

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 1 Description

The iW248 is a highly integrated solution for induction heating (IH) cooking applications for home appliances. The iW248 consists of a highly integrated hardware controller which supports I<sup>2</sup>C or Dialog's digital link (DLNK) communication protocol; a plate feedback network which ensures the stability of operation and a smart IGBT gate driver, significantly reducing the number of discrete components required. The hardware controller integrates valley-mode switching IGBT control to allow effective operation. It includes key built-in protection features in order to effectively protect the IGBT from damage. An innovative continuous low power mode allows the system to deliver continuous output power with 10W resolution. It provides several built-in pot detection features to allow fault-free heating to protect the IGBT from damage with different pot materials. The driving capability of the controller enables driving two IGBTs in parallel for higher output power applications.

### 2 Features

- Dedicated IGBT driving protection when over voltage occurs at gate voltage
- Supports both constant-current operation and constant-power operation
- Reduces EMI using valley-mode switching and optional turn-on time control feature
- Innovative pot detection through IGBT ring detection circuit
- Programmable protections include:
  - Over voltage protection - IGBT collector
  - Three dedicated temperature (OTP) sensing pins
  - Input surge voltage protection
  - Input surge current protection
  - Output power compensation to improve power accuracy
- Advanced innovative features (optional):
  - Low Power Continuous Mode (LPCM) for low output power operation
  - Able to control output power by 10W per step

### 3 Applications

- Inductive heating control

Smart IGBT Driver and Controller  
Solution for Inductive Heating Control

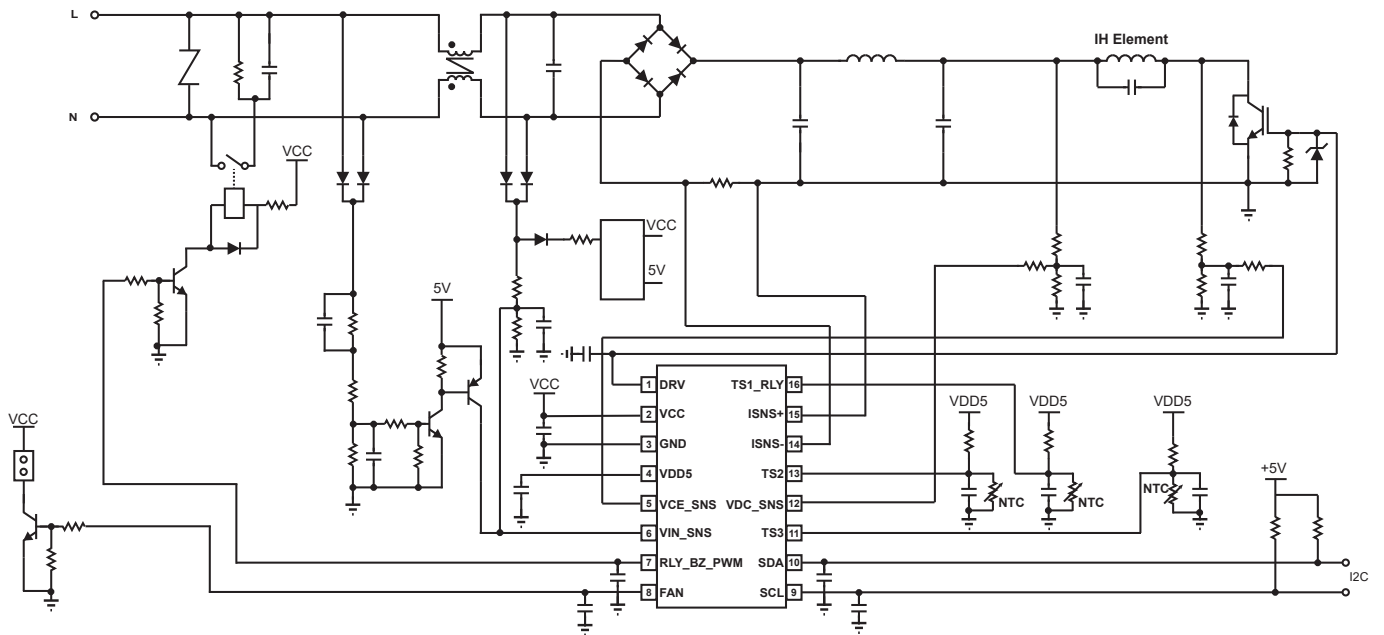


Figure 3.1 : iW248 Typical Application Circuit using I<sup>2</sup>C

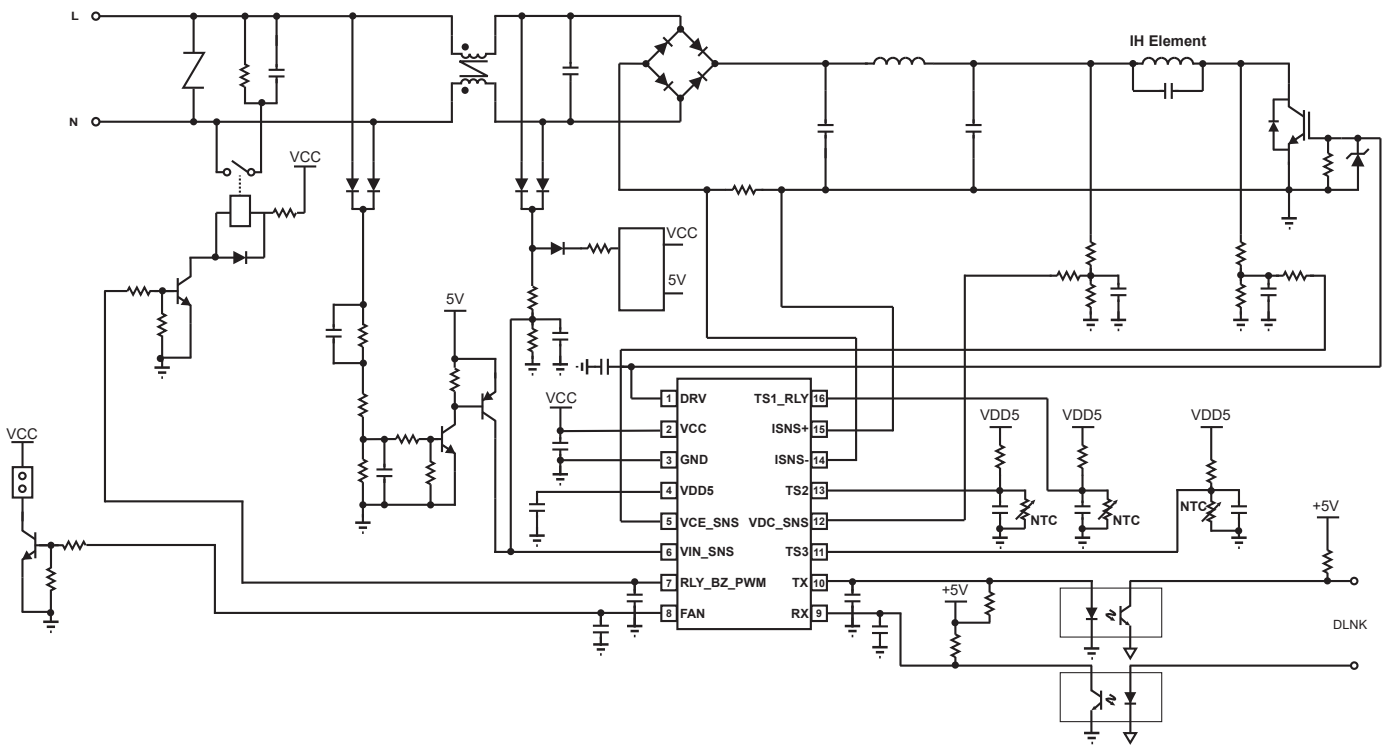


Figure 3.2 : iW248 Typical Application Circuit using DLNK

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 4 Pinout Description

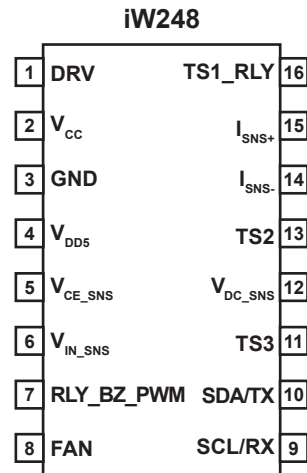


Figure 4.1 : 16-Lead SOIC Package

Pin #	Name	Type	Pin Description
1	DRV	Digital Output	Gate drive for the external IGBT.
2	V <sub>CC</sub>	Power Input	Determined by the V <sub>GE</sub> of the chosen IGBT (16-20V).
3	GND	Ground	Ground.
4	V <sub>DD5</sub>	Power	Output of 5V DC. Connect this pin to a capacitor.
5	V <sub>CE_SNS</sub>	Analog Input	IGBT collector voltage sense.
6	V <sub>IN_SNS</sub>	Analog Input	AC line voltage sense.
7	RL_BZ_PWM	Digital Output	Multi-function control pin for relay, buzzer and PWM driver.
8	FAN	Digital Output	PWM signal for Fan driver.
9	SCL/RX	Digital Input	I <sup>2</sup> C SCL/DLNK RX.
10	SDA/TX	Digital Input/ Output	I <sup>2</sup> C SDA/DLNK TX (open drain).
11	TS3	Analog Input/ Output	Temperature sense. Connect this pin to an NTC resistor.
12	V <sub>DC_SNS</sub>	Analog Input	Coil Voltage sense.
13	TS2	Analog Input/ Output	Temperature sense. Connect this pin to an NTC resistor.
14	I <sub>SNS-</sub>	Analog Input	Current sense input. Connect to negative terminal.
15	I <sub>SNS+</sub>	Analog Input	Current sense input. Connect to positive terminal.
16	TS1_RLY	Analog Input/ Output	Multi-function pin. Connect to an NTC resistor for temperature sensing. Or, use to control relay.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 5 Absolute Maximum Ratings

Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded. For maximum safe operating conditions, refer to the Electrical Characteristics section.

Parameter	Symbol	Value	Units
DC supply voltage range (pin 2, $I_{CC} = 20$ mA max)	$V_{CC}$	-0.3 to 22.0	V
Internal DC supply voltage range (pin 4, $I_{CC} = 20$ mA max)	$V_{DD5}$	-0.3 to 6.5	V
Current sense (pin 15)	$V_{ISNS+}$	-0.3 to 0.3	V
Current sense (pin 14)	$V_{ISNS-}$	-0.8 to 0.3	V
Voltage sense input (pin 5, 6, 12)	$V_{CE\_SNS}, V_{DC\_SNS}, V_{IN\_SNS}$	-0.3 to 6.5	V
Temperature sense input (pin 11, 13, 16)	TS1, TS2, TS3	-0.3 to 6.5	V
Digital input (pin 9, 10)	SCL/RX, SDA/TX	-0.3 to 6.5	V
Maximum junction temperature	$T_{JMAX}$	150	°C
Operating junction temperature	$T_{JOPT}$	-40 to 150	°C
Storage temperature	$T_{STG}$	-55 to 150	°C
Electrostatic Discharge Capability (Human Body Model), JEDEC JS-001-2017	$ESD_{(HBM)}$	±2000	V
Electrostatic Discharge Capability (Charged Device Model), JS-002-2014	$ESD_{(CDM)}$	±1000	V
Latch-up test per JESD78E		±100	mA

### 6 Thermal Information

Parameter	Symbol	Value	Unit
Thermal Shutdown Threshold (Note 1)	$T_{SD}$	145	°C
Thermal Shutdown hysteresis (Note 1)	$T_{Hy}$	30	°C

#### Notes:

Note 1. These parameters are typical and they are guaranteed by design.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 7 Electrical Characteristics

$V_{CC} = 18V$ ,  $-40^{\circ}C \leq T_A \leq 85^{\circ}C$ , unless otherwise specified (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>DRV SECTION (Pin 1)</b>						
Pull-up resistance	$R_{OH}$	$I_{OUT} = -10mA$ , $V_{CC} = 18V$	18		38	$\Omega$
Pull-down resistance	$R_{OL}$	$I_{OUT} = 10mA$ , $V_{CC} = 18V$	3		10	$\Omega$
<b>V<sub>CC</sub> SECTION (Pin 2)</b>						
Operating voltage (Note 1)	$V_{CC}$		16	18	20	V
Start-up threshold	$V_{CC(ST)}$	$V_{CC}$ rising	9.6	10	10.4	V
Under-voltage lockout threshold	$V_{CC(UVL)}$	$V_{CC}$ falling	6.6	7	7.4	V
Operating current	$I_{CC\_VCC}$	$V_{CC} = 18V$ , without driving IGBT, fan and relay	5		8	mA
<b>V<sub>DD5</sub> SECTION (Pin 4)</b>						
Output voltage	$V_{DD5}$		4.95	5.00	5.05	V
Start-up threshold	$V_{DD5(ST)}$	$V_{CC}$ rising	4.4	4.5	4.6	V
Under-voltage lockout threshold	$V_{DD5(UVL)}$	$V_{CC}$ falling	3.9	4.0	4.1	V
<b>VCE_SNS SECTION (Pin 5)</b>						
Over voltage protection threshold	$V_{CE\_OVP}$		1.73	1.79	1.85	V
Valley voltage detection threshold	$V_{CE\_VAL}$		0.235	0.25	0.27	V
Configuration current	$I_{CE\_CFG}$		93	100	107	$\mu A$
Cross mid-voltage threshold	$V_{CE\_MID}$		0.1		0.6	V
<b>VIN_SNS SECTION (Pin 6)</b>						
Surge voltage protection threshold	$V_{IN\_SVP}$		3.6	4	4.4	V
$V_{IN}$ Surge Voltage Protection Hysteresis	$V_{IN\_SVP\_HYS}$			80		mV
Unplug detection voltage threshold	$V_{IN\_POD}$	$V_{IN}$ falling	0.42	0.45	0.485	V
Unplug detection voltage hysteresis	$V_{IN\_HYS}$			25		mV
<b>Fan and Relay driver SECTION (Pin 7 = RLY_BZ_PWM , 8 = FAN)</b>						
Driving tolerance voltage	$V_{FAN\_DRV}$ $V_{RELAY\_DRV}$		4.95	5	5.05	V
High-level output voltage	$V_{OH}$	$V_{OH} = V_{DD} - V_{OUT}$ , $I_{SINK} = 5mA$	$V_{DD} - 0.4$			V
Low-level output voltage	$V_{OL}$	$I_{SOURCE} = 5mA$			0.2	V

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 7 Electrical Characteristics (cont.)

$V_{CC} = 18V$ ,  $-40^{\circ}C \leq T_A \leq 85^{\circ}C$ , unless otherwise specified (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>I<sup>2</sup>C/ DLNK SECTION (Pin 9 &amp; 10)</b>						
High level input voltage	$V_{IH\_5V}$	5V option	3.7			V
	$V_{IH\_3V3}$	3.3V option	2.4			
Low level input voltage	$V_{IL\_5V}$	5V option			1.2	V
	$V_{IL\_3V3}$	3.3V option			1.0	
Low level SDA for I <sup>2</sup> C option	$V_{OL\_SDA}$	$I_{SOURCE} = 5mA$			0.2	V
<b>Temperature sensing TS1, TS2 &amp; TS3 SECTION (Pin 11, 13 &amp; 16 )</b>						
Input voltage range	$V_{TS1\_RANGE}$		0		2.4	V
<b>TS1 SECTION , when used as relay driver (Pin 16)</b>						
Driving tolerance voltage	$V_{TS1\_RLY\_DRV}$		4.95	5	5.05	V
High-level output voltage	$V_{OH\_TS1}$	$V_{OH} = V_{DD} - V_{OUT}$ , $I_{SINK} = 5mA$	$V_{DD} - 0.4$			V
Low-level output voltage	$V_{OL\_TS1}$	$I_{SOURCE} = 5mA$			0.2	V
<b>VDC_SNS SECTION (Pin 12)</b>						
Configuration current	$I_{DC\_CFG}$		93	100	107	$\mu A$
<b>Current sensing SECTION (Pin 14 &amp; 15)</b>						
Sense voltage range	$V_{ISNS\_RANGE}$		-0.4		0	V

#### Notes:

Note 1. These parameters are not 100% tested. They are guaranteed by design and characterization.

Smart IGBT Driver and Controller  
Solution for Inductive Heating Control

8 Functional Block Diagram

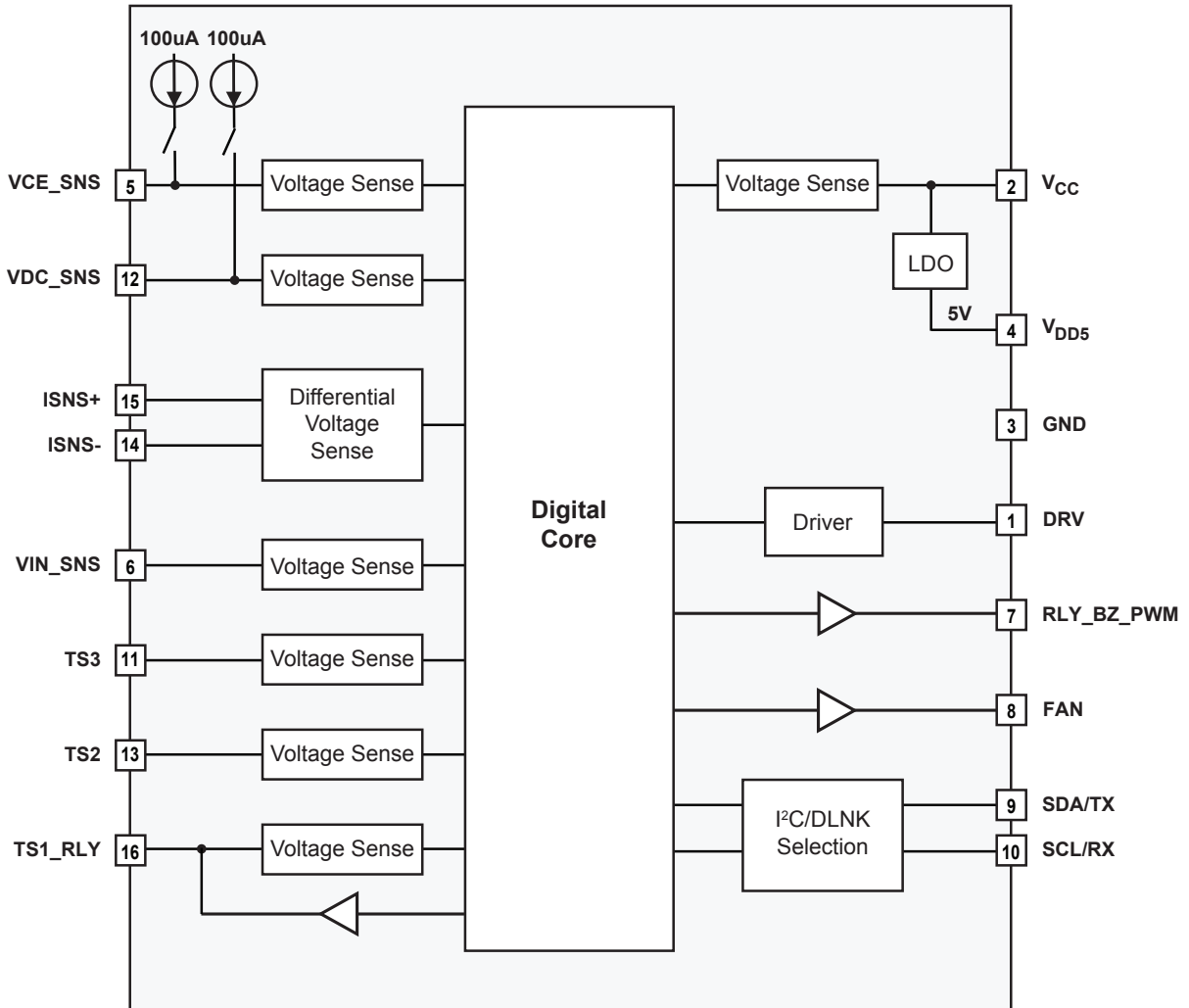


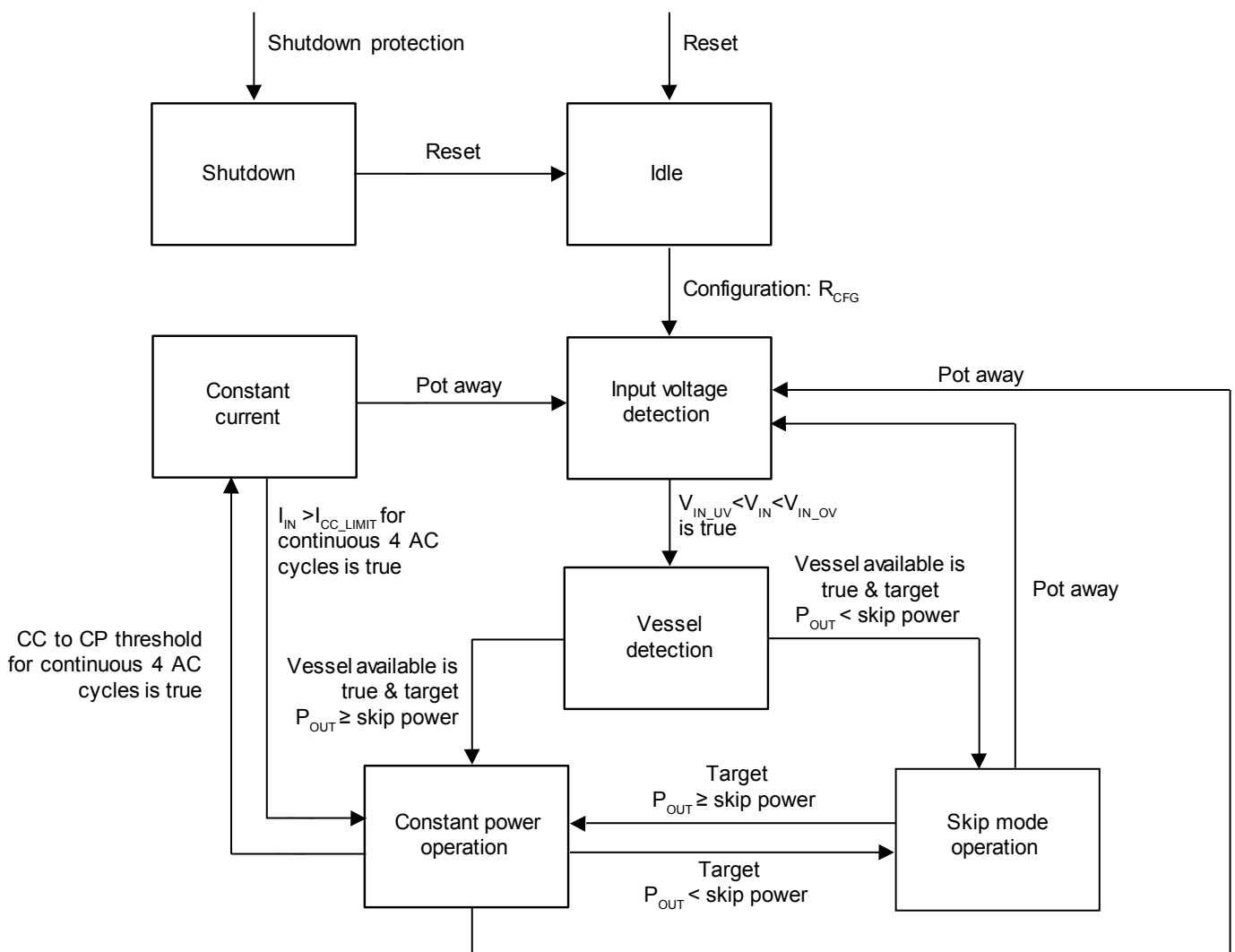
Figure 8.1 : iW248 Functional Block Diagram

**Smart IGBT Driver and Controller  
Solution for Inductive Heating Control**

**9 Theory of Operation**

The iW248 is a digital controller with an integrated IGBT driver for inductive (IH) cooking applications. Once  $V_{CC}$  reaches the startup threshold level (Figure 9.1), the controller operates in idle mode and is ready to receive instructions from the user interface MCU. Soon after the iW248 receives instructions, it starts to detect and determine the input line voltage. If the input line voltage is within the operation range, the controller enters pot detection mode. The iW248 features an innovative pot detection method by detecting the number of rings on  $V_{CE}$  of the IGBT. A pulse is sent out at DRV pin every second by default, a pot is detected if the number of rings on  $V_{CE}$  is less than nine. When a pot is detected, the iW248 goes to constant power mode operation or constant current mode according to the input line voltage.

Figure 9.1 outlines the state machine diagram.



**Figure 9.1 : State Machine Diagram**

The iW248 has different parameter settings based on different ranges of operating input voltage (typically 110V<sub>AC</sub> or 220V<sub>AC</sub>). Please follow the design considerations for 110V<sub>AC</sub> designs or 220V<sub>AC</sub> designs based on your application need.



## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 220V<sub>AC</sub> Input Voltage Applications

To achieve precise output power, the internal digital control block performs best with a 20mΩ current sensing resistor and internal ratio of 180 (denoted as  $C_{RV\_SNS}$  in register table) with  $V_{IN\_SNS}$ . In addition,  $I_{SNS+}$  and  $I_{SNS-}$  shall be as close as possible to the current sensing resistor otherwise output power accuracy will be affected. The innovative controller is capable of delivering precision output power by integral of  $V_{IN}$  and  $I_{IN}$  through signal from  $V_{IN\_SNS}$ ,  $I_{SEN+}$  and  $I_{SEN-}$ . Precision output power during skip mode operation is possible with Dialog's innovative internal digital block.

### 110V<sub>AC</sub> Input Voltage Applications

For output power control at 110V<sub>AC</sub> applications, the sensing resistor needs to be 10mΩ and internal ratio of 90 (denoted as  $C_{RV\_SNS}$  in register table)  $V_{IN\_SNS}$ .

In case output power is offset, a power compensation feature is available by either changing the values of  $R_{CFG1}$  and  $R_{CFG2}$  or changing the value of register 0x05 [7:4].

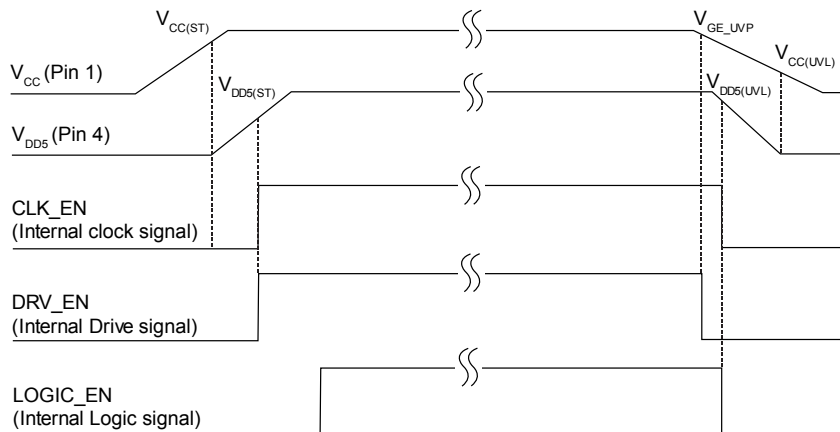
Table 9.1 shows the power compensation setting and the range of resistors values. During the power compensation configuration, the internal digital control block senses  $R_{CFG1}$  and  $R_{CFG2}$ , and then sets a corresponding percentage of power compensation.

Power Compensation Setting	$R_{CFG1}$			
	<3kΩ	5-7kΩ	9-11kΩ	13-15kΩ
$R_{CFG2} < 7k\Omega$	0%	+3.125%	+6.25%	-6.25%
$9k\Omega < R_{CFG2} < 15k\Omega$	-3.125%	+1.56%	-1.56%	+4.69%

**Table 9.1: Power compensation settings**

Low power continuous mode (LPCM) operation is an optional feature for system design with a power delivery requirement of 10W per step at low power range. The feature is described in the following section 9.3.

In case the iW248 detects any fault condition, it will take action to protect the system to avoid catastrophic damage. Clearly the IH system will fail if the  $V_{CC}$  pin and is shorted to the DRV pin. Care must be taken to ensure this does not happen during the manufacturing process. The protection features and actions are outlined in the protection section. Figure 9.2 illustrates of the start-up and shutdown sequences.



**Figure 9.2 : Start-up and Shutdown Sequencing Diagram**

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 9.1 Pin Detail

#### Pin 1 – DRV

Gate drive for the external IGBT. It can be programmed to operate as patented soft drive feature.

#### Pin 2 – V<sub>CC</sub>

Power supply for the controller. Start-up when V<sub>CC</sub> reaches 10V (typ) and shutdown when V<sub>CC</sub> falls below 7V (typ). A ceramic capacitor of 4.7μF should connect between V<sub>CC</sub> to GND (pin 3).

#### Pin 3 – GND

Ground.

#### Pin 4 – V<sub>DD5</sub>

Internal 5 V LDO output pin. A ceramic capacitor of 4.7μF should connect between V<sub>DD5</sub> to GND (pin 3). V<sub>DD5</sub> is a dedicated power supply solely for temperature sensing circuits to ensure the temperature sensing accuracy. It is not intended to drive other circuits.

#### Pin 5 – VCE\_SNS

IGBT collector voltage sense pin.

#### Pin 6 – VIN\_SNS

AC line voltage sense pin.

#### Pin 7 – RLT\_BZ\_PWM

Multi-function control pin for relay, buzzer and PWM driver. Programmed by I<sup>2</sup>C/DLNK.

#### Pin 8 – FAN

Fan drive pin.

#### Pin 9 – SCL/ RX

Communication pin. SCL for I<sup>2</sup>C (clock frequency 100kHz). Rx for DLNK. User is recommended to use DLNK version for multi-panel design.

#### Pin 10 – SDA/ TX

Communication pin. SDA for I<sup>2</sup>C. Tx for DLNK.

#### Pin 11 –TS3

Temperature sense pin. Connect this pin to a NTC resistor.

#### Pin 12 – VDC\_SNS

Coil Voltage sense pin.

#### Pin 13 – TS2

Temperature sense pin. Connect this pin to a NTC resistor. The current sense resistor should be 20mΩ for 220V<sub>AC</sub> applications and 10mΩ for 110V<sub>AC</sub> applications.

#### Pin 14 – ISNS-

Current sense input. Connect to negative terminal.

#### Pin 15 – ISNS+

Current sense input. Connect to positive terminal.

#### Pin 16 – TS1\_RLY

Multi-function control pin for temperature sense or relay.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 9.2 Normal Switching Operation

The iW248 drives an LC circuit comprised of an induction heating element and resonant capacitor. The controller uses Dialog's quasi-resonant valley-mode switching technology to drive an IGBT to control the heating element as effectively as possible. The controller modulates the  $t_{ON}$  time and delay time ( $t_{DELAY}$ ) to maintain a constant output power requested by the user interface MCU. When the IGBT turns off, the voltage at the collector of the IGBT will quickly rise up above the input voltage as the resonant capacitor charges up by the current of the inductor. The voltage at the collector of the IGBT will fall from its maximum value when the polarity of the inductor changes. When the voltage on the collector of the IGBT reaches the same value as the voltage on the coil, the internal block of the controller gives the next driving pulse after it waits a programmed delay time ( $t_{DELAY}$ ). This delay time can be adjusted via the digital control bus based on the system requirements. Figure 9.3 shows a typical waveform of an IH system. The iW248 directly monitors input voltage and current and the digital control unit inside the iW248 uses these values to calculate the on-time required as a function of requested output power.

As the output power decreases, the energy in the LC tank is insufficient to achieve zero-voltage switching. To prevent the IGBT from over-heated from excessive switching loss, the  $V_{CE\_SNS}$  pin senses the  $V_{CE}$  level for every switching cycle and counts the occurrence when the  $V_{CE}$  doesn't reach its valley threshold. The default  $V_{CE}$  valley threshold is 150V; the value is programmable. The user interface MCU can read the number of occurrences within four rectified AC cycles from register 0x8D and determine the necessary action.

Protection circuits are included in the iW248 to ensure that the switching frequency stays within a desired range. See section 9.4 for more details.

Channel 1:  $V_{GE}$  Channel 2:  $V_{DC\_COIL}$  Channel 3:  $V_{CE}$  Channel 4:  $I_{COIL}$

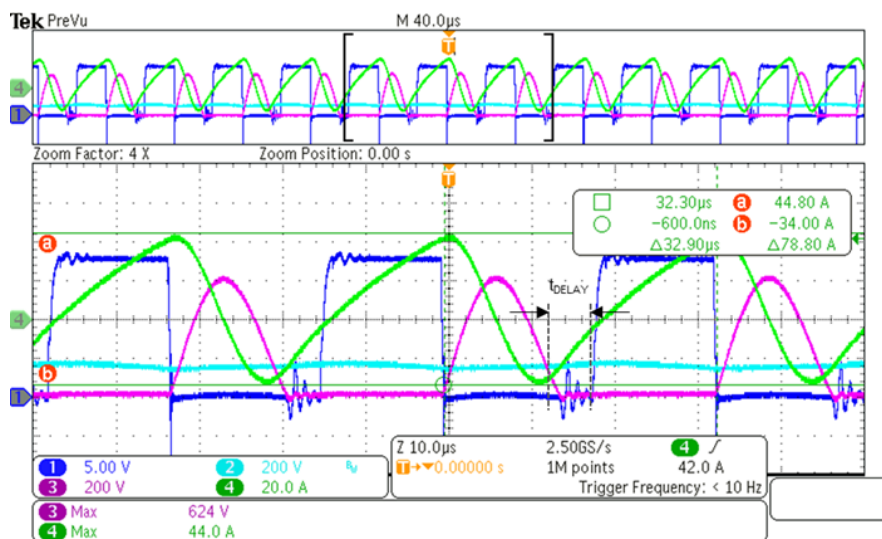


Figure 9.3 : Static operation

### 9.3 Low Power Continuous Mode (LPCM) Operation (Patent Pending)

During normal operation, the controller uses Dialog's quasi-resonant valley-mode zero-voltage switching technology to minimize the loss across the IGBT. When the power level needs to go to a pre-defined lower level, there is a point at which zero-voltage switching can no longer be achieved and the IGBT can become hot during the switching transitions. To protect the IGBT and maintain good efficiency, the iW248 enters skip mode operation to reduce the average power. The controller determines the number of cycles to skip based on the requested target power and the minimum continuous power setting. The skip mode period can also be configured digitally through the control registers. Dialog's unique implementation allows the end appliance to improve output power accuracy and reduce the power level in a

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

manner where the end user cannot see the skip mode operation as the skipping period is according to the number of rectified AC cycles. The IH system can achieve 10W resolution with the advanced digital control block.

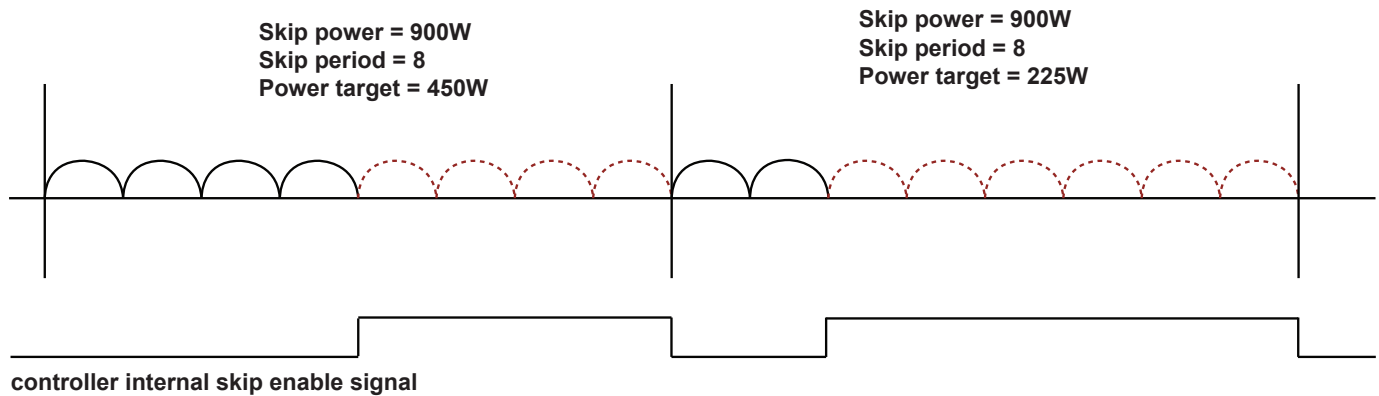


Figure 9.4 : Low Power Continuous Mode Operation

## 9.4 Protection Features

The iW248 includes several protection features to offer a robust solution for driving an IGBT in a high voltage, high current application to ensure a fully protected solution for induction cooktop appliances.

### 9.4.1 IGBT Gate Protection

The IGBT gate is a MOSFET structure and is susceptible to voltage overstress if not carefully controlled. The iW248 offers both over voltage and under voltage circuits for protecting the gate of the IGBT. The over voltage protection level for the IGBT gate is set at a default value of 20V but can be programmed via the digital control bus. If the controller detects a voltage higher than the OVP threshold for more than 128 $\mu$ s, the DRV output is disabled until the voltage on the DRV pin drops below 19V, at which point, the controller goes back to input voltage detection state.

The iW248 also includes an under voltage protection circuit to ensure that the IGBT has enough drive to turn on safely. The default value is 10V but can also be programmed via the digital bus. Similar to the over voltage protection, when a fault is detected for 128 $\mu$ s, the DRV output is disabled until the voltage goes above 11V. At that point, the controller goes back to input voltage detection state.

### 9.4.2 IGBT $V_{CE}$ Protection

The iW248 also protects the IGBT by monitoring the voltage at the collector of the IGBT for over voltage conditions. If the voltage at the IGBT exceeds a programmed value (default  $V_{CE\_OVP} = 1075V$ ) for more than 1 $\mu$ s, the controller reduces the on-time by 1.5% until the  $V_{CE}$  value drops below the OVP threshold value or the on-time reaches the  $T_{ON\_NOR}$  value. If the controller on-time reaches the  $T_{ON\_NOR}$  value before the IGBT voltage goes below the OVP threshold, the controller will drive the IGBT at its internally calculated  $T_{ON}$  value for the next 20 AC cycles. If  $T_{ON}$  is at its minimum value and  $V_{CE}$  is still higher than  $V_{CE\_OVP}$  for 8 cycles, the system will be shutdown. If  $V_{CE}$  is greater than  $V_{CE\_OVP}$  for more than 50 $\mu$ s, then the output switching is disabled immediately and the system shuts down. The system needs to be restarted via software or by a power-on reset signal.

The iW248 also provides a secondary over voltage protection for the IGBT. With a default threshold voltage of 1200V (programmable), the controller reduces the on-time by 50% (programmable). If the over voltage event occurs for 4 consecutive switching cycles (number of cycles are programmable), the output drive of the iW248 shuts down and stays off for 3 seconds. After this time, the controller goes back to the input voltage detection state.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### 9.4.3 Input Surge Current

If the input current is greater than 40A (programmable via digital bus from 20A to 57.5A) for more than 10 $\mu$ s (programmable between 6 $\mu$ s to 21 $\mu$ s), the output switching pulse is disabled. The circuit waits for 3 seconds and goes back to the input voltage detection state.

### 9.4.4 Input Current Transient

The absolute value of the input current on each AC cycle is monitored and compared to the current in the previous cycle. If the absolute value of the input current exceeds the absolute value of the current from the previous cycle by 2A (programmable to 0.5A/1A/2A or 3A), the T<sub>ON</sub> time is reset to minimum and increased gradually to the target power. This can also be programmed to reduce the output power to the minimum level and stay there for 3 seconds after the fault is removed. The minimum power will be the power target/skip power target.

### 9.4.5 Input Voltage Transient

Similar to the Input Current Transient protection, the RMS voltage is measured and compared to the previous AC cycle. If the voltage changes by more than 20V default (programmable from 8V to 68V), the controller changes the output power to the minimum value and stays at minimum power for 3 seconds after the fault is removed. The minimum power will be the power target/skip power target.

### 9.4.6 Input Over and Under Voltage

If the input voltage exceeds an internal high voltage threshold of 285V (programmable) for more than 8 consecutive AC cycles, the switching is disabled until the input voltage drops to a normal operating voltage range. At this point, the controller restarts the start-up sequence.

If the input voltage drops below an internal low voltage threshold of 125V (programmable) for more than 8 AC cycles (number of cycles is also programmable to 2/4/8/15), switching is disabled until the input voltage returns to a normal operating voltage range. At this point, the controller goes back to input voltage detection state.

### 9.4.7 Input Surge Voltage Protection

If the input voltage exceeds 600V the output is immediately disabled and the circuit is shut down until fault removal and stays off for 3 seconds after fault removal. After the 3 seconds period times out, the controller goes back to input voltage detection state.

### 9.4.8 Switching Frequency Protection

The iW248 modulates the on-time to control the output power, but it also monitors on-time to protect the IGBT from failure. If the switching frequency goes below a minimum switching frequency the device will automatically reduce the on-time by 1 $\mu$ s. If the frequency stays below the minimum switching frequency for more than 8 AC cycles, the system will be restarted by a software and POR reset.

If the 1 $\mu$ s reduction to the on-time is enough to bring the switching frequency above the 16kHz minimum, the on-time will keep this adjusted value until the switching frequency goes above the minimum switching frequency plus some hysteresis calculated by equation 9.1.

$$F_{SW\_OK} = \frac{1}{\left(\frac{1}{F_{SW\_MIN}} - 2\mu\text{s}\right)} \quad (9.1)$$

The iW248 also includes maximum switching frequency protection. Once the switching frequency exceeds the maximum value, the iW248 counts and stores the number of cycles when the switching frequency is above the maximum value. If the value goes 10kHz above the maximum switching frequency for 8 AC cycles, the system will reset.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

The default minimum switching frequency for the iW248 is 16kHz and the default maximum switching frequency is 35kHz, and both values are programmable via the I<sup>2</sup>C/DLTK communication bus.

### 9.4.9 I<sup>2</sup>C/DLTK Communication Error

If the digital communication protocol fails to complete a write operation within 1 second, the output drive pulse will turn off and the controller will go back to the start-up sequence.

## 9.5 Over Temperature Protection (OTP)

The iW248 integrates both internal and external temperature protection circuits to protect both the controller and the entire system.

### 9.5.1 Internal OTP

The iW248 controller has an internal temperature sensor and when the internal junction temperature exceeds 145°C, the output stops switching and waits until the junction temperature drops below the recovery threshold of 115°C before the device restarts the start-up sequence. Both the shutdown threshold and recovery threshold are programmable.

### 9.5.2 External OTP

The iW248 has multiple sensor inputs to monitor system temperature and uses those inputs to protect the system.

#### TS1\_RLY

The TS1\_RLY works with the recommended circuit in figure 9.5 and has a default over temperature threshold of 110°C and a default recovery threshold of 80°C. These are both programmable via the digital control bus.

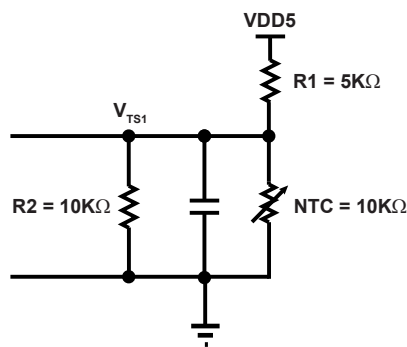


Figure 9.5 : External NTC Circuit for TS1\_RLY

#### TS2

The TS2 works with the recommended circuit in figure 9.6 and has a default over temperature threshold of 200°C and a default recovery threshold of 170°C. These are both programmable via the digital control bus.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

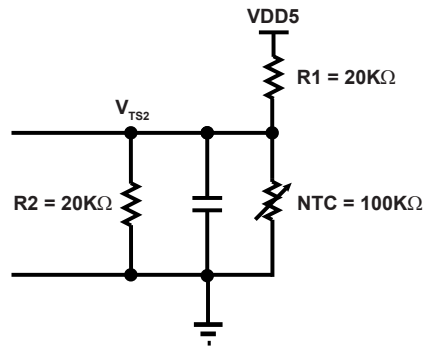


Figure 9.6 : External NTC Circuit for TS2

### TS3

The TS3 input works with the recommended circuit in figure 9.7 and has a default over temperature threshold of 200°C and a default recovery threshold of 170°C. These are both programmable via the digital control bus.

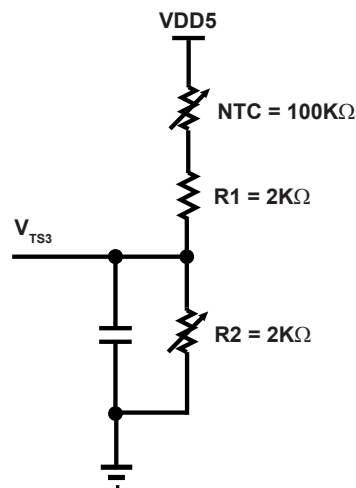


Figure 9.7 : External NTC Circuit for TS3

## 9.6 EMI Enhancement Features

The iW248 consists of a programmable EMI enhancement feature. The turn on time ( $T_{ON}$ ) of the IGBT is calculated according to the envelope of the rectified input voltage; therefore, the harmonics of the switching frequency causes relatively high EMI emission.

This is an option to spread out the switching frequency to reduce EMI. Output power will match with the target output power as the internal digital block calculates the required  $T_{ON}$ . Dialog recommends implementing this feature at heavy output power. The default option works by having the controller decrease  $T_{ON}$  by a step of 1/2048 starting from 2ms before reaching the peak of the AC cycle. Then, the controller increases  $T_{ON}$  by the same step for 2ms. The step size, duration of  $T_{ON}$  control and the position of the AC cycle where to count for the duration are programmable.

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

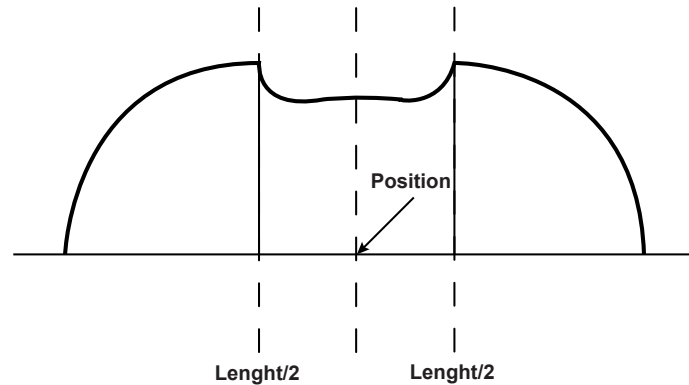


Figure 9.8 : Default EMI Enhancement control

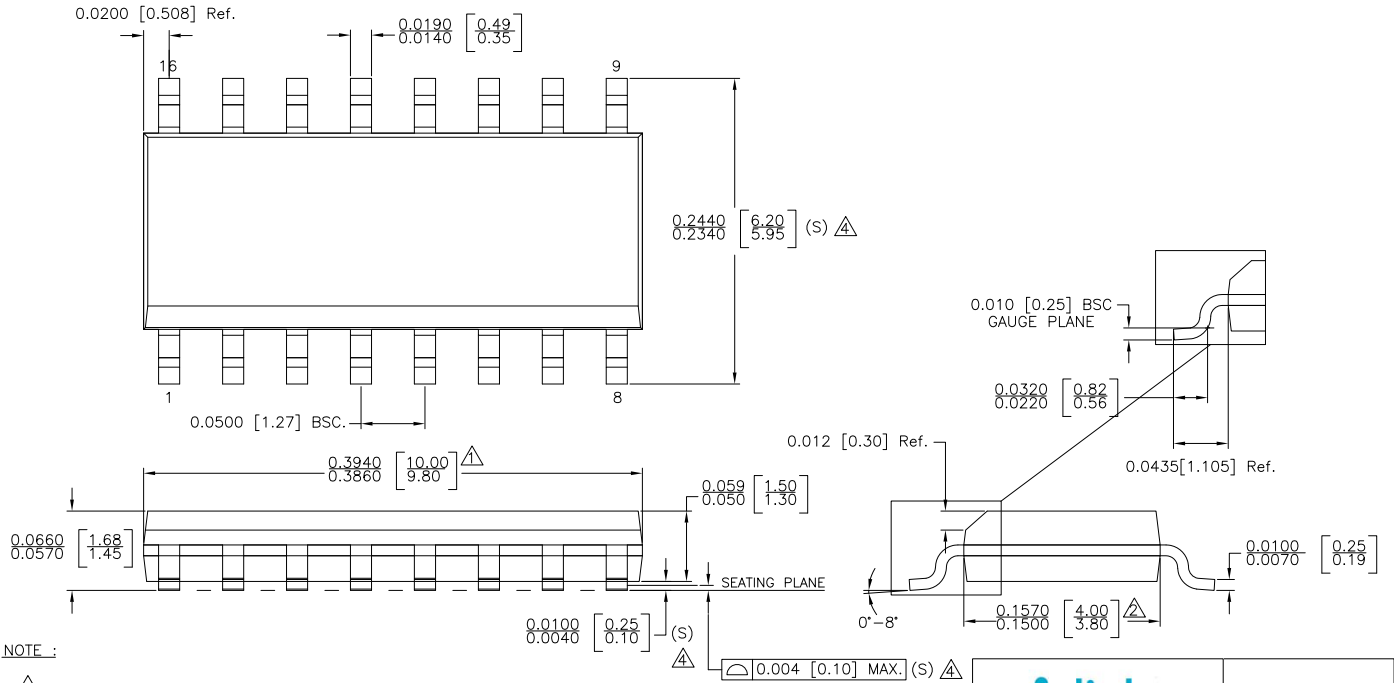
### 9.7 $V_{CC}$ Power Supply Voltage

The iW248 requires a  $V_{CC}$  voltage for proper operation and most systems will also require a lower DC voltage such as 5V or 3.3V for a human interface MCU. The  $V_{CC}$  voltage can be as high as 18V, but will directly depend upon the voltage required to drive the IGBT. Dialog offers multiple solutions for the  $V_{CC}$  power supply circuit, including isolated or non-isolated solutions. The decision between isolated or non-isolated will depend upon the specific application safety requirements. For isolated applications, the iW1819 can be configured with a dual output to provide both  $V_{CC}$  and the MCU power supply voltage. For non-isolated applications, the iW1900 can be used to generate the  $V_{CC}$  power supply and a DC/DC converter to convert to 5V/3.3V for the MCU can be used. For more information, consult the Dialog website.



Smart IGBT Driver and Controller  
Solution for Inductive Heating Control

10 Physical Dimensions



- NOTE :
- 1. DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .006 INCH PER SIDE.
  - 2. DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .010 INCH PER SIDE.
  - 3. THIS PART IS COMPLIANT WITH JEDEC SPECIFICATION MS-012 AC.
  - 4. LEAD SPAN/STAND OFF HEIGHT/COPLANARITY ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S)
  - 5. CONTROL DIMENSIONS IN INCHES.[mm]

STATUS: RELEASED	SCALE: DO NOT SCALE
TERMINAL FINISH: 100% Sn	
TITLE: 16 SOIC PACKAGE OUTLINE	
REV: A	REVISION NOTE: NEW DRAWING
DATE: 25-OCT-2017	

## Smart IGBT Driver and Controller Solution for Inductive Heating Control

### IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas’ products are provided only subject to Renesas’ Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

© 2022 Renesas Electronics Corporation. All rights reserved.

### RoHS Compliance

Dialog Semiconductor’s suppliers certify that its products are in compliance with the requirements of Directive 2011/65/EU of the European Parliament on the restriction of the use of certain hazardous substances in electrical and electronic equipment. RoHS certificates from our suppliers are available on request.

(Rev.1.0 Mar 2020)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:  
[www.renesas.com/contact/](http://www.renesas.com/contact/)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.