

R2J20652ANP

Integrated Driver – MOS FET (DrMOS)

REJ03G1867-0300

Rev.3.00

Feb 26, 2010

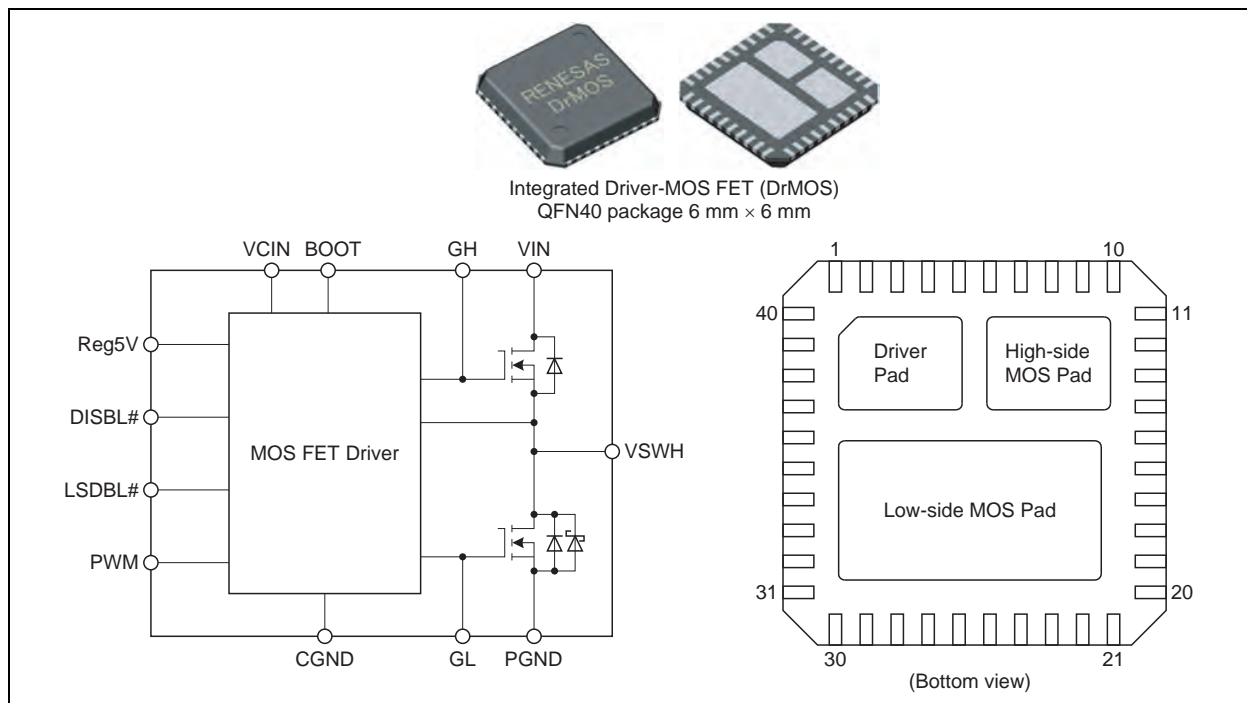
Description

The R2J20652ANP multi-chip module incorporates a high-side MOS FET, low-side MOS FET, and MOS-FET driver in a single QFN package. The on and off timing of the power MOS FET is optimized by the built-in driver, making this device suitable for large-current buck converters. The chip also incorporates a high-side bootstrap switch, eliminating the need for an external SBD for this purpose.

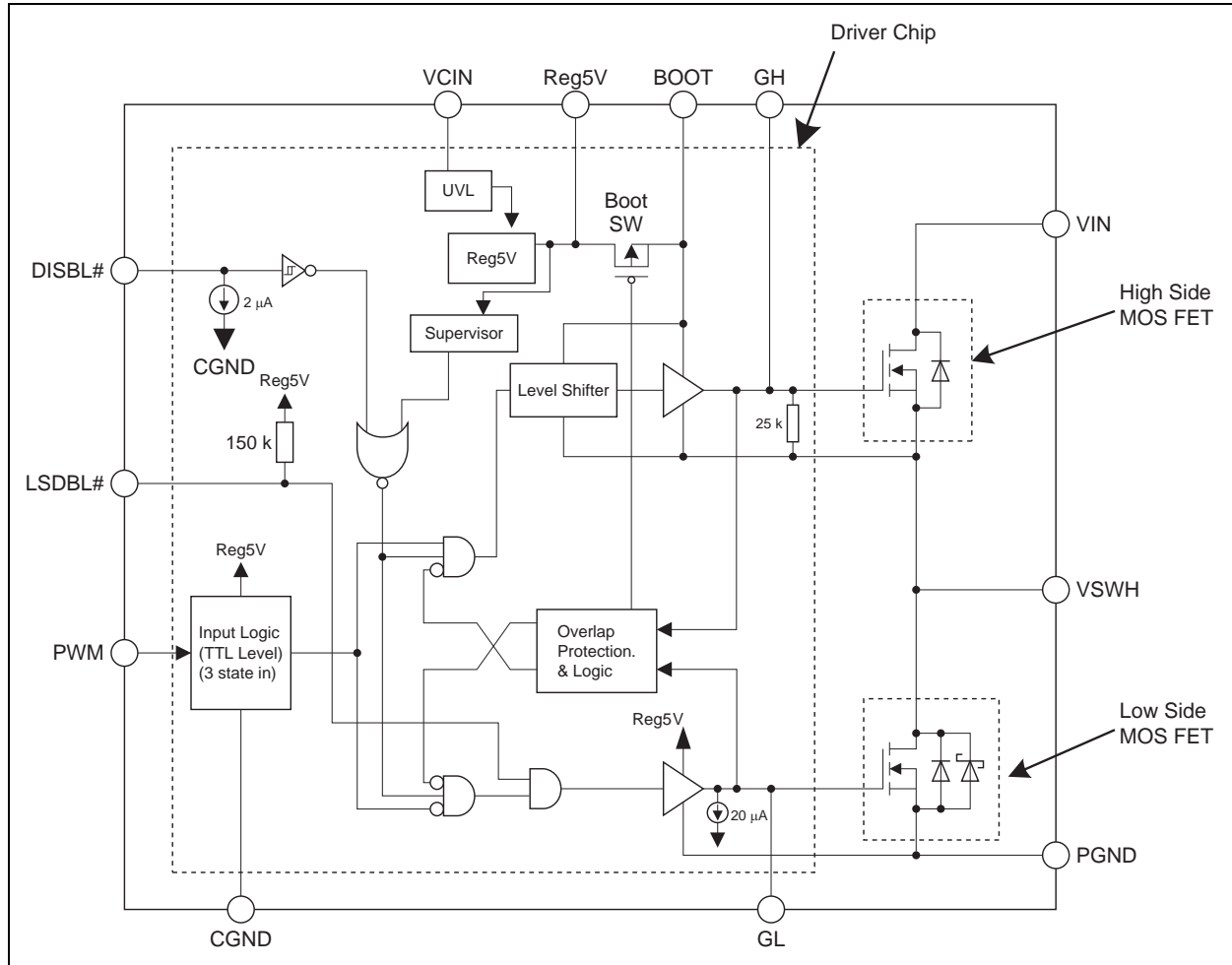
Features

- Based on Intel 6 × 6 DrMOS specification pin out
- Built-in power MOS FET suitable for Notebook, Desktop, Server application
- Low-side MOS FET with built-in SBD for lower loss and reduced ringing
- Built-in driver circuit which matches the power MOS FET
- Built-in tri-state input function which can support a number of PWM controllers
- VIN operating-voltage range: 27 V max
- High-frequency operation (above 1 MHz) possible
- Large average output current (Max. 35 A)
- Achieve low power dissipation
- Controllable driver: Remote on/off
- Low-side MOS FET disabled function for DCM operation
- Built-in bootstrapping switch
- Small package: QFN40 (6 mm × 6 mm × 0.95 mm)
- Terminal Pb-free/Halogen-free

Outline



Block Diagram



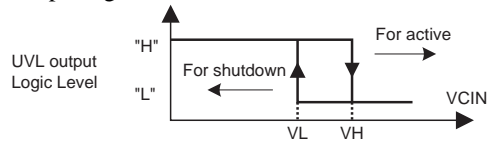
Notes: 1. Truth table for the DISBL# pin.

| DISBL# Input | Driver Chip Status |
|--------------|----------------------------|
| "L" | Shutdown (GL, GH = "L") |
| "Open" | Shutdown (GL, GH = "L") |
| "H" | Enable (GL, GH = "Active") |

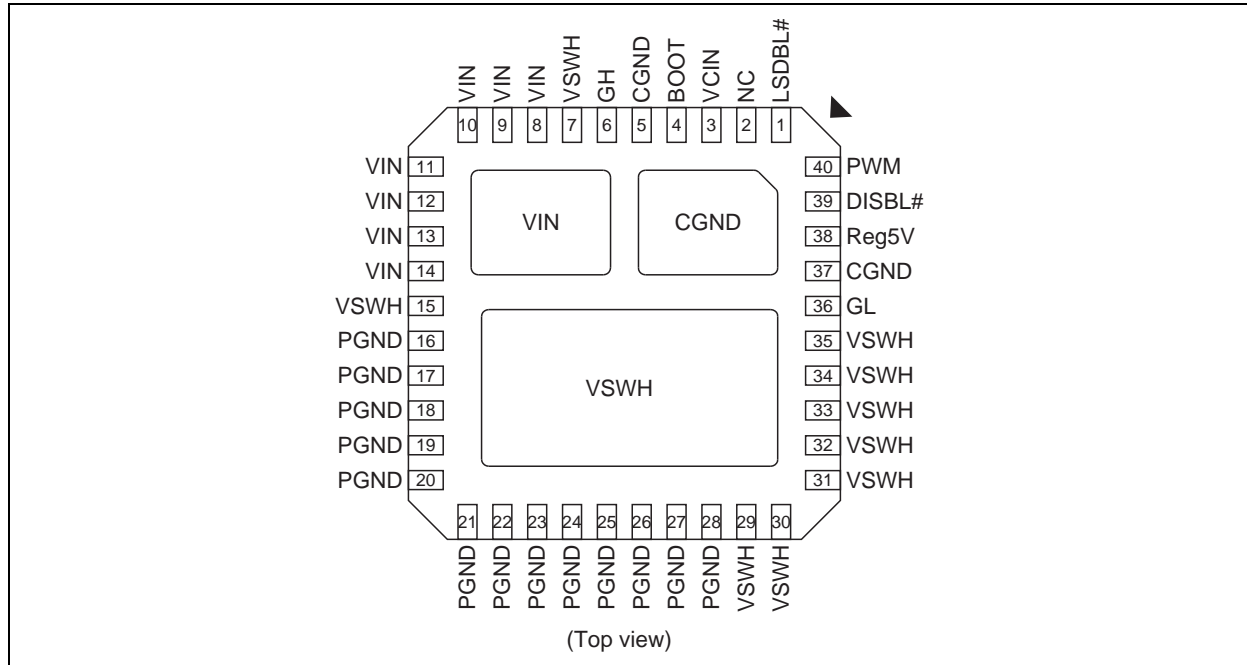
2. Truth table for the LSDBL# pin.

| LSDBL# Input | GL Status |
|--------------|-----------|
| "L" | "L" |
| "Open" | "Active" |
| "H" | "Active" |

3. Output signal from the UVL block



Pin Arrangement



Note: All die-pads (three pads in total) should be soldered to PCB.

Pin Description

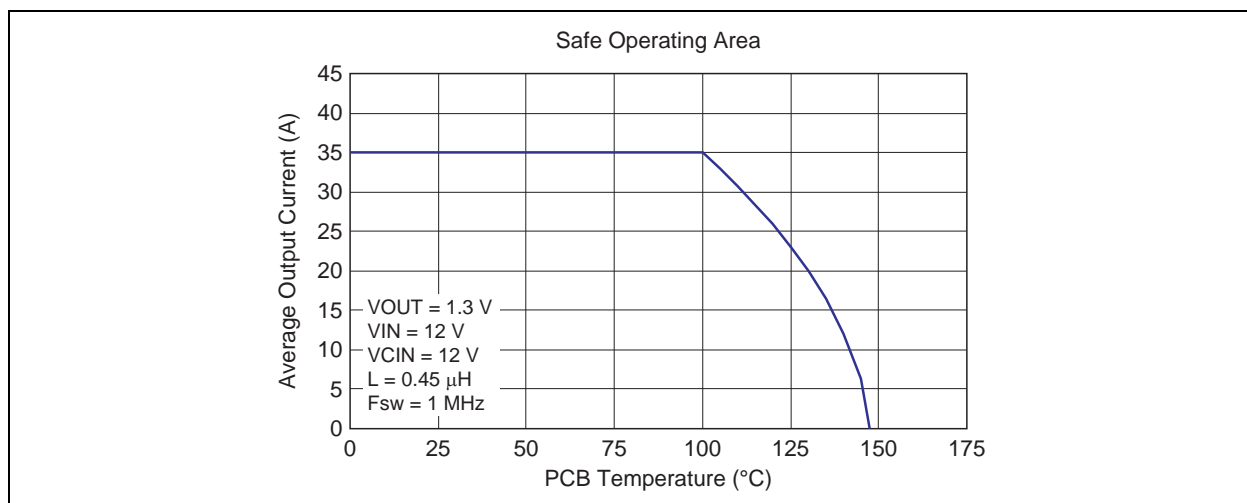
| Pin Name | Pin No. | Description | Remarks |
|----------|----------------------|--------------------------------|-------------------------------------------------|
| LSDBL# | 1 | Low-side gate disable | When asserted "L" signal, Low-side gate disable |
| NC | 2 | No connect | |
| VCIN | 3 | Control input voltage | Driver Vcc input |
| BOOT | 4 | Bootstrap voltage pin | To be supplied +5 V through internal switch |
| CGND | 5, 37, Pad | Control signal ground | Should be connected to PGND externally |
| GH | 6 | High-side gate signal | Pin for Monitor |
| VIN | 8 to 14, Pad | Input voltage | |
| VSWH | 7, 15, 29 to 35, Pad | Phase output/Switch output | |
| PGND | 16 to 28 | Power ground | |
| GL | 36 | Low-side gate signal | Pin for Monitor |
| Reg5V | 38 | +5 V logic power supply output | |
| DISBL# | 39 | Signal disable | Disabled when DISBL# is "L" |
| PWM | 40 | PWM drive logic input | 5 V logic input |

Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Rating | Units | Note |
|--------------------------------|----------------|----------------------------------------------------------------------|-------|-------------------------|
| Power dissipation | Pt(25) | 25 | W | 1 |
| | Pt(110) | 8 | | |
| Average output current | Iout | 35 | A | |
| Input voltage | VIN(DC) | -0.3 to +27 | V | 2 |
| | VIN(AC) | 30 | | 2, 4, 6 |
| Switch node voltage | VSWH(DC) | 27 | V | 2 |
| | VSWH(AC) | 30 | | 2, 4, 6 |
| BOOT voltage | VBOOT(DC) | 32 | V | 2 |
| | VBOOT(AC) | 36 | | 2, 4, 6 |
| Supply voltage | VCIN | -0.3 to +27 | V | 2 |
| PWM voltage | Vpwm | -0.3 to +5.5 @UVL OFF -0.3 to +0.3 @UVL ON -0.3 to Reg5V + 0.3 | V | 2, 4 2, 5 2, 7, 8 |
| Other I/O voltage | Vdisbl, Vlsdbl | -0.3 to VCIN + 0.3 | V | 2 |
| Reg5V voltage | Vreg5V | -0.3 to +6 | V | 7 |
| Reg5V current | Ireg5V | -20 to +0.1 | mA | 3 |
| DISBL# current | Idisbl | 0 to 1.0 | mA | 3 |
| Operating junction temperature | Tj-opr | -40 to +150 | °C | |
| Storage temperature | Tstg | -55 to +150 | °C | |

- Notes:
1. Pt(25) represents a PCB temperature of 25°C, and Pt(110) represents 110°C.
 2. Rated voltages are relative to voltages on the CGND and PGND pins.
 3. For rated current, (+) indicates inflow to the chip and (-) indicates outflow.
 4. This rating is when UVL (Under Voltage Lock out) is ineffective (normal operation mode).
 5. This rating is when UVL (Under Voltage Lock out) is effective (lock out mode).
 6. The specification values indicated "AC" are limited within 100 ns.
 7. This rating is when the external power-source is applied to Reg5V pin.
 8. Reg5V + 0.3 V < 6 V



Recommended Operating Condition

| Item | Symbol | Rating | Units | Note |
|----------------|--------|-----------------------------|-------|--------------------------------------------------------------------------------------------------------|
| Input voltage | VIN | 4.5 to 22 | V | When the usage of VCIN = 4.5 V to 5.5 V, VCIN should be connected to Reg5V (Refer to "Pin Connection") |
| Supply voltage | VCIN | 4.5 to 5.5 or 8 to 22 | V | |

Electrical Characteristics

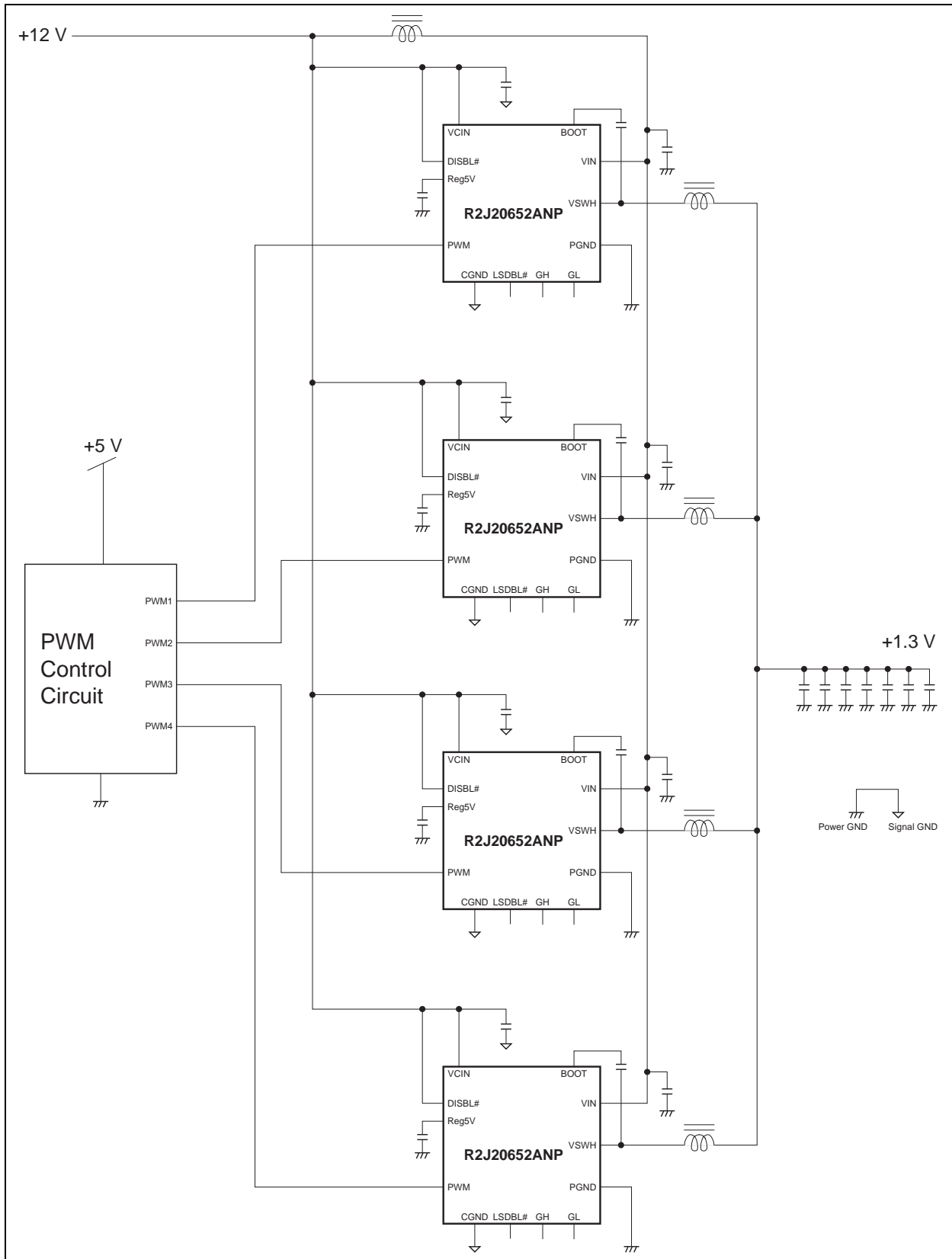
(Ta = 25°C, VCIN = 12 V, VSWH = 0 V, unless otherwise specified)

| Item | | Symbol | Min | Typ | Max | Units | Test Conditions |
|---------------|-------------------------------|--------------------------|--------------------|-----|--------------------|-------|-----------------------------------------------|
| Supply | VCIN start threshold | V _H | 7.0 | 7.4 | 7.8 | V | |
| | VCIN shutdown threshold | V _L | 6.6 | 7.0 | 7.4 | V | |
| | UVLO hysteresis | dUVL | — | 0.4 | — | V | V _H - V _L |
| | VCIN operating current | I _{CIN} | — | 34 | — | mA | f _{PWM} = 1 MHz, Ton_pwm = 120 ns |
| | VCIN disable current | I _{CIN-DISBL} | — | — | 2.5 | mA | DISBL# = 0 V, PWM = 0 V, LSDBL# = Open |
| PWM input | PWM rising threshold | V _{H-PWM} | 3.0 | 3.4 | 3.8 | V | |
| | PWM falling threshold | V _{L-PWM} | 0.9 | 1.2 | 1.5 | V | |
| | PWM input resistance | R _{IN-PWM} | 10 | 20 | 40 | kΩ | PWM = 1 V |
| | Tri-state shutdown window | V _{IN-SD} | V _{L-PWM} | — | V _{H-PWM} | V | |
| | Shutdown hold-off time | t _{HOLD-OFF} *1 | — | 100 | — | ns | |
| 5 V regulator | Output voltage | V _{reg} | 4.95 | 5.2 | 5.45 | V | |
| | Line regulation | V _{reg-line} | -10 | 0 | 10 | mV | VCIN = 12 V to 16 V |
| | Load regulation | V _{reg-load} | -10 | 0 | 10 | mV | I _{reg} = 0 to 10 mA |
| DISBL# input | Disable threshold | V _{DISBL} | 0.9 | 1.2 | 1.5 | V | |
| | Enable threshold | V _{ENBL} | 1.9 | 2.4 | 2.9 | V | |
| | Input current | I _{DISBL} | 10 | 20 | 40 | μA | DISBL# = 1 V |
| LSDBL# input | Low-side activation threshold | V _{LSDBLH} | 1.9 | 2.4 | 2.9 | V | |
| | Low-side disable threshold | V _{LSDBLL} | 0.9 | 1.2 | 1.5 | V | |
| | Input current | I _{LSDBL} | -56 | -28 | -14 | μA | LSDBL# = 1 V |

Note: 1. Reference values for design. Not 100% tested in production.

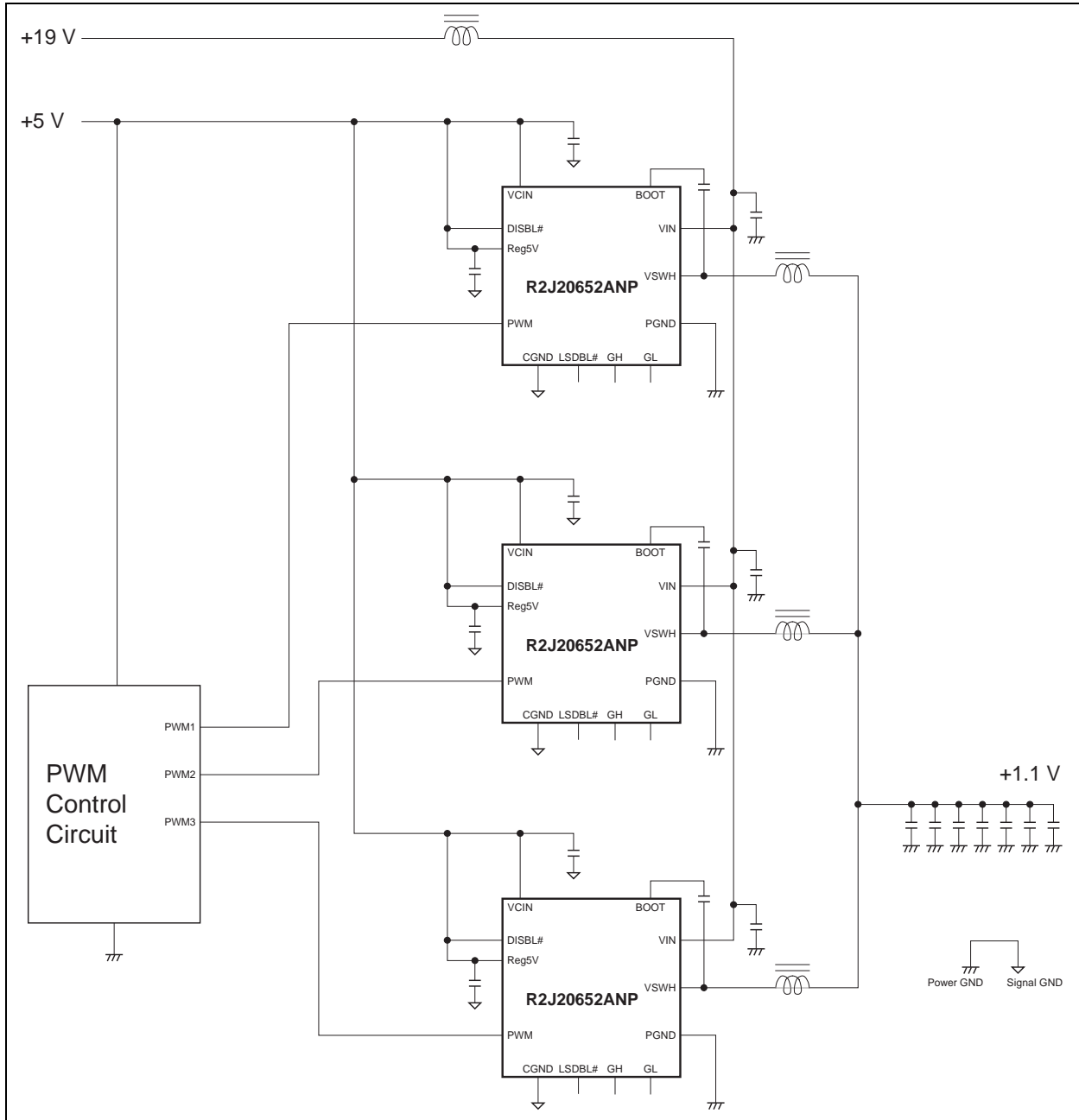
Typical Application

(1) Desktop/Server Application



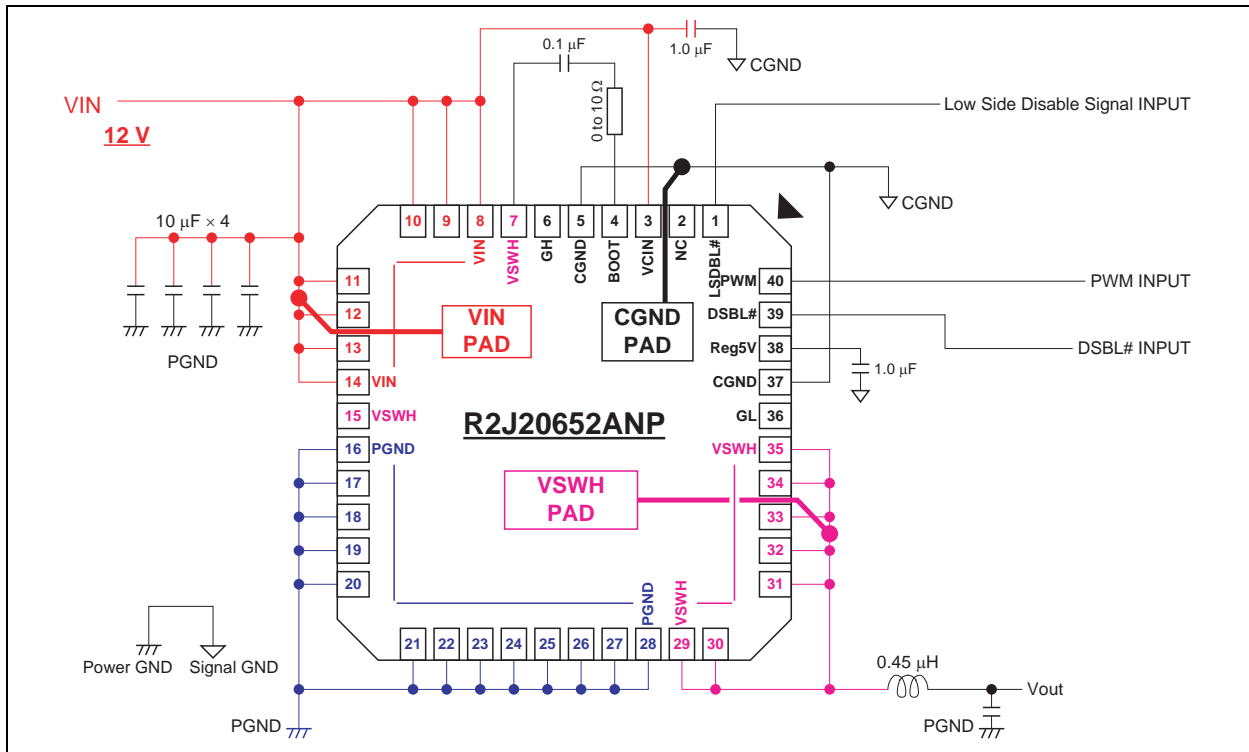
Typical Application (cont.)

(2) Notebook Application

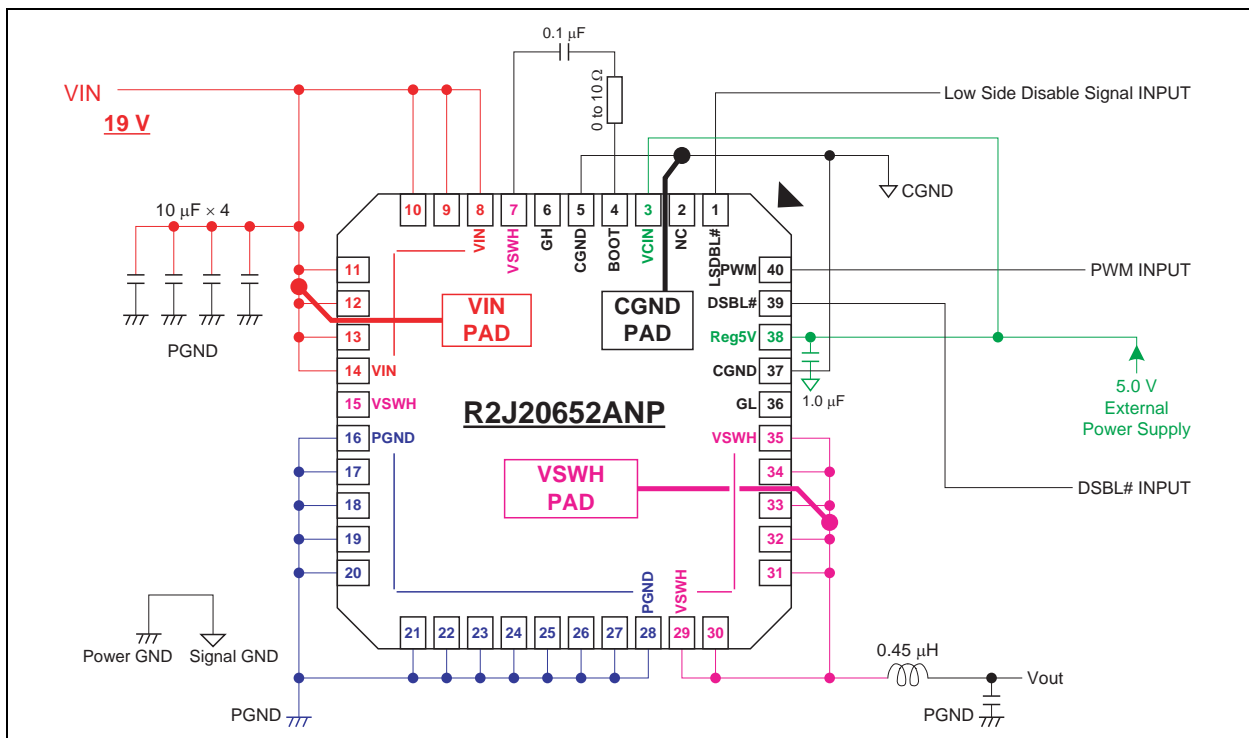


Pin Connection

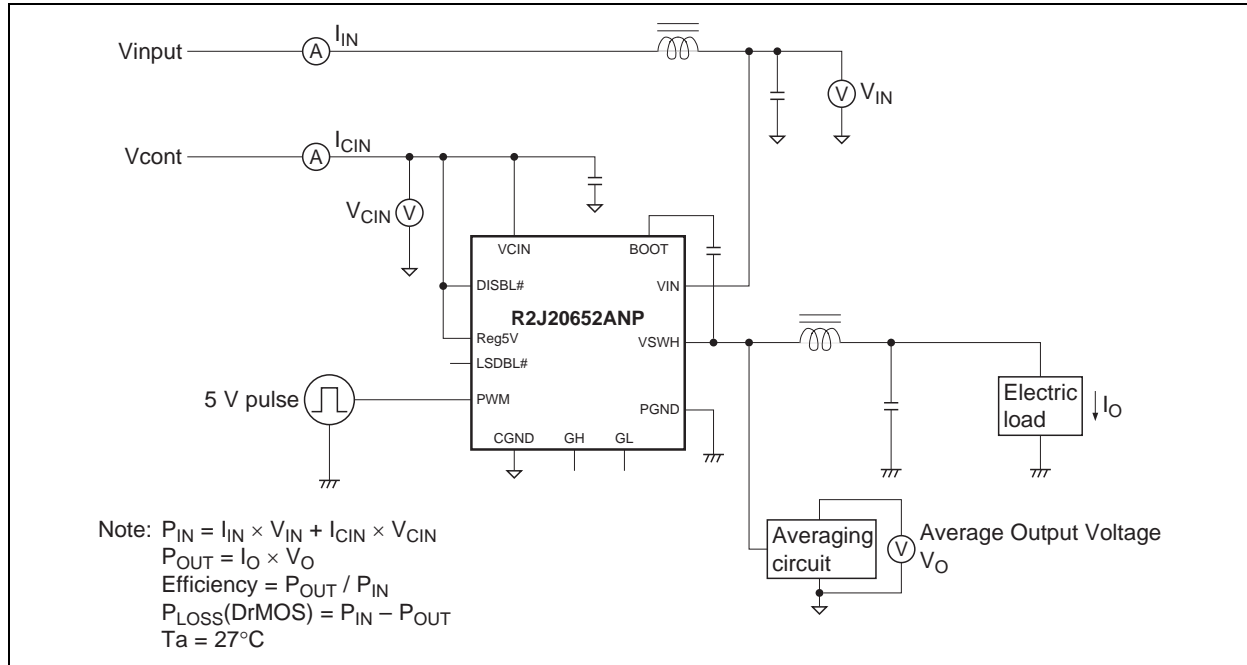
(1) Typical Desktop/Server Application



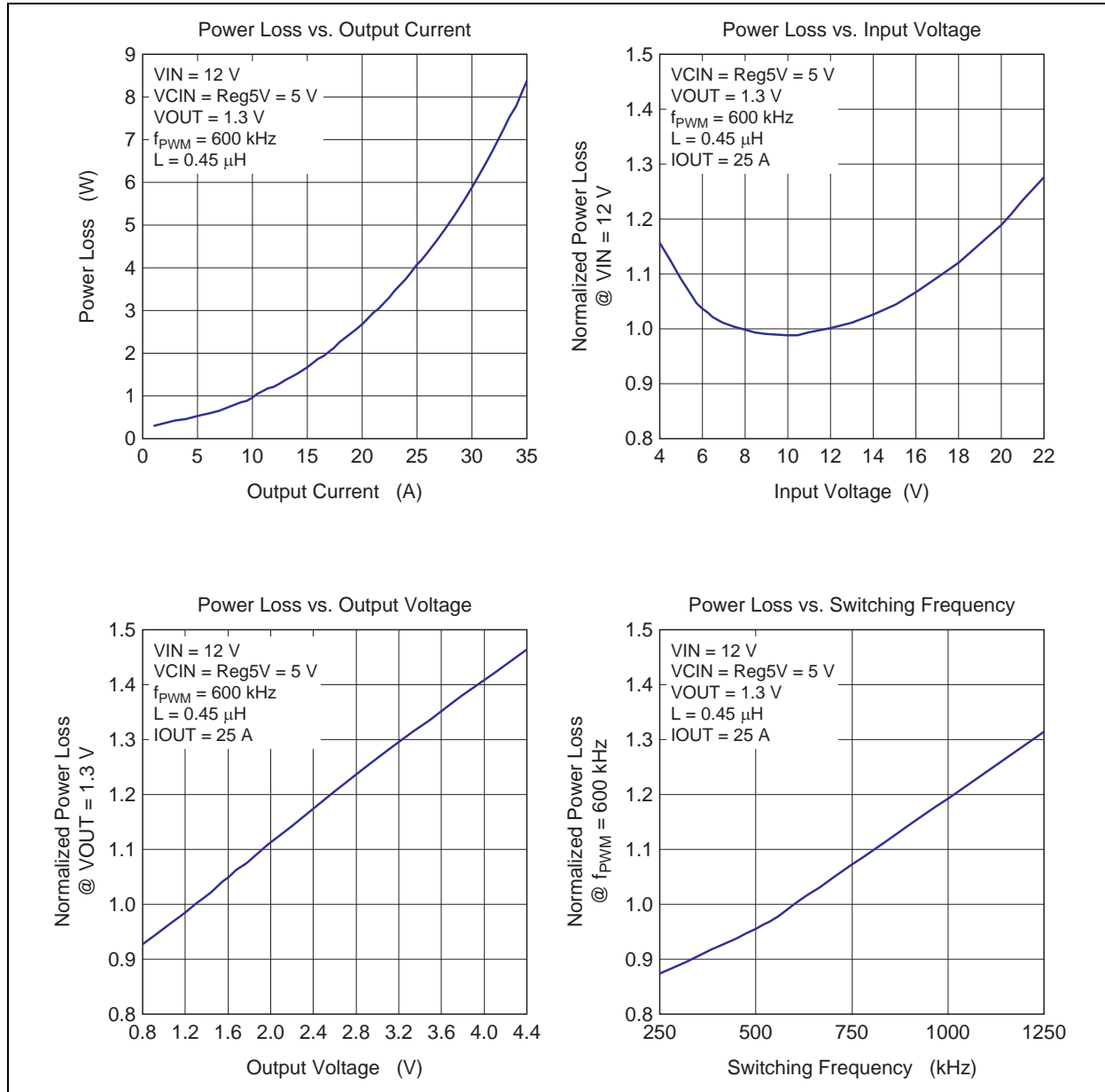
(2) Typical Notebook Application

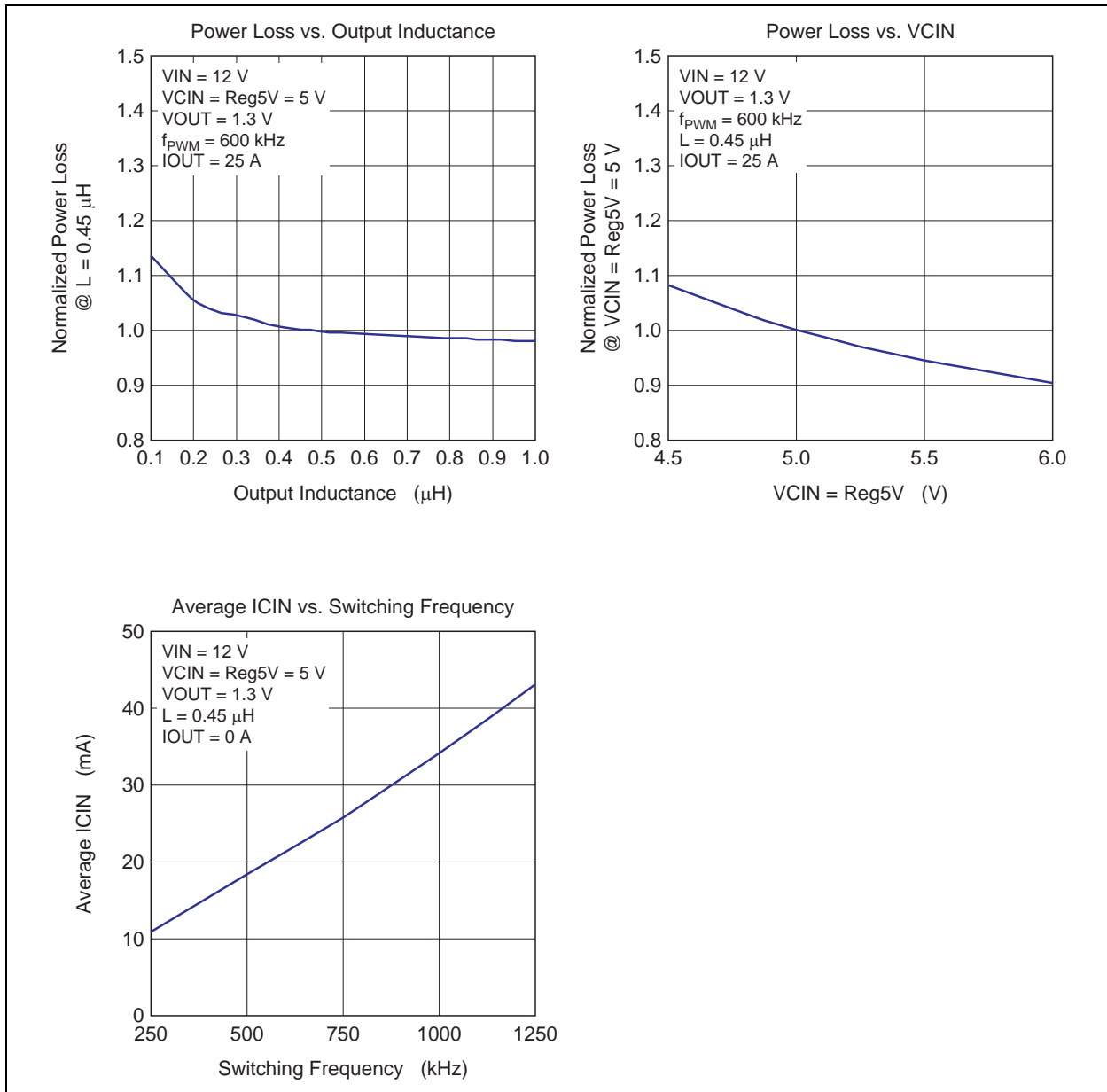


Test Circuit



Typical Data





Description of Operation

The DrMOS multi-chip module incorporates a high-side MOS FET, low-side MOS FET, and MOS-FET driver in a single QFN package. Since the parasitic inductance between each chip is extremely small, the module is highly suitable for use in buck converters to be operated at high frequencies. The control timing between the high-side MOS FET, low-side MOS FET, and driver is optimized so that high efficiency can be obtained at low output-voltage.

VCIN & DISBL#

The VCIN pin is connected to the UVL (under-voltage lockout) module, so that the built-in 5 V regulator is disabled as long as VCIN is 7.4 V or less. On cancellation of UVL, the built-in 5 V regulator remains enabled until the UVL input is driven to 7.0 V or less.

The built-in 5 V regulator is a series regulator with temperature compensation. A ceramic capacitor with a value of 0.1 μ F or more must be connected between the CGND plane and the Reg5V Pin.

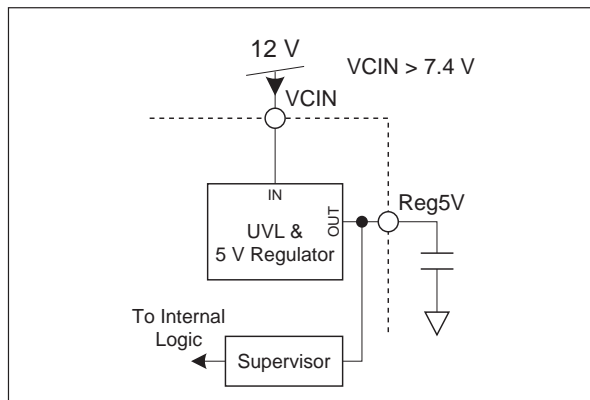
The output of 5 V regulator is monitored by the internal Supervisor circuits. When the Supervisor detects this output is more than 4.2 V (typ.), the driver state becomes active (figure1.1).

Figure 1.2 shows the application when the external 5 V regulator is used. When the Reg5V pin is applied into external 5 V, the Supervisor can activate the driver. In this application usage, VCIN should be connected to Reg5V.

The signal on pin DISBL# also enables or disables the circuit. When UVL disables the circuit, the built-in 5 V regulator does not operate, but when the signal on DISBL# disables the circuit, only output-pulse generation is terminated, and the 5 V regulator is not disabled.

Voltages from -0.3 V to VCIN + 0.3 V can be applied to the DISBL# pin, so on/off control by a logic IC or the use of a resistor, etc., to pull the DISBL# line up to VCIN are both possible.

| VCIN | DISBL# | REG5V | Driver State |
|------|--------|--------|----------------------|
| L | * | 0 | Disable (GL, GH = L) |
| H | L | Active | Disable (GL, GH = L) |
| H | H | Active | Active |
| H | Open | Active | Disable (GL, GH = L) |



**Figure 1.1 Typical 12 V Input Application
(Activate Built-in 5 V Regulator)**

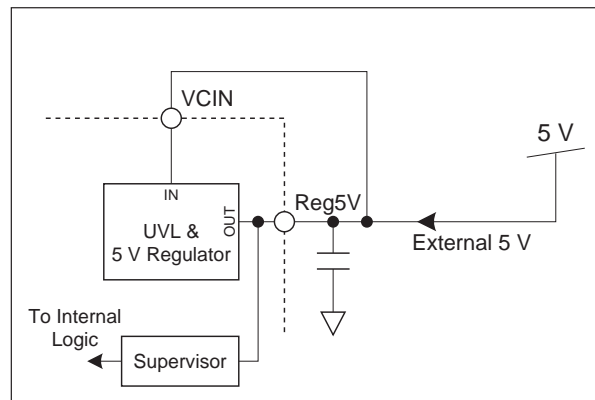


Figure 1.2 External 5 V Application

PWM & LSDBL#

The PWM pin is the signal input pin for the driver chip. When the PWM input is high, the gate of the high-side MOS FET (GH) is high and the gate of the low-side MOS FET (GL) is low.

| PWM | GH | GL |
|-----|----|----|
| L | L | H |
| H | H | L |

The LSDBL# pin is the Low Side Gate Disable pin for "Discontinuous Conduction Mode (DCM)" when LSDBL# is low.

Figure 2 shows the Typical high-side and low-side gate switching and Inductor current (IL) during "Continuous Conduction Mode (CCM)" and low-side gate disabled when asserting LSDBL# signal.

This pin is internally pulled up to Reg5V with 150 kΩ resistor.

When low-side disable function is not used, keep this pin open or pulled up to VCIN.

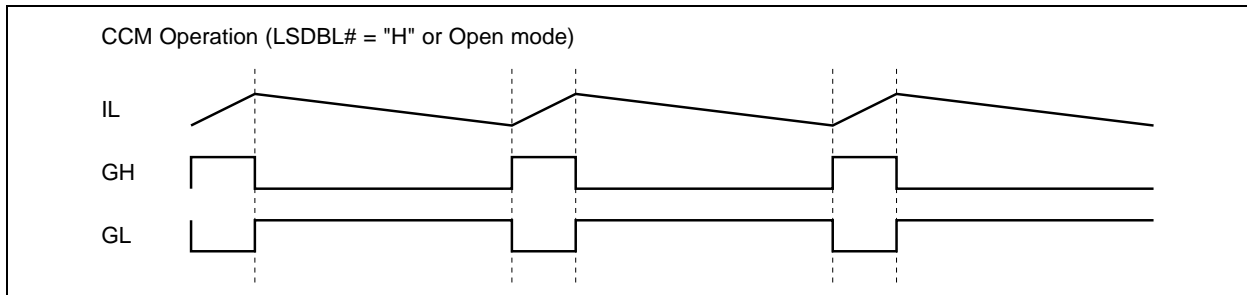


Figure 2.1 Typical Signals during CCM

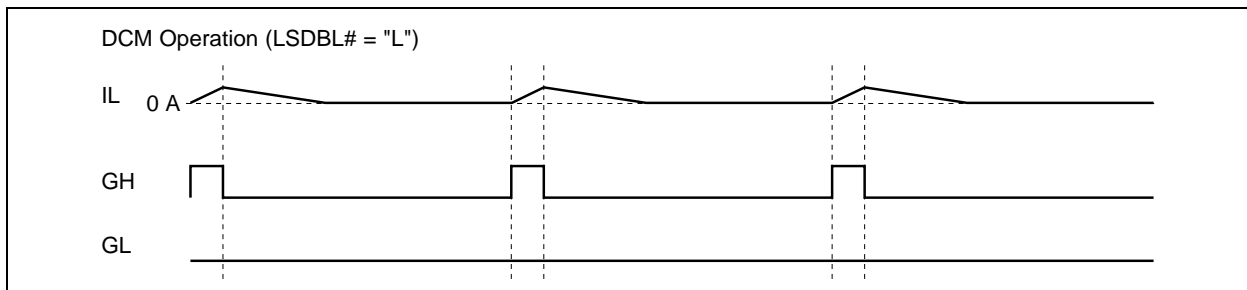


Figure 2.2 Typical Signals during DCM

The PWM input is TTL level and has hysteresis. When the signal route from the control IC is high impedance, the tri-state function turns off the high- and low-side MOS FETs. This function operates when the PWM input signal stays in the input hysteresis window for 100 ns (typ.). After the tri-state mode has been entered and GH and GL have become low, a PWM input voltage of 3.4 V or more is required to make the circuit return to normal operation.

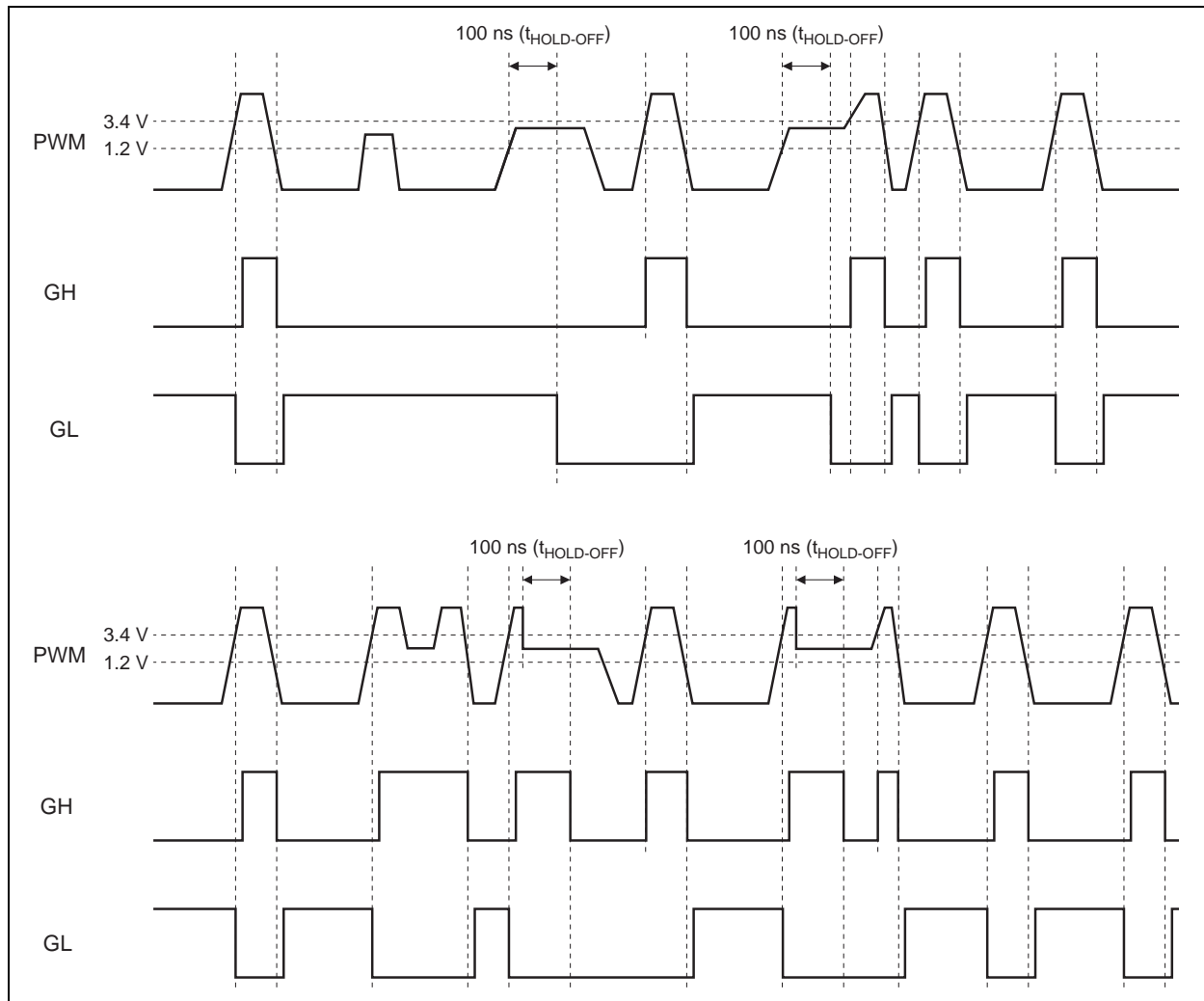


Figure 3 PWM Shutdown-Hold Time Signal

The equivalent circuit for the PWM-pin input is shown in the next figure. M1 is in the ON state during normal operation; after the PWM input signal has stayed in the hysteresis window for 100 ns (typ.) and the tri-state detection signal has been driven high, the transistor M1 is turned off.

When VCIN is powered up, M1 is started in the OFF state regardless of PWM Low or Open state. After PWM is asserted high signal, M1 becomes ON and shifts to normal operation.

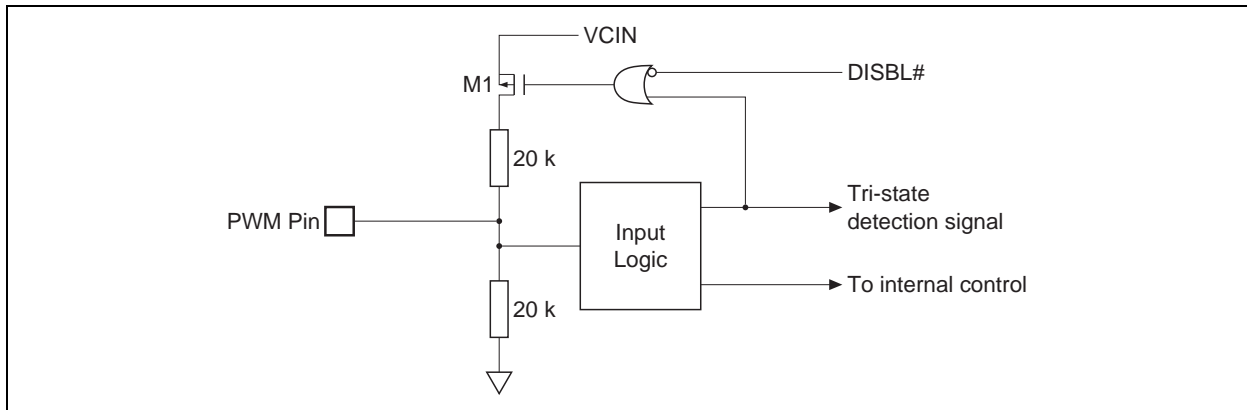
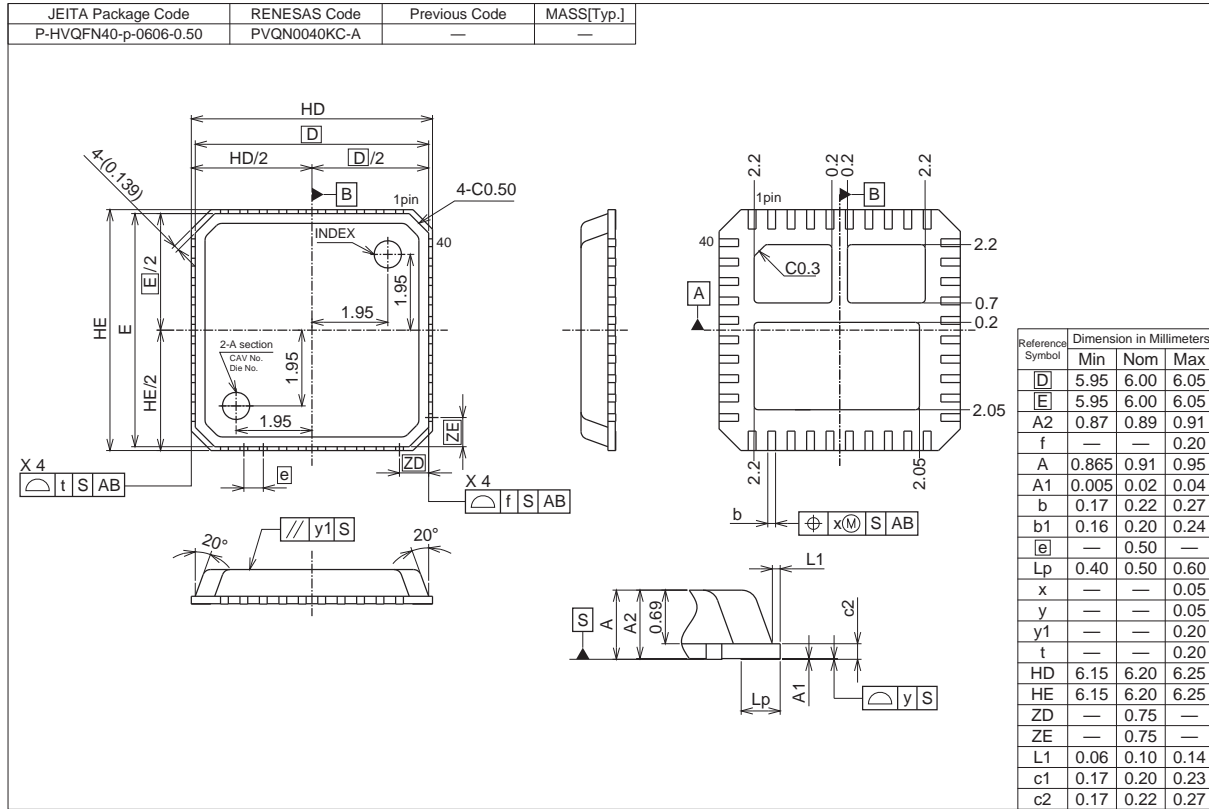


Figure 4 Equivalent Circuit for the PWM-pin Input

MOS FETs

The MOS FETs incorporated in R2J20652ANP are highly suitable for synchronous-rectification buck conversion. For the high-side MOS FET, the drain is connected to the VIN pin and the source is connected to the VSWH pin. For the low-side MOS FET, the drain is connected to the VSWH pin and the source is connected to the PGND pin.

Package Dimensions



Ordering Information

| Part Name | Quantity | Shipping Container |
|----------------|----------|--------------------|
| R2J20652ANP#G3 | 2500 pcs | Taping Reel |

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