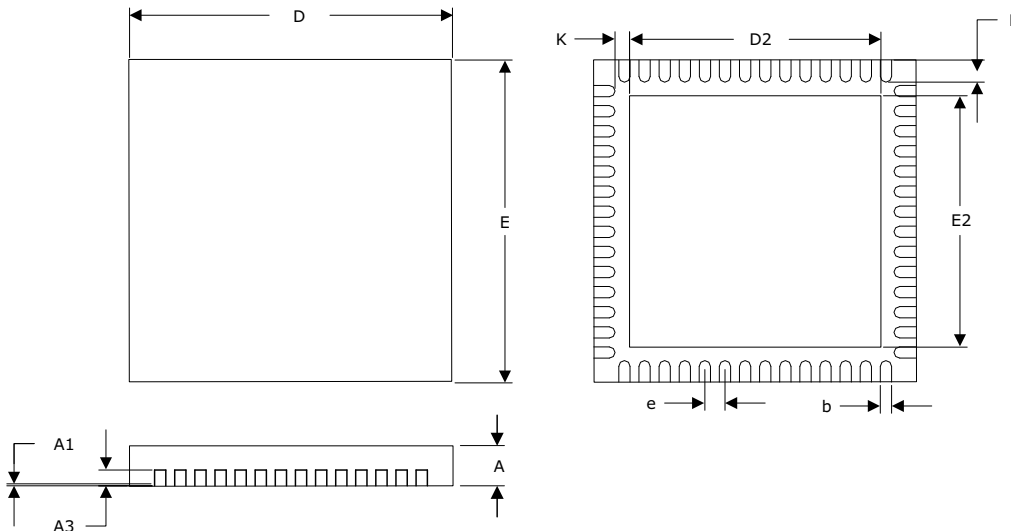
Dimension	Millimeters		Inches	
	Min	Max	Min	Max
A	0.80	1.00	0.031	0.039
A1	0.00	0.05	0	0.002
A3	0.20 REF		0.008 REF	
K	0.20 MIN		0.008 MIN	
e	0.50 BSC		0.02 BSC	
L	0.30	0.50	0.012	0.02
b	0.18	0.30	0.007	0.012
D2	3.50	3.70	0.138	0.147
E2	3.50	3.70	0.138	0.147
D	5.00 BSC		0.197 BSC	
E	5.00 BSC		0.197 BSC	

**Note:** Dimensions do not include protrusions; they should not exceed 0.155 mm (.006) on any side. Lead dimension should not include solder coverage. Dimensions are in millimeters and inches for reference.

## 6.2 PD69208M Package Outline Drawing

The following figure illustrates the package drawing of the PD69208M package.

**Figure 14 • PD69208M Package Drawing (56 Pin QFN 8 mm x 8 mm)**



The following table lists the dimensions and measurements of the PD69208M package.

**Table 21 • PD69208M Package Outline Dimensions and Measurements**

Dimension	Millimeters		Inches	
	Min	Max	Min	Max
A	0.80	1.00	0.031	0.039
A1	0.00	0.05	0	0.002
A3	0.20 REF		0.008 REF	
K	0.20 MIN		0.008 MIN	
e	0.50 BSC		0.02 BSC	
L	0.30	0.50	0.012	0.02
b	0.18	0.30	0.007	0.012
D2	6.50	6.75	0.256	0.267
E2	6.50	6.75	0.256	0.267
D	8.00 BSC		0.315 BSC	
E	8.00 BSC		0.315 BSC	

**Note:** Dimensions do not include protrusions; they should not exceed 0.155mm (.006) on any side. Lead dimension should not include solder coverage. Dimensions are in millimeters and inches for reference.

## 6.3 PD69208M Thermal Specifications

The following tables list the thermal specifications of PD69208M and PD69200.

**Table 22 • PD69208M Thermal Specifications**

Thermal Resistance	Typ	Units	Notes
$\theta_{JA}$	19.0	°C/W	Junction-to-ambient thermal resistance.
$\Psi_{JT}$	0.05	°C/W	Junction-to-top thermal characterization parameter. A thermal metric derived from the difference in junction temperature (T <sub>J</sub> ) and package top temperature (T <sub>T</sub> ) divided by total heating power (P <sub>H</sub> ).
$\theta_{JC (top)}$	4.9	°C/W	Junction-to-case thermal resistance with heat flow through package top.
$\theta_{JB}$	2.2	°C/W	Junction-to-board thermal resistance.

**Note:** All parameters are as per JEDEC JESD-51.

**Table 23 • PD69200 Thermal Specifications**

Thermal Resistance	Typ	Units	Notes
$\theta_{JA}$	33	°C/W	Junction-to-ambient thermal resistance.
$\Psi_{JT}$	8	°C/W	Junction-to-top thermal characterization parameter. A thermal metric derived from the difference in junction temperature (T <sub>J</sub> ) and package top temperature (T <sub>T</sub> ) divided by total heating power (P <sub>H</sub> ).
$\theta_{JC (top)}$	1.8	°C/W	Junction-to-case thermal resistance with heat flow through package top.
$\theta_{JB}$	12	°C/W	Junction-to-board thermal resistance.

## 6.4 Recommended Solder Reflow Information

- RoHS 6/6
- Pb-free 100% Matte Tin Finish
- Package Peak Temperature for Solder Reflow(40 seconds maximum exposure)—260 °C (+0 °C, -5 °C)

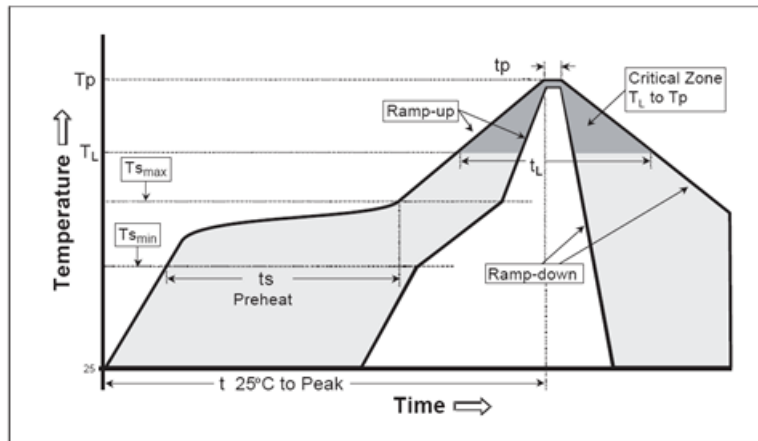
**Table 24 • Classification Reflow Profiles**

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-up Rate (T <sub>S<sub>max</sub></sub> to T <sub>p</sub> )	3 °C/second max	3 °C/second max
Preheat		
Temperature Min (T <sub>S<sub>min</sub></sub> )	100 °C	150 °C
Temperature Max (T <sub>S<sub>max</sub></sub> )	150 °C	200 °C
Time (t <sub>S<sub>min</sub></sub> to t <sub>S<sub>max</sub></sub> )	60 - 120 seconds	60 - 180 seconds

**Table 24 • Classification Reflow Profiles**

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Time Maintained		
Temperature ( $T_L$ )	183 °C	217 °C
Time ( $t_L$ )	60 - 150 seconds	60 - 150 seconds
Peak Classification Temperature ( $T_P$ )	210 - 235 °C	240 - 255 °C
Time within 5 °C of actual peak temperature ( $t_p$ )	10 - 30 seconds	20 - 40 seconds
Ramp-Down Rate	6 °C/second max	6 °C/second max
Time 25 °C to Peak Temperature	6 minutes max	8 minutes max

**Figure 15 • Classification Reflow Profiles**



**Table 25 • Pb-Free Process – Package Classification Reflow Temperatures**

Package Thickness	Volume $\text{mm}^3$		
	Volume $\text{mm}^3 < 350$	350 – 2000	Volume $\text{mm}^3 > 2000$
$< 1.6 \text{ mm}^1$	260 +0 °C	260 +0 °C	260 +0 °C
1.6 mm - 2.5 $\text{mm}^1$	260 +0 °C	250 +0 °C	245 +0 °C
$\geq 2.5 \text{ mm}^1$	250 +0 °C	245 +0 °C	245 +0 °C

1. Tolerance: The device manufacturer or supplier should assure process compatibility up to and including the stated classification temperature, meaning that the Peak reflow temperature is +0 °C. For example, 260 °C to 0 °C, at the rated MSL value.

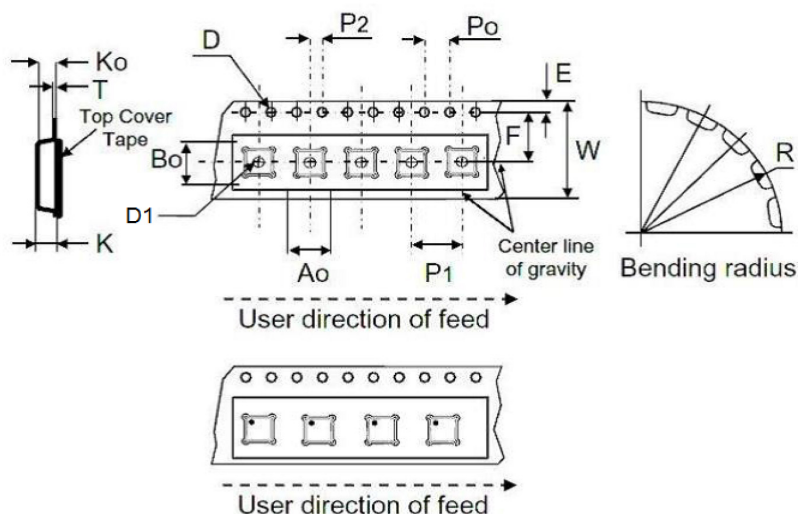
**Note:** Exceeding the ratings that are mentioned in [Table 25](#), page 32 may cause damage to the device.

## 6.5 Tape and Reel—Packaging Information

The following sections provide the tape and reel information.

### 6.5.1 PD69200 Tape and Reel Specification

Figure 16 • PD69200 Tape Specification

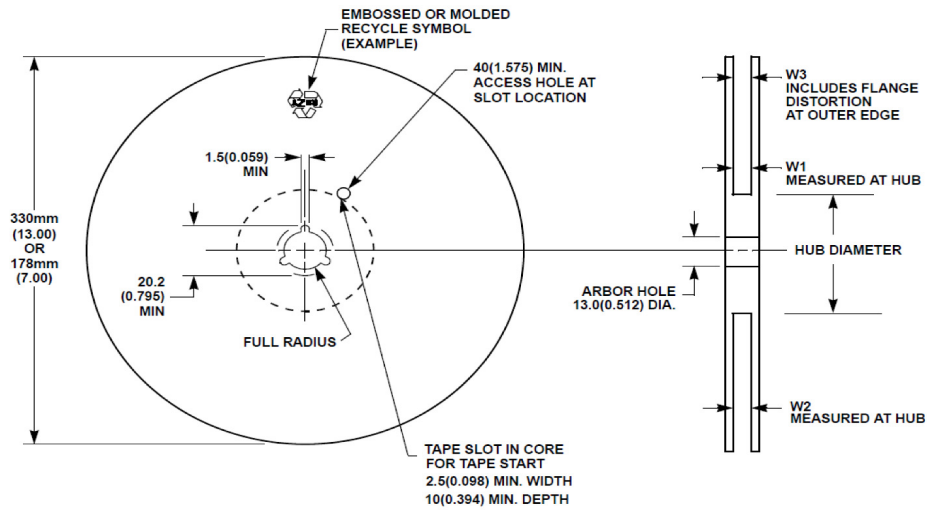


The following table lists the PD69200 tape mechanical data.

Table 26 • PD69200 Tape Mechanical Data

Dimensions	Value (mm)	Value (inches)
D	1.50 + 0.1/0	0.059 + 0.004/0
E	1.75 ±0.1	0.069 ±0.004
P0	4.00 ±0.1	0.157 ±0.004
T (max)	0.3 ±0.05	0.0118 ±0.003
D1	1.5	0.059
F	5.5 ±0.1	0.216 ±0.003
K (max)	1.6 ±0.1	0.063 ±0.004
P2	2.00 ±0.1	0.079 ±0.004
R	30	1.181
W	12.00 ±0.3	0.472 ±0.012
P1	8.00 ±0.1	0.31 ±0.004
K0	1.1	0.043
A0	5.30	0.208
B0	5.30	0.208

**Figure 17 • PD69200 Reel Specification**



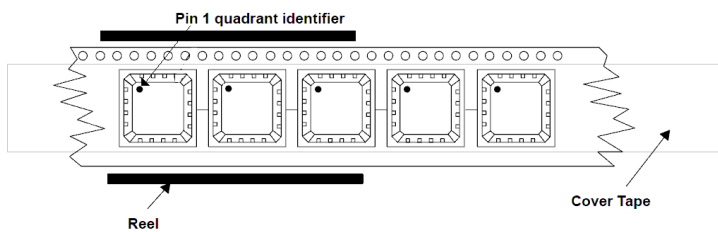
The following table lists the PD69200 reel mechanical data.

**Table 27 • PD69200 Reel Mechanical Data**

Dimensions	Value (mm)	Value (inches)
Tape size	12 +0.3	0.472 +0.012
W1	12.4	0.488
W2	18.4	0.724
W3	15.4	0.606

## 6.5.2 PD69208M Tape and Reel Specification

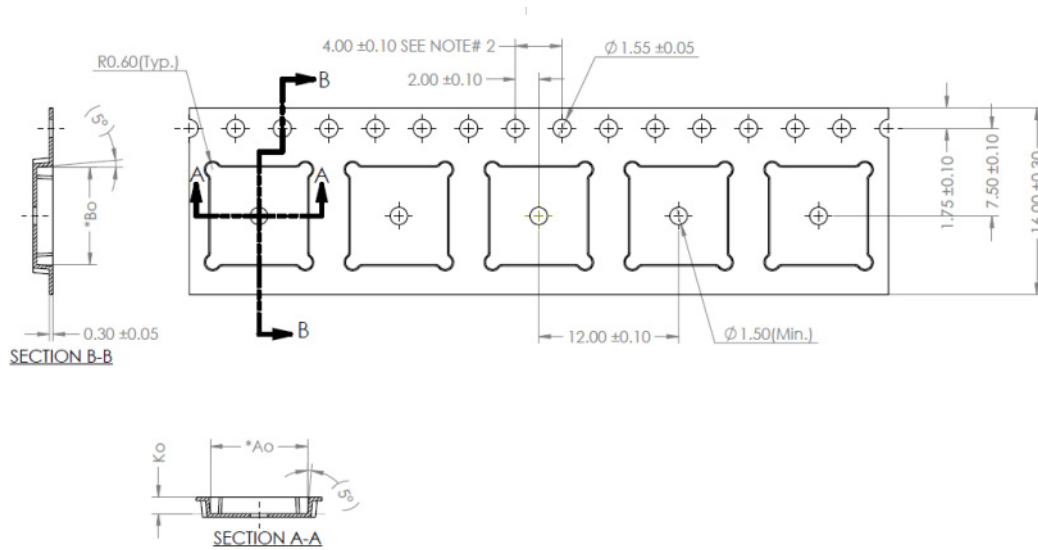
**Figure 18 • PD69208M Tape and Reel Pin-1 Orientation**



**Pin-1 Orientation of QFN Packages**



**Figure 19 • PD69208M Tape Specifications**

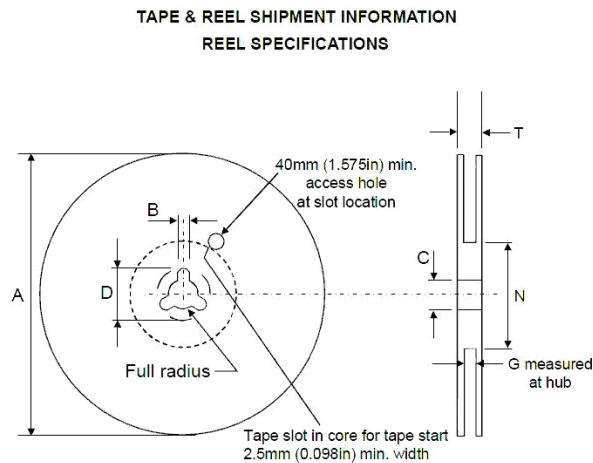


The following table lists the PD69208M tape mechanical data.

**Table 28 • PD69208M Tape Mechanical Data**

Dimension	Value (mm)
A0	8.35 ± 0.10
B0	8.35 ± 0.10
K0	1.40 ± 0.10
K1	N/A
Pitch	12.00 ± 0.10
Width	16.00 ± 0.30

**Figure 20 • PD69208M Reel Specifications**



**Table 29 • PD69208M Reel Mechanical Data**

Dimensions	Value (mm)	Value (inch)
Tape size	16.00 ±0.3	0.630 ±0.012
A max.	330	13"
B max	1.5	0.059
C	13.0 ±0.20	0.512 ±0.008
D min.	20.2	0.795
N min.	50	1.968
G	16.4+2.0/-0.0	0.645+ 0.079/-0.0
T max	29	1.142
BASE QUANTITY	2000 pcs.	

## 6.6 Reference Documents

- IEEE Std 802.3-2018 Clause 33 Power over Ethernet over 2-Pair and Clause 145 Power over Ethernet
- Microsemi, Serial communication protocol user guide, Catalog Number: PD69200\_UG\_COMM\_PROT
- Microsemi, Designing 48-port Enhanced PoE System (802.3af/802.3at Compliant) application note, Catalog Number: PD69208\_AN\_211
- Microsemi, Software Download Algorithm technical note (TN-140), Catalog Number: 06-0024-081
- Microsemi, PoE LED stream technical note, Catalog Number: PD69100\_TN\_201
- NXP, Kinetis\_L MKL15Z128VFM4 datasheet
- NXP package drawings 98ASA00473D

## 7 Application Information

PD69208M/PD69200 PSE Chipset performs IEEE802.3af (Type 1), IEEE802.3at (Type 2), and IEEE802.3bt (Type 3) PSE functionalities in addition to pre-standard and legacy (capacitor) detection. Moreover, it includes additional protections such as short circuit and dV/dT protection upon startup.

**Note:** IEEE802.3bt functionality will be enabled by a firmware upgrade.

### 7.1 PD Detection

The PD detection feature detects a valid IEEE802.3af, IEEE802.3at or IEEE802.3bt. The PD detection is done based on four different voltage levels generated over PD (the load) as illustrated in [Figure 22](#), page 38.

### 7.2 Legacy (Reduced Capacitor) Detection

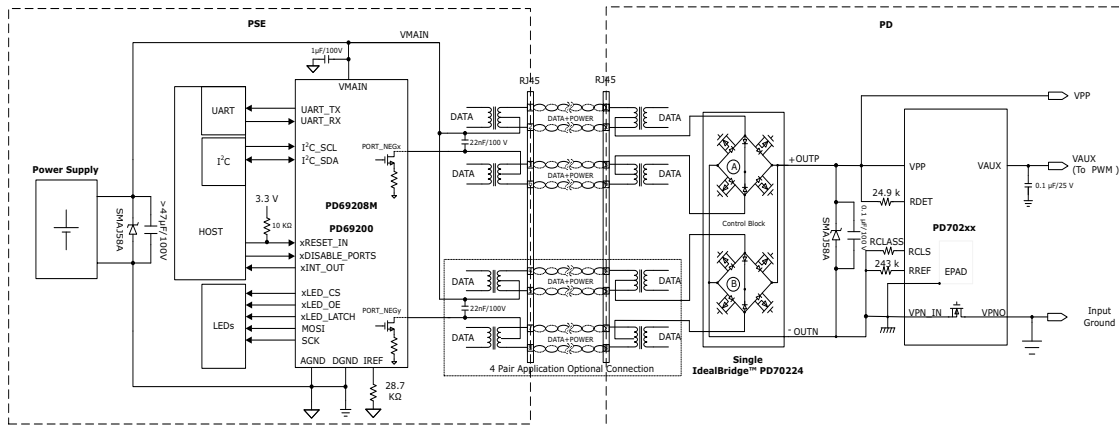
When legacy detection is enabled, the PD detection mechanism detects and powers up legacy and pre-standard PDs as well as IEEE802.3af, IEEE802.3at and IEEE802.3bt standard compliant PDs (Classes 0 - 6).

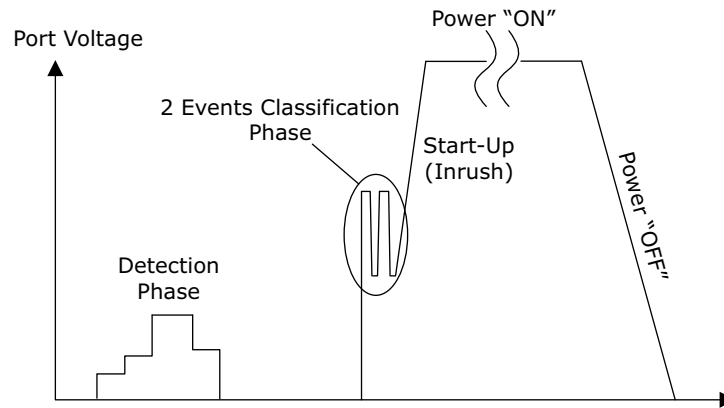
### 7.3 Classification

The classification process takes place immediately after PD detection is successfully completed. The goal of the classification process is to detect PD class as specified in IEEE802.3 standards.

In IEEE802.3af mode, the classification mechanism is based on a single voltage level (single event). In IEEE802.3at and IEEE802.3bt modes, the classification mechanism is based on two voltage levels (multiple events) as defined in IEEE802.3-2015 Clause 33 and IEEE802.3bt.

**Figure 21 • 4-Pair PoE System Diagram**



**Figure 22 • Typical IEEE802.3at Port PoE Voltage Diagram**


## 7.4 Port Start Up

Upon a successful detection and classification process, power is applied to the load via a controlled start up mechanism.

During this period, inrush current is limited to 425 mA for a typical duration of 65 mS, which allows PD load to charge and allows steady state of power condition.

## 7.5 Over-Load Detection and Port Shut Down

After power up, PD69208M automatically initializes its internal protection mechanisms. These mechanisms are used to monitor and disconnect power from the PD when extreme conditions occur, as specified in the IEEE802.3 standards. These conditions include over-current or short ports terminals scenarios.

## 7.6 Disconnect Detection

PD69208M supports the DC disconnect function as per IEEE802.3 standards. This mechanism continuously monitors load current and disconnects power according to  $I_{UDL}$ ,  $T_{MPDO}$ , and  $T_{MPS}$  parameters as specified in Table 10, page 14.

## 7.7 IC Thermal Monitoring

PD69208M contain a thermal sensor that is sampled by the PD69200 for every 20 mS so that the PD69208M die temperature is monitored at all times. If the die exceeds the temperature limit (150 °C), the system ports are disconnected to protect the PD69208M ICs.

A temperature alarm threshold can be set by PD69200 controller to send interrupt indication by the xINT\_OUT pin before ports are disconnected. The temperature can be read and monitored by the host as well, if required.

## 7.8 Over-Temperature Protection

In addition to the die thermal sensor, there are thermal sensors on each MOSFET that continuously monitors each port main MOSFETs junction temperature, and shuts down the port load power when the temperature exceeds 200 °C.

## 7.9 $V_{MAIN}$ Out of Range Protection

The system automatically disconnects ports power when  $V_{MAIN}$  exceeds the pre-configured over-voltage and under-voltage thresholds.

## 7.10 2-Pair and 4-Pair Ports

Operation modes include the following:

- POE Type 1/2 class 0-4 (up to 30 W)
- POE Type 3 class 0-4 2-Pair and class 5-6 4-Pair (up to 60 W)

**Note:** For more information about 4-Pair operation modes and power configuration, see *Microsemi\_PoE\_4\_Pair\_Behavior\_PD6920x\_PSE\_Application\_Note\_160159*.

## 7.11 Power Management

System supports three power management modes:

- Class (LLDP and CDP)
- Dynamic
- Static

## 7.12 Port Power Limit

Port power limit (PPL) is used to configure port power limit. When a port exceeds the power limit, it gets disconnected automatically.

## 7.13 Reset Pin

xRESET pin is PD69200 digital host reset input (Active Low). The shortest pulse that is guaranteed to be recognized is 100 nSec. PD69200 can generate self-reset. The xRESET pin is driven low by PD69200 for at least 128 bus clock cycles until the flash initialization has completed. It is recommended to connect this pin to a host open drain output with pull-up in a range of 4.7 K $\Omega$  to 10 K $\Omega$ . If this pin is connected to a push/pull driver, a serial resistor of 4.7 K $\Omega$  must be connected instead of pull-up. Avoid resetting the PD69208M IC directly by the RESET\_N pin. The PD69200 controls the PD69208M ICs if system reset is needed.

For more information about this pin connectivity, see the hardware application note, Catalog Number: PD69208\_AN\_211.

## 7.14 System OK Indication

Digital output pin to host is used as a system validity indication. When system is OK pin state is low. The behavior of this output is controlled by software mask register settings (Mask 0x28). The mask default settings is 0, meaning that this pin indicates valid software and  $V_{main}$  is in range. This pin is active low.

For more information, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200\_UG\_COMM\_PROT.

## 7.15 Interrupt Pin

Interrupt out from PoE controller, indicating events such as: port on, port off, port fault, PoE device fault, voltage out of range, and more. For a full list of interrupt events, see the Serial Communication Protocol User Guide document - Catalog Number: PD69200\_UG\_COMM\_PROT. This pin is active low.

## 7.16 Port Matrix Control

Port matrix control enables layout designers to ascribe each physical port in the system to a logical port if required.

## 7.17 Power Good Interrupt

Interrupt from power supply directly to PD69208M manager. For systems comprising more than a single power supply, in case one power supply fails, a port shutdown mechanism is executed to maintain operation and prevent collapse of other power supplies.

When function is used, PGD0, PGD1, PGD2, and PGD3 should be connected to main power supplies status indication pin. Any change of at least 1  $\mu$ S on these lines triggers a pre-defined disconnection

matrix. This matrix is defined by PD69200 system power parameters. The port shutdown function reacts within 2  $\mu\text{s}$  to any power good event.

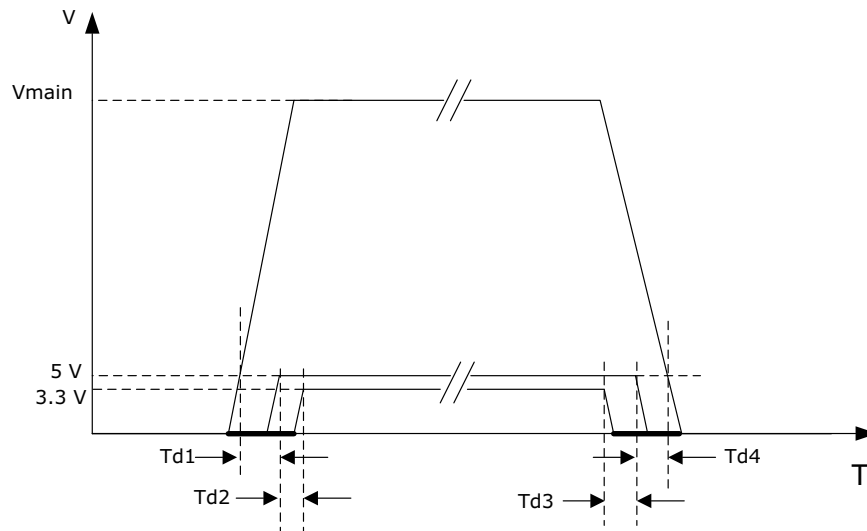
## 7.18 LED Stream

The direct SPI interface to an external LED stream circuitry that can drive LEDs directly without the host intervention. It enables designers to implement a simple LED circuit that does not require a software code. The LED stream clock frequency is 1 MHz.

For more information, see the TN-218, catalog number PD69200\_TN\_218.

## 7.19 Power Sequencing

Figure 23 • Power Sequencing



When using external  $V_{aux5}$  or  $V_{aux3p3}$

- Td1:  $V_{main}$  at 5 V to  $V_{aux5} > 0 \mu\text{S}$
- Td2:  $V_{aux5}$  to  $V_{aux3p3} > 0 \mu\text{S}$
- Td3:  $V_{aux3p3}$  to  $V_{aux5} > 0 \mu\text{S}$
- Td4:  $V_{aux5}$  to  $V_{main}$  at 5 V  $> 0 \mu\text{S}$
- $DV_{DD} = V_{aux3p3}$

**Note:** See the Application Note AN211 - Designing a PD69208 48-port PoE System 802.3af/802.3at compliant.

For proper operations, you need to ensure that  $V_{main}$  is always in the highest voltage connected to the IC. With an external DC-DC converter, the maximum 3.3 V slew rate is 100 mS.

## 8 Ordering Information

The following table the part ordering information for PD69200 and PD69208M devices.

**Table 30 • Ordering Information**

Part Number	Package	Packaging Type	Temperature	Part Marking	Tray Marking
PD69200D <sup>1</sup> -VVVV <sup>2</sup> SS <sup>3</sup>	Plastic QFN 5 mm × 5 mm (32 lead)	Tray	–40 °C to 85 °C	Microsemi Logo NXP Logo 69200 M15M7V <sup>4</sup> XXXXX <sup>5</sup> YYYYY <sup>6</sup>	PD69200D- VVVVSS PD-OOOOG3bb <sup>7</sup> YYWW
PD69200D-VVVVSS-TR	Plastic QFN 5 mm × 5 mm (32 lead)	Tape and Reel	–40 °C to 85 °C	Microsemi Logo NXP Logo 69200 M15M7V <sup>4</sup> XXXXX <sup>5</sup> YYYYY <sup>6</sup>	PD69200- VVVVSS-TR PD-OOOOT3bb <sup>7</sup> YYWW
PD69208MILQ-TR-LE	Plastic QFN 8 mm × 8 mm (56 lead)	Tape and Reel	–40 °C to 85 °C	Microsemi Logo PD69208M F R e4 <sup>8</sup> YYWWAZZ <sup>9</sup>	
PD69208MILQ-TR	Plastic QFN 8 mm × 8 mm (56 lead)	Tape and Reel	–40 °C to 85 °C	Microsemi Logo PD69208M F R e4 <sup>8</sup> YYWWAZZ <sup>9</sup>	

- D stands for the detection method set as: C: Detection Method = IEEE802.3 and pre-standard;  
R: Detection Method = IEEE802.3.
- VVVV is firmware revision
- SS stands for firmware parameters option
- Short part number
- Mask set
- Date code
- MKTG Product Type (Detection = R: Resistor/D = C: Resistor/Legacy)/Version/SW Parameters/Operation P/N.
- F = FAB Code, R = Product revision code (D for V2R2 and E for V2R4), and e4 = 2<sup>nd</sup> level interconnect.
- YY = Year, WW = Week, A = Assembly location, and ZZ = assembly lot sequence code.

The Firmware Release Notes has all the required information about how to specify the choice of VVVV and SS. You can find the Firmware Release Notes in the [Microchip Software Libraries](#), and register yourself to a My Microchip account to have access to the release notes.

**Note:** The package meets RoHS, Pb-free, and MSL3 of the European Council to minimize the environmental impact of electrical equipment.

**Note:** Initial burning of controller's firmware is performed in factory. Firmware upgrades can be performed by users using communication interface. For more information, see TN-140, Catalog Number: 06-0024-081.

The following table lists the manufacturing and ordering part numbers of PD69208M devices.

**Table 31 • PD69208M Manufacturing and Ordering Part Numbers**

Ordering Part Number	Die Revision	Product Revision Code	Manufacturing Part Number
PD69208MILQ-TR-LE	V2R4	E	PD69208MILQ-TR-LE
PD69208MILQ-TR	V2R4	E	PD69208MILQ-TR-LE

Customers can order the PD69208M device using either the ordering part number or the manufacturing part number. See [Table 30](#), page 41 for package, packing type, temperature, and part marking information.