



# LN10006

## Low-Noise 3.5W DUAL DC/DC CONVERTER

9–18V<sub>IN</sub>, +15V<sub>OUT</sub>@200mA, +5V<sub>OUT</sub>@200mA

US Patent 5,777,519

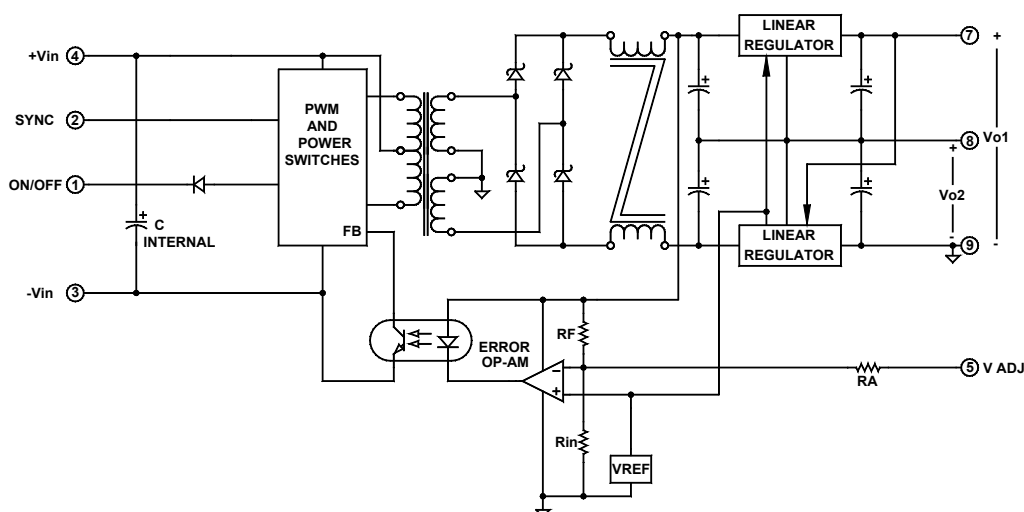
### Key Features

- Wide input voltage range (2:1)
- Less than 5mV output noise
- Six-sided shielding
- Soft start
- Dual output
- Short circuit protection
- Adjustable output
- 750μA off state current
- 250mV dropout linear regulators
- Dual output tracking linear regulator
- 5μS transient response
- Industry pinouts



### Functional Description

The LN10006 is a 3.5W dual positive, isolated DC/DC converter that accepts 9V<sub>IN</sub> to 18V<sub>IN</sub> and provides +15V<sub>OUT</sub>@200mA and +5V<sub>OUT</sub>@200mA. The converter's design is based on Beta Dyne's patents and offers low noise and an operating temperature range from -40°C to +70°C.



Typical Block Diagram of Dual Output Converter

## Electrical Specifications

### INPUT SPECIFICATIONS

Unless otherwise specified, all parameters are given under typical +25°C with nominal input voltage and under full output load conditions.

| PARAMETER                        | CONDITION / NOTE                               | MIN  | TYP | MAX | UNIT              |
|----------------------------------|------------------------------------------------|------|-----|-----|-------------------|
| Input Voltage Range              |                                                | 9    | 12  | 18  | Vdc               |
| No Load Input Current            |                                                |      | 40  |     | mA                |
| Full Load Input Current          | V = 28V@FL (±250mA)                            |      | 410 |     | mA                |
| Input Filter                     | C                                              |      |     |     |                   |
| Reverse Polarity Input Current   | External series-blocking diode                 |      |     | 12  | A                 |
| Input Surge Current (20µs Spike) |                                                |      |     | 10  | A                 |
| Short Circuit Current Limit      |                                                |      | 150 |     | % I <sub>IN</sub> |
| Undervoltage Shutdown            |                                                | 4.5  |     |     | Vdc               |
| Off State Current                |                                                |      | 750 |     | µA                |
| Remote ON/OFF Control            |                                                |      |     |     |                   |
| Converter ON                     | Open (Open circuit voltage at Pin 1: 10V Max.) |      |     |     |                   |
| Converter OFF                    |                                                | -0.6 | 0   | 0.2 | Vdc               |
| Logic Input Reference            | -Input                                         |      |     |     |                   |
| Logic Compatibility              | TTL Open Collector or CMOS Open Drain          |      |     |     |                   |

### OUTPUT SPECIFICATIONS

| PARAMETER                                                     | CONDITION / NOTE                                   | MIN | TYP  | MAX  | UNIT                     |
|---------------------------------------------------------------|----------------------------------------------------|-----|------|------|--------------------------|
| Output Voltage, V <sub>O1</sub>                               | Pin 7 = +15Vdc, Pin 9 = Output Ground              |     | 15   |      | Vdc                      |
| Output Voltage, V <sub>O2</sub>                               | Pin 8 = +5Vdc, Pin 9 = Output Ground               |     | 5    |      | Vdc                      |
| Output Voltage Accuracy                                       |                                                    |     | ±1   | ±1.5 | %                        |
| Output Voltage Adjustment                                     | Reference to Pin 8                                 |     | 3    | ±5   | %                        |
| Output Current, V <sub>O1</sub>                               |                                                    |     | 200  |      | mA                       |
| Output Current, V <sub>O2</sub>                               |                                                    |     | 200  |      | mA                       |
| Minimum Load                                                  | Not required                                       |     |      |      |                          |
| Ripple & Noise                                                | See Figure 3                                       |     | 5    | 10   | mV <sub>pp</sub>         |
| Line Regulation                                               | Minimum V <sub>IN</sub> to maximum V <sub>IN</sub> |     | 0.05 | 0.1  | %                        |
| Load Regulation                                               |                                                    |     | ±1   |      | %                        |
| Temperature Coefficient @ FL                                  |                                                    |     | 0.02 |      | %/°C of V <sub>OUT</sub> |
| Transient Response Time (to within 0.5% of V <sub>OUT</sub> ) | 50% FL to FL to 50% FL, See Figure 1               |     | 5    |      | µs                       |
| Short Circuit Protection                                      | All outputs, by input current limiting             |     |      |      |                          |

### GENERAL SPECIFICATIONS

| PARAMETER                  | CONDITION / NOTE    | MIN | TYP             | MAX | UNIT |
|----------------------------|---------------------|-----|-----------------|-----|------|
| Efficiency                 | V = 28V, I = ±250mA |     | 71              |     | %    |
| Isolation Voltage (1 min.) |                     |     | 1500            |     | Vdc  |
| Isolation Resistance       |                     |     | 10 <sup>9</sup> |     | Ω    |
| Isolation Capacitance      |                     |     | 80              |     | pF   |
| Switching Frequency        |                     | 300 | 320             | 333 | kHz  |

### ENVIRONMENTAL SPECIFICATIONS

| PARAMETER                          | CONDITION / NOTE                         | MIN | TYP               | MAX  | UNIT                 |
|------------------------------------|------------------------------------------|-----|-------------------|------|----------------------|
| Operating Temperature              |                                          | -40 |                   | +70  | °C                   |
| Storage Temperature Range          |                                          | -55 |                   | +125 | °C                   |
| Thermal Resistance                 |                                          |     | 3.5               | 4    | °C/W <sub>DISS</sub> |
| Maximum Operating Case Temperature |                                          |     |                   | 105  | °C                   |
| Humidity                           | Up to 95% non-condensing                 |     |                   |      |                      |
| Cooling                            | Free-air convection                      |     |                   |      |                      |
| EMI/RFI                            | Six-sided continuous shielded metal case |     |                   |      |                      |
| MTBF                               | per MIL-HNBK-217F (Ground benign, +25°C) |     | 1×10 <sup>6</sup> |      | hours                |

PHYSICAL CHARACTERISTICS

| PARAMETER            | CONDITION / NOTE                          | MIN | TYP | MAX | UNIT |
|----------------------|-------------------------------------------|-----|-----|-----|------|
| Dimensions (L×W×H)   | 2.00×1.00×0.395 in. (50.80×25.40×10.03mm) |     |     |     |      |
| Weight               | 1.04 oz. (30g)                            |     |     |     |      |
| Case Material        | Coated metal                              |     |     |     |      |
| Shielding Connection | -Input (Pin 3)                            |     |     |     |      |

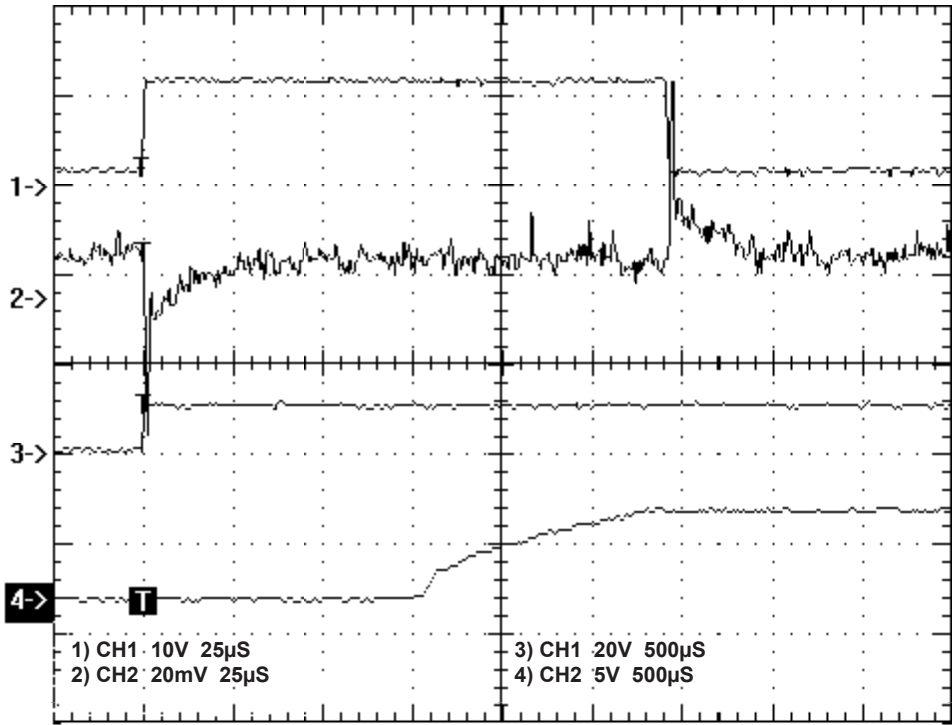


FIGURE 1. Transient response and turn on delay with soft start

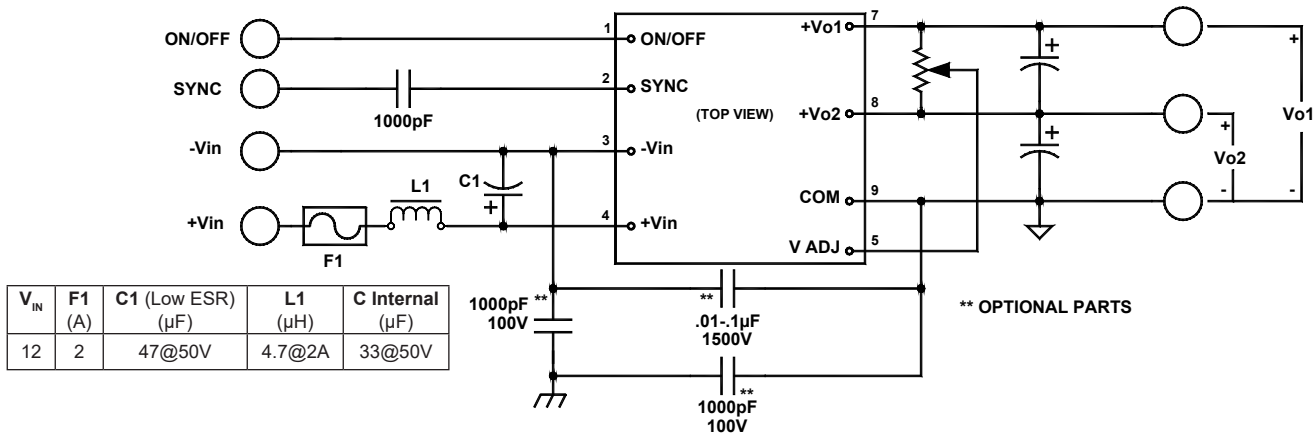
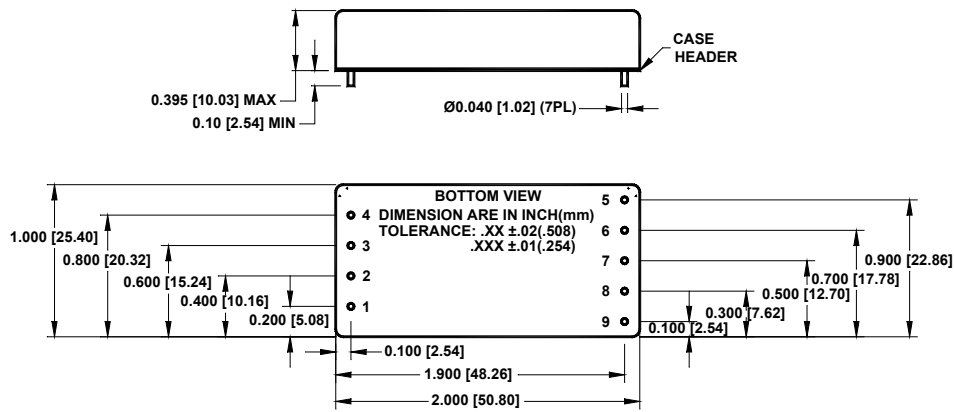


FIGURE 2. Typical connection diagram of Low-Noise 10W Dual DC/DC Converter

## MECHANICAL SPECIFICATIONS



| Pin | Function                |
|-----|-------------------------|
|     | <b>DUAL</b>             |
| 1   | ON/OFF                  |
| 2   | SYNC                    |
| 3   | -V <sub>IN</sub>        |
| 4   | +V <sub>IN</sub>        |
| 5   | V <sub>OUT</sub> ADJ    |
| 6   | No Pin                  |
| 7   | +15V (V <sub>O1</sub> ) |
| 8   | +5V (V <sub>O2</sub> )  |
| 9   | OUTPUT GND              |

## OUTPUT VOLTAGE ADJUSTMENT

For both single and dual models, the output reference voltage is referenced to the output ground: Pin 6 for singles and Pin 8 for duals. To trim the output voltage high, connect a 1% resistor (0kΩ–200kΩ range) between -V<sub>OUT</sub> (Pin 6) and V<sub>OUT</sub> Adjust (Pin 9) for the singles, and COM (Pin 8) and V<sub>OUT</sub> Adjust (Pin 5) for the duals. To trim the output voltage low, connect a 1% resistor (50kΩ–500kΩ range) between +V<sub>OUT</sub> (Pin 5) and V<sub>OUT</sub> Adjust (Pin 9) for the singles,

and +V<sub>OUT</sub> (Pin 7) and V<sub>OUT</sub> Adjust (Pin 5) for the duals.

With the wiper connected to the V<sub>OUT</sub> Adjust pin, a variable resistor (potentiometer) can also be used for V<sub>OUT</sub> adjustment by connecting each end to +V<sub>OUT</sub> and -V<sub>OUT</sub> for the singles, and +V<sub>OUT</sub> and COM for the duals. A potentiometer between 50kΩ–100kΩ can be used. Avoid using a low resistance potentiometer or a high temperature coefficient such as wound wire.

## EXTERNAL SYNCHRONIZATION

This series of converters can be synchronized to an external system clock of 320kHz -2% to 10%. The external clock is AC-coupled to the input SYNC terminal (Pin 2) through a coupling capacitor

from 220pF to 1000pF. The required amplitude is 3.3V to 5V and its duty cycle is 50% ±20%. Please refer to *Application Note DC-005: Synchronization* for more information.

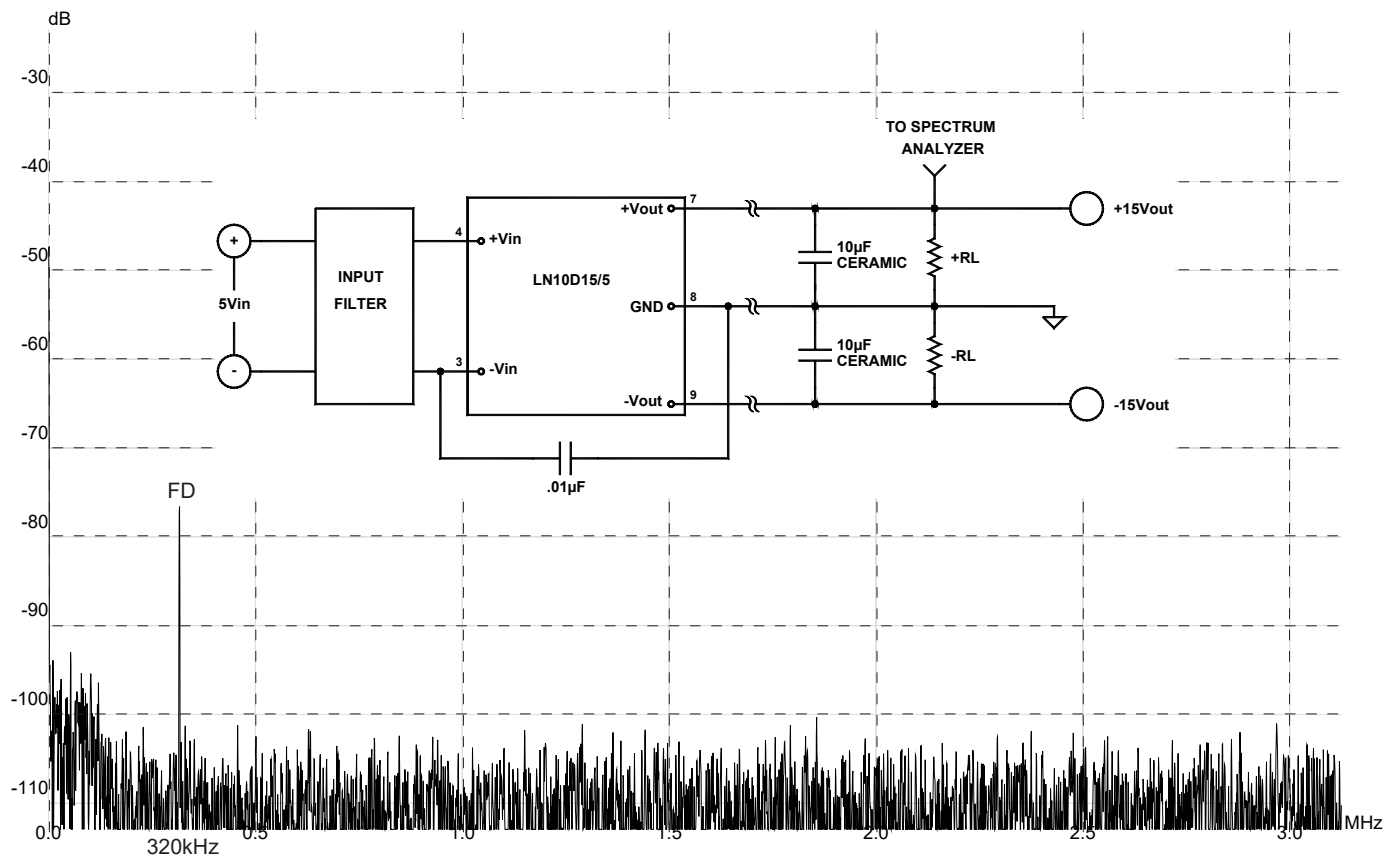


FIGURE 3. Setup and reading for output voltage noise spectrum

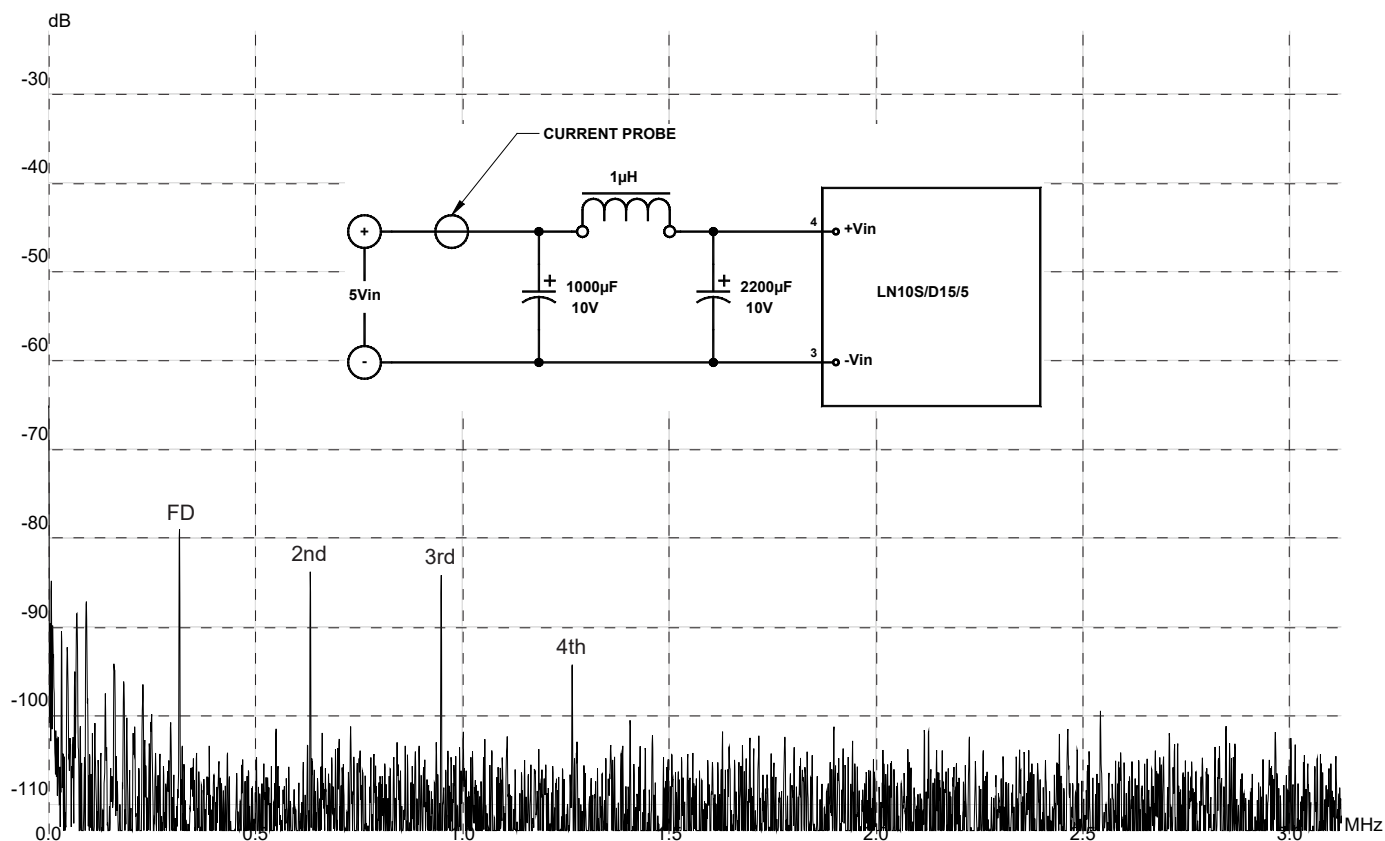


FIGURE 4. Setup and reading for reflected ripple current