







TPS23882B SLVSG51A - APRIL 2021 - REVISED FEBRUARY 2022

TPS23882B Type-3 2-Pair 8-Channel PSE Controller with Autonomous Mode, SRAM, and 200-mΩ RSENSE

1 Features

- IEEE 802.3bt PSE solution for PoE 2 Type-3 2-Pair power over ethernet applications
- Compatible with TI's FirmPSE system firmware
- SRAM Programmable memory
- Programmable power limiting accuracy ±4%
- 200-m Ω current sense resistor
- User-selectable 15-W or 30-W autonomous mode with no MCU required
- Selectable 2-pair port power allocations
 - 4 W. 7 W. 15.4 W. or 30 W
- Dedicated 14-bit integrating current ADC per port
 - Noise immune MPS for DC disconnect
 - 2% current sensing accuracy
- 1- or 3-bit fast port shutdown input
- Auto-class discovery and power measurement
- Never fooled 4-point detection
- Inrush and operational foldback protection
- 425-mA and 1.25-A selectable current limits
- Port re-mapping
- 8-bit or 16-bit I²C communication
- Flexible processor controlled operating modes
 - Auto, semiauto and manual / diagnostic
- Per port voltage monitoring and telemetry
- -40 °C to +125 °C temperature operation

2 Applications

- Video recorder (NVR, DVR, and so forth)
- Small business switch
- Campus and branch switches

3 Description

The TPS23882B is an 8-channel power sourcing equipment (PSE) controller engineered to insert power onto Ethernet cables in accordance with the IEEE 802.3bt standard. The PSE controller can detect powered devices (PDs) that have a valid signature, complete mutual identification, and apply power.

The TPS23882B improves on the TPS2388 with reduced current sense resistors, SRAM power programmability, programmable capacitance measurement, and compatibility with TI's FirmPSE system firmware (see Device Comparison Table).

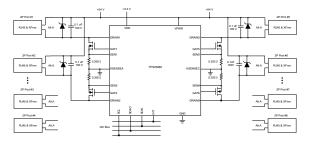
Programmable SRAM enables in-field firmware upgradability over I²C to ensure IEEE compliance and interoperability with the latest PoE enabled devices. Dedicated per port ADCs provide continuous port current monitoring and the ability to perform parallel classification measurements for faster port turn on times. A 1.25-A port current limit and adjustable power limiting allows for the support of non-standard applications above 60-W sourced. The 200-m Ω current sense resistor and external FET architecture allow designs to balance size, efficiency, thermal and solution cost requirements.

Port remapping and pin-to-pin compatibility with the TPS2388, TPS23880, and TPS23881 devices eases migration from previous generation PSE designs and enables interchangeable 2-layer PCB designs to accommodate different system PoE power configurations.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS23882B	VQFN (56)	8.00 mm × 8.00 mm

For all available packages, see the orderable addendum at the end of the data sheet.



Simplified Schematic



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

С	hanges from Revision * (April 2021) to Revision A (February 2022)	Page
•	Changed all instances of legacy terminology to controller and target where I ² C is mentioned	1
•	Corrected the ESD Ratings charged device model row to show testing was per JS-002	7
•	Updated the Functional Block Diagram	26
•	Changed the reset state value for register 0x43	33
	Updated Figure 12-2	



5 Device Comparison Table

Table 5-1 summarizes the primary differences between the available 2-pair PSE devices.

KEY FEATURES	TPS23880	TPS23881	TPS23882B
Compatible with TI's FirmPSE system firmware	N/A	Yes	Yes
Pin-to-pin compatible	Yes	Yes	Yes
Number of PSE channels	8	8	8
Supported IEEE 802.3 PSE Types	PoE 2 802.3bt Type 3 or 4 (2 or 4 pair)	PoE 2 802.3bt Type 3 or 4 (2 or 4 pair)	PoE 2 802.3bt Type 3 (2 pair)
R _{SENSE}	0.255 Ω	0.200 Ω	0.200 Ω
2-pair P _{CUT} programmable ranges	0.5 W to 54 W	2 W to 65 W	2 W to 65 W
4-pair P _{CUT} programmable ranges	0.5 W to 108 W	4 W to 127 W	N/A
90+ W 4-pair P _{CUT} accuracy	±3.0 %	±2.5 %	N/A
Channel capacitance measurement range	N/A	1 μF to 12 μF	1 μF to 12 μF
ULA packaging	No	Yes (TPS23881A)	N/A
I ² C programmable SRAM memory	16 kB	16 kB	16 kB

Table 5-1. 2-Pair PSE Key Feature Comparisons

Table 5-1. 2-1 all 1 3E Rey 1 eature companisons							
KEY FEATURES	TPS23861	TPS2388	TPS23881	TPS23882B			
Compatible with TI's <i>FirmPSE</i> system firmware	N/A	N/A	Yes	Yes			
Pin-to-pin compatible	N/A	Yes	Yes	Yes			
Number of PSE channels	4	8	8	8			
Supported IEEE 802.3 PSE Types	PoE 1 802.3 at Type 1 or 2	PoE 1 802.3 at Type 1 or 2	PoE 2 802.3bt Type 3 or 4 (2 or 4 pair)	PoE 2 802.3bt Type 3 (2 pair)			
R _{SENSE}	0.255 Ω	0.255 Ω	0.200 Ω	0.200 Ω			
2-pair P _{CUT} programmable ranges	N/A I _{CUT} adjustable up to 920 mA	N/A I _{CUT} adjustable up to 920 mA	2 W to 65 W	2 W to 65 W			
T _{MPS}	15 ms	15 ms	3 ms	3 ms			
Port current limit (1x / 2x)	425 mA / 1060 mA	425 mA / 1060 mA	425 mA / 1250 mA	425 mA / 1250 mA			
Channel capacitance measurement range	N/A	N/A	1 μF to 12 μF	1 μF to 12 μF			
PD auto-class discovery and power measurement	N/A	N/A	Yes	Yes			
I ² C programmable SRAM memory	N/A	N/A	16 kB	16 kB			



6 Pin Configuration and Functions

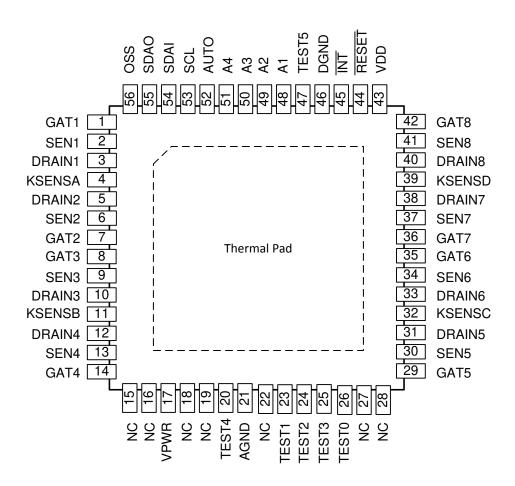


Figure 6-1. RTQ Package with Exposed Thermal Pad 56-Pin VQFN Top View

Table 6-1. Pin Functions

F	PIN	I/O	DESCRIPTION	
NAME	NO.	1/0	DESCRIF HON	
A1-4	48–51	ı	I ² C A1-A4 address lines. These pins are internally pulled up to VDD.	
AGND	21	_	Analog ground. Connect to GND plane and exposed thermal pad.	
DGND	46	_	ital ground. Connect to GND plane and exposed thermal pad.	
DRAIN1-8	3, 5, 10, 12, 31, 33, 38, 40	I	nannel 1-8 output voltage monitor	
GAT1-8	1, 7, 8, 14, 29, 35, 36, 42	0	Channel 1-8 gate drive output	
ĪNT	45	0	Interrupt output. This pin asserts low when a bit in the interrupt register is asserted. This output is open-drain.	
KSENSA/B	4, 11	I	lvin point connection for SEN1-4	
KSENSC/D	32, 39	I	Kelvin point connection for SEN5-8	

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Table 6-1. Pin Functions (continued)

F	PIN	I/O	DESCRIPTION
NAME NO.		1/0	DESCRIPTION
NC	15, 16, 18, 19	0	No connect pins. These pins are internally biased at 1/3 and 2/3 of VPWR in order to control the voltage gradient from VPWR. Leave open.
	22, 27, 28	_	No connect pin. Leave open.
oss	56	ı	Channel 1-8 fast shutdown. This pin is internally pulled down to DGND.
RESET	44	ı	Reset input. When asserted low, the TPS23882B is reset. This pin is internally pulled up to VDD.
SCL	53	ı	Serial clock input for I ² C bus.
SDAI	54	ı	Serial data input for I ² C bus. This pin can be connected to SDAO for non-isolated systems.
SDAO	55	0	Serial data output for I ² C bus. This pin can be connected to SDAI for non-isolated systems. This output is open-drain.
AUTO	52	I/O	Autonomous mode enable and selection pin
SEN1-8	2, 6, 9, 13, 30, 34, 37, 41	ı	Channel 1-8 current sense input
TEST0-5	20, 23, 24, 25, 26, 47	I/O	Used internally for test purposes only. Leave open.
Thermal pad	_	_	The DGND and AGND terminals must be connected to the exposed thermal pad for proper operation.
VDD	43	_	Digital supply. Bypass with 0.1 μF to DGND pin.
VPWR	17	_	Analog 54-V positive supply. Bypass with 0.1 μF to AGND pin.

6.1 Detailed Pin Description

The following descriptions refer to the pinout and the functional block diagram.

DRAIN1-DRAIN8: Channels 1-8 output voltage monitor and detect sense. Used to measure the port output voltage, for port voltage monitoring, port power good detection and foldback action. Detection probe currents also flow into this pin.

The TPS23882B uses an innovative 4-point technique to provide reliable PD detection and avoids powering an invalid load. The discovery is performed by sinking two different current levels via the DRAINn pin, while the PD voltage is measured from VPWR to DRAINn. If prior to starting a new detection cycle the port voltage is > 2.5 V, an internal $100\text{-k}\Omega$ resistor is connected in parallel with the port and a 400-ms detect backoff period is applied to allow the port capacitor to be discharged before the detection cycle starts.

There is an internal resistor between each DRAINn pin and VPWR in any operating mode except during detection or while the port is ON. If the port n is not used, DRAINn can be left floating or tied to GND.

GAT1-GAT8: Channels 1-8 gate drive outputs are used for external N-channel MOSFET gate control. At port turn-on, the gate drive outputs are driven positive by a low current source to turn the MOSFET on. GATn is pulled low whenever any of the input supplies are low or if an overcurrent timeout has occurred. GATn is also pulled low if the port is turned off by use of manual shutdown inputs. Leave floating if unused.

For improved design robustness, the current foldback functions limit the power dissipation of the MOSFET during low resistance load or short-circuit events and during the inrush period at port turn on. There is also fast overload protection comparator for major faults like a direct short that forces the MOSFET to turn off in less than a microsecond.

The circuit leakage paths between the GATn pin and any nearby DRAINn pin, GND or Kelvin point connection must be minimized (< 250 nA), to ensure correct MOSFET control.

INT: This interrupt output pin asserts low when a bit in the interrupt register is asserted. This output is open-drain.

KSENSA, **KSENSB**, **KSENSC**, **KSENSD**: Kelvin point connection used to perform a differential voltage measurement across the associated current sense resistors.

Each KSENS is shared between two neighbor SEN pins as following: KSENSA with SEN1 and SEN2, KSENSB with SEN3 and SEN4, KSENSC with SEN5 and SEN6, KSENSD with SEN7 and SEN8. To optimize the measurement accuracy, ensure proper PCB layout practices are followed.

OSS: Fast shutdown, active high. This pin is internally pulled down to DGND, with an internal 1-µs to 5-µs deglitch filter.

The turn-off procedure is similar to a port reset using reset command (1Ah register). The 3-bit OSS function allows for a series of pulses on the OSS pin to turn off individual or multiple ports with up to eight levels of priority.

RESET: Reset input, active low. When asserted, the TPS23882B resets, turning off all ports and forcing the registers to their power-up state. This pin is internally pulled up to VDD, with internal 1-µs to 5-µs deglitch filter. The designer can use an external RC network to delay the turn-on. There is also an internal power-on-reset which is independent of the RESET input.

SCL: Serial clock input for I²C bus.

SDAI: Serial data input for I²C bus. This pin can be connected to SDAO for non-isolated systems.

SDAO: Open-drain I²C bus output data line. Requires an external resistive pullup. The TPS23882B uses separate SDAO and SDAI lines to allow optoisolated I²C interface. SDAO can be connected to SDAI for non-isolated systems.

AUTO: Autonomous mode selection pin: Floating this pin disables autonomous operation. Tying this pin to GND through a resistor (R_{AUTO}) enables autonomous operation at selectable port power allocation levels. A 10-nF capacitor is required between the AUTO pin and GND if R_{AUTO} is connected.

A4-A1: I²C bus address inputs. These pins are internally pulled up to VDD. See *Section 9.6.2.13* for more details.

SEN1-8: Channel current sense input relative to KSENSn (see KSENSn description). A differential measurement is performed using KSENSA-D Kelvin point connection. Monitors the external MOSFET current by use of a $0.200-\Omega$ current sense resistor connected to GND. Used by current foldback engine and also during classification. Can be used to perform load current monitoring via ADC conversion.

When the TPS23882B performs the classification measurements, the current flows through the external MOSFETs. This flow avoids heat concentration in the device and makes it possible for the TPS23882B to perform classification measurements on multiple ports at the same time. For the current limit with foldback function, there is an internal 2- μ S analog filter on the SEN1-8 pins to provide glitch filtering. For measurements through an ADC, an anti-aliasing filter is present on the SEN1-8 pins. This includes the port-powered current monitoring, port policing, and DC disconnect.

If the port is not used, tie SENn to GND.

VDD: 3.3-V logic power supply input.

VPWR: High voltage power supply input. Nominally 54 V.

AGND and DGND: Ground references for internal analog and digital circuitry respectively. Not connected together internally. Both pins require a low resistance path to the system GND plane. If a robust GND plane is used to extract heat from the device's thermal pad, these pins can be connected together through the thermal pad connection on the pcb.



7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
	VPWR	-0.3	70	V
	VDD	-0.3	4	V
	OSS, RESET, A1-A4	-0.3	4	V
	SDAI, SDAO, SCL, INT	-0.3	4	V
Voltage	SEN1-8, KSENSA, KSENSB, KSENSC, KSENSD	-0.3	3	V
	GATE1-8	-0.3	13	V
	DRAIN1-8	-0.3	70	V
	AGND-GDND	-0.3	0.3	V
Sink Current	INT, SDA		20	mA
Lead Temperatu	re 1/6mm from case for 10 seconds		260	°C
T _{stg}	Storage temperature	-65	150	°C

⁽¹⁾ Stresses beyond those listed under Absolute Maximum Rating may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Condition. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

7.2 ESD Ratings

			VALUE	UNIT
V	Electrostatio discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾	±2000	V
V _(ESD)		Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002, all pins ⁽²⁾	± 500	

- (1) JEDEC documentJEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC documentJEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_{VDD}		3	3.3	3.6	V
V _{VPWR}		44	54	57	V
	Voltage slew rate on VPWR			1	V/µs
f _{SCL}	I ² C clock frequency			400	kHz
T _J	Junction temperature	-40		125	°C

7.4 Thermal Information

		TPS23882B		
	THERMAL METRIC ⁽¹⁾	RTQ Package (VQFN)	UNIT	
		56 PINS		
$R_{\theta JA}$	Junction-to-ambient thermal resistance	25.3	°C/W	
R ₀ JC(top)	Junction-to-case (top) thermal resistance	9.7	°C/W	
R _{θJB}	Junction-to-board thermal resistance	3.7	°C/W	
Ψ_{JT}	Junction-to-top characterization parameter	0.2	°C/W	
Ψ_{JB}	Junction-to-board characterization parameter	3.7	°C/W	
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	0.5	°C/W	

For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.



7.5 Electrical Characteristics

Conditions are $-40 < T_J < 125~^{\circ}\text{C}$ unless otherwise noted. $V_{VDD} = 3.3~\text{V}, V_{VPWR} = 54~\text{V}, V_{DGND} = V_{AGND}, DGND, KSENSA, KSENSB, KSENSC and KSENSD connected to AGND, and all outputs are unloaded, <math>2xFBn = 0$. Positive currents are into pins. $R_S = 0.200~\Omega$, to KSENSA (SEN1 orSEN2), to KSENSB (SEN3 or SEN4), to KSENSC (SEN5 or SEN6) or to KSENSD (SEN7 or SEN8). Typical values are at 25 °C. All voltages are with respect to AGND unless otherwise noted. Operating registers loaded with default values unless otherwise noted.

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
INPUT SUPPL	Y VPWR				-	
I _{VPWR}	VPWR Current consumption	VVPWR = 54 V		10	12.5	mA
V _{UVLOPW_F}	VPWR UVLO falling threshold	Check internal oscillator stops operating	14.5		17.5	V
V _{UVLOPW_R}	VPWR UVLO rising threshold		15.5		18.5	V
V _{PUV_F}	VPWR Undervoltage falling threshold	VPUV threshold	25	26.5	28	V
INPUT SUPPL	Y VDD				1	
I _{VDD}	VDD Current consumption			6	12	mA
V _{UVDD_F}	VDD UVLO falling threshold	For channel deassertion	2.1	2.25	2.4	V
V _{UVDD_R}	VDD UVLO rising threshold		2.45	2.6	2.75	V
V _{UVDD_HYS}	Hysteresis VDD UVLO			0.35		V
V _{UVW_F}	VDD UVLO warning threshold	VDD falling	2.6	2.8	3	V
A/D CONVERT	TERS				1	
T _{CONV_I}	Conversion time	All ranges, each channel	0.64	0.8	0.96	ms
T _{CONV_V}	Conversiontime	All ranges, each channel	0.82	1.03	1.2	ms
T _{INT_CUR}	Integration time, Current	Each channel, channel ON current	82	102	122	ms
T _{INT_DET}	Integration time, Detection		13.1	16.6	20	ms
T _{INT_channelV}	Integration time, Channel Voltage	channel powered	3.25	4.12	4.9	ms
T _{INT_inV}	Integration time, Input Voltage		3.25	4.12	4.9	ms
	Input voltage conversion scale factor and accuracy	VVPWR = 57 V	15175	15565	15955	Counts
			55.57	57	58.43	V
		VVPWR = 44 V	11713	12015	12316	Counts
			42.89	44	45.10	V
		VVPWR - VDRAINn = 57 V	15175	15565	15955	Counts
	Powered Channel voltage conversion scale		55.57	57	58.43	V
	factor and accuracy	VA (DIAID VADDAIN 44.V	11713	12015	12316	Counts
		VVPWR - VDRAINn = 44 V	42.89	44	45.10	V
δV/V _{Channel}	Voltage reading accuracy		-2.5		2.5	%
		Oh	8431	8604	8776	Counts
	Powered Channel current conversion scale	Channel current = 770 mA	754.5	770	785.4	mA
	factor and accuracy	Channel Comment - 400 A	1084	1118	1152	Counts
		Channel Current = 100 mA	97	100	103	mA
\$1/I	Comment and the comment	Channel Current = 100 mA	-3		3	01
δI/I _{Channel}	Current reading accuracy	Channel Current = 770 mA	-2		2	%
δR/R _{Channel}	Resistance reading accuracy	15 kΩ ≤ R _{Channel} ≤ 33 kΩ, C _{Channel} ≤ 0.25 μF	-7		7	%
I _{bias}	Sense Pin bias current	Channel ON or during class	-2.5		0	μA

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	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
GATE 1-8					'	
V _{GOH}	Gate drive voltage	V _{GATEn} , I _{GATE} = -1 μA	10		12.5	٧
I _{GO-}	Gate sinking current with Power-on Reset, OSS detected or channel turnoff command	V _{GATEn} = 5 V	60	100	190	mA
I _{GO short-}	Gate sinking current with channel short-circuit	V _{GATEn} = 5 V, V _{SENn} ≥ V _{short} (or V _{short2X} if 2X mode)	60	100	190	mA
I _{GO+}	Gate sourcing current	V _{GATEn} = 0 V, default selection	39	50	63	μA
t _{D_off_OSS}	Gate turnoff time from 1-bit OSS input	From OSS to VGATEn < 1 V, VSENn = 0 V, MbitPrty = 0	1		5	μs
t _{OSS_OFF}	Gate turnoff time from 3-bit OSS input	From Start bit falling edge to VGATEn < 1 V, VSENn = 0 V, MbitPrty = 1	72		104	μs
t _{P_off_CMD}	Gate turnoff time from channel turnoff command	From Channel off command (POFFn = 1) to V _{GATEn} < 1 V, V _{SENn} = 0 V			300	μs
t _{P_off_RST}	Gate turnoff time with /RESET	From /RESET low to V _{GATEn} < 1 V, V _{SENn} = 0 V	1		5	μs
DRAIN 1-8			-			
V _{PGT}	Power-Good threshold	Measured at V _{DRAINn}	1	2.13	3	V
V _{SHT}	Shorted FET threshold	Measured at V _{DRAINn}	4	6	8	٧
R _{DRAIN}	Resistance from DRAINn to VPWR	Any operating mode except during detection or while the Channel is ON, including in device RESET state	80	100	190	kΩ
AUTOCLASS						
t _{Class_ACS}	Start of Autoclass Detection	Measured from the start of Class	90		100	ms
		Measured from the end of Inrush	1.4		1.6	s
t _{AUTO_PSE1}	Start of Autoclass Power Measurement	Measured from setting the MACx bit while channel is already powered			10	ms
t _{AUTO}	Duration of Autoclass Power Measurement		1.7	1.8	1.9	s
t _{AUTO_window}	Autoclass Power Measurement Sliding Window		0.15		0.3	s
D	Autoclass Channel Power conversion scale	VPWR = 52 V, VDRAINn = 0 V, Channel current = 770 mA	76	80	84	Counts
P _{AC}	factor and accuracy	VPWR = 50 V, VDRAINn = 0 V, Channel current = 100 mA	9	10	11	



Conditions are $-40 < T_J < 125$ °C unless otherwise noted.V_{VDD} = 3.3 V,V_{VPWR} = 54 V, V_{DGND} = V_{AGND},DGND, KSENSA, KSENSB, KSENSC and KSENSD connected to AGND, and all outputs are unloaded, 2xFBn =0. Positive currents are into pins. R_S = 0.200 Ω , to KSENSA (SEN1 orSEN2), to KSENSB (SEN3 or SEN4), to KSENSC (SEN5 or SEN6) or to KSENSD (SEN7 or SEN8). Typical values are at 25 °C. All voltages are with respect to AGND unless otherwise noted. Operating registers loaded with default values unless otherwise noted.

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DETECTION					•	
	Data diana arranda	First and 3rd detection points VVPWR – VDRAINn = 0 V	145	160	190	4
I _{DISC}	Detection current	2nd and 4th detection points VVPWR – VDRAINn = 0 V	235	270	300	μА
ΔI _{DISC}	2nd – 1st detection currents	VVPWR - VDRAINn = 0 V	98	110	118	μA
V _{det_open}	Open circuit detection voltage	Measured as VVPWR – VDRAINn	23.5	26	29	٧
R _{REJ_LOW}	Rejected resistance low range		0.86		15	kΩ
R _{REJ_HI}	Rejected resistance high range		33		100	kΩ
R _{ACCEPT}	Accepted resistance range		19	25	26.5	kΩ
R _{SHORT}	Shorted Channel threshold				360	Ω
R _{OPEN}	Open Channel Threshold		400			kΩ
t _{DET}	Detection Duration	Time to complete a detection	275	350	425	ms
	Detect backoff pause between discovery	VVPWR – VDRAINn > 2.5 V	300	400	500	ms
t _{DET_BOFF}	attempts	VVPWR – VDRAINn < 2.5 V	20		100	ms
t _{DET_DLY}	Detection delay	From command or PD attachment to Channel detection complete			590	ms
	Capacitance Measurement	Cport = 10uF	8.5	10	11.5	uF
CLASSIFICA	TION				•	
V _{CLASS}	Classification Voltage	VVPWR – VDRAINn, VSENn ≥ 0 mV I _{channel} ≥ 180 μA	15.5	18.5	20.5	V
I _{CLASS_Lim}	Classification Current Limit	VVPWR – VDRAINn = 0 V	65	75	90	mA
		Class 0-1	5		8	mA
		Class 1-2	13		16	mA
I _{CLASS_TH}	Classification Threshold Current	Class 2-3	21		25	mA
		Class 3-4	31		35	mA
		Class 4-Class overcurrent	45		51	mA
t _{LCE}	Classification Duration (1st Finger)	From detection complete	95		105	ms
t _{CLE2/3}	Classification Duration (2nd & 3th Finger)	From Mark complete	6.5		12	ms
MARK		-				
V _{MARK}	Mark Voltage	4 mA ≥ I _{Channel} ≥ 180 μA VVPWR – VDRAINn	7		10	V
I _{MARK_Lim}	Mark Sinking Current Limit	VVPWR – VDRAINn = 0 V	60	75	90	mA
t _{ME}	Mark Duration		6		12	ms

Product Folder Links: TPS23882B

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DC DISCONN	ECT				-	
V _{IMIN}	DC disconnect threshold		0.8	1.3	1.8	mV
		TMPDO = 00	320		400	ms
	PD Maintain Power signature dropout time	TMPDO = 01	75		100	ms
t _{MPDO}	limit	TMPDO = 10	150		200	ms
		TMPDO = 11	600		800	ms
t _{MPS}	PD Maintain Power Signature time for validity			2.5	3	ms
PORT POWER	RPOLICING					
δP _{CUT} /P _{CUT}	PCUT tolerance	< 15 W	0	6	12	%
δP _{CUT} /P _{CUT}	PCUT tolerance	≥ 15 W	0	4	8	%
		TOVLD = 00	50		70	
t _{OVLD}	PCUT time limit	TOVLD = 01	25		35	ms
		TOVLD = 10	100		140	1115
		TOVLD = 11	200		280	
PORT CURRE	NT INRUSH					
		VVPWR – VDRAINn = 1 V	19	30	41	
		VVPWR – VDRAINn = 10 V	19	30	41	
	IInrush limit, ALTIRNn = 0	VVPWR – VDRAINn = 15 V	33	44	55	
		VVPWR – VDRAINn = 30 V	80		90	
V _{Inrush}		VVPWR – VDRAINn = 55 V	80		90	mV
v Inrush		VVPWR – VDRAINn = 1 V	19	30	41	IIIV
		VVPWR – VDRAINn = 10 V	36	47	58	
	IInrush limit, ALTIRNn = 1	VVPWR – VDRAINn = 15 V	53	64	75	
		VVPWR – VDRAINn = 30 V	80		90	
		VVPWR – VDRAINn = 55 V	80		90	
		TSTART = 00	50		70	
t _{START}	Maximum current limit duration in start-up	TSTART = 01	25		35	ms
		TSTART = 10	100		140	



Conditions are $-40 < T_J < 125$ °C unless otherwise noted.V_{VDD} = 3.3 V,V_{VPWR} = 54 V, V_{DGND} = V_{AGND},DGND, KSENSA, KSENSB, KSENSC and KSENSD connected to AGND, and all outputs are unloaded, 2xFBn =0. Positive currents are into pins. R_S = 0.200 Ω , to KSENSA (SEN1 orSEN2), to KSENSB (SEN3 or SEN4), to KSENSC (SEN5 or SEN6) or to KSENSD (SEN7 or SEN8). Typical values are at 25 °C. All voltages are with respect to AGND unless otherwise noted. Operating registers loaded with default values unless otherwise noted.

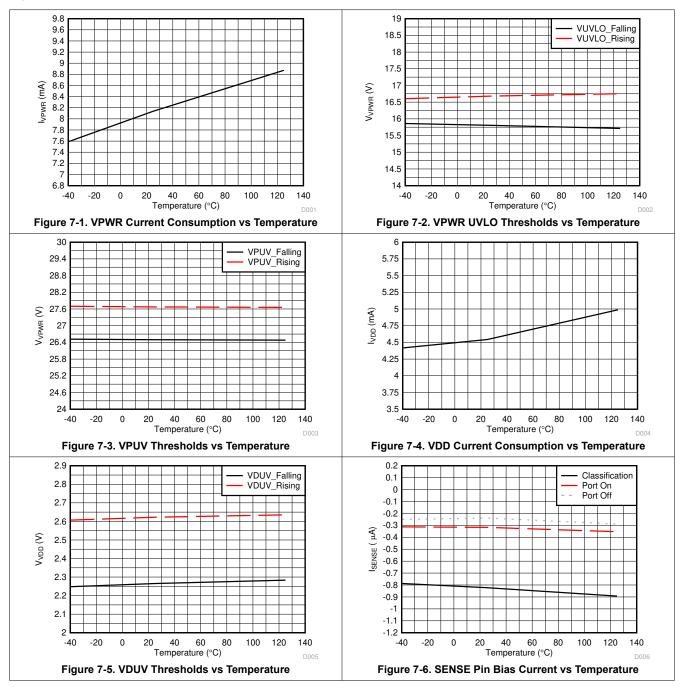
	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
PORT CURR	ENT FOLDBACK					
		VDRAINn = 1 V	80		90	
	HIMANY! I O ED O LAITED O	VDRAINn = 15 V	80		90	
	ILIM 1X limit, 2xFB = 0 and ALTFBn = 0	VDRAINn = 30 V	51	58	65	
		VDRAINn = 50 V	23	30	37	\/
V_{LIM}		VDRAINn = 1 V	80		90	mV
	II INA AV II STA CUED - O A A TED A	VDRAINn = 25 V	80		90	
	ILIM 1X limit, 2xFB = 0 and ALTFBn = 1	VDRAINn = 40 V	45	51	57	
		VDRAINn = 50 V	23	30	37	
		VDRAINn = 1 V	245	250	262	
	II IM 2V limit 2vED = 1 and ALTED = 0	VDRAINn = 10 V	164	180	196	
	ILIM 2X limit, 2xFB = 1 and ALTFBn = 0	VDRAINn = 30 V	51	58	64	
\/		VDRAINn = 50 V	23	30	37	m\/
V_{LIM2X}		VDRAINn = 1 V	245	250	262	mV
	ILIM 2X limit, 2xFB = 1 and ALTFBn = 1	VDRAINn = 20 V	139	147	155	
	ILIM 2A IIIIII, 2XFB = 1 and ALTFBH = 1	VDRAINn = 40 V	45	51	57	
		VDRAINn = 50 V	23	30	37	
	ILIM time limit	2xFBn = 0	55	60	65	
		TLIM = 00	55	60	65	
t _{LIM}	2xFBn = 1	TLIM = 01	15	16	17	ms
	ZXFDII - I	TLIM = 10	10	11	12	
		TLIM = 11	6	6.5	7	
SHORT CIRC	CUIT DETECTION				<u>'</u>	
V _{short}	I _{SHORT} threshold in 1X mode and during inrush		205		245	mV
V _{short2X}	I _{SHORT} threshold in 2X mode		280		320	
	Cote turn off time from SENIn input	2xFBn = 0, VDRAINn = 1 V From VSENn pulsed to 0.425 V.			0.9	
t _{D_off_} SEN	Gate turnoff time from SENn input	2xFBn = 1, VDRAINn = 1 V From VSENn pulsed to 0.62 V.			0.9	μs
CURRENT FA	AULT RECOVERY (BACKOFF) TIMING				-	
t _{ed}	Error delay timing. Delay before next attempt to power a channel following power removal due to error condition	P _{CUT} , I _{LIM} or I _{Inrush} fault semiauto mode	0.8	1	1.2	s
δl _{fault}	Duty cycle of I _{channel} with current fault		5.5		6.7	%
THERMAL SI	HUTDOWN				1	
	Shutdown temperature	Temperature rising	135	146		°C
	Hysteresis			7		°C

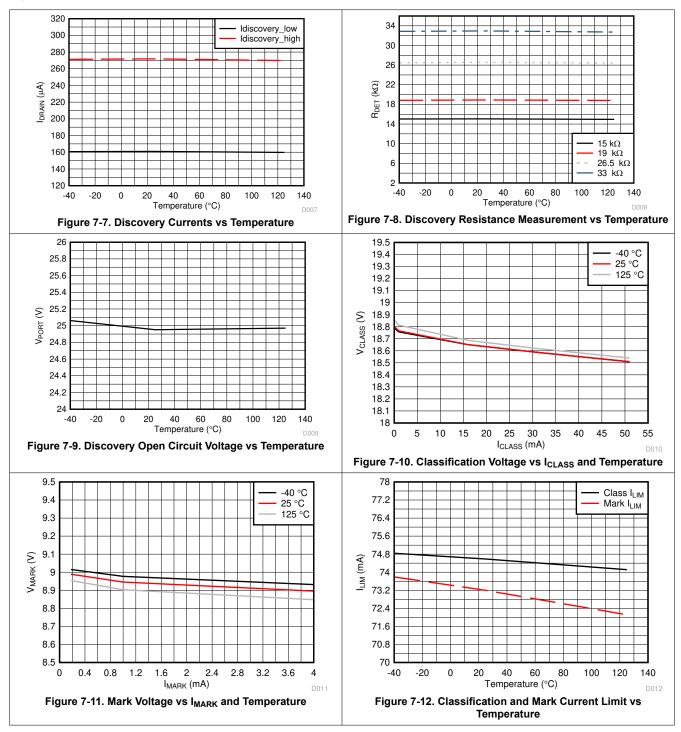
Product Folder Links: TPS23882B

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DIGITAL I/O	(SCL, SDAI, A1-A4, /RESET, OSS unless otherwi	se stated)				
V _{IH}	Digital input High		2.1			V
V _{IL}	Digital input Low				0.9	V
V _{IT_HYS}	Input voltage hysteresis		0.17			V
.,	Digital output Low	SDAO at 9mA			0.4	V
V _{OL}	Digital output Low	/INT at 3mA			0.4	V
R _{pullup}	Pullup resistor to VDD	/RESET, A1-A4, TEST0	30	50	80	kΩ
R _{pulldown}	Pulldown resistor to DGND	OSS, TEST1, TEST2	30	50	80	kΩ
t _{FLT_INT}	Fault to /INT assertion	Time to internally register an Interrupt fault, from Channel turn off		50	500	μs
T _{RESETmin}	/RESET input minimum pulse width				5	μs
T _{bit_OSS}	3-bit OSS bit period	MbitPrty = 1	24	25	26	μs
t _{OSS_IDL}	Idle time between consecutive shutdown code transmission in 3-bit mode	MbitPrty = 1	48	50		μs
t _{r_OSS}	Input rise time of OSS in 3-bit mode	0.8 V → 2.3 V, MbitPrty = 1	1		300	ns
t _{f_OSS}	Input fall time of OSS in 3-bit mode	2.3 V → 0.8 V, MbitPrty = 1	1		300	ns
I2C TIMING F	REQUIREMENTS				'	
t _{POR}	Device power-on reset delay				20	ms
f _{SCL}	SCL clock frequency		10		400	kHz
t _{LOW}	LOW period of the clock		0.5			μs
t _{HIGH}	HIGH period of the clock		0.26			μs
t _{fo}	SDAO output fall time	SDAO, 2.3 V \rightarrow 0.8 V, Cb = 10 pF, 10 k Ω pull-up to 3.3 V	10		50	ns
10	ob) to super tall this	SDAO, 2.3 V \rightarrow 0.8 V, Cb = 400 pF, 1.3 k Ω pull-up to 3.3 V	10		50	ns
C _{I2C}	SCL capacitance				10	pF
C _{I2C_SDA}	SDAI, SDAO capacitance				6	pF
t _{SU,DATW}	Data setup tme (Write operation)		50			ns
t _{HD,DATW}	Data hold time (Write operation)		0			ns
t _{HD,DATR}	Data hold time (Read operation)		150		400	ns
t _{fSDA}	Input fall times of SDAI	2.3 V → 0.8 V	20		120	ns
t _{rSDA}	Input rise times of SDAI	0.8 V → 2.3 V	20		120	ns
t _r	Input rise time of SCL	0.8 V → 2.3 V	20		120	ns
t _f	Input fall time of SCL	2.3 V → 0.8 V	20		120	ns
t _{BUF}	Bus free time between a STOP and START condition		0.5			μs
t _{HD,STA}	Hold time After (Repeated) START condition		0.26			μs
t _{SU,STA}	Repeated START condition setup time		0.26			μs
t _{su,sto}	STOP condition setup time		0.26			μs
t _{DG}	Suppressed spike pulse width, SDAI and SCL		50			ns
t _{WDT_I2C}	I2C Watchdog trip delay		1.1	2.2	3.3	sec

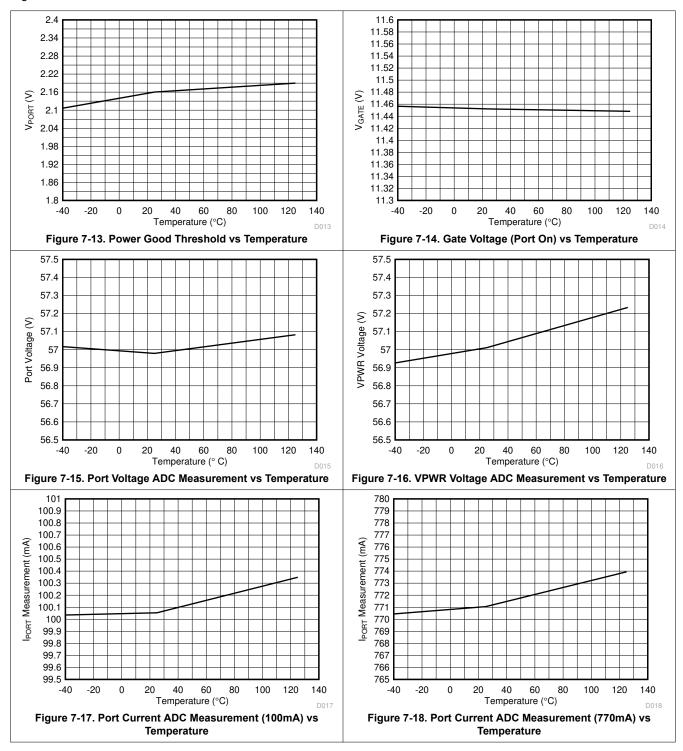


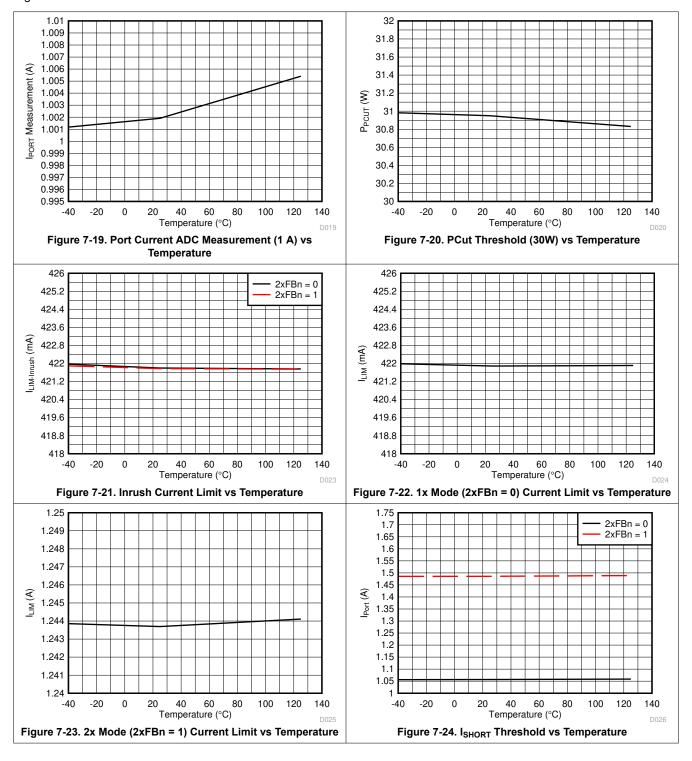
7.6 Typical Characteristics



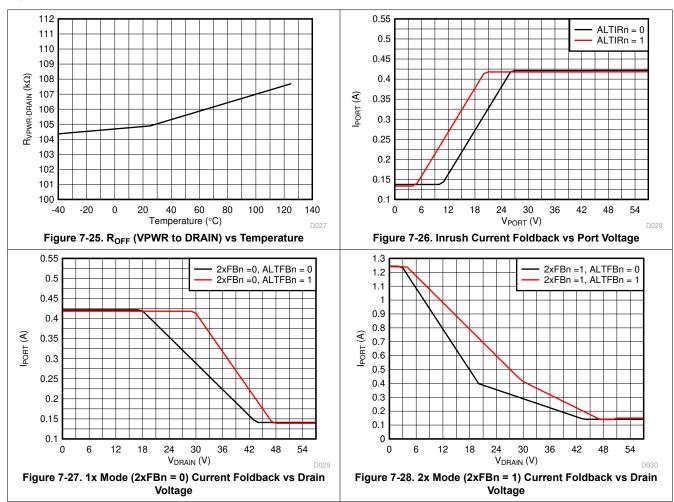














8 Parameter Measurement Information

8.1 Timing Diagrams

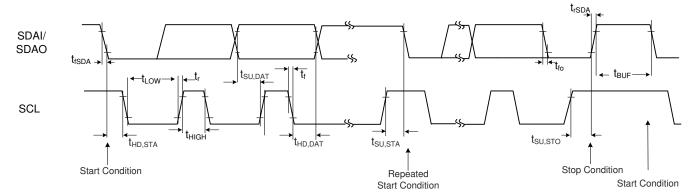


Figure 8-1. I²C Timings

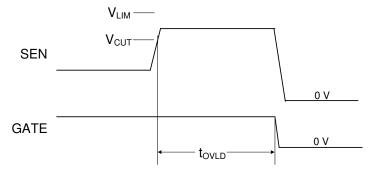


Figure 8-2. Overcurrent Fault Timing



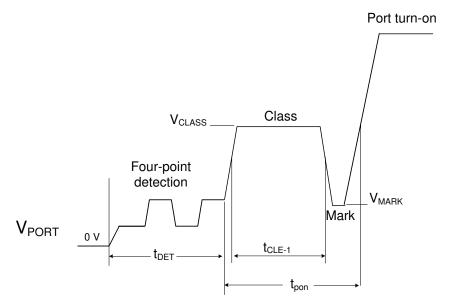


Figure 8-3. 2-Pair Detection, 1-Event Classification and Turn On

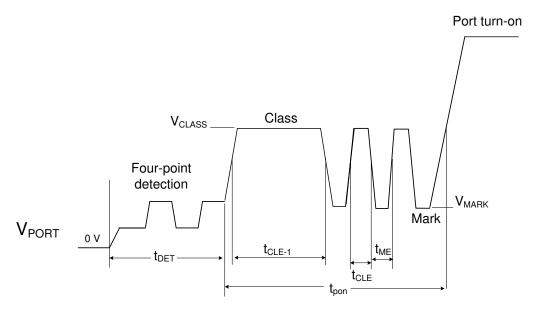


Figure 8-4. 2-Pair Detection, 3-Event Classification and Turn-On



9 Detailed Description

9.1 Overview

The TPS23882B is an eight-channel PSE for Power over Ethernet applications. Each of the eight channels provides detection, classification, protection, and shutdown in compliance with the IEEE 802.3bt standard.

Basic PoE features include the following:

- · Performs high-reliability 4-point load detection
- Performs multi-finger classification including the 100-ms long first class finger for autoclass discovery and to identify as a 802.3bt complainant PSE
- Enables power with protective foldback current limiting and an adjustable P_{CUT} threshold
- · Shuts down during faults such as overcurrent or outputs shorts
- · Performs a maintain power signature function to ensure power is removed if the load is disconnected
- Undervoltage lockout occurs if VPWR falls below V_{PUV F} (typical 26.5 V)

Enhanced features include the following:

- Programmable SRAM memory
- · Dedicated 14-bit integrating current ADCs per port
- Port re-mapping capability
- 8- and 16-bit access mode selectable
- 1- and 3-bit port shutdown priority

9.1.1 Operating Modes

9.1.1.1 Auto

The port performs detection and classification (if valid detection occurs) continuously. Registers are updated each time a detection or classification occurs. The port power is automatically turned on based on the Power Allocation settings in register 0x29 if a valid classification is measured.

9.1.1.2 Autonomous

Unlike auto mode, which still requires a host to initialize the TPS23882B operation through a series of I^2C commands, there is no host or I^2C communication required when the device is in configured in autonomous mode

During power up, the resistance on the AUTO pin (R_{AUTO}) is measured, and the device is pre-configured according to Table 9-15. The port automatically performs detection and classification (if valid detection occurs) continuously on all ports. Port power is automatically turned on based on power allocation settings in register 0x29 if a valid classification is measured.

For applications that still require port telemetry, the I²C functionality is still supported in autonomous mode.

Note

A 10-nF capacitor is required in parallel with R_{AUTO} to ensure stability in the autonomous mode selection.

The auto pin resistance (R_{AUTO}) is measured following a device reset (assertion of the \overline{RESET} pin or RESAL bit in register 0x1A). The device only measures (R_{AUTO}) and pre-configures the internal registers during power up (V_{VPWR} and V_{VDD} rising above their respective UVLO thresholds).

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Note

The device SRAM must be programmed to support applications that desire to remove a device from autonomous mode after having initially powered up in autonomous mode.

A device running from the internal ROM (SRAM unprogrammed) in autonomous mode turns off and automatically resume discovery and power on any valid loads following the assertion of the RESET pin, I2C register 0x1A RESAL or RESPn bits, or a mode off command. Whereas a device running in autonomous mode with the SRAM programmed turns off and remains inactive until the host re-enables the ports through the I²C bus.

9.1.1.3 Semiauto

The port performs detection and classification (if valid detection occurs) continuously. Registers are updated each time a detection or classification occurs. The port power is not automatically turned on. A Power Enable command is required to turn on the port.

9.1.1.4 Manual and Diagnostic

The use of this mode is intended for system diagnostic purposes only in the event that ports cannot be powered in accordance with the IEEE 802.3bt standard from semiauto or auto modes.

The port performs the functions as configured in the registers. There is no automatic state change. Singular detection and classification measurements are performed when commanded. Ports are turned on immediately after a Power Enable command without any detection or classification measurements. Even though multiple classification events can be provided, the port voltage resets immediately after the last finger, resetting the PD.

9.1.1.5 Power Off

The port is powered off and does not perform a detection, classification, or power-on. In this mode, status and enable bits for the associated port are reset.

Product Folder Links: TPS23882B

9.1.2 PoE Compliance Terminology

With the release of the IEEE 802.3bt standard, compliant PoE equipment has expanded to include four different *Types* of devices that support power over 2 pair or 4 pair, in either single or dual signature configurations, with classifications ranging from 0 to 8. Different manufactures have used varying terminology over time to describe their equipment capabilities, and it can become difficult to identify how to correctly categorize and brand a particular piece of equipment. For this reason and in conjunction with the Ethernet Alliance (EA), the industry leading providers of PoE equipment and devices have agreed to transition to using the "PoE 1" and "PoE 2" banding per Table 9-1 below.

Table 9-1. Summary Table of PoE Compliance Terminology

Brand,	IEEE	Clause	Clause Title	Types	Classes	EA Certified Logo
Acronym	Standard 802.3af		Davisan avan Ethamat avan 2	1	0 - 3	-
PoE 1	802.3at	33	Power over Ethernet over 2 pairs	2	0 - 4	Gen 1 Class 1-4
DoE 2	802.3bt 145 Power over Ether		Dower over Ethernet	3	1 - 6, or 1-4 DS ⁽¹⁾	Gen 2 Class 1-8
PoE 2			Fower over Ethernet	4	7 - 8, or 5 DS ⁽¹⁾	Gen 2 Class 1-0

^{(1) &}quot;DS" is used to designate "Dual Signature" PDs.

Note

By design PoE 2 PSEs are fully interoperable with any existing PoE 1 equipment, and although not all functionality may be enabled, PoE 2 PDs connected to PoE 1 PSEs are required to limit their power consumption to the PSE presented power capabilities. See *Power Allocation and Power Demotion*.

9.1.3 PoE 2 Type-3 2-Pair PoE

Upon release of the new IEEE 802.3bt standard, the IEEE introduced two new "Types" of PoE equipment. The addition of Type-3 and Type-4 equipment are most commonly associated with the addition of 4-Pair PoE and their available power increases of to up to 90 W sourced from a PSE port. However, the new PoE 2 Type-3 designation also applies to new 2-Pair PoE equipment as well. Most notably, the new 802.3bt standard supports a reduced T_{MPS} time (6 ms versus 60 ms) and a new feature called Autoclass, and by definition any device that supports these new features is designated as Type-3 equipment even if power is only provided over 2 pairs (one alternative pairset) in an Ethernet cable. Because the TPS23882B supports these new features including its use of the 100-ms long first class finger to identify itself as an IEEE 802.3bt PSE, it is officially classified as a Type-3 PSE even through power delivery is limited to 2 pair.

Please note that as the 802.3at standard created "Type-2" equipment that was fully interoperable with the previous PoE 1 Type-1 (802.3af) equipment, any new 802.3bt Type-3 equipment including the TPS23882B is fully operable with any existing PoE 1 Type-1 (.af) and Type-2 (.at) equipment.

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9.1.4 Requested Class Versus Assigned Class

The *requested* class is the classification the PSE measures during mutual identification prior to turn-on, whereas the *assigned* class is the classification level the channel was powered on with based on the power allocation setting in register 0x29h. In most cases where the power allocation equals or exceeds the *requested* class, the *requested* and *assigned* classes is the same. However, in the case of power demotion, these values differ.

For example: If a 4-pair Class 8 PD is connected to a 30-W (Class 4) configured PSE port, the *requested* class reports "Class 8", while the *assigned* class reports "Class 4".

The requested classification results are available in registers 0x0C-0F.

The assigned classification results are available in registers 0x4C-4F.

Note

There is no Assigned Class assigned for ports and channels powered out of manual and diagnostic mode.

9.1.5 Power Allocation and Power Demotion

The Power Allocation settings in register 0x29 sets the maximum power level a port powers on. Settings for each class level from 2-pair 4 W (Class 1) up to 2-pair 30 W (Class 4) have been provided to maximize system design flexibility.

Note

The Power Allocation settings in register 0x29 do not set the power limit for a given port. The port and channel power limiting is configured with the 2P (registers 0x1E- x 21) policing registers

During a turn-on attempt, if a PD presents a classification level greater than the power allocation setting for a port, the TPS23882B limits the number of classification fingers presented to the PD prior to turn on based on the power allocation settings in register 0x29. This behavior is called *Power Demotion* as it is the number of fingers presented to the PD that sets the maximum level of power the PD is allowed to draw before the PSE is allowed to disable it.

Note

The IEEE 802.3 standard requires PDs that are power demoted by a PSE to limit their total power draw below the Type/class level set by the number of fingers presented by the PSE during mutual identification.

In a 2-pair system, Power demotion is limited to either 30 W (3-fingers) or 15.4 W (1-finger) as there is no other physical means of indicating to a PD over the physical layer that less than 15.4 W is available.

If register 0x29 is configured for either 4 W (class 1) or 7 W (Class 2), and a class 3 or higher device is connected, the port is not powered and a Start Fault is reported along with an "Insufficient Power" indication provided in register 0x24.

Table 9-2. 2-Pair Power Demotion Table

Power Allocation	Assigned Class Value (Based on the PD Connected at the Port)									
Register 0x29	Class 1 PD	Class 2 PD	Class 3 PD	Class 4 PD	Class 5+ PDs					
2-Pair 4 W	Class 1	Start Fault Insufficient Power	Start Fault Insufficient Power	Start Fault Insufficient Power	Start Fault Insufficient Power					
2-Pair 7 W	Class 1	Class 2	Start Fault Insufficient Power	Start Fault Insufficient Power	Start Fault Insufficient Power					
2-Pair 15.5 W	Class 1	Class 2	Class 3	Class 3	Class 3					

Product Folder Links: TPS23882B

Table 9-2. 2-Pair Power Demotion Table (continued)

Power Allocation	Assigned Class Value (Based on the PD Connected at the Port)										
Register 0x29	Class 1 PD	Class 2 PD	Class 3 PD	Class 4 PD	Class 5+ PDs						
2-Pair 30 W	Class 1	Class 2	Class 3	Class 4	Class 4						

9.1.6 Programmable SRAM

The TPS23882B device has been designed to include programmable SRAM that accommodates future firmware updates to support interoperability and compliance issues that can arise as new equipment is introduced in conjunction with the release of the IEEE 802.3bt standard.

Note

The latest version of firmware and SRAM release notes can be accessed from the *TI mySecure Software* web page.

The SRAM release notes and ROM advisory document includes more detailed information regarding any know issues and changes that were associated with each firmware release.

Upon power up, it is recommended that the TPS23882B device's SRAM be programmed with the latest version of SRAM code via the I²C to ensure proper operation and IEEE complaint performance. All I²C traffic other than those commands required to program the SRAM should be deferred until after the SRAM programming sequences are completed.

For systems that include multiple TPS23882B devices, the 0x7F "global" broadcast I2C address can be used to programmed all of the devices at the same time.

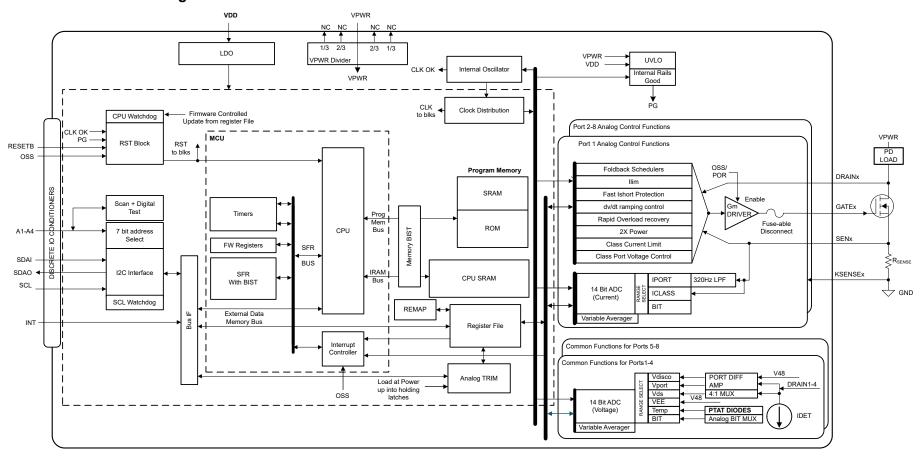
For more detailed instructions on the SRAM programing procedures, please refer to SRAM CONTROL Register and the *How to Load TPS2388x SRAM and Parity Code Over I*²C application brief on Tl.com.

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9.2 Functional Block Diagram



9.3 Feature Description

9.3.1 Port Remapping

The TPS23882B provides port remapping capability, from the logical ports to the physical channels and pins.

The remapping is between any channel of a 4-port group (1 to 4, 5 to 8).

The following example is applicable to 0x26 register = 00111001, 00111001b.

- Logical port 2 (6) ↔ Physical channel 3 (7)
- Logical port 3 (7) ↔ Physical channel 4 (8)
- Logical port 4 (8) ↔ Physical channel 1 (5)

Note

The device ignores any remapping command unless all four ports are in off mode.

If the TPS23882B receives an incorrect configuration, it ignores the incorrect configuration and retains the previous configuration. The ACK is sent as usual at the end of communication. For example, if the same remapping code is received for more than one port, then a read back of the Re-Mapping register (0x26) is the last valid configuration.

Note that if an IC reset command (1Ah register) is received, the port remapping configuration is kept unchanged. However, if there is a Power-on Reset or if the RESET pin is activated, the Re-Mapping register is reinitialized to a default value.

9.3.2 Port Power Priority

The TPS23882B supports 1- and 3-bit shutdown priority, which are selected with the MbitPrty bit of General Mask register (0x17).

The 1-bit shutdown priority works with the Port Power Priority (0x15) register. An OSSn bit with a value of 1 indicates that the corresponding port is treated as low priority, while a value of 0 corresponds to a high priority. As soon as the OSS input goes high, the low-priority ports are turned off.

The 3-bit shutdown priority works with the Multi Bit Power Priority (0x27/28) register, which holds the priority settings. A port with "000" code in this register has highest priority. Port priority reduces as the 3-bit value increases, with up to 8 priority levels. See Figure 9-1.

The multi bit port priority implementation is defined as the following:

- OSS code ≤ Priority setting (0x27/28 register): Port is disabled
- OSS code > Priority setting (0x27/28 register): Port remains active

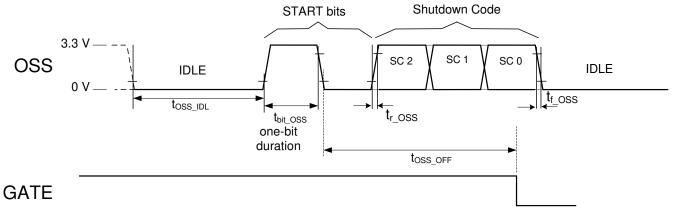


Figure 9-1. Multi Bit Priority Port Shutdown if Lower-Priority Port



Note

Prior to setting the MbitPrty bit from 0 to 1, make sure the OSS input is in the idle (low) state for a minimum of 200 μ s, to avoid any port misbehavior related to loss of synchronization with the OSS bit stream.

Note

The OSS input has an internal 1-µs to 5-µs deglitch filter. From the idle state, a pulse with a longer duration is interpreted as a valid start bit. Ensure that the OSS signal is noise free.

9.3.3 Analog-to-Digital Converters (ADC)

The TPS23882B features 10 multi-slope integrating converters. Each of the first eight converters is dedicated to current measurement for one channel and operate independently to perform measurements during classification and when the channel is powered on. When the channel is powered, the converter is used for current (100-ms averaged) monitoring, power policing, and DC disconnect. Each of the last two converters are shared within a group of four channels for discovery (16.6-ms averaged), port powered voltage monitoring, power-good status, and FET short detection. These converters are also used for general-purpose measurements including input voltage (1 ms) and die temperature.

The ADC type used in the TPS23882B differs from other similar types of converters in that the ADCs continuously convert while the input signal is sampled by the integrator, providing inherent filtering over the conversion period. The typical conversion time of the current converters is 800 µs, while the conversion time is 1 ms for the other converters. Powered-device detection is performed by averaging 16 consecutive samples which provides significant rejection of noise at 50-Hz or 60-Hz line frequency. While a port is powered, digital averaging provides a channel current measurement integrated over a 100-ms time period. Note that an anti-aliasing filter is present for powered current monitoring.

Note

During powered mode, current conversions are performed continuously. Also, in powered mode, the t_{START} timer must expire before any current or voltage ADC conversion can begin.

9.3.4 I²C Watchdog

An I²C Watchdog timer is available on the TPS23882B device. The timer monitors the I²C, SCL line for clock edges. When enabled, a timeout of the watchdog resets the I²C interface along with any active ports. This feature provides protection in the event of a hung software situation or I²C bus hang-up by target devices. In the latter case, if a target is attempting to send a data bit of 0 when the controller stops sending clocks, then the target may drive the data line low indefinitely. Because the data line is driven low, the controller cannot send a STOP to clean up the bus. Activating the I²C watchdog feature of the TPS23882B clears this deadlocked condition. If the timer of two seconds expires, the ports latch off and the WD status bit is set. Note that WD Status is set even if the watchdog is not enabled. The WD status bit can only be cleared by a device reset or writing a 0 to the WDS status bit location. The 4-bit watchdog disable field shuts down this feature when a code of 1011b is loaded. This field is preset to 1011b whenever the TPS23882B is initially powered. See I²C WATCHDOG Register for more details.

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9.3.5 Current Foldback Protection

The TPS23882B features two types of foldback mechanisms for complete MOSFET protection.

During inrush, at channel turn-on, the foldback is based on the channel voltage as shown in Figure 9-2. Note that the inrush current profile remains the same, regardless of the state of the 2xFBn bits in register 0x40.

After the channel is powered and the Power Good is valid, a dual-slope operational foldback is used, providing protection against partial and total short-circuit at port output, while still being able to maintain the PD powered during normal transients at the PSE input voltage. Note that setting the 2xFBn bit selects the 2× curve and clearing it selects the 1× curve. See Figure 9-3.

In addition to the default foldback curves, the TPS23882B has individually enabled *alternative* foldback curves for both inrush and powered operation. These curves have been designed to accommodate certain loads that do not fully comply with the IEEE standard and requires additional power to be turned on or remain powered. See Figure 9-2 and Figure 9-3.

Note

If using the Alternative Foldback curves (ALTIRn or ALTFBn = 1), designers must account for the additional power dissipation that can occur in the FETs under these conditions.

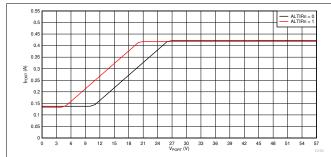


Figure 9-2. Foldback During Inrush (at Port Turn-On): I_{LIM} vs V_{port}

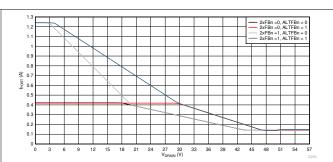


Figure 9-3. Foldback When the Port is Already On: I_{LIM} vs V_{drain}

9.4 Device Functional Modes

9.4.1 Detection

To eliminate the possibility of false detection, the TPS23882B uses a TI proprietary 4-point detection method to determine the signature resistance of the PD device. A false detection of a valid 25-k Ω signature can occur with 2-point detection type PSEs in noisy environments or if the load is highly capacitive.

Detection 1 and Detection 2 are merged into a single detection function which is repeated. Detection 1 applies I1 (160 μ A) to a channel, waits approximately 60 ms, then measures the channel voltage (V1) with the integrating ADC. Detection 2 then applies I2 (270 μ A) to the channel, waits another approximately 60 ms, then measures the channel voltage again (V2). The process is then repeated a second time to capture a third (V3) and fourth (V4) channel voltage measurements. Multiple comparisons and calculations are performed on all four measurement point combinations to eliminate the effects of a nonlinear or hysteretic PD signature. The resulting channel signature is then sorted into the appropriate category.

Note

The detection resistance measurement result is also available in the Channel Detect Resistance registers (0x44 - 0x47).

9.4.2 Classification

Hardware classification (class) is performed by supplying a voltage and sampling the resulting current. To eliminate the high power of a classification event from occurring in the power controller chip, the TPS23882B uses the external power FET for classification.

During classification, the voltage on the gate node of the external MOSFET is part of a linear control loop. The control loop applies the appropriate MOSFET drive to maintain a differential voltage between VPWR and DRAIN of 18.5 V. During classification the voltage across the sense resistor in the source of the MOSFET is measured and converted to a class level within the TPS23882B. If a load short occurs during classification, the MOSFET gate voltage reduces to a linearly controlled, short-circuit value for the duration of the class event.

Classification results are read through the I²C Detection Event and Channel-n Discovery Registers. The TPS23882B also supports 1, and 3 finger classification for PDs ranging from Class 0 through Class 4, using the Power Enable and Port Power Allocation registers. Additionally, by providing a 3rd class finger during discovery in semiauto mode, the TPS23882B is capable of identifying if a 4-pair Class 5-8 PD is connected to the port.

9.4.3 DC Disconnect

Disconnect is the automated process of turning off power to the port. When the port is unloaded or at least falls below minimum load, it is required to turn off power to the port and restart detection. In DC disconnect, the voltage across the sense resistors is measured. When enabled, the DC disconnect function monitors the sense resistor voltage of a powered port to verify the port is drawing at least the minimum current to remain active. The T_{DIS} timer counts up whenever the port current is below the disconnect threshold (6.5-mA typical). If a timeout occurs, the port is shut down and the corresponding disconnect bit in the Fault Event Register is set. In the case of a PD implementing MPS (maintain Power Signature) current pulsing, the T_{DIS} counter is reset each time the current goes continuously higher than the disconnect threshold for at least 3 ms.

The T_{DIS} duration is set by the T_{MPDO} Bits of the Timing Configuration register (0x16).

9.5 I²C Programming

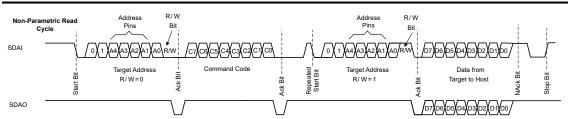
9.5.1 I²C Serial Interface

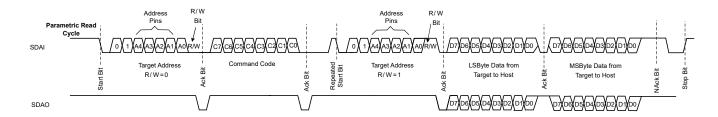
The TPS23882B features a 3-wire I²C interface, using SDAI, SDAO, and SCL. Each transmission includes a START condition sent by the controller, followed by the device address (7-bit) with R/W bit, a register address byte, then one or two data bytes and a STOP condition. The recipient sends an acknowledge bit following each byte transmitted. SDAI/SDAO is stable while SCL is high except during a START or STOP condition.

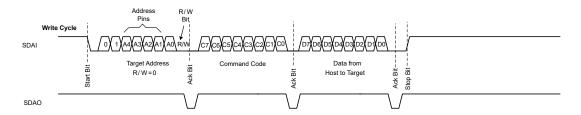
Figure 9-4 and Figure 9-5 show read and write operations through I²C interface, using configuration A or B (see Table 9-24 for more details). The parametric read operation is applicable to ADC conversion results. The TPS23882B features quick access to the latest addressed register through I²C bus. When a STOP bit is received, the register pointer is not automatically reset.

It is also possible to perform a write operation to many TPS23882B devices at the same time. The target address during this broadcast access is 0x7F, as shown in *PIN STATUS Register*. Depending on which configuration (A or B) is selected, a global write proceeds as following:

- Config A: Both 4-port devices (1 to 4 and 5 to 8) are addressed at same time.
- Config B: The whole device is addressed.







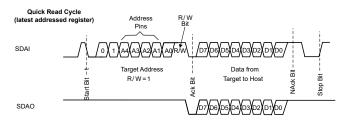


Figure 9-4. I²C interface Read and Write Protocol – Configuration A



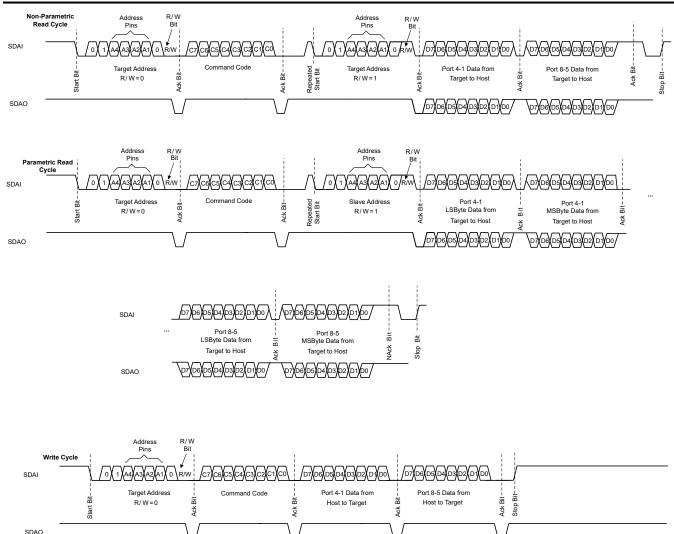


Figure 9-5. I²C interface Read and Write Protocol – Configuration B



9.6 Register Maps

9.6.1 Complete Register Set

Table 9-3. Main Registers

lable 9-3. Main Registers														
Cmd Code	Register or Command Name	I ² C R/W	Data Byte	RST State				Bits De	scription					
					11	NTERRUPT	S							
00h	INTERRUPT	RO	1	1000,0000b (1)	SUPF	STRTF	IFAULT	CLASC	DETC	DISF	PGC	PEC		
01h	INTERRUPT MASK	R/W	1	1000,0000b	SUMSK	STMSK	IFMSK	CLMSK	DEMSK	DIMSK	PGMSK	PEMSK		
						EVENT	1							
02h	POWER EVENT	RO	1	d0000,0000b	P	ower Good	status chang	je	Р	Power Enable status change				
03h	FOWEREVEINT	CoR	1	0000,0000	PGC4	PGC3	PGC2	PGC1	PEC4	PEC3	PEC2	PEC1		
04h	DETECTION	RO	1	d0000,0000b		Classi	fication			Dete	ection			
05h	EVENT	CoR	1	0000,0000	CLSC4	CLSC3	CLSC2	CLSC1	DETC4	DETC3	DETC2	DETC1		
06h	FAULT EVENT	RO	1	0000.000b	Disc	Disconnect occurred				PCUT fau	ılt occurred			
07h	TAOLI EVENT	CoR	1	0000,0000	DISF4	DISF3	DISF2	DISF1	PCUT4	PCUT3	PCUT2	PCUT1		
08h	START/ILIM EVENT	RO	1	d0000,0000b		ILIM faul	t occurred			START fat	ult occurred			
09h	START/ILIWI EVENT	CoR	1	0000,0000	ILIM4	ILIM3	ILIM2	ILIM1	STRT4	STRT3	STRT2	STRT1		
0Ah	SUPPLY/FAULT	RO	1	0111,0000b	TSD	VDUV	VDWRN	VPUV	Rsvrd	Rsvrd	OSSE	RAMFLT		
0Bh	EVENT	CoR	1	(2)	130	VDOV	VDWKN	VFOV	INSVIU	INSVIU	USSE	IXAWII LI		
						STATUS								
0Ch	CHANNEL 1 DISCOVERY	RO	1	0000,0000b	Re	equested CL	ASS Channe	el 1		DETECT	Channel 1			
0Dh	CHANNEL 2 DISCOVERY	RO	1	0000,0000ь	Re	equested CL	ASS Channe	el 2		DETECT	Channel 2			
0Eh	CHANNEL 3 DISCOVERY	RO	1	0000,000b	Re	equested CL	ASS Channe	el 3		DETECT	Channel 3			
0Fh	CHANNEL 4 DISCOVERY	RO	1	0000,000b	Re	equested CL	ASS Channe	el 4		DETECT	Channel 4			
10h	POWER STATUS	RO	1	0000,0000b	PG4	PG3	PG2	PG1	PE4	PE3	PE2	PE1		
11h	PIN STATUS	RO	1	0,A[4:0],0,0	Rsvd	SLA4	SLA3	SLA2	SLA1	SLA0	Rsvd	Rsvd		
					СО	NFIGURATI	ON		'					
12h	OPERATING MODE	R/W	1	0000,0000b	Channe	I 4 Mode	Channe	I 3 Mode	Channe	I 2 Mode	Channe	I 1 Mode		
13h	DISCONNECT ENABLE	R/W	1	0000 ,1111b	Rsvd	Rsvd	Rsvd	Rsvd	DCDE4	DCDE3	DCDE2	DCDE1		
14h	DETECT/CLASS ENABLE	R/W	1	0000,0000b	CLE4	CLE3	CLE2	CLE1	DETE4	DETE3	DETE2	DETE1		
15h	PWRPR/PCUT DISABLE	R/W	1	0000,0000b	OSS4	OSS3	OSS2	OSS1	DCUT4	DCUT3	DCUT2	DCUT1		
16h	TIMING CONFIG	R/W	1	0000,0000b	TL	IM	TST	ART	TO	VLD	TMPDO			
17h	GENERAL MASK	R/W	1	1000,0000b	INTEN	Rsvd	nbitACC	MbitPrty	CLCHE	DECHE	R	svd		



Table 9-3. Main Registers (continued)

				145.00	O. Maii	itegiste	ers (com	aoa,				
Cmd Code	Register or Command Name	I ² C R/W	Data Byte	RST State				Bits De	scription			
	•				PU	SH ВUТТО	NS					
18h	DETECT/CLASS Restart	wo	1	0000,0000b	RCL4	RCL3	RCL2	RCL1	RDET4	RDET3	RDET2	RDET1
19h	POWER ENABLE	WO	1	0000,0000b	POFF4	POFF3	POFF2	POFF1	PWON4	PWON3	PWON2	PWON1
1Ah	RESET	WO	1	0000,0000b	CLRAIN	CLINP	Rsvd	RESAL	RESP4	RESP3	RESP2	RESP1
					GENER	RAL/SPECIA	LIZED					•
1Bh	ID	RO	1	0101,0101b			MFR ID				IC Version	
1Ch	AUTOCLASS	R/O	1	0000,0000b	AC4	AC3	AC2	AC1	Rsvrd	Rsvrd	Rsvrd	Rsvrd
1Dh	RESERVED	R/W	1	0000,0000b				Rs	srvd			•
1Eh	2P POLICE 1 CONFIG	R/W	1	1111,1111b				2-Pair POLI	CE Channel	1		
1Fh	2P POLICE 2 CONFIG	R/W	1	1111,1111b	2-Pair POLICE Channel 2							
20h	2P POLICE 3 CONFIG	R/W	1	1111,1111b	2-Pair POLICE Channel 3							
21h	2P POLICE 4CONFIG	R/W	1	1111,1111b	2-Pair POLICE Channel 4							
22h	CAP MEASUREMENT ⁽³⁾	R/W	1	0000,0000b	Rsvd	CDET4	Rsvd	CDET3	Rsvd	CDET2	Rsvd	CDET1
23h	Reserved	R/W	1	0000,0000b	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd
24h	Power-on FAULT	RO	1	0000.000b	DE Ch	annel 4	DE Ch	annel 3	DE Ch	annel 2	DE Ch	annel 1
25h	Power-on FAULI	CoR	1	0000,0000	PF Ch	annei 4	PF Cn	annei 3	PF Cn	annei Z	PF Cn	annei 1
26h	RE-MAPPING	R/W	1	1110,0100b		l re-map l Port 4		ıl re-map ıl Port 3		l re-map l Port 2		al re-map al Port 1
27h	Multi-Bit Priority 21	R/W	1	0000,0000b	Rsvd		Channel 2		Rsvd		Channel 1	
28h	Multi-Bit Priority 43	R/W	1	0000,0000b	Rsvd		Channel 4		Rsvd		Channel 3	
29h	Port Power Allocation	R/W	1	0000,0000b	Rsvd		MC34		Rsvd		MC12	
2A - 2Bh	Reserved	R/W	1	1111,1111b				Rs	srvd			
2Ch	TEMPERATURE	RO	1	0000,0000b				Temperatur	e (bits 7 to 0)		
2Dh	Reserved	R/W	1	0000,0000b	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd	Rsvd
2Eh	INIDUITAGE	RO	2	0000,0000b				Input Volta	ge: LSByte			
2Fh	INPUT VOLTAGE	RO	2	0000,0000b	Rsvd	Rsvd		Input	Voltage: MS	BByte (bits 1	3 to 8)	
			•	EXTENDED R	EGISTER S	ET – PARAI	METRIC ME	ASUREMEN	IT			
30h	Channel 1	RO	2	0000,0000b			(Channel 1 C	urrent: LSBy	te		
31h	CURRENT	RO		0000,0000b	00b Rsvd Rsvd Channel 1 Current: MSByte (bits 13 to 8)							
32h	Channel 1	RO	2	0000,0000b	Ob Channel 1 Voltage: LSByte							
33h	VOLTAGE	RO		0000,0000b	Rsvd	Rsvd		Channe	el 1 Voltage:	MSByte (bits	s 13 to 8)	

- (1) SUPF bit reset state shown is at Power up only
- (2) VDUV, VPUV and VDWRN bits reset state shown is at Power up only
- (3) Capacitance Measurement is only supported if SRAM code is programmed

Table 9-4. Main Registers

	Table 5-4. Maili Registers											
Cmd Code	Register or Command Name	I ² C R/W	Data Byte	RST State				Bits De	scription			
34h	Channel 2	RO	2	0000,0000b				Channel 2 C	urrent: LSBy	yte		
35h	CURRENT	RO		0000,0000b	Rsvd	Rsvd		Chanr	nel 2 Current	t: MSByte (bi	ts 13 to 8)	
36h	Channel 2	RO	2	0000,0000b				Channel 2 V	oltage: LSBy	/te		
37h	VOLTAGE	RO		0000,0000b	Rsvd	Rsvd		Chanr	nel 2 Voltage	: MSByte (bi	ts 13 to 8)	
38h	Channel 3	RO	2	0000,0000b		•	•	Channel 3 c	urrent: LSBy	rte		
39h	CURRENT	RO		0000,0000b	Rsvd	Rsvd		Chanr	nel 3 Current	t: MSByte (bi	ts 13 to 8)	
3Ah	Channel 3	RO	_	0000,0000b		•		Channel 3 V	oltage: LSBy	yte		
3Bh	VOLTAGE	RO	- 2	0000,0000b	Rsvd	Rsvd Rsvd Channel 3 Voltage: MSByte (bits 13 to 8)						
3Ch	Channel 4	RO	_	0000,0000b	Channel 4 current: LSByte							
3Dh	CURRENT	RO	- 2	0000,0000b	Rsvd Rsvd Channel 4 Current: MSByte (bits 13 to 8)							
3Eh	Channel 4	RO	_	0000,0000b	Channel 4 Voltage: LSByte							
3Fh	VOLTAGE	RO	- 2	0000,0000b	Rsvd Rsvd Channel 4 Voltage: MSByte (bits 13 to 8)							
					CONFIGUI	RATION/OTI	HERS					
40h	CHANNEL FOLDBACK	R/W	1	0000,0000b	2xFB4 2xFB3 2xFB2 2xFB1 MPOL4 MPOL3 MPOL2 MPO						MPOL1	
41h	FIRMWARE REVISION	RO	1	RRRR,RRRRb				Firmwar	e Revision			
42h	I2C WATCHDOG	R/W	1	0001,0110b	Rsvd	Rsvd	Rsvd		Watchdo	g Disable		WDS
43h	DEVICE ID	RO	1	0011,0100b		Device ID r	umber			Silicon Revi	sion number	
					SIGNATURE	MEASURE	MENTS					
44h	Ch1 DETECT RESISTANCE	RO	1	0000,0000b				Channel 1	Resistance			
45h	Ch2 DETECT RESISTANCE	RO	1	0000,0000b				Channel 2	Resistance	ı		
46h	Ch3 DETECT RESISTANCE	RO	1	0000,0000b				Channel 3	Resistance	ı		
47h	Ch4 DETECT RESISTANCE	RO	1	0000,0000b				Channel 4	Resistance	ı		
48h	Ch1 CAP MEASUREMENT	RO	1	0000,0000b				Channel 1	Capacitance	e		
49h	Ch2 CAP MEASUREMENT	RO	1	0000,0000b	Channel 2 Capacitance							
4Ah	Ch3 CAP MEASUREMENT	RO	1	0000,0000b	Channel 3 Capacitance							
4Bh	Ch4 CAP MEASUREMENT	RO	1	0000,0000b	Channel 4 Capacitance							



Table 9-4. Main Registers (continued)

Cmd Code	Register or Command Name	I ² C R/W	Data Byte	RST State	4. Maii i		\	•	escription			
					ASSIGNED (CHANNEL S	TATUS					
4Ch	ASSIGNED CLASS CHANNEL 1	RO	1	0000,0000b	Assi	gned CLAS	S Channe	l 1	F	Previous CLA	SS Channel	1
4Dh	ASSIGNED CLASS CHANNEL 2	RO	1	0000,0000b	Assi	gned CLASS	S Channe	l 2	F	Previous CLA	SS Channel	2
4Eh	ASSIGNED CLASS CHANNEL 3	RO	1	0000,0000b	Assigned CLASS Channel 3 Previous CLASS Channel 3					3		
4Fh	ASSIGNED CLASS CHANNEL 4	RO	1	0000,0000b	Assigned CLASS Channel 4 Previous CLASS Channel 4					4		
				AUTOCL	ASS CONFIG	URATION/N	IEASURE	MENTS				
50h	AUTOCLASS CONTROL	R/W	1	0000,0000b	MAC4 MAC3 MAC2 MAC1 AAC4 AAC3 AAC2 AA						AAC1	
51h	CHANNEL 1 AUTOCLASS PWR	RO	1	0000,0000b	Rsrvd Channel 1 AutoClass Power							
52h	CHANNEL 2 AUTOCLASS PWR	RO	1	0000,0000b	Rsrvd			Chan	nel 2 AutoCla	ass Power		
53h	CHANNEL 3 AUTOCLASS PWR	RO	1	0000,0000b	Rsrvd			Chan	nel 3 AutoCla	ass Power		
54h	CHANNEL 4 AUTOCLASS PWR	RO	1	0000,0000b	Rsrvd			Chan	nel 4 AutoCla	ass Power		
			'		MISCE	LLANEOUS	3					
55h	ALTERNATIVE FOLDBACK	R/W	1	0000,0000b	ALTFB4	ALTFB3	ALTFB 2	ALTFB1	ALTIR4	ALTIR3	ALTIR2	ALTIR1
56h - 5Fh	RESERVED	R/W	1	0000,0000ь	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd
						SRAM						
60h	SRAM CONTROL	R/W	1	0000,0000b	PROG_SEL CPU_RST Rsrvd PAR_EN RAM_EN PAR_SEL RZ/W CLR_PTR						CLR_PTR	
61h	SRAM DATA	R/W	-	-	SRAM DATA - Read and Write (continuous)							
62h	START ADDRESS	R/W	1	0000,0000b	Ob Programming Start Address (LSB)							
63h	GIAINI ADDINESS	R/W	1	0000,0000b	Programming Start Address (MSB)							
64h - 6Fh	RESERVED	R/W	1	0000,0000ь	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd	Rsrvd

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9.6.2 Detailed Register Descriptions

9.6.2.1 INTERRUPT Register

COMMAND = 00h with 1 Data Byte, Read only

Active high, each bit corresponds to a particular event that occurred. Each bit can be individually reset by doing a read at the corresponding event register address, or by setting bit 7 of Reset register.

Any active bit of Interrupt register activates the $\overline{\text{INT}}$ output if its corresponding Mask bit in INTERRUPT Mask register (01h) is set, as well as the INTEN bit in the General Mask register.

Figure 9-6. INTERRUPT Register Format

7	6	5	4	3	2	1	0
SUPF	STRTF	IFAULT	CLASC	DETC	DISF	PGC	PEC
R-1	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-5. INTERRUPT Register Field Descriptions

Bit	Field	Туре		Description
7	SUPF	R	1	Indicates that a Supply Event Fault or SRAM memory fault occurred SUPF = TSD VDUV VDWRN VPUV RAMFLT 1 = At least one Supply Event Fault or SRAM memory fault occurred 0 = No such event occurred
6	STRTF	R	0	Indicates that a t _{START} Fault occurred on at least one channel. STRTF = STRT1 STRT2 STRT3 STRT4 1 = t _{START} Fault occurred for at least one channel 0 = No t _{START} Fault occurred
5	IFAULT	R	0	Indicates that a t _{OVLD} or t _{LIM} Fault occurred on at least one channel. IFAULT = PCUT1 PCUT2 PCUT3 PCUT4 ILIM1 ILIM2 ILIM3 ILIM4 1 = t _{OVLD} and/or t _{LIM} Fault occurred for at least one channel 0 = No t _{OVLD} nor t _{LIM} Fault occurred
4	CLASC	R	0	Indicates that at least one classification cycle occurred on at least one channel CLASC = CLSC1 CLSC2 CLSC3 CLSC4 1 = At least one classification cycle occurred for at least one channel 0 = No classification cycle occurred
3	DETC	R	0	Indicates that at least one detection cycle occurred on at least one channel DETC = DETC1 DETC2 DETC3 DETC4 1 = At least one detection cycle occurred for at least one channel 0 = No detection cycle occurred
2	DISF	R	0	Indicates that a disconnect event occurred on at least one channel. DISF = DISF1 DISF2 DISF3 DISF4 1 = Disconnect event occurred for at least one channel 0 = No disconnect event occurred
1	PGC	R	0	Indicates that a power good status change occurred on at least one channel. PGC = PGC1 PGC2 PGC3 PGC4 1 = Power good status change occurred on at least one channel 0 = No power good status change occurred

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Table 9-5. INTERRUPT Register Field Descriptions (continued)

Bit	Field	Туре	Reset	Description
0	PEC	R	0	Indicates that a power enable status change occurred on at least one channel PEC = PEC1 PEC2 PEC3 PEC4
				1 = Power enable status change occurred on at least one channel
				0 = No power enable status change occurred

9.6.2.2 INTERRUPT MASK Register

COMMAND = 01h with 1 Data Byte, Read/Write

Each bit corresponds to a particular event or fault as defined in the Interrupt register.

Writing a 0 into a bit will mask the corresponding event/fault from activating the INT output.

Note that the bits of the Interrupt register always change state according to events or faults, regardless of the state of the Interrupt Mask register.

Note that the INTEN bit of the General Mask register must also be set in order to allow an event to activate the INT output.

Figure 9-7. INTERRUPT MASK Register Format

7	6	5	4	3	2	1	0
SUMSK	STMSK	IFMSK	CLMSK	DEMSK	DIMSK	PGMSK	PEMSK
R/W-1	R/W-0						

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-6. INTERRUPT MASK Register Field Descriptions

	Table 9-6. INTERRUPT MASK Register Field Descriptions									
Bit	Field	Type	Reset	Description						
7	SUMSK	R/W	1	Supply Event Fault mask bit.						
				1 = Supply Event Fault will activate the INT output.						
				0 = Supply Event Fault will have no impact on INT output.						
6	STMSK	R/W	0	t _{START} Fault mask bit.						
				1 = t _{START} Fault will activate the INT output.						
				0 = t _{START} Fault will have no impact on INT output.						
5	IFMSK	R/W	0	t _{OVLD} or t _{LIM} Fault mask bit.						
				1 = t _{OVLD} and/or t _{LIM} Fault occurrence will activate the INT output						
				0 = t _{OVLD} and/or t _{LIM} Fault occurrence will have no impact on INT output						
4	CLMSK	R/W	0	Classification cycle mask bit.						
				1 = Classification cycle occurrence will activate the INT output.						
				0 = Classification cycle occurrence will have no impact on INT output.						
3	DEMSK	R/W	0	Detection cycle mask bit.						
				1 = Detection cycle occurrence will activate the $\overline{\text{INT}}$ output.						
				0 = Detection cycle occurrence will have no impact on INT output.						
2	DIMSK	R/W	0	Disconnect event mask bit.						
				1 = Disconnect event occurrence will activate th INT output.						
				0 = Disconnect event occurrence will have no impact on INT output.						
1	PGMSK	R/W	0	Power good status change mask bit.						
				1 = Power good status change will activate the INT output.						
				0 = Power good status change will have no impact on INT output.						
0	PEMSK	R/W	0	Power enable status change mask bit.						
				1 = Power enable status change will activate the $\overline{\text{INT}}$ output.						
				0 = Power enable status change will have no impact on INT output.						
-										



9.6.2.3 POWER EVENT Register

COMMAND = 02h with 1 Data Byte, Read only

COMMAND = 03h with 1 Data Byte, Clear on Read

Active high, each bit corresponds to a particular event that occurred.

Each bit xxx1-4 represents an individual channel.

A read at each location (02h or 03h) returns the same register data with the exception that the Clear on Read command clears all bits of the register.

If this register is causing the $\overline{\text{INT}}$ pin to be activated, this Clear on Read will release the $\overline{\text{INT}}$ pin.

Any active bit will have an impact on the Interrupt register as indicated in the Interrupt register description.

Figure 9-8. POWER EVENT Register Format

7	6	5	4	3	2	1	0
PGC4	PGC3	PGC2	PGC1	PEC4	PEC3	PEC2	PEC1
R-0							
CR-0							

LEGEND: R/W = Read/Write; R = Read only; ; CR = Clear on Read, -n = value after reset

Table 9-7. POWER EVENT Register Field Descriptions

Bit	Field	Type	Reset	Description
7–4	PGC4-PGC1	R or CR	0	Indicates that a power good status change occurred. 1 = Power good status change occurred 0 = No power good status change occurred
3–0	PEC4-PEC1	R or CR	0	Indicates that a power enable status change occurred. 1 = Power enable status change occurred 0 = No power enable status change occurred

9.6.2.4 DETECTION EVENT Register

COMMAND = 04h with 1 Data Byte, Read only

COMMAND = 05h with 1 Data Byte, Clear on Read

Active high, each bit corresponds to a particular event that occurred.

Each bit xxx1-4 represents an individual channel.

A read at each location (04h or 05h) returns the same register data with the exception that the Clear on Read command clears all bits of the register. These bits are cleared when channel-n is turned off.

If this register is causing the INT pin to be activated, this Clear on Read will release the INT pin.

Any active bit will have an impact on the Interrupt register as indicated in the Interrupt register description.

Figure 9-9. DETECTION EVENT Register Format

7	6	5	4	3	2	1	0
CLSC4	CLSC3	CLSC2	CLSC1	DETC4	DETC3	DETC2	DETC1
R-0							
CR-0							

LEGEND: R/W = Read/Write; R = Read only; ; CR = Clear on Read, -n = value after reset

Table 9-8. DETECTION EVENT Register Field Descriptions

Bit	Field	Type	Reset	Description
7–4	CLSC4-CLSC1	R or CR	0	Indicates that at least one classification cycle occurred if the CLCHE bit in General Mask register is low. Conversely, it indicates when a change of class occurred if the CLCHE bit is set.
				1 = At least one classification cycle occurred (if CLCHE = 0) or a change of class occurred (CLCHE = 1)
				0 = No classification cycle occurred (if CLCHE = 0) or no change of class occurred (CLCHE = 1)
3–0	DETC4-DETC1	R or CR	0	Indicates that at least one detection cycle occurred if the DECHE bit in General Mask register is low. Conversely, it indicates when a change in detection occurred if the DECHE bit is set.
				1 = At least one detection cycle occurred (if DECHE = 0) or a change in detection occurred (DECHE = 1)
				0 = No detection cycle occurred (if DECHE = 0) or no change in detection occurred (DECHE = 1)

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9.6.2.5 FAULT EVENT Register

COMMAND = 06h with 1 Data Byte, Read only

COMMAND = 07h with 1 Data Byte, Clear on Read

Active high, each bit corresponds to a particular event that occurred.

Each bit xxx1-4 represents an individual channel.

A read at each location (06h or 07h) returns the same register data with the exception that the Clear on Read command clears all bits of the register. These bits are cleared when channel-n is turned off.

If this register is causing the $\overline{\rm INT}$ pin to be activated, this Clear on Read will release the $\overline{\rm INT}$ pin.

Any active bit will have an impact on the Interrupt register as indicated in the Interrupt register description.

Figure 9-10. FAULT EVENT Register Format

7	6	5	4	3	2	1	0
DISF4	DISF3	DISF2	DISF1	PCUT4	PCUT3	PCUT2	PCUT1
R-0							
CR-0							

LEGEND: R/W = Read/Write; R = Read only; ; CR = Clear on Read, -n = value after reset

Table 9-9. FAULT EVENT Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–4	DISF4-DISF1	R or CR	0	Indicates that a disconnect event occurred. 1 = Disconnect event occurred
				0 = No disconnect event occurred
3–0	PCUT4-PCUT1	R or	0	Indicates that a t _{OVLD} Fault occurred.
		CR		1 = t _{OVLD} Fault occurred
				0 = No t _{OVLD} Fault occurred

Clearing a PCUT event has no impact on the TLIM or TOVLD counters.



9.6.2.6 START/ILIM EVENT Register

COMMAND = 08h with 1 Data Byte, Read only

COMMAND = 09h with 1 Data Byte, Clear on Read

Active high, each bit corresponds to a particular event that occurred.

Each bit xxx1-4 represents an individual channel.

A read at each location (08h or 09h) returns the same register data with the exception that the Clear on Read command clears all bits of the register. These bits are cleared when channel-n is turned off.

If this register is causing the $\overline{\rm INT}$ pin to be activated, this Clear on Read will release the $\overline{\rm INT}$ pin.

Any active bit will have an impact on the Interrupt register as indicated in the Interrupt register description.

Figure 9-11. START/ILIM EVENT Register Format

7	6	5	4	3	2	1	0
ILIM4	ILIM3	ILIM2	ILIM1	STRT4	STRT3	STRT2	STRT1
R-0							
CR-0							

LEGEND: R/W = Read/Write; R = Read only; ; CR = Clear on Read, -n = value after reset

Table 9-10. START/ILIM EVENT Register Field Descriptions

Bit	Field	Type	Reset	Description
7–4	ILIM4–ILIM1	R or CR	0	Indicates that a t_{LIM} fault occurred, which means the channel has limited its output current to I_{LIM} or the folded back I_{LIM} for more than t_{LIM} .
				1 = t _{LIM} fault occurred
				0 = No t _{LIM} fault occurred
3–0	STRT4-STRT1	R or	0	Indicates that a t _{START} fault occurred during turn on.
		CR		1 = t _{START} fault or class/detect error occurred
				0 = No t _{START} fault or class/detect error occurred

Note

When a Start Fault is reported and the PECn bit in Power Event register is set, then there is an Inrush fault.

When a Start Fault is reported and the PECn bit is **not** set, then the Power-On Fault register (0x24h) will indicate the cause of the fault.

In auto mode, STRTn faults will not be reported and register 0x24h will not be updated due to invalid discovery results.

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9.6.2.7 SUPPLY and FAULT EVENT Register

COMMAND = 0Ah with 1 Data Byte, Read only

COMMAND = 0Bh with 1 Data Byte, Clear on Read

Active high, each bit corresponds to a particular event that occurred.

A read at each location (0Ah or 0Bh) returns the same register data with the exception that the Clear on Read command clears all bits of the register.

If this register is causing the $\overline{\text{INT}}$ pin to be activated, this Clear on Read will release the $\overline{\text{INT}}$ pin.

Any active bit will have an impact on the Interrupt register as indicated in the Interrupt register description.

Figure 9-12. SUPPLY and FAULT EVENT Register Format

7	6	5	4	3	2	1	0
TSD	VDUV	VDWRN	VPUV	Rsvrd	Rsvrd	OSSE	RAMFLT
R	R	R	R	R	R	R	R
CR	CR	CR	CR	CR	CR	CR	CR

LEGEND: R/W = Read/Write; R = Read only; ; CR = Clear on Read, -n = value after reset

Table 9-11. SUPPLY and FAULT EVENT Register Field Descriptions

Bit	Field	Туре	POR/R ST	Description
7	TSD	R or CR	0/P	Indicates that a thermal shutdown occurred. When there is thermal shutdown, all channels are turned off and are put in OFF mode. The internal circuitry continues to operate however, including the ADCs. Note that at as soon as the internal temperature has decreased below the low threshold, the channels can be turned back ON regardless of the status of the TSD bit. 1 = Thermal shutdown occurred 0 = No thermal shutdown occurred
6	VDUV	R or CR	1/P	Indicates that a VDD UVLO occurred. 1 = VDD UVLO occurred 0 = No VDD UVLO occurred
5	VDWRN	R or CR	1/P	Indicates that the VDD has fallen under the UVLO warning threshold. 1 = VDD UV Warning occurred 0 = No VDD UV warning occurred
4	VPUV	R or CR	1 / P	Indicates that a VPWR undervoltage occurred. 1 = VPWR undervoltage occurred 0 = No VPWR undervoltage occurred
3-2	Rsvrd	R or CR	0/0	Reserved
1	OSSE	R or CR	0/0	Indicates that an OSS Event occurred 1 = one or more channels with a group of 4 were disabled due to the assertion of the OSS pin or provided 3-bit OSS code 0 = No OSS events occurred
0	RAMFLT	R or CR	0/0	Indicates that a SRAM fault has occurred 1 = SRAM fault occurred 0 = No SRAM fault occurred

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Note

The RST condition of "P" indicates that the previous state of these bits will be preserved following a device reset using the RESET pin. Thus, pulling the RESET input low will not clear the TSD, VDUV, VDWRN, or VPUV bits.

Note

While the VPUV bit is set, any PWONn commands will be ignored until V_{VPWR} > 30 V.

During VPUV undervoltage condition, the Detection Event register (CLSCn, DETCn) is not cleared, unless VPWR also falls below the VPWR UVLO falling threshold (approximately18 V).

A clear on Read will not effectively clear VDUV bit as long as the VPWR undervoltage condition is maintained.

Note

In 1-bit mode (MbitPrty = 0 in reg 0x17), the OSSE bit will be set anytime a channel within a group of 4 has OSS enabled and the OSS pin is asserted.

In 3-bit mode (MbitPrty = 1 in reg 0x17), the OSSE bit will be set anytime a 3-bit priority code is sent that is equal to or greater than the MBPn settings in registers 0x27 and 0x28 channel for a group of 4 channels.

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9.6.2.7.1 Detected SRAM Faults and "Safe Mode"

The TPS23882B is configured with internal SRAM memory fault monitoring, and in the event that an error is detected with the SRAM memory, the device will enter "safe mode". While in "Safe mode" the FW Revision value in register 0x41 will be set to 0xFFh.

Any channels that are currently powered will remain powered, but the majority of the operation will be disabled until the SRAM can be reloaded. The device UVLO and Thermal Shutdown features in addition to the disconnect and current foldback functions for the powered channels will be preserved in "safe mode".

Any channels that were not powered prior to the SRAM fault detection will be set to OFF mode (see register 0x12h description for additional changes that will occur as a result of the change to OFF mode). Port Remapping (0x26h) and any other channel configuration settings (ie Power Allocation 0x29h) will be preserved.

Upon detection of a SRAM fault the "RAM_EN" bit in 0x60 will be cleared and the RAMFLT bit will be set in register 0x0A. The internal firmware will continue to run in "safe mode" until this bit is set again by the host after the SRAM is reloaded or a POR (Power on Reset) event occurs. In order to ensure a smooth transition into and out of "safe mode", any I2C commands other than those to reprogram the SRAM need to be deferred until after the SRAM is reloaded and determined to be "valid" (see register 0x60 SRAM programing descriptions).

Note

Once set, the RAMFLT bit will remain set even after the device is removed from safe mode. it is recommend that this bit be cleared prior to setting the RAM_EN bit in register 0x60 following the SRAM reload.

Note

The PAR_EN bit in reg 0x60 must be set and the corresponding SRAM_Parity code (available for download from the *TI mySecure Software* webpage) must be loaded into the device in order for the SRAM fault monitoring to be active.

Please refer to the *How to Load TPS2388x SRAM Code* document for more information on the recommended SRAM programming procedure.



9.6.2.8 CHANNEL 1 DISCOVERY Register

COMMAND = 0Ch with 1 Data Byte, Read Only

Figure 9-13. CHANNEL 1 DISCOVERY Register Format

7	6	5	4	3	2	1	0	
	REQUESTED	CLASS Ch1		DETECT Ch1				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.9 CHANNEL 2 DISCOVERY Register

COMMAND = 0Dh with 1 Data Byte, Read Only

Figure 9-14. CHANNEL 2 DISCOVERY Register Format

7	6	5	4	3	2	1	0	
	REQUESTED	CLASS Ch2		DETECT Ch2				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.10 CHANNEL 3 DISCOVERY Register

COMMAND = 0Eh with 1 Data Byte, Read Only

Figure 9-15. CHANNEL 3 DISCOVERY Register Format

7	6	5	4	3	2	1	0	
	REQUESTED	CLASS Ch3		DETECT Ch3				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.11 CHANNEL 4 DISCOVERY Register

COMMAND = 0Fh with 1 Data Byte, Read Only

Figure 9-16. CHANNEL 4 DISCOVERY Register Format

7	6	5	4	3	2	1	0	
	REQUESTED	CLASS Ch4		DETECT Ch4				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Bit Descriptions: These bits represent the most recent **"requested"** classification and detection results for channel n. These bits are cleared when channel n is turned off.

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Table 9-12. CHANNEL n DISCOVERY Register Field Descriptions

Bit	Field	Туре	Reset		Description					
7–4	RCLASS	R	0	Most red	cent cla	ssifica	tion re	sult on channel n.		
	Ch-n			The sele	ection is	s as fol	lowing			
				RCL	ASS C	h-n		Requested Class		
				0	0	0	0	Unknown		
				0	0	0	1	Class 1		
				0	0	1	0	Class 2		
				0	0	1	1	Class 3		
				0	1	0	0	Class 4		
				0	1	0	1	Reserved – read as Class 0		
				0	1	1	0	Class 0		
				0	1	1	1	Class Overcurrent		
				1	0	0	0	Class 5 - 4-Pair Single Signature		
				1	0	0	1	Class 6 - 4-Pair Single Signature		
				1	0	1	0	Class 7 - 4-Pair Single Signature		
				1	0	1	1	Class 8 - 4-Pair Single Signature		
				1	1	0	0	Class 4+ - Type-1 Limited		
				1	1	0	1	Class 5 - 4-Pair Dual Signature		
				1	1	1	0	Reserved		
				1	1	1	1	Class Mismatch		
3–0	DETECT	R	0	Most red	cent de	tection	result	on channel n.		
	Ch-n			The sele	ection is	s as fol	lowing			
				DET	ECT C	h-n		Detection Status		
				0	0	0	0	Unknown		
				0	0	0	1	Short-circuit		
				0	0	1	0	Reserved		
				0	0	1	1	Too Low		
				0	1	0	0	Valid		
				0	1	0	1	Too High		
				0	1	1	0	Open Circuit		
				0	1	1	1	Reserved		
				1	1	1	0	MOSFET fault		

"Requested" vs. "Assigned" Classification: The "requested" class is the classification the PSE measures during Mutual Identification prior to turn on, whereas the "assigned" class is the classification level the channel was powered on with based on the Power Allocation setting in register 0x29h. The "assigned" classification values are available in registers 0x4C-4F

Note

Due to the need to power on after 1 class finger, the "Class 4+ - Type 1 Limited" Requested Class is reported anytime a Class 4 or higher PD is powered with register 0x29 configured for 15.5W.

Upon being powered, devices that present a class 0 signature during discovery will be given an assigned class of "Class 3"

Even though the TPS23882B is a 2-pair PSE controller, due to the use of 3-finger classification, it is still capable of identifying if a Class 5+ 4-pair PDs is connected.



9.6.2.12 POWER STATUS Register

COMMAND = 10h with 1 Data Byte, Read only

Each bit represents the actual power status of a channel.

Each bit xx1-4 represents an individual channel.

These bits are cleared when channel-n is turned off, including if the turn off is caused by a fault condition.

Figure 9-17. POWER STATUS Register Format

		•					
7	6	5	4	3	2	1	0
PG4	PG3	PG2	PG1	PE4	PE3	PE2	PE1
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-13. POWER STATUS Register Field Descriptions

	Table 3-10. I OWER O'M TOO Register Field Descriptions							
Bit	Field	Type	Reset	Description				
7–4	PG4–PG1	R	0	Each bit, when at 1, indicates that the channel is on and that the voltage at DRAINn pin has gone below the power good threshold during turn on. These bits are latched high once the turn on is complete and can only be cleared when the channel is turned off or at RESET/POR. 1 = Power is good 0 = Power is not good				
3–0	PE4-PE1	R	0	Each bit indicates the ON/OFF state of the corresponding channel. 1 = Channel is on 0 = Channel is off				

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9.6.2.13 PIN STATUS Register

COMMAND = 11h with 1 Data Byte, Read Only

Figure 9-18. PIN STATUS Register Format

7	6	5	4	3	2	1	0
0	SLA4	SLA3	SLA2	SLA1	SLA0	0	0
0	A4 pin	A3 pin	A2 pin	A1 pin	0/1 ⁽¹⁾	0	0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

(1) If Configuration A, it can be 0 or 1. If configuration B, it is 0.

Table 9-14. PIN STATUS Register Field Descriptions

Bit	Field	Туре	Reset	Description
6-3	SLA4-SLA1	R	See above	I ² C device address, as defined while using pins A4-A1.
2	SLA0	R		SLA0 bit is internally defined to 0 or 1 0 = Channel 1-4 1 = Channels 5-8
7, 1-0	-	R		Reserved

DECODIDEION			BINARY		ADDRESS PINS						
DESCRIPTION	6	5	4	3	2	1	0	A4	А3	A2	A1
Broadcast access	1	1	1	1	1	1	1	Х	Х	Х	Х
Target 0	0	1	0	0	0	0	0/1	GND	GND	GND	GND
	0	1	0	0	0	1	0/1	GND	GND	GND	HIGH
	0	1	0	0	1	0	0/1	GND	GND	HIGH	GND
	0	1	0	0	1	1	0/1	GND	GND	HIGH	HIGH
	0	1	0	1	0	0	0/1	GND	HIGH	GND	GND
	0	1	0	1	0	1	0/1	GND	HIGH	GND	HIGH
	0	1	0	1	1	0	0/1	GND	HIGH	HIGH	GND
	0	1	0	1	1	1	0/1	GND	HIGH	HIGH	HIGH
	0	1	1	0	0	0	0/1	HIGH	GND	GND	GND
	0	1	1	0	0	1	0/1	HIGH	GND	GND	HIGH
	0	1	1	0	1	0	0/1	HIGH	GND	HIGH	GND
	0	1	1	0	1	1	0/1	HIGH	GND	HIGH	HIGH
	0	1	1	1	0	0	0/1	HIGH	HIGH	GND	GND
	0	1	1	1	0	1	0/1	HIGH	HIGH	GND	HIGH
	0	1	1	1	1	0	0/1	HIGH	HIGH	HIGH	GND
Target 15	0	1	1	1	1	1	0/1	HIGH	HIGH	HIGH	HIGH

9.6.2.13.1 AUTONOMOUS MODE

In autonomous mode, the TPS23882B is capable of operating without any I²C communication or host control. As in auto mode, when the device is operating in autonomous mode, the ports will be continuously cycling through discovery, and the ports will automatically power whenever a valid (defection and classification) PD is connected.

Connecting a resistor between the AUTO pin and GND based on the table below Table 9-15will enable autonomous mode and configure all the ports to the same Power Allocation settings. In the event a PD is connected with a higher requested class than the autonomous mode configuration, the port will power demote the PD to the selected autonomous mode configuration power level.

Table 9-15. AUTO Pin Programming

AUTO Pin	Autonomous Mode Configuration	Resu	Resulting Register Configurations			
		0x12h	0x14h	0x29h		
Open/Floating	Disabled	0000, 0000b	0000, 0000b	0000, 0000b		
124 kΩ	2-pair 15W	1111, 1111b	1111, 1111b	0000, 0000b		
62 kΩ	2-pair 30W	1111, 1111b	1111, 1111b	0011 0011b		

Note

A 10 nF capacitor is required in parallel with R_{AUTO} to ensure stability in the Autonomous mode selection.

The I2C interface is still fully operational in Autonomous mode, and the all of the port telemetry and configurability is still supported

The AUTO pin resistance (R_{AUTO}) will not be measured following a device reset (assertion of the \overline{RESET} pin or RESAL bit in register 0x1A). The device will only measured (R_{AUTO}) and preconfigure the internal registers during power up (V_{VPWR} and V_{VDD} rising above their respective UVLO thresholds).

Note

The device SRAM will need to be programmed in order to support applications that desire to remove a device from Autonomous mode after having initially powered up in Autonomous mode.

A device running from the internal ROM (SRAM unprogrammed) in Autonomous mode will turn off and automatically resume discovery and power on any valid loads following the assertion of the $\overline{\text{RESET}}$ pin, I2C register 0x1A RESAL or RESPn bits, or a mode off command. Whereas a device running in Autonomous mode with the SRAM programmed will turn off and remain inactive until the host re-enables the port(s) through the I 2 C bus.



9.6.2.14 OPERATING MODE Register

COMMAND = 12h with 1 Data Byte, Read/Write

Figure 9-19. OPERATING MODE Register Format

7	6	5	4	3	2	1	0
C4M1	C4M0	C3M1	C3M0	C2M1	C2M0	C1M1	C1M0
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-16. OPERATING MODE Register Field Descriptions

Bit	Field	Type	Reset	Description						
7-0	CnM1-CnM0	R/W	0	Each pair of bits configures the operating mode per channel. The selection is as following:						
				M1 M0 Operating Mode						
				0 0 OFF						
				0 1 Diagnostic/Manual						
				1 0 Semiauto						
				1	1 1 Auto					
					•	•	•			



OFF MODE:

In OFF mode, the Channel is OFF and neither detection nor classification is performed independent of the DETE, CLSE or PWON bits.

The table below depicts what bits will be cleared when a channel is changed to OFF mode from any other operating mode:

Table 9-17. Transition to OFF Mode

Register	Bits to be reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

Note

it may take upwards of 5 ms before all of the registers are cleared following a change to OFF mode.

Only the bits associated with the channel/port ("n") being set into OFF mode will be cleared. Those bits associated with channels/ports remaining in operation will not be changed.

In the event either the PGn or PEn bits were changed from a 1 to a zero, the corresponding PGCn and PECn bits will be set in the POWER EVENT register 0x02h.

Also, a change of mode from semiauto to manual/diagnostic mode or OFF mode will cancel any ongoing cooldown time period.

DIAGNOSTIC/MANUAL MODE:

In Manual/Diagnostic mode, there is no automatic state change. The channel remains idle until DETE, CLSE (0x14h or 0x18h), or PWON command is provided. Upon the setting of the DETE and/or CLSE bits, the channel will perform a singular detection and/or classification cycle on the corresponding channel.

Note

Setting a PWONn bit in register 0x19 results in the immediate turn on of that channel.

There is no Assigned Class assigned for ports/channels powered out of Manual/Diagnostic mode. Any settings such as the port power policing and 1x/2x foldback selection that are typically configure based on the assigned class result need to manually configured by the user.

Note

Setting a PWONn bit in register 0x19 results in the immediate turn on of that channel.

SEMIAUTO MODE:

In semiauto mode, as long as the Channel is unpowered, detection and classifications may be performed continuously depending if the corresponding class and detect enable bits are set (register 0x14h).

Table 9-18. Channel Behavior in Semiauto Mode

CLEn	DETn	Channel Operation
0	0	Idle
0	1	Cycling Detection Measurements only
1	0	Idle
1	1	Cycling Detection and Classification Measurements



AUTO MODE:

In auto mode, channels will automatically power on any valid detection and classification signature based on the Port Power Allocation settings in 0x29. The channels will remain idle until DETE and CLSE (0x14 or 0x18) are set, or a PWON command is given.

Prior to setting DETE and CLE or sending a PWON command in AUTO mode, the following registers need to be configured according to the system requirements and configuration:

Register	Bits			
0x26	Port Re-mapping			
0x29	Port Power Allocation			
0x50	Auto AC Enable			
0x55	Alternative Inrush and Powered Foldback Enable			

Note

Changes to these registers after the DETE and CLE bits are set in auto mode may result in undesired or non IEEE complaint operation.

The following registers may be configured or changed after turn on if changes to the default operation are desired as these values are internally set during power on based on the port configuration and resulting assigned PD class:

Register	Bits
0x1E-21	2-Pair Policing
0x40	2x Foldback Enable

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9.6.2.15 DISCONNECT ENABLE Register

COMMAND = 13h with 1 Data Byte, Read/Write

Bit Descriptions: Defines the disconnect detection mechanism for each channel.

Figure 9-20. DISCONNECT ENABLE Register Format

					•		
7	6	5	4	3	2	1	0
_	_	_	_	DCDE4	DCDE3	DCDE2	DCDE1
R/W-0	R/W-0	R/W-0	R/W-0	R/W-1	R/W-1	R/W-1	R/W-1

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-19. DISCONNECT ENABLE Register Field Descriptions

	idalo o ioi bio o inita di alta della inita della init							
Bit	Field	Туре	Reset	Description				
7–4	_	R/W	0					
3–0	DCDE4-DCDE1	R/W	1	DC disconnect enable				
				1 = DC Disconnect Enabled				
				0 = DC Disconnect Disabled				
				Look at the TIMING CONFIGURATION register for more details on how to define the TDIS time period.				

DC disconnect consists in measuring the Channel DC current at SENn, starting a timer (T_{DIS}) if this current is below a threshold and turning the Channel off if a time-out occurs. Also, the corresponding disconnect bit (DISFn) in the FAULT EVENT register is set accordingly. The T_{DIS} counter is reset each time the current rises above the disconnect threshold for at least 3 msec. The counter does not decrement below zero.

9.6.2.16 DETECT/CLASS ENABLE Register

COMMAND = 14h with 1 Data Byte, Read/Write

During t_{OVLD}, t_{LIM} or t_{START} cool down cycle, any Detect/Class Enable command for that channel will be delayed until end of cool-down period. Note that at the end of cool down cycle, one or more detection/class cycles are automatically restarted as described previously, if the class and/or detect enable bits are set.

Figure 9-21. DETECT/CLASS ENABLE Register Format

		<u> </u>					
7	6	5	4	3	2	1	0
CLE4	CLE3	CLE2	CLE1	DETE4	DETE3	DETE2	DETE1
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-20. DETECT/CLASS ENABLE Register Field Descriptions

	Bit	Field	Туре	Reset	Description
	7–4	CLE4-CLE1	R/W	0	Classification enable bits.
;	3–0	DETE4-DETE1	R/W	0	Detection enable bits.

Bit Descriptions:

Detection and classification enable for each channel.

When in Manual mode, setting a bit means that only one cycle (detection or classification) is performed for the corresponding channel. The bit is automatically cleared by the time the cycle has been completed.

Note that similar result can be obtained by writing to the Detect/Class Restart register 0x18.

It is also cleared if a turn off (Power Enable register) command is issued.

When in semiauto mode, as long as the port is kept off, detection and classification are performed continuously, as long as the class and detect enable bits are kept set, but the class will be done only if the detection was valid. A Detect/Class Restart PB command can also be used to set the CLEn and DETEn bits, if in semiauto mode.

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9.6.2.17 Power Priority / 2Pair PCUT Disable Register Name

COMMAND = 15h with 1 Data Byte, R/W

Figure 9-22. Power Priority / 2P-PCUT Disable Register Format

7	6	5	4	3	2	1	0
OSS4	OSS3	OSS2	OSS1	DCUT4	DCUT3	DCUT2	DCUT1
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-21. Power Priority / 2P-PCUT Disable Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–4	OSS4-OSS1	R/W	0	Power priority bits: When the MBitPrty bit in 0x17 =0: 1 = When the OSS signal is asserted, the corresponding channel is powered off. 0 = OSS signal has no impact on the channel.
3–0	DCUT4-DCUT1	R/W	0	2-Pair PCUT disable for each channel. Used to prevent removal of the associated channel's power due to a 2-Pair PCUT fault, regardless of the programming status of the Timing Configuration register. Note that there is still monitoring of ILIM faults. 1: Channel's PCUT is disabled. This means that an PCUT fault alone will not turn off this channel. 0: Channel's PCUT is enabled. This enables channel turn off if there is PCUT fault.

Note

If the MbitPrty bit = 1 (0x17h): The OSSn bits must be cleared to ensure proper operation. Refer to registers 0x27/28h for more information on the Multi-bit priority shutdown feature.

Note

If DCUT = 1 for a channel, the channel will not be automatically turned off during a PCUT fault condition. However, the PCUT fault flag will still be operational, with a fault timeout equal to t_{OVLD} .

Any change in the state of DCUTn bits will result in the resetting of the T_{OVLD} timer for that channel.



The OSSn bits are used to determine which channels are shut down in response to an external assertion of the OSS fast shutdown signal.

The turn off procedure due to OSS is similar to a channel reset or change to OFF mode, with the exception that OSS does not cancel any ongoing fault cool down timers. the table below includes the bits that will be cleared when a channel is disabled due to OSS:

Table 9-22. Channel Turn Off with OSS

Register	Bits to be reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

Note

it may take upwards of 5 ms before all of the registers are cleared following an OSS event.

Only the bits associated with the channel/port ("n") with OSS enabled will be cleared. Those bits associated with channels/ports remaining in operation will not be changed.

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9.6.2.18 TIMING CONFIGURATION Register

COMMAND = 16h with 1 Data Byte, Read/Write

Bit Descriptions: These bits define the timing configuration for all four channels.

Figure 9-23. TIMING CONFIGURATION Register Format

		•			•		
7	6	6 5		5 4 3 2		1	0
TLIM		TST	ART	TO	VLD	TMF	PDO
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-23. TIMING CONFIGURATION Register Field Descriptions

Bit	Field	Туре	Reset			Descr	·				
7 –6	TLIM	R/W	0	ILIM fault timing, which is the output current limit time duration before channel turn off. When a 2xFBn bit in register 0x40 = 0, the t _{LIM} used for the associated channel is always the nominal value (about 60 ms). This timer is active and increments to the settings defined below after expiration of the TSTART time window and when the channel is limiting its output current to I _{LIM} . If the ILIM counter is allowed							
					cool de	own timer is then started, and the	ed below, the channel will be powered off. The channel can not be turned-on until the counter				
						,	n reached), while the channel current is below				
							of the increment rate. The counter does not				
						command, a DC disconnect even	eared in the event of a turn off due to a Power t or the OSS input				
						•	while this timer is already active for a channel,				
				this timer	is auto	matically reset then restarted with	the new programmed time-out duration.				
						•	emiauto mode, a detection cycle is automatically				
						etect enable bit is set. Also note th reset command, or if the OFF or N	nat the cool down time count is immediately				
						*	for associated channel is programmable with the				
				following							
				TLI	И	Minimum t _{LIM} (ms)					
				0	0	58					
				0	1	15					
				1	0	10					
				1	1	6					
5-4	TSTART (or	R/W	0	TSTART	period t	the current is still limited to I_{Inrush} ,					
	TINRUSH)					•	luring which the channel can not be turned-on emiauto mode, a detection cycle is automatically				
						lass and detect enable bits are set					
				Note that	in the	event the TSTART setting is chang	ged while this timer is already active for a channel,				
				this new setting is ignored and will be applied only next time the channel is turned ON.							
				The selection is as following:							
				TSTART Nominal t _{START} (ms)							
				0 0 60							
				0	1	30					
				1	0	120					
				1	1	Reserved					



Table 9-23. TIMING CONFIGURATION Register Field Descriptions (continued)

Bit	Field	Туре	Reset				Descr	. ,		
3-2	TOVLD	R/W	0	increm curren is allow off. The counted In other same below Reset Note to this tire Note to restard cance Note to for the when	ments that meets were to a counter of the total cou	o the ts or reaction the ts or r	g, which is the overcurrent time described by the settings defined below after expected by the programmed time-out durated cool down timer is then started, the completion. It is a cool to the programmed time-out durated completion. It is a cool to the programmed time out the started, the completion. It is a cool to the programmed time out the started of the interest of the programmed time. The programmed time is also cleared in the programmed time the programmed to the programmed time. The programmed time is the programmed time the programmed time time time time the programmed time time time time time time. The programmed time time time time time time time time	uration before turn off. This timer is active and irration of the TSTART time window and when the ed by the current foldback. If the PCUT counter tion specified below, the channel will be powered and the channel can not be turned-on until the encrement rate. The counter does not decrement the event of a turn off due to a Power Enable or SS input ed while this timer is already active for a channel, at the new programmed time-out duration. The new programmed time-out duration. The emiauto mode, a detection cycle is automatically that the cool down time count is immediately Manual mode is selected. Ity/PCUT Disable register, the PCUT fault timing even though the channel will not be turned off		
				0) 1		30			
				1	1 0		120			
				1	1 1		240			
1-0	TMPDO	R/W	0	Disconnect delay, which is the time to turn off a channel once there is a disconnect condition, and if the dc disconnect detect method has been enabled. The TDIS counter is reset each time the current goes continuously higher than the disconnect threshold for nominally 15 ms. The counter does not decrement below zero. The selection is as following:						
				TMPDO Nominal t _{MPDO} (ms)						
				0 0 360						
				0			90			
				1			180			
					1 1		180			

Note

The PGn and PEn bits (Power Status register) are cleared when there is a TLIM, TOVLD, TMPDO, or TSTART fault condition.

Note

The settings for t_{LIM} set the minimum timeout based on the IEEE compliance requirements.

9.6.2.19 GENERAL MASK Register

COMMAND = 17h with 1 Data Byte, Read/Write

Figure 9-24. GENERAL MASK Register Format

7	6	5	4	3	2	1	0
INTEN	_	nbitACC	MbitPrty	CLCHE	DECHE	_	_
R/W-1	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-24. GENERAL MASK Register Field Descriptions

	Table 9-24. GENERAL MASK Register Field Descriptions								
Bit	Field	Type	Reset	Description					
7	INTEN	R/W	1	INT pin mask bit. Writing a 0 will mask any bit of Interrupt register from activating the INT output, whatever the state of the Interrupt Mask register. Note that activating INTEN has no impact on the event registers.					
				1 = Any unmasked bit of Interrupt register can activate the INT output					
				0 = ĪNT output cannot be activated					
6	_	R/W	0						
5	nbitACC	R/W	0	I ² C Register Access Configuration bit.					
				1 = Configuration B. This means 16-bit access with a single device address (A0 = 0).					
				0 = Configuration A. This means 8-bit access, while the 8-channel device is treated as 2					
				separate 4-channel devices with 2 consecutive target addresses.					
				See register 0x11 for more information on the I2C address programming					
4	MbitPrty	R/W	0	Multi Bit Priority bit. Used to select between 1-bit shutdown priority and 3-bit shutdown priority.					
				1 = 3-bit shutdown priority. Register 0x27 and 0x28 need to be followed for priority and OSS action.					
				0 = 1-bit shutdown priority. Register 0x15 needs to be followed for priority and OSS action					
3	CLCHE	R/W	0	Class change Enable bit. When set, the CLSCn bits in Detection Event register only indicates when the result of the most current classification operation differs from the result of the previous one.					
				1 = CLSCn bit is set only when a change of class occurred for the associated channel.					
				0 = CLSCn bit is set each time a classification cycle occurred for the associated channel.					
2	DECHE	R/W	0	Detect Change Enable bit. When set, the DETCn bits in Detection Event register only indicates when the result of the most current detection operation differs from the result of the previous one.					
				1 = DETCn bit is set only when a change in detection occurred for the associated channel.					
				0 = DETCn bit is set each time a detection cycle occurred for the associated channel.					
1	_	R/W	0						
0	_	R/W	0						

Note

If the MbitPrty bit needs to be changed from 0 to 1, make sure the OSS input pin is in the idle (low) state for a minimum of 200 µsec prior to setting the MbitPrty bit, to avoid any misbehavior related to loss of synchronization with the OSS bit stream.



Note

Only the nbitACC bit for channels 1-4 needs to be set to enable 16-bit I²C operation.

Table 9-25. nbitACC = 1: Register Operations in 8-Bit (Config A) and 16-bit (Config B) I²C Mode

		C = 1: Register Opera	ations in 8-Bit (Config A) and 16	5-bit (Config B) I-C Wode				
Cmd Code	Register or Command Name	Bits Description	Configuration A (8-bit)	Configuration B (16-bit)				
00h	INTERRUPT	INT bits P1-4, P5-8	Separate mask and interrupt result per group	of 4 channels.				
01h	INTERRUPT MASK	MSK bits P1-4, P5-8	The Supply event bit is repeated twice.					
02h 03h	POWER EVENT	PGC_PEC P4-1, P8-5						
04h 05h	DETECTION EVENT	CLS_DET P4-1, P8-5	Separate event byte per group of 4 channels.					
06h 07h	FAULT EVENT	DIS_PCUT P4-1, P8-5	- Separate event byte per group of 4 chainlets.					
08h 09h	START/ILIM EVENT	ILIM_STR P4-1, P8-5						
0Ah 0Bh	SUPPLY/FAULT EVENT	TSD, VDUV, VDUW, VPUV , RAMFLT OSSE4-1, OSSE8-5	Both 8-bit registers (channel 1 to 4 and channel VDUV, VPUV and RAMFLT. The PCUTxx and group of 4 channels. Clearing at least one VPUV/VDUV also clears	OSSEx bits will. have separate status per				
0Ch	CHANNEL 1 DISCOVERY	CLS&DET1_CLS&DET5	3					
0Dh	CHANNEL 2 DISCOVERY	CLS&DET2_CLS&DET6	- Separate Status byte per channel					
0Eh	CHANNEL 3 DISCOVERY	CLS&DET3_CLS&DET7	- Soparato Status Syto por Granmor					
0Fh	CHANNEL 4 DISCOVERY	CLS&DET4_CLS&DET8						
10h	POWER STATUS	PG_PE P4-1, P8-5	Separate status byte per group of 4 channels					
11h	PIN STATUS	A4-A1,A0	Both 8-bit registers (channel 1 to 4 and channel 5 to 8) will show the same result, except that A0 = 0 (channel 1 to 4) or 1 (channel 5 to 8).	Both 8-bit registers (channel 1 to 4 and channel 5 to 8) will show the same result, including A0 = 0.				
12h	OPERATING MODE	MODE P4-1, P8-5	Separate Mode byte per group of 4 channels.					
13h	DISCONNECT ENABLE	DCDE P4-1, P8-5	Separate DC disconnect enable byte per grou	p of 4 channels.				
14h	DETECT/CLASS ENABLE	CLE_DETE P4-1, P8-5	Separate Detect/Class Enable byte per group	of 4 channels.				
15h	PWRPR/2P-PCUT DISABLE	OSS_DCUT P4-1, P8-5	Separate OSS/DCUT byte per group of 4 char	nnels.				
16h	TIMING CONFIG	TLIM_TSTRT_TOVLD_TMPD O P4-1, P8-5	Separate Timing byte per group of 4 channels					
17h	GENERAL MASK	P4-1, P8-5 including n-bit access	Separate byte per group of 4 channels. n-bit access: Setting this in at least one of the enter Config B mode. To go back to config A, of MbitPrty: Setting this in at least one of the virtus. 3-bit shutdown priority. To go back to 1-bit shu	clear both. ual quad register space is enough to enter				
18h	DETECT/CLASS Restart	RCL_RDET P4-1, P8-5	Separate DET/CL RST byte per group of 4 cha	annels				
19h	POWER ENABLE	POF_PWON P4-1, P8-5	Separate POF/PWON byte per group of 4 cha	nnels				
1Ah	RESET	P4-1, P8-5	Separate byte per group of 4 channels, Clear Int pin and Clear All int.	Separate byte per group of 4 channels.				
1Bh	ID		Both 8-bit registers (channel 1 to 4 and channel modified through I ² C.	el 5 to 8) will show the same result unless				
1Ch	AUTOCLASS	AC4-1, AC8-5	Separate byte per group of 4 channels.					
1Eh	2P POLICE 1/5 CONFIG	POL1, POL5						
1Fh	2P POLICE 2/6 CONFIG	POL2, POL6	1					
20h	2P POLICE 3/7 CONFIG	POL3, POL7	Separate Policing byte per channel.					
2011			-					

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Table 9-25. nbitACC = 1: Register Operations in 8-Bit (Config A) and 16-bit (Config B) I²C Mode (continued)

			(continued)						
Cmd Code	Register or Command Name	Bits Description	Configuration A (8-bit)	Configuration B (16-bit)					
22h	CAP MEASUREMENT	CDET4-1, CDET8-5	Separate capacitance measurement enable by	ytes per group of 4 channels.					
24h 25h	Power-on FAULT	PF P4-1, P8-5	Separate Power-on FAULT byte per group of 4	4 channels					
26h	PORT REMAPPING	Logical P4-1, P8-5	Separate Remapping byte per group of 4 channels. Reinitialized only if POR or RESET pin. Kept unchanged if 0x1A IC reset or CPU watchdog reset.						
27h	Multi-Bit Priority 21 / 65	MBP2-1, MBP6-5	Separate MBP byte per group of 2 channels						
28h	Multi-Bit Priority 43 / 87	MBP4-3, MBP8-7	Separate MBP byte per group of 2 channels						
29h	PORT POWER ALLOCATION	MC34-12, MC78-56	Separate MCnn byte per group of 4 channels						
2Ch	TEMPERATURE	TEMP P1-4, P5-8	Both 8-bit registers (channel 1 to 4 and chann	el 5 to 8) must show the same result.					
2Eh 2Fh	INPUT VOLTAGE	VPWR P1-4, P5-8	Both 8-bit registers (channel 1 to 4 and chann	el 5 to 8) must show the same result.					
30h	CHANNEL 1 CURRENT	11, 15	Separate 2-byte per group of 4 channels	Separate 2-byte per group of 4 channels. 2-byte Read at 0x30 gives I1 4-byte Read at 0x30 gives I1, I5.					
31h			N/A	2-byte Read at 0x31 gives I5.					
32h	CHANNEL 1 VOLTAGE	V1, V5	Separate 2-byte per group of 4 channels	2-byte Read at 0x32 gives V1 4-byte Read at 0x32 gives V1, V5.					
33h			N/A	2-byte Read at 0x33 gives V5.					
34h	CHANNEL 2 CURRENT	12, 16	Separate 2-byte per group of 4 channels	2-byte Read at 0x34 gives I2 4-byte Read at 0x34 gives I2, I6.					
35h			N/A	2-byte Read at 0x35 gives I6.					
36h	CHANNEL 2 VOLTAGE	V2, V6	Separate 2-byte per group of 4 channels	2-byte Read at 0x36 gives V2 4-byte Read at 0x36 gives V2, V6.					
37h			N/A	2-byte Read at 0x37 gives V6.					
38h	CHANNEL 3 CURRENT	13, 17	Separate 2-byte per group of 4 channels	2-byte Read at 0x38 gives I3 4-byte Read at 0x38 gives I3, I7.					
39h			N/A	2-byte Read at 0x39 gives I7.					
3Ah	CHANNEL 3 VOLTAGE	V3, V7	Separate 2-byte per group of 4 channels	2-byte Read at 0x3A gives V3 4-byte Read at 0x3A gives V3, V7.					
3Bh			N/A	2-byte Read at 0x3B gives V7.					
3Ch	CHANNEL 4 CURRENT	14, 18	Separate 2-byte per group of 4 channels	2-byte Read at 0x3C gives I4 4-byte Read at 0x3C gives I4, I8.					
3Dh			N/A	2-byte Read at 0x3D gives I8.					
3Eh	CHANNEL 4 VOLTAGE	V4, V8	Separate 2-byte per group of 4 channels	2-byte Read at 0x3E gives V4 4-byte Read at 0x3E gives V4, V8.					
3Fh			N/A	2-byte Read at 0x3F gives V8.					
40h	OPERATIONAL FOLDBACK	2xFB4-1, 2xFB8-5	Separate 2xFBn config byte per group of 4 ch	annels.					
41h	FIRMWARE REVISION	FRV P1-4, P5-8	Both 8-bit registers (channel 1 to 4 and chann	el 5 to 8) must show the same result.					
42h	I2C WATCHDOG	P1-4, P5-8	IWD3-0: if at least one of the two 4-port setting enabled for all 8 channels. WDS: Both 8-bit registers (channel 1 to 4 and result. Each WDS bit needs to be cleared indiv	channel 5 to 8) must show the same WDS					
43h	DEVICE ID	DID_SR P1-4, P5-8	Both 8-bit registers (channel 1 to 4 and chann	el 5 to 8) will show the same result .					
44h	CHANNEL 1 RESISTANCE	RDET1, RDET5							
45h	CHANNEL 2 RESISTANCE	RDET2, RDET6	Separate byte per channel.						
46h	CHANNEL 3 RESISTANCE	RDET3, RDET7	Detection resistance always updated, detection	n good or bad.					
47h	CHANNEL 4 RESISTANCE	RDET4, RDET8							



Table 9-25. nbitACC = 1: Register Operations in 8-Bit (Config A) and 16-bit (Config B) I²C Mode (continued)

Cmd Code	Register or Command Name	Bits Description	Configuration A (8-bit)	Configuration B (16-bit)				
4Ch	CHANNEL 1 ASSIGNED CLASS	ACLS&PCLS1_ACLS&PCLS5						
4Dh	CHANNEL 2 ASSIGNED CLASS	ACLS&PCLS2_ACLS&PCLS6						
4Eh	CHANNEL 3 ASSIGNED CLASS	ACLS&PCLS3_ACLS&PCLS7	Separate Status byte per channel					
4Fh	CHANNEL 4 ASSIGNED CLASS	ACLS&PCLS4_ACLS&PCLS8						
50h	AUTOCLASS CONTROL	MAC4-1, AAC4-1, MAC8-5, AAC8-5	Separate Auto Class control bytes per 4 chann	nels				
51h	AUTOCLASS POWER 1/5	PAC1, PAC5						
52h	AUTOCLASS POWER 2/6	PAC2, PAC6						
53h	AUTOCLASS POWER 3/7	PAC3, PAC7	Separate Auto Class Power Measurement byte	e per channer				
54h	AUTOCLASS POWER 4/8	PAC4, PAC8						
55h	ALTERNATIVE FOLDBACK	ALTFB4-1, ALTIR4-1, ALTFN8-5, ALTIR8-5	Separate Alternative Foldback byte per group	of 4 channels				
60h	SRAM CONTROL	SRAM CNTRL BITS	These bits must be configured for the lower vir no functionality for the upper virtual quad (A0=					
61h	SRAM DATA		Streaming data input is independent of I ² C cor	figuration				
62h	START ADDRESS (LSB)		These bits must be configured for the lower vir no functionality for the upper virtual quad (A0=					
63h	START ADDRESS (MSB)		These bits must be configured for the lower vir no functionality for the upper virtual quad (A0=					

9.6.2.20 DETECT/CLASS RESTART Register

COMMAND = 18h with 1 Data Byte, Write Only

Push button register.

Each bit corresponds to a particular cycle (detect or class restart) per channel. Each cycle can be individually triggered by writing a 1 at that bit location, while writing a 0 does not change anything for that event.

In Diagnostic/Manual mode, a single cycle (detect or class restart) will be triggered when these bits are set while in semiauto mode, it sets the corresponding bit in the Detect/Class Enable register 0x14.

A Read operation will return 00h.

During t_{OVLD} , t_{LIM} or t_{START} cool down cycle, any Detect/Class Restart command for that channel will be accepted but the corresponding action will be delayed until end of cool-down period.

Figure 9-25. DETECT/CLASS RESTART Register Format

7	6	5	4	3	2	1	0
RCL4	RCL3	RCL2	RCL1	RDET4	RDET3	RDET2	RDET1
W-0	W-0	W-0	W-0	W-0	W-0	W-0	W-0

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 9-26. DETECT/CLASS RESTART Register Field Descriptions

	Bit	Field	Type	Reset	Description
	7–4	RCL4-RCL1	W	0	Restart classification bit
ſ	3–0	RDET4-RDET1	W	0	Restart detection bits

These bits may be used in place of completing a "Read-Modify-Write" sequence in register 0x14 to enable detection and classification on a per channel basis.

9.6.2.21 POWER ENABLE Register

COMMAND = 19h with 1 Data Byte, Write Only

Push button register.

Used to initiate a channel(s) turn on or turn off in any mode except OFF mode.

Figure 9-26. POWER ENABLE Register Format

7	6	5	4	3	2	1	0
POFF4	POFF3	POFF2	POFF1	PWON4	PWON3	PWON2	PWON1
W-0							

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 9-27. POWER ENABLE Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–4	POFF4-POFF1	W	0	Channel power off bits
3–0	PWON4-PWON1	W	0	Channel power on bits



Note

Writing a "1" at POFFn and PWONn on same Channel during the same write operation turns the Channel off.

Note

The t_{OVLD} , t_{LIM} , t_{START} and disconnect events have priority over the PWON command. During t_{OVLD} , t_{LIM} or t_{START} , cool down cycle, any channel turn on using Power Enable command will be ignored and the Channel will be kept off.

PWONn in Diagnostic/Manual Mode:

If the PSE controller is configured in Diagnostic mode, writing a "1" at that PWONn bit location will immediately turn on the associated Channel.

PWONn in Semiauto Mode:

While in semiauto mode, writing a "1" at a PWONn bit will attempt to turn on the associated Channel. If the detection or class results are invalid, the Channel is not turned on, and there will be no additional attempts to turn on the Channel until this push button is reasserted and the channel will resume its configured semiauto mode operation.

Note

In semiauto mode, the Power Allocation (0x29h) value needs to be set prior to issuing a PWON command. Any changes to the Power Allocation value after a PWON command is given may be ignored.

Table 9-28. Channel Response to PWONn Command in Semiauto Mode

DETEN Channel Operation Result of PWONn Com

CLEn	DETEn	Channel Operation	Result of PWONn Command
0	0	Idle	Singular Turn On attempted with Full DET and CLS cycle
0	1	Cycling Detection Measurements only	Singular Turn On attempted with Full DET and CLS cycle
1	0	Idle	Singular Turn On attempted with Full DET and CLS cycle
1	1	Cycling Detection and Classification Measurements	Singular Turn On attempted after next (or current) DET and CLS cycle

In semiauto mode with DETE and CLE set, as long as the PWONx command is received prior to the start of classification, the Channel will be powered immediately after classification is complete provided the classification result is valid and the power allocations settings (see register 0x29h) are sufficient to enable power on.

PWONn in Auto Mode:

In auto mode with DETE or CLE set to 0, a PWONx command will initiate a singular detection and classification cycle and the port/channel will be powered immediately after classification is complete provided the classification result is valid and the power allocations settings (see register 0x29h) are sufficient to enable power on.

In auto mode with DETE and CLE = 1, there is no need for a PWON command. The port/channel will automatically attempt to turn on after each detection and classification cycle.



Note

In auto mode, the Power Allocation (0x29h) value needs to be set prior to issuing a PWON command. Any changes to the Power Allocation value after a PWON command is given may be ignored.

Table 9-29. Channel Response to PWONn Command in Auto Mode

CLEn	DETEn	Channel Operation	Result of PWONn Command
0	0	Idle	Singular Turn On attempted with Full DET and CLS cycle
0	1	Cycling Detection Measurements only	Singular Turn On attempted with Full DET and CLS cycle
1	0	Idle	Singular Turn On attempted with Full DET and CLS cycle
1	1	Cycling Detection and Classification Measurements	NA - Channel will power automatically after a valid detection and classification



PWOFFn in any Mode:

The channel is immediately disabled and the following registers are cleared:

Table 9-30. Channel Turn Off with PWOFFn Command

Register	Bits to be Reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

Note

It may take upwards of 5ms after PWOFFn command for all register values to be updated.

Only the bits associated with the channel/port ("n") with PWOFFn set will be cleared. Those bits associated with channels/ports remaining in operation will not be changed.

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9.6.2.22 RESET Register

COMMAND = 1Ah with 1 Data Byte, Write Only

Push button register.

Writing a 1 at a bit location triggers an event while a 0 has no impact. Self-clearing bits.

Figure 9-27. RESET Register Format

7	6	5	4	3	2	1	0
CLRAIN	CLINP	_	RESAL	RESP4	RESP3	RESP2	RESP1
W-0	W-0	W-0	W-0	W-0	W-0	W-0	W-0

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 9-31. RESET Register Field Descriptions

Bit	Field	Туре	Reset	Description
7	CLRAIN	W	0	Clear all interrupts bit. Writing a 1 to CLRAIN clears all event registers and all bits in the Interrupt register. It also releases the INT pin
6	CLINP	W	0	When set, it releases the $\overline{\text{INT}}$ pin without any impact on the Event registers nor on the Interrupt register.
5	_	W	0	
4	RESAL	W	0	Reset all bits when RESAL is set. Results in a state similar to a power-up reset. Note that the VDUV and VPUV bits (Supply Event register) follow the state of VDD and VPWR supply rails.
3–0	RESP4-RESP1	W	0	Reset channel bits. Used to force an immediate channel(s) turn off in any mode, by writing a 1 at the corresponding RESPn bit location(s).

Setting the RESAL bit will result in all of the I2C register being restored to the RST condition with the exception of those in the following table:

Register	Bits	RESAL Result		
0x00	All			
0x0A/B	TSD, VPUV, VDWRN, and VPUV			
0x26	All	Pre RESAL value will remain		
0x2C and 0x2E	All			
0x41	All			

Note

Setting the RESAL bit for only one group of four channels (1-4 or 5-8) will result in only those four channels being reset.

Note

After using the CLINP command, the $\overline{\text{INT}}$ pin will not be reasserted for any interrupts until all existing interrupts have been cleared.



Setting the RESPn bit will immediate turn off the associated channel and clear the registers according to the following table:

Table 9-32. Channel Turn Off with RESPn Command

Register	Bits to be Reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

Note

Only the bits associated with the channel/port ("n") with RESPn set will be cleared. Those bits associated with channels/ports remaining in operation will not be changed.

it may take upwards of 5 ms before all of the registers are cleared following a RESPn command.

The RESPn command will cancel any ongoing cool down cycles .

Users need to wait at least 3ms before trying to reenable discovery or power on ports following a RESPn command.

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9.6.2.23 ID Register

COMMAND = 1Bh with 1 Data Byte, Read/Write

Figure 9-28. ID Register Format

7	6 5		4	3	2	1	0	
		MFR ID	ICV					
R/W-0	R/W-0 R/W-1 R/W-0			R/W-0	R/W-1	R/W-0	R/W-1	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-33. ID Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–3	MFR ID	R/W	01010 b	Manufacture Identification number (0101,0)
2–0	ICV	R/W	101b	IC version number (011)

9.6.2.24 Connection Check and Auto Class Status Register

COMMAND = 1Ch with 1 Data Byte, Read Only

Figure 9-29. Connection Check and Auto Class Register Format

7	6	5	4	3	2	1	0
AC4	AC3	AC2	AC1	Rsvrd	Rsvrd	Rsvrd	Rsvrd
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-34. Connection Check and Auto Class Field Descriptions

Bit	Field	Туре	Reset	Description
7–4	ACn	R	0000b	Auto Class Detection Status
				1 = PD supports Auto Class
				0 = PD does not support Auto Class
3-0	Rsvrd	R	00b	Reserved

Auto Class:

The auto class detection measurement is completed at the end of the long classification finger, and if a PD is determined to support auto class, an auto class power measurement will be automatically completed after turn on in accordance with the IEEE auto class timing requirements.

Note

An Auto Class power measurement will be completed shortly after power on for all channels that are found to support auto class during classification.

These measurement results are available in registers (0x51h - 0x54h), and the auto class power measurements are provide per individual channel.

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9.6.2.25 2-Pair Police Ch-1 Configuration Register

COMMAND = 1Eh with 1 Data Byte, Read/Write

Figure 9-30. 2-Pair Police Ch-1 Register Format

7	6	5	4	3	2	1	0
POL1_7	POL1_6	POL1_5	POL1_5	POL1_3	POL1_2	POL1_1	POL1_0
R/W-1	R/W1						

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.26 2-Pair Police Ch-2 Configuration Register

COMMAND = 1Fh with 1 Data Byte, Read/Write

Figure 9-31. 2-Pair Police Ch-2 Register Format

7	6	5	4	3	2	1	0
POL2_7	POL2_6	POL2_5	POL2_4	POL2_3	POL2_2	POL2_1	POL2_0
R/W-1	R/W1						

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.27 2-Pair Police Ch-3 Configuration Register

COMMAND = 20h with 1 Data Byte, Read/Write

Figure 9-32. 2-Pair Police Ch-3 Register Format

7	6	5	4	3	2	1	0
POL3_7	POL3_6	POL3_5	POL3_5	POL3_3	POL3_2	POL3_1	POL3_0
R/W-1	R/W1						

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.28 2-Pair Police Ch-4 Configuration Register

COMMAND = 21h with 1 Data Byte, Read/Write

Figure 9-33. 2-Pair Police Ch-4 Register Format

7	6	5	4	3	2	1	0
POL4_7	POL4_6	POL4_5	POL4_4	POL4_3	POL4_2	POL4_1	POL4_0
R/W-1	R/W1						

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-35. 2-Pair Policing Register Fields Descriptions

Bit	Field	Туре	Reset	Description	
7–0	POLn_7- POLn_0	R/W	1	1-byte defining 2-Pair P_{CUT} minimum threshold. The equation defining the P_{CUT} is:	
				$P_{\text{CUT}} = (N \times PC_{\text{STEP}})$	
				Where, when assuming $0.200-\Omega$ Rsense resistor is used:	
				PC _{STEP} = 0.5 W	



Note

These bits set the minimum threshold for the design. Internally, the typical PCUT threshold is set slightly above this value to ensure that the device does not trip a Pcut fault at or below the set value in this register due to part to part or temperature variation.

The contents of this register is reset to 0xFFh anytime the port is turned off or disabled either due to fault condition or user command

Note

Programmed values of less than 2W are not supported. If a value of less than 2W is programmed into these registers, the device will use 2W as the 2-pair Policing value.

Power Policing:

The TPS23882B implements a true Power Policing limit, where the device will adjust the policing limit based on both voltage and current variation in order to ensure a reliable power limit.

In semiauto and auto modes, these bits are automatically set during power on based on the assigned class (see tables below). If an alternative value is desired, it needs to be set after the PEn bit is set in 0x10h, or it may also be configured prior to port turn on in combination with the use of the MPOLn bits in register 0x40 (see Section 9.6.2.45).

Table 9-36. 2-Pair Policing Settings based on the Assigned Class

Assigned Class	POLn7-0 Settings	Minimum Power
Class 1	0000 1000	4W
Class 2	0000 1110	7W
Class 3	0001 1111	15.5W
Class 4	0011 1100	30W

Product Folder Links: TPS23882B

9.6.2.29 Capacitance (Legacy PD) Detection

COMMAND = 22h with 1 Data Byte, Write Only

Used to do enable capacitance measurement from Maunal mode

Figure 9-34. Capacitance Detection Register Format

		•	•	•	,		
7	6	5	4	3	2	1	0
-	CDET4	-	CDET3	-	CDET2	-	CDET1
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 9-37. Capacitance Detection Register Field Descriptions

Bit	Field	Туре	Reset	Description
7, 5, 3, 1	Reserved	R/W	0	
6, 4, 2,	CDETn	R/W	0	Enables Capacitance defection for channel "n" 0 = Capacitance defection disabled 1 = Capacitance detection enabled

To complete a capacitance measurement on a channel, the channel must first be placed into diagnostic mode. Set the bits in register 0x22h to enable capacitance detection on the channel(s) desired. Then set the DETE bits in register 0x14h to begin the detection and process.

Note

The TPS23882B SRAM needs to be programmed in order for the capacitance measurement to operate properly.

The capacitance measurement is only supported in Manual/Diagnostic mode.

No capacitance measurement will be made if the result of the resistance detection is returned as "valid".

Upon completion of the capacitance measurement the DETCn bit will bet in register 0x04h, and the resistance and capacitance values will be updated in registers 0x44h - 0x4Bh.



9.6.2.30 Power-on Fault Register

COMMAND = 24h with 1 Data Byte, Read Only

COMMAND = 25h with 1 Data Byte, Clear on Read

Figure 9-35. Power-on Fault Register Format

7	6	5	4	3	2	1	0
PF4		PF3		PF2		PF1	
R-0							
CR-0							

LEGEND: R/W = Read/Write; R = Read only; W = Write only; CR = Clear on Read; -n = value after reset

Table 9-38. Power-on Fault Register Field Descriptions

Bit	Field	Туре	Reset		Description							
7–0	PF4-PF1	R or CR	0	on atter	Represents the fault status of the classification and detection for channel n, following a failed turn on attempt with the PWONn command. These bits are cleared when channel n is turned off. PFn: the selection is as follows:							
				Fault Code		Power-on Fault Description						
				0	0	No fault						
				0	1	Invalid detection						
				1	0	Classification Error						
				1	1	Insufficient Power						

Note

When a Start Fault occurs and the PECn bit is not set, then this register will indicate the cause of the fault.

An insufficient power fault is reported anytime the reg 0x29 configuration will not allow a channel to be powered. See the section describing *Section 9.1.5*.

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9.6.2.31 PORT RE-MAPPING Register

COMMAND = 26h with 1 Data Byte, Read/Write

Figure 9-36. PORT RE-MAPPING Register Format

	7	6	5	4	3	2	1	0
Phys	Physical Channel # of Logical Channel 4		Physical Channel # of Logical Channel 3		Physical Channel # of Logical Channel 2		Physical Channel # of Logical Channel 1	
R/	W-1	R/W-1	R/W-1	R/W-0	R/W-0	R/W-1	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; W = Write only; CR = Clear on Read; -n = value after reset

Table 9-39. PORT RE-MAPPING Register Field Descriptions

		Table 5-35. FORT RE-INIAFFING Register Field Descriptions											
Bit	Field	Tuno	POR / RST				Description						
	rieid	Type	KOI				Description						
7–0	Physical Channel # of Logical Channel n	R/W	1110 0100b / P	channe mode default Each p	el within 4-ch prior to receiv there is no re pair of bits co	annel group ([*] ving the port re e-mapping.	y due to physical board constraints 1-4 or 5-8). All channels of a group e-mapping command, otherwise the he logical port assigned.	o of four must be in OFF					
				Re	Re-Map Code Physical Channel Package Pins								
				0	0	1	Drain1,Gat1,Sen1						
				0	1	2	Drain2,Gat2,Sen2						
				1	0	3	Drain3,Gat3,Sen3						
				1	1	4	Drain4,Gat4,Sen4						
				When there is no re-mapping the default value of this register is 1110,0100. The 2 MSbit value 11 indicate that logical channel 4 is mapped onto physical channel #4, the next 2 the suggest logical channel 3 is mapped onto physical channel #3 and so on. Note: Code duplication is not allowed – that is, the same code cannot be written into the bits of more than one port – if such a value is received, it will be ignored and the chip will existing configuration. Note: Port remapping configuration is kept unchanged if 0x1A IC reset command is received.									

Note

The RST condition of "P" indicates that the previous state of these bits will be preserved following a device reset using the $\overline{\text{RESET}}$ pin. Thus, pulling the $\overline{\text{RESET}}$ input low will not overwrite any user changes to this register.

Note

After port remapping, TI recommends to do at least one detection-classification cycle before turn on.

9.6.2.32 Channels 1 and 2 Multi Bit Priority Register

COMMAND = 27h with 1 Data Byte, Read/Write.

Figure 9-37. Channels 1 and 2 MBP Register Format

7	6	5	4	3	2	1	0
_	MBP2_2	MBP2_1	MBP2_0	_	MBP1_2	MBP1_1	MBP1_0
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.33 Channels 3 and 4 Multi Bit Priority Register

COMMAND = 28h with 1 Data Byte, Read/Write

Figure 9-38. Channels 3 and 4 MBP Register Format

7	6	5	4	3	2	1	0
_	MBP4_2	MBP4_1	MBP4_0	_	MBP3_2	MBP3_1	MBP3_0
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-40. Channels n MBP Register Field Descriptions

Bit	Field	Type	Reset	Descripti	ion							
7–0	MBPn_2-0	R/W	0	MBPn_2-0: Multi Bit Priority bits, three bits per channel, if 3-bit shutdown priority has been (MbitPrty in General Mask register is high). It is used to determine which channel(s) is (are in response to a serial shutdown code received at the OSS shutdown input. The turn off procedure (including register bits clearing) is similar to a channel reset using F command (1Ah register), except that it does not cancel any ongoing fault cool down time of the priority is defined as followings: OSS code ≤ MBPn_2-0: when the OSS code is received, the corresponding channel is pools code > MBPn_2-0: OSS code has no impact on the channel								
					BPn_2-0 egister	0x27/28	Multi Bit Priority	OSS Code for Channel Off				
				0	0	0	Highest	OSS = '000'				
				0	0	1	2	OSS = '000' or '001'				
				0	1	0	3	OSS ≤ '010'				
				0	1	1	4	OSS ≤ '011'				
				1 0 0 4 OSS ≤ '100'								
				1	1 0 1 6 OSS = any code except '111'							
				1	1	1	Lowest	OSS = any code				

The priority reduces as the 3-bit value increases. Thus, a channel with a "000" setting has the highest priority, while one with a "111" setting has the lowest.

It is permissible to apply the same settings to multiple channels. Doing so will result in all channels with the same setting will be disabled when the appropriate OSS code is presented.

The turn off procedure due to OSS is similar to a channel reset or change to OFF mode, with the exception that OSS does not cancel any ongoing fault cool down timers. the table below includes the bits that will be cleared when a channel is disabled due to OSS:

Product Folder Links: TPS23882B

Table 9-41. Channel Turn Off with MBP OSS

Register	Bits to be Reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

Note

There is no memory of any preceding 3-bit OSS commands. Each 3-bit OSS command is processed immediately (prior to the end of the last OSS MBP pulse) based on the MBPn settings for each Channel. Any attempt to shutdown additional Channels thereafter will require additional 3-bit OSS commands.



9.6.2.34 Port Power Allocation Register

COMMAND = 29h with 1 Data Byte, Read/Write

Figure 9-39. Power Allocation Register Format

7	6	5	4	3	2	1	0
Rsvrd	MC34_2	MC34_1	MC34_0	Rsvrd	MC12_2	MC12_1	MC12_0
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-42. Power Allocation Register Field Descriptions

Bit	Field	Type	Reset	Description
7,3	Rsvrd	R/W	0	Reserved
6 - 4 , 2 - 0	MCnn_2-0	R/W		MCnn_2-0: Port Power Allocation bits. These bits set the maximum power classification level that a given channel is allowed to power on In semiauto mode these bits need to be set prior to issuing a PWONn command, while in auto mode these bits need to be set prior to setting the DETE and CLE bits in 0x14.

Table 9-43. Power Allocation Settings

MCnn_2	MCnn_1	MCnn_0	Power Allocation
0	0	0	2-Pair 15.4W
0	0	1	2-Pair 4 W
0	1	0	2-Pair 7 W
0	1	1	2-Pair 30W
1	х	Х	Reserved

Note

The Power Allocation (0x29h) value needs to be set prior to issuing a PWON command in semiauto or auto modes, and prior to setting the DETE and CLE bits in auto mode. Any changes to the Power Allocation value after a PWON command is given may be ignored.

Note

For 2-Pair wired ports, the MCnn_2-0 bits set the power allocation settings for both channels 1 and 2 and 3 and 4 concurrently.

It is possible to have channels 3 and 4 set to 15.4W while channels 1 and 2 are set to 30W, but it is not possible to have different power allocation settings between channels 1 and 2 or 3 and 4

Note

Setting register 0x29 to the 4 W Power Allocation configuration will only allow Class 1 PDs to be powered. Attempts to power any other class PDs will result in an insufficient power fault

Setting register 0x29 to the 7 W Power Allocation configuration will only allow Class 1 & 2 PDs to be powered. Attempts to power a class 3 or 4+ PDs will result in an insufficient power fault

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9.6.2.35 TEMPERATURE Register

COMMAND = 2Ch with 1 Data Byte, Read Only

Figure 9-40. TEMPERATURE Register Format

7	6	5	4	3	2	1	0
TEMP7	TEMP6	TEMP5	TEMP4	TEMP3	TEMP2	TEMP1	TEMP0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-44. TEMPERATURE Register Field Descriptions

Bit	Field	Type	Reset	Description							
7–0	TEMP7-TEMP0	R	0	8-bit Data of around once The equation $T = -20 + N$	conversion result of ten e per second. on defining the tempera I × T _{STEP}	nperature, from –20°C to 12	'				
				Mode Full Scale Value T _{STEP}							
				Any 146.2°C 0.652°C							



9.6.2.36 INPUT VOLTAGE Register

COMMAND = 2Eh with 2 Data Byte (LSByte first, MSByte second), Read only

Figure 9-41. INPUT VOLTAGE Register Format

		J · · ·					
7	6	5	4	3	2	1	0
LSB:							
VPWR7	VPWR6	VPWR5	VPWR4	VPWR3	VPWR2	VPWR1	VPWR0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
MSB:							
_	_	VPWR13	VPWR12	VPWR11	VPWR10	VPWR9	VPWR8
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-45. INPUT VOLTAGE Register Field Descriptions

	Table 3-43. INFOT VOLTAGE Register Fleid Descriptions												
Bit	Field	Туре	Reset		Description								
13–0	VPWR13- VPWR0	R	0	14-bit Data The equatio $V = N \times V_{ST}$	Bit Descriptions: Data conversion result. The I ² C data transmission is a 2-byte transfer. 14-bit Data conversion result of input voltage. The equation defining the voltage measured is: V = N × V _{STEP} Where V _{STEP} is defined below as well as the full scale value:								
				Mode	Full Scale Value	V _{STEP}							
				Any 60 V 3.662 mV									
	Note that the measurement is made between VPWR and AGND.												

Product Folder Links: TPS23882B

9.6.2.37 CHANNEL 1 CURRENT Register

COMMAND = 30h with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-42. CHANNEL 1 CURRENT Register Format

		J					
7	6	5	4	3	2	1	0
LSB:							
I1_7	I1_6	I1_5	I1_4	I1_3	I1_2	I1_1	I1_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
MSB:							
_	_	I1_13	I1_12	l1_11	I1_10	I1 <u>_</u> 9	I1 <u>_</u> 8
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.38 CHANNEL 2 CURRENT Register

COMMAND = 34h with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-43. CHANNEL 2 CURRENT Register Format

					9.0.0.		
7	6	5	4	3	2	1	0
LSB:							
12_7	I2_6	12_5	12_4	I2_3	12_2	I2_1	12_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
MSB:							
_	_	I2_13	I2_12	I2_11	I2_10	12_9	12_8
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.39 CHANNEL 3 CURRENT Register

COMMAND = 38h with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-44. CHANNEL 3 CURRENT Register Format

6	5	4	3	2	1	0
I3_6	I3 <u>_</u> 5	13_4	I3_3	I3 <u>_</u> 2	I3_1	13_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0
_	I3_13	I3_12	I3_11	I3_10	13_9	13_8
R-0	R-0	R-0	R-0	R-0	R-0	R-0
	I3_6 R-0	I3_6	I3_6	I3_6	I3_6	I3_6

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.40 CHANNEL 4 CURRENT Register

COMMAND = 3Ch with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-45, CHANNEL 4 CURRENT Register Format

	rigure 3-43. CHANNEL 4 CONNENT Register i offinat											
7	6	5	4	3	2	1	0					
LSB:												
14_7	I4_6	I4_5	14_4	I4_3	14_2	I4_1	14_0					
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0					
MSB:												



Figure 9-45. CHANNEL 4 CURRENT Register Format (continued)

						•		
_	_	I4_13	I4_12	I4_11	I4_10	14_9	14_8	
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-46. CHANNEL n CURRENT Register Field Descriptions

	I				TREAT REGISTER FIELD	<u> </u>					
Bit	Field	Type	Reset	Description							
13-0	In_13- In_0	R	0	Bit Descriptions: Data conversion result. The I ² C data transmission is a 2-byte transfer. Note that the conversion is done using a TI proprietary multi-slope integrating converter. 14-bit Data conversion result of current for channel n. The update rate is around once per 100 in powered state. The equation defining the current measured is: I = N × I _{STEP} Where I _{STEP} is defined below as well as the full scale value, according to the operating mode.							
				Mode	Full Scale Value	I _{STEP}					
				Powered and Classification	1.46 A (with 0.2-Ω Rsense)	89.5 μΑ					
				Note: in any of the follow channel is in OFF mode channel is OFF while in channel is OFF while in In diagnostic/manual mo- result of the last measure	1						

Note

1.46A is the theoretical full scale range of the ADC based on 14bits * Istep. However, due to the 1.25A channel current limit, the channel current will foldback and be disabled when the current exceeds the ILIM-2X threshold (V_{LIM2X}) .

Class Current Reading

Following the completion of any classification measurement on a channel, the measured classification current is reported in these registers until either a port current reading is completed following a port turn on or the port is disabled.

Note

The scaling factor for the class current reading is decreased by a factor of 10x to 8.95uA/bit.

9.6.2.41 CHANNEL 1 VOLTAGE Register

COMMAND = 32h with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-46. CHANNEL 1 VOLTAGE Register Format

		•		•	,		
7	6	5	4	3	2	1	0
LSB:							
V1_7	V1_6	V1_5	V1_4	V1_3	V1_2	V1_1	V1_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
MSB:							
_	_	V1_13	V1_12	V1_11	V1_10	V1_9	V1_8
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.42 CHANNEL 2 VOLTAGE Register

COMMAND = 36h with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-47. CHANNEL 2 VOLTAGE Register Format

		9			J		
7	6	5	4	3	2	1	0
LSB:							
V2_7	V2_6	V2_5	V2_4	V2_3	V2_2	V2_1	V2_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
MSB:							
_	_	V2_13	V2_12	V2_11	V2_10	V2_9	V2_8
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.43 CHANNEL 3 VOLTAGE Register

COMMAND = 3Ah with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-48. CHANNEL 3 VOLTAGE Register Format

6	5	4	3	2	1	0
V3_6	V3_5	V3_4	V3_3	V3_2	V3_1	V3_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0
_	V3_13	V3_12	V3_11	V3_10	V3_9	V3_8
R-0	R-0	R-0	R-0	R-0	R-0	R-0
	V3_6 R-0	V3_6 V3_5 R-0 R-0 - V3_13	V3_6 V3_5 V3_4 R-0 R-0 R-0 - V3_13 V3_12	6 5 4 3 V3_6 V3_5 V3_4 V3_3 R-0 R-0 R-0 R-0 - V3_13 V3_12 V3_11	V3_6 V3_5 V3_4 V3_3 V3_2 R-0 R-0 R-0 R-0 - V3_13 V3_12 V3_11 V3_10	6 5 4 3 2 1 V3_6 V3_5 V3_4 V3_3 V3_2 V3_1 R-0 R-0 R-0 R-0 R-0 R-0 - V3_13 V3_12 V3_11 V3_10 V3_9

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.44 CHANNEL 4 VOLTAGE Register

COMMAND = 3Eh with 2 Data Byte, (LSByte First, MSByte second), Read Only

Figure 9-49, CHANNEL 4 VOLTAGE Register Format

	rigure 3-43. OffANNEL 4 VOLTAGE Register i offinat													
7	6	5	4	3	2	1	0							
LSB:														
V4_7	V4_6	V4_5	V4_4	V4_3	V4_2	V4_1	V4_0							
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0							
MSB:														



Figure 9-49. CHANNEL 4 VOLTAGE Register Format (continued)

				. •				
_	_	V4_13	V4_12	V4_11	V4_10	V4_9	V4_8	
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-47. CHANNEL n VOLTAGE Register Field Descriptions

Bit	Field	Туре	Reset		Description						
13-0	Vn_13- Vn_0	R	0	The equation defi $V = N \times V_{STEP}$	Data conversion result. T ning the voltage measure efined below as well as t	ed is:	ion is a 2-byte transfer.				
				Mode Powered	Full Scale Value 60 ∨	V _{STEP} 3.662 mV					
					red voltage measuremen is OFF, the result throug						



9.6.2.45 2x FOLDBACK SELECTION Register

COMMAND = 40h with1 Data Byte Read/Write

Figure 9-50. 2x FOLDBACK SELECTION Register Format

7	6	5	4	3	2	1	0
2xFB4	2xFB3	2xFB2	2xFB1	MPOL4	MPOL3	MPOL2	MPOL1
R/W-0	R/W-0	R/W-0	R/W-0	R/W -0	R/W -0	R/W -0	R/W -0

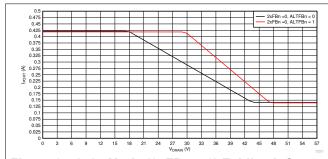
LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-48. 2x FOLDBACK SELECTION Register Field Descriptions

	idado d 46. 2x i despitat de esta riola baccinplicita									
Bit	Field	Type	Reset	Description						
7–4	2xFB4- 2xFB1	R/W	0	When set, this activates the 2x Foldback mode for a channel which increases its I_{LIM} and I_{SHORT} levels normal settings, as shown in Figure 9-3. Note that the fault timer starts when the I_{LIM} threshold is exceeded.						
				Notes:						
				1) At turn on, the inrush current profile is unaffected by these bits, as shown in Figure 9-2.						
				2) When a 2xFBn bit is deasserted, the t _{LIM} setting used for the associated channel is always the nominal value (approximately 60 ms). If 2xFBn bit is asserted, then t _{LIM} for associated channel is programmable as defined in the Timing Configuration register (0x16).						
				3) If the assigned class for a channel is class 4 or above, the 2xFB bit will be automatically set during turn on.						
3-0	MPOL4 -	R/W	0	Manual Policing and Foldback configuration bits						
	MPOL1			0 = The internal device firmware automatically adjusts the Policing (P_{CUT}) and 2xFBn settings based on the assigned class during port turn on						
				1 = The Policing (P_{CUT}) and 2xFBn settings will not be changed during port turn on.						
				Note: Independent of these settings, the Policing (P _{CUT}) and 2xFBn settings are returned to their default values upon port turn off.						
				Note: Setting either bit for a 4P configured port disables the automatic configuration on both channels						
				The MPOLn bits are cleared upon port turn off.						

Note

Refer to register 0x55h description for more information on additional Foldback and Inrush configuration options



IPORT VS VDRAIN

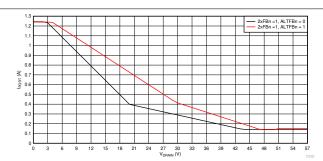


Figure 9-51. 1x Mode (2xFBn = 0) Foldback Curves, Figure 9-52. 2x Mode (2xFBn = 1) Foldback Curves, IPORT VS VDRAIN

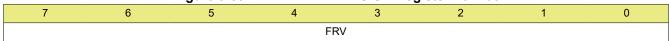
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9.6.2.46 FIRMWARE REVISION Register

COMMAND = 41h with 1 Data Byte, Read Only

Figure 9-53. FIRMWARE REVISION Register Format



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-49. FIRMWARE REVISION Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–0	FRV	R		Firmware Revision number

After a RESET or POR fault this value will default to 0000, 0000b, but upon a "valid" SRAM load, this value will reflect the corresponding SRAM version of firmware (0x01h – 0xFEh).

Note

If the value of this register = 0xFFh, the device is running in "safe mode", and the SRAM needs to be reprogrammed to resume normal operation.

9.6.2.47 I2C WATCHDOG Register

COMMAND = 42h with 1 Data Byte, Read/Write

The I²C watchdog timer monitors the I²C clock line in order to prevent hung software situations that could leave ports in a hazardous state. The timer can be reset by either edge on SCL input. If the watchdog timer expires, all channels will be turned off and WDS bit will be set. The nominal watchdog time-out period is 2 seconds.

7	6	5	4	3	2	1	0
_	_	_	IWDD3	IWDD2	IWDD1	IWDD0	WDS
-	_	_	R/W-1	R/W-0	R/W-1	R/W-1	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-50. I2C WATCHDOG Register Field Descriptions

Bit	Field	Type	Reset	Description
4–1	IWDD3-IWDD0	R/W	1011b	I ² C Watchdog disable. When equal to 1011b, the watchdog is masked. Otherwise, it is umasked and the watchdog is operational.
0	WDS	R/W	0	I ² C Watchdog timer status, valid even if the watchdog is masked. When set, it means that the watchdog timer has expired without any activity on I ² C clock line. Writing 0 at WDS location clears it. Note that when the watchdog timer expires and if the watchdog is unmasked, all channels are also turned off.

When the channels are turned OFF due to I²C watchdog, the corresponding bits are also cleared:

Table 9-51, I2C WATCHDOG Reset

Register	Bits to be Reset
0x04	CLSCn and DETCn
0x06	DISFn and PCUTn
0x08	STRTn and ILIMn
0x0C-0F	Requested Class and Detection
0x10	PGn and PEn
0x14	CLEn and DETEn
0x1C	ACn
0x1E-21	2P Policing set to 0xFFh
0x24	PFn
0x30-3F	Channel Voltage and Current Measurements
0x40	2xFBn
0x44 - 47	Detection Resistance Measurements
0x4C-4F	Assigned Class and Previous Class
0x51-54	Autoclass Measurement

The corresponding PGCn and PECn bits of Power Event register will also be set if there is a change. The corresponding PEn and PGn bits of Power Status Register are also updated accordingly.

Note

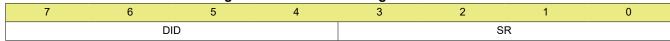
If the I^2C watchdog timer has expired, the Temperature and Input voltage registers will stop being updated until the WDS bit is cleared. The WDS bit must then be cleared to allow these registers to work normally.



9.6.2.48 DEVICE ID Register

COMMAND = 43h with 1 Data Byte, Read Only

Figure 9-55. DEVICE ID Register Format



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-52. DEVICE ID Register Field Descriptions

Bit	Field	Туре	Reset	Description
7–5	DID	R	0011b	Device ID number
4–0	SR	R	0100b	Silicon Revision number

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9.6.2.49 CHANNEL 1 DETECT RESISTANCE Register

COMMAND = 44h with 1 Data Byte, Read Only

Figure 9-56. CHANNEL 1 DETECT RESISTANCE Register Format

7	6	5	4	3	2	1	0
R1_7	R1_6	R1_5	R1_4	R1_3	R1_2	R1_1	R1_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.50 CHANNEL 2 DETECT RESISTANCE Register

COMMAND = 45h with 1 Data Byte, Read Only

Figure 9-57. CHANNEL 2 DETECT RESISTANCE Register Format

7	6	5	4	3	2	1	0
R2_7	R2_6	R2_5	R2_4	R2_3	R2_2	R2_1	R2_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.51 CHANNEL 3 DETECT RESISTANCE Register

COMMAND = 46h with 1 Data Byte, Read Only

Figure 9-58. CHANNEL 3 DETECT RESISTANCE Register Format

7	6	5	4	3	2	1	0
R3_7	R3_6	R3_5	R3_4	R3_3	R3_2	R3_1	R3_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.52 CHANNEL 4 DETECT RESISTANCE Register

COMMAND = 47h with 1 Data Byte, Read Only

Figure 9-59. CHANNEL 4 DETECT RESISTANCE Register Format

7	6	5	4	3	2	1	0
R4_7	R4_6	R4_5	R4_4	R4_3	R4_2	R4_1	R4_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-53. DETECT RESISTANCE Register Fields Descriptions

Bit	Field	Type	Reset		Description	
7-0	Rn_7- Rn_0	R	0	8-bit data conversion result of detection Most recent 2-point Detection Resistar Note that the register content is not clear. The equation defining the resistance in $R = N \times R_{STEP}$ Where R_{STEP} is defined below as well	nce measurement result. The ared at turn off. neasured is:	e I ² C data transmission is a 1-byte transfer.

9.6.2.53 CHANNEL 1 DETECT CAPACITANCE Register

COMMAND = 48h with 1 Data Byte, Read Only

Figure 9-60. CHANNEL 1 DETECT CAPACITANCE Register Format

7	6	5	4	3	2	1	0
C1_7	C1_6	C1_5	C1_4	C1_3	C1_2	C1_1	C1_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.54 CHANNEL 2 DETECT CAPACITANCE Register

COMMAND = 49h with 1 Data Byte, Read Only

Figure 9-61. CHANNEL 2 DETECT CAPACITANCE Register Format

7	6	5	4	3	2	1	0
C2_7	C2_6	C2_5	C2_4	C2_3	C2_2	C2_1	C2_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.55 CHANNEL 3 DETECT CAPACITANCE Register

COMMAND = 4Ah with 1 Data Byte, Read Only

Figure 9-62. CHANNEL 3 DETECT CAPACITANCE Register Format

7	6	5	4	3	2	1	0
C3_7	C3_6	C3_5	C3_4	C3_3	C3_2	C3_1	C3_0
R-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.56 CHANNEL 4 DETECT CAPACITANCE Register

COMMAND = 4Bh with 1 Data Byte, Read Only

Figure 9-63. CHANNEL 4 DETECT CAPACITANCE Register Format

7	6	5	4	3	2	1	0
C4_7	C4_6	C4_5	C4_4	C4_3	R4_2C	C4_1	C4_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset



Table 9-54. DETECT CAPACITANCE Register Fields Descriptions

Bit	Field	Type	Reset		Description						
7-0	Cn_7- Cn_0	R	0	8-bit data conversion result of capacita Most recent capacitance measurement The equation defining the resistance m $C = N \times C_{STEP}$ Where C_{STEP} is defined below as well a	t result. The l ² C data neasured is:	a transmission is a 1-byte transfer.					
				Useable Resistance Range	Useable Resistance Range C _{STEP}						
				1 μF to 12 μF	0.05 μF						
				Note that the register content is not cle	ared at turn off.						
				Note: The capacitance measurement is	s only supported in N	Manual/Diagnostic mode.					
				Note: No capacitance measurement wi	lote: No capacitance measurement will be made if the result of the resistance detection is						
				eturned as "valid".							
				ote: The TPS23882B SRAM needs to be programmed in order for the capacitance							
				measurement to operate properly.							



9.6.2.57 CHANNEL 1 ASSIGNED CLASS Register

COMMAND = 4Ch with 1 Data Byte, Read Only

Figure 9-64. CHANNEL 1 ASSIGNED CLASS Register Format

				· · · · · · · · · · · · · · · · · · ·				
7	6	5	4	3	2	1	0	
	ACLAS	SS Ch1		PCLASS Ch1				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.58 CHANNEL 2 ASSIGNED CLASS Register

COMMAND = 4Dh with 1 Data Byte, Read Only

Figure 9-65. CHANNEL 2 ASSIGNED CLASS Register Format

7	6	5	4	3	2	1	0	
	ACLAS	SS Ch2		PCLASS Ch2				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.59 CHANNEL 3 ASSIGNED CLASS Register

COMMAND = 4Eh with 1 Data Byte, Read Only

Figure 9-66. CHANNEL 3 ASSIGNED CLASS Register Format

7	6	5	4	3	2	1	0	
	ACLAS	SS Ch3		PCLASS Ch3				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.60 CHANNEL 4 ASSIGNED CLASS Register

COMMAND = 4Fh with 1 Data Byte, Read Only

Figure 9-67. CHANNEL 4 ASSIGNED CLASS Register Format

7	6	5	4	3	2	1	0
	ACLAS	SS Ch4			PCLAS	SS Ch4	
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Bit Descriptions: These bits represent the **"assigned"** and previous classification results for channel n. These bits are cleared when channel n is turned off.

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Table 9-55. CHANNEL n ASSIGNED CLASS Register Field Descriptions

Bit	Field	Туре	Reset	Description				
7–4	ACLASS Ch-n	R	0	Assigned classification on channel n. See Table 9-56 below				
3–0	PCLASS Ch-n			Previous Class result on channel n. See Table 9-57 below				

Table 9-56. Assigned Class Designations

		SS-Chn		Assigned Class
	T			Assigned oldss
Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	Unknown
0	0	0	1	Class 1
0	0	1	0	Class 2
0	0	1	1	Class 3
0	1	0	0	Class 4
0	1	0	1	Reserved
0	1	1	0	Reserved
0	0 1		1	Reserved
1	X	X	Х	Reserved

Table 9-57. Previous Class Designations

		bie 3-37. i Tevious	Olass Besign	
	PCLAS	SS-Chn		Previous Class
Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	Unknown
0	0	0	1	Class 1
0	0	1	0	Class 2
0	0	1	1	Class 3
0	1	0	0	Class 4
0	1	0	1	Reserved
0	1	1	0	Class 0
0	1	1	1	Reserved
1	0	0	0	Class 5 - 4-Pair
1	0	0	1	Class 6 - 4-Pair
1	0	1	0	Class 7 - 4-Pair
1	0	1	1	Class 8 - 4-Pair
1	1	X	Х	Reserved



"Requested" vs. "Assigned" Classification:

The "requested" class is the classification the PSE measures during Mutual Identification prior to turn on, whereas the "assigned" class is the classification level the Channel was powered on with based on the Power Allocation setting in register 0x29h. The "requested" classification values are available in registers 0x0C-0F

Note

Upon being powered, devices that present a class 0 signature during discovery will be given an assigned class of "Class 3"

Note

There is no Assigned Class assigned for ports/channels powered out of Manual/Diagnostic mode. Any settings such as the port power policing and 1x/2x foldback selection that are typically configure based on the assigned class result need to manually configured by the user.

Previous Classification

In certain circumstances the requested class result in 0x0C-0F can not properly reflect the actual classification of the PD connected to the port/channel. This will happen when a port has a power allocation limit of 15.4W and the PSE can only provide 1 classification finger during turn on. When this occurs and if the device is configured to run in semiauto mode with det and cls enabled, the 3-finger classification measurement that preceded the turn on detection and classification cycle will be stored here. This information can be useful in scenarios where a port had to be demoted to stay under the system power limit at turn on but additional power budget comes available later on.

Note

The Previous Classification results are only valid for channels being used in semiauto mode with ongoing discovery (DETE and CLE = 1).



9.6.2.61 AUTO CLASS CONTROL Register

COMMAND = 50h with 1 Data Byte, Read/Write

Figure 9-68. AUTO CLASS CONTROL Register Format

7	6	5	4	3	2	1	0
MAC4	MAC3	MAC2	MAC1	AAC4	AAC3	AAC2	AAC1
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-58. AUTO CLASS CONTROL Register Field Descriptions

Bit	Field	Type	Reset	Description
7 - 4	MACn	R/W	0	Manual Auto Class Measurement bits
				1 = Manual Auto Class Measurement enabled
				0 = Manual Auto Class measurement complete
				The auto class measurement will begin within 10ms of this bit being set.
				This bit will be cleared by the internal firmware within 1ms of the updated Autoclass
				measurement result(s) in 0x51-54h.
3 -0	AACn	R/W	0	Auto Class Auto Adjustment Enable bits
				1 = Autoclass auto adjust is enabled and the corresponding PCUT settings will be
				automatically adjusted based on the measured autoclass power
				0 = Autoclass auto adjust is disabled and it is up to the user to adjust the value of PCUT as
				desired.

Note

Any MACn bits set prior to turn on will be ignored and cleared during turn on.

Auto Class Pcut Adjustments:

If the ACx bit(s) are set in register 0x50h, the TPS23882B will automatically adjust its PCUT value based on the auto class power measurement (P_{AC} in registers 0x51-54) and Any Automatic Auto Class facilitated (AACn = 1) PCut adjustments will be made within 5 ms of the end of the auto class measurement period.

9.6.2.62 CHANNEL 1 AUTO CLASS POWER Register

COMMAND = 51h with 1 Data Byte, Read Only

Figure 9-69. CHANNEL 1 AUTO CLASS POWER Register Format

7	6 5		4	3	2	1	0
-	PAC1_6	PAC1_5	PAC1_4	PAC1_3	PAC1_2	PAC1_1	PAC1_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.63 CHANNEL 2 AUTO CLASS POWER Register

COMMAND = 52h with 1 Data Byte, Read Only

Figure 9-70. CHANNEL 2 AUTO CLASS POWER Register Format

7	6 5		4	3	2	1	0
-	PAC2_6	PAC2_5	PAC2_4	PAC2_3	PAC2_2	PAC2_1	PAC2_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.64 CHANNEL 3 AUTO CLASS POWER Register

COMMAND = 53h with 1 Data Byte, Read Only

Figure 9-71. CHANNEL 3 AUTO CLASS POWER Register Format

7	7 6 5 - PAC3_6 PAC3_5		4	3	2	1	0
-			PAC3_4	PAC3_3	PAC3_2	PAC3_1	PAC3_0
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.65 CHANNEL 4 AUTO CLASS POWER Register

COMMAND = 54h with 1 Data Byte, Read Only

Figure 9-72. CHANNEL 4 AUTO CLASS POWER Register Format

7 6 5		5	4	3	2	1	0				
-	PAC4_6	PAC4_5	PAC4_4	PAC4_3	PAC4_2	PAC4_1	PAC4_0				
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0				

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-59. AUTO CLASS POWER Register Fields Descriptions

Bit	Field	Type	Reset	Description
6-0	PACn_6- PACn_0	R		8-bit data conversion result of the auto class power measurement for channel n. Peak average power calculation result from channel voltage and current data conversion measurements taken during the auto class power measurement window. The equation defining the auto class power measured is: $P_{AC} = N \times P_{AC_STEP}$ Where, when assuming 0.200- Ω Rsense resistor is used: $PC_{STEP} = 0.5 \text{ W}$

Product Folder Links: TPS23882B



9.6.2.66 ALTERNATIVE FOLDBACK Register

COMMAND = 55h with 1 Data Byte, Read/Write

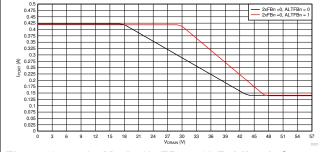
Figure 9-73. ALTERNATIVE FOLDBACK Register Format

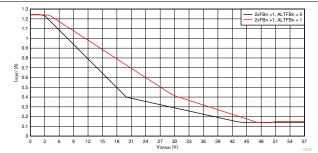
7	6	5	4	3	2	1	0
ALTFB4	ALTFB3	ALTFB2	ALTFB1	ALTIR4	ALTIR3	ALTIR2	ALTIR1
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-60, ALTERNATIVE FOLDBACK Register Field Descriptions

	Table Co. ALI LIMATIVE TO LEGISTED THOM DOCUMENTS						
Bit	Field	Type	Reset	Description			
7-4	ALTFBn	R	0	Alternative Foldback Enable bits: Used to enable the operational alterative foldback curves while powered. 1 = Alternative Foldback is enabled 0 = Alternative Foldback is disabled The ALTFBn bits should be set prior to issuing a PWONn command to ensure the desired foldback curve is being used.			
3-0	ALTIRn	R	0	Alternative Inrush Enable bits: Used to enable the alterative foldback curves during inrush on channel n 1 = Alternative Inrush is enabled 0 = Alternative Inrush is disabled Note: The ALTIRn bits need to be set prior to sending a PWONn command to ensure the desired inrush behavior is followed			





IPORT VS VDRAIN

Figure 9-74. 1x Mode (2xFBn = 0) Foldback Curves, Figure 9-75. 2x Mode (2xFBn = 1) Foldback Curves, IPORT VS VDRAIN

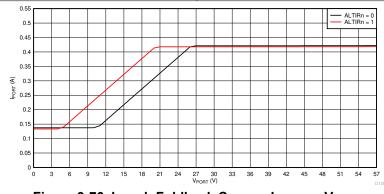


Figure 9-76. Inrush Foldback Curves, IPORT vs VPORT



9.6.2.67 SRAM CONTROL Register

COMMAND = 60h with 1 Data Byte, Read/Write

Figure 9-77. SRAM CONTROL Register Format

7	6	5	4	3	2	1	0
PROG_SEL	CPU_RST	-	PAR_EN	RAM_EN	PAR_SEL	R/WZ	CLR_PTR
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 9-61. SRAM CONTROL Register Field Descriptions

Bit Field Type Reset Description 7 PROG_SEL R/W 0 I2C Programming select bit. 1 = SRAM I2C read/write is enabled 0 = SRAM I2C read/write is disabled. 6 CPU_RST R/W 0 CPU Reset bit 1 = Internal CPU is held in RESET 0 = Internal CPU is active This is strictly a CPU reset. Toggling this bit reset the cpu only and will not change a contents of the I²C registers 5 Reserved R/W 0 Reserved 4 PAR_EN R/W 0 SRAM Parity Enable bit: 1 = SRAM Parity Check will be enabled 0 = SRAM Parity Check will be disabled 1 t is recommended that the Parity function be enable whenever SRAM is being used 3 RAM_EN R/W 0 SRAM Enable bit 1 = SRAM will be enabled and the internal CPU will run from both SRAM and internal CPU will run from internal ROM only This bit needs to be set to a 1 after SRAM programing to enable the utilization of the	
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This bit needs to be set to a 1 after SRAM programing to enable the utilization of the	al ROM
	SRAM
code	
2 PAR_SEL R/W 0 SRAM Parity Select bit: Setting this bit to a 1 in conjunction with the RZ/W bit enable	 ∋s
access to the SRAM Parity bits.	
1 = Parity bits read/write is enabled	
0 = Parity bits read/write is disabled	
1 R/WZ R/W 0 SRAM Read/Write select bit:	
0 = SRAM Write – SRAM data is written with a write to 0x61h	
1 = SRAM Read – SRAM data is read with a read from 0x61h	
SRAM data can be continuously read/written over I2C until a STOP bit is sent.	
0 CLR_PTR R/W 0 Clear Address Pointer bit:	
1 = Resets the memory address pointer	
0 = Releases pointer for use	
In order to ensure proper programming, this bit should be toggled (0-1-0) to writing	or
reading the SRAM or Parity memory.	

Product Folder Links: TPS23882B

9.6.2.67.1 SRAM START ADDRESS (LSB) Register

COMMAND = 62h with 1 Byte, Read/Write

Figure 9-78. SRAM START ADDRESS (LSB) Register Format

7	6	5	4	3	2	1	0
SA_7	SA_6	SA_5	SA_4	SA_3	SA_2	SA_1	SA_0
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.67.2 SRAM START ADDRESS (MSB) Register

COMMAND = 63h with 1 Byte, Read/Write

Figure 9-79. SRAM START ADDRESS (MSB) Register Format

7	6	5	4	3	2	1	0
SA_15	SA_14	SA_13	SA_12	SA_11	SA_10	SA_9	SA_8
R/W-0							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

9.6.2.67.3

Table 9-62. SRAM START ADDRESS Register Field Descriptions

	Bit	Field	Type	Reset	Description
1	15-0	SA_15- SA_0	R/W		SRAM and Parity Programing Start Address bits: the value entered into these registers sets the start address location for the SRAM or Parity
					programming

SRAM Programming:

Upon power up, it is recommended that the TPS23882B device's SRAM be programmed with the latest version of SRAM code via the I^2C to ensure proper operation and IEEE complaint performance. All I^2C traffic other than those commands required to program the SRAM should be deferred until after the SRAM programming sequences are completed.

Note

The latest version of firmware and SRAM release notes may be accessed from the *TI mySecure Software* webpage.

The SRAM Release Notes and ROM Advisory document includes more detailed information regarding any know issues and changes that were associated with each firmware release.

Note

The SRAM programming control must be completed at the lower I2C address (Channels 1-4, A0 = 0). Configuring this registers for the upper I2C device address (Channels 5-8) will not program the SRAM

For systems that include multiple TPS23882B devices, the 0x7F "global" broadcast I2C address may be used to programmed all of the devices at the same time.

Note

The SRAM programming needs to be delayed at least 50ms from the initial power on (VPWR and VDD above UVLO) of the device to allow for the device to complete its internal hardware initialization process

Note

For more detailed instructions on the SRAM programing procedures please refer the *How to Load TPS2388x SRAM Code* document on Tl.com.

0x60h setup for SRAM Programming: Prior to programming/writing the SRAM, the following bits sequence needs to be completed in register 0x60h:

7	6	5	4	3	2	1	0
PROG_SEL	CPU_RST	-	PAR_EN	RAM_EN	PAR_SEL	R/WZ	CLR_PTR
0 → 1	0 → 1	0	0	0	0	1 → 0	$0 \rightarrow 1 \rightarrow 0$

The same sequence is required to read the SRAM with the exception that the R/WZ bit needs to be set to "1".

If the device is in "Safe Mode", the same sequence as above may be used to reprogram the SRAM.

An I²C write to 0x61h following this sequence actively programs the SRAM program memory starting from the address set in registers 0x62h and 63h.

Product Folder Links: TPS23882B

0x60h setup for SRAM Parity Programming: Following the programming of the SRAM program memory, the following bits sequence needs to be completed in register 0x60h in order to configure the device to program the Parity memory:

7	6	5	4	3	2	1	0
PROG_SEL	CPU_RST	-	PAR_EN	RAM_EN	PAR_SEL	R/WZ	CLR_PTR
0 → 1	0 → 1	0	0	0	0 → 1	1 → 0	$0 \rightarrow 1 \rightarrow 0$

The same sequence is required to read the Parity with the exception that the R/WZ bit needs to be set to "1".

An I^2C write to 0x61h following this sequence actively programs the Parity memory starting from the address set in registers 0x62h and 63h.

0x60h setup to run from SRAM Program Memory: Upon completion of programming, the following bits sequence needs to be completed in register 0x60h in order to enable the device to run properly out of SRAM:

7	6	5	4	3	2	1	0
PROG_SEL	CPU_RST	-	PAR_EN	RAM_EN	PAR_SEL	R/WZ	CLR_PTR
1 → 0	1 → 0	0	0 → 1	0 → 1	1 → 0	0	0

Within 1ms of the completion of the above sequence, the device will complete a compatibility check on the SRAM

If the SRAM load is determined to be "Valid": Register 0x41h will have a value between 0x01h and 0xFEh, and the device will return to normal operation.

If the SRAM load is determined to be "Invalid":

- 0x41h will be set to 0xFFh
- The RAM_EN bit will be internally cleared
- The device will operating in "safe mode" until another programming attempt is completed

10 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

10.1 Application Information

The TPS23882B is an 8-channel, IEEE 802.3bt ready PoE PSE controller and can be used in high port count semiauto or fully micro-controller managed applications (TI recommends the MSP430FR5969 micro-controller for most applications). Subsequent sections describe detailed design procedures for applications with different requirements including host control.

The schematic of Figure 10-1 depicts semiauto mode operation of the TPS23882B, providing functionality to power PoE loads. The TPS23882B can do the following:

- 1. Performs load detection
- 2. Performs classification including the 100-ms long finger for Autoclass discovery and 80.23bt reduce T_{MPS} support
- 3. Enables power on with protective foldback current limiting, and port power policing (P_{CUT}) value
- 4. Shuts down in the event of fault loads and shorts
- 5. Performs Maintain Power Signature function to insure removal of power if load is disconnected
- 6. Undervoltage lockout occurs if VPWR falls below V_{PUV F} (typical 26.5 V)

Following a power-off command, disconnect or shutdown due to a Start, P_{CUT} or I_{LIM} fault, the port powers down. Following port power off due to a disconnect, the TPS23882B immediates restart the detection and classification cycles if the DETE and CLE bits are set in register 0x14. If the shutdown is due to a start, P_{CUT} or I_{LIM} fault, the TPS23882B enters into a cool-down period during which any Detect/Class Enable Command for that port is delayed. At the end of cool down cycle, one or more detection/class cycles are automatically restarted if the class and/or detect enable bits are set. If a port is disabled using the power off command, the DETE and CLE bits are cleared and these bits must be reset over I^2 C for detection and classification to resume.

10.1.1 Autonomous Operation

Unlike Auto mode, which still requires a host to initialize the TPS23882B operation through a a series of I²C commands, there is no host or I²C communication required when the TPS23882B in configured in autonomous mode.

Connecting a resistor between the AUTO pin and GND based on the table below Table 10-1 enables autonomous mode and configure all of the ports to the same Power Allocation settings. In the event a PD is connected with a higher requested class than the autonomous mode configuration, the port powers demote the PD to the selected autonomous mode configuration power level. The port automatically performs detection and classification (if valid detection occurs) continuously on all ports. Port power is automatically turned on based on Power Allocation settings in register 0x29 if a valid classification is measured.

Table 10-1. AUTO Pin Programming

Auto Pin	Autonomous Mode Configuration
Open/Floating	Disabled
124 kΩ	2-pair 15 W
62 kΩ	2-pair 30 W

Product Folder Links: TPS23882B

Note

A 10-nF capacitor is required in parallel with R_{AUTO} to ensure stability in the autonomous mode selection.

10.1.2 Introduction to PoE

Power-over-Ethernet (PoE) is a means of distributing power to Ethernet devices over the Ethernet cable using either data or spare pairs. PoE eliminates the need for power supplies at the Ethernet device. Common applications of PoE are security cameras, IP Phones and wireless access points (WAP). The host or mid-span equipment that supplies power is the power source equipment (PSE). The load at the Ethernet connector is the powered device (PD). PoE protocol between PSE and PD controlling power to the load is specified by IEEE 802.3bt standard. Transformers are used at Ethernet host ports, mid-spans and hubs, to interface data to the cable. A DC voltage can be applied to the center tap of the transformer with no effect on the data signals. As in any power transmission line, a relatively high voltage (approximately 50 V) is used to keep currents low and minimize the effects of IR drops in the line to preserve power delivery to the load. Standard 2-Pair PoE delivers approximately 13 W to a type 1 PD, and 25.5 W to a type 2 PD, whereas standard 4-Pair PoE are capable of delivering approximately 51 W to a type 3 PD and 71 W to a type 4 PD.

10.1.2.1 2-Pair Versus 4-Pair Power and the New IEEE802.3bt Standard

The IEEE 802.3at-2009 standard previously expanded PoE power delivery from 15.4 W (commonly referred to as .af or Type-1 PoE) to 30 W (.at or Type-2 PoE) of sourced power from the PSE (Power Sourcing Equipment) over 2-pairs of Ethernet wires (commonly known as either the Alt-A or Alt-B pair sets). The IEEE 802.3bt standard further expands power delivery up to 90 W sourced from a PSE by allowing for power delivery over both the ALT-A and ALT-B pairsets in parallel. Two new PoE equipment "Types" have also been created as part of the new standard. Type 3 PSE equipment is capable of sourcing up to 60 W of power over 4 pair or 30 W over 2 pair while supporting the new MPS requirements. Type 4 PSE equipment is capable of sourcing up to 90 W of power over 4 pair. The TPS23882B has been designed to be comply with the 2-Pair Type-3 requirements.

The Maintain Power Signature (or MPS) requirements have also been updated for the new standard. The previous version of the standard only required PSEs to maintain power on a port if the PD (Powered Device) current exceeded 10 mA for at least 60 ms every 300 ms to 400 ms. By decreasing these requirements to 6 ms every 320 ms to 400 ms, the minimum power requirement to maintain PoE power have been reduced by a factor of nearly 10.

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10.2 Typical Application

This typical application shows an eight (2-Pair) port, semiauto mode application using a MSP430 or similar micro-controller. Operation in any mode requires I²C host support. The TPS23882B provides useful telemetry in multi-port applications to aid in implementing port power management.

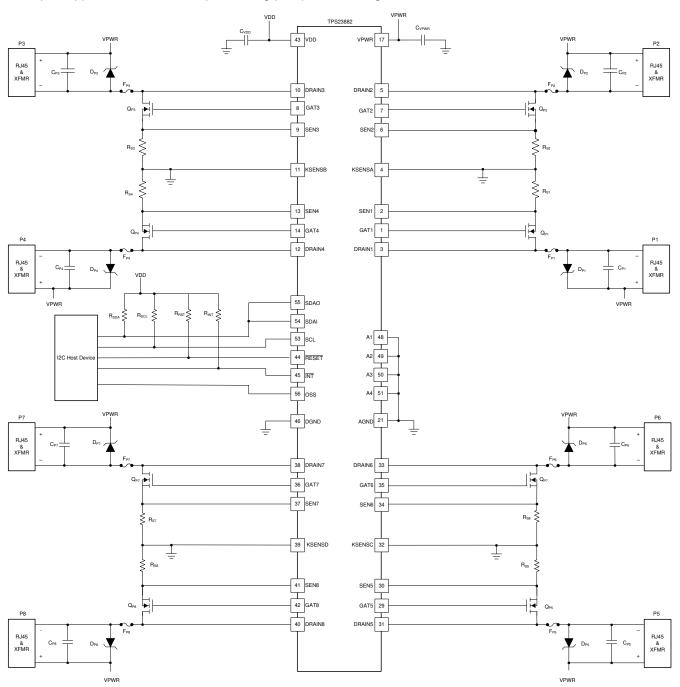


Figure 10-1. Eight 2-Pair Port Application

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10.2.1 Design Requirements

TPS23882B devices are used in the eight port configuration and are managed by the I^2C host device. The I^2C address for TPS23882B is programmed using the A4..A1 pins. When using multiple TPS23882B devices in a system, each device requires by a unique I^2C address. See *PIN STATUS Register* for more information on how to program the TPS23882B I^2C address.

A MCU is not required to operate the TPS23882B device, but some type of I²C controller and host controller device is required to program the internal SRAM and initialize the basic I²C register configuration of the TPS23882B.

TI recommends that the RESET pin be connected to a micro-controller or other external circuitry.

Note

The RESET pin must be held low until both VPWR and VDD are above their UVLO thresholds.

Refer to the *TPS23882EVM: PoE, PSE, TPS23882 Evaluation Module user's guide* for more detailed information.

10.2.2 Detailed Design Procedure

Refer to the *TPS23882EVM: PoE, PSE, TPS23882 Evaluation Module user's guide* for more detailed information on component selection and layout recommendations.

10.2.2.1 Connections on Unused Channels

On unused channels, TI recommends to ground the SENx pin and leave the GATx pin open. DRAINx pins can be grounded or left open (leaving open can slightly reduce power consumption). Figure 10-2 shows an example of an unused PORT2.

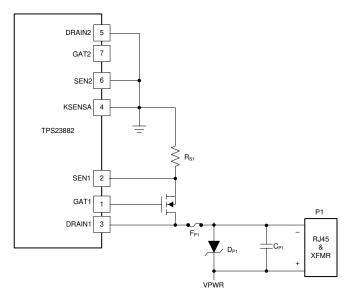


Figure 10-2. Unused PORT2 Connections



10.2.2.2 Power Pin Bypass Capacitors

- C_{VPWR}: 0.1-µF, 100-V, X7R ceramic at pin 17 (VPWR)
- C_{VDD}: 0.1-μF, 5-V, X7R ceramic at pin 43 (VDD)

10.2.2.3 Per Port Components

- C_{Pn}: 0.1-μF, 100-V, X7R ceramic between VPWR and Pn-
- R_{Sn}: Each channel's current sense resistor is a 0.2-Ω. TI recommends a 1%, 0.25-W resistor in an 0805 SMT package. If a 30-W Policing (P_{CUT}) threshold is selected, the maximum power dissipation for the resistor becomes approximately 93.3 mW.

Note

For systems requiring either more accurate system power monitoring or precise Port Power Policing accuracy, TI recommends that 0.1% R_{SENSE} resistors be used.

• Q_{Pn} : The port MOSFET can be a small, inexpensive device with average performance characteristics. \overline{BV}_{DSS} should be 100-V minimum. Target a MOSFET $R_{DS(on)}$ at V_{GS} = 10 V of between 50 m Ω and 150 m Ω . The MOSFET GATE charge (Q_G) and input capacitance (C_{ISS}) should be less than 50 nC and 2000 pF respectively. The maximum power dissipation for Q_{Pn} with RDS(on) = 100 m Ω at 640 mA nominal policing (I_{CUT}) threshold is approximately 45 mW.

Note

In addition to the MOSFET $R_{DS(on)}$ and BV_{DSS} characteristics, the power MOSFET SOA ratings also must be taken into consideration when selecting these components for your system design. TI recommends that a MOSFET be chosen with an SOA rating that exceeds the inrush and operational foldback characteristic curves as shown in Figure 9-2 and Figure 9-3. When using the standard current foldback (ALTIRn or ALTFBn = 0) options, TI recommends the CSD19538Q3A 100V N-Channel MOSFET.

- $\mathbf{F_{Pn}}$: The port fuse must be a slow blow type rated for at least 60 VDC and above approximately 2 × P_{CUT} (maximum). The cold resistance must be below 200 m Ω to reduce the DC losses. The power dissipation for FPn with a cold resistance of 180 m Ω at maximum P_{CUT} is approximately 150 mW.
- D_{PnA}: The port TVS must be rated for the expected port surge environment. D_{PnA} must have a minimum
 reverse standoff voltage of 58 V and a maximum clamping voltage of less than 95 V at the expected peak
 surge current.

Product Folder Links: TPS23882B

10.2.2.4 System Level Components (not Shown in the Schematic Diagrams)

The system TVS and bulk VPWR capacitance work together to protect the PSE system from surge events which can cause VPWR to surge above 70 V. The TVS and bulk capacitors must be placed on the PCB such that all TPS23882B ports are adequately protected.

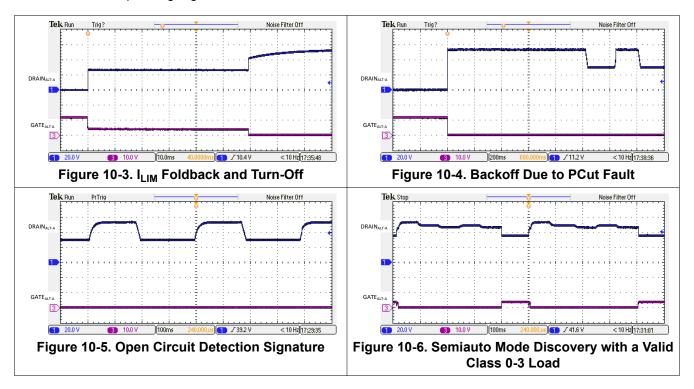
- TVS: The system TVS must be rated for the expected peak surge power of the system and have a minimum reverse standoff voltage of 58 V. Together with the VPWR bulk capacitance, the TVS must prevent the VPWR rail from exceeding 70 V.
- **Bulk Capacitor:** The system bulk capacitors must be rated for 100 V and can be of aluminum electrolytic type. Two 47-µF capacitors can be used for each TPS23882B on board.
- **Distributed Capacitance:** In higher port count systems, it can be necessary to distribute 1-uF, 100-V, X7R ceramic capacitors across the 54-V power bus. TI recommends one capacitor per each TPS23882B pair.
- **Digital I/O Pullup Resistors:** $\overline{\text{RESET}}$ and A1-A4 are internally pulled up to VDD, while OSS is internally pulled down, each with a 50-k Ω (typical) resistor. A stronger pullup and down resistor can be added externally such as a 10 k Ω , 1%, 0.063 W type in a SMT package. SCL, SDAI, SDAO, and INT require external pullup resistors within a range of 1 k Ω to 10 k Ω depending on the total number of devices on the bus .
- Ethernet Data Transformer (per port): The Ethernet data transformer must be rated to operate within the IEEE802.3bt standard in the presence of the DC port current conditions. The transformer is also chosen to be compatible with the Ethernet PHY. The transformer may also be integrated into the RJ45 connector and cable terminations.
- **RJ45 Connector (per port):** The majority of the RJ45 connector requirements are mechanical in nature and include tab orientation, housing type (shielded or unshielded), or highly integrated. An integrated RJ45 consists of the Ethernet data transformer and cable terminations at a minimum. The integrated type may also contain the port TVS and common mode EMI filtering.
- Cable Terminations (per port): The cable terminations typically consist of series resistor (usually 75 Ω) and capacitor (usually 10 nF) circuits from each data transformer center tap to a common node which is then bypassed to a chassis ground (or system earth ground) with a high-voltage capacitor (usually 1000 pF to 4700 pF at 2 kV).

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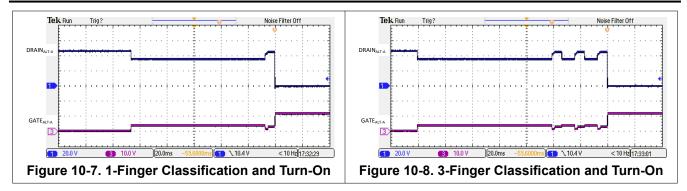
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10.2.3 Application Curves

Unless otherwise noted, measurements taken on the TPS23882B EVM and Sifos PSA-3000 PowerSync Analyzer with PSA3202 test cards. Test conditions are $T_J = 25~^{\circ}\text{C}$, $V_{VDD} = 3.3~\text{V}$, $V_{VPWR} = 54~\text{V}$, $V_{DGND} = V_{AGND}$, DGND, KSENSA, KSENSB, KSENSC and KSENSD connected to AGND, and all outputs are unloaded, 2xFBn = 0. Positive currents are into pins. $R_S = 0.200~\Omega$, to KSENSA (SEN1 or SEN2), to KSENSB (SEN3 or SEN4), to KSENSC (SEN5 or SEN6) or to KSENSD (SEN7 or SEN8). All voltages are with respect to AGND unless otherwise noted. Operating registers loaded with default values unless otherwise noted.







11 Power Supply Recommendations 11.1 VDD

The recommended VDD supply voltage requirement is 3.3 V, ±0.3 V. The TPS23882B requires approximately 6-mA typical and 12-mA maximum from the VDD supply. The VDD supply can be generated from VPWR with a buck-type regulator (TI recommends a LM5017 based device for a higher port count PSE using multiple TPS23882B devices operating in semiauto mode. The power supply design must ensure the VDD rail rises monotonically through the VDD UVLO thresholds without any droop under the UVLO fall threshold as the loads are turned on. This action is accomplished with proper bulk capacitance across the VDD rail for the expected load current steps over worst case design corners. Furthermore, the combination of decoupling capacitance and bulk storage capacitance must hold the VDD rail above the UVLO fall threshold during any expected transient outages after power is applied.

11.2 VPWR

Although the supported VPWR supply voltage range is 44 V to 57 V, as with the 802.3at standard for Type-2 PoE, a 50-V minimum supply is required to comply with 2-Pair Type-3 (up to 30W) IEEE requirements. The TPS23882B requires approximately 10-mA typical and 12-mA maximum from the VPWR supply, but the total output current required from the VPWR supply depends on the number and type of ports required in the system. The TPS23882B can be configured to support either 15.5 W, or 30 W per port and the power limit is set proportionally at turn-on. The port power limit, P_{CUT}, is also programmable to provide even greater system design flexibility. However, size the VPWR supply accordingly to the PoE Type to be supported. As an example, TI recommends a 130-W or greater power supply for eight type 1 (15.5 W each) ports, or TI recommends a 250-W or greater power supply for eight 2-pair type 3 (30 W) ports, assuming maximum port and standby currents.

Note

In IEEE complaint applications, only 4-pair configured ports are capable of supporting power levels greater than 30 W.



12 Layout

12.1 Layout Guidelines

12.1.1 Kelvin Current Sensing Resistors

Load current in each PSE channel is sensed as the voltage across a low-end current-sense resistor with a value of 200 m Ω . For more accurate current sensing, kelvin sensing of the low end of the current-sense resistor is provided through pins KSENSA for channels 1 and 2, KSENSB for channels 3 and 4, KSENSC for channels 5 and 6 and KSENSD for channels 7 and 8.

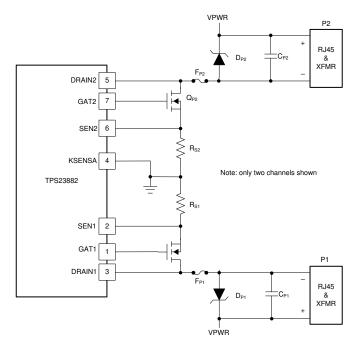


Figure 12-1. Kelvin Current-Sense Connection

KSENSA is shared between SEN1 and SEN2, KSENSB is shared between SEN3 and SEN4, KSENSC is shared between SEN5 and SEN6, and KSENSD is shared between SEN7 and SEN8. To optimize the accuracy of the measurement, the PCB layout must be done carefully to minimize impact of PCB trace resistance. Refer to Figure 12-2 as an example.

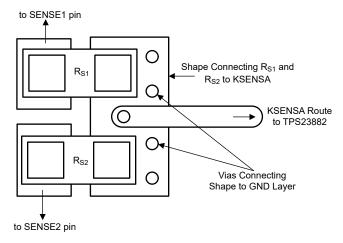
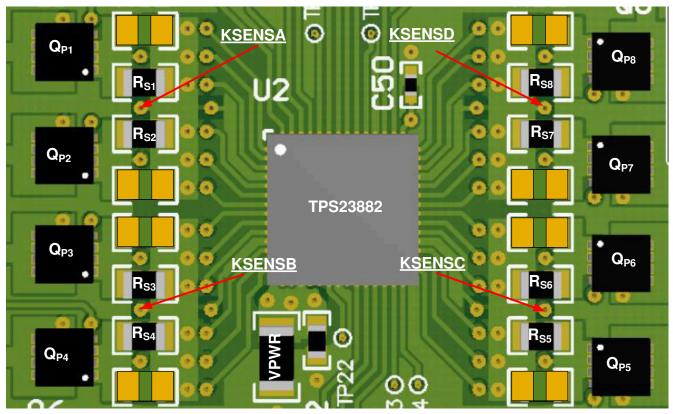


Figure 12-2. Kelvin Sense Layout Example

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12.2 Layout Example



Note: PCB layout includes footprints for optional parallel R_{SENSE} resistors

Figure 12-3. Eight Port Layout Example (Top Side)

12.2.1 Component Placement and Routing Guidelines

12.2.1.1 Power Pin Bypass Capacitors

- C_{VPWR}: Place close to pin 17 (VPWR) and connect with low inductance traces and vias according to Figure 12-3.
- CVDD: Place close to pin 43 (VDD) and connect with low inductance traces and vias according to Figure 12-3.

12.2.1.2 Per-Port Components

- R_{SnA} / R_{SnB}: Place according to in a manner that facilitates a clean Kelvin connection with KSENSEA/B/C/D.
- Q_{Pn}: Place Q_{Pn} around the TPS23882B as illustrated in Figure 12-3. Provide sufficient copper from Q_{Pn} drain to F_{Pn}.
- F_{Pn}, C_{Pn}, D_{PnA}, D_{PnB}: Place this circuit group near the RJ45 port connector (or port power interface if a
 daughter board type of interface is used as illustrated in Figure 12-3). Connect this circuit group to Q_{Pn} drain
 or GND (TPS23882B- AGND) using low inductance traces.



13 Device and Documentation Support

13.1 Documentation Support

13.1.1 Related Documentation

For related documentation see the following:

- Texas Isntruemnts, How to Load TPS2388x SRAM and Parity Code Over I ²C application brief
- Texas Instruments, TPS23882BEVM user's guide
- IEEE 802.3bt Ready PSE Daughter Card for 24-port PSE System
- Texas Instruments, How to Load TPS2388x SRAM and Parity Code Over I² application report
- TI mySecure Software

13.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

13.3 Support Resources

TI E2E[™] support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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13.4 Trademarks

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13.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

13.6 Glossary

TI Glossary

This glossary lists and explains terms, acronyms, and definitions.

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type	Package Pins	Package qty Carrier	RoHS	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
TPS23882B1RTQR	Active	Production	QFN (RTQ) 56	2000 LARGE T&R	Yes	NIPDAUAG	Level-3-260C-168 HR	-40 to 125	TPS23882B1
TPS23882B1RTQR.A	Active	Production	QFN (RTQ) 56	2000 LARGE T&R	Yes	NIPDAUAG	Level-3-260C-168 HR	-40 to 125	TPS23882B1

⁽¹⁾ Status: For more details on status, see our product life cycle.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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⁽²⁾ Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

⁽⁴⁾ Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS23882B1RTQR	QFN	RTQ	56	2000	330.0	16.4	8.3	8.3	1.1	12.0	16.0	Q2

PACKAGE MATERIALS INFORMATION

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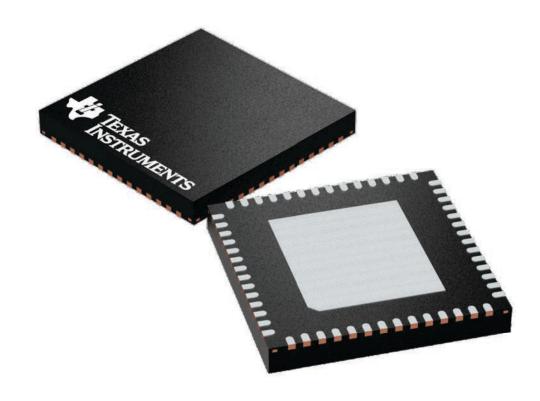


*All dimensions are nominal

Ì	Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)	
ı	TPS23882B1RTQR	QFN	RTQ	56	2000	367.0	367.0	38.0	

8 x 8, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD



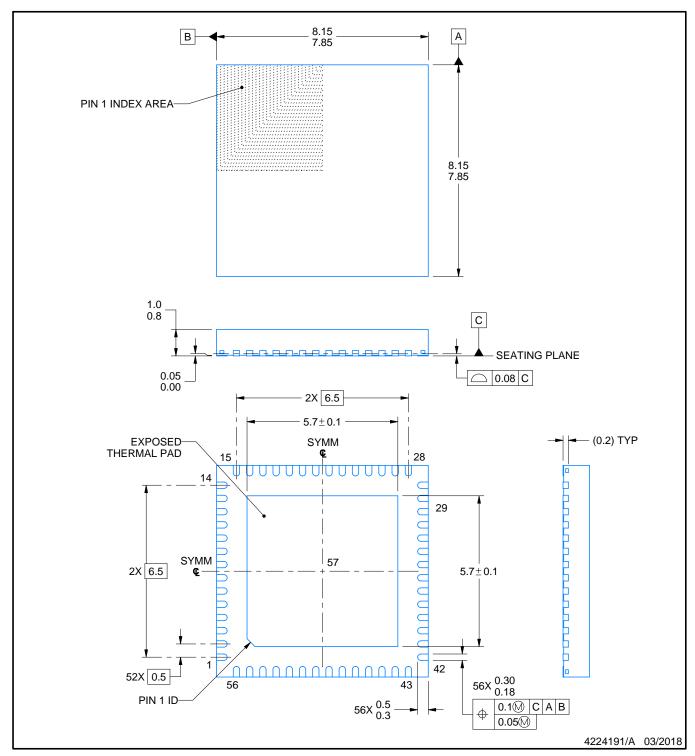
Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.

4224653/A





PLASTIC QUAD FLATPACK - NO LEAD

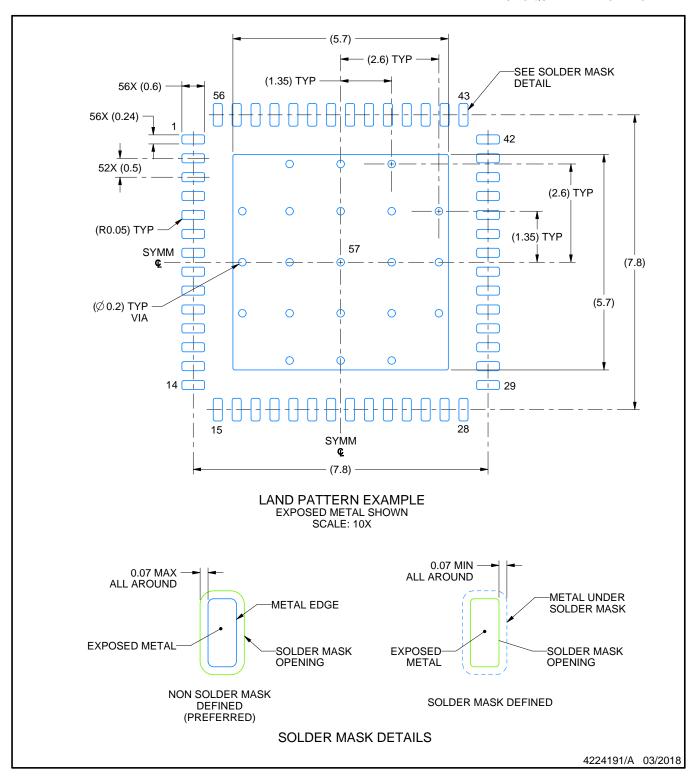


NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
 2. This drawing is subject to change without notice.
- 3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



PLASTIC QUAD FLATPACK - NO LEAD

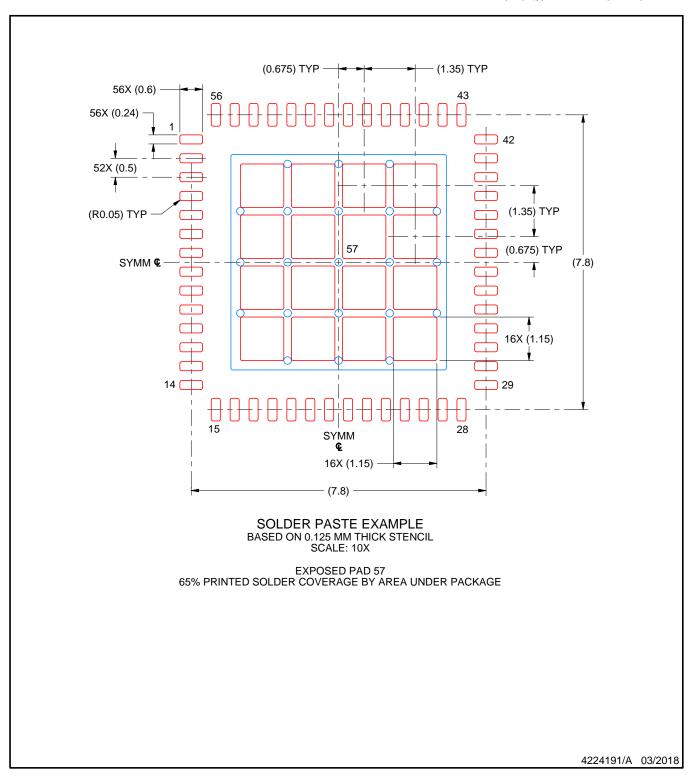


NOTES: (continued)

- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



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