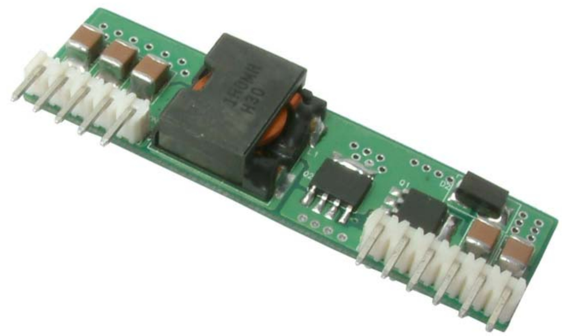
V·INFINITY

Non-Isolated DC-DC Point of Load Converter

Features
- ·Delivers 10A of output current
- ·High efficiency
- ·Low output ripple and noise
- ·Small size and low profile
- ·Cost efficient open frame design
- ·Single inline (SIP) and SMT package
- ·Remote on/off (active low)
- ·Trimmable output voltage via external resistor
- ·Over current protection
- ·Over temperature protection
- ·Wide opening temperature range -40°C~85°C



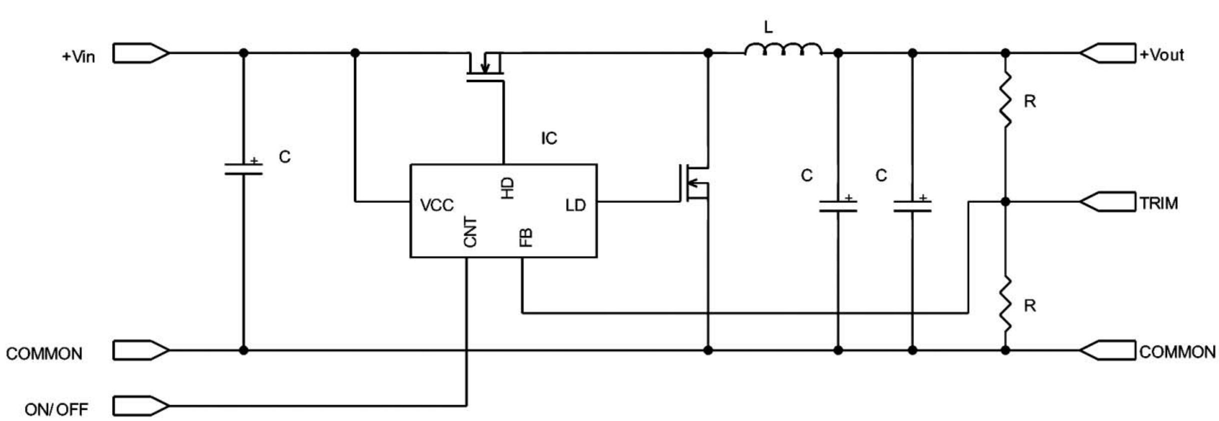
Model Number	Input Voltage	Input Current	Output	Maximum Power	Ripple & Noise Max.	Efficiency Typ.
VSNS10-5-1R0	3.0-5.5V	2.36A	1.0@10A	10.0W	30mVp-p	85%
VSNS10-5-1R5	3.0-5.5V	3.42A	1.5@10A	15.0W	30mVp-p	89%
VSNS10-5-1R8	3.0-5.5V	4.09A	1.8@10A	18.0W	30mVp-p	90%
VSNS10-5-2R0	3.0-5.5V	4.46A	2.0@10A	20.0W	30mVp-p	91%
VSNS10-5-2R5	3.0-5.5V	5.42A	2.5@10A	25.0W	30mVp-p	92%
VSNS10-5-3R3	4.5-5.5V	7.08A	3.3@10A	33.0W	30mVp-p	94%

1. Typical at Ta = 25°C under nominal line voltage and full load conditions, unless otherwise noted. All models are tested and specified with external input and output capacitors. (Cin= 100 μF) These capacitors are necessary to accommodate our test equipment.
2. Ripple and noise are tested / specified over a 20 MHz bandwidth and may be reduced with external filtering. See I/O filtering.
3. These devices have no minimum load requirement and will regulate under no-load conditions. Regulation specifications describe the output voltage deviation as the line voltage or load is varied from its minimum value to either extreme.

Electrical specifications

Efficiency	94% @ 3.3V
Input Voltage	3.0V-5.5V
Output voltage	1.0V-3.3V
Voltage tolerance	±2.0%
Line regulation	±0.3%
Load regulation	±0.4%
Switching frequency	300KHz
*Ripple and noise	30mVp-p
MTBF	7.6 x 10^5 hrs

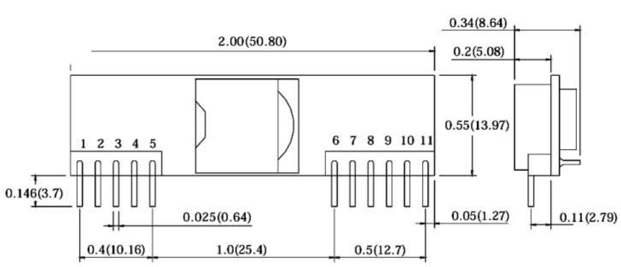
* Ripple and noise is tested / specified over a 20MHz bandwidth and may be reduced with external filtering.



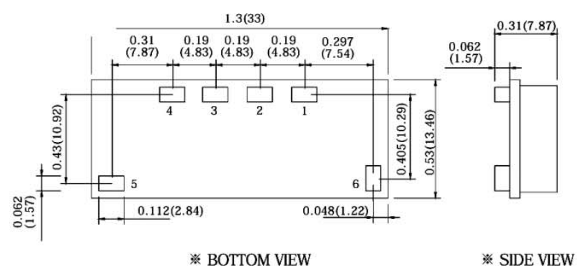
Pin assignments

Single Output (SIP)	Single Output (SMT)
1. +Vout	1. Sense
2. +Vout	2. Trim
3. Sense	3. +Vout
4. +Vout	4. COM
5. COM	5.+Vin
6. COM	6. ON/OFF
7. +Vin	
8. +Vin	
9. No Pin	
10. TRIM	
11. ON/OFF	

Dimensions



<SIP TYPE>



<SMT TYPE>

NOTES
1. All dimensions are in inches (mm)
2. Weight : 7.8g or less (SIP)
5.6g or less (SMT)

Environmental

MTBF: Ta = 25°C Full load, natural convection	0.8 million hrs
Operating Temperature: (ambient)	
Without derating (natural convection)	-40°C to 50°C
With derating	See derating curve
Thermal shutdown	+135°C

Absolute maximum ratings

Input voltage:	See electrical specifications
Continuous or transient	5.5V
On/off control	+Vin
Input reverse-polarity protection	None
Output overvoltage protection	None
Output current	Current limited
Storage temperature	-40°C to 125°C
Lead temperature(soldering, 10 sec)	300°C

These are stress ratings. Exposure of device to any of these conditions may adversely affect long term reliability. Proper operation under conditions other than those listed in the performance/functional specifications table is not implied.

Input

Input voltage range	3.0V-5.5 (5V nominal)
Input current:	
Nominal operating conditions	See electrical specifications
Standby/off mode	1mA
Output short circuit condition	850mA average
Input reflected ripple current	30mAp-p
Input filter type	Capacitive
Overvoltage protection	None
Reverse polarity protection	None
Undervoltage shutdown	2.0V typ.
On/off control	On= open / off = +2.6 to +Vin

Output

Vout accuracy	±2%
Minimum loading	No load
Vout programmable range	0.75V-3.6V
Ripple and Noise (20MHz BW)	See electrical specifications
Line / load regulation	See electrical specifications
Efficiency	See electrical specifications
Overcurrent detection and short circuit protection:	
Current limiting detection point	Min 17 Amps
SC protection technique	Hiccup with auto recovery
Short circuit current	1.7A average

Dynamic characteristics

Transient response (50% load step)	35μs to ±2% of final value
Start up time:	
Vin to Vout	1.5 msec
On/off to Vout	1.3 msec
Switching frequency	300KHz (+40KHz, -50KHz)

Physical

Dimensions	See dimension specification
Package	Open frame, single in line(SIP)
Pin material	Brass, copper under coated
Weight	7.8g (SIP), 5.6g (SMT)
Pin flammability rating	UL94V-0 / nylon 66

Test configurations

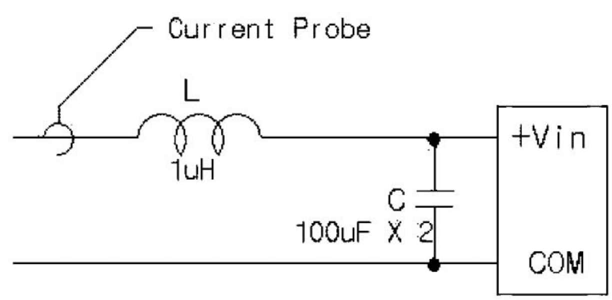


Fig 1. Input Reflected Ripple Current Test Setup

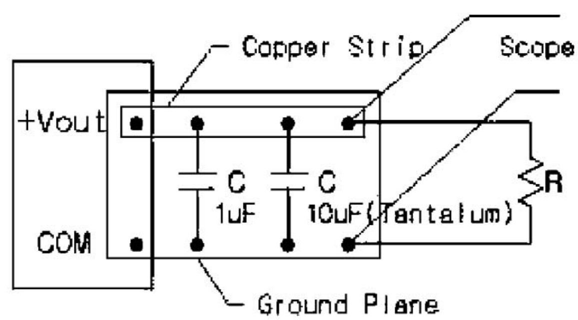


Fig 2. Output Ripple and Noise Test Setup

Application notes

I/O Filtering and Noise Reduction

An input capacitor must be placed directly adjacent to the input pin of the module, to minimize input ripple voltage and ensure module stability. To minimize input voltage ripple, low-ESR polymer and ceramic capacitor are recommended at the input of the module. Fig. 13 shows the input ripple voltage for the input ripple voltage for the 3.3V outputs with 100 μF X 2 tantalum capacitors at full load. The VSNS10 series is designed for low output ripple voltage and will meet the maximum output specification with 1 μF ceramic and 10 μF tantalum capacitors at the output of the module. Fig. 9 shows the output ripple and noise for 3.3V output at full load. However, additional output filtering may be required by the system designer for a number of reasons. First, there may be a need to further reduce the output ripple and noise of the module. Second, their dynamic response characteristics may need to be customized to a particular load change. To reduce the output ripple and improve the dynamic response to a step load change, additional capacitance at the output can be used. All external capacitors should have appropriate voltage ratings and be located as close to the converters as possible. Temperature variations for all relevant parameters should be taken into consideration. Low ESR polymer and ceramic capacitors are recommended to improve the dynamic response of the module.

Input Fusing

Most applications and or safety agencies require the installation of fuses at the inputs of power conversion components. VSNS10 Series DC/DC converters are not internally fused. Therefore, if input fusing is mandatory, fast-blow fuse with a value no greater than 6 Amps should be installed within the ungrounded input path to the converter. As a general rule, we recommend using a fast-blow fuse with a typical value of about twice the maximum input current, calculated at low line with the converters minimum efficiency.

Input Voltage and Reverse-Polarity Protection

VSNS10A Series DC/DC converters do not incorporate either input overvoltage or input reverse-polarity protection. Input voltages in excess of the specified absolute maximum ratings and input polarity reversals of longer than “instantaneous” duration can cause permanent damage to these devices.

Input Undervoltage Lockout

At input voltage below the input undervoltage lockout limit, module operation is disabled. The module will begin to operate at an input voltage above the undervoltage lockout turn-on threshold.

Output Overcurrent Detection

Overloading the output of a power converter for an extended period of time will invariably cause internal component temperatures to exceed their maximum ratings and eventually lead to component failure. High-current-carrying components such as inductors, FET’s and diodes are at the highest risk. VSNS10 SIP Series DC/DC converters incorporate an output overcurrent detection and shutdown function that serves to protect both the power converter and its load. If the output current exceeds its maximum rating by typically 80% (8 Amp) original value, the VSNS10’s internal overcurrent detection circuitry immediately turns off the converter, which then goes into a “hiccup” mode. While hiccuping, the converter will continuously attempt to restart itself, go into overcurrent, and then shut down. Once the output short is removed, the converter will automatically restart itself.

Thermal Protection and Thermal Considerations

To provide over temperature protection in a fault condition, the unit relies upon the thermal protection feature of the controller IC. The unit will shutdown if the thermal reference point Tref, exceeds 135°C (typical), but the thermal shutdown is not intended as a guarantee that the unit will survive temperature beyond its rating. The module will automatically restart after it cools down. The typical output current thermal derating curves shown Fig. 6 enable designers to determine how much current they can reliably derive from each model of the VSNS10 SIP’s under known ambient temperature and air flow conditions. Similarly, the curves indicate how much air flow is required to reliably deliver a required output current at known temperatures. Note that the airflow is parallel to the long axis of the module as shown in Fig. 3. The derating data applies to airflow in either direction of the module’s long axis. Once the module is assembled in the actual system the module’s temperature should be checked to ensure it does not exceed 100°C.

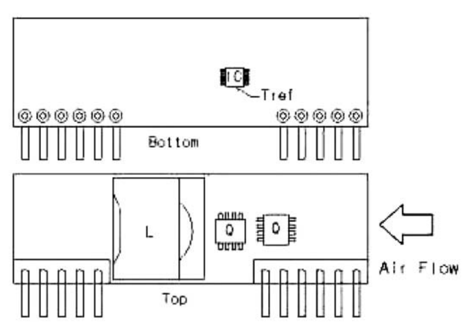


Fig 3. Thermal measurement location

Remote On/Off

The on/off control pin may be used for remote on/off operation. VSNS10 Series DC/DC's are designed so they are enabled when the control pin is left open and disabled when the control pin is pulled high (2.6V to +Vin).

Dynamic control of the on/off function is best accomplished with a mechanical relay or open-collector/open-drain drive circuit. The drive circuit should be able to sink appropriate current when activated and withstand appropriate voltage when deactivated.

The on/off control function, however, can be externally inverted so that the converter will be disabled while the input voltage is ramping up and then "released" once the input has stabilized.

For a controlled start-up of one or more VSNS10's, or if several output voltages need to be powered-up in a given sequence, the on/off control pin can be pulled high (external pull-up resistor, converter disabled) and then driven low with an external open collector device to enable the converter, as shown in Fig. 4.

To switch the module on and off using remote on/off, connect an open collector pnp transistor between the on/off pin and Vin pin (Fig. 4).

When the transistor Q1 is in the off state, the power module is on. (logic low on the on/off of the module). During a logic-high when the the transistor is in the active state, the power module is off. During this state Von/off = 2.6V-5.5V

Remote on/off can also be implemented using open-drain logic devices with an external pull-up resistor. Fig. 5 shows the circuit configuration using this approach.

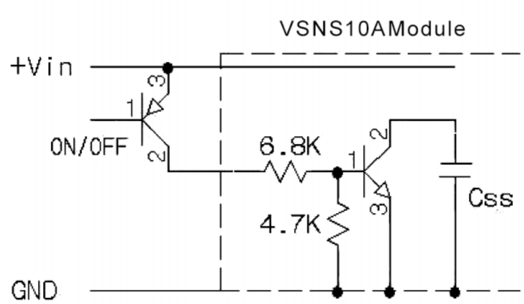


Fig 4. Driving the ON/OFF Control Pin with an Open collector Drive circuit

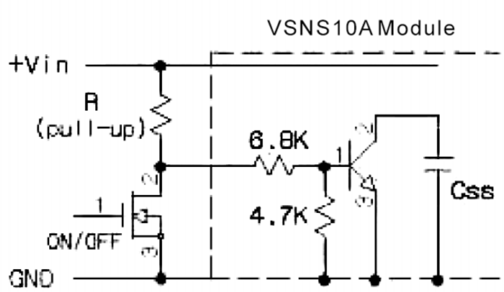


Fig 5. Drive the On/Off Control Pin with an external pull up resistor

Output Voltage Trimming

Trimming is accomplished with a single fixed resistor, as shown in figure 6, between the Trim pin and +Output to trim down the output voltage, or between the Trim pin and Common to trim up the output voltage. The equations below can be used as starting points for selecting specific trim-resistor values.

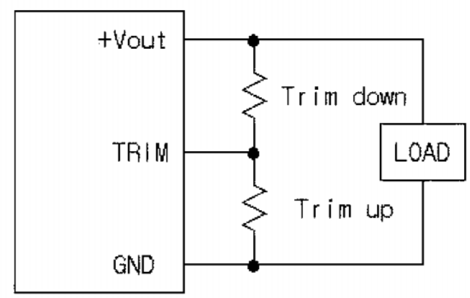
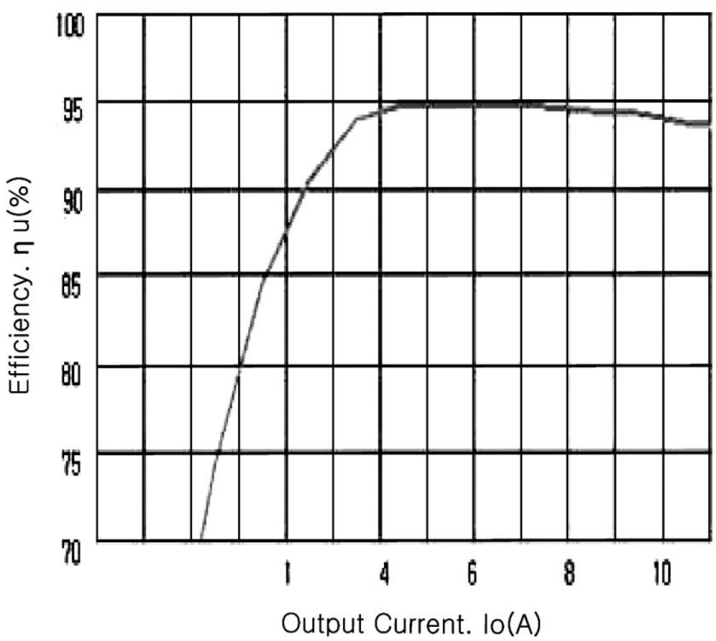


Fig 6. Trim Connection Using Fixed Resistor

Model	Trim Equations
VSNS10-5-1R0	$R_{up} = \frac{1701}{75(V_o-0.7)-22.68}$
	$R_{down} = \frac{2430(V_o-0.7)}{22.68-75(V_o-0.7)}$
VSNS10-5-1R5	$R_{up} = \frac{635.04}{28(V_o-0.7)-22.68}$
	$R_{down} = \frac{907.2(V_o-0.7)}{22.68-28(V_o-0.7)}$
VSNS10-5-1R8	$R_{up} = \frac{464.94}{20.5(V_o-0.7)-22.68}$
	$R_{down} = \frac{664.2(V_o-0.7)}{22.68-20.5(V_o-0.7)}$
VSNS10-5-2R0	$R_{up} = \frac{394.632}{17.4(V_o-0.7)-22.68}$
	$R_{down} = \frac{563.76(V_o-0.7)}{22.68-17.4(V_o-0.7)}$
VSNS10-5-2R5	$R_{up} = \frac{281.232}{12.4(V_o-0.7)-22.68}$
	$R_{down} = \frac{401.76(V_o-0.7)}{22.68-12.4(V_o-0.7)}$
VSNS10-5-3R3	$R_{up} = \frac{196.4088}{8.66(V_o-0.7)-22.68}$
	$R_{down} = \frac{280.584(V_o-0.7)}{22.68-8.66(V_o-0.7)}$

Efficiency vs. Load Current



Output Current vs. Ambient Temperature

Preparing

Fig 6. Derating Output Current VS Local Ambient
Temperature and Airflow (Vin = 5V, Vo = 3.3V)

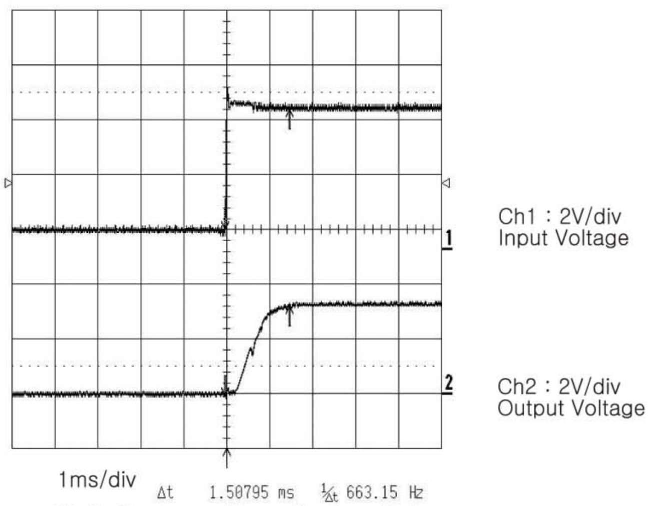


Fig 9. Start-up with application of Vin
(Vo = 3.3V , Io = 10A)

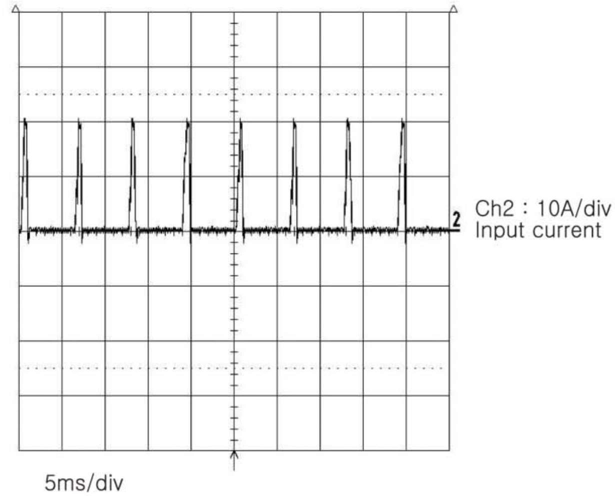


Fig 10. Input Current with Short Circuit at Output
(Vo = 3.3V , Io = 10A)

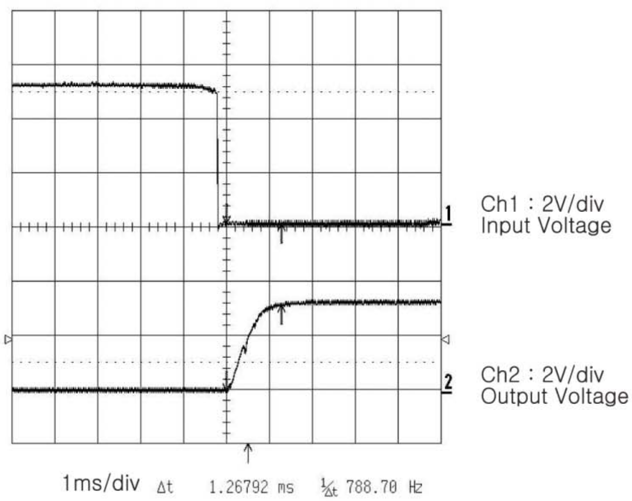


Fig 8. Start-up using Remote ON/OFF with Prebias
(Vo = 3.3V , Io = 10A)

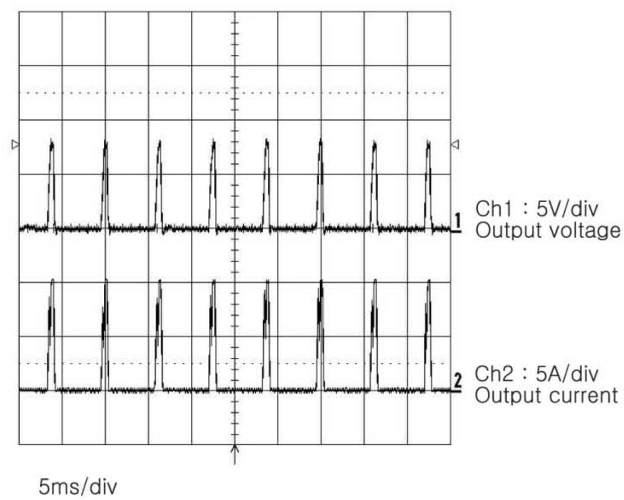


Fig 11. Output Current and Voltage
with Short Circuit at Output
(Vo = 3.3V , Io = 10A)

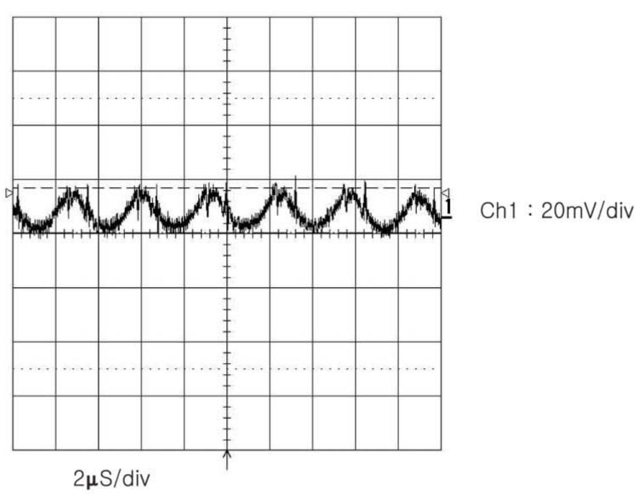


Fig 9. Output Ripple and Noise (Cout = 10㎌
Tantalum capacitor, Vo = 3.3V , Io = 10A)

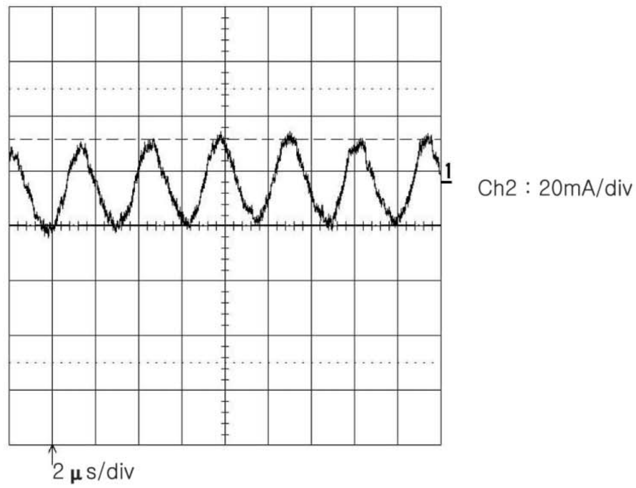


Fig 12. Input Reflected Ripple Current
(C_{in} = 100µF x 2 and C_{out} = 10µF Tantalum capacitor
Vo = 3.3V , Io = 10A)

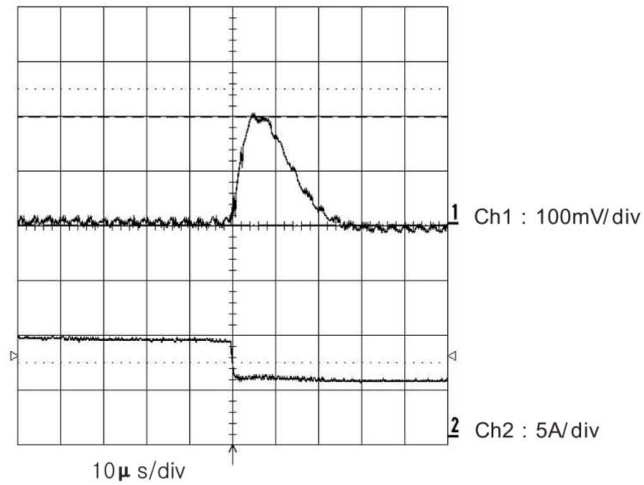


Fig 14. Transient Response to Dynamic Load Change from 100% to 50% of full load
(C_{in} = 100µF x 2 and C_{out} =10µF Tantalum capacitor
Vo = 3.3V , Io = 10A)

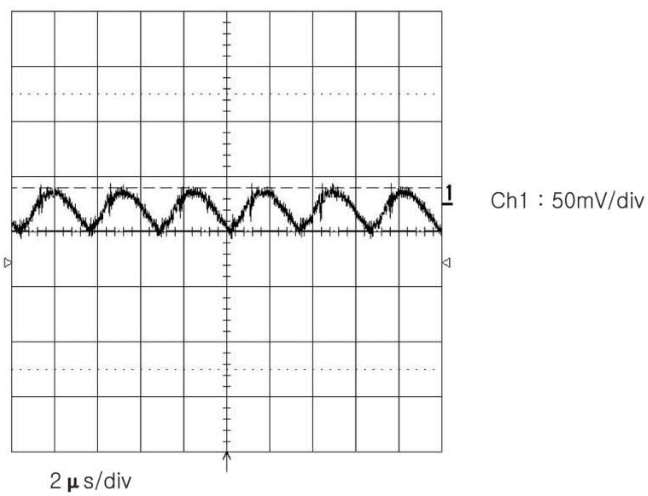


Fig 13. Input Reflected Ripple Voltage
(C_{in} = 100µF x 2 and C_{out} = 10µF Tantalum capacitor
Vo = 3.3V , Io = 10A)

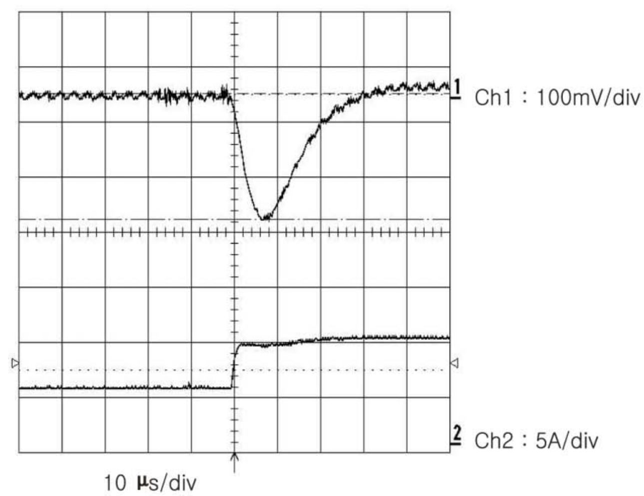


Fig 15. Transient Response to Dynamic Load Change from 50% to 100% of full load
(C_{in} = 100µF x 2 and C_{out} = 10µF Tantalum capacitor
Vo = 3.3V , Io = 10A)

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