

Power-Distribution Switches with Soft Start

Features

- Wide Supply Voltage Range: 4.5V to 22V
- 80mΩ High Side MOSFET
- Power Good pin indicated output status
- Current Limit setting
- Current Limit Protection (Latched Off)
- Under Voltage Lockout Protection
- Over-temperature Protection (Latched Off)
- Logic Level Enable Input
- Lead Free and Green Devices Available (RoHS Compliant)
- TDFN2X2-6 Package
- UL 2367 Recognition-File No. E232223
- IEC 62368-1 Certified

Applications

- TFT LCD Modules
- Notebook and Desktop Computers
- USB Ports
- High-side Power Protection Switches

General Description

The G2176 is a power-distribution switch with some protection functions. The device incorporates an 80mΩ N-channel MOSFET power switch that is controlled by an enable logic pin and has a built-in soft-start control that can be used in application where the inrush current is concerned.

The device integrates some protection features, including current limit protection, over-temperature protection, UVLO and current limit setting. The current limit protection can protect down-stream devices from catastrophic failure by limiting the output current at current limit threshold during over-load or short circuit events. The over-temperature protection function shuts down IC when the junction temperature rises beyond 150°C. The UVLO function keeps the power switch in off state until there is a valid input voltage present. The current limit can be set by connecting resistor from the current limit adjustable pin ISET to ground.

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G2176RB1U	2176	-40°C to +85°C	TDFN2X2-6

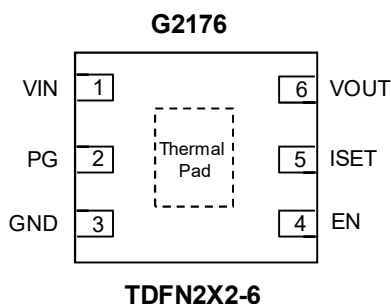
Note: RB: TDFN2X2-6

1: Bonding Code

U: Tape & Reel

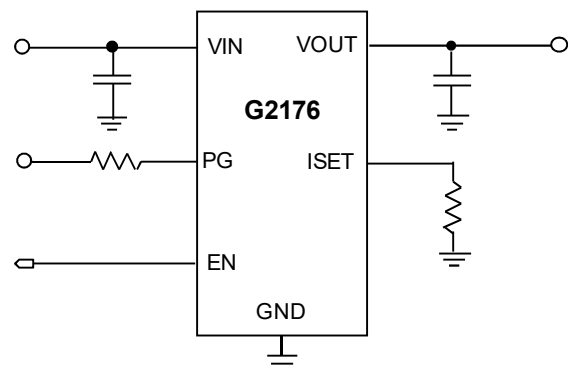
Green : Lead Free / Halogen Free

Pin Configuration



Note: Recommend connecting the Thermal Pad to the Ground for excellent power dissipation.

Typical Application Circuit



Absolute Maximum Ratings

VIN to GND Voltage (V_{IN}) -0.3V to +26V
 VOUT to GND Voltage (V_{OUT}) -0.3V to +26V
 EN to GND Voltage (V_{EN}) -0.3V to +7V
 ISET to GND Voltage (V_{ISET}) -0.3V to +7V
 PG to GND Voltage (V_{PG}) -0.3V to +7V
 Thermal Resistance of Junction to Ambient (θ_{JA})
 TDFN2X2-6 225°C/W
 Thermal Resistance of Junction to Case (θ_{JC})
 TDFN2X2-6 56°C/W

Continuous Power Dissipation ($T_A = +25^\circ\text{C}$)
 TDFN2X2-6 0.55W
 Maximum Junction Temperature (T_J) . . -40°C to 150°C
 Storage Temperature (T_{STG}) -65°C to 150°C
 Maximum Lead Soldering Temperature (10 Seconds)
 (T_{SDR}) 260°C
 ESD (HBM) 2KV
 ESD (MM) 200V
 Ambient Temperature (T_A) -40°C to +85°C

Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

(VIN=12V, VEN=5V, Typical values are $T_A=25^\circ\text{C}$.)

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Current						
VIN Voltage Range	VIN		4.5	12	22	V
VIN Supply Current	I _{STDBY}	No load, V _{EN} =0V	---	20	40	μA
	I _{VIN}	No load, V _{EN} =5V, R _{ISET} =300kΩ	---	200	260	μA
Leakage Current	I _{LEAK}	V _{OUT} =GND , V _{EN} =0V	---	---	1	μA
Power Switch						
Power Switch On Resistance	R _{DS(ON)}	I _{OUT} =0.2A	---	70	84	mΩ
Under-Voltage Lockout						
VIN UVLO Threshold Voltage	V _{UVLO}	VIN rising	3.9	4.2	4.5	V
VIN UVLO Hysteresis	V _{UVLO-HYS}		0.2	0.4	0.5	V
Current Limit Protection						
Current Limit Threshold	I _{LIM}	R _{ISET} =300kΩ	0.85	1	1.15	A
Soft-Start & Falling time						
Soft-Start Time	t _{SS}	V _{IN} =6V, No load, Cout=1μF	0.5	1.3	2.1	ms
		V _{IN} =20V, No load, Cout=1μF	3.5	6	8.5	ms
VOUT Falling time *1	t _f	V _{IN} =6V, RL=1000Ω, Cout=0.1μF	---	90	---	μs
		V _{IN} =20V, RL=1000Ω, Cout=0.1μF	---	100	---	μs
EN Input						
Input Logic High	V _{IH}		1.6	---	---	V
Input Logic Low	V _{IL}		---	---	0.6	V
Input Current	I _{EN}	VEN=5V	---	---	15	μA
VOUT Discharge Resistance	R _{DIS}	VEN=0V	750	950	1200	Ω
Turn on Delay Time	t _{D(ON)}		200	500	900	μs
Power Good, PG						
Pull high Delay Time	t _{hd}	From VOUT=VIN-0.7V to PG rising	300	550	800	μs
Over-Temperature Protection (OTP)						
Over-Temperature Threshold	T _{OTP}	T _J rising	---	150	---	°C

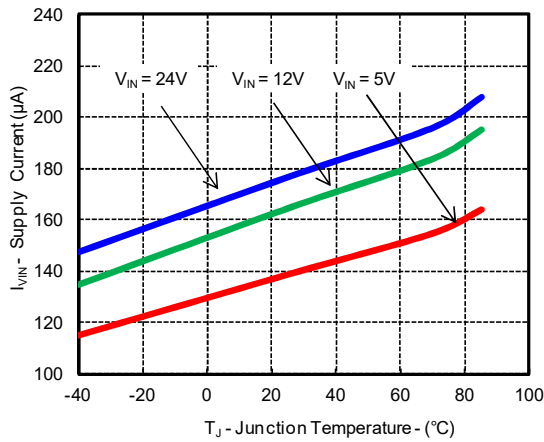
Note

(1) Falling time is guaranteed by calculation and design

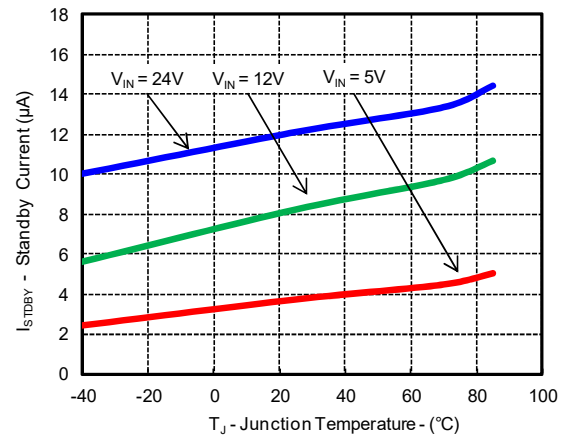
Typical Performance Characteristics

($V_{IN} = 12V$, $V_{EN} = 5V$, $T_A = 25^\circ C$, unless otherwise noted.)

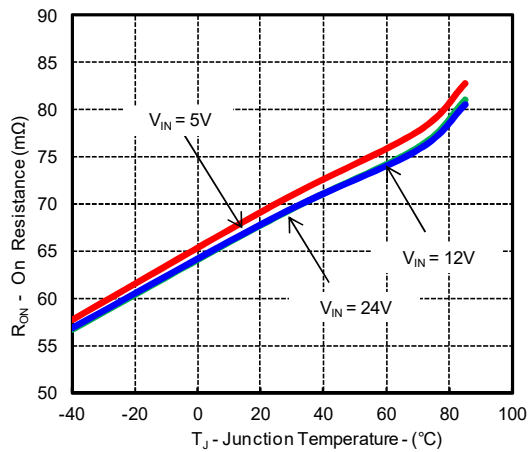
Supply Current VS. Junction Temperature



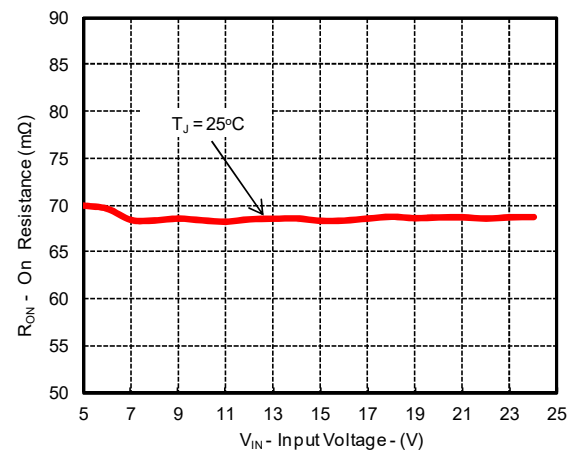
Standby Current VS. Junction Temperature



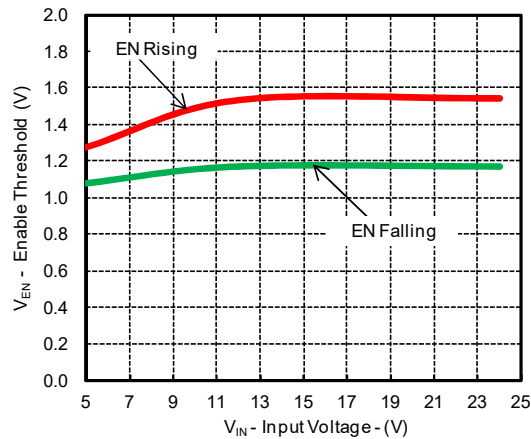
On Resistance VS. Junction Temperature



On Resistance VS. Input Voltage

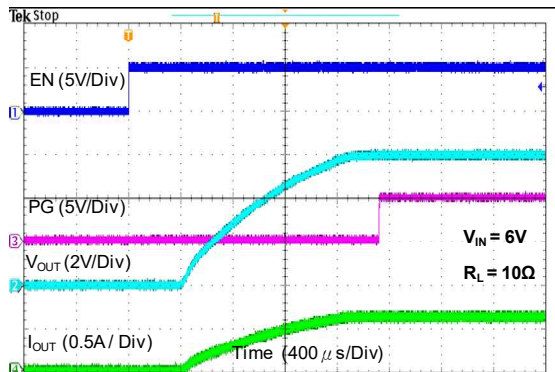


EN Threshold VS. Input Voltage

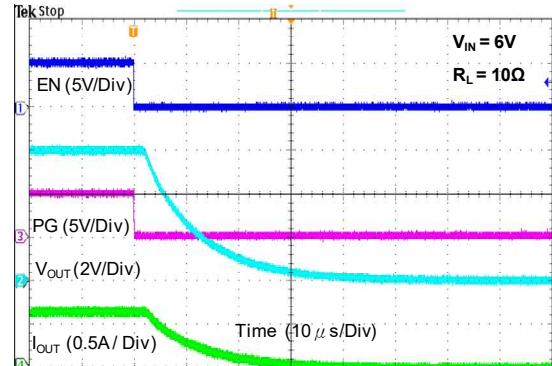


Typical Performance Characteristics (continued)

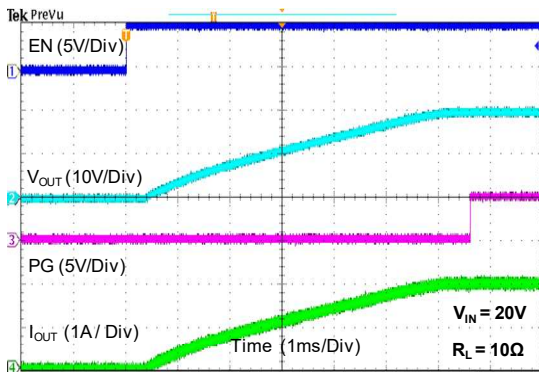
Device Enable



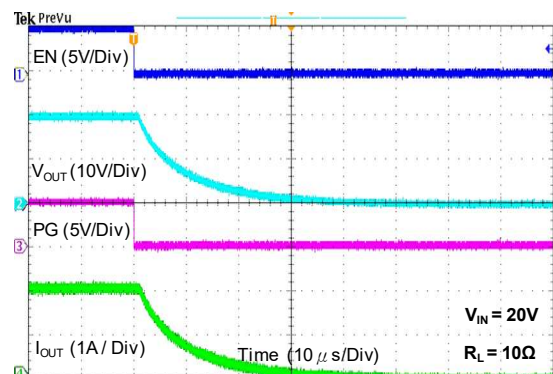
Device Disable



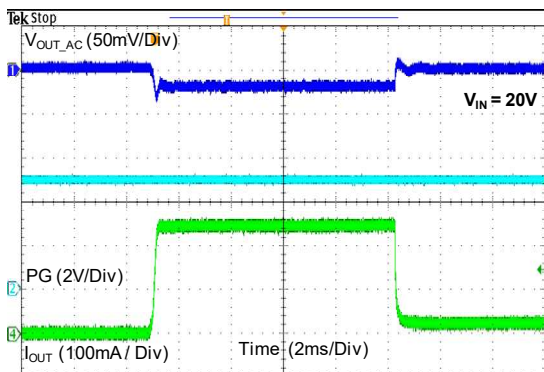
Device Enable



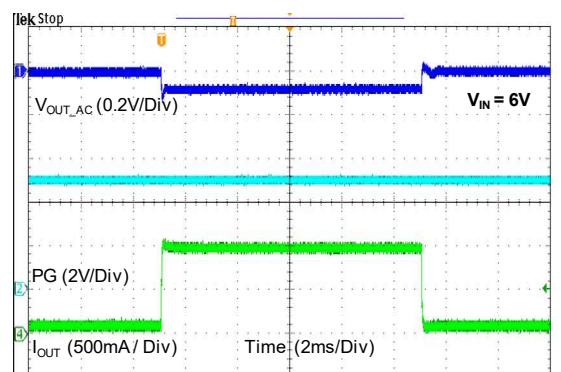
Device Disable



Load Transient Response

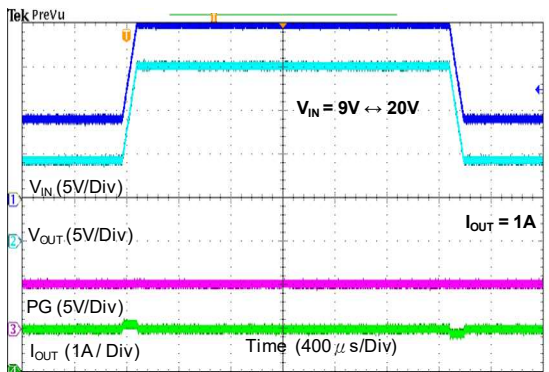


Load Transient Response

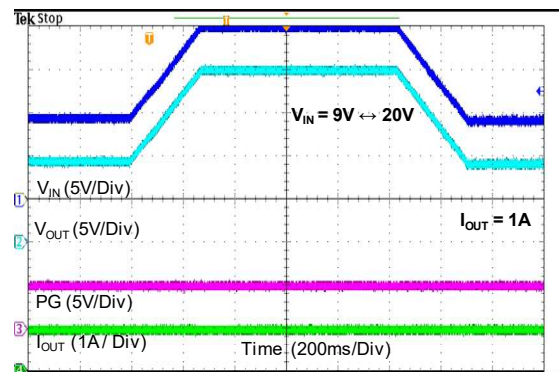


Typical Performance Characteristics (continued)

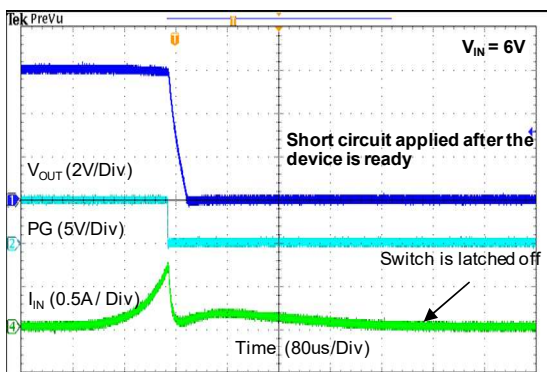
Line Transient Response



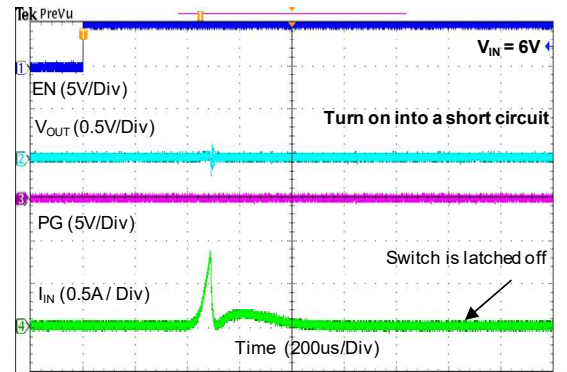
Line Transient Response



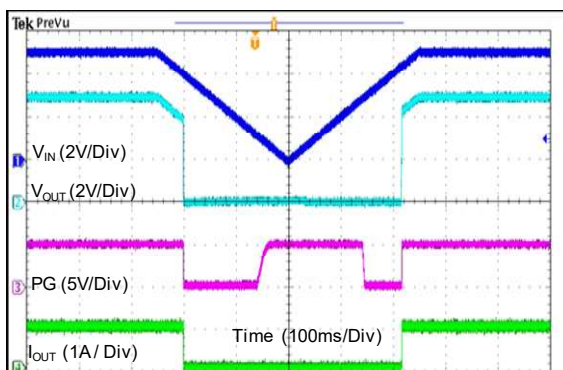
Short Circuit Protection



Short Circuit Protection

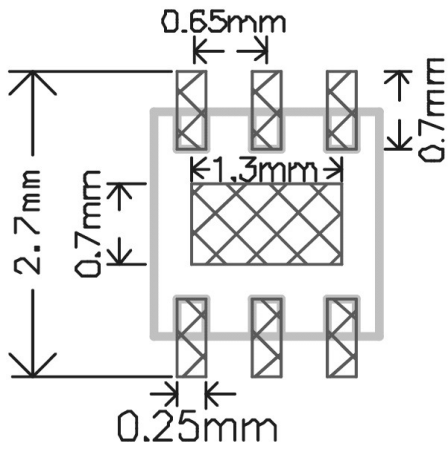


UVLO



Minimum Footprint PCB Layout Section

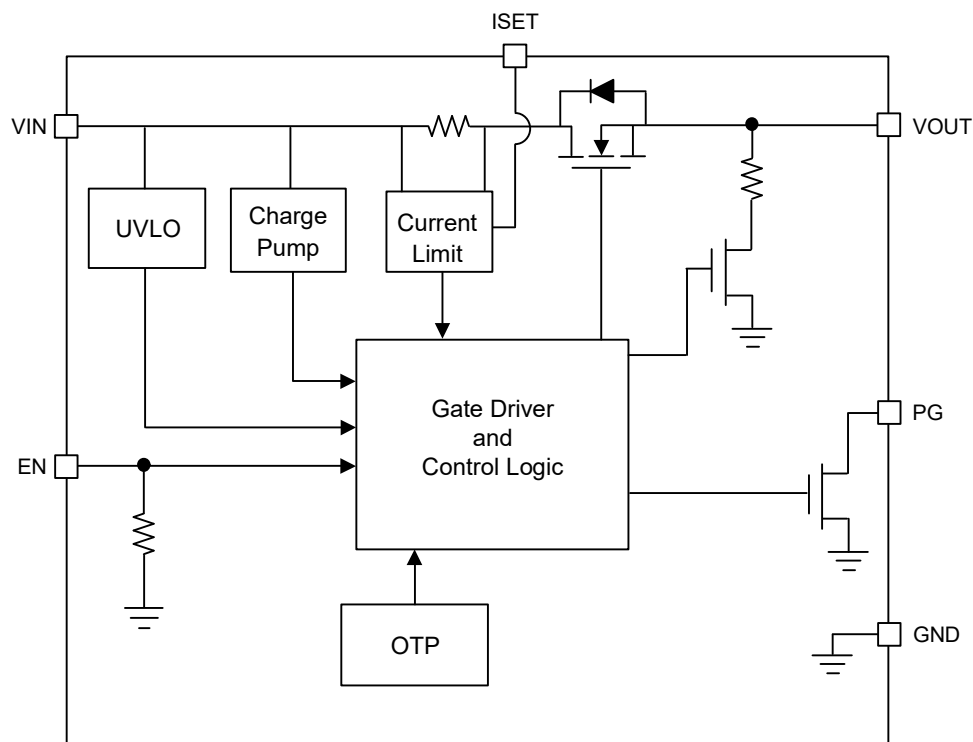
TDFN2X2-6



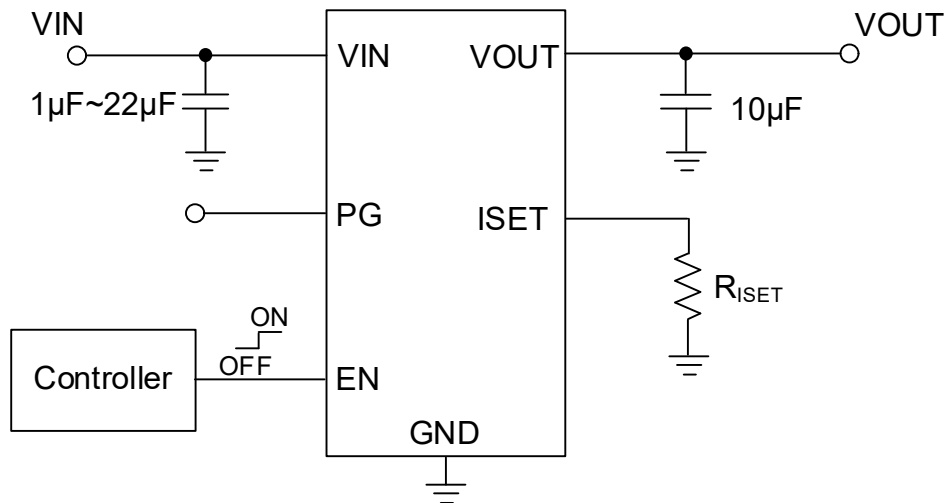
Pin Description

PIN	NAME	FUNCTION
1	VIN	Power Supply Input. Connect this pin to external DC supply.
2	PG	Power Good Pin. Open drain structure, connect a resistor to 5V. When the VOUT reach to VIN voltage and delay 550 μ s PG in 5V status. when output OC, OT or short circuit PG in pull low status.
3	GND	GND.
4	EN	Enable Input. Pull this pin to high to enable the device and pull this pin to low to disable device. The EN pin cannot be left floating
5	ISET	Connect a resistor to GND to adjust OCP level.
6	VOUT	Output Voltage Pin. The output voltage follows the input voltage. When EN is low the output voltage is discharged by an internal resistor.

Function Block Diagram



Typical Application Circuit



Function Description

Under-voltage Lockout (UVLO)

The G2176 power switch is built-in an under-voltage lockout circuit to keep the output shut off until internal circuitry is operating properly. The UVLO circuit has hysteresis and a de-glitch feature so that it will typically ignore undershoot transients on the input. When input voltage exceeds the UVLO threshold, the output voltage starts a soft-start to reduce the inrush current.

Power Switch

The power switch is an N-channel MOSFET with a low $R_{DS(ON)}$. When IC is off, the MOSFET prevents a current flowing from the V_{OUT} back to V_{IN} and V_{IN} to V_{OUT} .

Current Limit Protection

The G2176 power switch provides the current limit and fast over current protection function. When current limit or fast over current occur, IC latch off. The fast over current protection prevents excessive current from flowing by stopping operation when the output is short-circuited due to some kind of abnormality.

Power-Good

The G2176 provides an indicated power good pin, When the V_{OUT} reach to V_{IN} voltage and delay 550μs PG in 5V status. when output OC, OT or short circuit PG in pull low status.

Enable/Disable

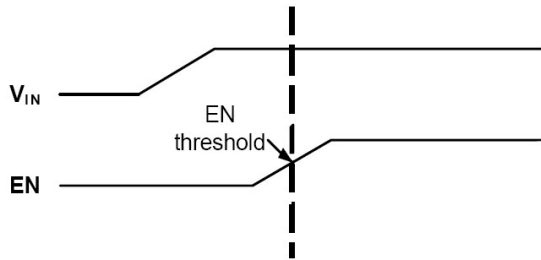
Pull the EN below 0.6V to disable the device and pull EN above 1.6V to enable the device. When the IC is disabled the supply current is reduced to less than 20μA. The en-able input is compatible with both TTL and CMOS logic levels. The EN pin cannot be left floating.

Over-temperature Protection

When the junction temperature exceeds 150°C, the internal thermal sense circuit turns off the power FET and allows the device to cool down. When over temperature protection occur, IC latch off. Thermal protection is de-signed to protect the IC in the event of over temperature conditions. For normal operation, the junction temperature cannot exceed $T_J=+125^{\circ}\text{C}$.

Application Information

Power Sequencing



At start-up, it is necessary to ensure that the V_{IN} and EN are sequenced correctly.

Input Capacitor

A 1 μ F to 22 μ F MLCC bypass capacitor from V_{IN} to GND, located near the G2176, is strongly recommended to suppress the ringing during short-circuit fault event. Without the by-pass capacitor, the output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry.

Output Capacitor

A low-ESR 0.1 μ F to 10 μ F MLCC between V_{OUT} and GND is strongly recommended to reduce the voltage droop during hot-attachment of down stream peripheral. Higher-value output capacitor is better when the output load is heavy. Additionally, bypassing the output with a 0.1 μ F ceramic capacitor improves the immunity of the device to short-circuit transients.

Soft-Start Capacitor

The G2176 has a built-in soft-start control to reduce inrush current.

Layout Consideration

The PCB layout should be carefully performed to maximize thermal dissipation and to minimize voltage drop, droop and EMI. The following guidelines must be considered:

1. Please place the input capacitors near the V_{IN} pin as close as possible.
2. Output decoupling capacitors for load must be placed near the load as close as possible for decoupling high frequency ripples.
3. Locate G2176 and output capacitors near the load to reduce parasitic resistance and inductance for excellent load transient performance.
4. The negative pins of the input and output capacitors and the GND pin must be connected to the ground plane of the load.
5. Keep V_{IN} and V_{OUT} traces as wide and short as possible

Current Limit Setting

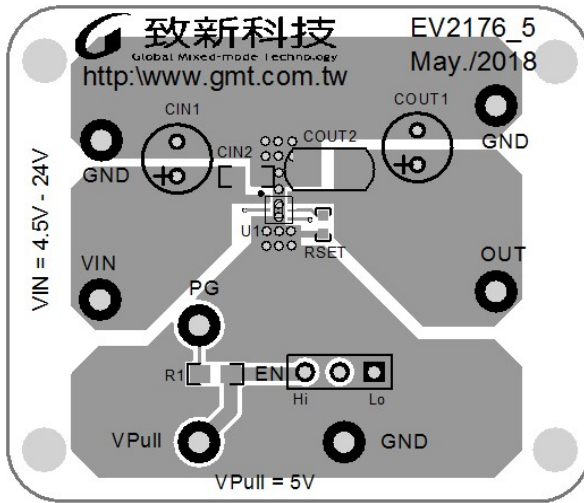
The current limit can be set by connecting resistor from the current limit adjustable pin ISET to ground. The required value of resistor $R_{ISET}(k\Omega)$ for current limit(A) is calculated as follows:

$$R_{ISET}(k\Omega) = 300 / I_{LIM}(A)$$

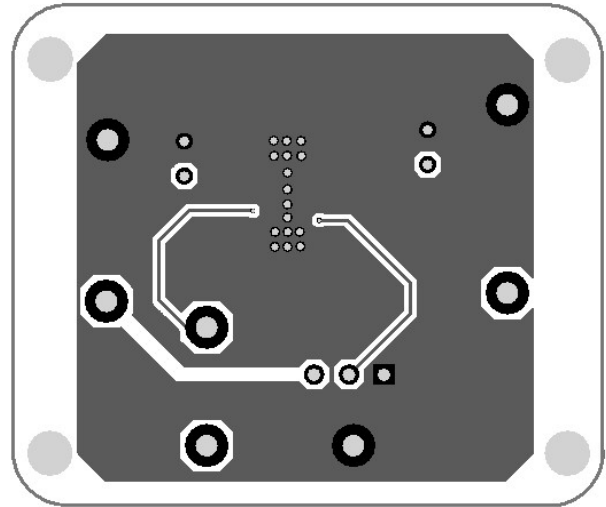
Please note that keeps R_{ISET} in the range between 174k Ω and 1M Ω , otherwise the IC will not work normally.

EV Board PCB Layout Section

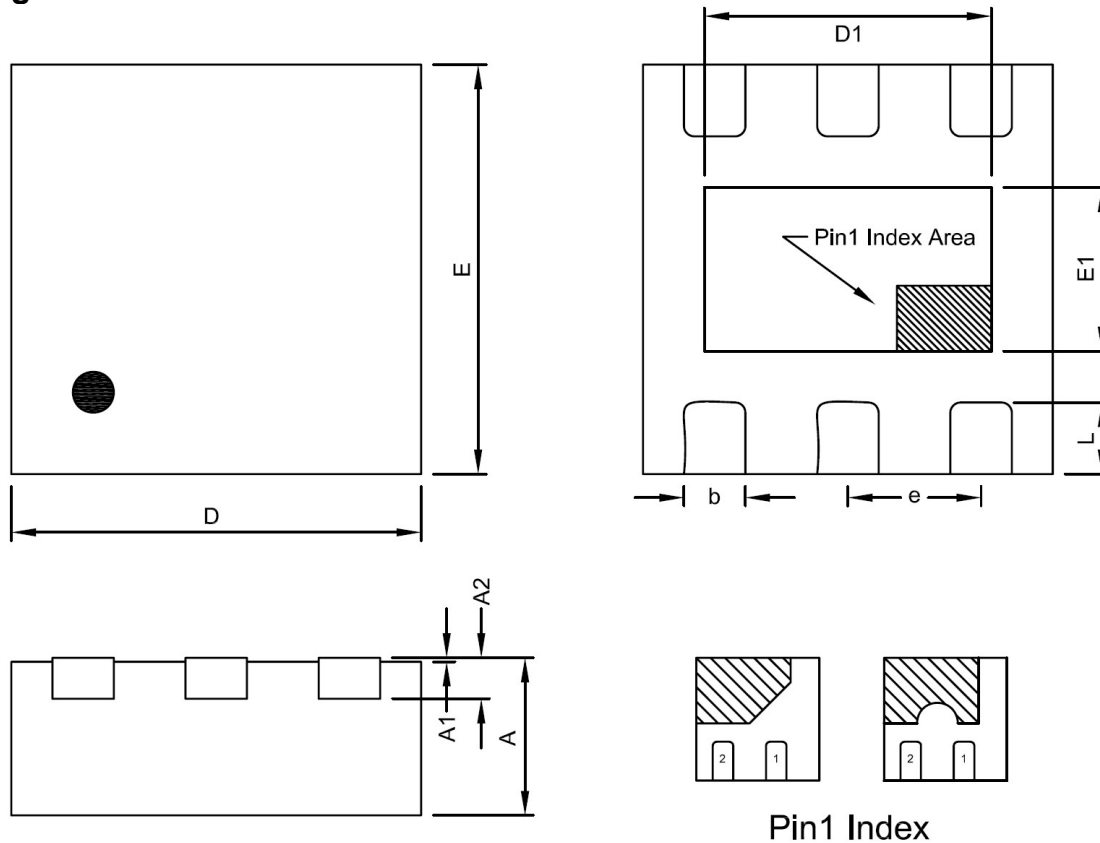
Top Layer



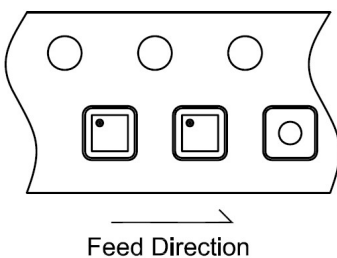
Bottom Layer



EV2176 PCB	Information
Board Material	FR4
Size	43mm×36mm
Board Thickness	1.6mm
Layers	2
Copper Thickness	2 oz.

Package Information

TDFN2X2-6 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	1.15	1.30	1.45	0.0453	0.0512	0.0571
E1	0.55	0.70	0.85	0.0217	0.0276	0.0335
b	0.20	0.30	0.35	0.0079	0.0118	0.0138
e	0.65 BSC			0.0256 BSC		
L	0.30	0.35	0.40	0.0118	0.0138	0.0157

Taping Specification


PACKAGE	Q'TY/REEL
TDFN2X2-6	3,000 ea

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