One Package Regulator Series

# 0.65A Output, Fully Integrated, Step-down Switching Power Supply Module

## BZ6Axx06GMP Series

### ●General Description

Tne BZ6Axx06GMP is a fully integrated power supply module that is useful for shortening the product at the design period and shortening the product launch time for electronics product, communication of portable it, and various applications industrial etc.
BZ6Axx06GMP is based on a high efficiency 6MHz synchronous step-down switching regulator. It provides up to 0.65A load current and an input voltage range from 2.3V to 5.5V, optimized for battery powered portable applications.
BZ6Axx06GMP has a mode control pin that allows the user to select Forced PWM(Pulse Width Modulation) mode or PFM(Pulse Frequency Modulation) and PWM auto change mode utilized power save operation at light load current.

### ●Features

- No External components required SMPS
- Fast transient response
- Automatic PFM/PWM operation
- Forced PWM operation
- Internal Soft Start
- Under voltage lockout
- Over current protection
- Thermal shutdown
- Ultra small and low profile package

### ●Applications

Smart Phones, Cell phones, Portable applications,
POL applications, RF applications, and USB Line Application

### ●Package(s)

| | W(Typ.) x D(Typ.) x H(Max.) |
|---|---|
| BGA-MDP | 2.90mm x 2.30mm x 1.05mm |

### ●Typical Application Circuit(s)

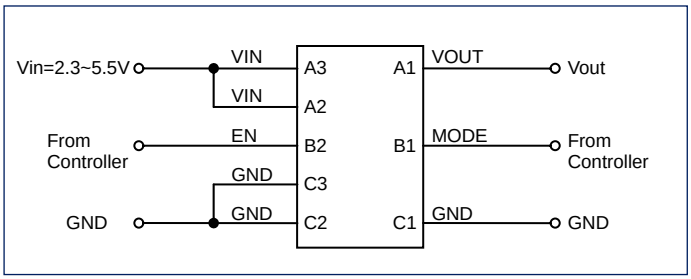



Figure 1. Typical Application Circuit(s)

### ●Lineup

| 機種名 | 出力電圧 |
|---|---|
| BZ6A1206GMP | 1.20V |
| BZ6A1806GMP | 1.80V |
| BZ6AB906GMP | 1.85V |

### ●Pin Configuration(s) (Top View)

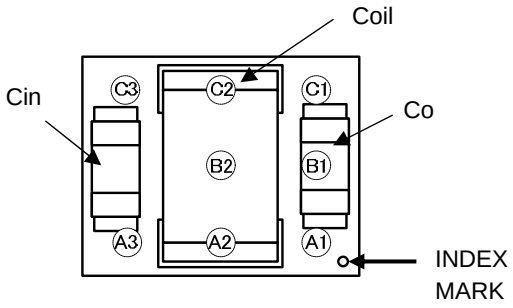
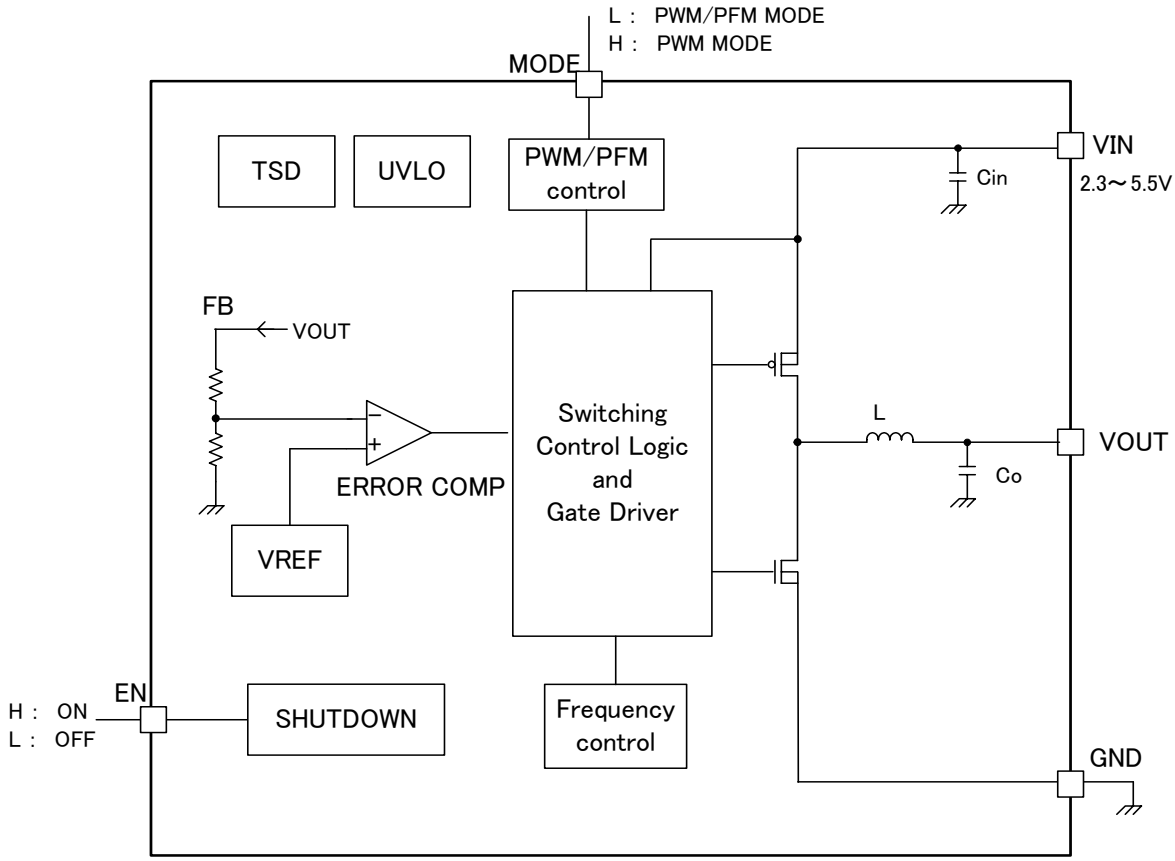



Figure 2. Pin Configuration(s)

### ●Pin Description(s)

| Pin No. | Symbol | Name | Function |
|---|---|---|---|
| 1 | A1 | VOUT | Output pin |
| 2 | A2 | VIN | Power supply input pin |
| 3 | A3 | VIN | Power supply input pin |
| 4 | B1 | MODE | Forced PWM mode pin |
| 5 | B2 | EN | Enable pin |
| 6 | C1 | GND | GND pin |
| 7 | C2 | GND | GND pin |
| 8 | C3 | GND | GND pin |

●**Block Diagram(s)**




Cin : C1005X5R0J225M
Co : C1005X5R0J475M
L : MDT2012-CLH1R0M

Figure 3. Block Diagram(s)

●**Description of Block(s)**

The BZ6Axx06GMP are a synchronous step-down DC/DC converter that achieves fast transient response from light load to heavy load by hysteretic PWM control system and current constant PFM control system.

○PWM control

BZ6Axx06GMP operates by hysteretic PWM control. This scheme ensures fast switching, high efficiency, and fast transient response.
When the output voltage is below the VREF voltage, the error comparator output is low to high and turning on P-channel MOSFET until above the VREF voltage and minimum on time.

○PFM control

At light load the regulator and MODE=low, the regulator operates with reduced switching frequency and improves the efficiency.

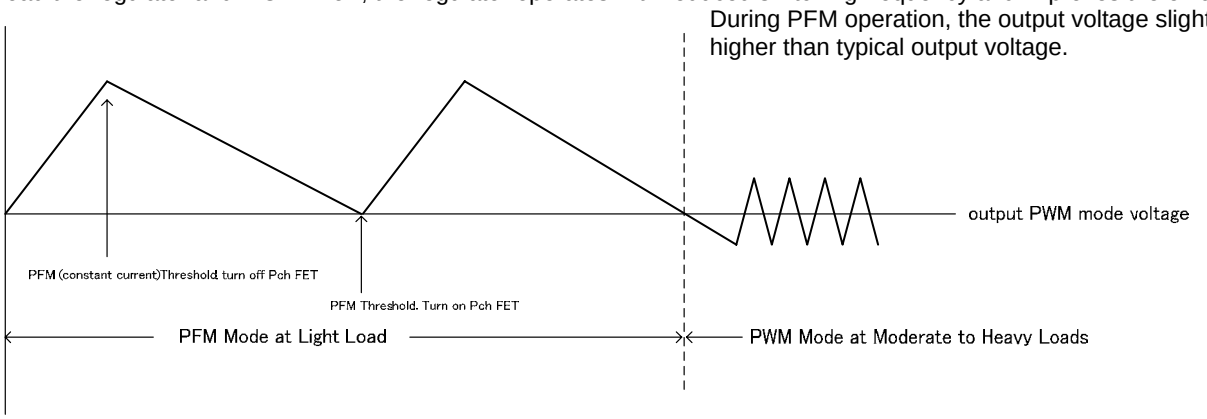



Figure 4. Operation of PFM mode and PWM mode

## ●Description of operations

1) Shutdown
If the EN input pin set to low (<0.4V), all circuit are shut down and the regulator is standby mode.
Do not leave the EN pin floating.

2) Soft start function
The regulator has a soft start circuit that reduces in-rush current at start-up. Typical start up times with a 4.7uF output capacitor is 120usec.

3) Current limit
The BZ6Axx06GMP has a current limit circuit that protects itself and external components during overload condition.

4) Under Voltage Lock Out (UVLO)
The BZ6Axx06GMP has a Under Voltage Lock Out circuit that turn off device when VIN>2.05V(typ.)

5) FORCED PWM MODE
Setting MODE pin high (>1.4V) places the regulator in forced PWM.This control provides noise reduction and output stability.
Do not leave the MODE pin floating.

6) TSD
The BZ6Axx06GMP has a thermal shutdown feature to protect the device if the junction temperature exceeds 150℃.In thermal shutdown, the DRIVER is disabled.
This circuit is only to cut off the IC from thermal runaway, and has not been design to protect or guarantee the IC. Therefore, the user should not plan to activate this circuit with continued operation in mind.

## ●Absolute Maximum Ratings (Ta=25℃)

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Maximum input power supply voltage | VIN | 7 | V |
| Power dissipation | Pd | 0.75 *1 | W |
| Operating temperature range | Topr | -40 to +85 | ℃ |
| Storage temperature range | Tstg | -55 to +125 | ℃ |
| Junction temperature | Tjmax | +125 | ℃ |

*1 When mounted on the specified PCB (55mm x 63mm), Deducted by 3.9m W/c when used over Ta=25c

## ●Recommended Operating Rating(s)

| Parameter | Symbol | Rating | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Input voltage | VIN | 2.3 | | 5.5 | V |
| Output current | IOUT | 0 | | 0.65 | A |

●**Electrical Characteristic(s)** (unless otherwise specified VIN=3.6V, Ta=25℃)

| Item | | Symbol | Rating | | | Unit | Condition |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| 【Switching regulator】 | | | | | | | |
| Output voltage accuracy | | VOUTA | -2.5 | - | +2.5 | % | MODE:H(PWM Operation) |
| | | | -2.5 | - | +3.5 | | MODE:L(PFM Operation) |
| 【Soft start】 | | | | | | | |
| Soft start time | | Tss | 65 | 120 | 240 | usec | |
| 【Control】 | | | | | | | |
| EN pin control voltage | Operation | VENH | 1.4 | - | VIN | V | |
| | Non Operation | VENL | 0 | - | 0.4 | V | |
| MODE pin control voltage | Operation | VMODEH | 1.4 | - | VIN | V | Forced PWM |
| | Non Operation | VMODEL | 0 | - | 0.4 | V | Automatic PFM/PWM |
| 【UVLO】 | | | | | | | |
| Protect threshold voltage | | Uvth | 1.95 | 2.05 | 2.15 | V | |
| Hysteresis | | Uvhy | 50 | 100 | 150 | mV | |
| 【Circuit current】 | | | | | | | |
| Operating quiescent current | | IINS | - | 45 | 72 | uA | EN:H, MODE:L, VOUT=3.6V forced Not switching |
| Shutdown current | | SHD | - | 0 | 1 | uA | EN=0V |

●**Electrical characteristic curves (Reference data)**
**BZ6A1206GMP(1.2V OUTPUT)**

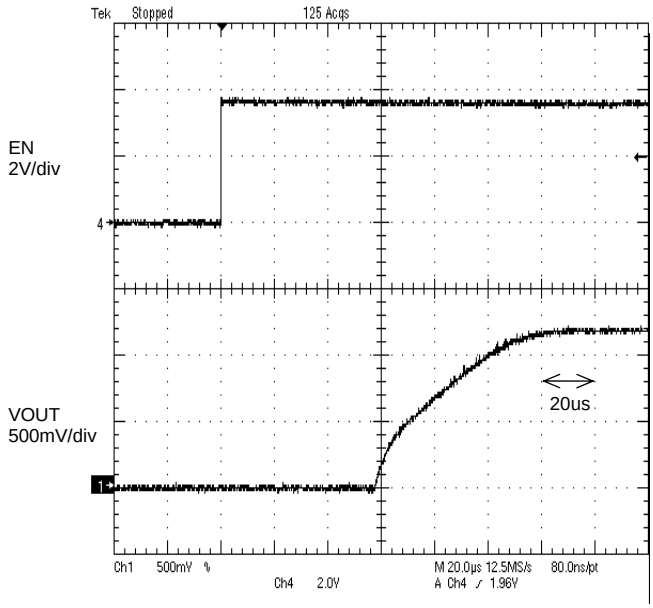



Figure 5. Start up

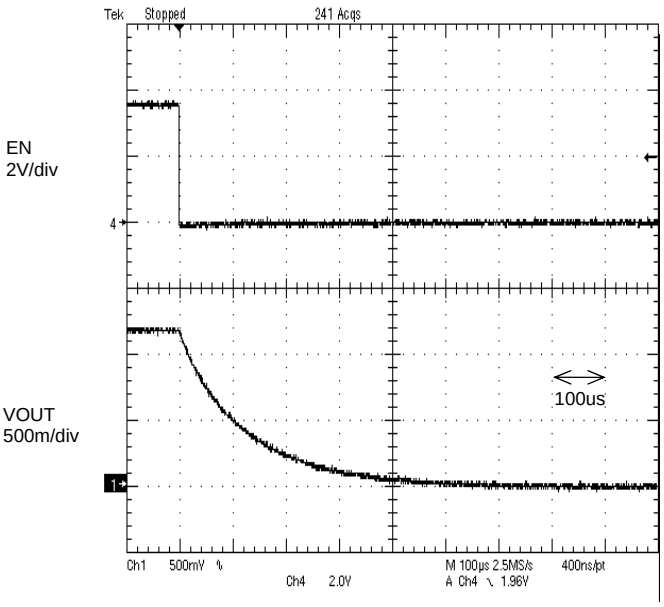



Figure 6. Shut down

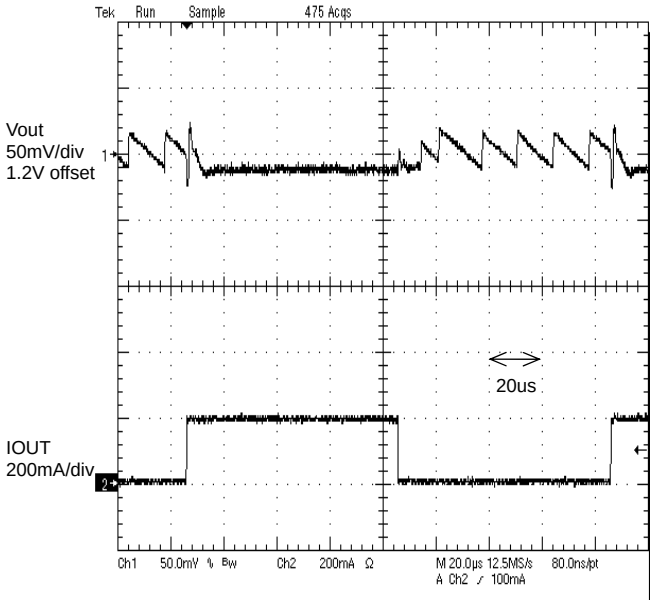



Figure 7. Load transient response 5mA to 200mA
tr=tf=100ns, MODE : Low

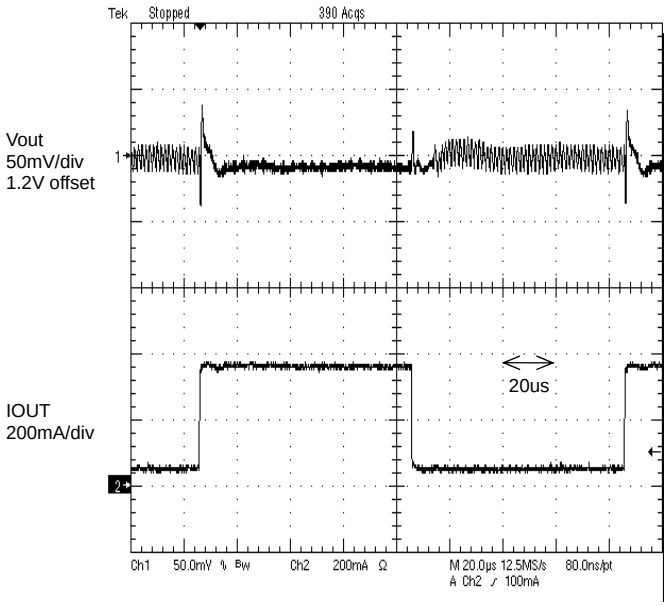



Figure 8. Load transient response 50mA to 350mA
tr=tf=100ns, MODE : Low

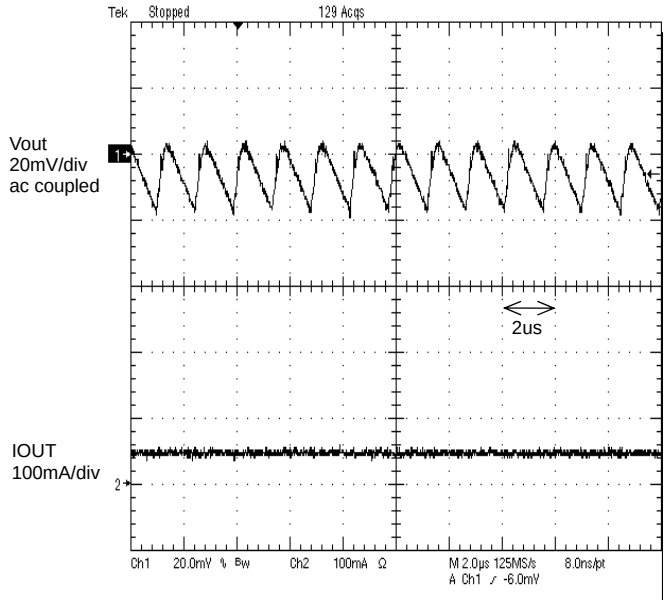



Figure 9. PWM/PFM Auto mode Operation
Iout=50mA

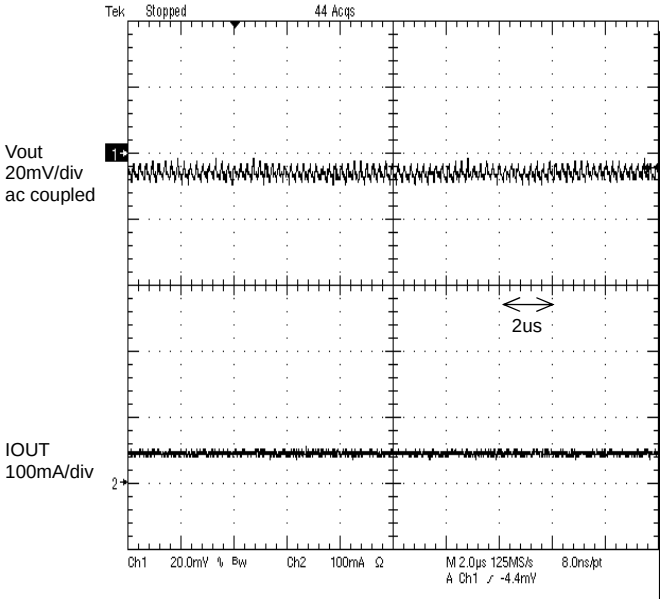



Figure 10. PWM mode Operation
Iout=50mA

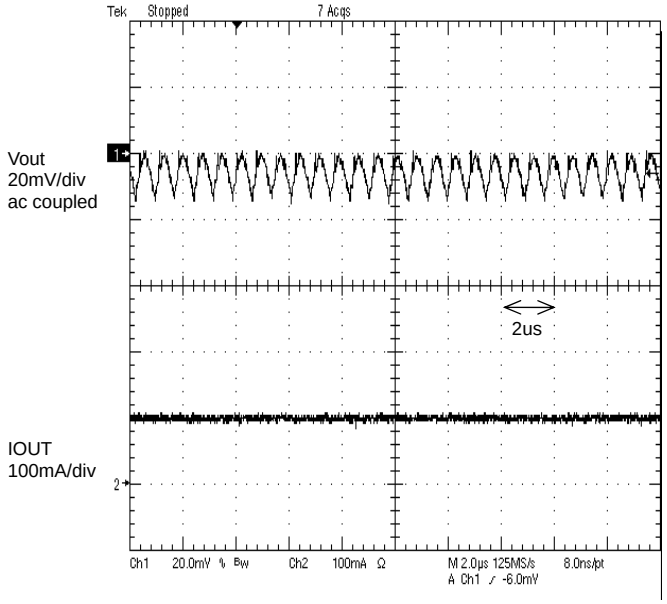



Figure 11. PWM/PFM Auto mode Operation
Iout=100mA

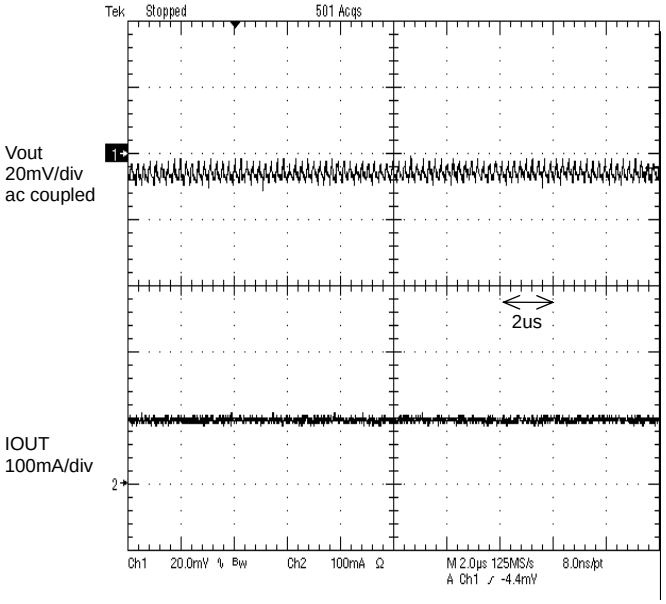



Figure 12. PWM mode Operation
Iout=100mA

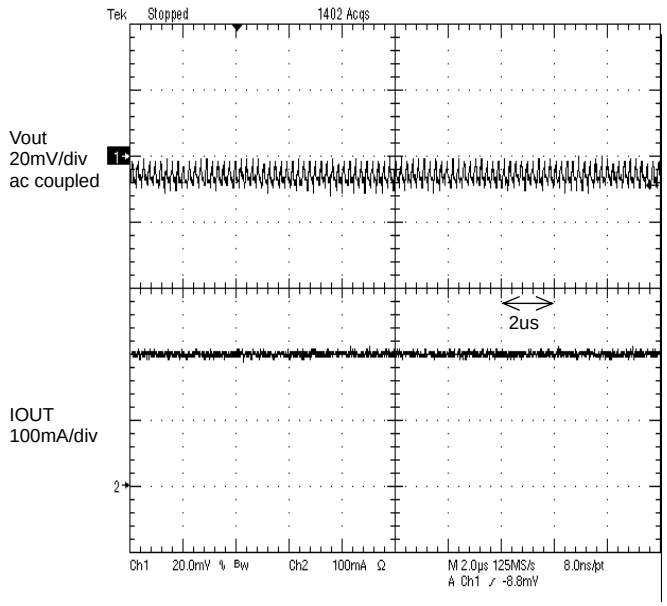



Figure 13. PWM/PFM Auto mode Operation
Iout=200mA

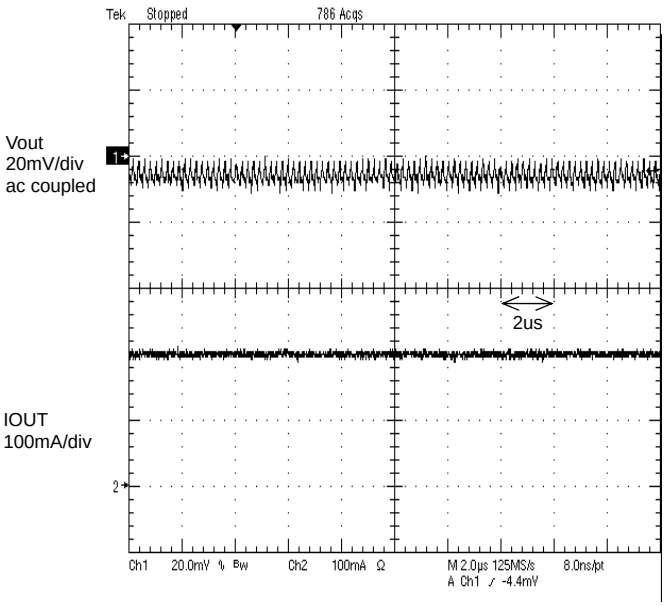



Figure 14. PWM mode Operation
Iout=200mA

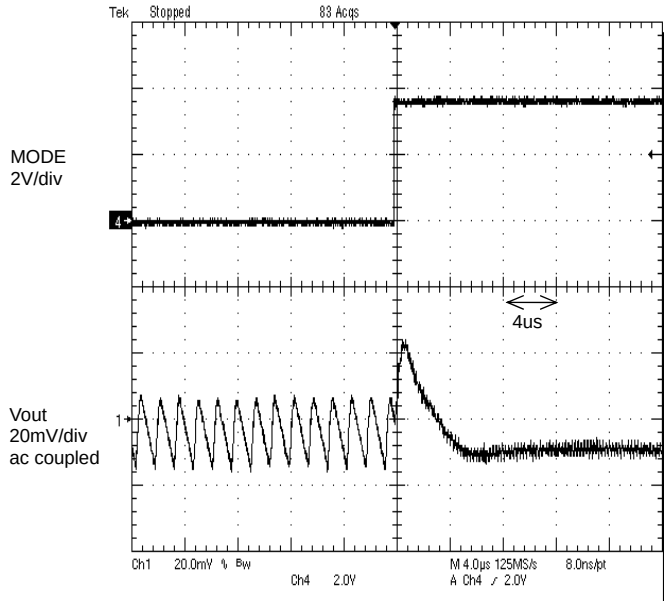



Figure 15. Mode Change Response
MODE : Low to High

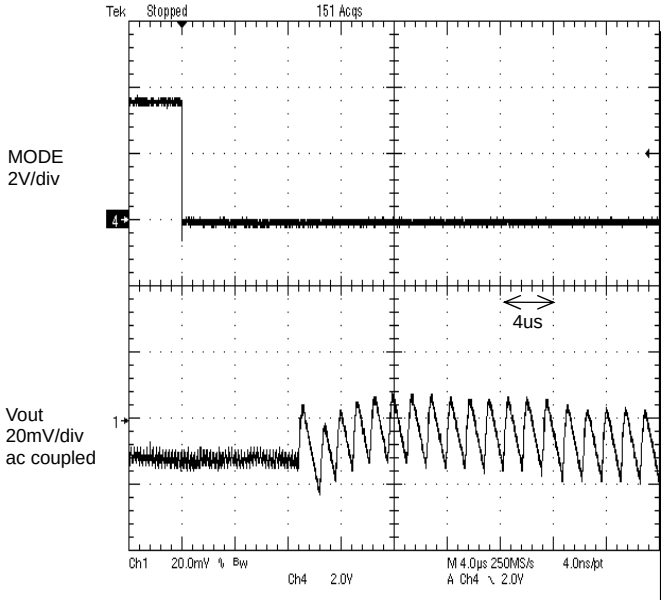



Figure 16. Mode Change Response
MODE : High to Low

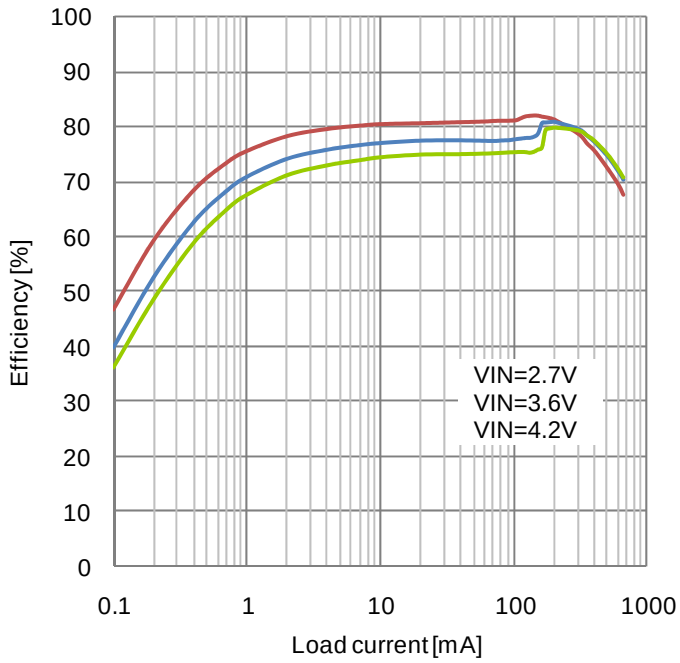



Figure 17. Efficiency vs Load current
PWM/PFM Auto mode

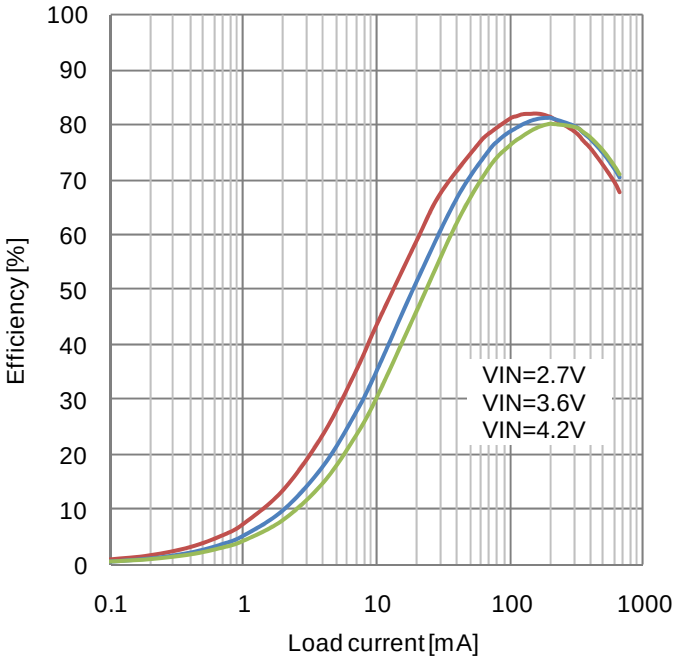



Figure 18. Efficiency vs Load current
PWM mode

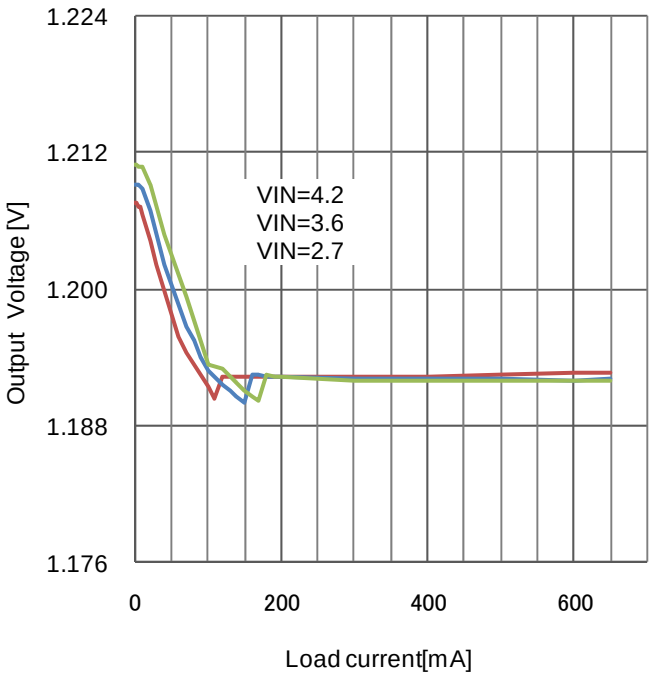



Figure 19. Load regulation
PWM/PFM Auto mode

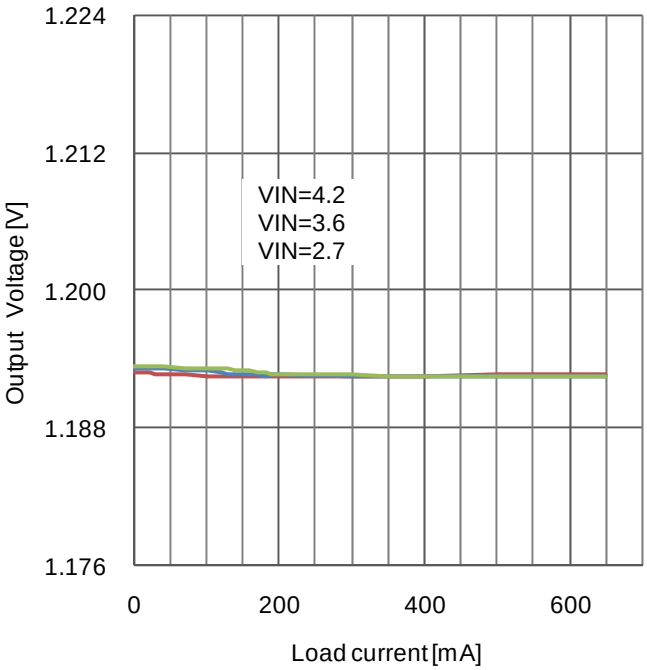



Figure 20. Load regulation
PWM mode

●**Electrical characteristic curves (Reference data)**
**BZ6A1806GMP(1.8V OUTPUT)**

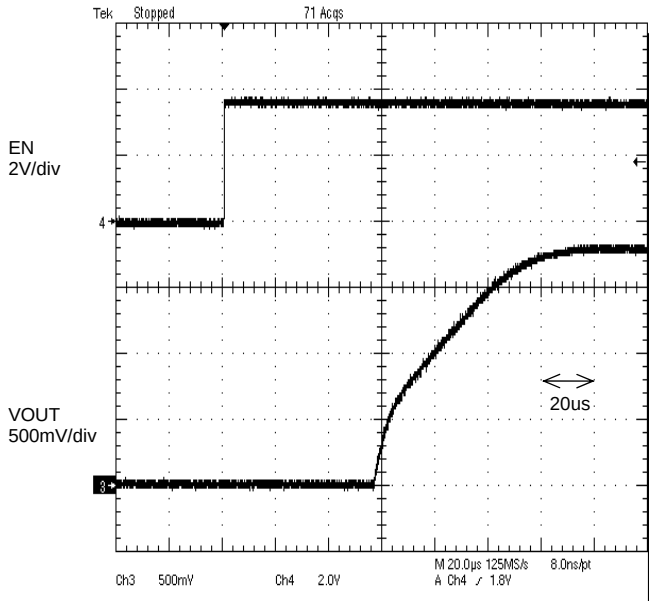



Figure 21. Start up

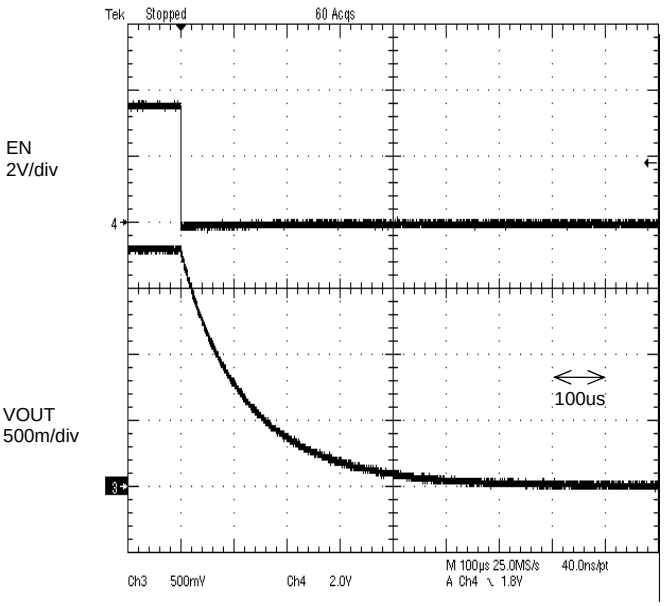



Figure 22. Shut down

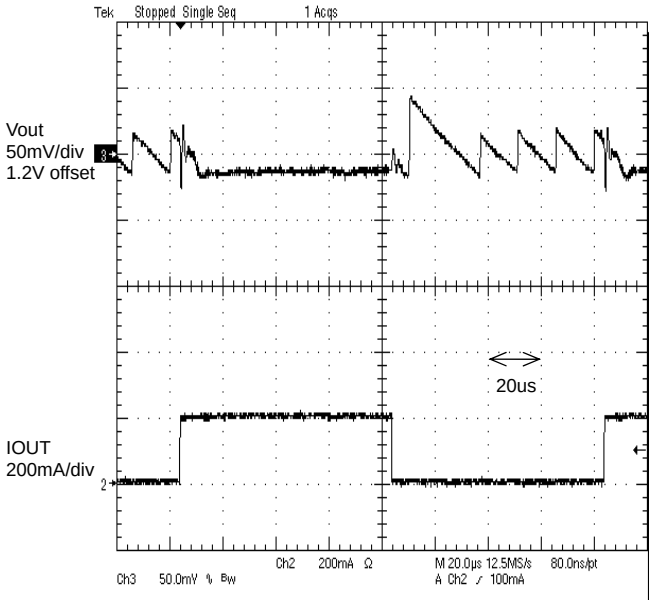



Figure 23. Load transient response 5mA to 200mA
tr=tf=100ns, MODE : Low

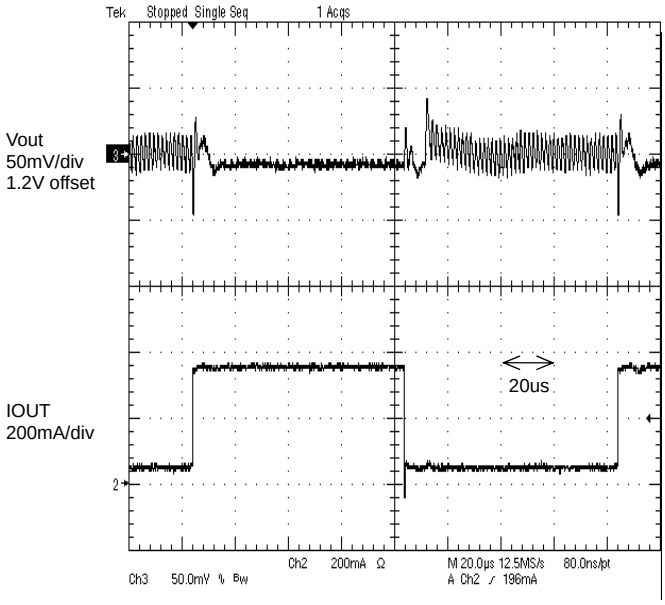



Figure 24. Load transient response 50mA to 350mA
tr=tf=100ns, MODE : Low

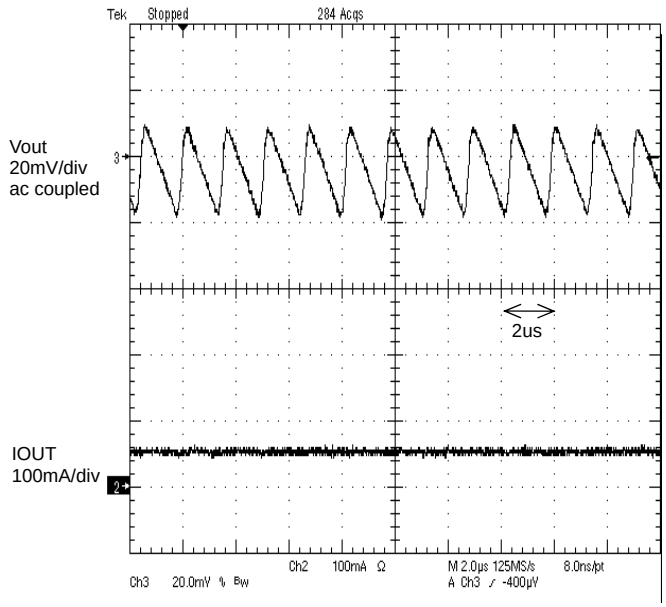



Figure 25. PWM/PFM Auto mode Operation
Iout=50mA

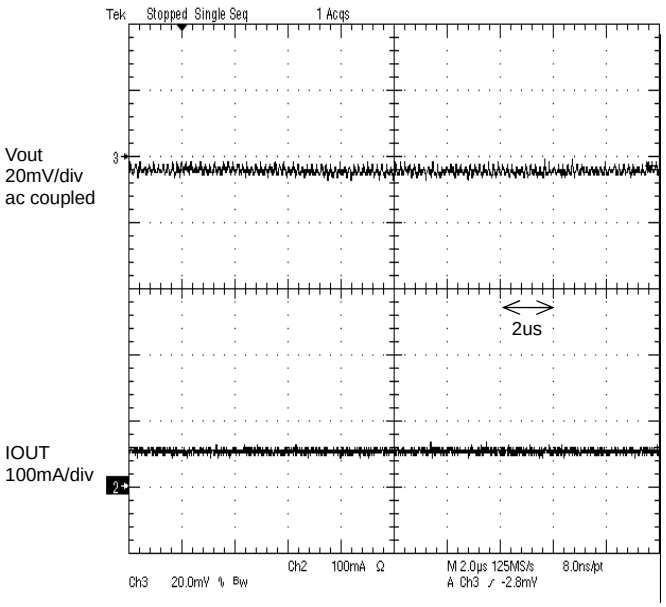



Figure 26. PWM mode Operation
Iout=50mA

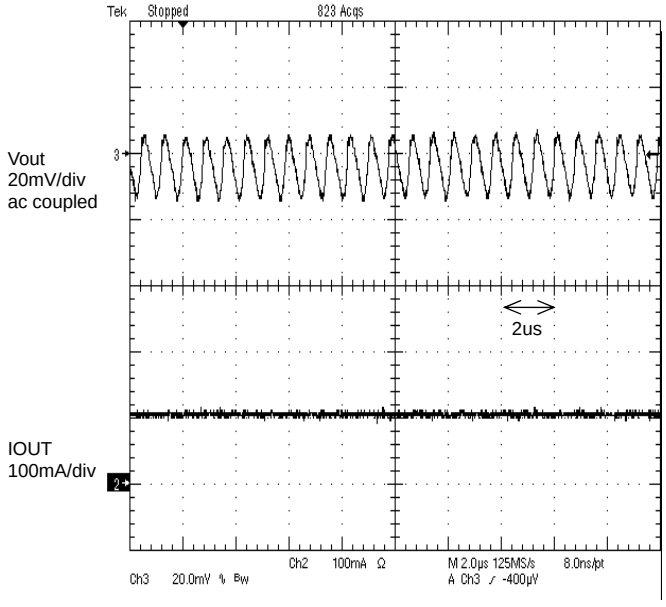



Figure 27. PWM/PFM Auto mode Operation
Iout=100mA

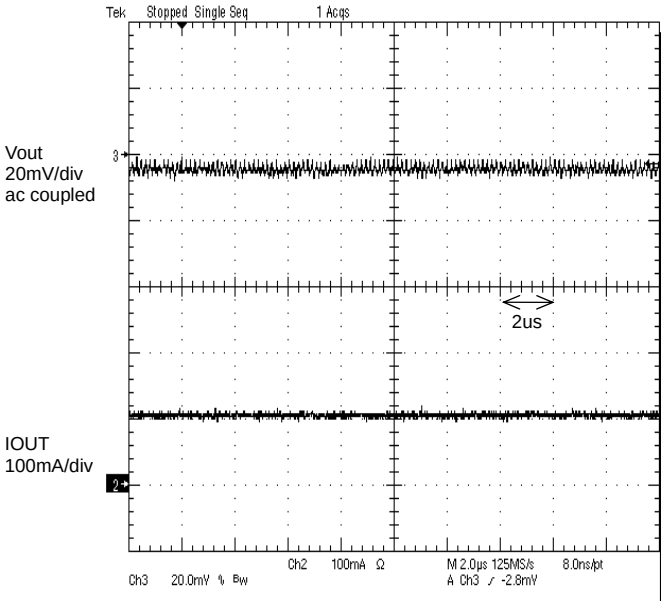



Figure 28. PWM mode Operation
Iout=100mA

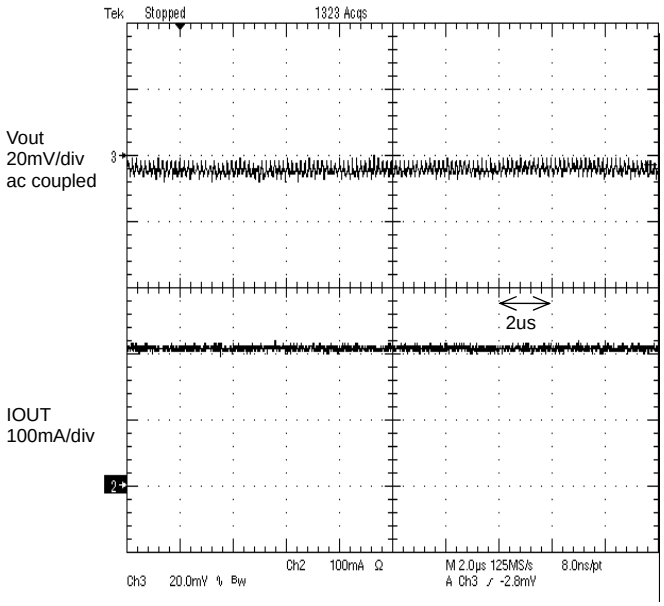



Figure 29. PWM/PFM Auto mode Operation
Iout=200mA

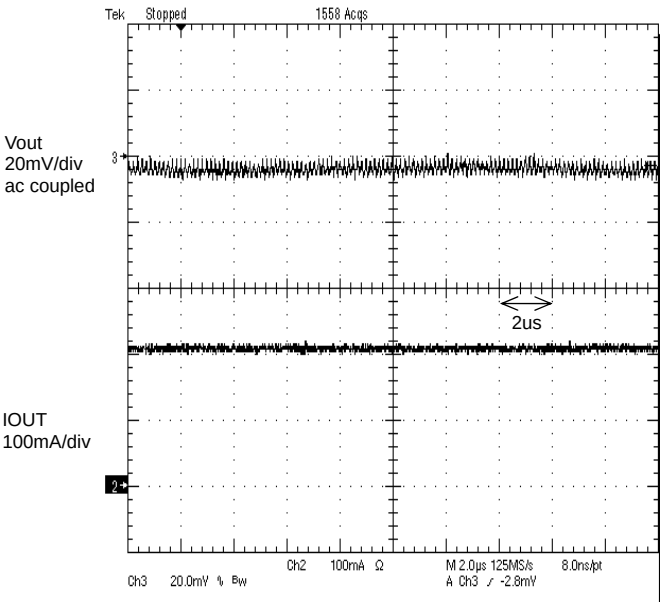



Figure 30. PWM mode Operation
Iout=200mA

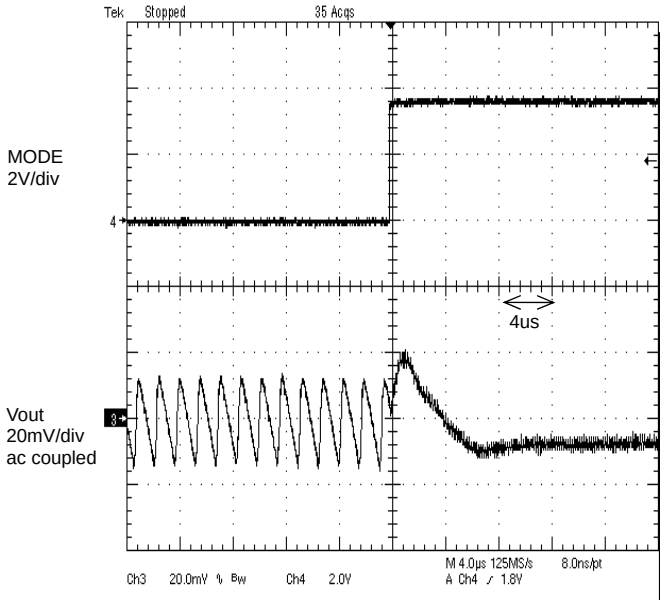



Figure 31. Mode Change Response
MODE : Low to High

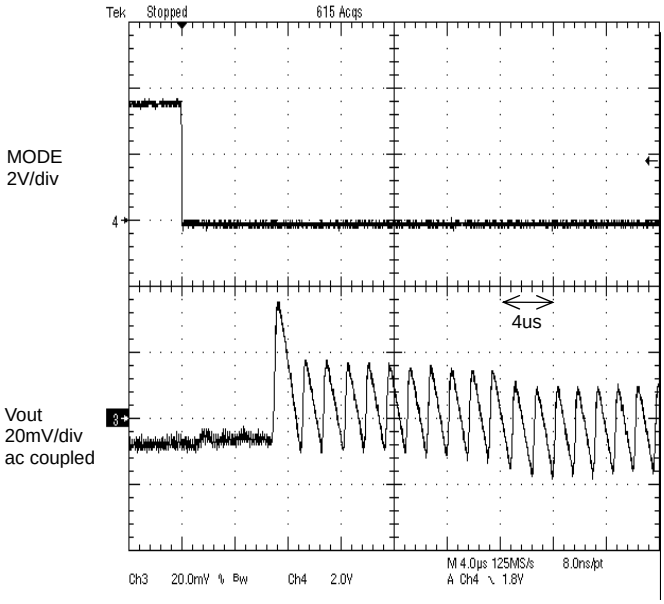



Figure 32. Mode Change Response
MODE : High to Low

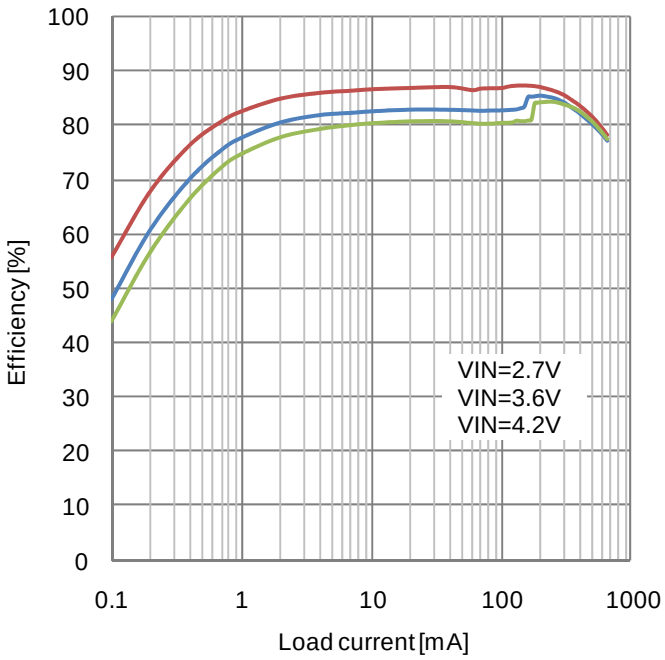



Figure 33. Efficiency vs Load current
PWM/PFM Auto mode

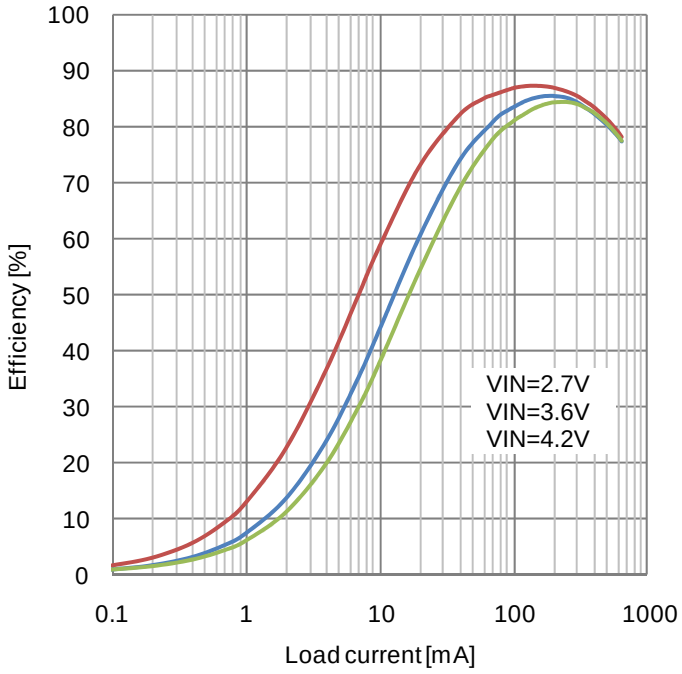



Figure 34. Efficiency vs Load current
PWM mode

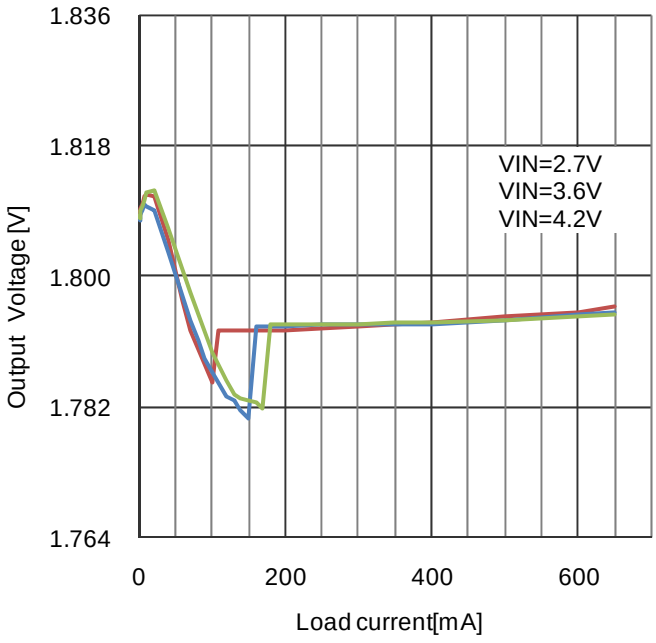



Figure 35. Load regulation
PWM/PFM Auto mode

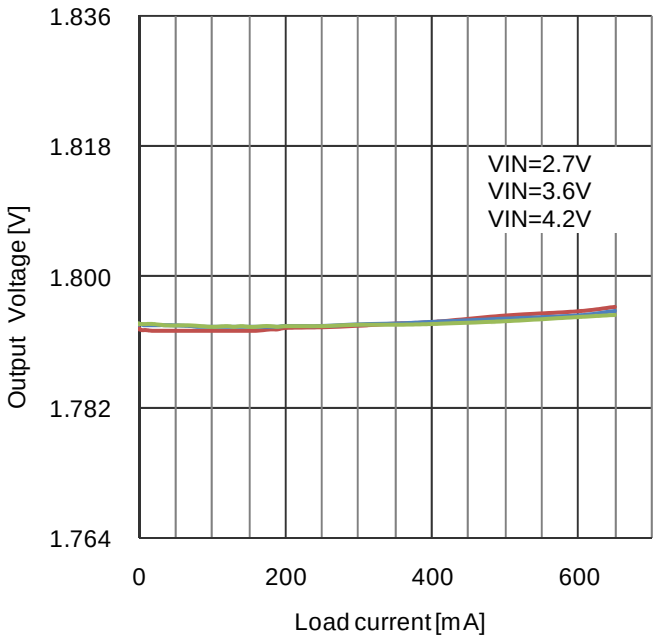



Figure 36. Load regulation
PWM mode

●**Electrical characteristic curves (Reference data)**
**BZ6AB906GMP(1.85V OUTPUT)**

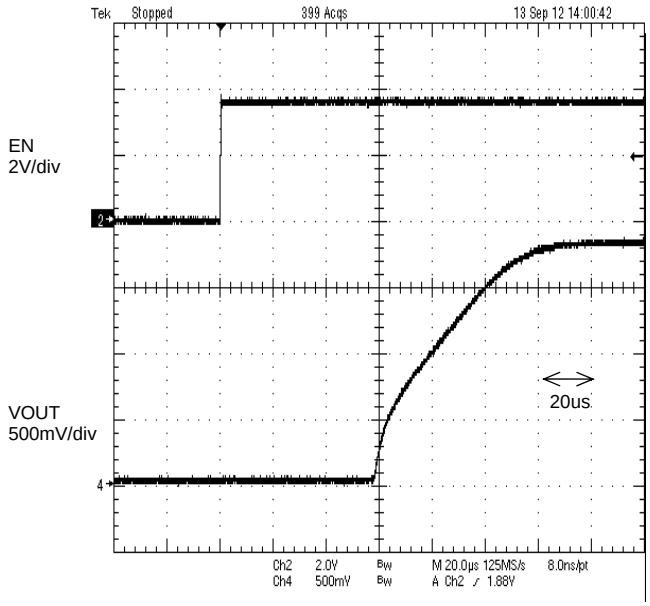



Figure 37. Start up

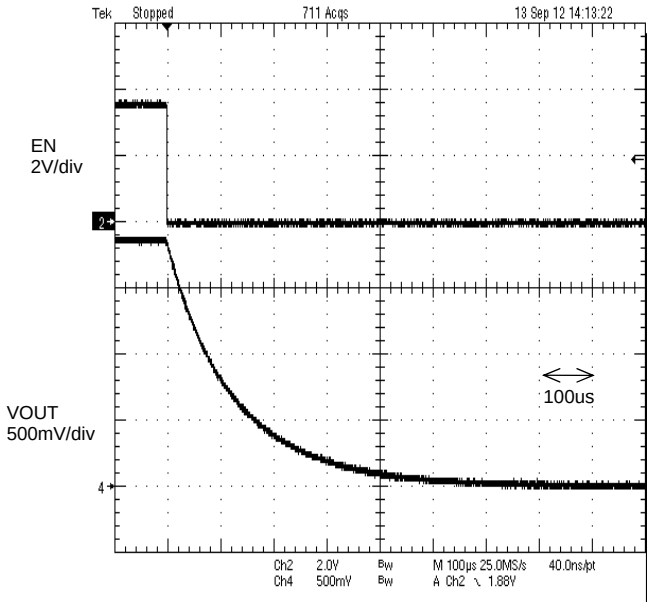



Figure 38. Shut down

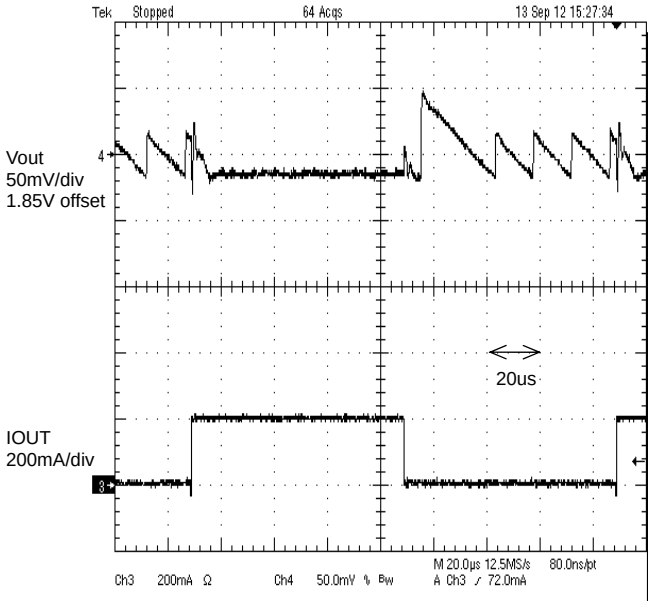



Figure 39. Load transient response 5mA to 200mA
tr=tf=100ns, MODE : Low

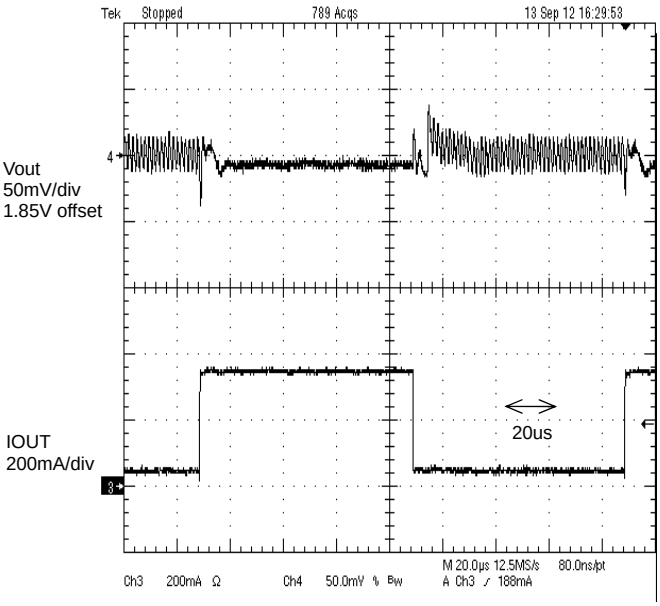



Figure 40. Load transient response 50mA to 350mA
tr=tf=100ns, MODE : Low

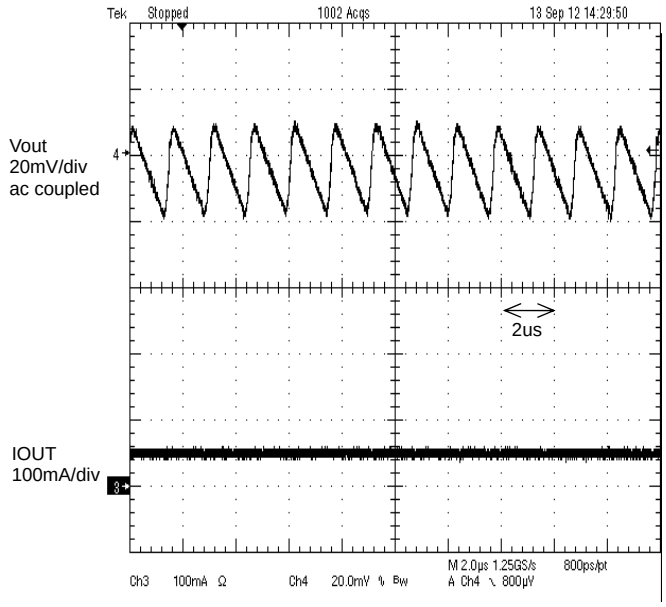



Figure 41. PWM/PFM Auto mode Operation
Iout=50mA

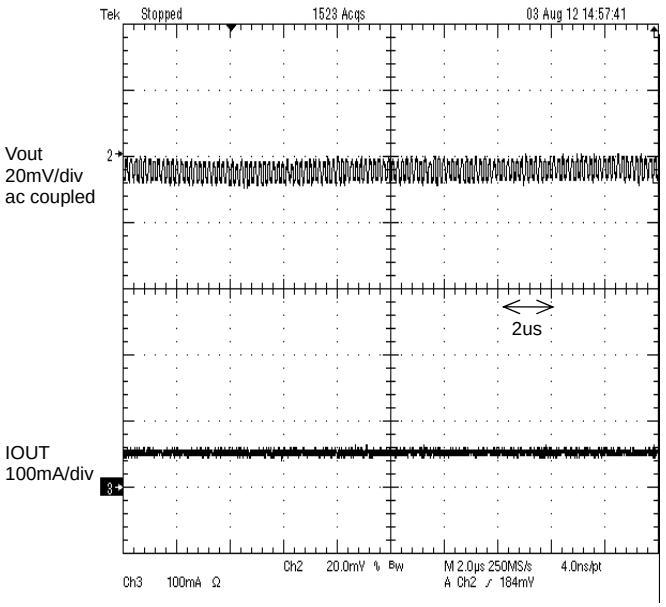



Figure 42. PWM mode Operation
Iout=50mA

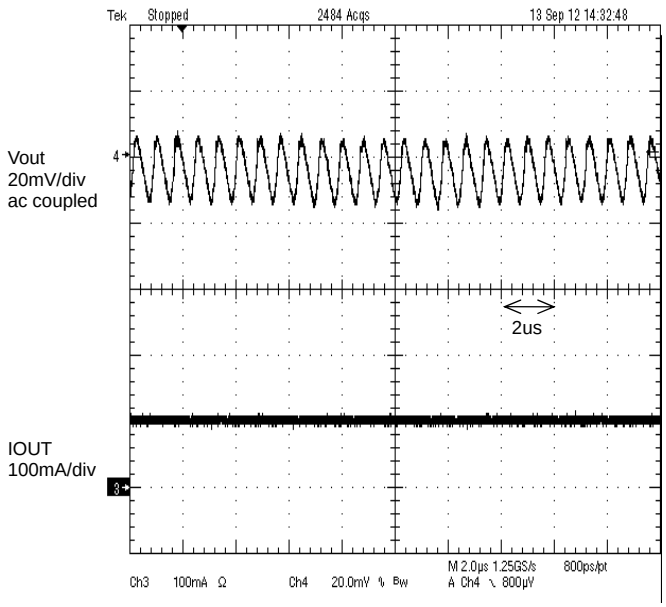



Figure 43. PWM/PFM Auto mode Operation
Iout=100mA

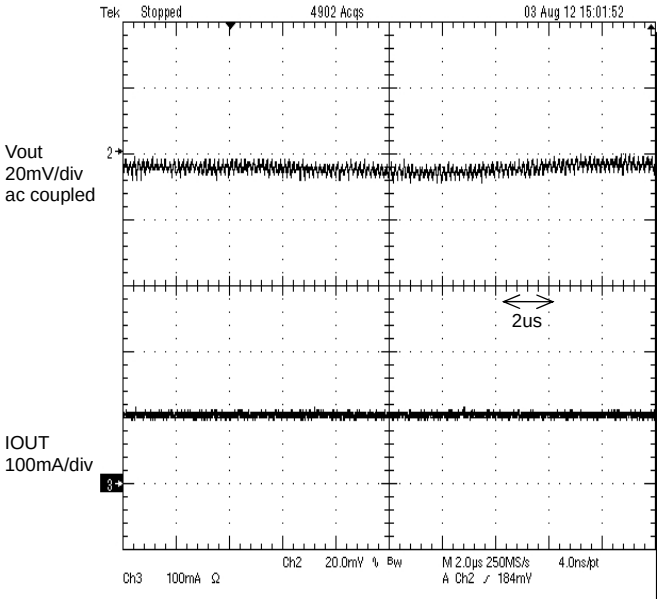



Figure 44. PWM mode Operation
Iout=100mA

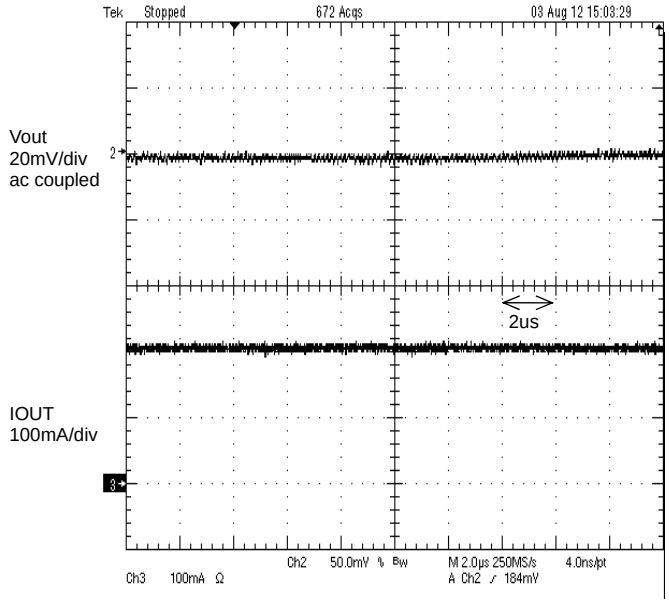



Figure 45 PWM/PFM Auto mode Operation
Iout=200mA

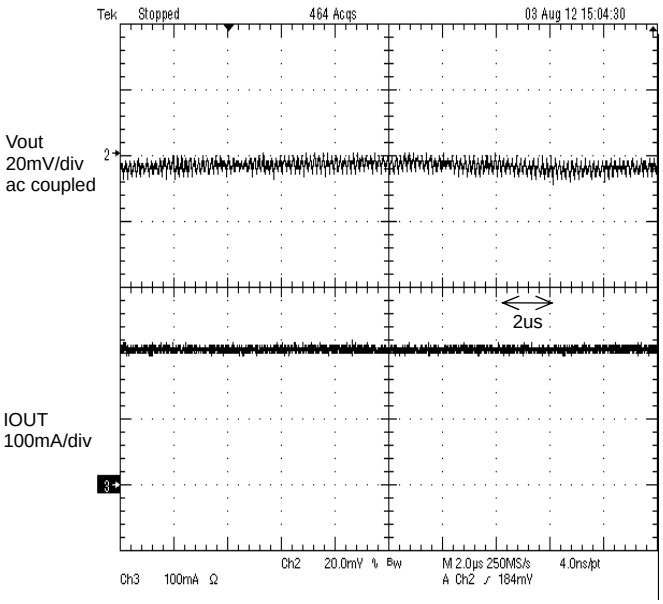



Figure 46. PWM mode Operation
Iout=200mA

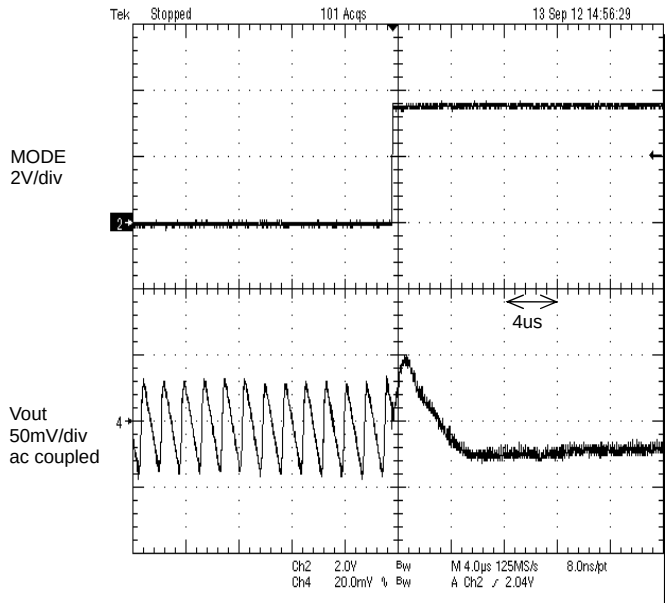



Figure 47. Mode Change Response
MODE : Low to High

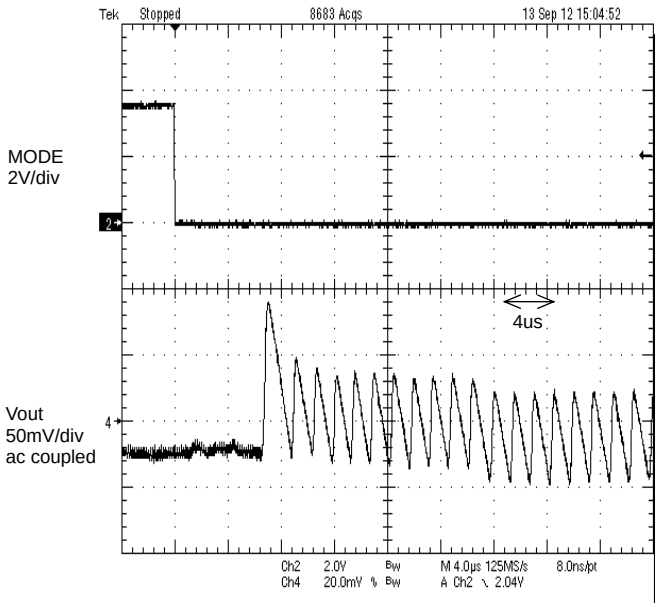



Figure 48. Mode Change Response
MODE : High to Low

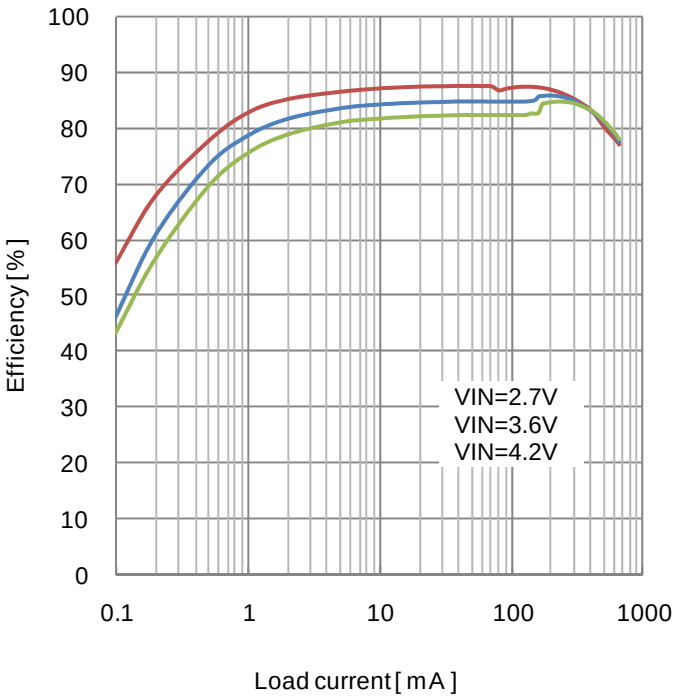



Figure 49. Efficiency vs Load current
PWM/PFM Auto mode

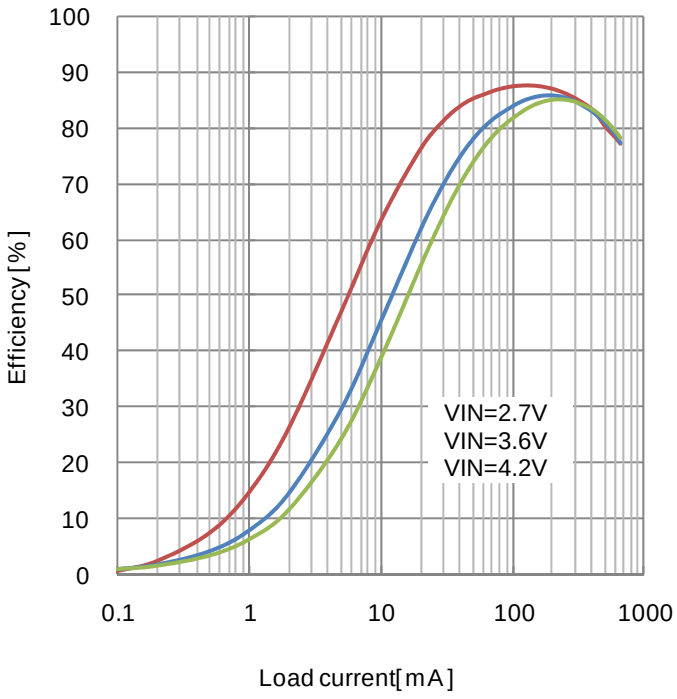



Figure 50. Efficiency vs Load current
PWM mode

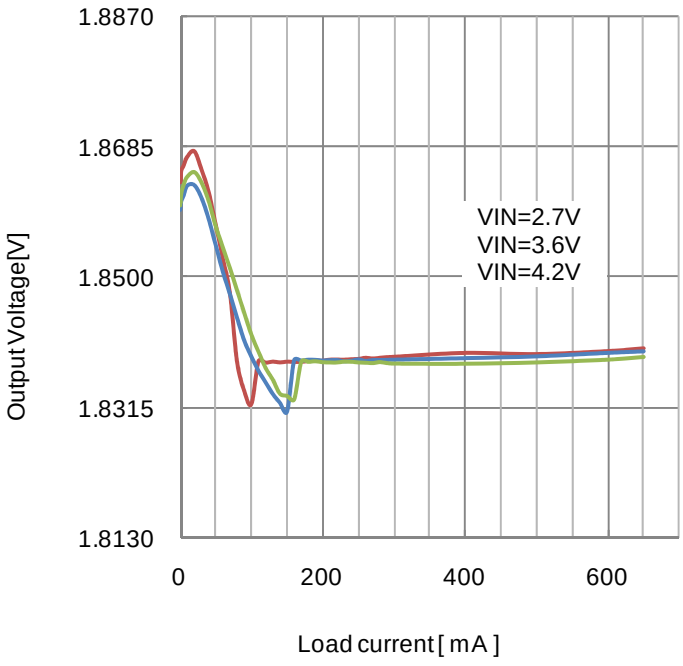



Figure 51. Load regulation
PWM/PFM Auto mode

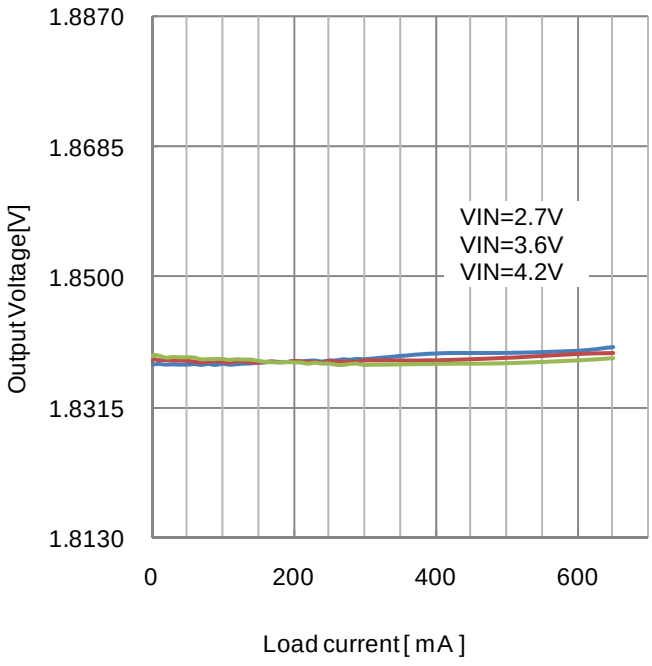



Figure 52. Load regulation
PWM mode

●PC Board layout

The suggested PCB layout for the BZ6Axx06GMP is shown in Figure. The following guidelines should be used to ensure a proper layout.

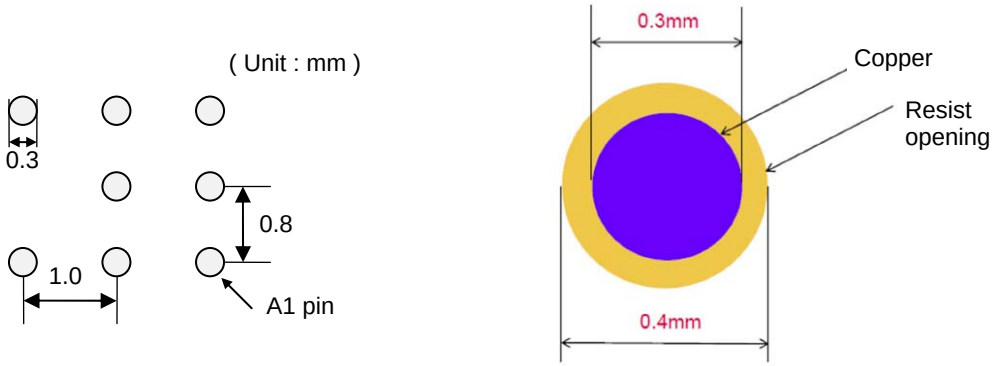



Figure 53. Recommended Land Pattern (TOP VIEW)

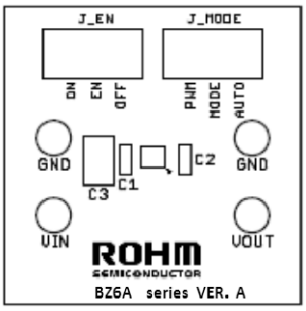



Figure 54. PCB layout (Mount side)

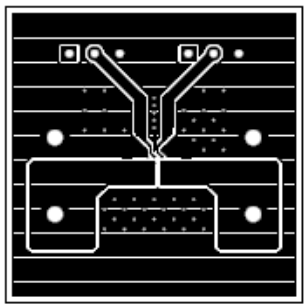


Figure 55. PCB layout (solder side)

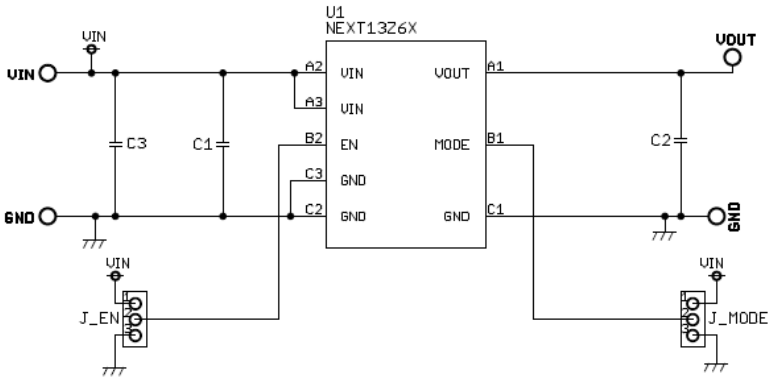



Figure 56. PCB Circuit

**●Caution of use**

1) Absolute maximum ratings

An excess in the absolute maximum rating, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2) GND voltage

The potential of GND pin must be minimum potential in all condition. As an exception, the circuit design allows voltages up to -0.3 V to be applied to the IC pin.

3) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

4) Inter-pin shorts and mounting errors

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

5) Actions in strong electromagnetic field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

6) Mutual impedance

Power supply and ground wiring should reflect consideration of the need to lower mutual impedance and minimize ripple as much as possible (by making wiring as short and thick as possible or rejecting ripple by incorporating inductance and capacitance).

7) Thermal shutdown Circuit (TSD Circuit)

This model IC has a built-in TSD circuit. This circuit is only to cut off the IC from thermal runaway, and has not been design to protect or guarantee the IC. Therefore, the user should not plan to activate this circuit with continued operation in mind.

8) Regarding input pin of the IC

This monolithic 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 these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, as shown in the figures below, the relation between each potential is as follows:

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 can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

Status of this document

The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.

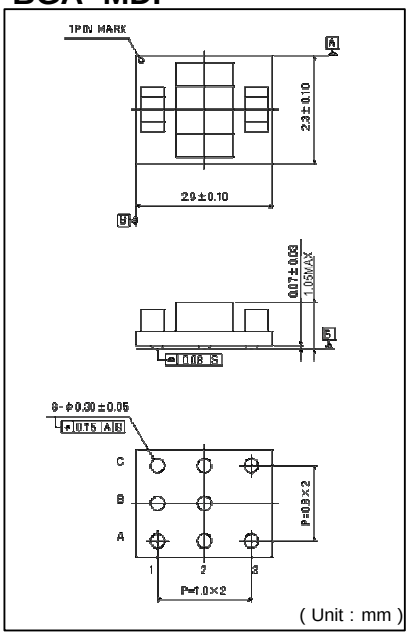
If there are any differences in translation version of this document formal version takes priority

## ●Ordering Information

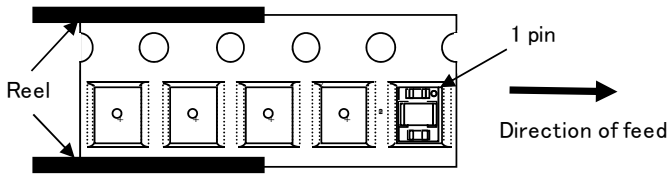
| B Z 6 A x x 0 6 G M P | TR |
|---|---|
| Part Number | Packaging and forming specification<br>TR: Embossed tape and reel |
| Frequency<br>6A : 6MHz | |
| Output voltage<br>12 : 1.20V<br>18 : 1.80V<br>B9 : 1.85V | |
| Output current<br>06 : 0.65A | |
| Package<br>GMP: BGA-MDP | |

## ●Physical Dimension Tape and Reel Information

### BGA- MDP




| | |
|---|---|
| Tape | Embossed carrier tape |
| Quantity | 3,000pcs |
| Direction of feed | TR<br>( The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand. ) |




* Order quantity needs to be multiple of the minimum quantity.

●**Revision History**

| Date | Revision | Changes |
|---|---|---|
| 11.Jul.2012 | 001 | New Release |
| 24.Aug.2012 | 002 | Page1：Package(s)<br>2.90mm x 2.30mm x 1.00mm ⇒ 2.90mm x 2.30mm x 1.05mm<br>Page11 : Physical Dimension Tape and Reel Information<br>1.0MAX ⇒ 1.05MAX<br><br>Page3 : Absolute Maximum Ratings<br>Maximum voltage at EN, FB, LX, MODE ⇒ Delete item<br>Page4 : Electrical Characteristic(s)<br>Output voltage accuracy<br>PWM<br>Min：1.176V ⇒ 1.170V<br>Max：1.224V ⇒ 1.230V<br>PFM<br>Min：1.176V ⇒ 1.170V<br>Max：1.236V ⇒ 1.242V<br>Frequency control ⇒ Delete item<br>Driver ⇒ Delete item<br>Current limit ⇒ Delete item<br>Output discharge ⇒ Delete item<br>Operating quiescent current<br>Max：65uA ⇒ 72uA |
| 18.Sep.2012 | 003 | BZ6A1206GMP ⇒ BZ6Axx06GMP Series<br>Page1 : Lineup added<br>Page4 : Output voltage accuracy<br>Unit : V ⇒ %<br>Page9-16 : Reference data<br>BZ6A1806GMP and BZ6AB906GMP added<br>Page19 : Ordering Information<br>BZ6A1806GMP and BZ6AB906GMP added |

# Notice

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   [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 (even if you use no-clean type fluxes, cleaning residue of flux is recommended); 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 (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient 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; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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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 Cl2, H2S, NH3, SO2, and NO2
   [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.

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