Dual USB Power Control Switch with Over-Current/Voltage Protection

MIK3526M-H/L   June 2001 –revised November 2001

Description

The MIK3526M is a dual integrated high-side power switch with independent enable and flag functions, optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. The MIK3526M satisfies the following USB requirements: each switch channel supplies up to 100 mA; the switch's low on-resistance meets USB voltage drop requirements; fault current is limited to typically 250mA, and a flag output is available to indicate fault conditions to the local USB controller. Additional features include thermal shutdown to prevent catastrophic switch failure from high-current loads, undervoltage lockout (UVLO) to ensure that the device remains off unless there is a valid input voltage present, and 3.3V and 5V logic compatible enable inputs. The MIK3526M is available in active-high and active-low versions in 8-pin DIP and SOIC packages.

Features

- 2 independent switches
- Individual open-drain fault flag pins
- 2.7V to 5.5V input
- 100mA continuous load current per port
- 500mΩ maximum on-resistance
- 1µA Maximum Standby Supply Current
- Thermal shutdown
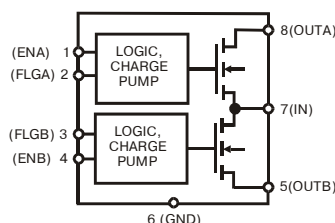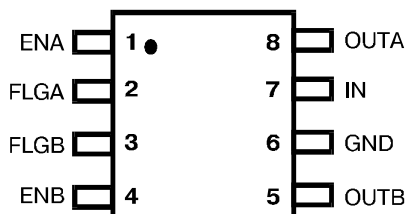- Undervoltage lockout (UVLO)
- Active-high or active-low enable versions

Applications

- USB Power Management
- Hot plug-in power supplies
- Battery - Charger circuits

Ordering Information

Part Number	Enable	Temperature Range
MIK3526M-H	Active High	-40°C to +85°C
MIK3526M-L	Active Low	-40°C to +85°C

Pin configuration MIK3526M–X

Pin Description

Pin Number	Pin Name	Pin Function
1, 4	EN(A/B)	Enable (Input): Logic-compatible enable input. High input > 2.1V typical. Low input <1.9V typical (H active high, L active low).
2, 3	FLG(A/B)	Fault Flag (Output): Active-low, open-drain output. Indicates overcurrent, and thermal shutdown, UVLO, OVLO.
6	GND	Ground.
7	IN	Supply Input: Output MOSFET drain. Also supplies IC's internal circuitry.
8, 5	OUT(A/B)	Switch Output: Output MOSFET source. Typically connect to switched side of load.

Detailed description

Power switch
The power switch is an N-channel MOSFET with a maximum on-state resistance of 500 mΩ (V_{IN}=5V). The power switch supplies a minimum of 100 mA per switch.

Enable (EN or EN)
The logic enable disables the power switch and the bias for the charge pump, driver, and other circuitry to reduce the supply current to less than 1µA when a logic high is present on EN (MIK3526M-L) or a logic low is present on EN (MIK3526M-H). The enable input is compatible with both TTL and CMOS logic levels.

Driver
The driver controls the gate voltage of the power switch. To limit large current surges the driver incorporates circuitry that controls the rise times and fall times of the output voltage.

Charge pump
An internal charge pump supplies power to the driver circuit and provides the necessary voltage to pull the gate of the MOSFET above the source.

Fault Flag FLG (A/B)
FLG is an N-channel, open-drain MOSFET output. The fault-flag is active (low) for one or more of the following conditions: undervoltage, current limit, or thermal shutdown. The flag output MOSFET is capable of sinking a 10 mA load to typically 100mV above ground. Multiple FLG pins may be "wire NORed" to a common pull-up resistor.

Thermal shutdown
An internal thermal-sense circuit shuts off the power switch when the junction temperature rises to approximately 150$^{°}$C. Hysteresis is built into the thermal sense circuit.

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Current sense (CS)

A sense FET monitors the current supplied to the load. When an overload or short circuit is encountered, the current-sense circuitry sends a control signal to the driver. The driver in turn reduces the gate voltage and sends the power FET into its saturation region, which switches the output into a constant current mode.

Undervoltage lockout

UVLO (undervoltage lockout) prevents the output MOSFET from turning on until V_{IN} exceeds approximately 2.3V. In the undervoltage state, the FLAG will be low. After the switch turns on, if the voltage drops below approximately 2.1V, UVLO shuts off the output MOSFET and signals fault flag. Undervoltage detection functions only when at least one switch is enabled.

Overvoltage lockout

OVLO (overvoltage lockout) prevents the output MOSET from turniny on if V_{IN} exeeds approximately 6.5V. Overvoltage detection functions only when at least one switch is enabled.

Absolute Maximum Ratings (Note1)

Parameter	Maximum	Units
Supply Voltage (V_{IN})	6	V
Fault Flag Voltage (V_{FLG})	6	
Fault Flag Current (I_{FLG})	50	mA
Output Voltage (V_{OUT})	6	V
Output Current (I_{OUT})	Internally Limited	A
Control input (V_{EN})	-0.3 to 12	V
Storage Temperature (T_S)	-65 to 150	^{0}C

Operating Ratings (Note 2)

Parameter	MIK3526M
Supply Voltage (V_{IN})	2.7V to 5.5V
Ambient Operating Temperature (T_A)	-40^0C to $+85^0$C

Electrical Characteristics

TA = 25oC, VIN = +5V; unless noted

| Parameter	Condition	Min	Typ	Max	Units
Supply Current	Note 3, switch off, OUT = open,		0.5	1	μA
	Note 3, all switches on, OUT = open,		120	200	
Enable Input Threshold	Low-to-high transition		2.1	2.4	V
	High-to-low transition, Note 3	0.8	1.9		
Enable Input Current	V_{EN}= 0V ÷ 5.5V	-0.5	±0.01	0.5	μA
Enable Input Capacitance			1		pF
Switch Resistance	V_{IN}= 5V, I_{OUT}=100mA , each switch		400	500	mΩ
	V_{IN}= 3,3V, I_{OUT}=100mA , each switch		500	600	
Output Turn-On Delay	R_L=10 Ω, each output		0.5		ms
Output Turn-On Rise Time	R_L=10 Ω, each output		1		ms
Output Turn off Delay	R_L=10 Ω, each output		1	20	μs
Output Turn off Fall Time	R_L=10 Ω, each output		1	20	μs
Output Leakage Current	each output (output disabled)			10	μA
Continuous Load Current	each output	0.1			A
Short-Circuit Current Limit	each output (enable into load) V_{OUT}=4.0V	0.1	0.25	0.5	A
	each output (enable into load) V_{OUT}=0.1V		0.25	0.5	
Current-Limit Threshold	Ramped load applied to enabled output, $V_{OUT} \leq 4.0$ V		0.35	0.55	A
Over temperature Shutdown Threshold	T_J increasing		135		°C
	T_J decreasing		125		
Error Flag Output Resistance	V_{IN}=5,0V, I_L=10mÀ		10	25	Ω
	V_{IN}=3,3V, I_L=10mA		11	35	
	V_{IN}=2,7V, I_L=10mA		12	40	
Error Flag Off Current	V_{FLAG}=5 V		0.01	1	μA
UVLO Threshold	V_{IN} increasing		2.3		V
	V_{IN} decreasing		2.1		
OVLO Threshold	V_{IN} increasing		6.5		V
	V_{IN} decreasing		6.3		

Note 1: Exceeding the absolute maximum rating may damage the device.
Note 2: The device is not guaranteed to function outside its operating rating.
Note 3: Off is ≤ 0.8V and on is ≥ 2.4V for the MIK3526M-H. Off is ≥ 2.4V and on is ≤ 0.8V for the MIK3526M-L. The enable input has approximately 200mV of hysteresis.

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Block Diagram
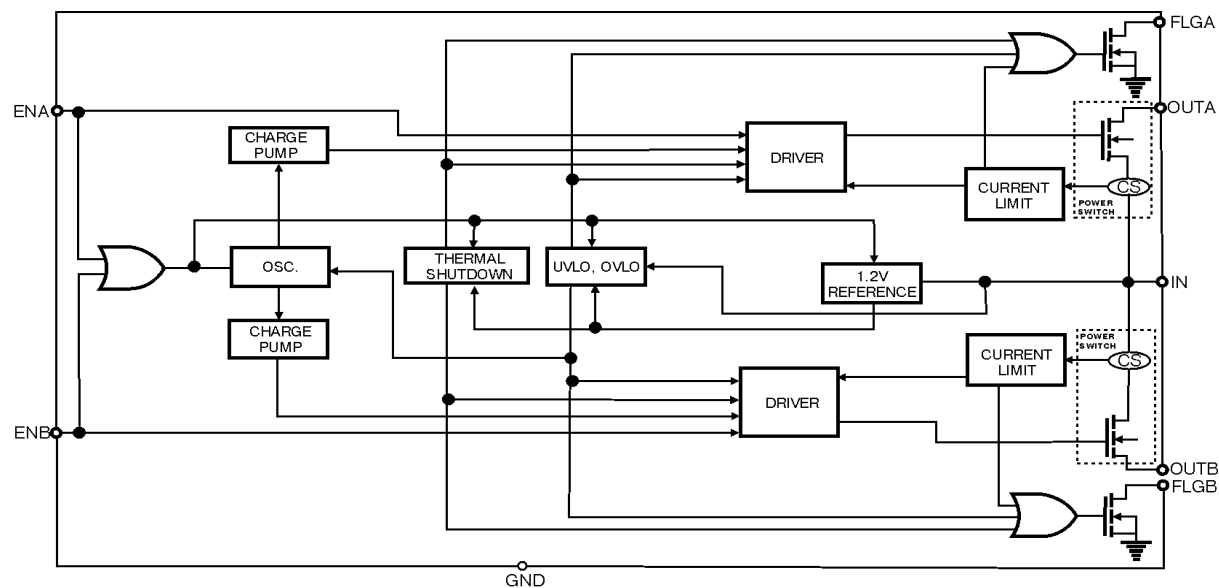
PAD LOCATION MIK3526M
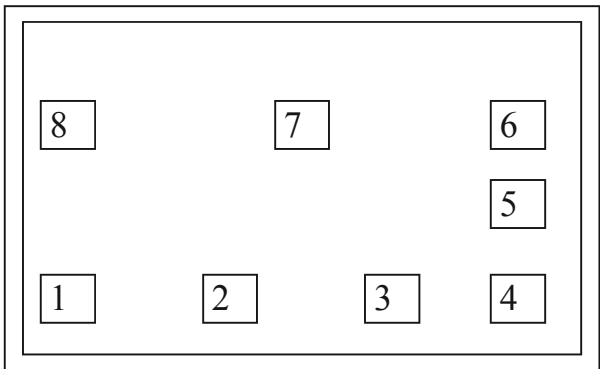
Chip size 3.3 x 1.15 mm

Pad Location Coordinates

N	Pad Name	Pad size (μm x μm)	Coordinates, μm	
			X	Y
1	ENA	136 x 120	323.5	220
2	FLGA	140 x 130	1111.5	237.5
3	FLGB	140 x 130	2187.5	237.5
4	ENB	136 x 120	2975.5	220
5	OUTB	140 x 180	3079	732
6	GND	140 x 130	3079	958
7	IN	140 x 210	1650	900.5
8	OUTA	140 x 180	220	732