CBC Microelectronics

(MC2180)
2.5V to 5.5V 60mohm Single Channel High-side Power Switch

MC2180 is 60mohm High-side Power Switch with Enable and Flag, fast short response (1.0us), 2.0ms turn-on time with SOT-23-5 and SOT-23 package.
It is ideally used in USB2.0/3.0, LVDS, HDMI and DP port.

2.5V to 5.5V 70mohm Single Channel High-Side Power Switch

Description

The MC2180 serial products are high-side power switch with 70mohm Rdson, available with 0.5A, 1.0A, 1.5A, 2.0A and 2.5A continuous output capability. They are suitable for 2.8V, 3.0V, 3.3V and 5.0V power rail.

MC2180 has enable pin with selectable active high or low level. It also has selectable discharge feature for output. It has FLAG pin to indicate the chip status, active low with open drain output once OCP or OTP triggered.

MC2180 has very fast short response time, 1.5us to avoid significant large current draw from input.

MC2180 has another important feature – no reverse current from output to input during shutdown.

Available Package: SOT-23-5

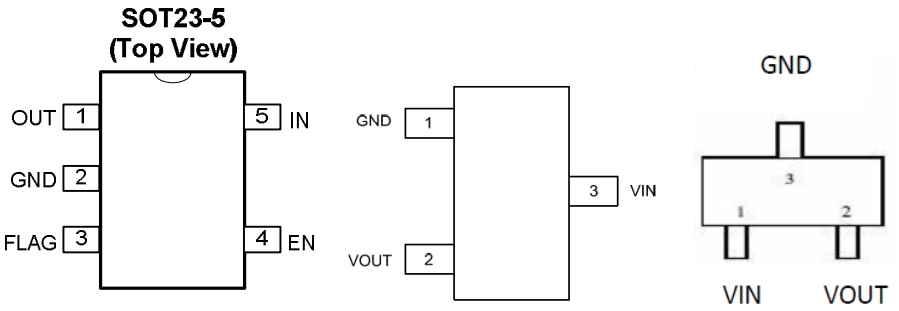
Features

- Integrated high-side Power MOS: 65mohm
- Operation Voltage: 2.5V to 5.5V
- Quiescent Current: 35uA (Typ.)
- Shutdown current: 1.0uA (Max.)
- Enable active level selectable: High/Low
- Shutdown discharge selectable: Yes/No
- Available 5 continuous current versions: 0.5A/1.0A/1.5A/2.0A/2.5A
- Turn-on + rising time: 2.0ms
- Shutdown pull-low resistance: 200ohm
- Fast short response time: 1.5us
- Input UVLO
- OCP, OTP protection and automatic release
- Deglitched FLAG output with open-drain to indicate OCP, Load short, OTP UVLO and OUT-to-IN reverse
- No reverse current after shutdown, power-off

Applications

- Notebook & Ultrabook
- Tablet, PAD
- USB 2.0/3.0 Port, LVDS Port, HDMI Port, DP Port

PIN Configurations



SOT-23-5 (N) SOT-23(S) SOT-23(SR)

Typical Application

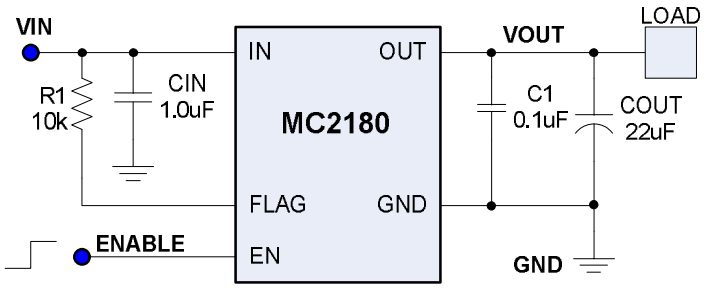


Figure 1: Typical Application of MC2180

Pin description

PIN Name	PIN No.	Description
	SOT-23-5	
IN	5	Power supply input pin, using 1.0uF capacitor to ground
OUT	1	Output pin, using 1.0uF bypass capacitor is enough in most application, if distance is long in layout, please using 10uF or 22uF Capacitor in parallel 0.1uF close to load node
GND	2	Ground
EN	4	Enable pin, active low or high. Must be set high or low, can not be left floating
FLAG	3	Flag output with open drain, active low. Connect a pull-up resistor (10k) to input.

Function Block

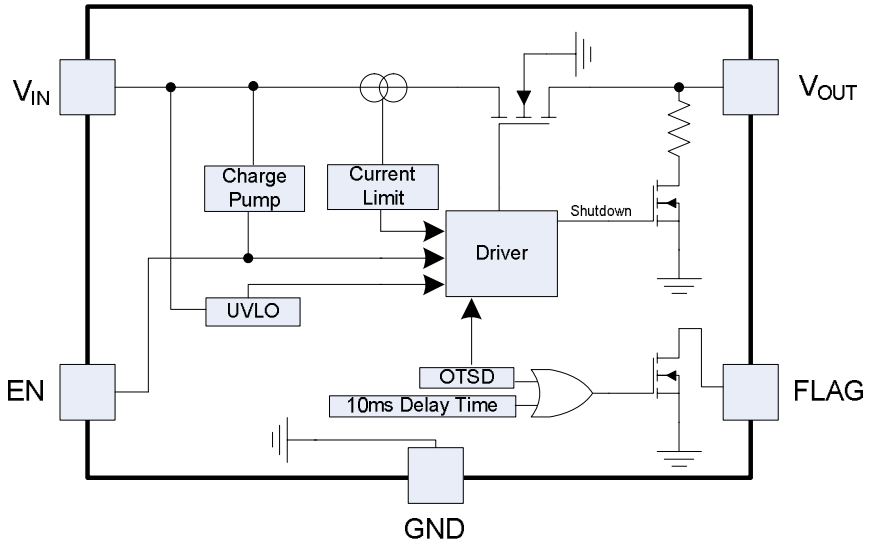
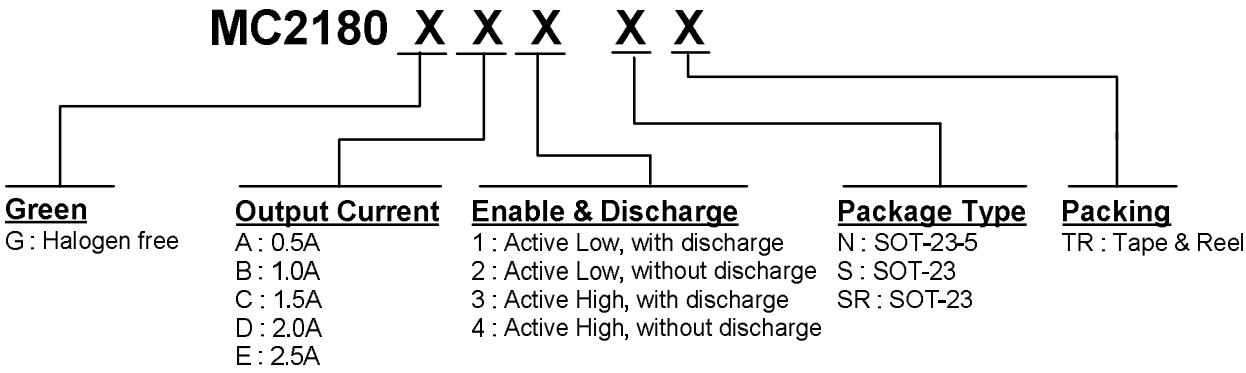


Figure 2. MC2180 function block

Ordering Information



Order PN	Output Current	Enable	Output Discharge	Marking ID	Package	Operation Temperature
MC2180GA1STR	0.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GA2STR	0.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GA3STR	0.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GA4STR	0.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GB1STR	1.0A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GB2STR	1.0A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GB3STR	1.0A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GB4STR	1.0A	Active High	No		SOT-23	-40°C~+85°C
MC2180GC1STR	1.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GC2STR	1.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GC3STR	1.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GC4STR	1.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GD1STR	2.0A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GD2STR	2.0A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GD3STR	2.0A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GD4STR	2.0A	Active High	No		SOT-23	-40°C~+85°C
MC2180GE1STR	2.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GE2STR	2.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GE3STR	2.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GE4STR	2.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GA1SRTR	0.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GA2SRTR	0.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GA3SRTR	0.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GA4SRTR	0.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GB1SRTR	1.0A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GB2SRTR	1.0A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GB3SRTR	1.0A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GB4SRTR	1.0A	Active High	No		SOT-23	-40°C~+85°C
MC2180GC1SRTR	1.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GC2SRTR	1.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GC3SRTR	1.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GC4SRTR	1.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GD1SRTR	2.0A	Active Low	Yes		SOT-23	-40°C~+85°C

MC2180GD2SRTR	2.0A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GD3SRTR	2.0A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GD4SRTR	2.0A	Active High	No		SOT-23	-40°C~+85°C
MC2180GE1SRTR	2.5A	Active Low	Yes		SOT-23	-40°C~+85°C
MC2180GE2SRTR	2.5A	Active Low	No		SOT-23	-40°C~+85°C
MC2180GE3SRTR	2.5A	Active High	Yes		SOT-23	-40°C~+85°C
MC2180GE4SRTR	2.5A	Active High	No		SOT-23	-40°C~+85°C
MC2180GA1NTR	0.5A	Active Low	Yes		SOT-23-5	-40°C~+85°C
MC2180GA2NTR	0.5A	Active Low	No		SOT-23-5	-40°C~+85°C
MC2180GA3NTR	0.5A	Active High	Yes		SOT-23-5	-40°C~+85°C
MC2180GA4NTR	0.5A	Active High	No		SOT-23-5	-40°C~+85°C
MC2180GB1NTR	1.0A	Active Low	Yes		SOT-23-5	-40°C~+85°C
MC2180GB2NTR	1.0A	Active Low	No		SOT-23-5	-40°C~+85°C
MC2180GB3NTR	1.0A	Active High	Yes		SOT-23-5	-40°C~+85°C
MC2180GB4NTR	1.0A	Active High	No		SOT-23-5	-40°C~+85°C
MC2180GC1NTR	1.5A	Active Low	Yes		SOT-23-5	-40°C~+85°C
MC2180GC2NTR	1.5A	Active Low	No		SOT-23-5	-40°C~+85°C
MC2180GC3NTR	1.5A	Active High	Yes		SOT-23-5	-40°C~+85°C
MC2180GC4NTR	1.5A	Active High	No		SOT-23-5	-40°C~+85°C
MC2180GD1NTR	2.0A	Active Low	Yes		SOT-23-5	-40°C~+85°C
MC2180GD2NTR	2.0A	Active Low	No		SOT-23-5	-40°C~+85°C
MC2180GD3NTR	2.0A	Active High	Yes		SOT-23-5	-40°C~+85°C
MC2180GD4NTR	2.0A	Active High	No		SOT-23-5	-40°C~+85°C
MC2180GE1NTR	2.5A	Active Low	Yes		SOT-23-5	-40°C~+85°C
MC2180GE2NTR	2.5A	Active Low	No		SOT-23-5	-40°C~+85°C
MC2180GE3NTR	2.5A	Active High	Yes		SOT-23-5	-40°C~+85°C
MC2180GE4NTR	2.5A	Active High	No		SOT-23-5	-40°C~+85°C

Note 1

Based on ROHS Y2012 spec, Halogen free can cover Lead free, so for most package types MicroAudio does only product Halogen free products instead of lead free products.

Absolute Maximum Ratings (Note 2)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN} to GND	-0.5 to 6.0	V
Input Voltage for Enable	V_{EN} to GND	-0.5 to 6.0	V
Operation junction temperature	T_J	150	ºC
Storage temperature Range	T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10 Seconds)	T_{LEAD}	260	ºC
Thermal Resistance junction to ambient (Note 2)	SOT23-5	250	ºC/W
ESD MM	ESD_{MM}	400	V
ESD HBM	ESD_{HBM}	4000	V
ESD CDM	ESD_{CDM}	1000	V

Note 2

1. *Stresses greater than 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 Ratings" for extended periods may affect device reliability.*
2. *Using 2oz dual layer (Top, Bottom) FR4 PCB with 4x4 mm^2 cooper as thermal PAD*

Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	2.5 ~ 5.5	V
Ambient Operation Temperature Range	T_A	-40 ~ +85	°C

Electrical Characteristics (Note 3)

Test Condition: C_{IN} = C_{OUT} = 1.0uF, V_{IN}=5.0V, R_L = 10Ω, C_L = 4.7uF unless otherwise specified, all limits are test at T_A=25°C, and bold type is limited at T_A= -40 to 85°C.

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage		V_{IN}		2.5		5.5	V
Input Under Voltage Lock-out		V_{UVLO}		1.8	2.1	2.4	V
Under Voltage Lock-out Hysteresis Voltage		V_{UVLOHY}			0.2		V
Switch ON Resistance		R_{DSON}	V_{IN} = 5.0V, I_{OUT} = 1.0A		65	90	mΩ
			V_{IN} = 3.3V, I_{OUT} = 1.0A		65	90	mΩ
Quiescent Current		I_Q	V_{IN} = 5.0V		40	70	uA
			V_{IN} = 3.3V		35	60	uA
Shutdown Current		$I_{SHUTDOWN}$			0.1	1.0	uA
Current Limit	MC2180A(0.5A)	I_{LIMIT}	V_{OUT} = 4.0V	0.7	1.0	1.3	
	MC2180B(1.0A)		V_{OUT} = 4.0V	1.1	1.5	1.9	A
	MC2180C(1.5A)		V_{OUT} = 4.0V	1.6	2.2	2.8	A
	MC2180D(2.0A)		V_{OUT} = 4.0V	2.1	2.6	3.2	A
	MC2180E(2.5A)		V_{OUT} = 4.0V	2.6	3.2	3.8	A
Fold-back short current	MC2180A(0.5A)	I_{SHORT}	V_{OUT} = 0V		0.7		A
	MC2180B(1.0A)		V_{OUT} = 0V		1.0		A
	MC2180C(1.5A)		V_{OUT} = 0V		1.5		A
	MC2180D(2.0A)		V_{OUT} = 0V		1.8		A
	MC2180E(2.5A)		V_{OUT} = 0V		2.2		A
Leakage Current (Vin to Vout)		$I_{LEAKAGE}$	Disable EN pin, V_{OUT} = 0V		0.1	1.0	uA
Reverse Current (Vout to Vin)		$I_{REVERSE}$	Disable EN pin, V_{OUT} > V_{IN}		0.1	1.0	uA
Enable Active High Voltage		V_{ENH}		1.5		5.5	V
Enable Active Low Voltage		V_{ENL}		0		1.0	V
Enable pin input current (Note 3)		I_{EN}	Force 0V to 5.5V at EN pin	-1.0		1.0	uA
Output pull-low resistor		R_{PULL}	with discharge device		200	300	Ω
Output turn-on + rising time		t_{ON}	From EN active to output rising 90%, V_{IN} = 5.0V, R_L = 10	1.0	2.0	3.0	ms
FLAG response delay time		t_{FLAG_D}	From OCP trigger to FLAG active	5.0	10.0	15.0	ms
FLAG pin output voltage		V_{FLAG}	FLAG active, I_{SINK} = 5mA		0.5	1.0	V
FLAG pin leakage		I_{FLAG_L}	FLAG disable, force 5.0V		0.1	1.0	uA
Load short response time		t_{SHORT}			1.5		us
Out to In reverse trigger voltage		V_{OIR}	Enable active, (V_{OUT} - V_{IN})		20	50	mV
Out to In reverse deglitch time		t_{OIR}	Enable active, Duration time		5	10	ms
Out to In reverse trigger current		I_{OIR}	Enable active, From output to input		200	500	mA
Out to In reverse current after trigger		I_{OIRT}	output to input leakage after trigger		2.0		uA
Thermal shutdown temperature		T_{OTP}			140		℃
Thermal shutdown hysteresis		T_{HY}			20		℃
Thermal resistance (junction-case)		θ_{JC}	SOT-23-5		20		℃/W

Note 3:

1. *All devices are 100% production tested at T_A = +25°C; all specifications over the automotive temperature range is guaranteed by design, not production tested. Parameter is guaranteed by design.*
2. *No parasitic diode between EN pin and VIN pin.*

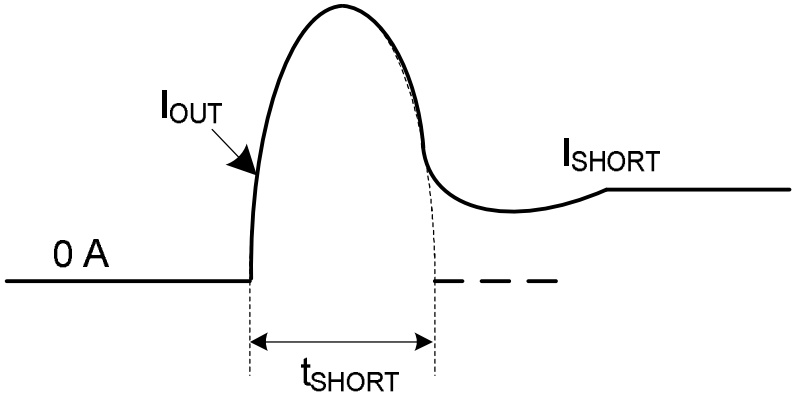
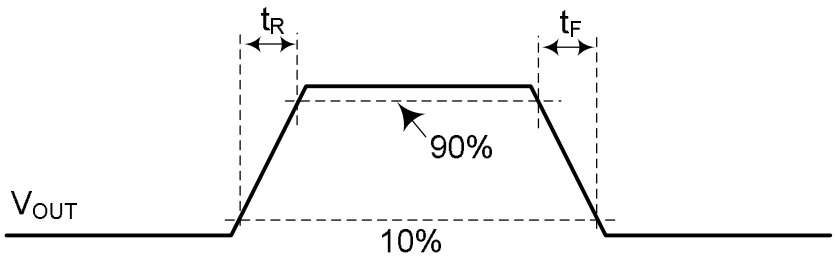
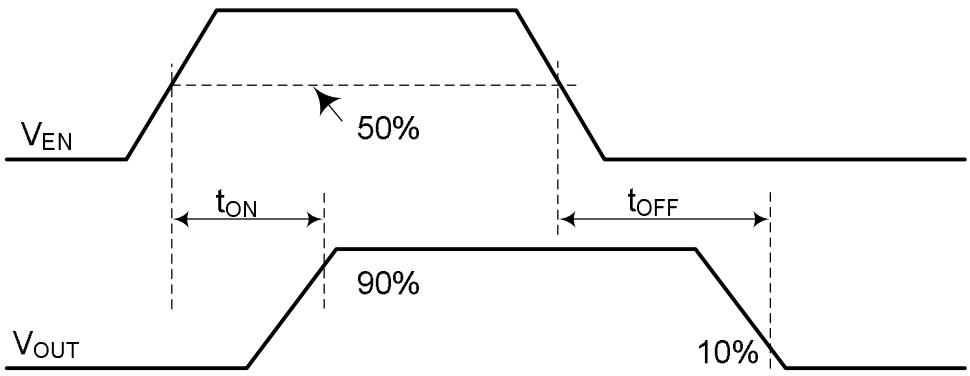


Figure 3. output short response time



t_R – output rising time
t_F – output falling time



t_{ON} – the time from 50% of Enable rising to 90% of Vout rising edge
t_{OFF} – the time from 50% of Enable falling to 10% of Vout falling edge

Figure 4. turn-on/off and rising/falling time

Characteristics

Figure-5 Quiescent current vs. supply voltage (room/high/low temperature)

Figure-6 Quiescent current vs. temperature (3.3V/5.0V)

Figure-7 Enable active voltage vs. temperature (VIN=3.3V/5.0V)

Figure-8 Enable active voltage vs. input voltage (T=25)

Figure-9 UVLO voltage vs. temperature (rising/falling)

Figure-10 UVLO voltage vs. input voltage (rising/falling)

Figure-11 Rdson vs. input voltage (room/high/low)

Figure-12 Rdson vs. Temperature (3.0V/3.3V/5.0V)

Figure-13 short current vs. input voltage (T=25)

Figure-14 short current vs. Temperature (3.0V/3.3V/5.0V)

Figure-15 output voltage vs. output current (A, 3.3V/5.0V, room/high/low)

Figure-16 output voltage vs. output current (B, 3.3V/5.0V, room/high/low)

Figure-17 output voltage vs. output current (C, 3.3V/5.0V, room/high/low)

Figure-18 output voltage vs. output current (D, 3.3V/5.0V, room/high/low)

Figure-19 Current limit vs. temperature (VIN=3.3V/5.0V)

Figure-20 flag deglitch time vs. input voltage (room/high/low)

Figure-21 shutdown current vs. input voltage (room/high/low)

Figure-22 shutdown current vs. temperature (3.3V/5.0V)

Figure-23 Reverse current vs. input voltage (room/high/low)

Figure-24 Reverse current vs. Temperature (3.3V/5.0V)

Figure-25 turn-on and rising time (3.3V, 1.0uF, No Load/10ohm)

Figure-26 turn-on and rising time (5.0V, 1.0uF, No Load/10ohm)

Figure-27 turn-off and falling time (3.3V, 1.0uF, No Load/10ohm)

Figure-28 turn-off and falling time (5.0V, 1.0uF, No Load/10ohm)

Figure-29 inrush current with resistance load (3.3V, 1.0uF, 1.6ohm)

Figure-30 inrush current with resistance load (5.0V, 1.0uF, 1.6ohm)

Figure-31 inrush current with capacitance load (3.3V, 4700uF, 10ohm)

Figure-32 inrush current with capacitance load (5.0V, 4700uF, 10ohm)

Figure-33 thermal shutdown (3.3V, 1.0uF, 1.0ohm, EN/VO/IN/FLAG)

Figure-34 thermal shutdown (3.3V, 1.0uF, 1.0ohm, EN/VO/IN/FLAG)

Figure-35 UVLO at rising (3.3V, 5.0V)

Figure-36 UVLO at falling (3.3V, 5.0V)

Figure-37 inrush short response (5.0V, VIN, VOUT, IOUT)

Figure-38 short response at power-on (5.0V, VIN, VOUT, IOUT, EN, FLAG)

Figure-39 short response at power-up(5.0V, VIN, VOUT, IOUT, EN, FLAG)

Figure-40 short response at power-up(3.3V, VIN, VOUT, IOUT, EN, FLAG)

Figure-41 reverse voltage protection response(3.3V, VIN, VOUT, IOUT, EN, FLAG)

Figure-42 reverse voltage protection response(5.0V, VIN, VOUT, IOUT, EN, FLAG)

Figure-43 reverse voltage recovery response(3.3V, VIN, VOUT, IOUT, EN, FLAG)

Figure-44 reverse voltage recovery response(5.0V, VIN, VOUT, IOUT, EN, FLAG)

Function Descriptions

Input and Output

IN (input) is the chip power supply connection to the logic circuit and the drain of the power MOSFET. OUT (output) is the source of the power MOSFET. In a typical application, current flows through the switch from IN to OUT. Both OUT pins must be connected together to the load.

Thermal Shutdown

Thermal shutdown protects MC2180 from excessive power dissipation. If the die temperature exceeds 140°C, the MOSFETS is turned-off and turn-on again once the die temperature drops to 120°C. Thermal shutdown circuit functions only when the device is enabled.

UVLO

UVLO (under-voltage-lockout) prevents the power MOSFET from turning-on until input voltage exceeds 2.1V (Typ.). If the input voltage drops below 2.1V (Typ.), UVLO feature turns-off the power MOSFET.

Over Current Trigger Point and Fold-back Load short

The MC2180 has 5 versions to offer 0.5A, 1.0A, 1.5A, 2.0A and 2.5A output current continually, and typical over current trigger point is 1.0A, 1.5A, 2.2A, 2.6A and 3.2A respectively. Also once load is short to ground, output current is limited typically at 0.7A, 1.0A, 1.5A, 1.8A and 2.2A respectively with fold-back. See below table.

Part No.	Output continuous current (A)	Current Limit or Over current Trigger			Fold-back load short current
		Min.	Typ.	Max.	
MC2180A	0.5	0.7	1.0	1.3	0.7
MC2180B	1.0	1.1	1.5	1.9	1.0
MC2180C	1.5	1.6	2.2	2.8	1.5
MC2180D	2.0	2.1	2.6	3.2	1.8
MC2180E	2.5	2.6	3.2	3.8	2.2

Output Reverse-Voltage Protection

The output reverse-voltage protection turns off the power MOSFET whenever the output voltage is higher than the input voltage by 20mV (typ) with duration 5ms (typ) and the MOSFET switch will turn on when output reverse-voltage condition is removed.

FLAG Function

The FLAG is output to indicate over current or over temperature, it is active low with open-drain output. when an over current condition is encountered after 10 ms deglitch timeout. The output remains asserted until the over-current condition is removed. Over temperature condition is also reported immediately, FLAG is also asserted (active low) in output reverse-voltage condition with typical 5ms deglitch timeout period until the output reverse-voltage condition is removed.

Applications Information

Supply Filtering

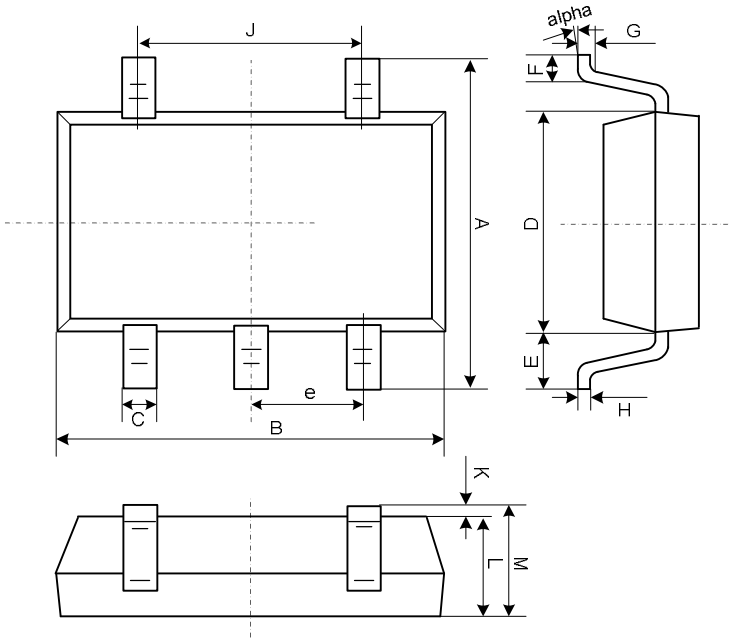
A 1μF bypass capacitor from IN to GND, close to the MC2180 is strongly recommended to depress supply transients. Without a bypass capacitor, an output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry. Input transients must not exceed the absolute maximum supply voltage (6.0V) even for a short duration.

Enable

EN must be driven logic high or logic low for a clearly defined input. Floating the input may cause unpredictable operation. EN should not be allowed to go negative voltage comparison to GND. There is no parasitic ESD Diodes between EN and VIN.

Package Outline Dimensions

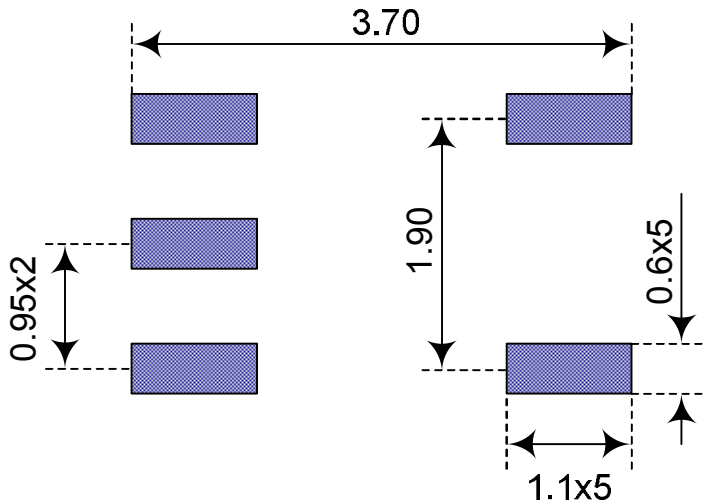
SOT23-5 Unit (mm)



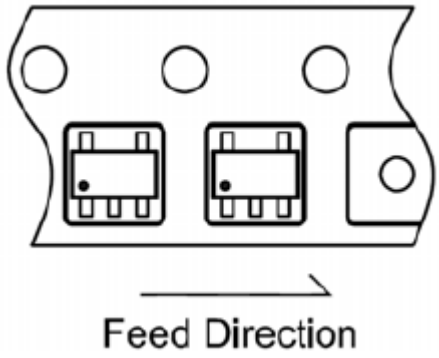
Symbol	Min.	Max.
A	2.65	2.95
B	2.82	3.02
C	0.30	0.40
D	1.50	1.70
F	0.30	0.60
H	0.10	0.20
K	0.00	0.15
L	0.90	1.30
M	1.10	1.45
J	1.80	2.00
alpha	0.0°	8.0°
e	0.95	
E	0.70	
G	0.20	

Recommended PAD Layout Pattern

SOT-23-5 Unit (mm)



Taping Specification



Package Type	Reel size	Quantity/Reel
SOT-23-5	13”	3,000

2.5V to 5.5V 70mohm Single Channel High-Side Power Switch

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