



Introduction

The MaxLinear XR76117 / 21 Series is very similar to the Infineon IR3824 / 25 / 26 / 29 Series in form, fit and function. Besides similar output current and input and output voltages, both series offer programmable switching frequency, soft-start, current limiting, enable input with voltage monitor, OCP, OTP, OVP, SCP, UVLO, integrated bootstrap diode / FET, and programmable power good. This document will provide a detailed description of the product similarities and differences, discuss how both Series can occupy the same socket on a PCB, and highlight the advantages of the MaxLinear regulators.

Major Specifications

The XR76117 and XR76121 are identical to each other except for their output current rating. Similarly, the IR3824 / 25 / 29 are identical to each other except for the differences shown in this section. Major specifications of each series are summarized in Table 1.

Spec	MaxLinear XR76117 / XR76121	Infineon IR3824 / IR3825 / IR3826 / IR3829
Max I _{OUT}	15A (XR76117); 20A (XR76121)	15A (IR3824); 16A (IR3829); 20A (IR3825); 23A (IR3826)
V _{IN} range	4.5V to 22V	5V to 21V
V _{OUT} range	0.6V to 18V	0.6V to 0.86 x V _{IN}
Frequency range	200kHz to 1MHz	Up to 1.5MHz
Temperature range	-40°C to 125°C	-40°C to 125°C
Supply current	17 mA	20mA

Table 1: Major Specification Comparison

The XR76117 / XR76121 can be soldered into a IR3824 / 25 / 26 / 29 socket, only minor board stuff options are required. The following discusses how both series can occupy the same socket on a PCB.

Pin-Out Comparison

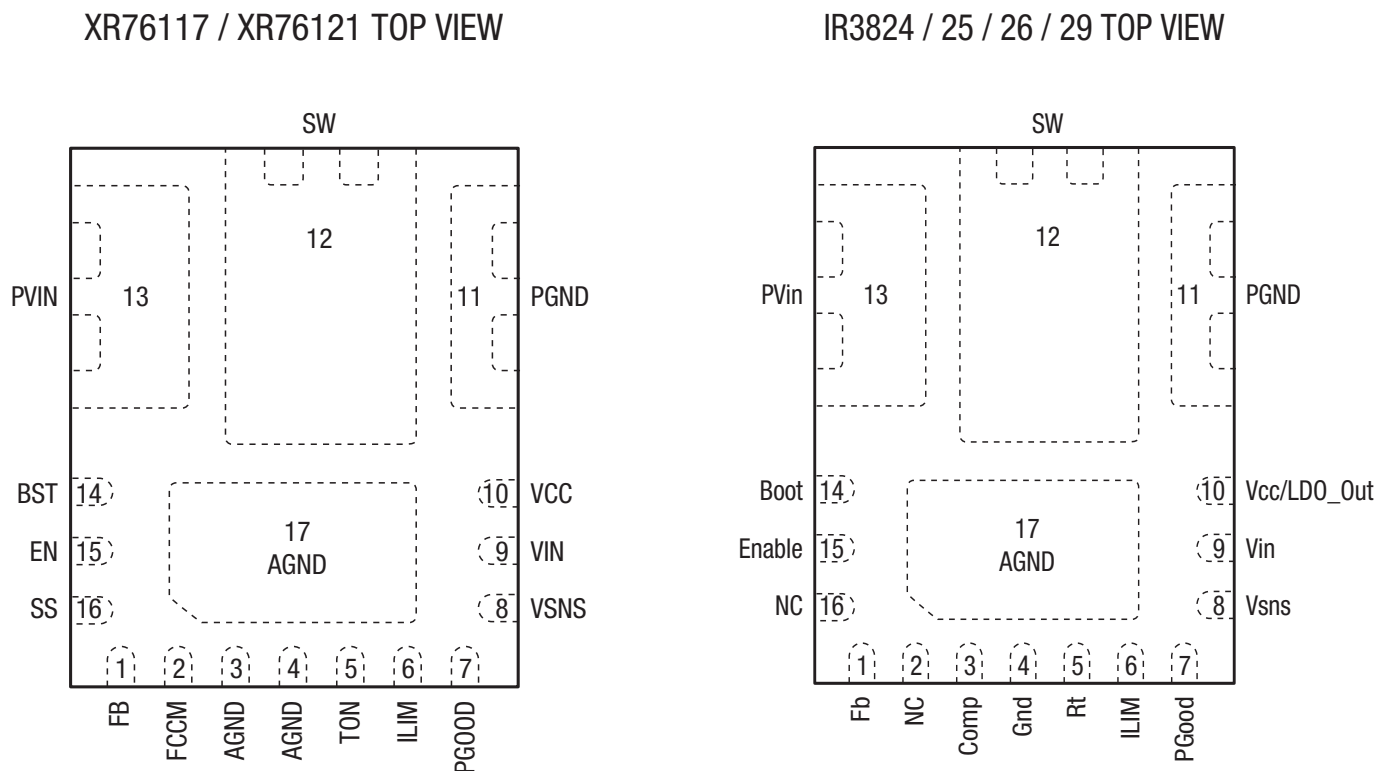


Figure 1: Pin-Out Comparison

Pin	XR76117 / XR76121	IR3824 / IR3825 / IR3826 / IR3829	Same function / same connection?	Comments
1	FB	Fb	Yes/Yes	Both provide feedback voltage and connect to the regulator output via a resistor divider.
2	FCCM	NC	No/No	For XR76117 / XR76121, pulling FCCM below 0.4V enables DCM and significantly increases light-load efficiency. Use a pull-up or pull-down. For IR3824 / IR3825 / IR3826 / IR3829, leave the pin floating or unconnected.
3	AGND	Comp	No/No	For XR76117 / XR76121, stuff a 0Ω resistor to jumper pin3 to pin4. Do not stuff compensation components. For IR3824 / IR3825 / IR3826 / IR3829, remove 0Ω resistor connecting pin3 to pin4 and stuff compensation.
4	AGND	Gnd	Yes/Yes	Small signal component GND. Must be isolated and connected to PGND via a 0Ω resistor.
5	TON	Rt	No/Yes	Both set frequency and require a resistor to GND. A different resistor value must be used for each solution.
6	ILIM	ILIM	Yes/No	Sets the current limit. For XR76117 / XR76121, stuff a resistor from ILIM to the SW node to set the current limit. The lower the resistor value, the lower the OCP trip point. For IR3824 / IR3825 / IR3826 / IR3829, stuff a resistor to connect to VCC or GND.
7	PGOOD	PGood	Yes/Yes	Both are Power Good status, open drain.
8	VSNS	Vsns	Yes/Yes	OVP sense pin, both connect to voltage divider from Vout to GND.
9	VIN	Vin	Yes/Yes	Both are controller input voltage and require a 0.1μF capacitor to GND.

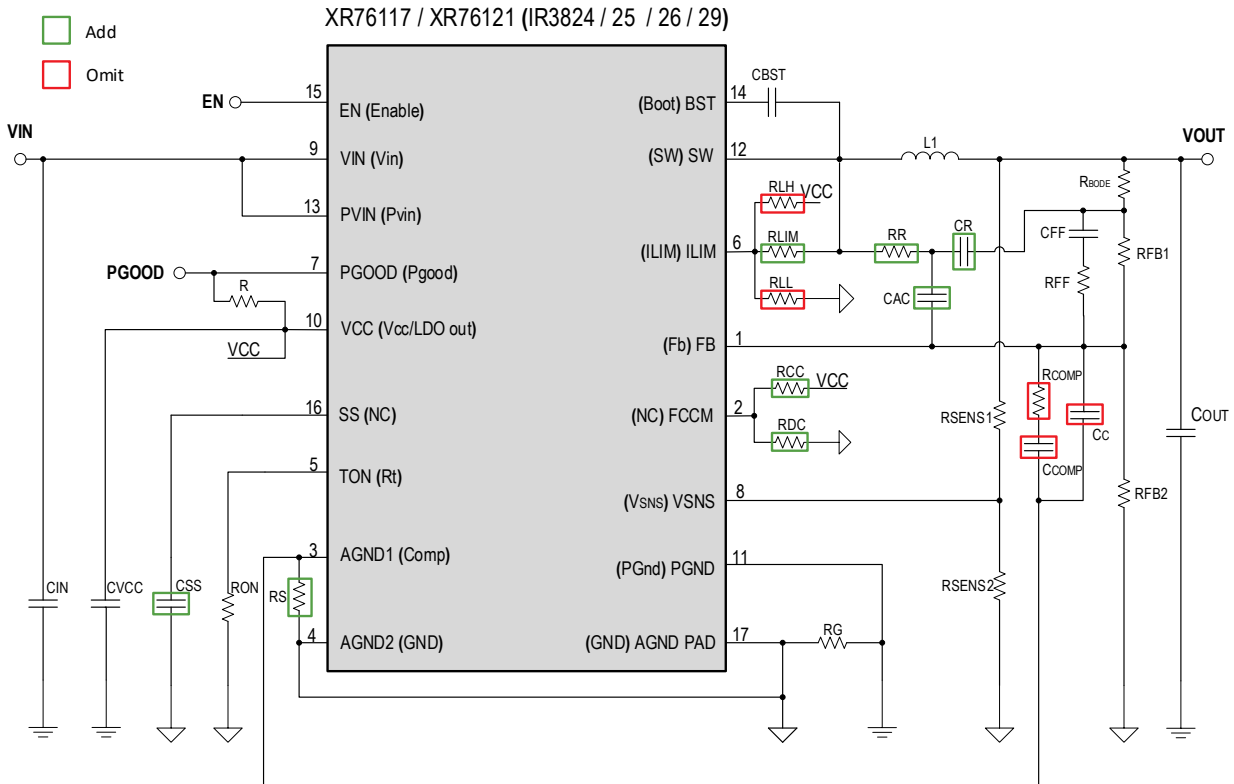
Pin-Out Comparison, Continued

Pin	XR76117 / XR76121	IR3824 / IR3825 / IR3826 / IR3829	Same function / same connection?	Comments
10	VCC	Vcc/ LDO_Out	Yes/Yes	Both are the LDO output and require a capacitor to GND. Use a 4.7 μ F capacitor for XR76117 / XR76121 and a 2.2 μ F capacitor for IR3824 / IR3825 / IR3826 / IR3829.
11	PGND	PGnd	Yes/Yes	Power Stage GND.
12	SW	SW	Yes/Yes	Both are switch node where MOSFETs connect and go to output inductor.
13	PVIN	PVIn	Yes/Yes	Both are input voltage for the power stage.
14	BST	Boot	Yes/Yes	Both are the high-side driver supply pin and require a 0.1 μ F capacitor to SW.
15	EN	Enable	Yes/Yes	Both enable the device and can be connected to PVIn via a voltage divider for UVLO.
16	SS	NC	No/No	For XR76117 / XR76121, connect a capacitor to GND. The soft start feature is useful if sequencing different controllers. For IR3824 / IR3825 / IR3826 / IR3829, leave floating.
17	AGND PAD	GND	Yes/Yes	Small signal component GND. Connect to pin 3 and pin 4 with a short trace.

Table 2: Side-by-Side Pin-out Descriptions

General Board Schematic

The PCB board can be easily designed to drop-in the XR76117 or XR76121 while maintaining compatibility to the IR3824 / 25 / 26 / 29. In Figure 2 below, pinning for both series are represented. The MaxLinear XR76117 and XR76121 pin names do not have parenthesis, and the same corresponding pins for the IR3824 / 25 / 29 are in parenthesis. As shown in the legend below, the components in green boxes are added, while the components in red boxes are omitted when switching from an IR BOM to an MxL BOM. Both a pull up and a pull down are shown for pins 2 and 6, but only one or the other will be stuffed depending on application. 4 passives will be removed, and depending on V_{OUT} , 4 or 7 additional passives will be added. Please refer to Table 3 for correct stuffing options.



NOTES:

1. For more information, see the XR76117 or XR76121 datasheet.

Figure 2: External Components

Component Number	Reference Designator	Stuffing Option for IR3824/25/29	Stuffing Option for XR76117 / XR76121	Comment
1	L1	L1	L1	Inductor L is selected based on frequency, efficiency, output power and maximum ripple current.
2	COUT	COUT	COUT	Output capacitors. These capacitors must have low ESR to meet the ripple and transient requirements.
3	RFB1	RFB1	RFB1	External voltage divider used to set VREF and program V _{OUT} . $V_{OUT} = VREF(1 + R1/R2)$
4	RFB2	RFB2	RFB2	
5	RSENS1	RSENS1	RSENS1	Resistor divider network used to monitor V _{OUT} and set PGOOD and OVP flags.
6	RSENS2	RSENS2	RSENS2	
7	CFF	CFF	CFF	Either the Feed Forward option or the Ripple Injection option is stuffed, depending on V _{OUT} . If IR to XR migration, the feed forward option is recommended for V _{OUT} > 2.0V and these two components are used. For lower V _{OUT} values, the Ripple Injection option is recommended.
8	RFF	RFF	RFF	
9	RR	-	RR	Either the Feed Forward option or the Ripple Injection option is stuffed, depending on V _{OUT} . The Ripple Injection option is recommended for V _{OUT} < 2.0V and these three components are used.
10	CR	-	CR	
11	CAC	-	CAC	
12	CBST	CBST	CBST	Feedback compensation. Not stuffed if IR to XR migration.
13	RCOMP	RCOMP	-	
14	CCOMP	CCOMP	-	
15	CC	CC	-	
16	RLH	RLH	-	Sets OCP tripping point. Not stuffed if IR to XR migration. RLIM between ILIM and SW is used to set OCP.
17	RLL	RLL	-	
18	RLIM	-	RLIM	Sets OCP tripping point. Tunable parameter.
19	RCC	-	RCC	CCM / DCM stuffing option. RCC selects CCM mode.
20	RDC	-	RDC	
21	R	R	R	Connects open drain PGOOD signal to VCC.
22	CIN	CIN	CIN	Provides ripple current during ON time of the control FET. The use of ceramic capacitors is recommended due to their peak current capabilities and low ESR / ESL at high frequencies.
23	CVCC	CVCC	CVCC	LDO bypass capacitor. If IR to XR migration, use a 4.7μF from this pin to PGND.
24	CSS	-	CSS	Soft start capacitor. Tunable parameter. Very useful if sequencing various regulators.
25	RON	RON	RON	Tunable parameter used to set duty cycle and frequency.
26	RBODE	RBODE	RBODE	AC signal insertion for loop gain test. RBODE = 10Ω.
27	RS	-	RS	RS connects pin 3 (NC) to GND for IR to XR migration. RS = 0Ω.
28	RG	RG	RG	Single point connection for system GND and power stage GND. RG = 0Ω.

Table 3: Stuffing Options

External Compensation

To achieve fast transient response and accurate output regulation, external compensation is recommended. The goal of this compensation circuit is to provide loop stability with the highest bandwidth, and phase margin greater than 45 degrees. The XR76117 and XR76121 devices offer 2 external compensation options which can be used to meet target board requirements. These 2 options are Feed Forward and Ripple Injection.

Feed Forward adds a capacitor across RFB1. The technique introduces a zero-pole pair at $F_Z = 1/(2 * \pi * CFF * RFB1)$ and $F_P = 1/(2 * \pi * CFF * RFB1 \parallel RFB2)$, that adds both phase lead and lag. Of the zero-pole pair, it is the zero that adds the most benefit to the phase margin results. The pole, which has the opposite effect, will cancel this benefit if placed too close to it. Therefore for best results, these 2 frequencies need to be far apart, which can only happen when $RFB1 > RFB2$. The greater RFB1 is in relation to RFB2, the farther apart these 2 frequencies are and the higher the output voltage seen at the output of the regulator is. The higher the output voltage, the higher the effectiveness of feed forward compensation in the loop. In the case of the XR76117 / XR76121 devices, bench results show that the minimum RFB1 to RFB2 ratio for feed forward to be effective is greater than 2.345. This means minimum output voltage where feed forward is still effective is $V_{OUT} > 0.6 * (1 + 2.345) = 2V$.

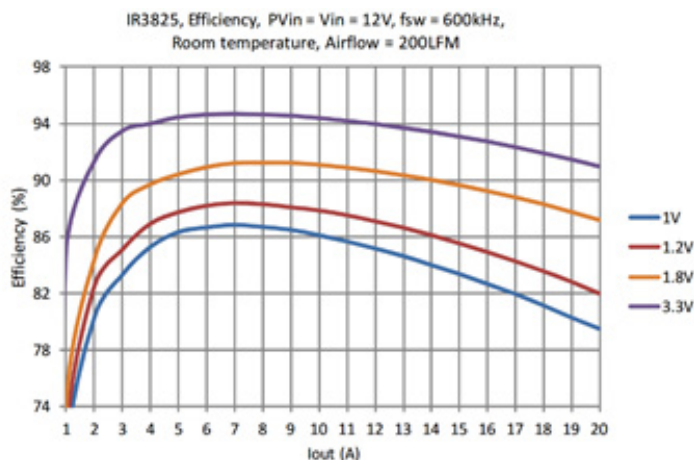
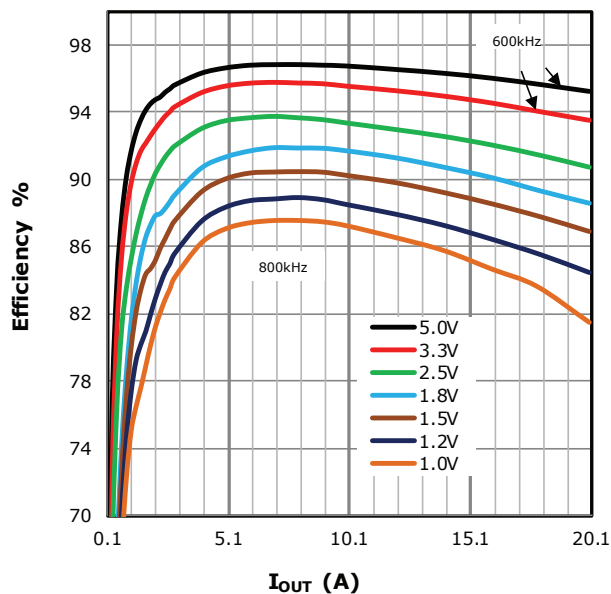
For $V_{OUT} > 2.0V$ --> The Feed Forward Option is recommended and both CFF and RFF are stuffed. This option can be used if $C_{OUT} * ESR > t_{ON} / 2$.

For $V_{OUT} \leq 2.0V$ --> The Ripple Injection is recommended and the RR, CR and CAC components are stuffed.

Performance

The MaxLinear XR76117 and XR76121 share the same features as the IR3824 / 25 / 26 / 29 and offer the following advantages:

- 1.Requires no loop compensation for most cases, simplifying circuit implementation and reducing component count. 3 components can be eliminated, depending on use.
- 2.Offers DCM mode to significantly increasing converter efficiency at light loads. There is also an option to force CCM for constant frequency applications.
- 3.Features more programmability of current limit value selection.
- 4.Provides adjustable soft-start duration which is better for controlling the sequencing of multiple regulators.
- 5.Power Good is low impedance when IC is unpowered. This prevents false good signals from occurring if a redundant supply goes down.
- 6.Transient performance is superior with the XR76117 / XR76121's proprietary COT control.
- 7.XR76117 and XR76121 have 1% accuracy over temperature versus 1.2% for the IR3824 / 25 / 26 / 29
- 8.XR76117 and XR76121 have 0.1% load and line regulation.
- 9.Offers better efficiency. Below is an efficiency comparison of 20A XR76121 and IR3825 devices:



Note: This document is meant for guidance purposes only. Refer to the most current device datasheet on the web for any functionality or specifications.

Figure 3: Efficiency Comparison

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