G2176A

Power -Distribution Switches with Soft Start

Features

- **Wide Supply Voltage Range : 4.5V to 22V**
- **Current Limit Range : 0.3A to 3A**
- **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 G2176A 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.

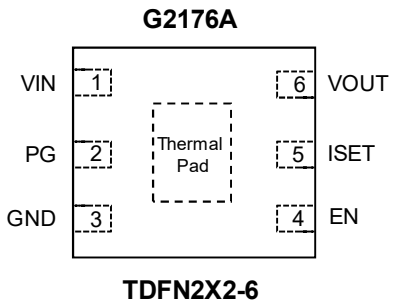
The device integrates some protection features, including current limit protection, over-temperature protection, UVLO and current limit setting. The current limit protection can protect down-stream devices from catastrophic failure by limiting the output current at current limit threshold during over-load 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)
G2176ARB1U	2176A	-40°C to +85°C	TDFN2X2-6

Note: RB: TDFN2X2-6
1: Bonding Code
U: Tape & Reel
Green : Lead Free / Halogen Free

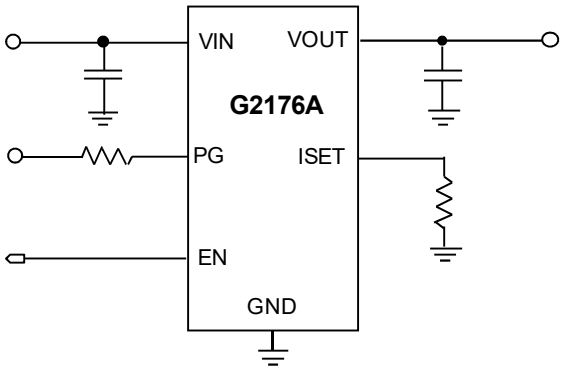
Pin Configuration



TDFN2X2-6

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

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
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.

Thermal Information

THERMAL METRIC		TDFN2x2-6	UNIT
$R_{\theta JA}$	Junction to ambient thermal resistance	63.5	°C/W
$R_{\theta JC\_top}$	Junction to case top thermal resistance	109.5	°C/W
$R_{\theta JB}$	Junction to board thermal resistance	29.3	°C/W
Ψ_{JT}	Junction to top characterization parameter	2.4	°C/W
Ψ_{JB}	Junction to board characterization parameter	29.4	°C/W
$R_{\theta JC\_bot}$	Junction to case bottom thermal resistance	5.4	°C/W

1. Package thermal metric is obtained using the method described in JEDEC specification JESD51-7, using a four-layer board.
2. 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

(VIN=12V, VEN=5V, Typical values are T_A=25°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 and Short Circuit Protections						
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	thd	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

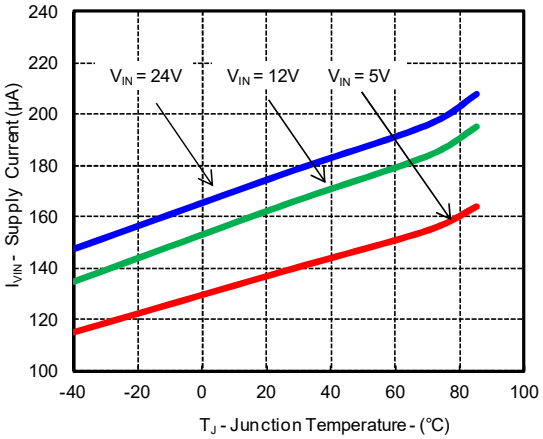
Note

(1) Falling time is guaranteed by calculation and design

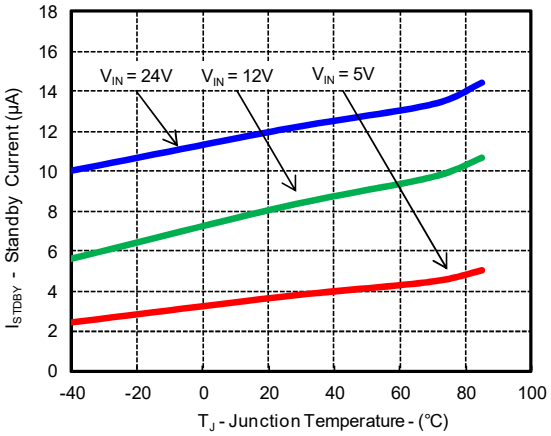
Typical Performance Characteristics

(V_{IN} = 12V, V_{EN} = 5V, T_A = 25°C, unless otherwise noted.)

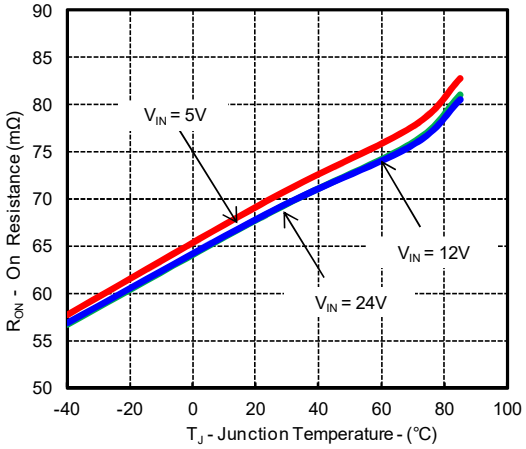
Supply Current VS. Junction Temperature



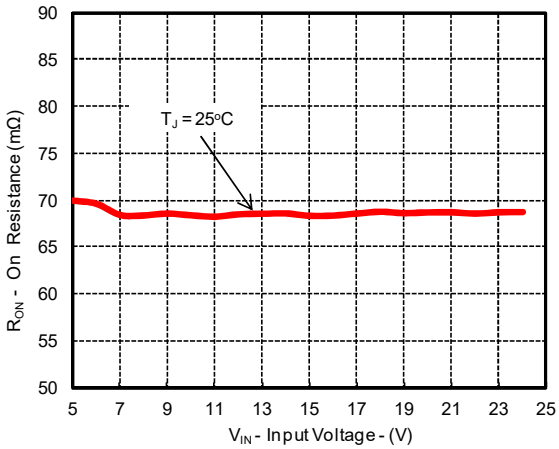
Standby Current VS. Junction Temperature



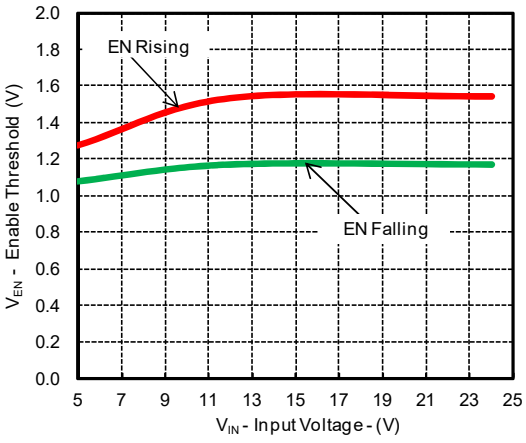
On Resistance VS. Junction Temperature



On Resistance VS. Input Voltage

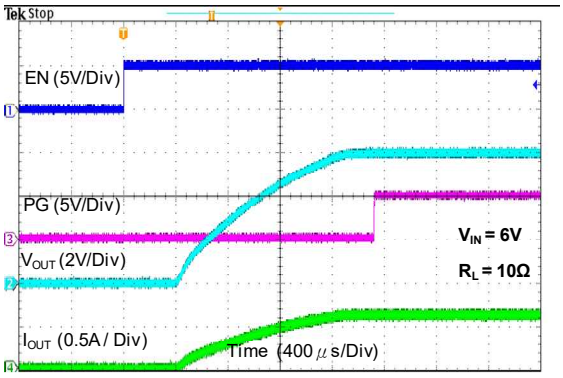


EN Threshold VS. Input Voltage

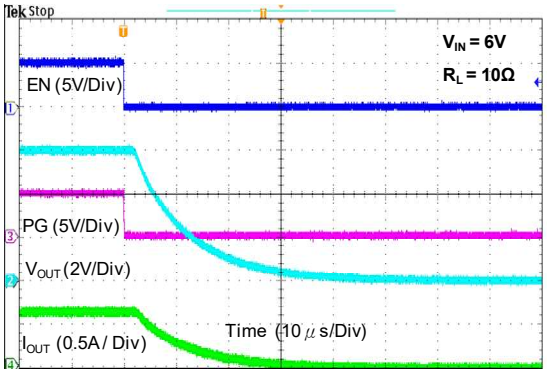


Typical Performance Characteristics (continued)

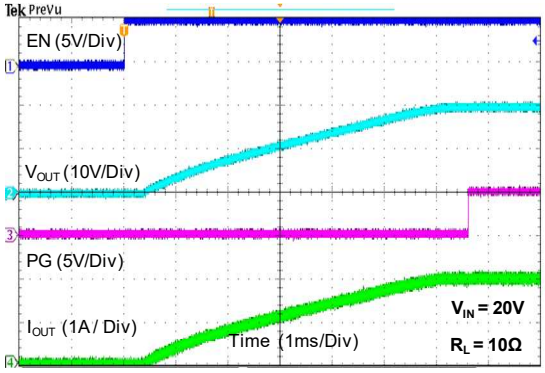
Device Enable



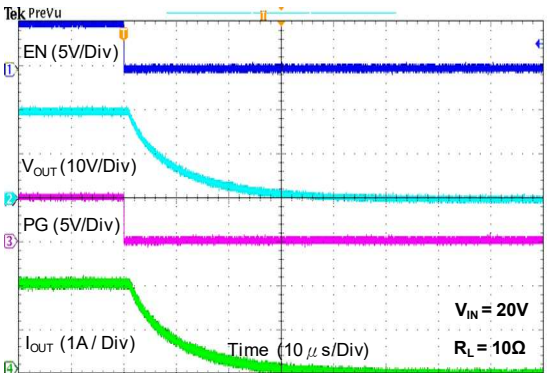
Device Disable



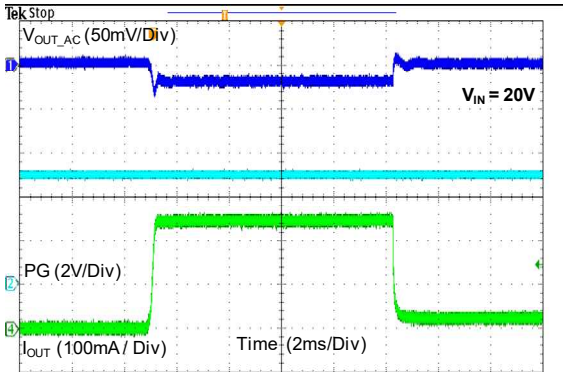
Device Enable



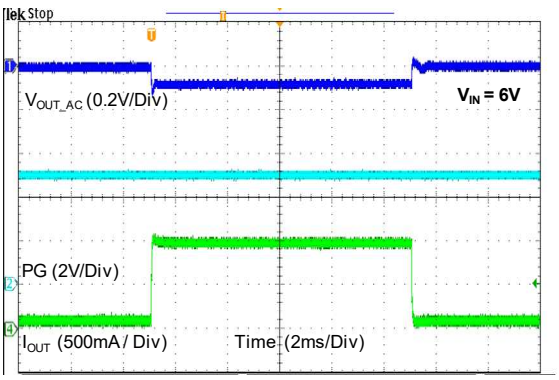
Device Disable



Load Transient Response

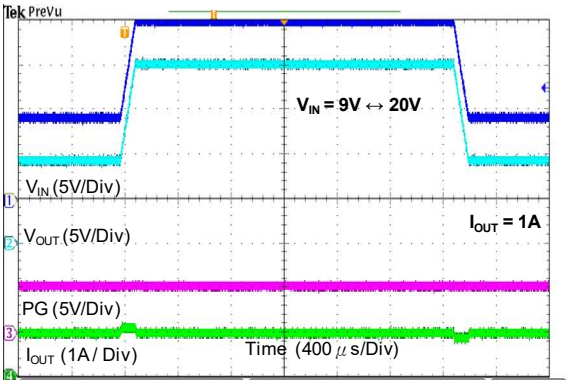


Load Transient Response

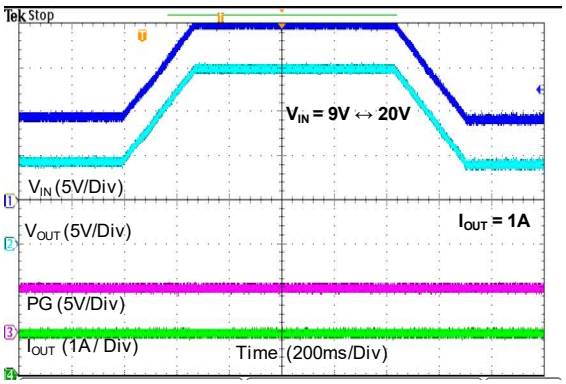


Typical Performance Characteristics (continued)

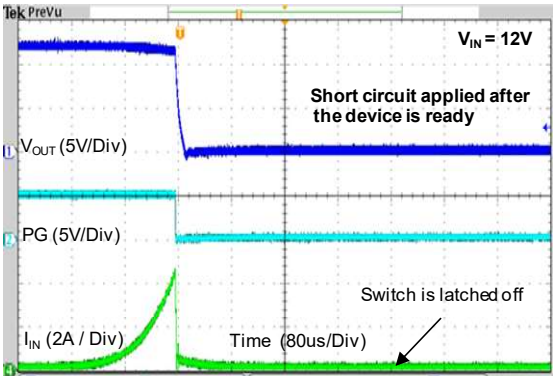
Line Transient Response



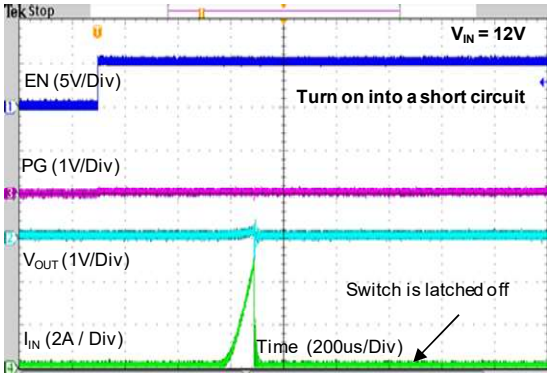
Line Transient Response



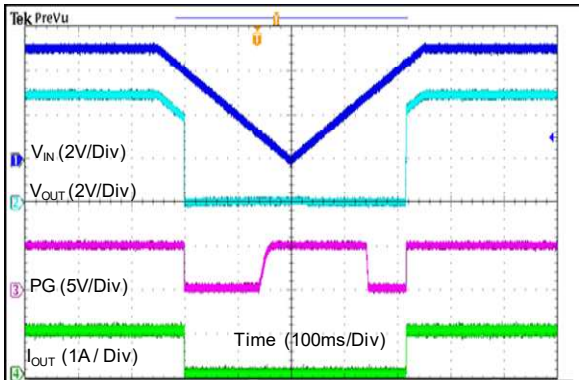
Short Circuit Protection



Short Circuit Protection



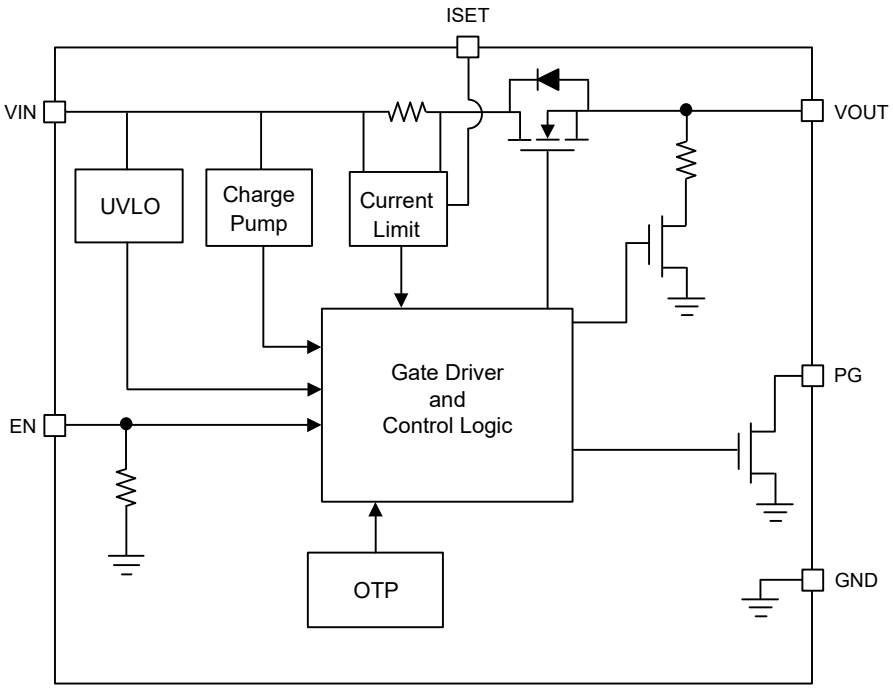
UVLO



Pin Description

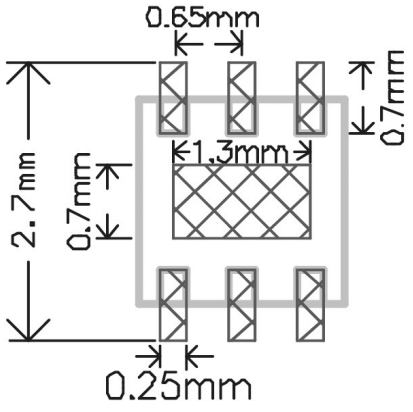
PIN	NAME	FUNCTION
1	VIN	Power Supply Input. Connect this pin to external DC supply.
2	PG	Power Good Pin. Open drain structure, connect a resistor to 5V. When the VOUT reach to VIN voltage and delay 550μs PG in 5V status. when output OC, OT or short circuit PG in pull low status.
3	GND	GND.
4	EN	Enable 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

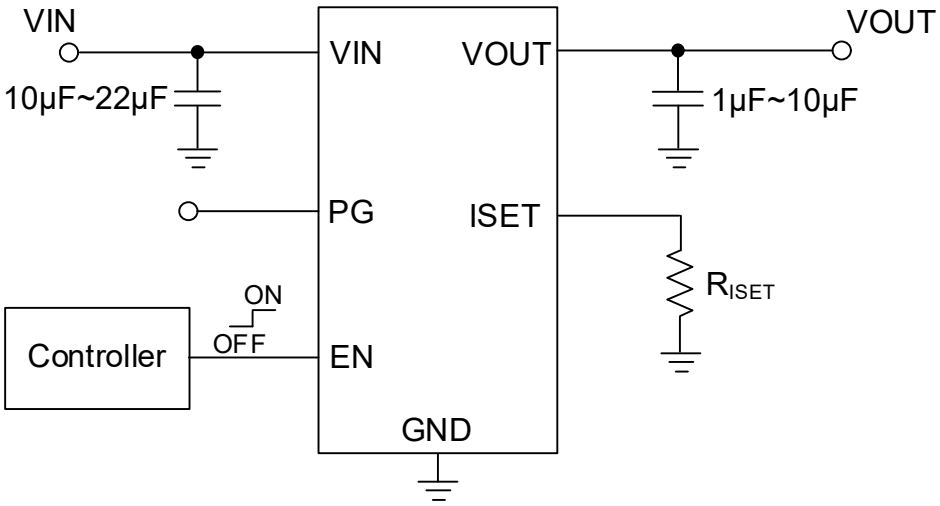


Minimum Footprint PCB Layout Section

TDFN2X2-6



Typical Application Circuit



Function Description

Under-voltage Lockout (UVLO)

The G2176A 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 volt-age 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 G2176A power switch provides the current limit protection function. When the current limit condition persists for more than the deglitch period of 10μs, the IC latches off.

Power-Good

The G2176A provides an indicated power good pin, When the VOUT reach to VIN voltage and delay 550μs PG in 5V status. when output OC, OT or short circuit PG in pull low status.

Enable/Disable

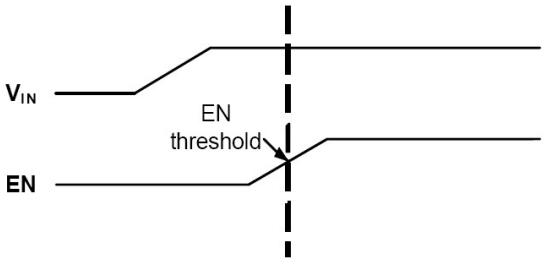
Pull the EN below 0.6V to disable the device and pull EN above 1.6V to enable the device. When the IC is disabled the supply current is reduced to less than 20μA. The en-able input is compatible with both TTL and CMOS logic levels. The EN pin cannot be left floating.

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°C.

Application Information

Power Sequencing



At start-up, it is necessary to ensure that the VIN and EN are sequenced correctly.

Input Capacitor

A 10μF to 22μF MLCC bypass capacitor from VIN to GND, located near the G2176A, 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 1μF to 10μF MLCC between VOUT 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 0.1μF ceramic capacitor improves the immunity of the device to short-circuit transients.

Soft-Start Capacitor

The G2176A 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 VIN 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 G2176A and output capacitors near the load to reduce parasitic resistance and inductance for excel-lent 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

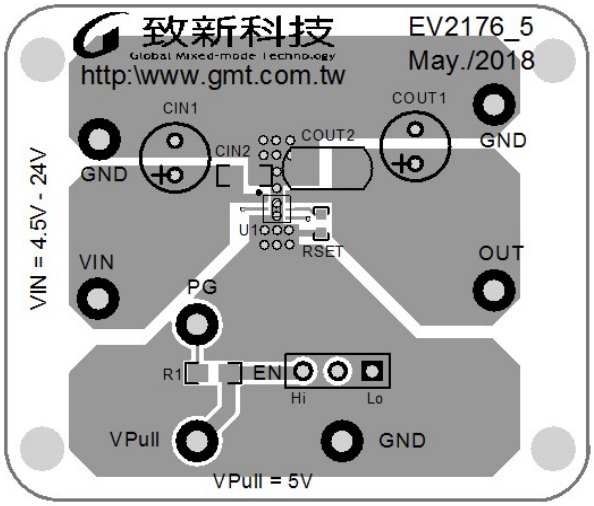
The current limit can be set by connecting resistor from the current limit adjustable pin ISET to ground. The required value of resistor $R_{ISET}(k\Omega)$for current limit(A) is calculated as follows:

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

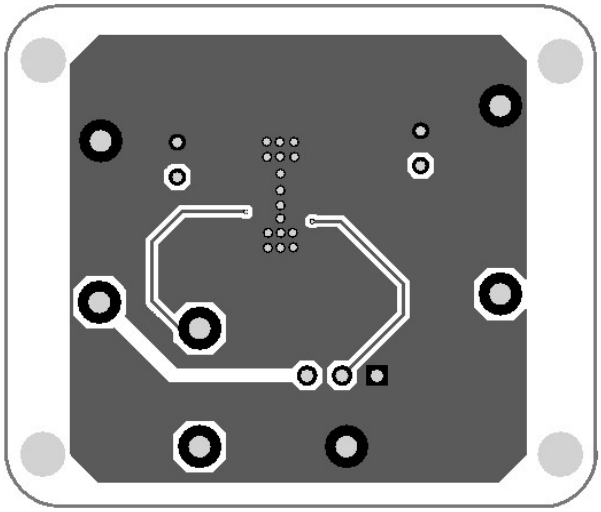
Please note that keeps R_{ISET} in the range between 100kΩ and 1MΩ, otherwise the IC will not work normally.

EV Board PCB Layout Section

Top Layer

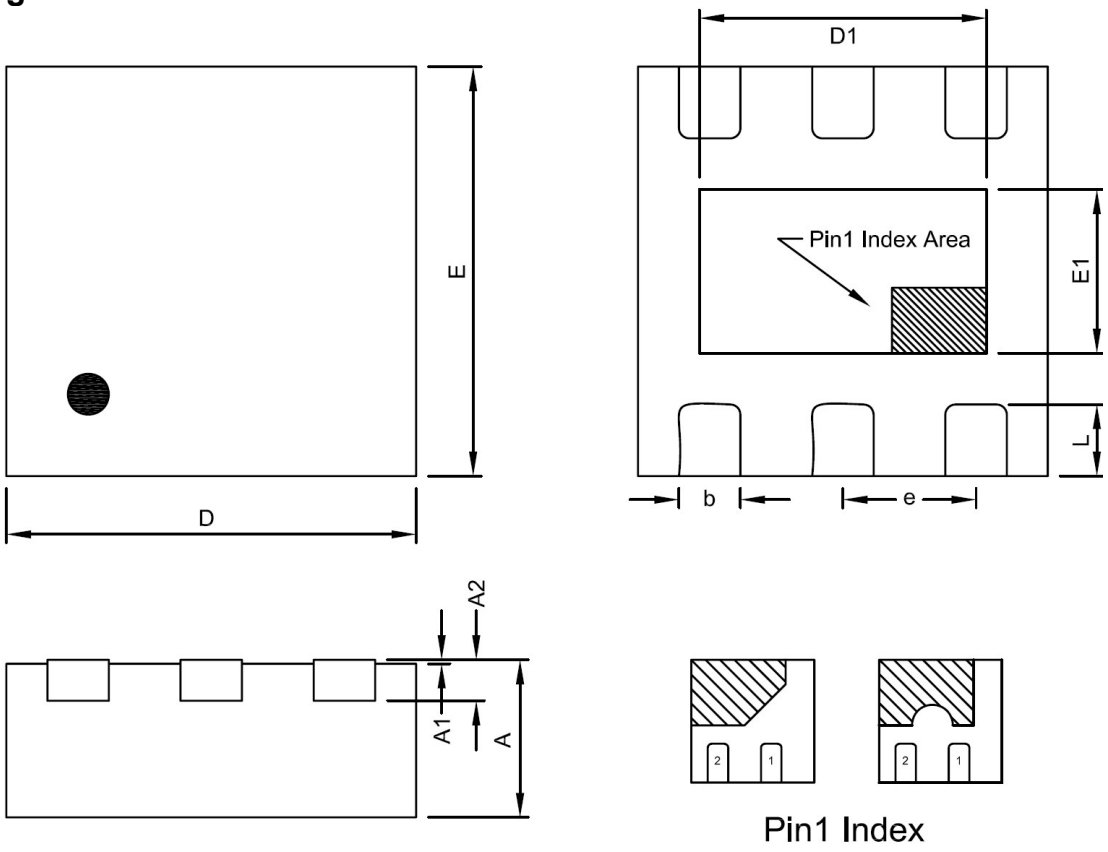


Bottom Layer



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

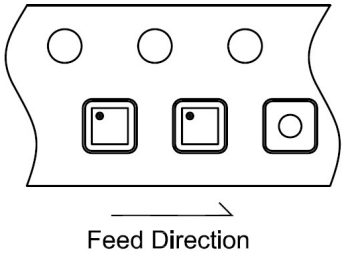
Package Information



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