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MAX16984

Automotive High-Current Step-Down Converter with USB Protection/Host Charger Adapter Emulator

General Description

The MAX16984 combines a 5V automotive-grade step-down converter capable of driving up to 2.5A, a USB host charger adapter emulator, and USB protection switches for automotive USB host applications. The USB protection switches provide high-ESD, short-circuit protection and feature integrated host-charger port-detection circuitry adhering to the USB 2.0 Battery Charging Specification BC1.2 battery charging specification and Chinese Telecommunication Industry Standard YD/T 1591-2009. They also include circuitry for iPod®/iPhone® 1.0A and iPad® 2.1A dedicated charging modes. The HVD+ and HVD- ESD protection features include protection to ±15kV Air/±8kV Contact on the HVD+ and HVD- outputs to the IEC 61000-4-2 model and 330Ω, 330pF ESD model.

The high-efficiency step-down DC-DC converter operates from a voltage up to 28V and is protected from load dump transients up to 42V. The device is optimized for high-frequency operation and includes resistor-programmable frequency selection from 220kHz to 2.2MHz to allow optimization of efficiency, noise, and board space based on application requirements. The converter has an internal high-side n-channel switch and uses a low forward-drop freewheeling Schottky diode for rectification. There is a small lowside n-channel switch to maintain fixed frequency under light loads. For lower quiescent current operation requirements, the low side n-channel switch can be disabled to allow skip mode operation under light loads. The converter can deliver up to 2.1A of continuous current at 105°C. The MAX16984S has an integrated spread-spectrum oscillator to improve EMI performance.

The MAX16984 also includes a USB load current-sense amplifier and configurable feedback adjustment circuit designed to provide automatic USB voltage adjustment to compensate for voltage drops in captive cables associated with automotive applications. The MAX16984 limits the USB load current using both a fixed internal peak current threshold of the DC-DC converter and a user-configurable external USB load current-sense amplifier threshold.

***Ordering Information* and *Typical Operating Circuit* appear at end of data sheet.**

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Features

- **High-Efficiency DC-DC Controller**
  - **4.5V to 28V (42V Load Dump) Operating Voltage**
  - **5V, 2.5A Output Current Capability**
  - **User-Adjustable USB Current Limit**
  - **Fixed-Frequency 220kHz to 2.2MHz Operation**
  - **Forced-PWM Option at No Load**
  - **Spread Spectrum for EMI Reduction**
  - **SYNC Input for Frequency Parking**
  - **Low Q Current Skip Mode and Low Q Shutdown**
  - **Reduced Inrush Current by Soft-Start**
- **Integrated Output Adjustment for Cable Voltage Drop**
  - **User-Adjustable Voltage Gain**
  - **Up to 3 Meter Cable/Up to 600mΩ**
- **USB D+/D- Protection and Host Charger Emulator**
  - **4Ω USB 2.0 480Mbps/12Mbps Data Switches**
  - **Integrated iPod/iPhone/iPad Charge Detection Termination Resistors**
  - **Supports USB BC1.2 Charging Downstream Port (CDP) and Dedicated Charging Port (DCP) Modes**
  - **Chinese Telecommunication Industry Standard YD/T 1591-2009**
  - **High-Speed Pass-Through Mode**
  - **Short to Battery and Short to V_{BUS} Protection**
  - **Compatible with USB On-the-Go Specification**
- **Split Supplies SUP and SUPSW Minimize Power Consumption**
- **Fault Indication Active-Low Open-Drain Output**
- **Automotive Grade ESD Protection (HVD±)**
  - **±25kV Air/±8kV Contact ISO 10605**
  - **±15kV Air/±8kV Contact IEC 61000-4-2**
  - **±15kV Air/±8kV Contact (330Ω, 330pF)**
- **Overtemperature and Short-Circuit Protection**
- **5mm x 5mm, 28-Pin TQFN and Side Wettable QFND Packages**
- **-40°C to +125°C Operating Temperature Range**

Applications

Automotive Radio and Navigation
USB Port for Host and Hub Applications
Automotive Connectivity
Telematics
Dedicated USB Power Charger

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

19-6627; Rev 1; 7/13

ABSOLUTE MAXIMUM RATINGS

IN, D+, D-, CD0, CD1, FBPER, FBMAX, SENSO, FBCAP to GND ..... -0.3V to +6V
FAULT, FOSC, BIAS, SYNC to GND ..... -0.3V to +6V
D+, D-, to IN ..... +0.3V
HVD+, HVD- to GND ..... -0.3V to +18V
SENSN, SENSP to GND ..... -0.3V to +30V
SENSP to SENSN ..... -6.0V to +6.0V
SUP, SUPSW, LX, ENBUCK to GND ..... -0.3V to +42V
SUP to SUPSW ..... -0.3V to +0.3V
BST to GND ..... -0.3V to +47V
BST to LX ..... -0.3V to +6V
PGND to GND ..... -0.3V to +0.3V
Output Short-Circuit Duration ..... Continuous
Continuous Power Dissipation (T_A = 70°C)
Side-Wettable QFND (derate 33.3mW/°C above +70°C) . 2666.7mW
TQFN (derate 34.5mW/°C above +70°C) 2759mW
Operating Temperature Range ..... -40°C to +125°C
Junction Temperature ..... +150°C
Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (soldering, 10s) ..... +300°C
Soldering Temperature (reflow) ..... +260°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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PACKAGE THERMAL CHARACTERISTICS (Note 1)

Side-Wettable QFND
Junction-to-Ambient Thermal Resistance (θ_{JA}) ..... 30°C/W
Junction-to-Case Thermal Resistance (θ_{JC}) ..... 2°C/W

TQFN
Junction-to-Ambient Thermal Resistance (θ_{JA}) ..... 29°C/W
Junction-to-Case Thermal Resistance (θ_{JC}) ..... 2°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maximintegrated.com/thermal-tutorial**.

ELECTRICAL CHARACTERISTICS

(V_{SUP} = V_{SUPSW} = 14V, V_{ENBUCK} = V_{IN} = 3.3V, T_A = T_J = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER SUPPLY AND ENABLE						
Supply Voltage Range	V_{SUP}	Normal operation	4.5		28	V
Load Dump Event Supply Voltage Range	V_{SUP_LD}	t < 1s (Note 3)			42	V
Supply Current	I_{SUP}	V_{IN} = 0V		6	20	µA
		V_{SYNC} = 0V, no load, skip mode		620	950	µA
		V_{SYNC} = 3.3V, no load, FPWM mode (Note 3)		9		mA
BIAS Voltage	V_{BIAS}	5.75V ≤ V_{SUP} = V_{SUPSW} ≤ 28V	4.71	5	5.31	V
BIAS Current Limit			40	120		mA
BIAS Undervoltage Lockout	V_{UV_BIAS}	V_{BIAS} rising	3.93	4.2	4.46	V
BIAS Undervoltage Lockout Hysteresis				0.36		V
IN Voltage Range	V_{IN}		3.0		3.6	V
IN Enable High	V_{IN_IH}		1.6			V
IN Enable Low	V_{IN_IL}				0.5	V

ELECTRICAL CHARACTERISTICS (continued)

(V_{SUP} = V_{SUPSW} = 14V, V_{ENBUCK} = V_{IN} = 3.3V, T_A = T_J = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IN Overvoltage Lockout	V_{IN_OVLO}	V_{IN} rising	3.85	4.0	4.15	V
IN Input Current	I_{IN}			5	10	µA
ENBUCK Enable High	V_{ENBUCK_IH}		2.4			V
ENBUCK Enable Low	V_{ENBUCK_IL}				0.6	V
ENBUCK Hysteresis				0.15		V
ENBUCK Input Leakage		V_{ENBUCK} = 42V		0.01	1	µA
D+, D- ANALOG USB SWITCHES						
Analog Signal Range		Guaranteed by R_{ON} measurement (Note 3)	0		3.6	V
Protection Trip Threshold	V_{OV_D}		3.7	3.85	4.15	V
Protection Response Time	t_{FP_D}	V_{IN} = 4.0V, $V_{HVD\pm}$ = 3.3V to 4.3V step, R_L = 15kΩ on D±, delay to $V_{D\pm}$ < 3V		5		µs
Overvoltage Blanking Timeout Period	t_{B,OV_D}	From overvoltage condition to $\overline{FAULT}$ asserted		18	30	ms
On-Resistance Switch A	R_{ON_SA}	I_L = 5mA, 0V ≤ $V_{D\pm}$ ≤ 3.6V		4		Ω
On-Resistance Match Between Channels Switch A	ΔR_{ON_SA}	I_L = 5mA, $V_{D\_}$ = 1.5V or 3.0V		10	150	mΩ
On-Resistance Flatness Switch A	$R_{FLAT(ON)A}$	I_L = 5mA, $V_{D\_}$ = 0V or 0.4V		10		mΩ
On Resistance of HVD+/HVD- Short	R_{SHORT}	V_{DP} = 1V, I_{DM} = 500µA		90	180	Ω
HVD+/HVD- On-Leakage Current	I_{HVD_ON}	$V_{HVD\pm}$ = 0V	-0.1	0	+0.1	µA
		$V_{HVD\pm}$ = 3.6V		2.5		
HVD+/HVD- Off-Leakage Current	I_{HVD_OFF}	$V_{HVD\pm}$ = 18V, $V_{D\pm}$ = 0V		12		µA
D+/D- Off-Leakage Current	I_{D_OFF}	$V_{HVD\pm}$ = 18V, $V_{D\pm}$ = 0V	-1		+1	µA
On-Channel -3dB Bandwidth	BW	R_L = 50Ω, source impedance 50Ω (Figure 3)		400		MHz
Crosstalk	V_{CT}	R_L = 50Ω, f = 480MHz (Figure 3)		-14		dB
On-Capacitance Switch A	C_{ON}	f = 240MHz, V_{BIAS} = 250mV, V = 500mV_{P-P}		15		pF
Rise-Time Propagation Delay	t_{PLH}	R_S = R_L = 50Ω		200		ps
Fall-Time Propagation Delay	t_{PHL}	R_S = R_L = 50Ω		200		ps
Output Skew Between Switches	$t_{SK(O)}$	Skew between D+ and D- switch, R_L = 50Ω		50		ps
Output Skew Same Switch	$t_{SK(P)}$	Skew between opposite transitions in same switch, R_L = 50Ω		50		ps
CURRENT-SENSE AMP (SENSP, SENSN, FBMAX, SENSO)						
FBMAX, SENSO Transconductance	G_{SENSO}, G_{FBMAX}	I/(V_{SENSP} - V_{SENSN}), V_{SENSP} = 5.25V		2.50		mA/V

ELECTRICAL CHARACTERISTICS (continued)

(V_{SUP} = V_{SUPSW} = 14V, V_{ENBUCK} = V_{IN} = 3.3V, T_A = T_J = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SENSO, FBMAX Voltage Range	V_{SENSO}, V_{FBMAX}		0		1.2	V
Input Differential Voltage Range	ΔV_{SENSO}, ΔV_{FBMAX}	V_{SENSP} - V_{SENSN}	0		120	mV
Bandwidth of Transconductance		Determined by external RC time constant; assumed R = 10kΩ, and C = 10pF		1		MHz
SENSP Pulldown Resistance	R_{SENSP_DIS}	V_{SENSP} = 5.05V, V_{ENBUCK} = 0V or CD1 toggle; going into and out of auto-detection modes		300	600	Ω
SENSP Discharge Time Upon CD1 Toggle	t_{SENSP_DIS}	CD1 toggle; going into and out of auto-detection modes	0.5	1.1	2	s
SENSP Input Bias Current	t_{SENSP_LK}	V_{SENSP} = 5.05V		130	230	µA
SENSN Input Bias Current	t_{SENSN_LK}	V_{SENSN} = 5.05V		70	120	µA
SENSP Voltage Range			3.2		28	V
SENSN Overvoltage Threshold	V_{OV_SENSN}		6.8	7	7.1	V
SENSP Undervoltage Threshold	V_{UV_SENSP}		4.64	4.75	4.81	V
SENSN Protection Response Time	t_{OV_SENSN}			8		µs
SENSN Overvoltage Fault Blanking Timeout Period	t_{B,OV_SENSN}	From overvoltage condition to $\overline{FAULT}$ asserted	3	10	20	ms
SENSO CURRENT LIMIT RELATIONSHIP						
SENSO ILIMIT Threshold	V_{TH_ILIM}	SENSO rising, threshold used to set DC current limit		1.20		V
Continuous Current-Limit Fault Blanking Timeout	$t_{B,ILIM}$	From overcurrent condition to $\overline{FAULT}$ asserted	9	16.5	27	ms
ANALOG FEEDBACK ADJ						
SENSP Analog Adjustment Gain $\Delta V_{SENSP}/\Delta V_{FBMAX}$	A_{SENSP}	V_{FBPER} = 3.3V		0.535		V/V
		V_{FBPER} = 0V		1.069		V/V
Maximum Feedback Adjustment (compared to SENSP)		V_{FBPER} = 0V, V_{FBMAX} = 1.2V		25		%
Maximum Feedback Adjustment (compared to SENSP)		V_{FBPER} = 3.3V, V_{FBMAX} = 1.2V		12.5		%
FBMAX Maximum Adjustment Threshold				1.2		V
CD0, CD1, FBPER INPUT						
Input Current		V_{PIN} = 5.5V, internal 2MΩ pulldown to GND		2.8	5.6	µA
Logic-High	V_{IH}		1.6			V
Logic-Low	V_{IL}				0.5	V

ELECTRICAL CHARACTERISTICS (continued)

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PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
USB 2.0 HOST CHARGER DETECTION, D+/D-						
Input Logic-High	V_{IH}		2.0			V
Input Logic-Low	V_{IL}				0.8	V
Data Sink Current	I_{DAT_SINK}	V_{DAT_SINK} = 0.25V to 0.4V	50	100	160	µA
Data Detect Voltage High	V_{DAT_REFH}		0.4			V
Data Detect Voltage Low	V_{DAT_REFL}				0.25	V
Data Detect Voltage Hysteresis	V_{DAT_HYST}			55		mV
Data Source Voltage	V_{DAT_SRC}		0.5		0.7	V
Data Source Load Current	I_{DAT_SRC}				200	µA
iPhone/iPad/DCP CHARGER DETECTION						
HVD+/HVD- Short Pulldown	R_{PD}		300	500	750	kΩ
RP1/RP2 Ratio	RT_{RP}		1.485	1.5	1.515	Ratio
RM1/RM2 Ratio	RT_{RM}		0.857	0.866	0.875	Ratio
DM1 Comparator Threshold	V_{DM1F}	iPhone mode, DM falling (in % of V_{BIAS})	45	46	47	%
		iPad mode, DM falling (in % of V_{BIAS})	29	30	31	
DM2 Comparator Threshold	V_{DM2F}	DM falling (in % of V_{BIAS})	6	7	8	%
DP Comparator Threshold	V_{DPR}	iPhone mode, DP rising (in % of V_{BIAS})	45	46	47	%
		iPad mode, DP rising (in % of V_{BIAS})	55.9	57.2	58.5	
DM1 Comparator Debounce Time	t_{DM1}	V_{DM1} step from 2.8V to 1.5V	4	9	15	ms
DM2 Comparator Debounce Time	t_{DM2}	V_{DM2} step from 2.0V to 0.2V	1	2	4	s
DP Comparator Debounce Time	t_{DP}	V_{DP} step from 1.5V to 2.5V	600	1100	1800	µs
SYNCHRONOUS STEP-DOWN DC-DC CONVERTER						
PWM Output Voltage Accuracy	V_{SENSP}	7V ≤ V_{SUPSW} ≤ 18V, no load, V_{SYNC} = 3.3V or V_{SYNC} = 0V and FPWM mode (see TOC 24)		5.05		V
Skip Mode Output Voltage Accuracy	V_{SENSP_SKIP}	7V ≤ V_{SUPSW} ≤ 18V, no load, V_{SYNC} = 0V, not in FPWM mode (Note 3)	4.96	5.05	5.25	V
Load Regulation		7V ≤ V_{SUPSW} ≤18V, 0A < I_{LOAD} < 2.1A, V_{FBMAX} = GND (Note 3)		1.2		%/A
Output Voltage Accuracy	V_{SENSP}	V_{SUPSW} = 16V, I_{LOAD} = 2.1A; V_{FBPER} = 0V, V_{FBMAX} = 1.2V, V_{SYNC} = 0V and FPWM mode (Note 3)	6	6.15	6.3	V
		V_{SUPSW} = 8V, I_{LOAD} = 2.1A; V_{FBPER} = 0V, V_{FBMAX} = 1.2V, V_{SYNC} = 0V and FPWM mode (Note 3)	6	6.15	6.3	
Oscillator Frequency	f_{SW}	R_{FOSC} = 68kΩ	380	440	480	kHz
		R_{FOSC} = 12kΩ	2.0	2.2	2.4	MHz

ELECTRICAL CHARACTERISTICS (continued)

(V_{SUP} = V_{SUPSW} = 14V, V_{ENBUCK} = V_{IN} = 3.3V, T_A = T_J = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

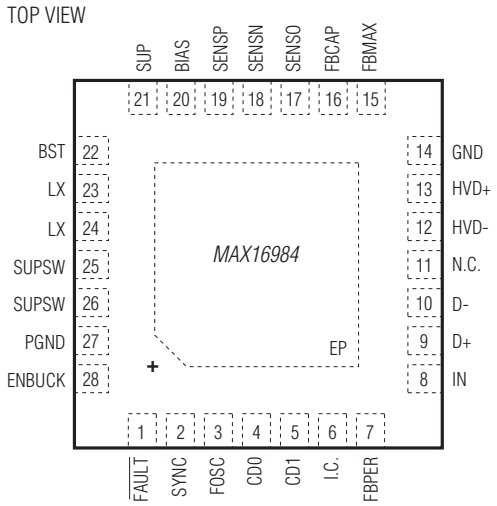
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Spread-Spectrum Range		MAX16984S only		6.5		%
SYNC Switching Threshold Hi	V_{SYNC_HI}	Rising	1.4			V
SYNC Switching Threshold Lo	V_{SYNC_LO}	Falling			0.4	V
SYNC Internal Pulldown				200	550	kΩ
SYNC Input Clock Acquisition Time	t_{SYNC}	(Note 3)		1		Cycle
High-Side Switch On Resistance	R_{ONH}	I_{LX} = 1A		200	450	mΩ
Low-Side Switch On Resistance	R_{ONL}	I_{LX} = 500mA		1	2	Ω
BST Input Current	I_{BST}	V_{BST} - V_{LX} = 5V, high side on		1.2	2	mA
LX Current-Limit Threshold		Peak Inductor current	2.7	3.6	4.7	A
Skip Mode Peak Current Threshold	I_{SKIP_TH}			300		mA
Negative Current Limit			0.65	0.85	1.1	A
Soft-Start Ramp Time	t_{SS}			9		ms
$\overline{FAULT}$ OUTPUT						
Output-High Leakage Current		$V_{\overline{FAULT}}$ = 5.5V	-5		+5	µA
Output Low Level		Sinking 1mA		0.03	0.4	V
THERMAL OVERLOAD						
Thermal Shutdown Temperature				+174		°C
Thermal Shutdown Hysteresis				30		°C
ESD PROTECTION (ALL PINS)						
ESD Protection Level	V_{ESD}	Human Body Model		±2		kV
ESD PROTECTION (HVD+, HVD-)						
ESD Protection Level	V_{ESD}	ISO 10605 Air Gap		±25		kV
		ISO 10605 Contact		±8		kV
		IEC 61000-4-2 Air Gap		±15		kV
		IEC 61000-4-2 Contact		±8		kV
		330Ω, 330pF Air		±15		kV
		330Ω, 330pF Contact		±8		kV

Note 2: Specifications with minimum and maximum limits are 100% production tested at T_A = +25°C and are guaranteed over the operating temperature range by design and characterization. Actual typical values may vary and are not guaranteed.

Note 3: Guaranteed by design and bench characterization; not production tested.

Automotive High-Current Step-Down Converter with USB Protection/Host Charger Adapter Emulator

Pin Configuration



TQFN/QFND

Pin Description

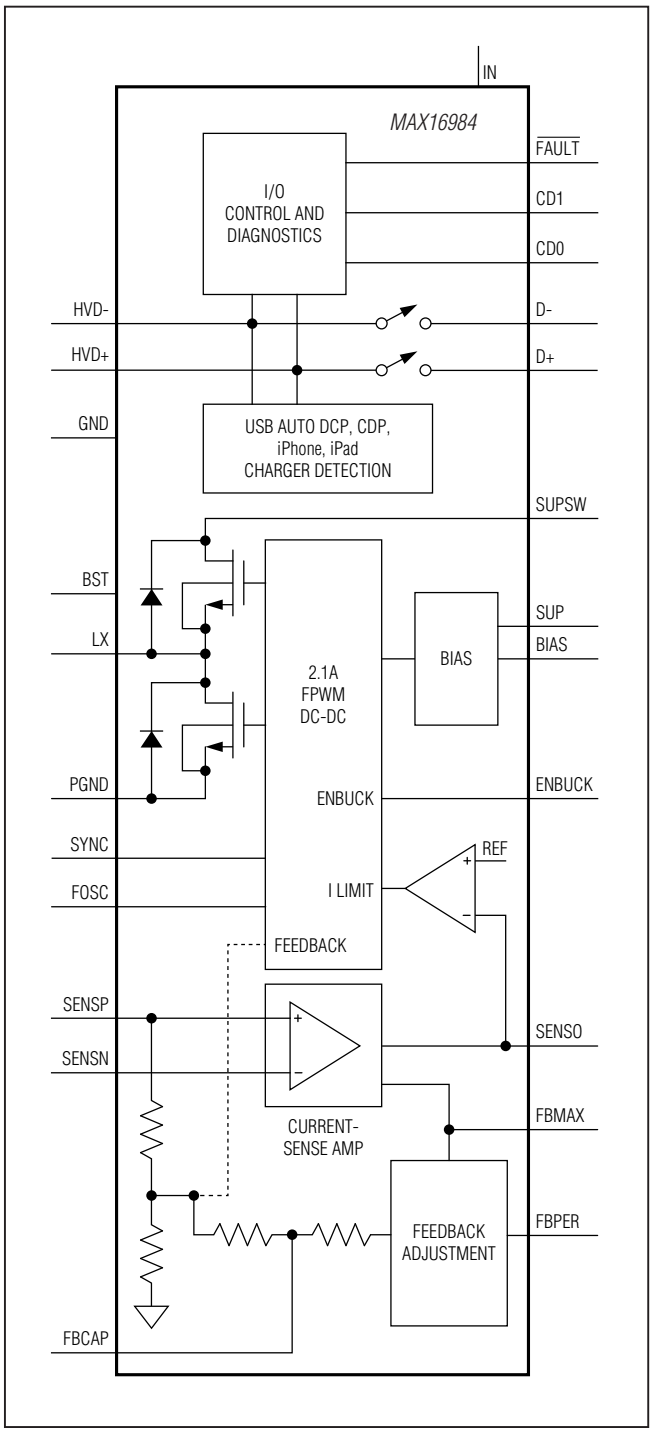
PIN	NAME	FUNCTION
1	$\overline{\text{FAULT}}$	Active-Low Open-Drain Fault Indicator Output. Connect a 100kΩ pullup resistor to IN.
2	SYNC	Synchronization Input. The device synchronizes to an external signal applied to SYNC. When connected to GND or unconnected, skip mode is allowed under light loads. See Table 1. When connected to a clock source or IN, forced-PWM (FPWM) mode is enabled.
3	FOSC	Resistor-Programmable Switching-Frequency Setting Control Input. Connect a resistor from FOSC to GND to set the switching frequency.
4	CD0	Charger Detection Configuration Bit 0
5	CD1	Charger Detection Configuration Bit 1
6	I.C.	Internal Connection. Must be connected to external GND.
7	FBPER	Digital Input. Used to select voltage feedback adjustment percentage.
8	IN	Logic Enable Input. Connect to I/O voltage of USB transceiver. IN is also used for clamping during overvoltage events on HVD+ or HVD-. Connect a 1µF ceramic capacitor from IN to GND.
9	D+	USB Differential Data D+ Input. Connect D+ to low-voltage USB transceiver D+ pin.
10	D-	USB Differential Data D- Input. Connect D- to low-voltage USB transceiver D- pin.
11	N.C.	No Connection
12	HVD-	High-Voltage-Protected USB Differential Data D- Output. Connect HVD- directly to the USB connector D- pin.

Pin Description (continued)

PIN	NAME	FUNCTION
13	HVD+	High-Voltage-Protected USB Differential Data D+ Output. Connect HVD+ directly to the USB connector D+ pin.
14	GND	Analog Ground
15	FBMAX	Current-Sense Amp Output. Connect a resistor to GND to set the USB DC current level at which maximum voltage feedback adjustment is reached.
16	FBCAP	External Capacitor Connection. Connect a capacitor to GND to set voltage feedback adjustment bandwidth
17	SENSO	Current-Sense Amp Output. Connect a resistor to GND to set the maximum USB DC current limit
18	SENSN	Current-Sense Amp Negative Input. Connect to negative terminal of current-sense resistor
19	SENSP	DC-DC Converter Feedback Input and Current-Sense Amp Positive Input. Connect to positive terminal of current-sense resistor and the main output of the converter. Used for internal voltage regulation loop.
20	BIAS	5V Linear Regulator Output. Connect a 1µF ceramic capacitor from BIAS to GND. BIAS powers up the internal circuitry.
21	SUP	Voltage Supply Input. SUP is the supply pin for the internal linear regulator. Connect a minimum of 4.7µF capacitor from SUP to GND close to the IC.
22	BST	High-Side Driver Supply. Connect a 0.1µF capacitor from BST to LX.
23, 24	LX	Inductor Connection. Connect a rectifying Schottky diode between LX and GND. Connect an inductor from LX to the DC-DC converter output (SENSP).
25, 26	SUPSW	Internal High-Side Switch-Supply Input. SUPSW provides power to the internal switch. Connect a 4.7µF ceramic capacitor in parallel with a 47µF capacitor from SUPSW to PGND. See the *DC-DC Input Capacitor Selection* section.
27	PGND	Power Ground
28	ENBUCK	Battery-Compatible Enable Input. Drive ENBUCK low/high to disable/enable the switching regulator.
—	EP	Exposed Pad. Connect EP to a large-area contiguous copper ground plane for effective power dissipation. Do not use as the only IC ground connection. EP must be connected to GND.

Automotive High-Current Step-Down Converter with USB Protection/Host Charger Adapter Emulator

Functional Diagram



Detailed Description

The MAX16984 combines a 5V/2.1A automotive grade step-down converter, a USB host charger adapter emulator, and USB protection switches. It is designed for high-power USB ports in automotive radio, navigation, connectivity, and USB hub applications.

The USB protection switches provide high-ESD and short-circuit protection for the low-voltage internal data lines of the multimedia processor's USB transceiver and support USB Hi-Speed (480Mbps) and USB Full-Speed (12Mbps) pass-through operation. The MAX16984 features integrated host-charger port-detection circuitry adhering to the USB 2.0 Battery Charging Specification BC1.2 and also includes dedicated bias resistors for iPod/iPhone 1.0A and iPad 2.1A dedicated charging modes.

The high-efficiency step-down DC-DC converter operates from a voltage up to 28V and is protected from load dump transients up to 42V. The device includes resistor-programmable frequency selection from 220kHz to 2.2MHz to allow optimization of efficiency, noise, and board space based on the application requirements. The converter can deliver up to 2.1A of continuous current at 105°C.

The MAX16984 also includes a high-side current-sense amplifier and configurable feedback adjustment circuit designed to provide automatic USB voltage adjustment to compensate for voltage drops in captive cables associated with automotive applications.

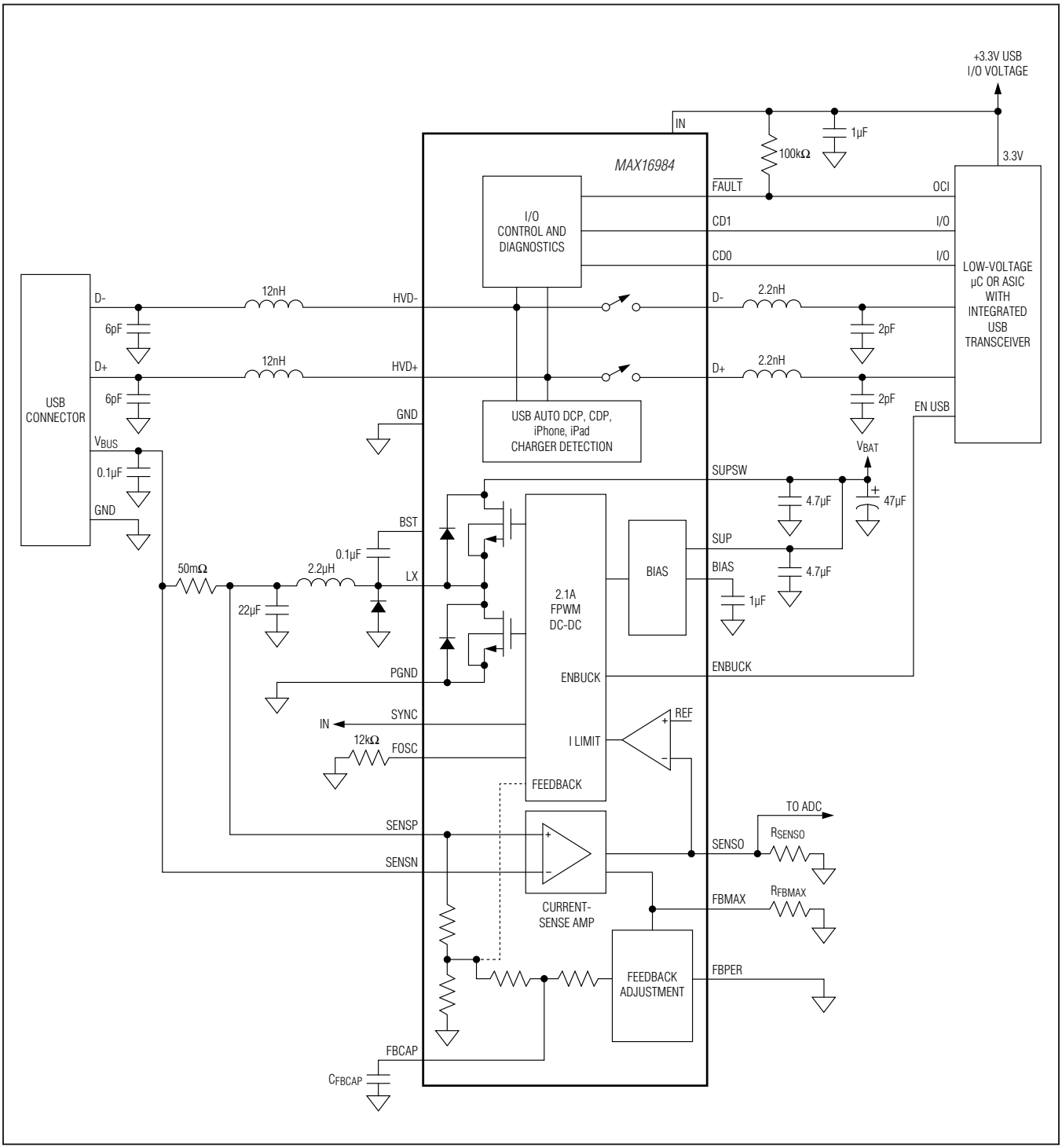
Power-Up and Enabling

System Enable (IN)

IN is used as the main enable to the MAX16984 and is also used to clamp the D+ and D- pins during an ESD and short-to-battery on the HVD+ and HVD- pins. This clamping protects the downstream USB transceiver. The IN pin contains an overvoltage lockout that disables the data switches if IN is above V_{IN_OVLO}. Bypass IN with a 1µF capacitor and connect it to the same 3.3V supply as shared with the multimedia processor's USB transceiver. If IN is logic-high, the protection switches are enabled and the USB switches operate in one of four modes per the CD0 and CD1 inputs. If IN is at a logic-low level, SUP power consumption is reduced and the device enters a standby low quiescent level.

Automotive High-Current Step-Down Converter with USB Protection/Host Charger Adapter Emulator

Typical Operating Circuit



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Ordering Information

PART	TEMP RANGE	SPREAD SPECTRUM	PIN-PACKAGE
MAX16984RAGI/VY+*	-40°C to +125°C	Disabled	28 QFND-EP** (SW)
MAX16984SAGI/VY+*	-40°C to +125°C	Enabled	28 QFND-EP** (SW)
MAX16984RATI/V+	-40°C to +125°C	Disabled	28 TQFN-EP**
MAX16984SATI/V+	-40°C to +125°C	Enabled	28 TQFN-EP**

+Denotes a lead(Pb)-free/RoHS-compliant package.
/V denotes an automotive qualified part.
**Future product—contact factory for availability.*
***EP = Exposed pad.*
(SW) = Side wettable.

Chip Information

PROCESS: BiCMOS

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
28 QFND-EP (Side Wettable)	G2855Y+2	21-0563	90-0375
28 TQFN-EP	T2855+6	21-0140	90-0026

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/13	Initial release	—
1	7/13	Corrected values/figures, updated *Electrical Characteristics* table specs, and clarified spread-spectrum information	3–6, 11, 12, 17, 19, 20, 22, 27, 28, 31,