Power Stage

650 V GaN HEMT Power Stage

BM3G205TCC-LBZ

General Description

This is the product guarantees long time support in industrial market.

BM3G205TCC-LBZ provides an optimum solution for all electronics systems that requires high power density and efficiency.

By integrating the 650 V enhancement GaN HEMT and silicon driver to ROHM's original package, parasitic inductance caused by a PCB and wire bonding is reduced significantly compared to traditional discrete solutions.

Owing to this, a high switching slew rate up to 100 V/ns can be achieved. On the other hand, adjustable gate drive strength contributes to low EMI, and various protections and other additional functions provide optimized cost, PCB size.

This IC is designed to adapt major exist controllers, so that it also can be used to replace the traditional discrete power switches, such as super junction MOSFET.

Key Specifications

- IN Voltage Range: 8.5 V to +20 V
- IN Operating Current @ 500 kHz: TBD mA (Typ)
- IN Quiescent Current: 1.5 mA (Typ)
- Allowable Input Switching Frequency: 2 MHz (Max)
- Turn-on Delay Time: 27 ns (Typ)
- Turn-off Delay Time: 10 ns (Typ)
- Operating Temperature Range: -40 °C to +125 °C
- GaN HEMT D-S ON State Resistance: 50 mΩ (Typ)

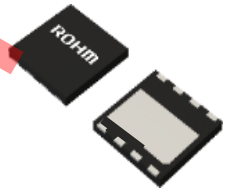
Package

DFN8080CK

W (Typ) x D (Typ) x H (Max)

8.0 mm x 8.0 mm x 0.9 mm

pitch 2.0 mm



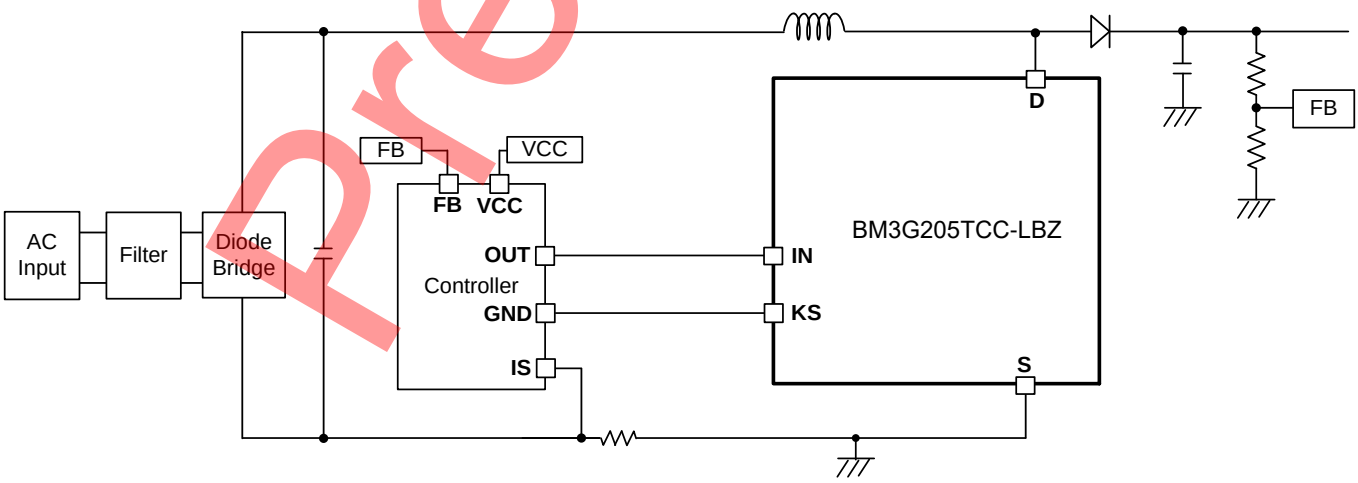
Features

- Long Time Support Product for Industrial Applications
- Optimized Integrated Gate Driver
- Wide Operating Range for IN Pin Voltage
- Low Propagation Delay
- High dv/dt Immunity
- Adjustable Gate Drive Strength
- De-saturation Protection
- Active Miller Clamp
- Thermal Shutdown Protection

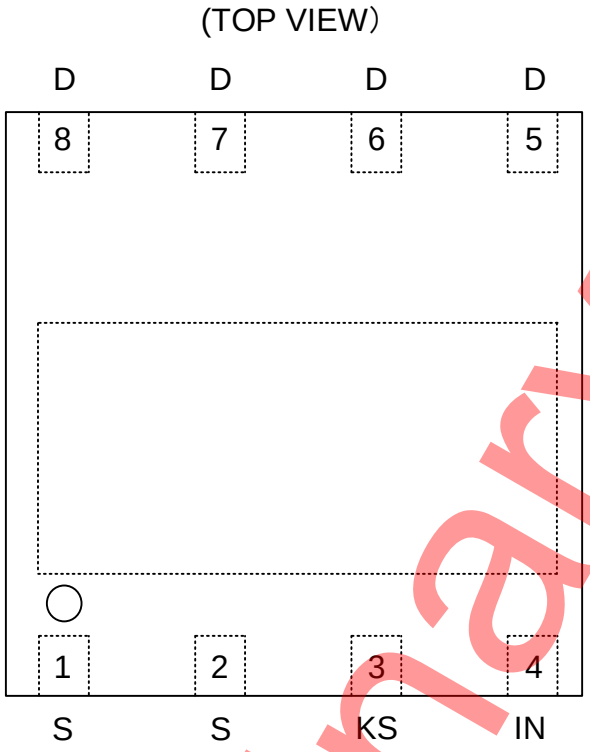
Applications

- Industrial Equipment, Power Supplies with High Power Density, High Efficiency Demand, or Bridge Topology such as Totem-pole PFC, LLC Power Supply, Adaptor, etc.

Typical Application Circuit



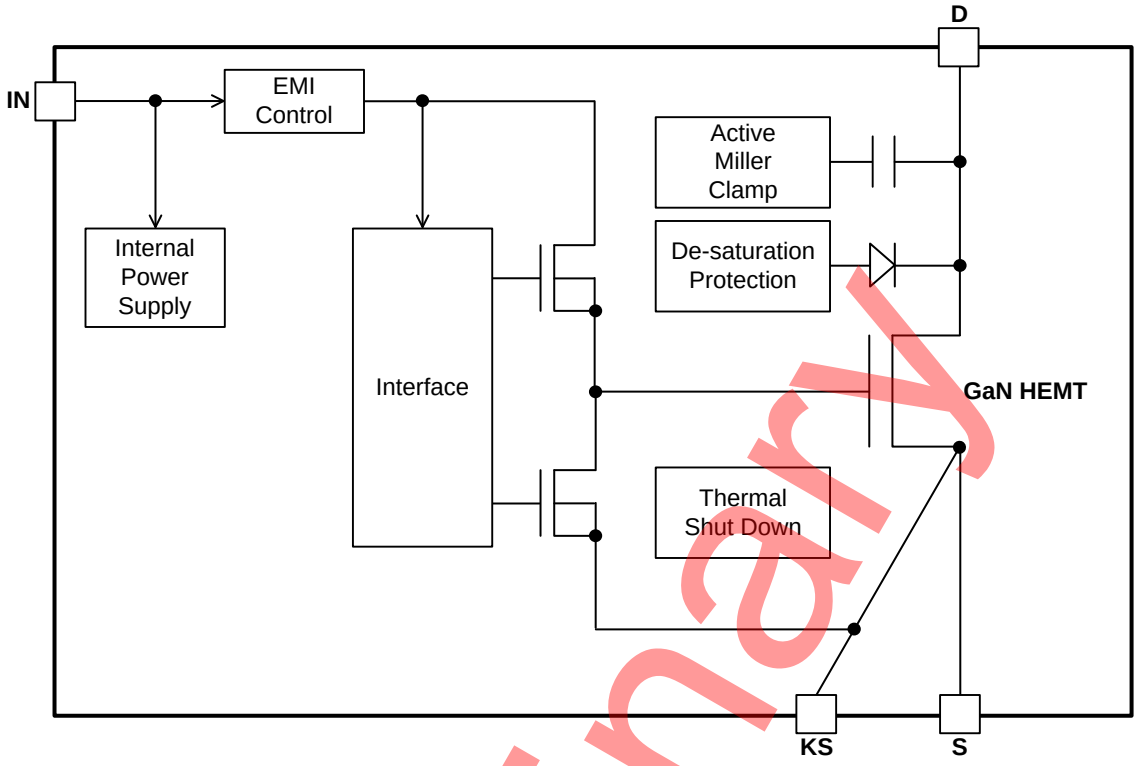
Pin Configuration



Pin Descriptions

Pin Number	Pin Name	I/O	Function
1, 2	S	I	GaN HEMT Source pin
3	KS	O	GaN HEMT Kelvin Source pin
4	IN	O	Non-inverting gate drive input pin
5-8	D	I	GaN HEMT Drain pin

Block Diagram



Description of Blocks

1 Overview

The IC, which integrates GaN device, gate driver and other additional functions such as protections, offers an optimum solution for making high power density design much easier and more efficient.
Due to a zero reverse recovery and extremely low output capacitance of GaN device, the IC achieves excellent efficiency especially in bridge-based topologies. It is also possible to replace existing Si MOSFETs and heatsinks to improve the efficiency and PCB size.
The integrated gate driver with wide operating the IN pin input voltage range brings a remarkable switching performance such as a high drain slew rate and low propagation delay, and it also makes the GaN device even much easier to use than traditional Si MOFET discrete.
Furthermore, various protections also contribute to reliability and robustness and protects this IC from damages.

2 Feature Descriptions

2.1 GaN HEMT

This IC integrates an enhancement-mode (normally-off) GaN device.
The enhancement-mode GaN device has smaller parasitic inductance and less switching loss than the cascode topology which connects a depletion-mode (normally-on) GaN device and a Si MOSFET in series because the cascode topology has additional parasitic inductance between a depletion-mode GaN device and Si MOSFET.
These characteristics offer advanced switching performance physically, and that is significant especially in large current applications.

2.2 EMI Control

Generally, there is a tradeoff between efficiency and EMI. A higher switching slew rate reduces the switching loss, in the other hand, it also increases the switching noise.
By resistance between the IN pin and an external driver IC's output pin, the turn-on slew rate SR_{ON} and the turn-off slew rate SR_{OFF} can be adjusted.
By using the diode as shown in Figure 2, SR_{ON} and SR_{OFF} can be adjusted independently.
It is recommended that an external driver IC's output source or sink current capability is more than 2 A.
It allows users to optimize the switching speed according to specific circumstance, such as an EMI filter space, PCB layout, etc.
Refer to Figure xx and Figure xx for the relationship between R_{INON} and SR_{ON}, and RIN_{OFF} and SR_{OFF}.

2.3 Active Miller Clamp

When dv/dt higher than dv/dt_{AMC} occurs at the D pin, the active miller clamp function operates and the gate of GaN HEMT is pulled down with an impedance of 0.5 Ω (typ).
The self-turn-on of GaN HEMT is prevented due to this function.
This function does not affect SR_{OFF} because this function is activated only when GaN HEMT's gate is less than plateau voltage.

2.4 De-saturation Protection

When the D pin at turn-on is higher than V_{DSAT}, the de-saturation protection operates and turn off the GaN HEMT.
This protection is pulse-by-pulse type.

2.5 Thermal Shut Down

This IC has thermal shut down function.

Description of Blocks – continued

3 Startup Sequence

Startup sequence is shown in Figure 1.

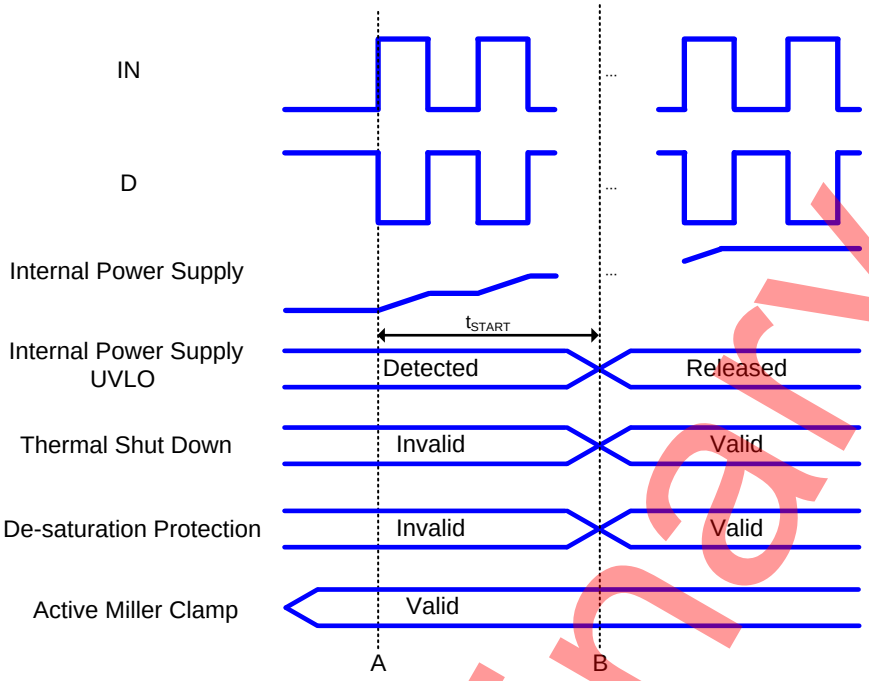


Figure 1. Startup Sequences Timing Chart

A: The IN pin pulse starts to be applied and internal power supply voltage starts to rise.
Active miller clamp function is constantly valid.

B: After tSTART from A, internal power supply UVLO is released and thermal shut down and de-saturation protection function becomes valid.

Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Rating	Unit	Conditions
Maximum Applied Voltage 1	V_{MAX1A}	-0.3 to +650	V	D pin voltage, DC
	V_{MAX1B}	-0.3 to +800	V	D pin voltage, tpulse < 1 μs *(Note 1)*
Maximum Applied Voltage 2	V_{MAX2}	-0.3 to +20	V	IN pin voltage
DRAIN Pin Current	$I_{D1(RMS)}$	23(TBD)	A	RMS, Tc = 25 °C
	$I_{D2(RMS)}$	15(TBD)	A	RMS, Tc = 100 °C
	$I_{D3(RMS)}$	10(TBD)	A	RMS, Tc = 125 °C
	$I_{D1(PULSE)}$	65(TBD)	A	tpulse < 1 μs *(Note 1)*, Tc = 25 °C
	$I_{D2(PULSE)}$	41(TBD)	A	tpulse < 1 μs *(Note 1)*, Tc = 100 °C
	$I_{D3(PULSE)}$	29(TBD)	A	tpulse < 1 μs *(Note 1)*, Tc = 125 °C
DRAIN dv/dt	dv/dt	100	V/ns	V_D = 0 V to 400 V
Maximum Junction Temperature	Tjmax	150	°C	
Storage Temperature Range	Tstg	-55 to +150	°C	

Caution 1: *Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.*

Caution 2: *Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.*

(Note 1) Duty is less than 1 %.

Thermal Resistance *(Note 2)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s *(Note 4)*	2s2p *(Note 5)*	
TOLL-8N				
Junction to Ambient	θ_{JA}	T.B.D.	T.B.D.	°C/W
Junction to Top Characterization Parameter *(Note 3)*	Ψ_{JT}	T.B.D.	T.B.D.	°C/W
Junction to Bottom Characterization Parameter	Ψ_{JC}	TBD	TBD	°C/W

(Note 2) Based on JESD51-2A (Still-Air).
(Note 3) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.
(Note 4) Using a PCB board based on JESD51-3.
(Note 5) Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
9Footprints and Traces	70 μm

Layer Number of Measurement Board	Material	Board Size	Thermal Via *(Note 6)*	
			Pitch	Diameter
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt	1.20 mm	Φ0.30 mm

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 μm	74.2 mm x 74.2 mm	35 μm	74.2 mm x 74.2 mm	70 μm

(Note 6) This thermal via connect with the copper pattern of layers 1,2, and 4. The placement and dimensions obey a land pattern.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Input Voltage Range 1	V_{IN_H}	8.5	-	20	V	IN pin high voltage
Input Voltage Range 2	V_{IN_L}	-0.3	0	+0.3	V	IN pin low voltage
IN Pin Series Resistor	R_{IN}	1	-	1000	Ω	
IN Pin High Pulse-width	t_{IN_H}	75	-	-	ns	
IN Pin Low Pulse-width	t_{IN_L}	75	-	-	ns	
IN Pulse Frequency	f_{IN}	-	-	2	MHz	
Operating Temperature	Topr	-40	-	+125	°C	Surrounding temperature

Electrical Characteristics (Unless noted otherwise, V_{IN} = 15 V, Ta = 25 °C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
GaN HEMT						
D-S Withstand Voltage	$V_{(BR)DDS1}$	650	-	-	V	V_{IN} = 0 V
	$V_{(BR)DDS2}$	800	-	-	V	V_{IN} = 0 V, tpulse < 1 μs *(Note 1)*
D Pin Leak Current	I_{DSS1}	-	-	TBD	μA	V_{DS} = 650 V, V_{IN} = 0 V, Ta = 25 °C
	I_{DSS2}	-	TBD	-	μA	V_{DS} = 650 V, V_{IN} = 0 V, Ta = 150 °C
D-S ON State Resistance	R_{ON1}	-	50	TBD	mΩ	I_D = 10.0 A, Ta = 25 °C
	R_{ON2}	-	TBD	-	mΩ	I_D = 10.0 A, Ta = 125 °C
	R_{ON3}	-	TBD	-	mΩ	I_D = 10.0 A, Ta = 150 °C
S-D Reverse Voltage	V_{SD}	-	TBD	-	V	I_D = -10.0 A, V_{IN} = 0 V
Output Capacitance	C_{OSS}	-	TBD	-	pF	V_{IN} = 0 V, V_D = 400 V, f = 1 MHz
Energy Related Effective Output Capacitance	$C_{O(ER)}$	-	TBD	-	pF	V_{IN} = 0 V, V_D = 0 V to 400 V
Time Related Effective Output Capacitance	$C_{O(TR)}$	-	TBD	-	pF	V_{IN} = 0 V, V_D = 0 V to 400 V
Reverse Recovery Charge	Q_{RR}	-	0	-	nC	
IN Pin						
IN Operating Current	I_{ON1}	-	TBD	TBD	μA	D pin = open, operating at 500 kHz, duty = 50 %
IN Quiescent Current	I_{ON2}	-	1.5	TBD	mA	V_{IN} = 15 V
Turn-on Delay Time	$t_{D(ON)}$	TBD	27	TBD	ns	R_{IN} = 1 Ω
Turn-off Delay Time	$t_{D(OFF)}$	TBD	10	TBD	ns	R_{IN} = 1 Ω
Protections						
De-saturation Protection Voltage	V_{DESAT}	IN-5	IN-3	IN-1	V	D Voltage
De-saturation Protection Propagation Delay	t_{DESAT}	-	80	-	ns	
TSD Temperature	T_{SD}	150	TBD	TBD	°C	
TSD Detection Delay	t_{TSD}	5	10	20	μs	
Active Miller Clamp dv/dt	d_{AMC}	-	10	-	V/ns	D pin rising dv/dt
Startup Items						
Internal Power Supply Validation Time	t_{START}	-	200	-	μs	D pin = open, operating at 500 kHz, duty = 50 %
Internal Power Supply Hold Time	t_{HOLD}	50	-	-	μs	V_{IN} = 0 V

(Note 1) Duty is less than 1 %.

Switching Parameter Measurement Information

Figure 2 shows the circuit for measurements of switching parameters.
Figure 3 shows instruction of them.

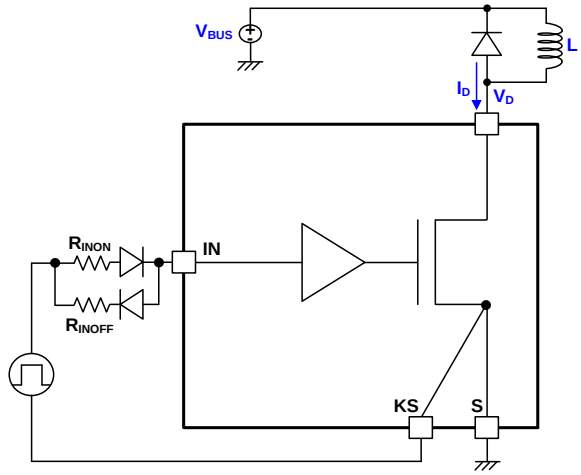


Figure 2. Switching Parameters Measurement Circuit

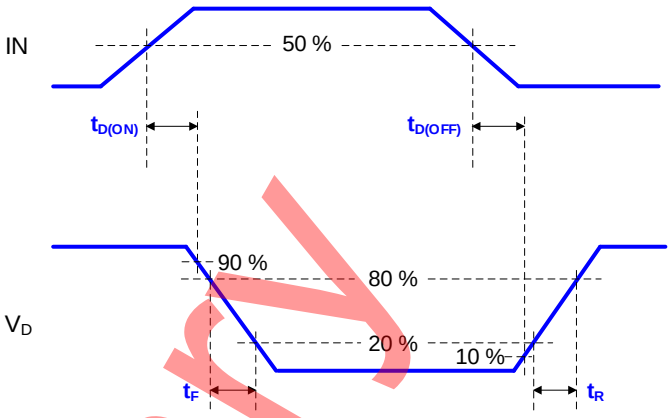


Figure 3. Instruction of Switching Parameters

1 Turn-on Delay Time: $t_{D(ON)}$

The turn-on delay time is the time from rising edge of the IN pin voltage (represented by 50 % of IN pin high voltage level) to when the GaN HEMT starts turning on (represented by V_D falling to 90 % of V_{BUS}).

2 Drain Fall Time: t_F

The drain fall time is the time it takes for V_D falls from 80 % to 20 % of V_{BUS}.

3 Turn-off Delay Time: $t_{D(OFF)}$

The turn-off delay time is the time from falling edge of the IN pin voltage (represented by 50 % of IN pin high voltage level) to when the GaN HEMT starts turning off (represented by V_D rising to 10 % of V_{BUS}).

4 Drain Rise Time: t_R

The drain rise time is the time it takes for V_D rises from 20 % to 80 % of V_{BUS}.

5 Turn-on Slew Rate: SR_{ON}

The turn-on slew rate is the slew rate which is when V_D falls from 80 % to 20 % of V_{BUS}.
It is calculated by the formula below.

$$SR_{ON} = \frac{V_{BUS} \times 60\ \%}{t_F}$$

where:
SR_{ON} is the turn-on slew rate.
V_{BUS} is the DC bus voltage.
t_F is the drain fall time.

6 Turn-off Slew Rate: SR_{OFF}

The turn-off slew rate is the slew rate which is when V_D rises from 80 % to 20 % of V_{BUS}.
It is calculated by the formula below.

$$SR_{OFF} = \frac{V_{BUS} \times 60\ \%}{t_R}$$

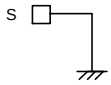
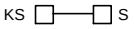
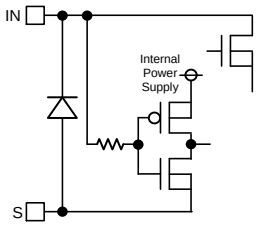
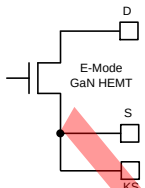
where:
SR_{OFF} is the turn-on slew rate.
V_{BUS} is the DC bus voltage.
t_R is the drain rise time.

Application Examples

TBD

Typical Performance Curves (Reference Data)
TBD

I/O Equivalence Circuit

1, 2	S	3	KS	4	IN	5-8	D
							

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Recommended Operating Conditions**
   The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

7. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

8. **Inter-pin Short and Mounting Errors**
   Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

9. **Unused Input Pins**
   Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

Operational Notes – continued

10. Regarding the Input Pin of the IC

This IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

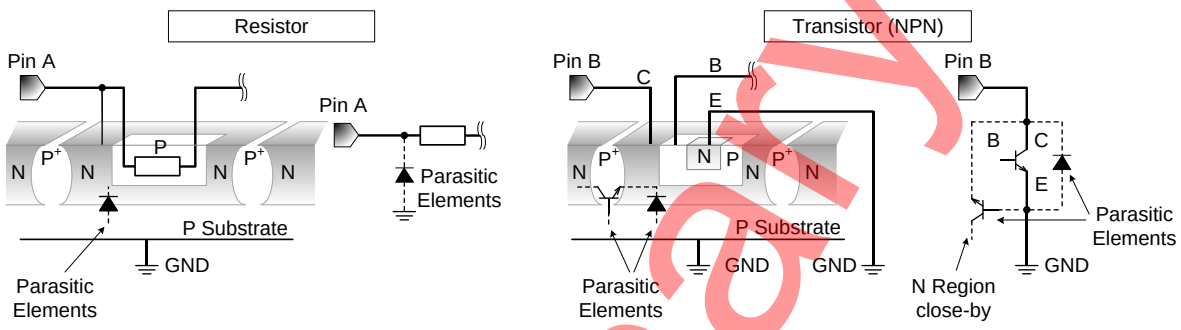


Figure 33. Example of IC Structure

11. Ceramic Capacitor

When using a ceramic capacitor, determine a capacitance value considering the change of capacitance with temperature and the decrease in nominaTCCpacitance due to DC bias and others.

12. Thermal Shutdown Circuit (TSD)

This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's maximum junction temperature rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF power output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

Ordering Information

B	M	3	G	2	0	5	T	C	C	-	L	B	E	2

GaN HEMT D-S ON State Resistance (Typ)
05: 50 mΩ

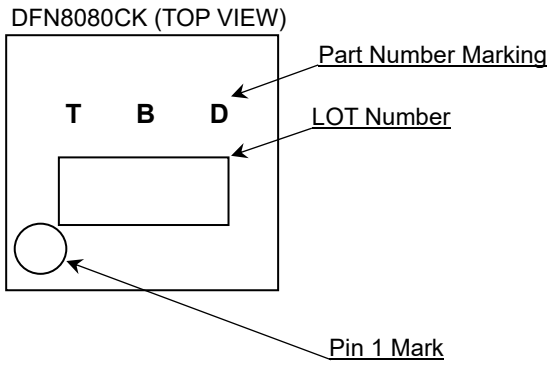
Package

TCC:
DFN8080CK

Product Class
LB: Industrial Applications

Packaging and forming specification
E2: Embossed tape and reel

Marking Diagram



Physical Dimension and Packing Information

Package Name	DFN8080CK

TBD

Revision History

Date	Revision	Changes
29.Aug.2024	001	Target Spec

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).

3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

Other Precaution

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3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

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General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

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