Examples of Connection Circuits

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The S-8473 Series and the S-8474 Series are wireless power ICs.
The S-8473 Series is a receiver control IC (Receiver), and the S-8474 Series is a transmitter control IC (Transmitter).
This application note serves as technical documentation that describes the combined operation and characteristics of the S-8473 Series and S-8474 Series.
Refer to the S-8473 Series and S-8474 Series datasheets for additional details.

Caution 1. Wireless power transfer devices which use the S-8473 Series and S-8474 Series are optimized to operate at LC resonant frequencies of approximately 88kHz to 106kHz. Within the 88kHz to 106kHz LC resonant frequency range, the circuit for detecting the receiver control IC operates, and the transmitter control IC also operates correctly. If the constants of the used coil (L) and capacitor (C) are changed, the LC resonant frequency also will change, so make sure to maintain the LC resonant frequency within the 88kHz to 106kHz range.

2. There is polarity to the receiver coil and transmitter coil in wireless power transfer devices which use the S-8473 Series and S-8474 Series. Combine receiver coils and transmitter coils according to the details in this application note.

7. Examples of Connection Circuits

7. 1 Addition of a step-up switching regulator to transmitter with a single 5V power supply

As shown in **Figure 42**, an external 9V VCC transmission line is no longer necessary if a step-up circuit is added to the 5V VDD1 line. Also, the regulator IC (S-812C50xxx) is connected in order to stabilize transmitter input voltage (V_{DD}).

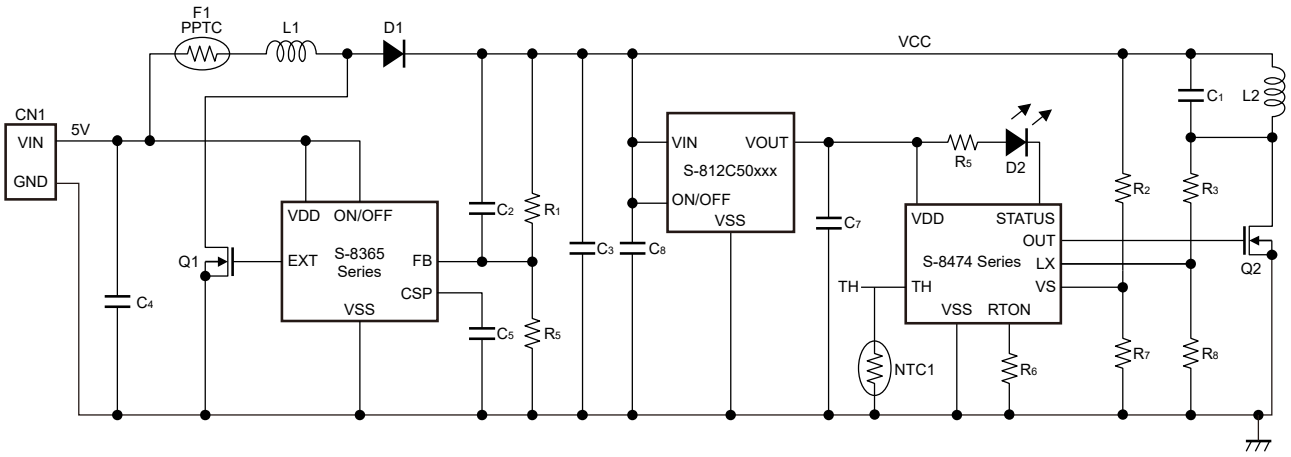

Figure 42 Example of Single Power Supply Input Transmission Circuit with Internal Step-up Circuit

7. 1. 1 PPTC (Resettable fuse)

Abnormal current will flow to VCC if a metal object is caught between the transmitter coil and receiver coil during power transfer. If this abnormal current causes the PPTC resistance to rise, the step-up operation of S-8365 Series will halt. If the step-up operation of S-8365 Series halts, the VIN line 5V will not be stepped up and will be supplied to the VCC as-is, so the VCC will operate at 5V. This results in decreased power transfer capacity, so the distance between coils required for continuous operation will be shorter, and S-8474 Series will switch to intermittent operation when the load current increases. In such cases, either shortening the distance between coils, or keeping the load current low maintains continuous operation. If the load current is low, the power transfer capacity is also low, so heat generation can be limited.

7. 1. 2 Current limit circuit

The method for detecting abnormal current higher than normal resulting from a metal object being caught between the transmitter coil and receiver coil during power transfer is shown in **Figure 43**. A 0.1Ω current sense resistor is used instead of a resettable fuse. Power transfer operation can be halted by detecting the current which flows through the current sense resistor using an operational amplifier or comparator and controlling the thermistor pin of S-8474 Series. Compared to a resettable fuse, this method allows for the detection current to be set arbitrarily, which is effective for reducing heat generation.

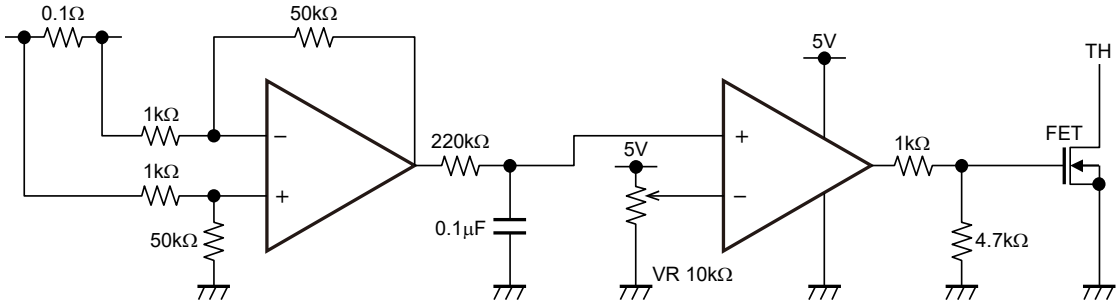

Figure 43 Example of Current Limit Circuit

Caution 1. The above connection diagram will not guarantee successful operation.
Perform thorough evaluation using the actual application to set the constant.
2. Since the transmitter detects reception, pay sufficient attention to the transmitter input voltage (V_{DD}) and the coil L1 voltage (V_{CC}) stabilities when designing a step-up circuit.
3. For transmitter VDD, it is recommended to connect a regulator IC when power is supplied.

7. 2 When the STATUS pin is connected to the customer circuit

Figure 44 shows a circuit example which the STATUS pin is connected to the customer circuit.
Using the STATUS pin signal, the operation status (during charge operation, during charge operation stop, or during error detection) can be detected in the customer circuit.
The STATUS pin outputs V_{OVP} during precharge operation, and precharge completion voltage (V_{PREH}) to charge completion voltage (V_{END}) during normal charge operation. FET3 drain pin logic for each status is shown in **Table 11**.

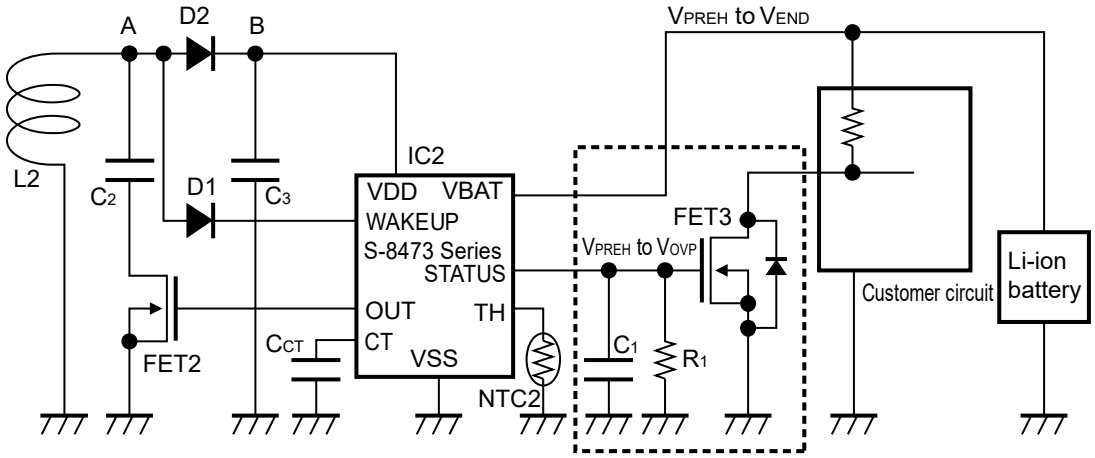

Figure 44 STATUS Pin Signal Usage Example

Note that a minute pulse with several μs width may be intermittently output from the STATUS pin at the last moment of charge operation completion.
Set R_1 to approximately 1MΩ and C_1 to approximately 1000pF as FET3 filters. If C_1 capacitance is too large, FET3 drain pin logic will not switch between "H" and "L" when an error is detected. Therefore, caution must be exercised.

Table 11

Operation Status		FET3 Drain Pin Logic
During charge operation	Precharge operation	"L"
	Normal charge operation	
During charge operation stop	Power-down status (Transmitter and receiver distant from each other)	"H"
During error detection	Short-circuit detection	"H"↔"L"
	Charge time-out status	

Remark The customer circuit is the load in the above example.

7. 3 Customer circuit operation during charging

The S-8473 Series does not assume the customer circuit operation during charging; however, operation for a short time during charging is possible. This will reduce the battery charge current and make the charging time longer.

If charging is not completed within the time set according to the C_{CT} capacitance, an error will be detected and charging will be stopped. Since charging cannot be carried out when an error is detected, the battery will be drained. After the error detection, separating the transmitter and receiver once and then placing them close together again will restart charging.

If the customer circuit is to be operated for an extended period of time during charging, maintain the customer circuit current consumption at the precharge current (I_{PRE}) or lower, and complete charging within the time set according to C_{CT} capacitance.

Remark The customer circuit is the load in the above example.

9. Board Design Considerations

- When wiring a board, make a single GND as described in the S-8473 Series and the S-8474 Series datasheets.
- To protect from overheat, be sure to connect an NTC thermistor to the TH pin for its use.
- For VCC in **Figure 47**, do not use a power supply which might cause frequency component amplitude of 1kHz to 110kHz (LC resonant frequency). It may result in a malfunction.
- For VDD in **Figure 47,** do not use a power supply which might cause frequency component amplitude to prevent from malfunction.
- When designing the board in **Figure 47**, for the following reasons, do not place a wiring near the RTON pin, the VS pin, and the TH pin. Layout so that resistor R_{TON} is as close to the RTON pin as possible.

  (1) Due to coil L1 and resonant capacitor (C_1), large voltage fluctuation is generated at point C.

  (2) Since impedance in the RTON pin, the VS pin, and the TH pin is high, they are easily affected by an extraneous signal.

  By connecting C_{RTON} (approximately 100pF to 1000pF) between the RTON pin and GND, C_{VS} (approximately 100pF to 1000pF) between the VS pin and GND and C_{NTC} (approximately 100pF to 1000pF) between the TH pin and GND, the influence of extraneous signal can be reduced.

  When detecting the coil temperature using an NTC thermistor in particular, the detection temperature may shift to the high temperature side as a result of the effect of the coil signal. It is recommended that C_{NTC} be connected between the TH pin and GND.

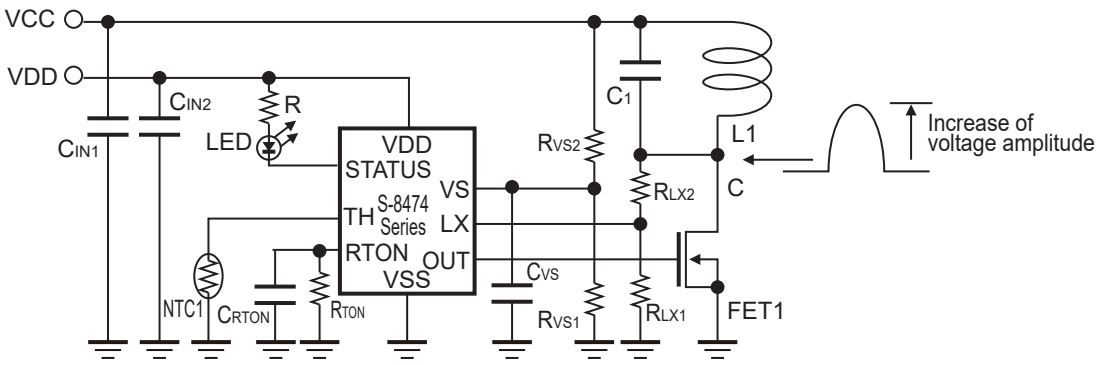

Figure 47

10. Precautions

- The usages described in this application note are typical examples using ABLIC Inc. ICs. Perform thorough evaluation before use.
- When designing for mass production using an application circuit described herein, the product deviation and temperature characteristics of the external components should be taken into consideration. ABLIC Inc. bears no responsibility for any patent infringements related to products using the circuits described herein.
- ABLIC Inc. claims no responsibility for any and all disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

11. Related Sources

Refer to the following datasheets for details of the S-8473 Series and the S-8474 Series.

S-8473 Series Datasheet
S-8474 Series Datasheet

The information described herein is subject to change without notice.
Please contact our sales representatives for information regarding the latest product version / revision.