

eFuse with Over Voltage Protection

Features

- 3-V eFuse
 - G3722H03NL/G3722H03N/G3722H03R
- 5-V eFuse
 - G3722H05NL/G3722H05N/G3722L05N/G3722H05R
- 12-V eFuse
 - G3722H12NL/G3722H12N
- Fixed Over-Voltage Clamp
 - 3.6V-Clamp: G3722H03NL/G3722H03N/G3722H03R
 - 5.5V-Clamp: G3722H05NL/G3722H05N/G3722L05N/G3722H05R
 - 13.6V-Clamp: G3722H12NL/G3722H12N
- Integrated 34mΩ Pass MOSFET
- 0.5A to 4A Adjustable I_{LIMIT}
- $\pm 7.5\%$ I_{LIMIT} Accuracy
- Programmable OUT Slew Rate, UVLO
- Built-in Thermal Shutdown
- Fault Indication Pin (FLTb)
- Small Foot Print – TDFN2X2-8
- UL 2367 Recognition-File NO. E232223
- IEC 62368-1 Certified

Applications

- Adapter Powered Devices
- SSD and HDD Drives
- Set Top Boxes
- Servers / AUX Supplies
- Fan Control
- PCI/PCIe Cards
- Hot-Swap, Hot-Plug
- Multi-function Printers
- Industrial Systems
- White Goods
- Digital TV

General Description

The G3722 series of eFuses is a highly integrated circuit protection and power management solution in a tiny package. The devices use few external components and provide multiple protection modes. They are a robust defense against overloads, shorts circuits, voltage surges, excessive inrush current, and reverse current.

Current limit level can be set with a single external resistor. Over voltage events are limited by internal clamping circuits to a safe fixed maximum, with no external components required. Applications with particular voltage ramp requirements can set dV/dT with a single capacitor to ensure proper output ramp rates.⁷

Quick output discharge function can be implemented in the G3722H03R/G3722H05R by connecting the OUT pin to the QOD pin.

The devices are characterized for operation over the temperature range of -40°C to $+125^{\circ}\text{C}$.

Pin Configuration

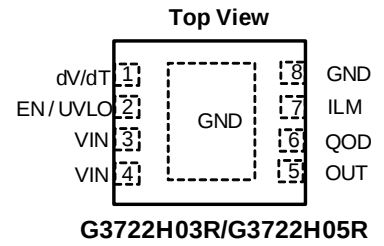
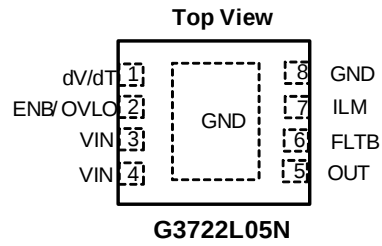
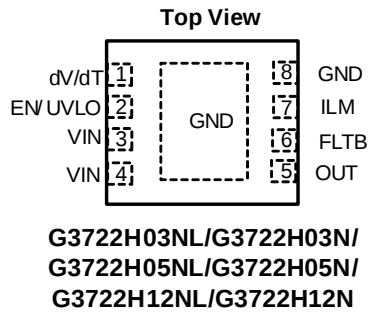
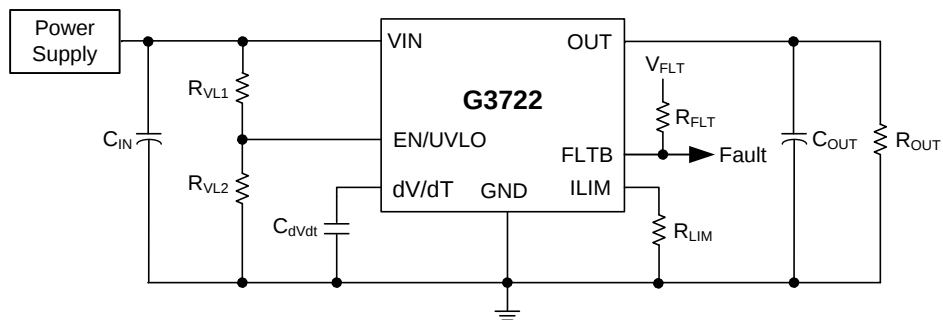


Table1. Pin Out Groups

Order Number	Group
G3722H03NL	A
G3722H03N	A
G3722H03R	C
G3722H05NL	A
G3722H05N	A
G3722L05N	B
G3722H05R	C
G3722H12NL	A
G3722H12N	A

Typical Application Circuit



Ordering Information

Order Number	Marking	Output Voltage Clamp	Response to Thermal Shutdown (TSD)	Enable	Temp. Range	Package (Green)
G3722H03NLRC1D	32AA	3.8	Latch-off	Active high	-40°C to +85°C	TDFN2x2-8
G3722H03NRC1D	32AB	3.8	Auto-retry	Active high	-40°C to +85°C	TDFN2x2-8
G3722H03RRC1D	32AC	3.8	Auto-retry	Active high	-40°C to +85°C	TDFN2x2-8
G3722H05NLRC1D	32BA	5.7	Latch-off	Active high	-40°C to +85°C	TDFN2x2-8
G3722H05NRC1D	32BB	5.7	Auto-retry	Active high	-40°C to +85°C	TDFN2x2-8
G3722L05NRC1D	32FB	5.7	Auto-retry	Active Low	-40°C to +85°C	TDFN2x2-8
G3722H05RRC1D	32BC	5.7	Auto-retry	Active high	-40°C to +85°C	TDFN2x2-8
G3722H12NLRC1D	32CA	13.7	Latch-off	Active high	-40°C to +85°C	TDFN2x2-8
G3722H12NRC1D	32CB	13.7	Auto-retry	Active high	-40°C to +85°C	TDFN2x2-8

Note: RC: TDFN2X2-8L

1: Bonding Code

D: Tape & Reel

Green: Lead Free / Halogen Free

Absolute Maximum Ratings

Supply Voltage

VIN -0.3V to 20V
 VIN (10msTransient) 22V

Output Voltage

OUT -0.3V to VIN+0.3V
 OUT (Transient<1μs) -1.2V

Voltage

ILIM -0.3V to 7V
 EN/UVLO -0.3V to 7V
 ENB/OVLO -0.3V to 7V
 dV/dT -0.3V to 7V
 FLTB -0.3V to 7V
 QOD -0.3V to 7V
 ESD(HBM) ±2.5KV
 ESD(CDM) ±500V

Recommended Operating Conditions

Input Voltage

VIN3V to 12.6V
 OUT 0V to VIN+0.3V
 dV/dT 0V to 6V
 EN/UVLO, ENB/OVLO 0V to 6V
 ILIM 0V to 3V
 Continuous output current (I_{OUT}) 0A to 4A
 Resistance (ILIM) 400Ω to 5kΩ

External capacitance

OUT 0.1 to 1000μF
 dV/dT3300pF
 Operating Junction Temperature (T_J) . . -40°C to 125°C
 Operating Ambient Temperature (T_A) . . -40°C to 85°C
 Storage Temperature (T_{STG}) -65°C to 150°C

Thermal Information

THERMAL METRIC		TDFN2X2-8	UNIT
R _{θJA}	Junction to ambient thermal resistance	72.8	°C/W
R _{θJC_top}	Junction to case top thermal resistance	107.8	°C/W
R _{θJB}	Junction to board thermal resistance	37.3	°C/W
Ψ _{JT}	Junction to top characterization parameter	2.9	°C/W
Ψ _{JB}	Junction to board characterization parameter	36.2	°C/W
R _{θJC_bot}	Junction to case bottom thermal resistance	11.3	°C/W

- Package thermal metric is obtained using the method described in JEDEC specification JESD51-7, using a four-layer board.

The maximum power dissipation is $P_{D(MAX)} = \frac{(T_{JMAX} - T_A)}{R_{\theta JA}}$, Exceeding the maximum allowable power dissipation results in excessive die temperature, and the device will enter thermal shutdown.

Electrical Characteristics

($-40^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$, $V_{\text{VIN}}=5\text{V}$, $V_{\text{EN/UVLO}}=2\text{V}$, $R_{\text{ILIM}}=487\Omega$, $C_{\text{dV/dT}}=\text{OPEN}$. All voltages referenced to GND)

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at $+25^{\circ}\text{C}$, unless otherwise specified.

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
VIN (Input Supply)							
UVLO Threshold	V _{UVR}	Group C	Rising	2.7	2.8	2.9	V
			Falling	2.58	2.68	2.78	
		Group A+B	Rising	2.44	2.54	2.64	
			Falling	2.33	2.43	2.53	
Quiescent Current	I _Q	Group A+C	V _{EN/UVLO} =2V	---	0.175	0.25	mA
		Group B	V _{ENB/OVLO} =0V				
Shutdown Current	I _{SHDN}	Group A+C	V _{EN} <0.5V, V _{VIN} ≤5V	---	0.04	---	μA
		Group B	V _{ENB/OVLO} >1.5V, 5V < V _{VIN} ≤12V	---	0.45	2	

Electrical Characteristics (Continued)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Output Voltage Clamp (OVC)							
Over-Voltage Clamp	V _{OVC}	G3722x03xx G3722x03x	V _{VIN} Rising, R _{OUT} =10kΩ	3.65	3.87	4.1	V
		G3722x05xx G3722x05x		5.5	5.7	5.9	
		G3722x12xx G3722x12x		13.3	13.7	14.3	
Output Voltage while Clamping	V _{CLAMP}	G3722x03xx G3722x03x	V _{VIN} ≥ V _{OVC} , I _{OUT} =10mA	3.4	3.6	3.8	
		G3722x05xx G3722x05x		5.2	5.45	5.7	
		G3722x12xx G3722x12x		13	13.55	14.1	
Output clamp response time	t _{OVC}	G3722x03xx G3722x03x G3722x05xx G3722x05x	I _{OUT} =4A	---	5	---	μs
		G3722x12xx G3722x12x	I _{OUT} =100mA	---	10	---	
OUT (Pass FET Output)							
FET ON Resistance	R _{DS(on)}	T _J =25°C	---	34	37	mΩ	
		T _J =125°C	---	---	53		
OUT Bias Current in off State	I _{OUT_OFF_LKG}	V _{EN/UVLO} =0V, V _{OUT} =0V (sourcing)	-5	0	1.2	μA	
	I _{OUT_OFF_SINK}	V _{EN/UVLO} =0V, V _{OUT} =300mV (sinking)	10	15	20		
EN/UVLO (Enable/UVLO Input) – Group A + C							
EN Threshold Voltage	V _{ENR}	Rising	1.13	1.2	1.27	V	
	V _{ENF}	Falling	1.03	1.1	1.17		
EN/UVLO Input Leakage Current	I _{EN}		-0.1	0	0.1	μA	
ENB/OVLO (Enableb/OVLO Input) – Group B							
ENB Threshold Voltage	V _{ENBR}	Rising	1.13	1.2	1.27	V	
	V _{ENBF}	Falling	1.03	1.1	1.17		
ENB/OVLO Input Leakage Current	I _{ENB}		-0.1	0	0.1	μA	
Over-Voltage Lockout Response time	t _{OVLO}	V _{ENB} > V _{OVLO} to FLTB	---	3	---	μs	

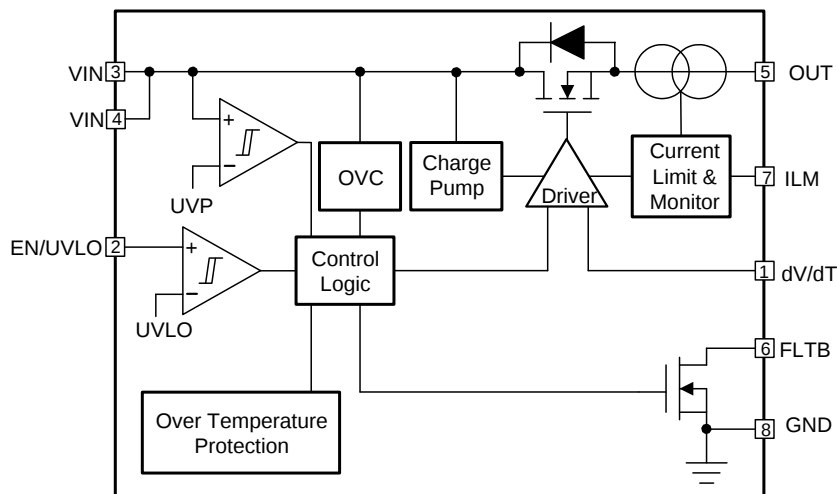
Electrical Characteristics (Continued)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
dV/dT (Output Slew Rate Control)							
Turn on Delay	t _{D_ON}	C _{dV/dT} =open	VIN=3.3V	---	147	---	μs
			VIN=5V	---	149	---	
			VIN=12V	---	153	---	
		C _{dV/dT} =3300pF	VIN=3.3V	---	254	---	
			VIN=5V	---	289	---	
			VIN=12V	---	335	---	
Turn off Delay	t _{D_OFF}	C _{dV/dT} =open	VIN=3.3V	---	11.6	---	
			VIN=5V	---	11.3	---	
			VIN=12V	---	11	---	
		C _{dV/dT} =3300pF	VIN=3.3V	---	11.6	---	
			VIN=5V	---	11.5	---	
			VIN=12V	---	11.4	---	
Output Ramp Time	t _R	C _{dV/dT} =open	VIN=3.3V	---	157	---	
			VIN=5V	---	179	---	
			VIN=12V	---	248	---	
		C _{dV/dT} =3300pF	VIN=3.3V	---	259	---	
			VIN=5V	---	349	---	
			VIN=12V	---	763	---	
ILIM (Current Limit)							
Current Monitor Gain	G _{IMON}	I _{ILIM} /I _{OUT} , I _{OUT} =1A		249	276	304	μA
Overload Current Limit	I _{OC}	R _{ILIM} =487Ω		3.87	4.17	4.42	A
		R _{ILIM} =1780Ω		1.09	1.17	1.24	
		R _{ILIM} =4420Ω		0.46	0.49	0.52	
	I _{OC_R_Short}	R _{ILIM} =0Ω		---	3	---	
	I _{OC_R_Open}	R _{ILIM} =OPEN		---	0	---	
Current limit response time	t _{LIM}	I _{OUT} > I _{LIMIT} +20% to I _{OUT} ≤ I _{LIMIT}		---	250	---	μs
Short circuit response time	t _{SC}	I _{OUT} > I _{SC} to I _{OUT} ≤ I _{LIMIT}		---	5	---	μs
FLTB (Fault Indication) – Group A + B							
FLTB pin resistance	R _{FLTB}	FLTB		---	12	---	Ω
FLTB pin leakage current	I _{FLTB}	V _{EN} =2V, V _{FLTB} =0V to 6V		-0.1	---	0.1	μA
QOD (Quick Output Discharge) – Group C							
QOD effective resistance	R _{QOD}	VIN connected to EN, OUT connected to QOD, EN ↓ to 1V		---	19	---	Ω
TSD (Thermal Shut Down)							
Thermal Shutdown Temperature	T _{SHDN}	Rising		---	157	---	°C
	T _{SD_HYS}	Hysteresis		---	5	---	°C
Retry Delay After TSD Recovery	T _{SD_DLY}	G3722x03x G3722x05x G3722H12N		---	93	---	ms
		G3722H03NL G3722H05NL G3722H12NL		Latch-off			

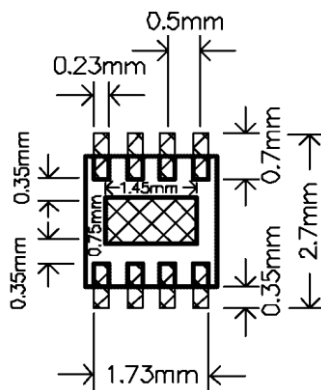
Pin Description

PIN	NAME	TYPE	FUNCTION
1	dV/dT	Analog I/O	A capacitor from this pin to GND sets the output turn on slew rate. Leave this pin Floating for the fastest turn on slew rate. (See Switching Characteristics).
2	EN/UVLO	Analog input	Active high enable for the Group A, Group C variants. A resistor divider can be used to adjust the under-voltage lockout threshold. Do not leave floating.
	ENB/OVLO		Active low enable for the Group B variants. A resistor divider can be used to adjust the over-voltage lockout threshold. Do not leave floating.
3,4	VIN	Power	Power input.
5	OUT	Power	Power input.
6	FLT B	Digital output	Group A+ Group B: Fault event indicator which is pulled low when a fault is detected. It is an open drain output that requires an external pull up resistance.
	QOD		Group C: Quick Output Discharge Pin, when tied to OUT directly or through external Resistor.
7	ILM	Analog I/O	This is a dual function pin used to limit and monitor the output current. An external resistor from this pin to GND sets the output current limit. The pin voltage can also be used to monitor the output load current. Do not leave floating.
8	GND	Ground	Ground
Thermal Pad	GND	Ground	The exposed pad is used primarily for heat dissipation and must be connected to GND.

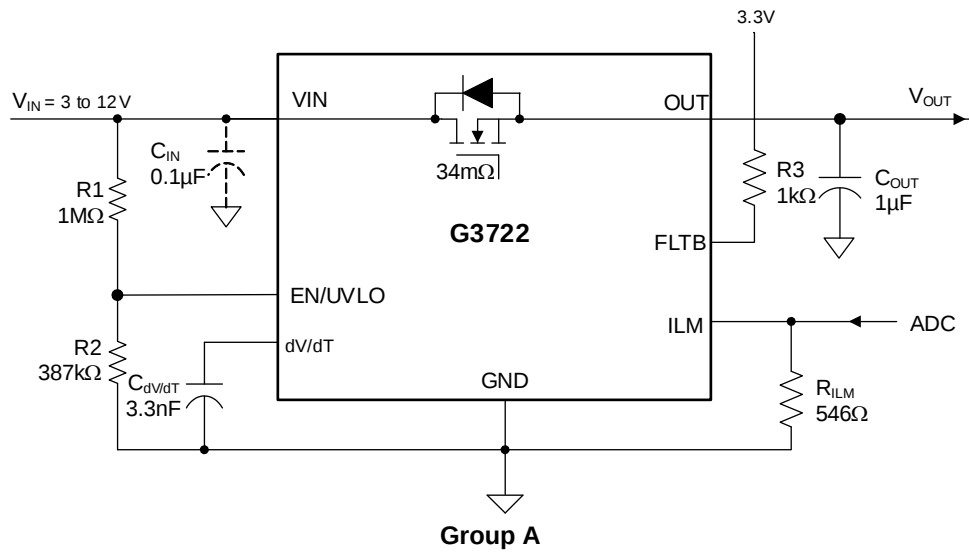
Block Diagram



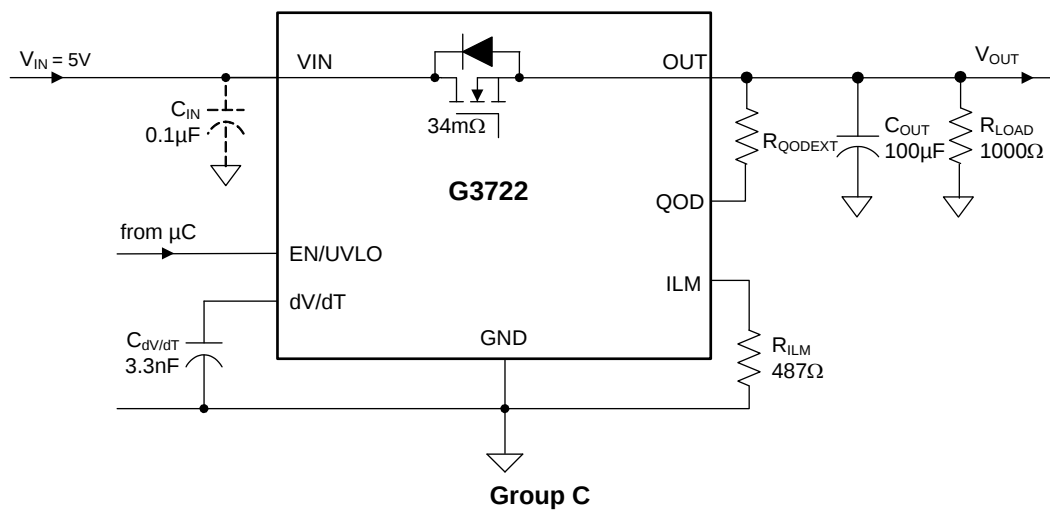
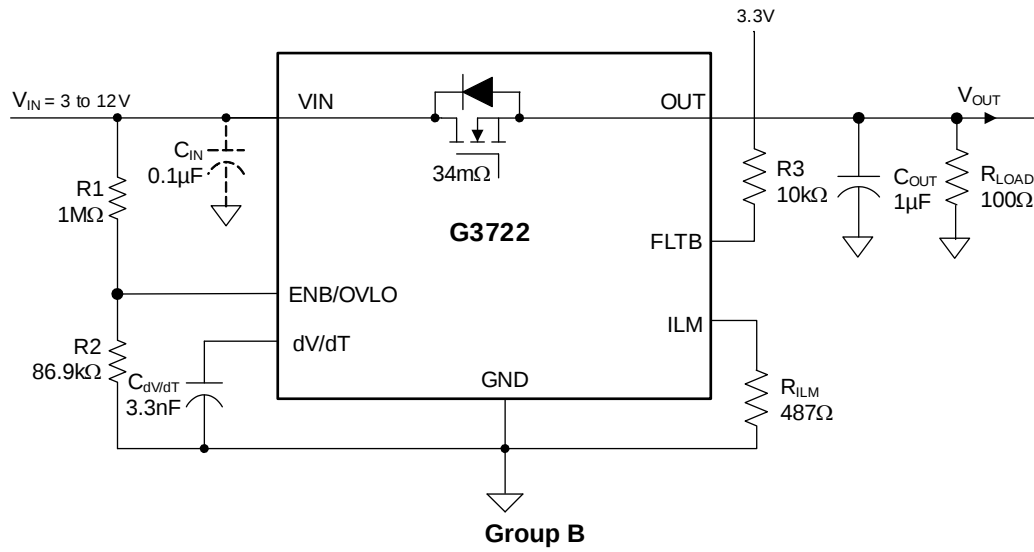
Minimum Footprint PCB Layout Section



Typical Applications



Typical Applications (continued)



Function Description

Slew Rate and Inrush Current Control (dV/dT)

The inrush current during turn on is directly proportional to the load capacitance and rising slew rate. Equation 1 can be used to find the slew rate SR_{ON} required to limit the inrush current I_{INRUSH} for a given load capacitance C_{OUT} .

$$SR_{ON} (V/ms) = I_{INRUSH} (mA) / C_{OUT} (\mu F) \quad (1)$$

For loads requiring a slower rising slew rate, a capacitance can be added to the dV/dT pin to adjust the rising slew rate and lower the inrush current during turn on. The required $C_{dV/dT}$ capacitance to produce a given slew rate can be calculated using Equation 2.

$$C_{dV/dT} (pF) = 42000 / SR_{ON} (V/ms) \quad (2)$$

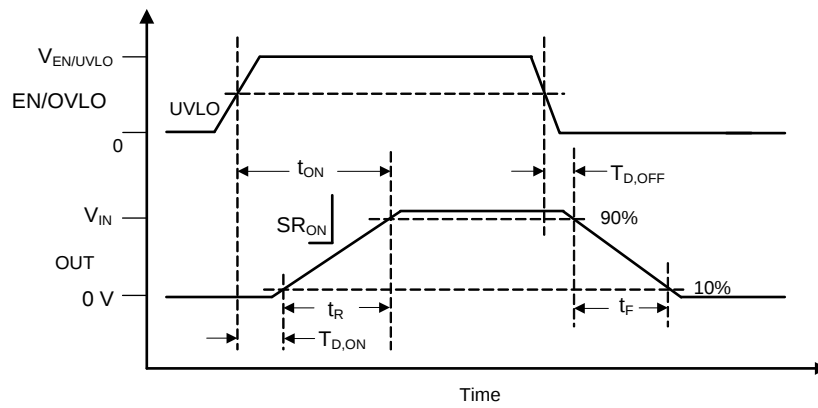
R_{ILIM} Selection for Current Limit

The R_{ILIM} resistor at the ILIM pin sets the over load current limit, this can be set as follows.

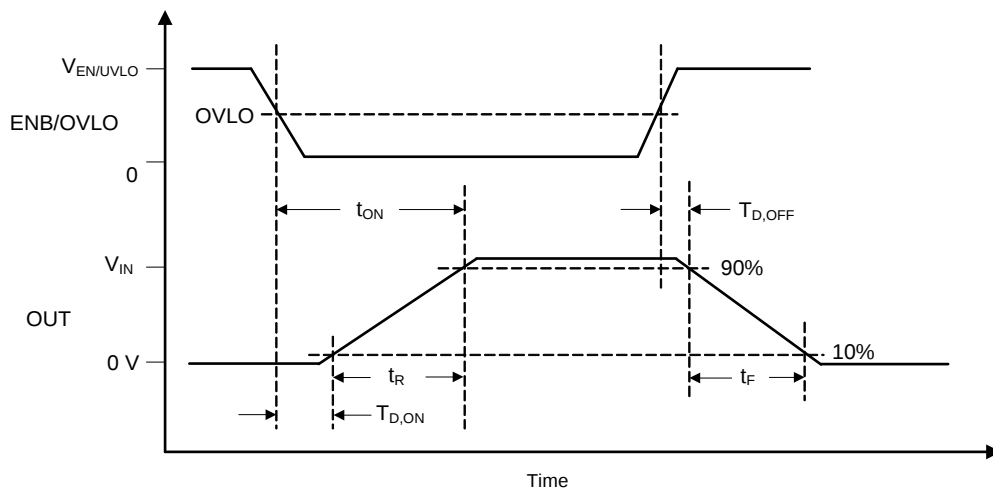
$$R_{ILIM} = 2000 / (I_{OC} - 0.04) \quad (3)$$

Fault Indication (FLT B)

FAULT	PROTECTION RESPONSE	FLT B INDICATION
Overtemperature	Shutdown	Yes
Overvoltage	Output Voltage Clamp (OVC)	No
Undervoltage	Shutdown (UVP or UVLO)	No
Overcurrent	Current Limiting	No
Short circuit	Current Limiting	No
ILM pin open	Shutdown	No
ILM pin short	Shutdown if $I_{OUT} > I_{OC_R_SHORT}$	Yes if $I_{OUT} > I_{OC_R_SHORT}$

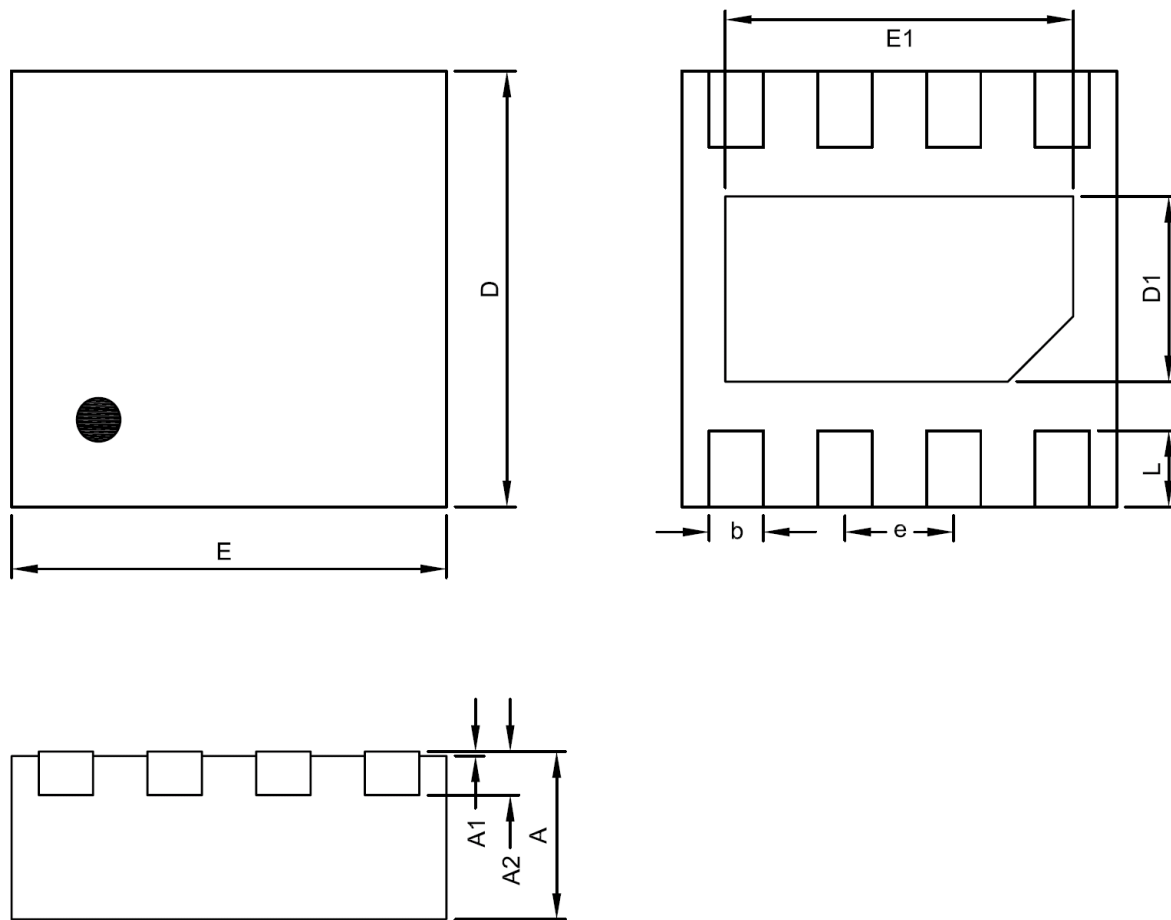


Group A switching times



Group B switching times

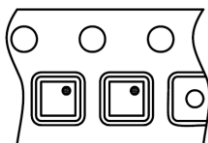
Package Information



TDFN2X2-8 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.0276	0.0295	0.0315
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.20 REF			0.0079 REF		
D	1.95	2.00	2.05	0.0768	0.0787	0.0807
E	1.95	2.00	2.05	0.0768	0.0787	0.0807
D1	0.75	0.85	0.95	0.0295	0.0335	0.0374
E1	1.45	1.55	1.65	0.0571	0.0610	0.0650
b	0.15	0.23	0.30	0.0059	0.0091	0.0118
e	0.50 BSC			0.0197 BSC		
L	0.30	0.35	0.40	0.0118	0.0138	0.0157

Taping Specification



Feed Direction

PACKAGE	Q'TY/BY REEL
TDFN2X2-8	3,000 ea

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