Application Note
How to Migrate Between LM614xx and LM624xx Product Families

TEXAS INSTRUMENTS

ABSTRACT

To meet a number of different applications, the LM614xx and LM624xx come in a wide variety of options (fixed output, different switching frequency, and so on.). Not all of these options are pin-to-pin (p2p) compatible. Currently the LM61435, LM61440, and LM61460 are p2p compatible between one another. Alternatively the LM62435 and LM62440 are p2p compatible. This application report highlights the different feature options and pin-outs between the LM61440 and LM62440 device examples. It also details how to best design a single universal PCB layout that is compatible with all devices in the LM614xx and LM624xx device set.

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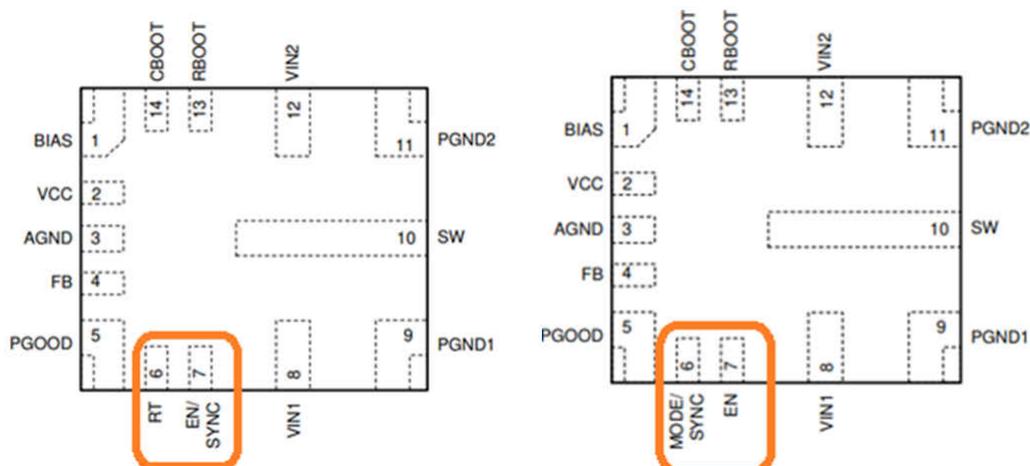# 1 LM61440-Q1 vs LM62440-Q1 Device Differences

Figure 1-1. LM61440-Q1 Pinout (Left) and LM62440-Q1 Pinout (Right)

Figure 1-1 highlights the key differences in device pin-out between the LM614xx and LM624xx device set using the LM61440-Q1 and LM62440-Q1 as device examples.

The primary distinctions between the LM614xx and LM624xx are listed below:

- **Switching frequency:** The LM624xx is internally set to a default switching frequency of 2.1MHz. The LM614xx enables control of the switching frequency through an adjustable RT resistor.
- **Mode selection:** The LM624xx enables control of the mode operation at light load. Pulling MODE/SYNC high results in FPWM mode setting while pulling MODE/SYNC low results in Auto mode setting. The LM614xx has the mode feature factory set and fixed per device option.
- **External synchronization:** To synchronize to a desired switching frequency the LM624xx requires a valid switching signal into the "MODE/SYNC" (Pin 6) for synchronization while the LM614xx uses "EN/SYNC" (Pin 7) for synchronization. Note that when using the external synchronization feature of the device spread-spectrum is disabled.
- **Output voltage setting:** The LM624xx is available in both adjustable and fixed output options. The LM614xx is only available in adjustable output option. For adjustable output options a top and bottom resistor is required while for fixed output options the feedback pin can be tied directly to the output rail for proper regulation.

Table 1-1 and Table 1-2 show the device comparison table of the LM61440-Q1 and LM62440-Q1 example devices and illustrates the difference between a LM614xx and LM624xx. The table provides the orderable device numbers and details the variety of different options the device is factory set to. Figure 1-2 and Figure 1-3 are example application circuits from the data sheet. To create a universal footprint to interchange between the LM614xx and LM624xx device set, several components must be considered.

Table 1-1. LM61440-Q1 Device Comparison Table

DEVICE	ORDERABLE PART NUMBER	REFERENCE PART NUMBER	LIGHT LOAD MODE	SPREAD SPECTRUM	OUTPUT VOLTAGE	SWITCHING FREQUENCY
LM61440-Q1	LM61440AANQRJRRQ1	LM61440AAN-Q1	Auto Mode	No	Adjustable	Adjustable
	LM61440AASQRJRRQ1	LM61440AAS-Q1	Auto Mode	Yes	Adjustable	Adjustable
	LM61440AFSQRJRRQ1	LM61440AFS-Q1	FPWM	Yes	Adjustable	Adjustable

Table 1-2. LM62440-Q1 Device Comparison Table

| DEVICE	ORDERABLE PART NUMBER	REFERENCE PART NUMBER	LIGHT LOAD MODE	SPREAD SPECTRUM	OUTPUT VOLTAGE	SWITCHING FREQUENCY
LM62440-Q1	LM62440APPQRJRRQ1	LM62440APP-Q1	Pin Selectable	Pin Selectable	Adjustable	2.1 MHz
	LM62440BPPQRJRRQ1	LM62440BPP-Q1	Pin Selectable	Pin Selectable	3.3 V	2.1 MHz
	LM62440CPPQRJRRQ1	LM62440CPP-Q1	Pin Selectable	Pin Selectable	5 V	2.1 MHz
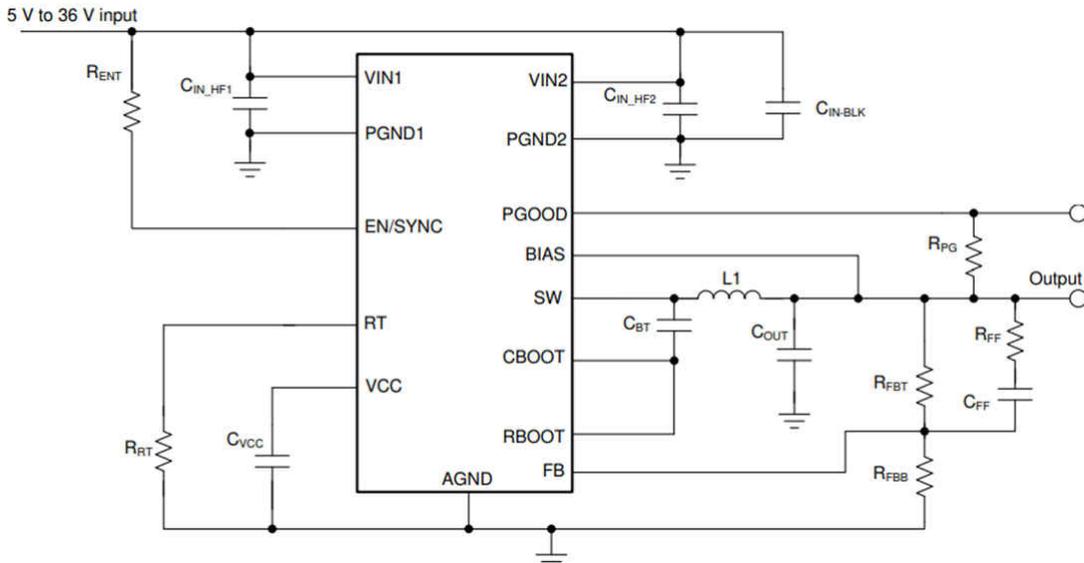
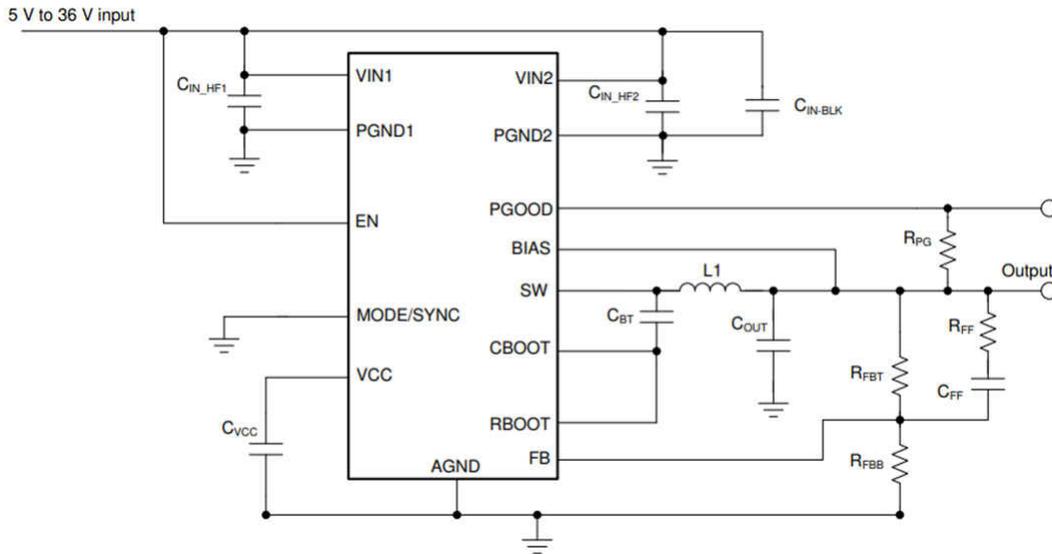**Figure 1-2. LM61440-Q1 Example Application Circuit**

Figure 1-3. LM62440-Q1 Example Application Circuit

2 Universal PCB Layout Design for Easy Swap Between LM614xx and LM624xx

2.1 FPWM and Auto Mode

In the case where FPWM mode is desired, the conversion from LM61440AFS-Q1 to LM62440APP-Q1 will require a layout change. This is because the change from the LM614xx to the LM624xx requires the resistor (RT resistor for LM614xx and MODE resistor for LM624xx) on Pin 6 to be connected to VIN or an external high voltage for the FPWM mode feature. To have a *future-proof* PCB layout that enables easy interchange between LM614xx to LM624xx, a top RT resistor between Pin 6 to VIN can be left DNP on the board.

If the FPWM variant of the LM614xx is used then that top RT resistor will be DNP. Alternatively if the LM624xx is used and FPWM mode is required then the bottom MODE resistor to GND is left DNP and the top MODE resistor to VIN is populated. For the case of Auto mode, the Auto mode variant of the LM614xx is used and the bottom RT resistor is populated to set the output voltage. Alternatively if the LM624xx is used and Auto mode is required then the top MODE resistor is left DNP and the bottom MODE resistor is populated.

2.2 Output voltage (Fixed to Adjustable, Vice Versa)

In the case where interchange between fixed and adjustable output is desired, the PCB should have both top and bottom feedback resistors on the board. This way for an adjustable output voltage device, both top and bottom feedback resistors are populated. In the case where the device is a fixed output variant, the bottom feedback resistor is left DNP while the top feedback resistor is populated to directly connect feedback to VOUT for proper regulation.

2.3 Component Selection Connection Instructions

Below is a list of considerations when using the LM614xx and LM624xx in the universal PCB layout design. Using the LM61460EVM as the basis for the universal PCB layout, only three additional components (C10, C13, and R4) are required to enable an easy swap between the LM614xx and LM624xx (Refer to Figure 2-1 for modified EVM schematic and Figure 2-2 for 3D EVM view of additional components).

Additional Components:

- R4 is the MODE_H pull up resistor for FPWM operation with the LM624xx
- C10 and C13 are the AC coupling capacitors for external synchronization on the SYNC pin of the LM614xx and LM624xx

LM614xx Component Selection Instructions:

- Pin 6 is RT pin on this device. Populate resistor RT/MODEL_L for desired switching frequency and leave resistor MODE_H resistor as DNP.
- Pin 7 is EN/SYNC. For external synchronization, populate (LM614xx)_CSYNC capacitor and leave capacitor (LM624xx)_CSYNC as DNP. Applying a valid external switching frequency on TP4 will set the device to FPWM Mode.

LM624xx Component Selection Instructions:

- Pin 6 is MODE/SYNC on this device.
- For Auto Mode feature, populate resistor RT/MODE_L and leave resistor MODE_H as DNP.
- For FPWM Mode feature, populate resistor MODE_H and leave resistor RT/MODE_L as DNP.
- For external synchronization, populate (LM624xx)_CSYNC capacitor and leave capacitor (LM614xx)_CSYNC as DNP. Applying a valid external switching frequency on TP4 will set the device to FPWM Mode.
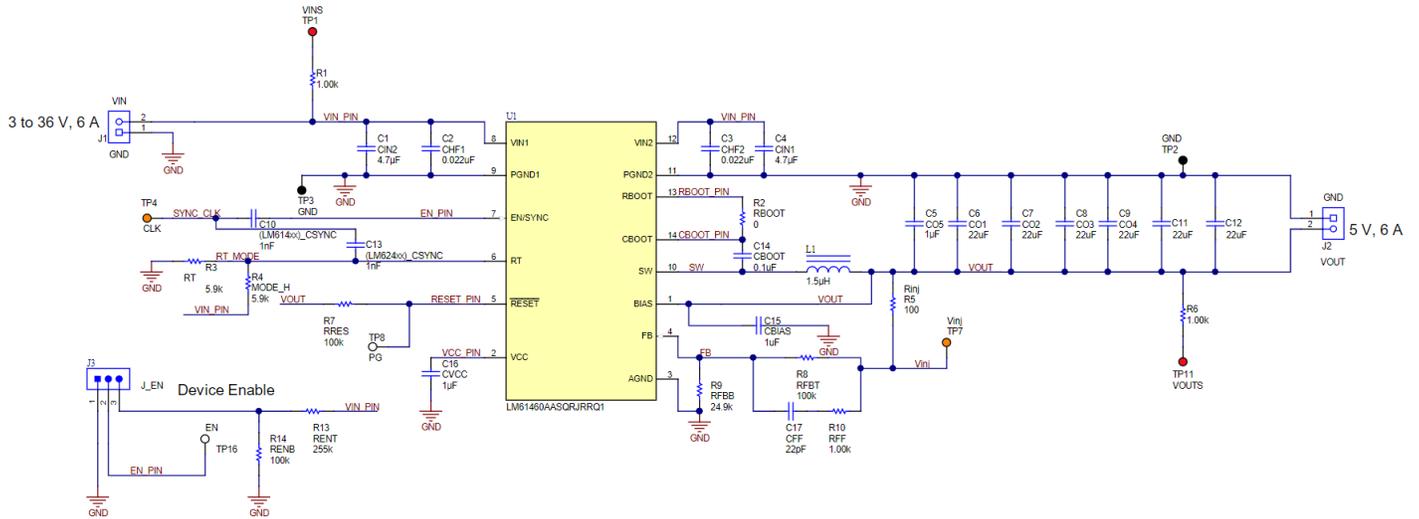
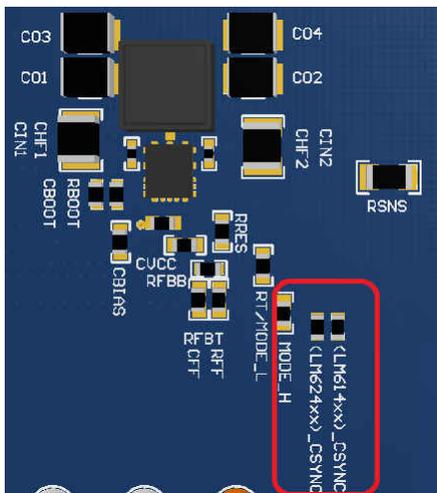**Figure 2-1. Universal Schematic with the LM61460-Q1**
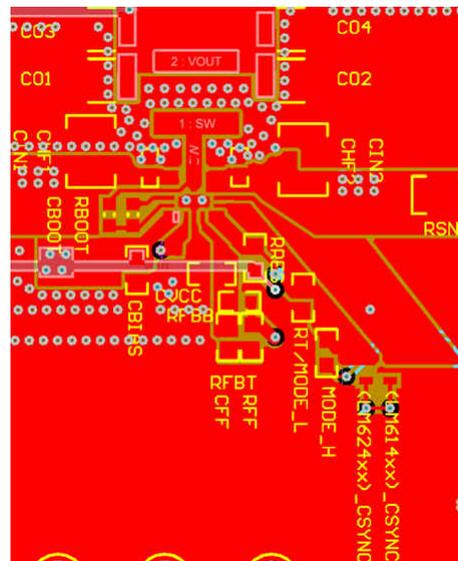

Figure 2-2. Universal PCB Layout 3D View
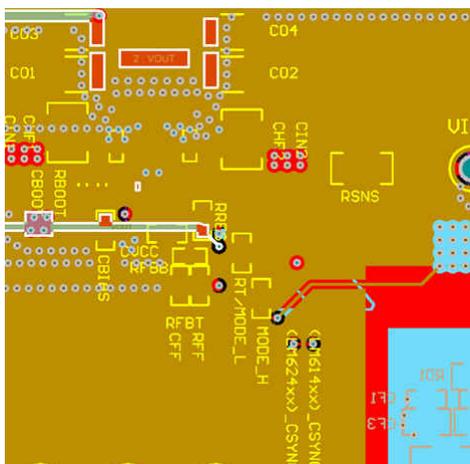

Figure 2-3. Universal PCB Layout Top Layer

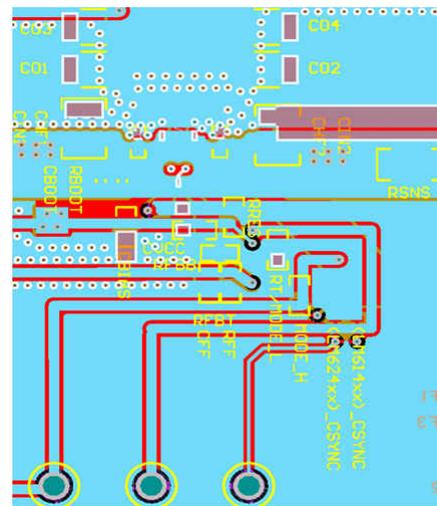**Figure 2-4. Universal PCB Layout Mid Layer 1**

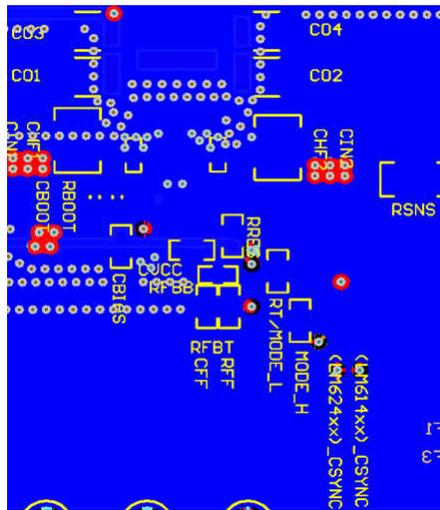**Figure 2-5. Universal PCB Layout Mid Layer 2**

Figure 2-6. Universal PCB Layout Bottom Layer

3 Summary

The details in this application note help differentiate the pinout difference between the LM614xx and LM624xx using the LM61440 and LM62440 as device examples. Pin 6 and Pin 7 are the two main device pinout differences that make the device family set not p2p compatible. A proposed universal PCB layout was provided to help customers create an all-in-one PCB layout solution that enables the quick swap between the LM614xx and LM624xx for a *future-proof* design. This makes it easy to interchange between the LM61435, LM61440, and LM61460 with the LM62435 and LM62440 devices.

4 References

1. Texas Instruments, *LM61440-Q1 Automotive 3-V to 36-V, 4-A, Low EMI Synchronous Step-Down Converter* data sheet.
2. Texas Instruments, *LM62440-Q1 Automotive 3-V to 36-V, 4-A, Low EMI Synchronous Step-Down Converter* data sheet.
3. Texas Instruments, *36-V, low EMI 6-A, 5-V Synchronous, 400-kHz, Step-Down Converter* evaluation module.

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