ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

LTC7897

Datasheet Comparison

LTC7897– Page 1

- Updated gate drive ABS MAX rating under FEATURES and GENERAL DESCRIPTION sections

Before

140V, Low I_Q, Synchronous Buck Controller with Programmable 5V to 10V Gate Drive

FEATURES

- Wide V_{IN} Range: 4V to 135V (140V ABS MAX)
- Wide Output Voltage Range: 0.8V ≤ V_{OUT} ≤ 135V (140V ABS MAX)
- Adjustable Gate Drive Level: 5V to 10V (OPTI-DRIVE, 15V ABS MAX)
- Adjustable Driver Voltage UVLO
- Adaptive or Resistor Adjustable Dead Times
- Split-Output Gate Drivers for Adjustable Turn-On and Turn-Off Driver Strengths
- 100% Duty Cycle Operation
- Low Operating I_Q: 5μA (48V_{IN} to 3.3V_{OUT})
- Spread Spectrum Frequency Modulation
- Programmable Frequency (100kHz to 2.5MHz)
- Synchronizable Frequency (100kHz to 2.5MHz)
- 28-Pin (4mm x 5mm) QFN Package

APPLICATIONS

- Industrial Power Systems
- Military/Avionics
- Telecommunications Power Systems

GENERAL DESCRIPTION

The *LTC®7897* is a high performance, 100% duty cycle capable, synchronous step-down, DC/DC switching regulator controller that drives all N-channel synchronous silicon metal oxide field effect transistor (MOSFET) power stages. Synchronous rectification increases efficiency, reduces power loss, and simplifies the application design by reducing thermal requirements.

The wide input and output voltage ranges of the LTC7897 enable not only high step-down ratios but also a wide range of positive to negative voltage conversion.

The gate drivers of the LTC7897 provide robustness with a 15V ABS MAX rating and flexibility with adjustable drive levels and dead times to optimize applications. The gate drive voltage of the LTC7897 can optionally be adjusted from 5V to 10V to allow use of logic-level or standard threshold MOSFETs. The dead times of the LTC7897 can be optimized with external resistors for margin or to tailor the application for higher efficiency and allow for high frequency operation.

After

140V, Low I_Q, Synchronous Buck Controller with Programmable 5V to 10V Gate Drive

Techdoc: change from 15V to 14V

FEATURES

- Wide V_{IN} Range: 4V to 135V (140V ABS MAX)
- Wide Output Voltage Range: 0.8V ≤ V_{OUT} ≤ 135V (140V ABS MAX)
- Adjustable Gate Drive Level: 5V to 10V (OPTI-DRIVE, 14V 15V ABS MAX)
- Adjustable Driver Voltage UVLO
- Adaptive or Resistor Adjustable Dead Times
- Split-Output Gate Drivers for Adjustable Turn-On and Turn-Off Driver Strengths
- 100% Duty Cycle Operation
- Low Operating I_Q: 5μA (48V_{IN} to 3.3V_{OUT})
- Spread Spectrum Frequency Modulation
- Programmable Frequency (100kHz to 2.5MHz)
- Synchronizable Frequency (100kHz to 2.5MHz)
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The *LTC®7897* is a high performance, 100% duty cycle capable, synchronous step-down, DC/DC switching regulator controller that drives all N-channel synchronous silicon metal oxide field effect transistor (MOSFET) power stages. Synchronous rectification increases efficiency, reduces power loss, and simplifies the application design by reducing thermal requirements.

The wide input and output voltage ranges of the LTC7897 enable not only high step-down ratios but also a wide range of positive to negative voltage conversion.

The gate drivers of the LTC7897 provide robustness with a 14V 15V ABS MAX rating and flexibility with adjustable drive levels and dead times to optimize applications. The gate drive voltage of the LTC7897 can optionally be adjusted from 5V to 10V to allow use of logic-level or standard threshold MOSFETs. The dead times of the LTC7897 can be optimized with external resistors for margin or to tailor the application for higher efficiency and allow for high frequency operation.

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- Correct text format.

Before

A	6/25	Updated Features and General Description sections Specifications and Absolute Maximum Ratings sections Updated Pin Descriptions table Updated Figure 4, Figure 23, Figure 25, and Figure30 Updated DRV_{CC} and $INTV_{CC}$ Regulators (OPTI-DRIVE) section Updated Minimum On-Time Considerations section Updated Efficiency Considerations section Updated Figure 54 and Figure 58	1 4–9 11 14, 18, 19 37 38 40 46, 48

After

REVISION HISTORY

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGE NUMBER
0	2/25	Initial release	—
A	6/25	Updated Features and General Description sections Specifications and Absolute Maximum Ratings sections Updated Pin Descriptions table Updated Figure 4, Figure 23, Figure 25, and Figure30 Updated DRV_{CC} and $INTV_{CC}$ Regulators (OPTI-DRIVE) section Updated Minimum On-Time Considerations section Updated Efficiency Considerations section Updated Figure 54 and Figure 58	1 4–9 11 14, 18, 19 37 38 40 46, 48

Techdoc: Add a space between "Figure" and "30"

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ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

- Corrected DRVSET condition setting

Before

Data Sheet **LTC7897**

SPECIFICATIONS

Table 1. Electrical Characteristics

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

After

Data Sheet **LTC7897**

Techdoc: change from INTVcc to 0V

SPECIFICATIONS

Table 1. Electrical Characteristics

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.) 0V

- Updated typical value on Sense- Pin Current

Before

$SENSE^-$ Pin Current	I_{SENSE^-}	$SENSE^-$ < 3V	2	µA
		3.2V ≤ $SENSE^-$ < $INTV_{CC}$ – 0.5V	30	µA
		$SENSE^-$ > $INTV_{CC}$ + 0.5V	700	µA

After

$SENSE^-$ Pin Current	I_{SENSE^-}	$SENSE^-$ < 3V	2	µA
		3.2V ≤ $SENSE^-$ < $INTV_{CC}$ – 0.5V	30	µA
		$SENSE^-$ > $INTV_{CC}$ + 0.5V	700	µA

Techdoc: change from 2 to 1

Techdoc: change from 30 to 60

LTC7897– Page 5

- Corrected DRVSET and EXTVcc conditions setting and updated typical value on EXTVcc current

Before

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
Soft-Start Charge Current		TRACK/SS = 0V	7	9	11	µA
RUN Pin ON Threshold RUN Pin Hysteresis		RUN Rising	1.15	1.20 120	1.25	V mV
OVLO Pin OFF Threshold OVLO Pin Hysteresis	OVLO	OVLO Rising	1.15	1.20 120	1.25	V mV
DC Supply Current						
V_{IN} Shutdown Current		RUN = 0V		1		µA
V_{IN} Sleep Mode Current		$SENSE^-$ < 3.2V, $EXTV_{CC}$ = 0V		15		µA
Sleep Mode Current[3] V_{IN} Current V_{IN} Current $EXTV_{CC}$ Current $SENSE^-$ Current		 $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ = 0V $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ ≥ 12V $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ ≥ 12V $SENSE^-$ ≥ 3.2V		 5 1 4 10		 µA µA µA µA
Pulse-Skipping or Forced Continuous Mode (FCM), V_{IN} or $EXTV_{CC}$ Current[3]				2		mA

After

Data Sheet **LTC7897**

Techdoc: change from INTVcc to 0V

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.) 0V

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
Soft-Start Charge Current		TRACK/SS = 0V	7	9	11	µA
RUN Pin ON Threshold RUN Pin Hysteresis		RUN Rising	1.15	1.20 120	1.25	V mV
OVLO Pin OFF Threshold OVLO Pin Hysteresis	OVLO	OVLO Rising	1.15	1.20 120	1.25	V mV
DC Supply Current		Techdoc: change from 0V to INTVcc				
V_{IN} Shutdown Current		RUN = 0V		1		µA
V_{IN} Sleep Mode Current		$SENSE^-$ < 3.2V, $EXTV_{CC}$ = 0V INTVcc		15		µA
Sleep Mode Current[3] V_{IN} Current V_{IN} Current $EXTV_{CC}$ Current $SENSE^-$ Current		 $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ = 0V INTVcc $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ ≥ 12V $SENSE^-$ ≥ 3.2V, $EXTV_{CC}$ ≥ 12V $SENSE^-$ ≥ 3.2V		 5 1 4 10		 µA µA µA µA
Pulse-Skipping or Forced Continuous Mode (FCM), V_{IN} or $EXTV_{CC}$ Current[3]		Techdoc: change from 4 to 6		2		mA

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- Corrected DRVSET and EXTVcc conditions setting. Updated TG Minimum On-Time typical value and Charge pump output current

Before

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
BGxx Off to TGxx On Adaptive Delay Time[4]		DTCB = 0V DTCB = $INTV_{CC}$		50 30		ns ns
BGxx Off to TGxx On Smart Delay[5]		DTCA = 10k DTCA = 50k DTCA = 100k		13 50 100		ns ns ns
TGxx Off to BGxx On Smart Delay[5]		DTCB = 10k DTCB = 50k DTCB = 100k		13 50 100		ns ns ns
TG Minimum On-Time[6]	$t_{ON(MIN)}$			60		ns
Maximum Duty Cycle		Output in Dropout, FREQ = 0V	100			%
Charge Pump for BST-SW Supply						
Charge Pump Output Current		V_{BST-SW} = 7V, V_{SW} = 0V V_{SW} = 12V		−50 −80		µA µA
Charge Pump Output Voltage	V_{BST-SW}	I_{BST} = −1µA, V_{SW} = 0V and 12V	10	11	12	V
Low Dropout (LDO) Linear Regulators						
DRV_{CC} Voltage for V_{IN} and $EXTV_{CC}$ LDOs		$EXTV_{CC}$ = 0V for V_{IN} LDO, $EXTV_{CC}$ = 12V for $EXTV_{CC}$ LDO DRVSET = $INTV_{CC}$ DRVSET = 64.9kΩ DRVSET = 0V	9.5 5.8 5.8	9.77 6.5 6.0	10.0 7.0 6.2	V V V
DRV_{CC} Load Regulation		DRV_{CC} load current = 0mA to 100mA, T_A = 25°C		1	3	%
Undervoltage Lockout	UVLO	DRV_{CC} Rising DRVUV = $INTV_{CC}$ DRVUV = floating DRVUV = 0V	7.1 5.2 3.8	7.4 5.35 3.93	7.6 5.5 4.0	V V V
		DRV_{CC} Falling DRVUV = $INTV_{CC}$ DRVUV = floating DRVUV = 0V	6.4 4.9 3.6	6.64 5.05 3.71	6.8 5.2 3.8	V V V

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After

Techdoc: before change
DRVcc load current = 0mA to 100mA

after change
EXTVcc = INTVcc for V_{IN} LDO,
EXTVcc = 12V for EXTVcc LDO,
DRVcc load current = 0mA to 100mA,

Data Sheet **LTC7897**

Techdoc: change from INTVcc to 0V
change from 60 to 80

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$ 0V, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
BGxx Off to TGxx On Adaptive Delay Time[4]		DTCB = 0V DTCB = $INTV_{CC}$		50 30		ns ns
BGxx Off to TGxx On Smart Delay[5]		DTCA = 10k DTCA = 50k DTCA = 100k		13 50 100		ns ns ns
TGxx Off to BGxx On Smart Delay[5]		DTCB = 10k DTCB = 50k DTCB = 100k		13 50 100		ns ns ns
TG Minimum On-Time[6]	$t_{ON(MIN)}$			60 80		ns
Maximum Duty Cycle		Output in Dropout, FREQ = 0V	100			%
Charge Pump for BST-SW Supply		Techdoc: change from -50 to-120				
Charge Pump Output Current		V_{BST-SW} = 7V, V_{SW} = 0V V_{SW} = 12V		−50 −80		µA µA
Charge Pump Output Voltage	V_{BST-SW}	I_{BST} = −1µA, V_{SW} = 0V and 12V	10	11	12	V
Low Dropout (LDO) Linear Regulators		Techdoc: change from 0V to INTVcc INTVcc				
DRV_{CC} Voltage for V_{IN} and $EXTV_{CC}$ LDOs		$EXTV_{CC}$ = 0V for V_{IN} LDO, $EXTV_{CC}$ = 12V for $EXTV_{CC}$ LDO DRVSET = $INTV_{CC}$ DRVSET = 64.9kΩ DRVSET = 0V	9.5 5.8 5.8	9.77 6.5 6.0	10.0 7.0 6.2	V V V
DRV_{CC} Load Regulation		DRV_{CC} load current = 0mA to 100mA, T_A = 25°C		1	3	%
Undervoltage Lockout	UVLO	DRV_{CC} Rising , EXTVcc=INTVcc DRVUV = $INTV_{CC}$ DRVUV = floating DRVUV = 0V	7.1 5.2 3.8	7.4 5.35 3.93	7.6 5.5 4.0	V V V
		DRV_{CC} Falling , EXTVcc=INTVcc DRVUV = $INTV_{CC}$ DRVUV = floating DRVUV = 0V	6.4 4.9 3.6	6.64 5.05 3.71	6.8 5.2 3.8	V V V

Techdoc: before change
DRVcc Rising
DRVcc Falling

after change
DRVcc Rising, EXTVcc = INTVcc
DRVcc Falling, EXTVcc = INTVcc

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LTC7897– Page 7

- Corrected DRVSET condition setting. Updated max value on EXTVcc Rising.

Before

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = 0V, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
$EXTV_{CC}$ LDO Switchover Voltage		DRVUV = $INTV_{CC}$, T_A = 25°C	7.5	7.7	8.0	V
		DRVUV = floating, T_A = 25°C	5.9	6.1	6.4	V
$EXTV_{CC}$ Rising		DRVUV = 0V, T_A = 25°C	4.6	4.8	5.0	V

After

Techdoc: change from INTVcc to 0V

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.) 0V

Techdoc: Change from 5.0 to 5.1

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = 0V, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS/COMMENTS	MIN	TYP	MAX	UNITS
$EXTV_{CC}$ LDO Switchover Voltage		DRVUV = $INTV_{CC}$, T_A = 25°C	7.5	7.7	8.0	V
		DRVUV = floating, T_A = 25°C	5.9	6.1	6.4	V
$EXTV_{CC}$ Rising		DRVUV = 0V, T_A = 25°C	4.6	4.8	5.0	V

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- Corrected DRVSET condition setting.

Before

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.)

After

Techdoc: change from INTVcc to 0V

Data Sheet **LTC7897**

(Specifications are for T_J = -40°C to +150°C for the minimum and maximum values, T_A = 25°C for the typical values, V_{IN} = 12V, RUN = 12V, VPRG = floating, $EXTV_{CC}$ = 0V, DRVSET = $INTV_{CC}$, DRVUV = 0V, TGUP = TGDN = TGxx, BGUP = BGDN = BGxx, and DTCA and DTCB = 0V, unless otherwise noted.) 0V

LTC7897– Page 9

- Updated DRVcc ABS MAX rating. Added EXTVcc to DRVcc ABS MAX rating.   Removed side wettable description under Note 2.

Before

Data Sheet **LTC7897**

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise specified.

Table 2. Absolute Maximum Ratings

PARAMETER	RATING
Input Supply (V_{IN})	−0.3V to 140V
RUN	−0.3V to 140V
BOOST	−0.3V to 150V
SW	−5V to 150V
BOOST to SW	−0.3V to 15V
TGUP, TGDN, BGUP, BGDN[1]	Not applicable
$EXTV_{CC}$	−0.3V to 30V
DRV_{CC}	−0.3V to 15V
$INTV_{CC}$	−0.3V to 6V
V_{FB}	−0.3V to 140V
PLLIN/SPREAD, FREQ, OVLO	−0.3V to 6V
TRACK/SS, ITH, ILIM	−0.3V to 6V
DRVSET, DRVUV, VPRG, PGOOD	−0.3V to 6V
DTCA, DTCB	−0.3V to 6V
$SENSE^+$, $SENSE^-$	−0.3V to 140V
$SENSE^+$ to $SENSE^-$ Continuous	−6V to 0.3V
$SENSE^+$ to $SENSE^-$ < 1ms	-100mA to 100mA
Operating Junction Temperature Range[2]	−40°C to 150°C
Storage Temperature Range	−65°C to 150°C

1 Do not apply a voltage or current source to these pins. They must be connected to capacitive loads only. Otherwise, permanent damage can occur.

2 The LTC7897 is specified over the −40°C to 150°C operating junction temperature range. High junction temperatures degrade operating lifetimes. Note the maximum ambient temperature consistent with these specifications is determined by specific operating conditions in conjunction with the board layout, rated package thermal impedance, and other environmental factors. The junction temperature (T_J, in °C) is calculated from the ambient temperature (T_A, in °C) and power dissipation (P_D, in Watts) according to the following formula: $T_J = T_A + (P_D \times \theta_{JA})$, where θ_{JA} is the package thermal impedance and equals 43°C/W for the 28-lead (4mm × 5mm), side wettable, quad flat no lead (QFN) package

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

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After

Techdoc: add one row as below between DRVcc and INTVcc rows
EXTVcc to DRVcc -6V to 30V

Data Sheet **LTC7897**

Techdoc: change from 15V to 14V

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise specified.

Table 2. Absolute Maximum Ratings

PARAMETER	RATING
Input Supply (V_{IN})	−0.3V to 140V
RUN	−0.3V to 140V
BOOST	−0.3V to 150V
SW	−5V to 150V
BOOST to SW	−0.3V to 15V
TGUP, TGDN, BGUP, BGDN[1]	Not applicable
$EXTV_{CC}$	−0.3V to 30V
DRV_{CC}	−0.3V to 15V 14V
$INTV_{CC}$	−0.3V to 6V
V_{FB}	−0.3V to 140V
PLLIN/SPREAD, FREQ, OVLO	−0.3V to 6V
TRACK/SS, ITH, ILIM	−0.3V to 6V
DRVSET, DRVUV, VPRG, PGOOD	−0.3V to 6V
DTCA, DTCB	−0.3V to 6V
$SENSE^+$, $SENSE^-$	−0.3V to 140V
$SENSE^+$ to $SENSE^-$ Continuous	−6V to 0.3V
$SENSE^+$ to $SENSE^-$ < 1ms	-100mA to 100mA
Operating Junction Temperature Range[2]	−40°C to 150°C
Storage Temperature Range	−65°C to 150°C

1 Do not apply a voltage or current source to these pins. They must be connected to capacitive loads only. Otherwise, permanent damage can occur.

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Techdoc: remove ,side wettable,

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- Updated pin description for EXTVcc

Before

Data Sheet **LTC7897**

		Connect VPRG to $INTV_{CC}$ or GND to program the output to 12V or 5V, respectively, through an internal resistor divider on V_{FB}.
7	V_{IN}	Main Supply Pin. A bypass capacitor must be tied between V_{IN} and GND.
8	DRV_{CC}	Gate Driver Output of the internal LDO regulator from V_{IN} or $EXTV_{CC}$. The gate drivers and the $INTV_{CC}$ internal LDO are powered from DRV_{CC}. A low ESR 4.7µF ceramic bypass capacitor should be connected between DRV_{CC} and GND, as close as possible to the IC.
9	OVLO	Overvoltage Lockout Input. A voltage on this pin above 1.2V disables switching of the controller. The DRV_{CC} and $INTV_{CC}$ supplies maintain regulation during an OVLO event. Exceeding the OVLO threshold also triggers a soft-start reset. If the OVLO function is not used, connect this pin to GND.
10	$EXTV_{CC}$	External Power Input to an Internal LDO Regulator Connected to DRV_{CC}. This LDO regulator supplies $INTV_{CC}$ power, bypassing the internal V_{IN} LDO regulator whenever $EXTV_{CC}$ is higher than the $EXTV_{CC}$ switchover voltage. See the $EXTV_{CC}$ connection in the *Power and Bias Supplies (VIN, EXTVCC, DRVCC, and INTVCC)* section. Do not exceed 30V on $EXTV_{CC}$. Connect $EXTV_{CC}$ to GND if the $EXTV_{CC}$ LDO regulator is not used.

After

Techdoc: change from GND to INTVcc

Data Sheet **LTC7897**

		Connect VPRG to $INTV_{CC}$ or GND to program the output to 12V or 5V, respectively, through an internal resistor divider on V_{FB}.
7	V_{IN}	Main Supply Pin. A bypass capacitor must be tied between V_{IN} and GND.
8	DRV_{CC}	Gate Driver Output of the internal LDO regulator from V_{IN} or $EXTV_{CC}$. The gate drivers and the $INTV_{CC}$ internal LDO are powered from DRV_{CC}. A low ESR 4.7µF ceramic bypass capacitor should be connected between DRV_{CC} and GND, as close as possible to the IC.
9	OVLO	Overvoltage Lockout Input. A voltage on this pin above 1.2V disables switching of the controller. The DRV_{CC} and $INTV_{CC}$ supplies maintain regulation during an OVLO event. Exceeding the OVLO threshold also triggers a soft-start reset. If the OVLO function is not used, connect this pin to GND.
10	$EXTV_{CC}$	External Power Input to an Internal LDO Regulator Connected to DRV_{CC}. This LDO regulator supplies $INTV_{CC}$ power, bypassing the internal V_{IN} LDO regulator whenever $EXTV_{CC}$ is higher than the $EXTV_{CC}$ switchover voltage. See the $EXTV_{CC}$ connection in the *Power and Bias Supplies (VIN, EXTVCC, DRVCC, and INTVCC)* section. Do not exceed 30V on $EXTV_{CC}$. Connect $EXTV_{CC}$ to GND if the $EXTV_{CC}$ LDO regulator is not used.

INTVcc

LTC7897– Page 12

- Updated pin description for DRVSET

Before

25	DTCA	Dead Time Control Pin for Bottom MOSFET Off to Top MOSFET On Delay. Connect DTCA to GND to program an adaptive delay of approximately 50ns. Connect DTCA to $INTV_{CC}$ to program an adaptive delay of approximately 30ns. Connect a 10kΩ to 100kΩ resistor between DTCA and GND to add a smart delay (from 13ns to 100ns) between BGUP falling and SW rising.
26	DRVSET	DRV_{CC} Regulation Program pin. This pin sets the regulation point for the DRV_{CC} low dropout (LDO) linear regulator. Connect to GND to set DRV_{CC} to 6.0V. Connect to $INTV_{CC}$ to set DRV_{CC} to 10.0V. Program voltages between 5V and 10V by placing a resistor (50k to 100k) between DRVSET and GND. The resistor and an internal 20μA source current create a voltage used by the DRV_{CC} LDO regulator to set the regulation point.
27	DRVUV	DRV_{CC} UVLO and $EXTV_{CC}$ Switchover Program Pin. DRVUV determines the DRV_{CC} UVLO and $EXTV_{CC}$ switchover rising and falling thresholds, as listed in *Table 1*.
28	RUN	Run Control Input for the Controller. Forcing the RUN pin below 1.1V disables control, while forcing the RUN pin below 0.7V shuts down the entire LTC7897, reducing quiescent current to approximately 1μA. Tie the RUN pin to V_{IN} for always-on operation.
29	GND (EPAD)	Ground (Exposed Pad). The exposed pad must be soldered to PCB GND for rated electrical and thermal performance.

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After

26	DRVSET	DRV_{CC} Regulation Program pin. This pin sets the regulation point for the DRV_{CC} low dropout (LDO) linear regulator. Connect to GND to set DRV_{CC} to 6.0V. Connect to $INTV_{CC}$ to set DRV_{CC} to 10.0V. Program voltages between 5V and 10V by placing a resistor (50k to 100k) between DRVSET and GND. The resistor and an internal 20μA source current create a voltage used by the DRV_{CC} LDO regulator to set the regulation point.
27	DRVUV	DRV_{CC} UVLO and $EXTV_{CC}$ Switchover Program Pin. DRVUV determines the DRV_{CC} UVLO and $EXTV_{CC}$ switchover rising and falling thresholds, as listed in *Table 1*.
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Techdoc: change from 10.0V to 9.7V

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ANALOG DEVICES
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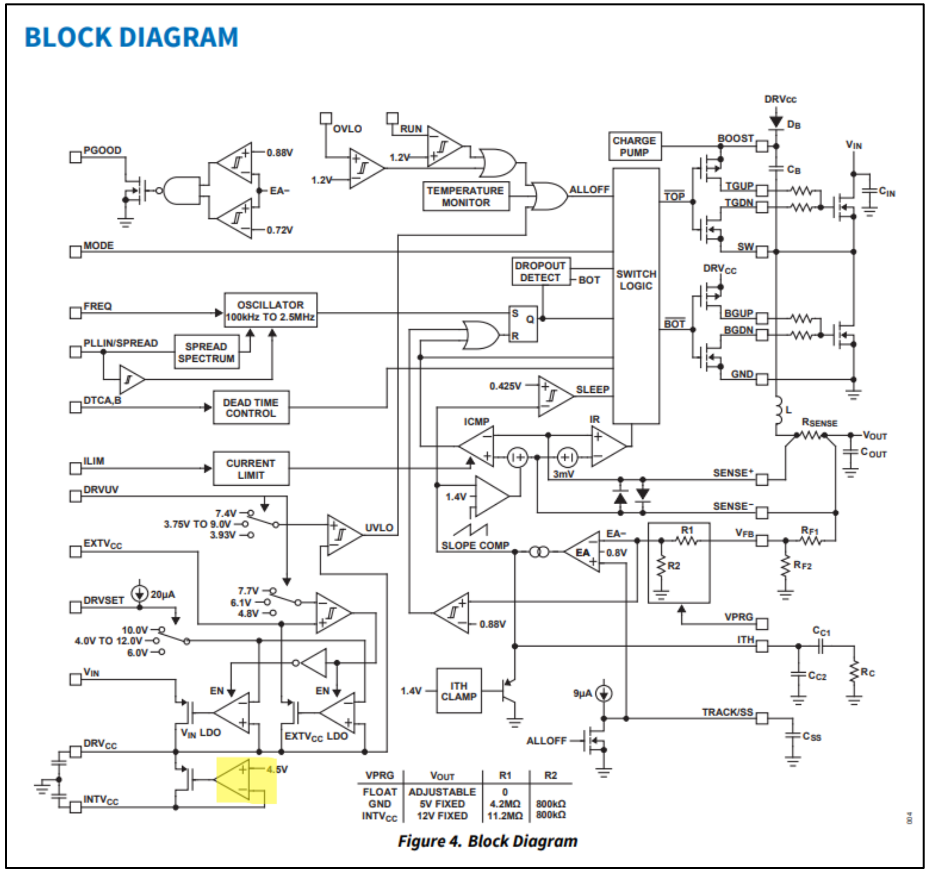
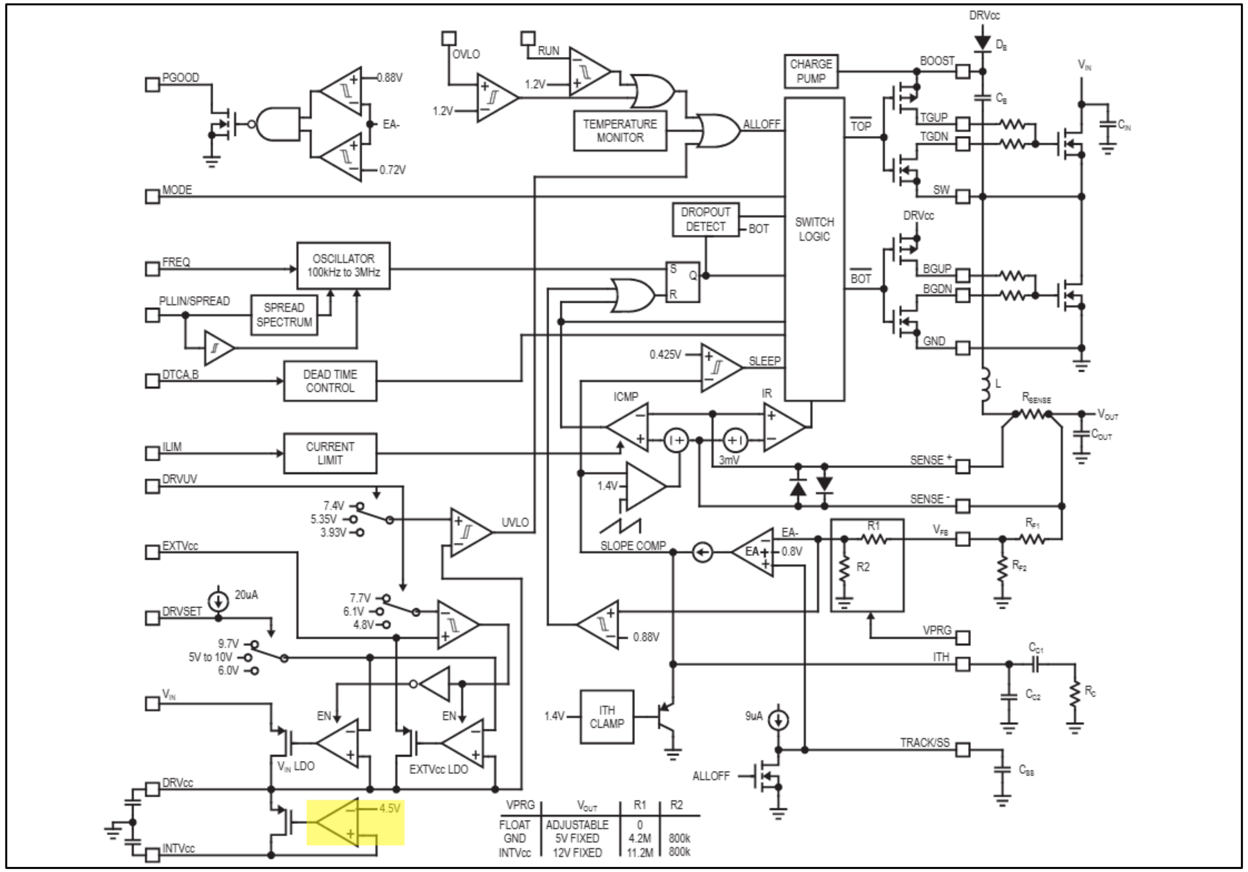
- Updated Figure 4.

Before



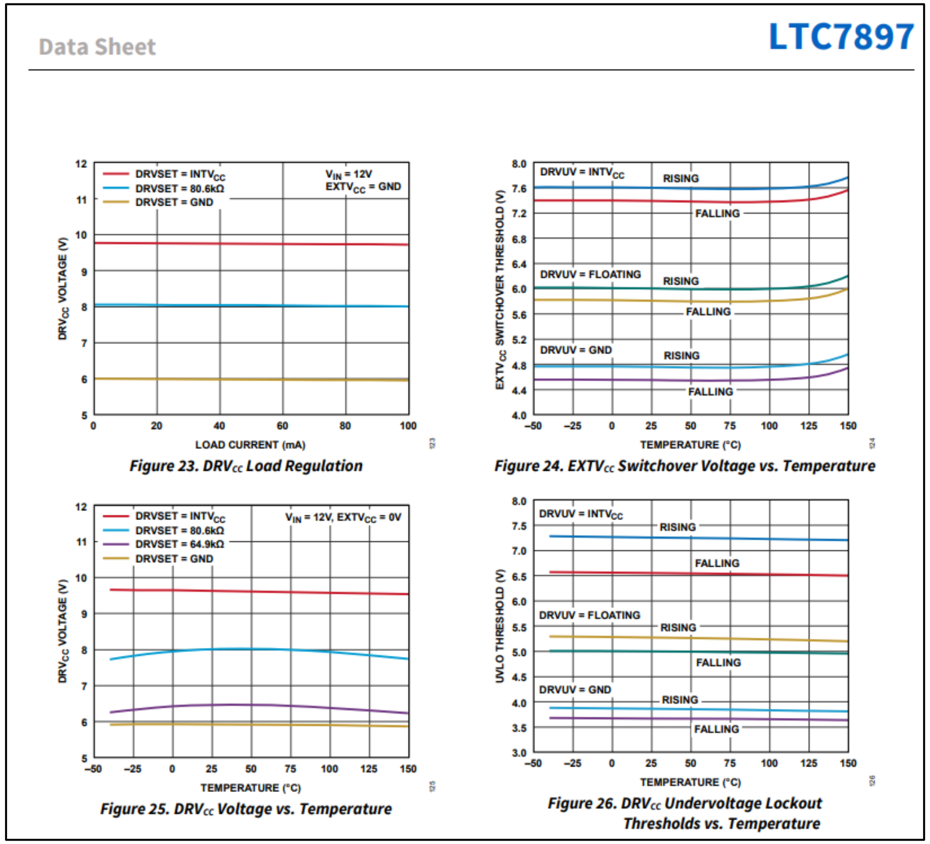
After



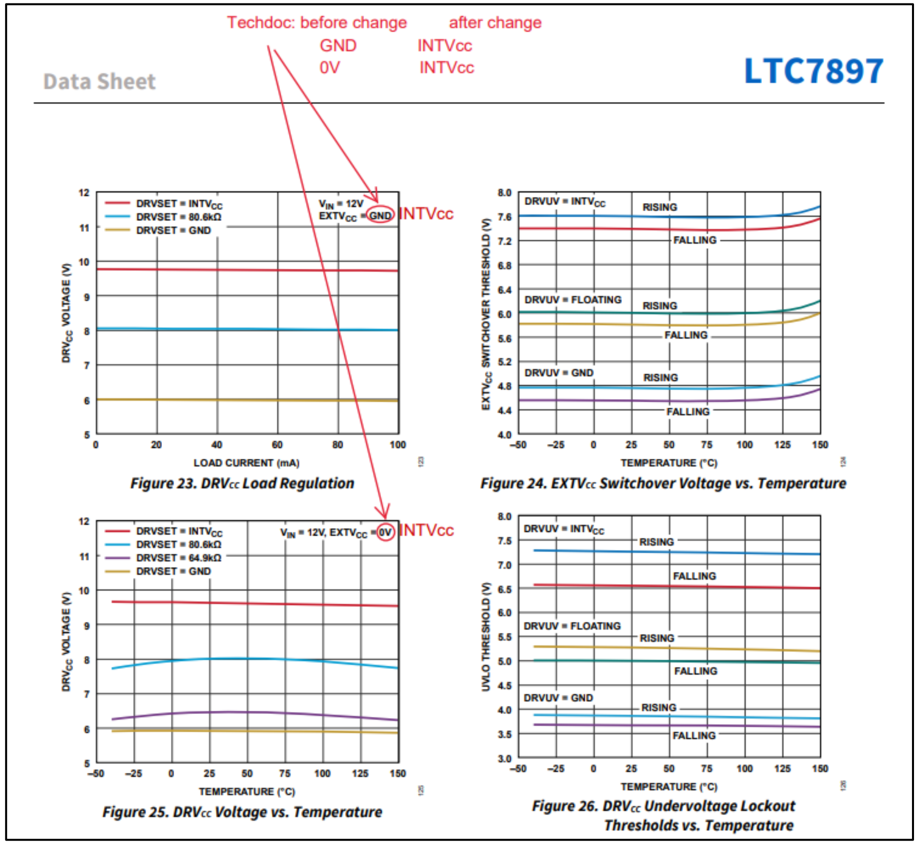
LTC7897– Page 17

- Corrected EXTVcc pin condition setting for Figures 23 and 25.

Before



After



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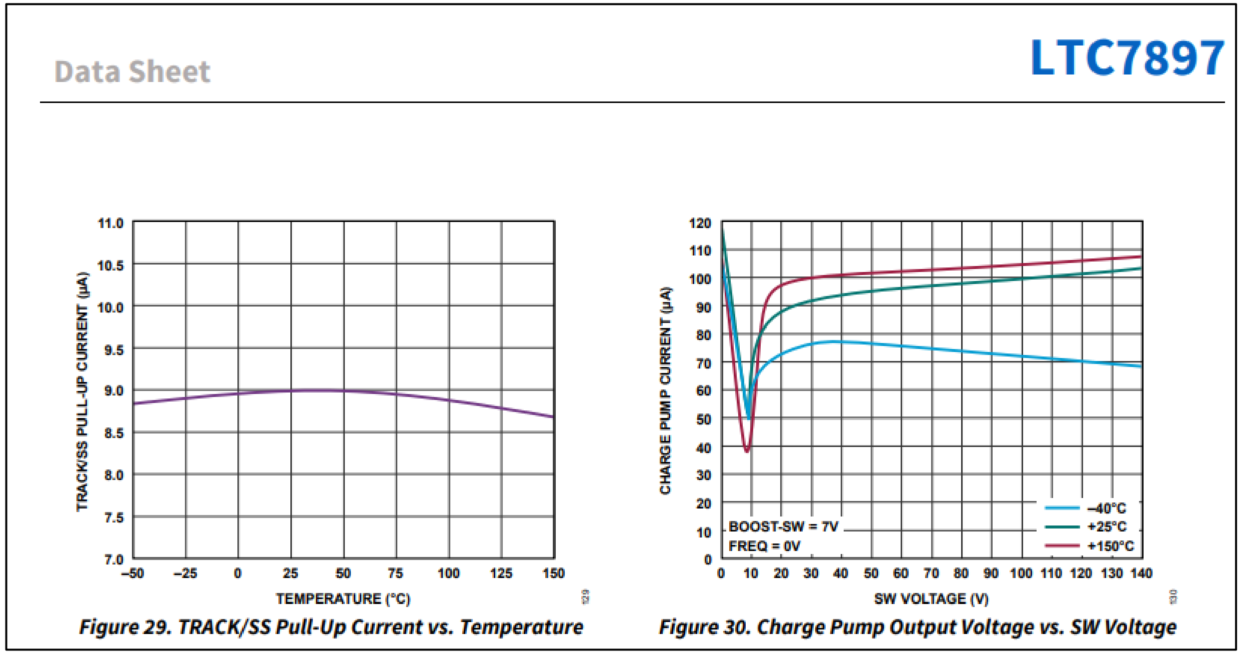
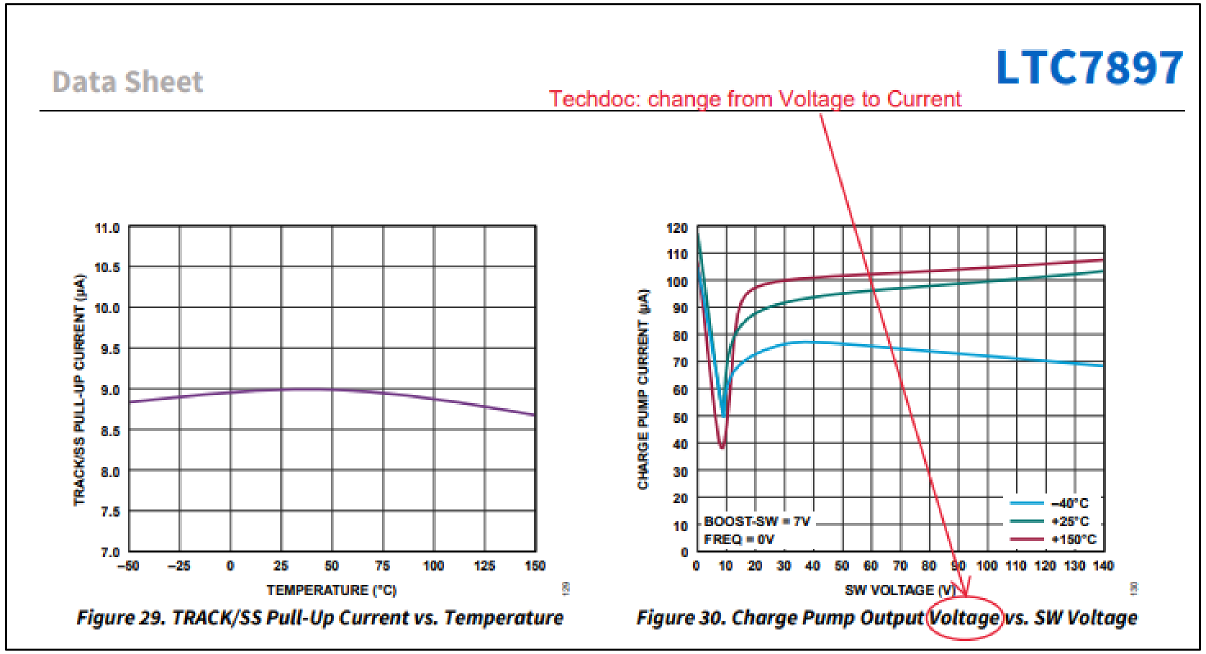
- Fixed figure description title for Figure 30.

Before



After



LTC7897– Page 35

- Update DRVcc condition.

Before

Data Sheet **LTC7897**

The DRVSET pin programs the DRV_{CC} supply voltage, and the DRVUV pin selects the different DRV_{CC} UVLO and $EXTV_{CC}$ switchover threshold voltages. *Table 6* summarizes the different DRVSET pin configurations along with the voltage settings that go with each configuration. *Table 7* summarizes the different DRVUV pin configurations and voltage settings. Tying the DRVSET pin to $INTV_{CC}$ programs DRV_{CC} to 10V. Tying the DRVSET pin to GND programs DRV_{CC} to 6V. Place a 50k to 100k resistor between DRVSET and GND to program the DRV_{CC} voltage between 5V to 10V, as shown in *Figure 48*.

Table 6. DRVSET Pin Configurations and Voltage Settings

DRVSET PIN	DRV_{CC} VOLTAGE (V)
GND	6
$INTV_{CC}$	9.7
Resistor to GND 50kΩ to 100kΩ	5 to 10

After

Data Sheet **LTC7897**

Techdoc: change 10V to 9.7V

The DRVSET pin programs the DRV_{CC} supply voltage, and the DRVUV pin selects the different DRV_{CC} UVLO and $EXTV_{CC}$ switchover threshold voltages. *Table 6* summarizes the different DRVSET pin configurations along with the voltage settings that go with each configuration. *Table 7* summarizes the different DRVUV pin configurations and voltage settings. Tying the DRVSET pin to $INTV_{CC}$ programs DRV_{CC} to 10V. Tying the DRVSET pin to GND programs DRV_{CC} to 6V. Place a 50k to 100k resistor between DRVSET and GND to program the DRV_{CC} voltage between 5V to 10V, as shown in *Figure 48*.

Table 6. DRVSET Pin Configurations and Voltage Settings

DRVSET PIN	DRV_{CC} VOLTAGE (V)
GND	6
$INTV_{CC}$	9.7
Resistor to GND 50kΩ to 100kΩ	5 to 10

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ANALOG DEVICES
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- Revised text in relation to EXTVcc pin setting.

Before

Data Sheet **LTC7897**

To prevent the junction temperature from exceeding the maximum rated as shown in *Table 2*, check the input supply current while operating in continuous conduction mode (MODE = $INTV_{CC}$) at maximum V_{IN}.

When the voltage applied to $EXTV_{CC}$ rises above its rising switchover threshold, the V_{IN} LDO regulator turns off and the $EXTV_{CC}$ LDO regulator enables. The $EXTV_{CC}$ LDO regulator remains on as long as the voltage applied to $EXTV_{CC}$ remains above its falling switchover threshold. The $EXTV_{CC}$ LDO attempts to regulate the DRV_{CC} voltage to the voltage as programmed by the DRVSET pin. Therefore, while $EXTV_{CC}$ is less than this voltage, the LDO regulator is in dropout, and the DRV_{CC} voltage is approximately equal to $EXTV_{CC}$. When $EXTV_{CC}$ is greater than the programmed voltage (up to an absolute maximum of 30V), DRV_{CC} is regulated to the programmed voltage. Using the $EXTV_{CC}$ LDO regulator allows the MOSFET driver and control power to be derived from one of the switching regulator outputs of the LTC7897 (4.7V ≤ V_{OUT} ≤ 30V) during normal operation, and from the V_{IN} LDO when the output is out of regulation (e.g., start up or short circuit). If more current is required through the $EXTV_{CC}$ LDO than is specified, add an external Schottky diode between the $EXTV_{CC}$ and DRV_{CC} pins. In this case, do not apply more than 15V to the $EXTV_{CC}$ pin.

Significant efficiency and thermal gains can be realized by powering DRV_{CC} from an outpu because the V_{IN} current resulting from the driver and control currents is scaled by a factor of $V_{OUT}/(V_{IN}$ • Efficiency). For 5V to 30V regulator outputs, connect the $EXTV_{CC}$ pin to V_{OUT}. Tying the $EXTV_{CC}$ pin to a 12V supply reduces the junction temperature in Equation 22 from 150°C to the results given by Equation 25, as follows:

$$T_J = 70°C + (39mA)(12V)(43°C/W) = 90°C \quad (25)$$

However, for 3.3V and other low voltage outputs, additional circuitry is required to derive DRV_{CC} power from the output.

The following list summarizes the four possible connections for $EXTV_{CC}$:

1. $EXTV_{CC}$ grounded. This connection causes the V_{IN} LDO regulator to power DRV_{CC}, resulting in an efficiency penalty of up to 10% or more at high input voltages.
2. $EXTV_{CC}$ connected directly to the regulator output. This connection is the normal connection for an application with an output range of 5V to 30V and provides the highest efficiency.
3. $EXTV_{CC}$ connected to an external supply. If an external supply is available, it can be used to power $EXTV_{CC}$, provided that it is compatible with the MOSFET gate drive requirements. This supply can be higher or lower than V_{IN}. However, a lower $EXTV_{CC}$ voltage results in higher efficiency.
4. $EXTV_{CC}$ connected to an output derived boost or charge pump. For regulators where outputs are below 5V, efficiency gains can still be realized by connecting $EXTV_{CC}$ to an output derived voltage that is boosted to greater than the $EXTV_{CC}$ switchover threshold.

After

Techdoc: before change
15V
outpu
grounded

after change
14V
output
connected to INTVcc

Data Sheet **LTC7897**

To prevent the junction temperature from exceeding the maximum rated as shown in *Table 2*, check the input supply current while operating in continuous conduction mode (MODE = $INTV_{CC}$) at maximum V_{IN}.

When the voltage applied to $EXTV_{CC}$ rises above its rising switchover threshold, the V_{IN} LDO regulator turns off and the $EXTV_{CC}$ LDO regulator enables. The $EXTV_{CC}$ LDO regulator remains on as long as the voltage applied to $EXTV_{CC}$ remains above its falling switchover threshold. The $EXTV_{CC}$ LDO attempts to regulate the DRV_{CC} voltage to the voltage as programmed by the DRVSET pin. Therefore, while $EXTV_{CC}$ is less than this voltage, the LDO regulator is in dropout, and the DRV_{CC} voltage is approximately equal to $EXTV_{CC}$. When $EXTV_{CC}$ is greater than the programmed voltage (up to an absolute maximum of 30V), DRV_{CC} is regulated to the programmed voltage. Using the $EXTV_{CC}$ LDO regulator allows the MOSFET driver and control power to be derived from one of the switching regulator outputs of the LTC7897 (4.7V ≤ V_{OUT} ≤ 30V) during normal operation, and from the V_{IN} LDO when the output is out of regulation (e.g., start up or short circuit). If more current is required through the $EXTV_{CC}$ LDO than is specified, add an external Schottky diode between the $EXTV_{CC}$ and DRV_{CC} pins. In this case, do not apply more than 15V to the $EXTV_{CC}$ pin.

14V

output

Significant efficiency and thermal gains can be realized by powering DRV_{CC} from an outpu because the V_{IN} current resulting from the driver and control currents is scaled by a factor of $V_{OUT}/(V_{IN}$ • Efficiency). For 5V to 30V regulator outputs, connect the $EXTV_{CC}$ pin to V_{OUT}. Tying the $EXTV_{CC}$ pin to a 12V supply reduces the junction temperature in Equation 22 from 150°C to the results given by Equation 25, as follows:

$$T_J = 70°C + (39mA)(12V)(43°C/W) = 90°C \quad (25)$$

However, for 3.3V and other low voltage outputs, additional circuitry is required to derive DRV_{CC} power from the output.

The following list summarizes the four possible connections for $EXTV_{CC}$:

connected to INTVcc

1. $EXTV_{CC}$ grounded. This connection causes the V_{IN} LDO regulator to power DRV_{CC}, resulting in an efficiency penalty of up to 10% or more at high input voltages.
2. $EXTV_{CC}$ connected directly to the regulator output. This connection is the normal connection for an application with an output range of 5V to 30V and provides the highest efficiency.
3. $EXTV_{CC}$ connected to an external supply. If an external supply is available, it can be used to power $EXTV_{CC}$, provided that it is compatible with the MOSFET gate drive requirements. This supply can be higher or lower than V_{IN}. However, a lower $EXTV_{CC}$ voltage results in higher efficiency.
4. $EXTV_{CC}$ connected to an output derived boost or charge pump. For regulators where outputs are below 5V, efficiency gains can still be realized by connecting $EXTV_{CC}$ to an output derived voltage that is boosted to greater than the $EXTV_{CC}$ switchover threshold.

LTC7897– Page 37

- Update minimum on time values.

Before

Data Sheet **LTC7897**

Minimum On-Time Considerations

The minimum on-time ($t_{ON(MIN)}$) is the smallest time duration that the LTC7897 is capable of turning on the top MOSFET. $t_{ON(MIN)}$ is determined by internal timing delays and the gate charge required to turn on the MOSFET. Low duty cycle applications can approach this minimum on-time limit. Take care to ensure the results in Equation 26, as follows:

$$t_{ON(MIN)} < \frac{V_{OUT}}{V_{IN} \cdot f} \quad (26)$$

If the duty cycle falls below what can be accommodated by the minimum on time, the controller begins to skip cycles. The output voltage continues to be regulated, but the ripple voltage and current increase. The minimum on time for the LTC7897 is approximately 60ns. However, as the peak sense voltage decreases, the minimum on time gradually increases up to about 80ns. This change is of particular concern in forced continuous applications with low ripple current at light loads. If the duty cycle drops below the minimum on-time limit in this situation, a significant amount of cycle skipping can occur with correspondingly larger current and voltage ripple.

Fault Conditions: Current Limit and Foldback

The LTC7897 includes current foldback to reduce the load current when the output is shorted to GND. If the output voltage falls below 70% of its regulation point, the maximum sense voltage is progressively lowered from 100% to 40% of its maximum value. Under short-circuit conditions with low duty cycles, the LTC7897 begins cycle skipping to limit the short-circuit current. In this situation, the bottom MOSFET dissipates most of the power, but less than in normal operation. The short-circuit ripple current ($\Delta I_{L(SC)}$) is determined by $t_{ON(MIN)} \approx$ 60ns, the input voltage, and the inductor value given by Equation 27, as follows:

$$\Delta I_{L(SC)} = t_{ON(MIN)} \cdot V_{IN}/L \quad (27)$$

The resulting average short-circuit current (I_{SC}) is given by Equation 28, as follows:

$$I_{SC} = 40\% \cdot I_{LIM(MAX)} - \frac{\Delta I_{L(SC)}}{2} \quad (28)$$

where $I_{LIM(MAX)}$ is the maximum peak inductor current.

After

Techdoc: before change	after change
60	80
80	100
60	80

Data Sheet **LTC7897**

Minimum On-Time Considerations

The minimum on-time ($t_{ON(MIN)}$) is the smallest time duration that the LTC7897 is capable of turning on the top MOSFET. $t_{ON(MIN)}$ is determined by internal timing delays and the gate charge required to turn on the MOSFET. Low duty cycle applications can approach this minimum on-time limit. Take care to ensure the results in Equation 26, as follows:

$$t_{ON(MIN)} < \frac{V_{OUT}}{V_{IN} \cdot f} \quad (26)$$

If the duty cycle falls below what can be accommodated by the minimum on time, the controller begins to skip cycles. The output voltage continues to be regulated, but the ripple voltage and current increase. The minimum on time for the LTC7897 is approximately 60ns (80). However, as the peak sense voltage decreases, the minimum on time gradually increases up to about 80ns (100). This change is of particular concern in forced continuous applications with low ripple current at light loads. If the duty cycle drops below the minimum on-time limit in this situation, a significant amount of cycle skipping can occur with correspondingly larger current and voltage ripple.

Fault Conditions: Current Limit and Foldback

The LTC7897 includes current foldback to reduce the load current when the output is shorted to GND. If the output voltage falls below 70% of its regulation point, the maximum sense voltage is progressively lowered from 100% to 40% of its maximum value. Under short-circuit conditions with low duty cycles, the LTC7897 begins cycle skipping to limit the short-circuit current. In this situation, the bottom MOSFET dissipates most of the power, but less than in normal operation. The short-circuit ripple current ($\Delta I_{L(SC)}$) is determined by $t_{ON(MIN)} \approx$ 60ns (80), the input voltage, and the inductor value given by Equation 27, as follows:

$$\Delta I_{L(SC)} = t_{ON(MIN)} \cdot V_{IN}/L \quad (27)$$

The resulting average short-circuit current (I_{SC}) is given by Equation 28, as follows:

$$I_{SC} = 40\% \cdot I_{LIM(MAX)} - \frac{\Delta I_{L(SC)}}{2} \quad (28)$$

where $I_{LIM(MAX)}$ is the maximum peak inductor current.

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- Updated text from Efficiency Considerations section.

Before

Data Sheet **LTC7897**

Other hidden losses, such as copper trace and internal battery resistances, can account for an additional 5% to 10% efficiency degradation in portable systems. It is important to include these system level losses during the design phase. The internal battery and fuse resistance losses can be minimized by making sure that C_{IN} has adequate charge storage and low ESR at the switching frequency. A 25W supply typically requires a minimum of 20µF to 40µF of capacitance with a maximum of 20mΩ to 50mΩ of ESR. Other losses, including inductor core losses, generally account for less than 2% of the total additional loss. Other losses, including inductor core losses, generally account for less than 2% of the total additional loss.

After

Techdoc: remove this sentence.

Data Sheet **LTC7897**

Other hidden losses, such as copper trace and internal battery resistances, can account for an additional 5% to 10% efficiency degradation in portable systems. It is important to include these system level losses during the design phase. The internal battery and fuse resistance losses can be minimized by making sure that C_{IN} has adequate charge storage and low ESR at the switching frequency. A 25W supply typically requires a minimum of 20µF to 40µF of capacitance with a maximum of 20mΩ to 50mΩ of ESR. Other losses, including inductor core losses, generally account for less than 2% of the total additional loss. ~~Other losses, including inductor core losses, generally account for less than 2% of the total additional loss.~~

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- Updated Figure 54.

Before

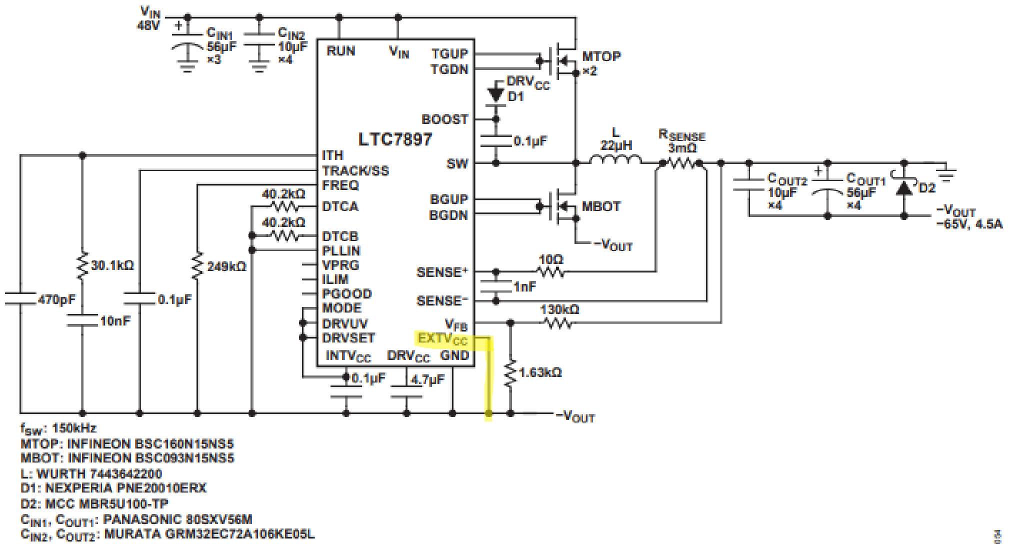
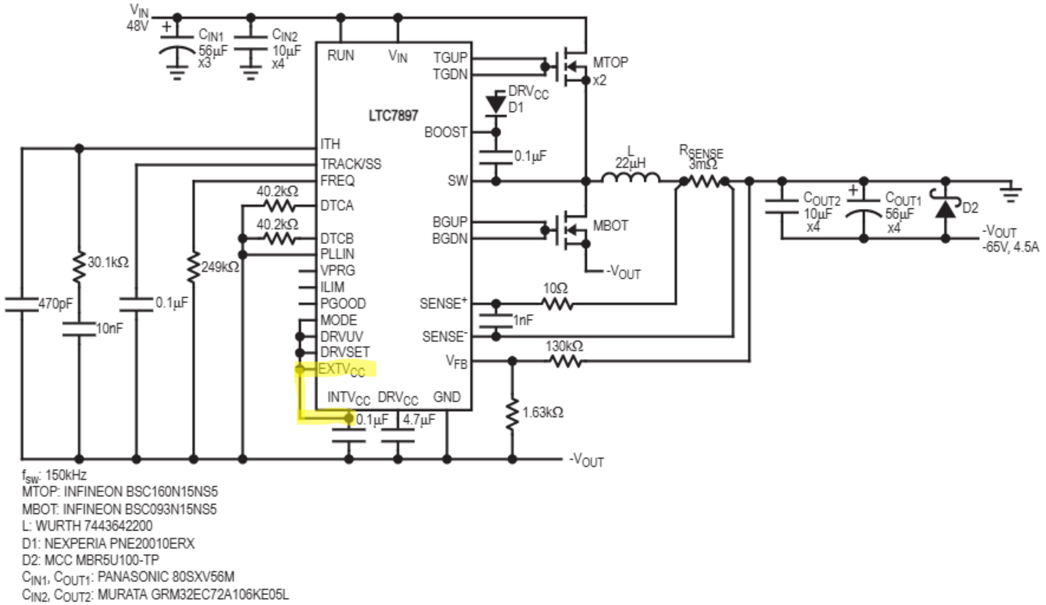


Figure 54. High Efficiency, 48V_{IN} to -65V_{OUT} Regulator

After



LTC7897– Page 47

- Updated Figure 58.

Before

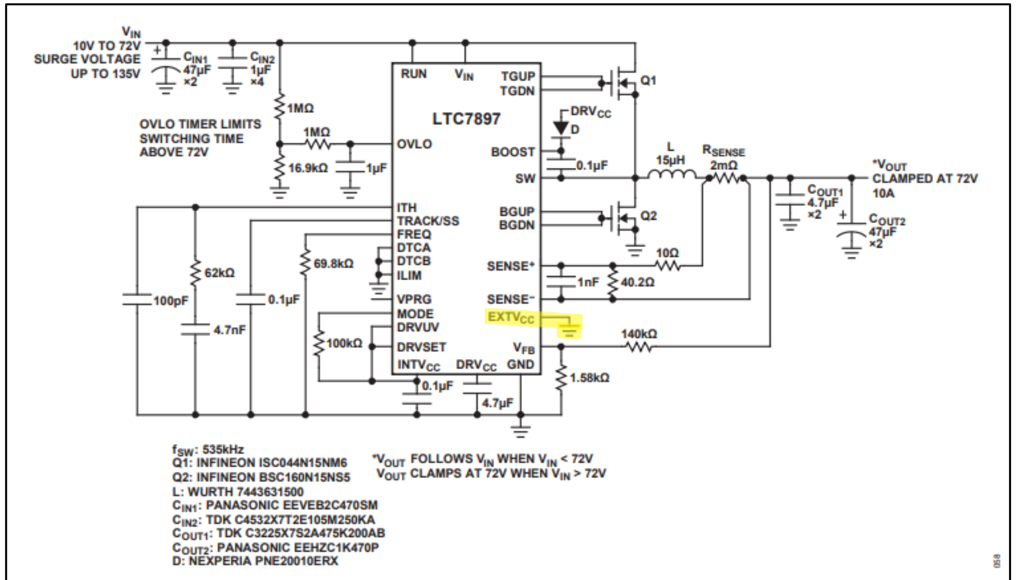


Figure 58. High Efficiency, 72V_{OUT}, Surge-Stopper

After