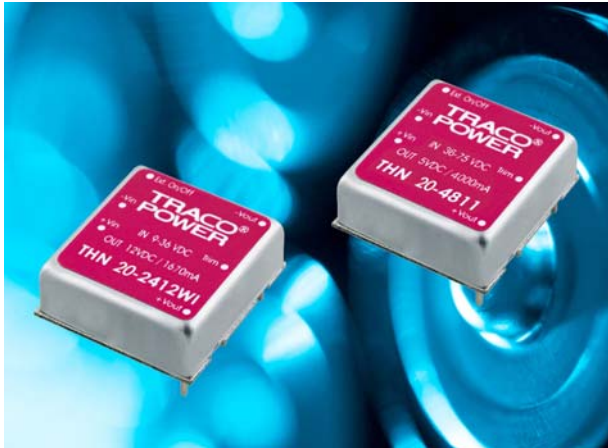


DC/DC Converter 9 to 36Vdc and 18 to 75Vdc input voltage, 20 Watt Output Power;  
3.3 to 15Vdc Single Output and  $\pm 12$ Vdc to  $\pm 15$ Vdc Dual Output



### Applications

- Wireless Network
- Telecom/Datacom
- Industry Control System
- Measurement
- Semiconductor Equipment

### General Description

THN 20WI single output DC/DC converters provide up to 20 watts of output power in an industry standard package and footprint. These units are specifically designed to meet the power needs of low profile. All models feature with 4:1 ultra wide input voltage range of 9 – 36Vdc and 18 – 75Vdc, comprehensively protected against over-current, over-voltage and input under-voltage protection conditions, and adjustable output voltage.

### Table of contents

|                                |           |                                     |     |
|--------------------------------|-----------|-------------------------------------|-----|
| Absolute Maximum Rating        | P2        | Output Voltage Adjustment           | P33 |
| Output Specification           | P2 & P3   | Short Circuitry Protection          | P34 |
| Input Specification            | P3        | Thermal Consideration               | P34 |
| General Specification          | P4        | Heat Sink Consideration             | P34 |
| Environmental Specifications   | P4        | Remote ON/OFF Control               | P35 |
| EMC Characteristics            | P4        | Mechanical Data                     | P36 |
| Characteristic Curves          | P5 – P28  | Recommended Pad Layout              | P37 |
| Testing Configurations         | P29       | Soldering Considerations            | P37 |
| EMI Consideration              | P30 – P32 | Packaging Information               | P38 |
| Input Source Impedance         | P32       | Part Number Structure               | P38 |
| Output Over Current Protection | P32       | Safety and Installation Instruction | P39 |
| Output Over Voltage Protection | P32       | MTBF and Reliability                | P39 |

### Features

- 20 watts maximum output power
- Ultra low quiescent current
- Single output current up to 4.5A
- 4:1 ultra wide input voltage range of 9-36Vdc and 18-75 Vdc
- Six-sided continuous shield
- Meet EN55022 CLASS A without external components
- Industry standard pin-out THN 15WI series compatible
- High efficiency up to 90%
- Low profile: 25.4 x 25.4 x 9.9mm (1.0 x 1.0 x 0.39 inch)
- Fixed switching frequency
- RoHS directive compliant
- No minimum load
- Input to output isolation: 1500Vdc, min
- Input under-voltage protection
- Output over-voltage protection
- Over-current protection, auto-recovery
- Output short circuit protection
- Remote ON/OFF control
- Adjustable output voltage

### Options

- Positive remote ON/OFF
- ON/OFF control function
- Trim function
- Heat sinks available for extended operation

| Absolute Maximum Rating                       |               |     |      |      |
|-----------------------------------------------|---------------|-----|------|------|
| Parameter                                     | Model         | Min | Max  | Unit |
| Input Voltage                                 |               |     |      |      |
| Continuous                                    | THN 20-24xxWI |     | 36   | Vdc  |
|                                               | THN 20-48xxWI |     | 75   |      |
| Transient (1sec max.)                         | THN 20-24xxWI |     | 50   |      |
|                                               | THN 20-48xxWI |     | 100  |      |
| Operating Ambient Temperature (with derating) | All           | -40 | +101 | °C   |
| Operating Case Temperature                    |               |     | +105 | °C   |
| Storage Temperature                           | All           | -55 | +125 | °C   |

\* Test condition with vertical direction by natural convection (20LFM).

| Output Specification                                                                                                                                                                                                   |                                                                                                    |                                                               |                                              |                                                               |                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------|---------------------|
| Parameter                                                                                                                                                                                                              | Model                                                                                              | Min                                                           | Typ                                          | Max                                                           | Unit                |
| Output Voltage Range<br>( $V_{in} = V_{in\,nom}$ ; Full Load; $T_A = 25^\circ\text{C}$ )                                                                                                                               | THN 20-xx10WI<br>THN 20-xx11WI<br>THN 20-xx12WI<br>THN 20-xx13WI<br>THN 20-xx22WI<br>THN 20-xx23WI | 3.267<br>4.95<br>11.88<br>14.85<br>$\pm 11.88$<br>$\pm 14.85$ | 3.3<br>5<br>12<br>15<br>$\pm 12$<br>$\pm 15$ | 3.333<br>5.05<br>12.12<br>15.15<br>$\pm 12.12$<br>$\pm 15.15$ | Vdc                 |
| Voltage Adjustability (See Page 33)                                                                                                                                                                                    | All                                                                                                | -10                                                           |                                              | +10                                                           | %                   |
| Output Regulation<br>Line ( $V_{in\,min}$ to $V_{in\,max}$ at Full Load)<br>Load (0% to 100% of Full Load)<br>Load (10% to 90% of Full Load)                                                                           | All                                                                                                | -0.2<br>-0.2<br>-0.1                                          |                                              | +0.2<br>+0.2<br>+0.1                                          | %                   |
| Cross Regulation<br>Asymmetrical Load 25% / 100% of Full Load                                                                                                                                                          | Dual Output                                                                                        | -5%                                                           |                                              | +5%                                                           | %                   |
| Output Ripple & Noise (See Page 29)<br>Peak-to-Peak (20MHz bandwidth)<br>(Measured with a 1 $\mu\text{F}$ M/C X7R and a 10 $\mu\text{F}$ T/C )                                                                         | THN 20-xx10WI<br>THN 20-xx11WI<br>THN 20-xx12WI<br>THN 20-xx13WI<br>THN 20-xx22WI<br>THN 20-xx23WI |                                                               | 75<br>75<br>100<br>100<br>100<br>100         |                                                               | mV <sub>Pk-Pk</sub> |
| Temperature Coefficient                                                                                                                                                                                                | All                                                                                                | -0.02                                                         |                                              | +0.02                                                         | %/°C                |
| Output Voltage Overshoot<br>( $V_{in\,min}$ to $V_{in\,max}$ ; Full Load ; $T_A = 25^\circ\text{C}$ )                                                                                                                  | All                                                                                                |                                                               |                                              | 5                                                             | % $V_{OUT}$         |
| Dynamic Load Response<br>( $V_{in} = V_{in\,nom}$ ; $T_A = 25^\circ\text{C}$ )<br>Load step change from<br>75% to 100% or 100 to 75% of Full Load<br>Peak Deviation<br>Setting Time ( $V_{OUT} < 10\%$ peak deviation) | All<br>All                                                                                         |                                                               | 350<br>250                                   |                                                               | mV<br>$\mu\text{S}$ |
| Output Current                                                                                                                                                                                                         | THN 20-xx10WI<br>THN 20-xx11WI<br>THN 20-xx12WI<br>THN 20-xx13WI<br>THN 20-xx22WI<br>THN 20-xx23WI | 0<br>0<br>0<br>0<br>0<br>0                                    |                                              | 4500<br>4000<br>1670<br>1330<br>$\pm 833$<br>$\pm 667$        | mA                  |

| Output Specification (Continued)                    |               |                            |     |       |       |
|-----------------------------------------------------|---------------|----------------------------|-----|-------|-------|
| Parameter                                           | Model         | Min                        | Typ | Max   | Unit  |
| Output Capacitor Load                               | THN 20-xx10WI |                            |     | 7000  | Vdc   |
|                                                     | THN 20-xx11WI |                            |     | 5000  |       |
|                                                     | THN 20-xx12WI |                            |     | 850   |       |
|                                                     | THN 20-xx13WI |                            |     | 700   |       |
|                                                     | THN 20-xx22WI |                            |     | ±500  |       |
|                                                     | THN 20-xx23WI |                            |     | ±350  |       |
| Output Over Voltage Protection<br>(Voltage Clamped) | THN 20-xx10WI | 3.7                        |     | 5.4   | Vdc   |
|                                                     | THN 20-xx11WI | 5.6                        |     | 7.0   |       |
|                                                     | THN 20-xx12WI | 13.5                       |     | 19.6  |       |
|                                                     | THN 20-xx13WI | 16.8                       |     | 20.5  |       |
|                                                     | THN 20-xx22WI | ±13.5                      |     | ±19.6 |       |
|                                                     | THN 20-xx23WI | ±16.8                      |     | ±20.5 |       |
| Output Over Current Protection                      | All           |                            | 150 |       | % FL. |
| Output Short Circuit Protection                     | All           | Hiccup, Automatic recovery |     |       |       |

| Input Specification                                                                                                                                                                                              |               |      |     |     |                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-----|-----|---------------------|
| Parameter                                                                                                                                                                                                        | Model         | Min  | Typ | Max | Unit                |
| Operating Input Voltage                                                                                                                                                                                          | THN 20-24xxWI | 9    | 24  | 36  | Vdc                 |
|                                                                                                                                                                                                                  | THN 20-48xxWI | 18   | 48  | 75  |                     |
| Input Standby Current<br>(Typical value at $V_{in} = V_{in,nom}$ ; No Load)                                                                                                                                      | THN 20-2410WI |      | 6   |     | mA                  |
|                                                                                                                                                                                                                  | THN 20-2411WI |      | 6   |     |                     |
|                                                                                                                                                                                                                  | THN 20-2412WI |      | 6   |     |                     |
|                                                                                                                                                                                                                  | THN 20-2413WI |      | 6   |     |                     |
|                                                                                                                                                                                                                  | THN 20-2422WI |      | 6   |     |                     |
|                                                                                                                                                                                                                  | THN 20-2423WI |      | 6   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4810WI |      | 4   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4811WI |      | 4   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4812WI |      | 4   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4813WI |      | 4   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4822WI |      | 4   |     |                     |
|                                                                                                                                                                                                                  | THN 20-4823WI |      | 4   |     |                     |
| Under Voltage Lockout Turn-on Threshold                                                                                                                                                                          | THN 20-24xxWI |      |     | 9   | Vdc                 |
|                                                                                                                                                                                                                  | THN 20-48xxWI |      |     | 18  |                     |
| Under Voltage Lockout Turn-off Threshold                                                                                                                                                                         | THN 20-24xxWI |      | 8   |     | Vdc                 |
|                                                                                                                                                                                                                  | THN 20-48xxWI |      | 16  |     |                     |
| Input Reflected Ripple Current (See Page 29)<br>(5 to 20MHz, 12µH source impedance)                                                                                                                              | All           |      | 30  |     | mA <sub>Pk-Pk</sub> |
| Start Up Time<br>( $V_{in} = V_{in,nom}$ and constant resistive load)<br>Power up<br>Remote ON/OFF                                                                                                               | All           |      |     | 30  | mS                  |
|                                                                                                                                                                                                                  |               |      |     | 30  |                     |
|                                                                                                                                                                                                                  |               |      |     | 30  |                     |
| Remote ON/OFF Control (See Page 35)<br>(The ON/OFF pin voltage is referenced to -V <sub>IN</sub> )<br>Negative Logic DC-DC ON (Short)<br>DC-DC OFF (Open)<br>Positive Logic DC-DC ON (Open)<br>DC-DC OFF (Short) | All           | 0    |     | 1.2 | Vdc                 |
|                                                                                                                                                                                                                  |               | 3    |     | 15  |                     |
|                                                                                                                                                                                                                  |               | 3    |     | 15  |                     |
|                                                                                                                                                                                                                  |               | 0    |     | 1.2 |                     |
| Remote Off Input Current                                                                                                                                                                                         | All           |      | 2.0 |     | mA                  |
| Input Current of Remote Control Pin                                                                                                                                                                              | All           | -0.5 |     | 1.0 | mA                  |

| General Specification                                                                 |                                                |      |                      |      |       |
|---------------------------------------------------------------------------------------|------------------------------------------------|------|----------------------|------|-------|
| Parameter                                                                             | Model                                          | Min  | Typ                  | Max  | Unit  |
| Efficiency (See Page 29)<br>( $V_{in} = V_{in nom}$ ; Full Load; $T_A = 25^\circ C$ ) | THN 20-2410WI                                  |      | 86                   |      | %     |
|                                                                                       | THN 20-2411WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-2412WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-2413WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-2422WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-2423WI                                  |      | 90                   |      |       |
|                                                                                       | THN 20-4810WI                                  |      | 87                   |      |       |
|                                                                                       | THN 20-4811WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-4812WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-4813WI                                  |      | 90                   |      |       |
|                                                                                       | THN 20-4822WI                                  |      | 89                   |      |       |
|                                                                                       | THN 20-4823WI                                  |      | 90                   |      |       |
| Isolation Voltage (for 60 seconds)                                                    |                                                |      |                      |      |       |
| Input to Output                                                                       | All                                            | 1500 |                      |      | Vdc   |
| Input (Output) to Case                                                                |                                                | 1000 |                      |      |       |
| Isolation Resistance                                                                  | All                                            | 1    |                      |      | GΩ    |
| Isolation Capacitance                                                                 | All                                            |      |                      | 1500 | pF    |
| Switching Frequency                                                                   | All                                            |      | 330                  |      | KHz   |
| Weight                                                                                | All                                            |      | 15                   |      | g     |
| MTBF (See Page 39)<br>Bellcore TR-NWT-000332, $T_C = 40^\circ C$<br>MIL-HDBK-217F     | All                                            |      | 1'766'000<br>553'000 |      | hours |
| Case Material                                                                         | Nickel-coated copper                           |      |                      |      |       |
| Base Material                                                                         | FR4 PCB                                        |      |                      |      |       |
| Potting Material                                                                      | Silicon (UL94-V0)                              |      |                      |      |       |
| Dimensions                                                                            | 1.0 X 1.0 X 0.39 Inch<br>(25.4 X 25.4 X 9.9mm) |      |                      |      |       |

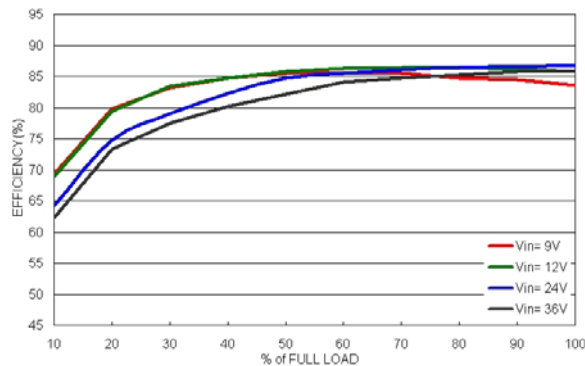
| Environmental Specifications |              |
|------------------------------|--------------|
| Thermal shock                | MIL-STD-810F |
| Vibration                    | MIL-STD-810F |
| Relative humidity            | 5% to 95% RH |

| EMC Characteristics    |              |                                    |                        |
|------------------------|--------------|------------------------------------|------------------------|
| EMI (See Page 30 - 32) | EN 55022     |                                    | Class B                |
| ESD                    | EN 61000-4-2 | Air $\pm 8KV$<br>Contact $\pm 6KV$ | Performance Criteria A |
| Radiated immunity      | EN 61000-4-3 | 10 V/m                             | Performance Criteria A |
| Fast transient*        | EN 61000-4-4 | $\pm 2KV$                          | Performance Criteria A |
| Surge*                 | EN 61000-4-5 | $\pm 2KV$                          | Performance Criteria A |
| Conducted immunity     | EN 61000-4-6 | 10 V <sub>rms</sub>                | Performance Criteria A |

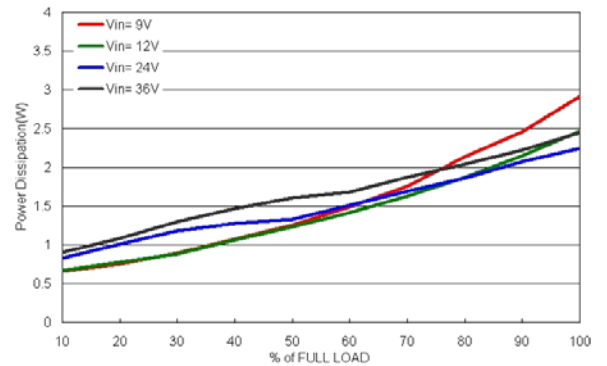
\* An external input filter capacitor is required if the module has to meet EN 61000-4-4, EN 61000-4-5.  
We suggest to use following filter capacitor: Nippon Chemi-Con KY series, 220μF/100V, ESR 48mΩ.

## Characteristic Curves

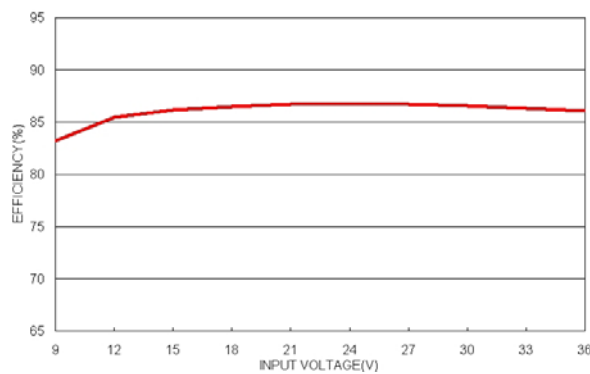
All test conditions are at 25°C. The figures are identical for THN 20-2410WI



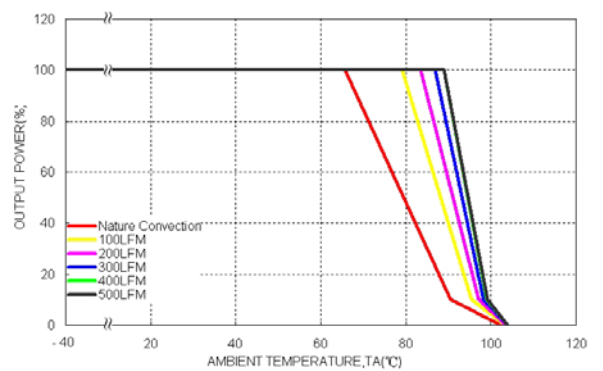
Efficiency versus Output Current



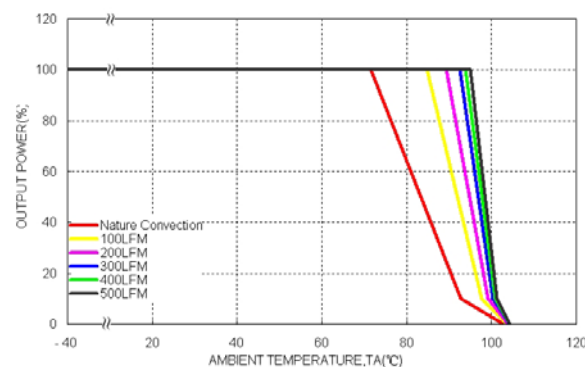
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



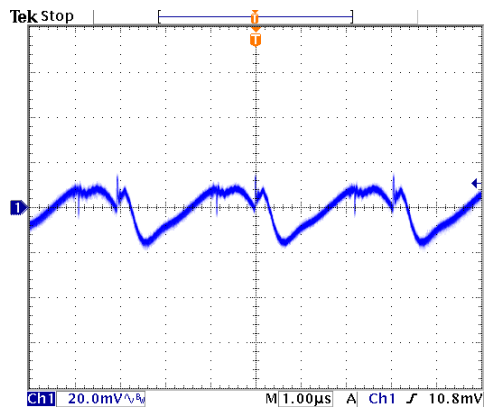
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\,nom}$



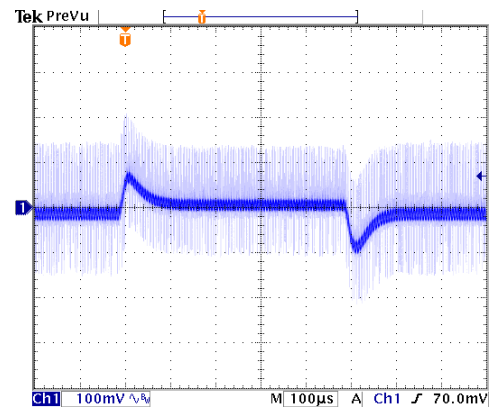
Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\,nom}$

## Characteristic Curves (Continued)

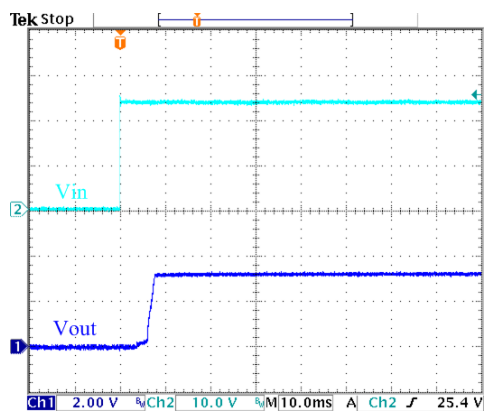
All test conditions are at 25°C. The figures are identical for THN 20-2410W1



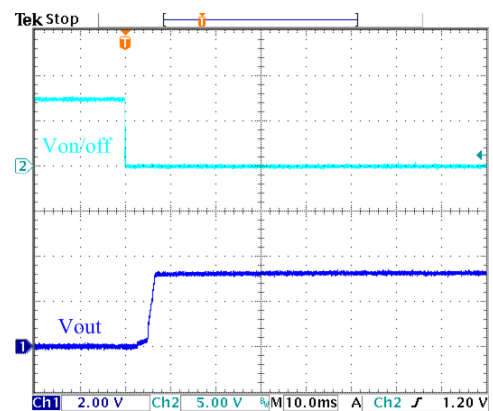
Typical Output Ripple and Noise.  
 $V_{in} = V_{in,nom}$ , Full Load



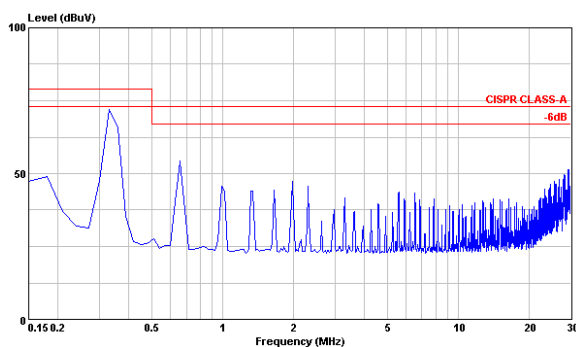
Transient Response to Dynamic Load Change from  
 100% to 75% to 100% of Full Load;  $V_{in} = V_{in,nom}$



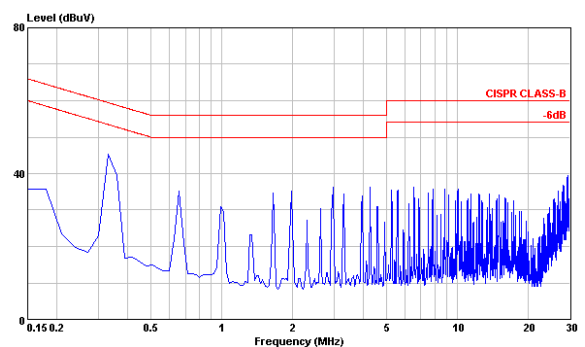
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in} = V_{in,nom}$ , Full Load



Using ON/OFF Voltage Start-Up and  $V_{out}$  Rise Characteristic  
 $V_{in} = V_{in,nom}$ , Full Load



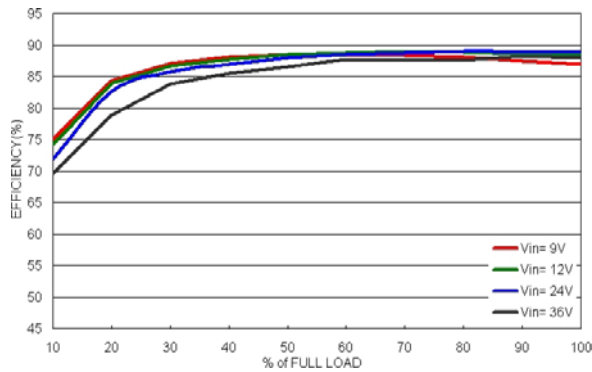
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in,nom}$ , Full Load



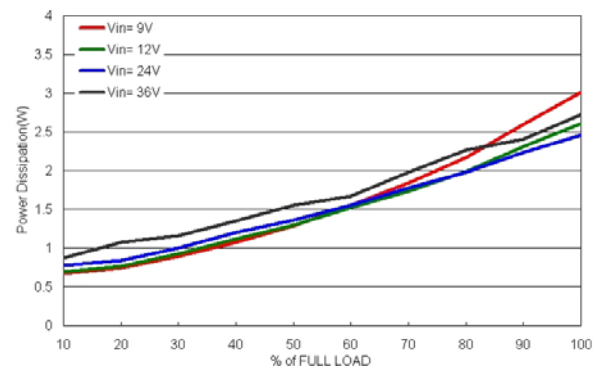
Conduction Emission of EN55022 Class B  
 $V_{in} = V_{in,nom}$ , Full Load

## Characteristic Curves (Continued)

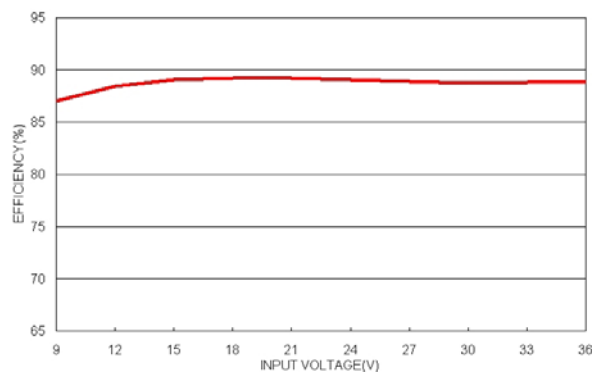
All test conditions are at 25°C. The figures are identical for THN 20-2411WI



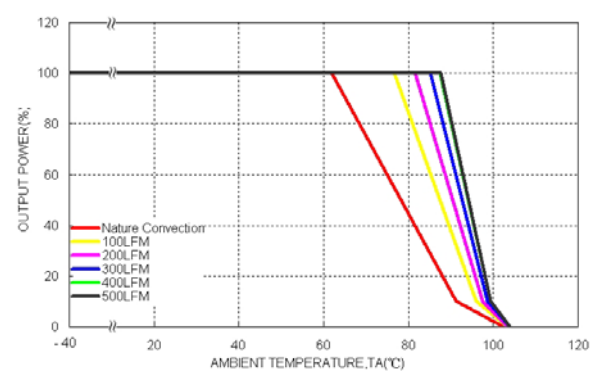
Efficiency versus Output Current



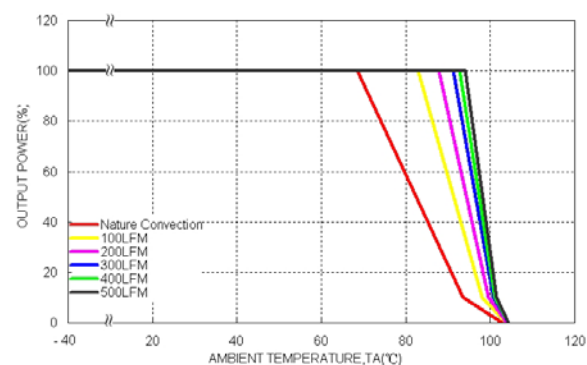
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



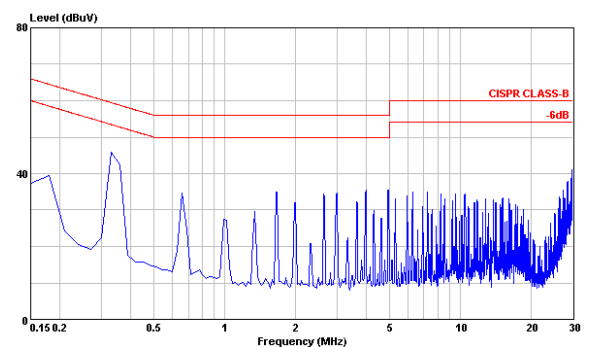
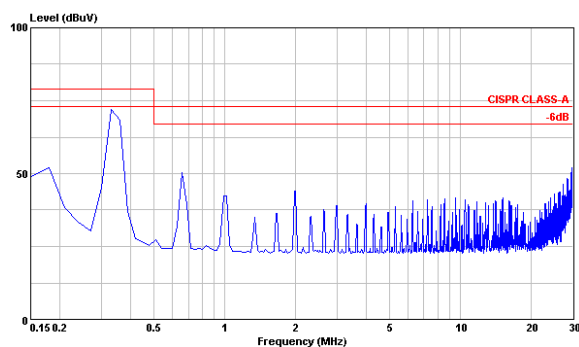
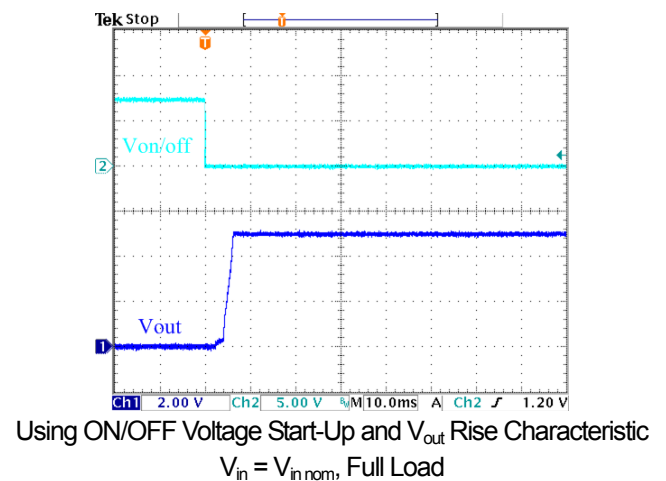
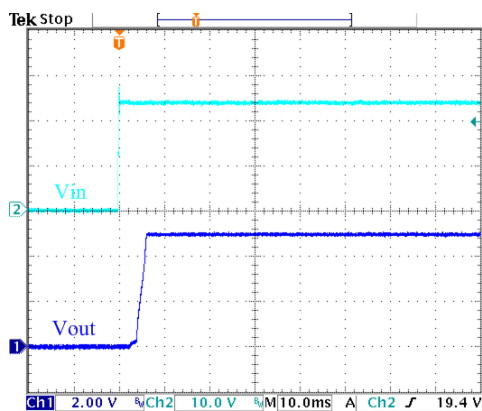
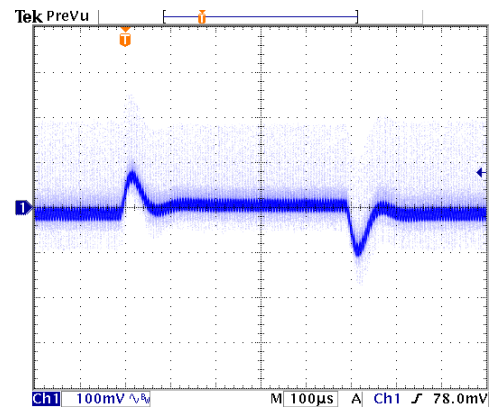
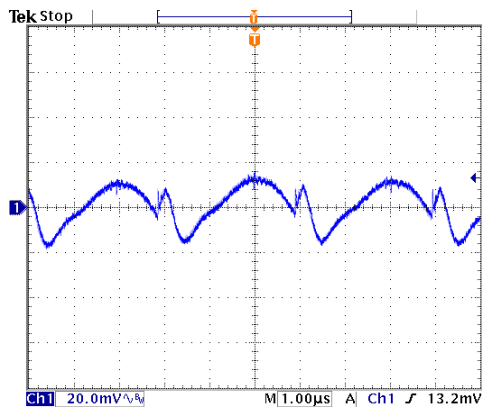
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\,nom}$

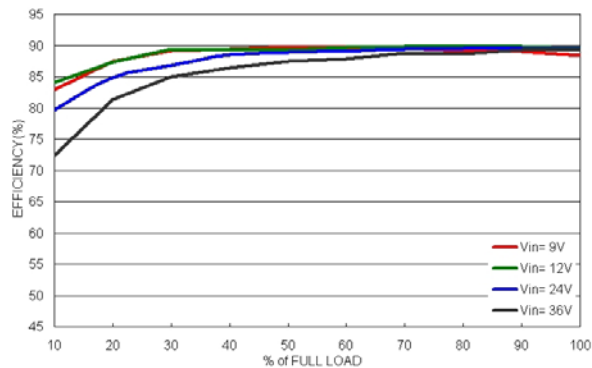
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-2411WI

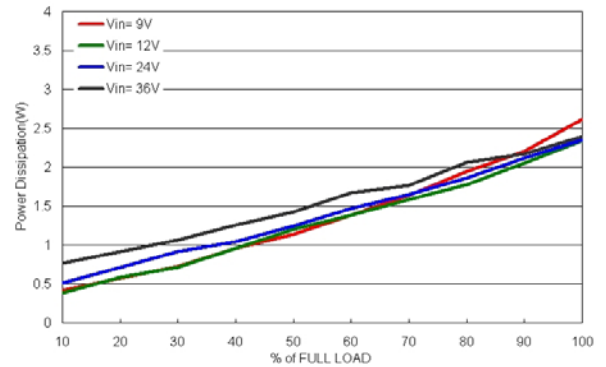


## Characteristic Curves (Continued)

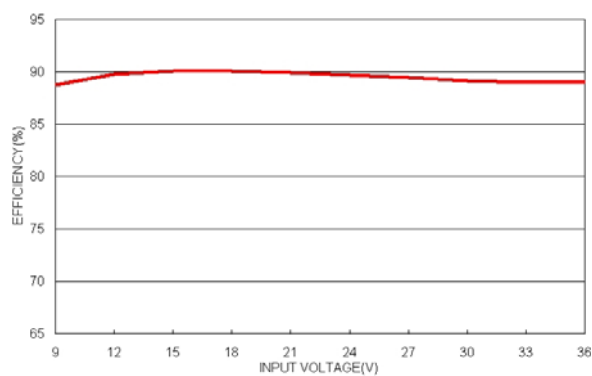
All test conditions are at 25°C. The figures are identical for THN 20-2412WI



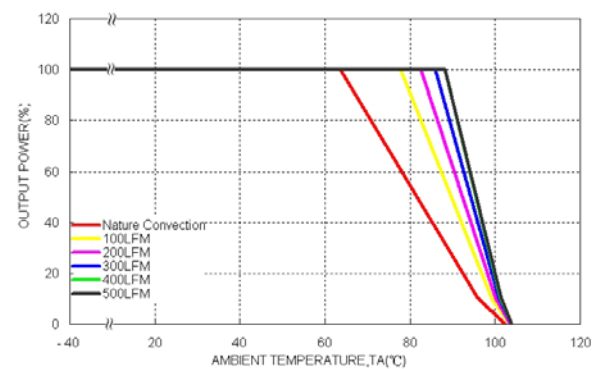
Efficiency versus Output Current



Power Dissipation versus Output Current

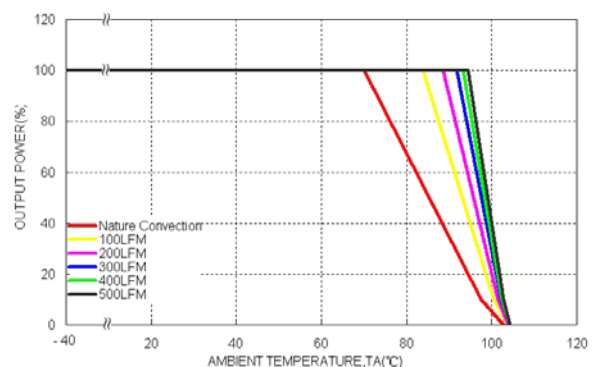


Efficiency versus Input Voltage. Full Load



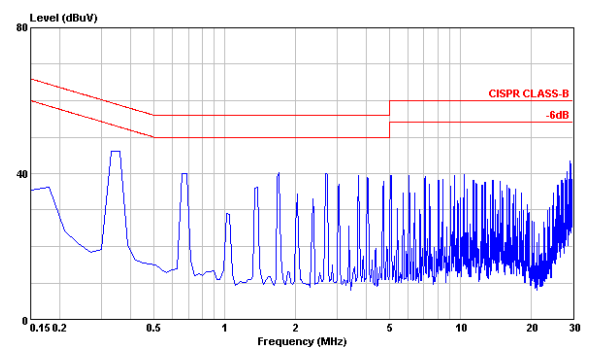
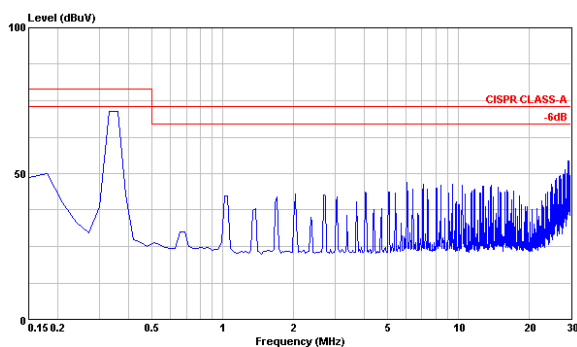
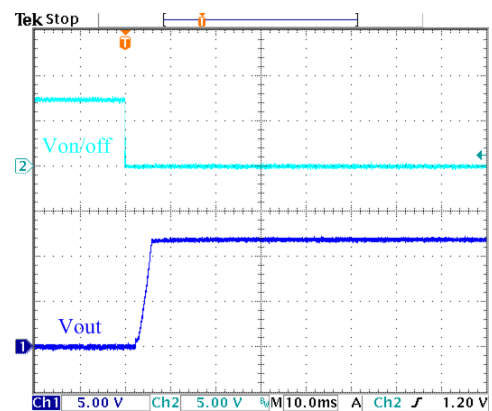
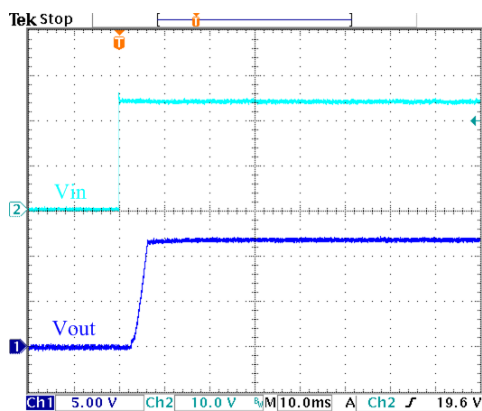
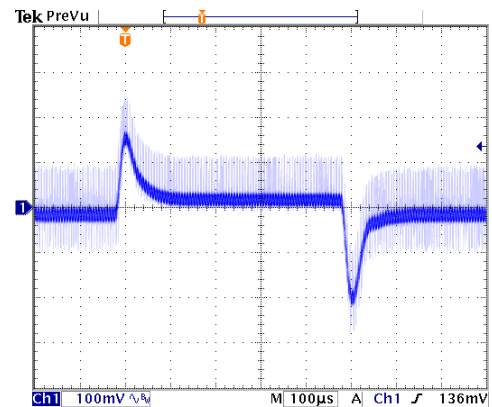
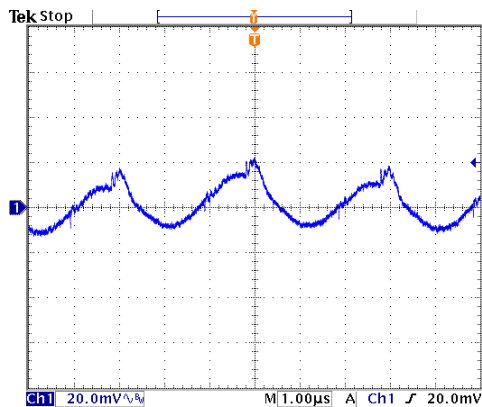
Derating Output Current versus Ambient Temperature with Airflow,

$$V_{in} = V_{in\text{nom}}$$

Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

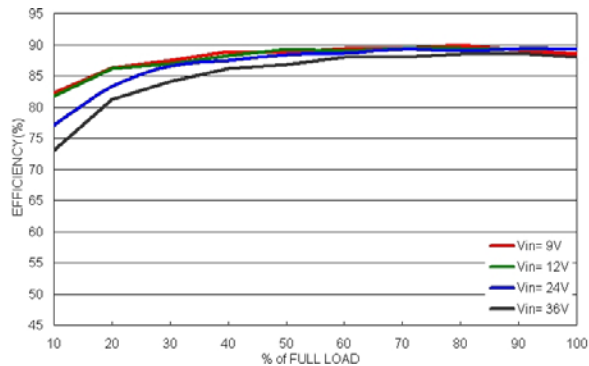
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-2412WI

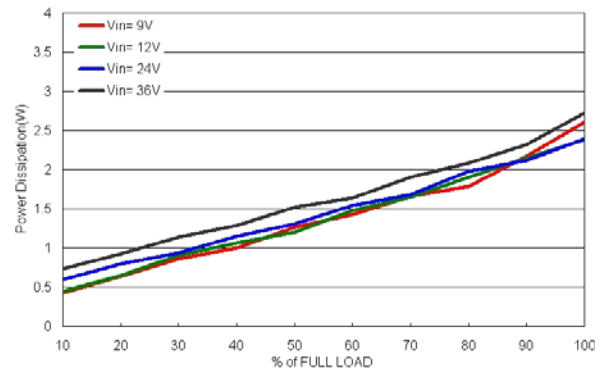


## Characteristic Curves (Continued)

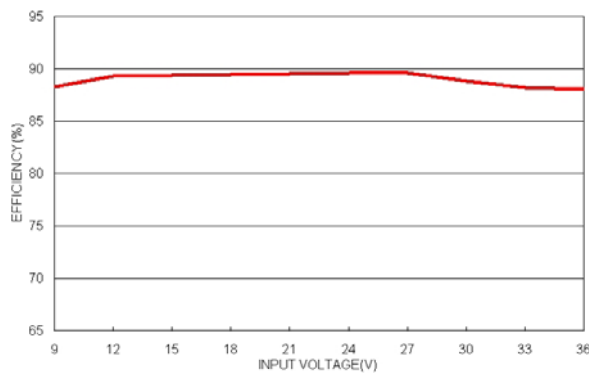
All test conditions are at 25°C. The figures are identical for THN 20-2413WI



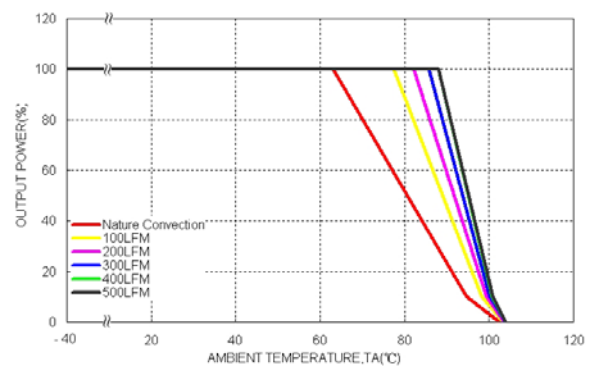
Efficiency versus Output Current



Power Dissipation versus Output Current

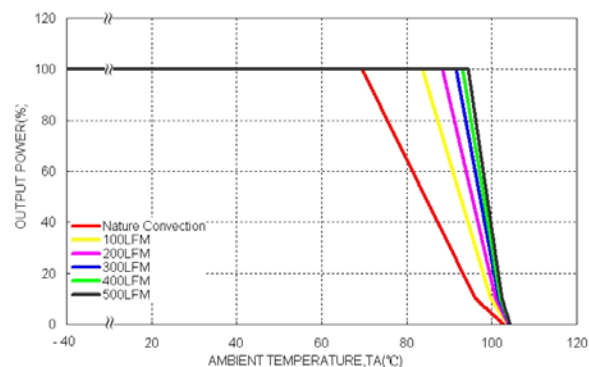


Efficiency versus Input Voltage. Full Load



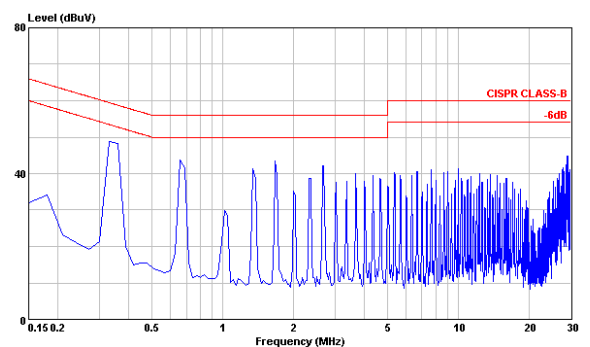
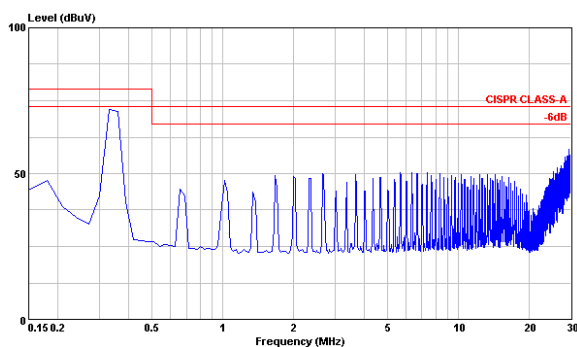
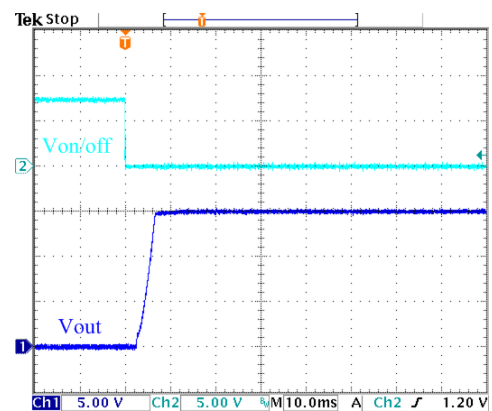
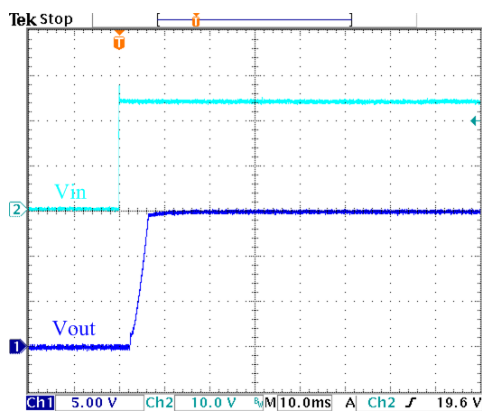
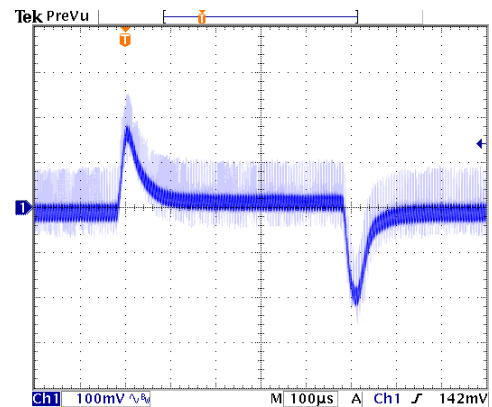
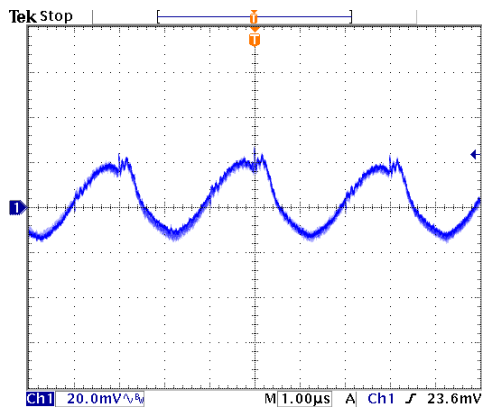
Derating Output Current versus Ambient Temperature with Airflow,

$$V_{in} = V_{in\text{nom}}$$

Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

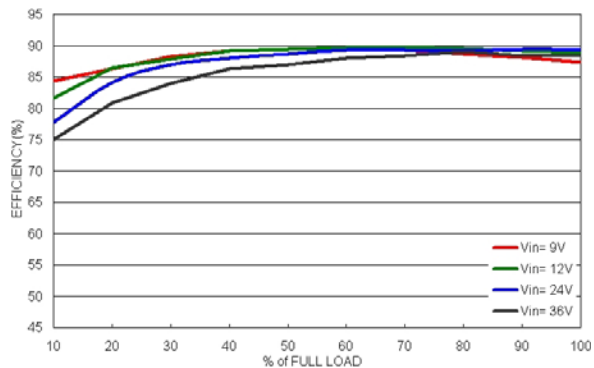
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-2413W1

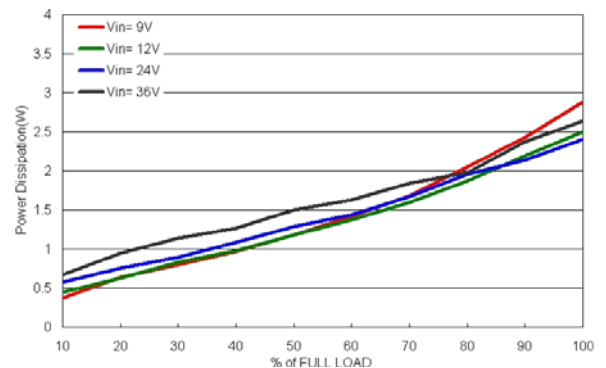


## Characteristic Curves (Continued)

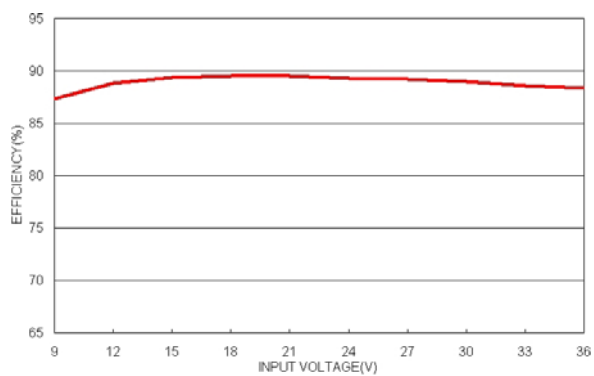
All test conditions are at 25°C. The figures are identical for THN 20-2422WI



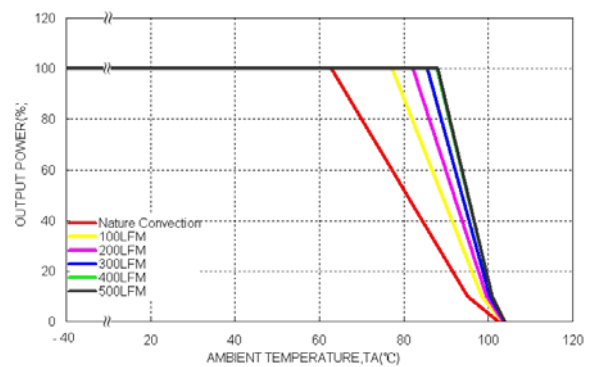
Efficiency versus Output Current



Power Dissipation versus Output Current

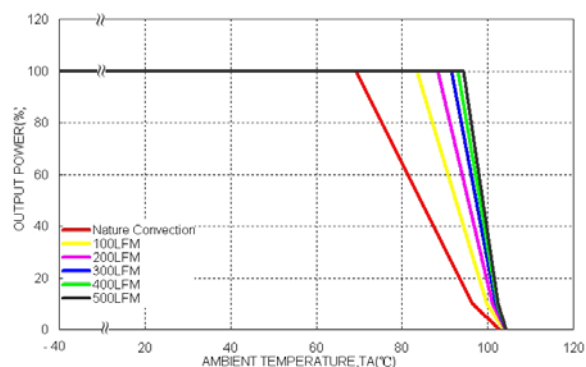


Efficiency versus Input Voltage, Full Load



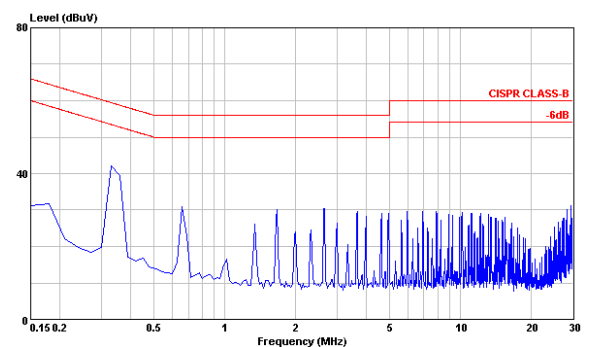
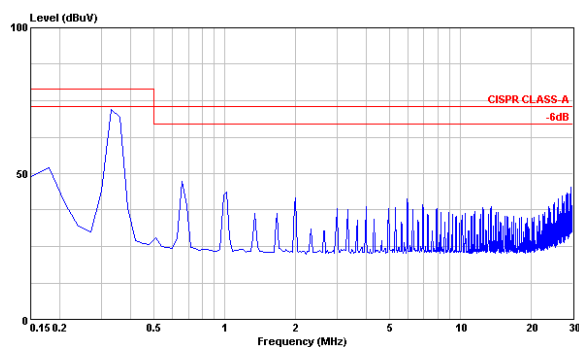
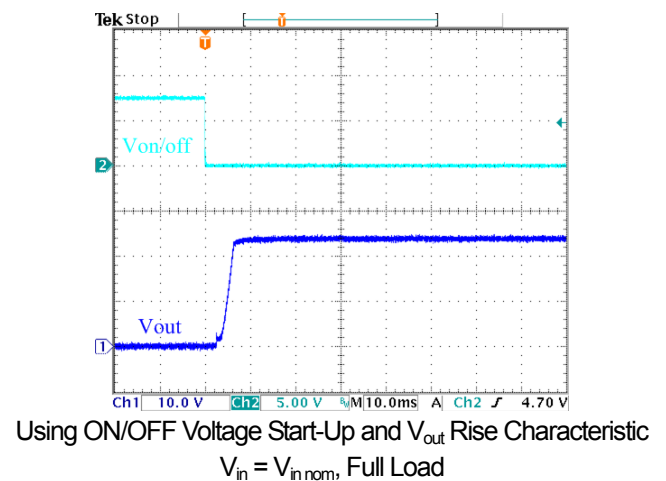
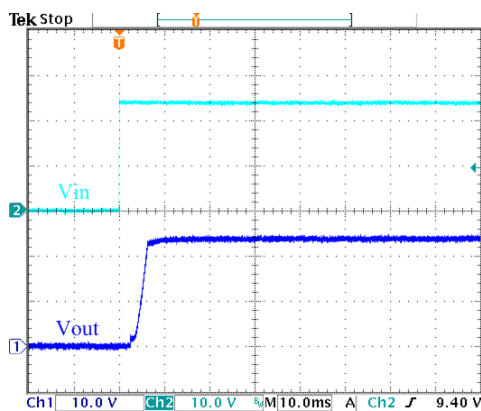
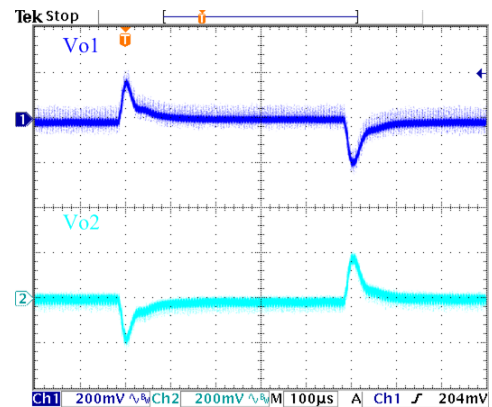
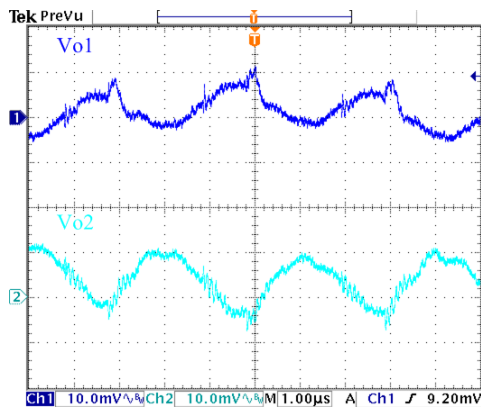
Derating Output Current versus Ambient Temperature with Airflow,

$$V_{in} = V_{in\text{nom}}$$

Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

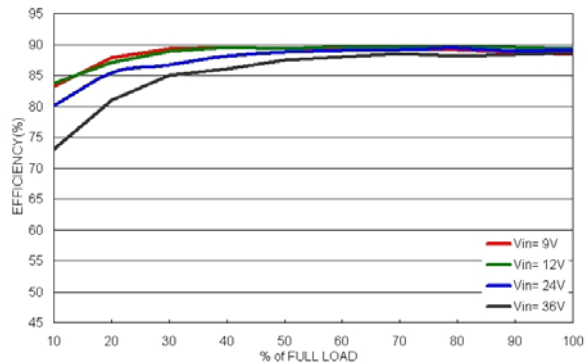
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-2422WI

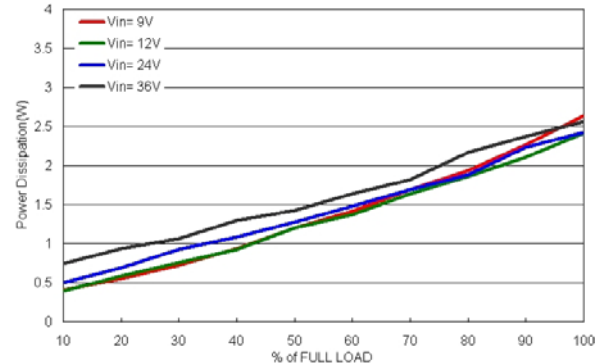


## Characteristic Curves (Continued)

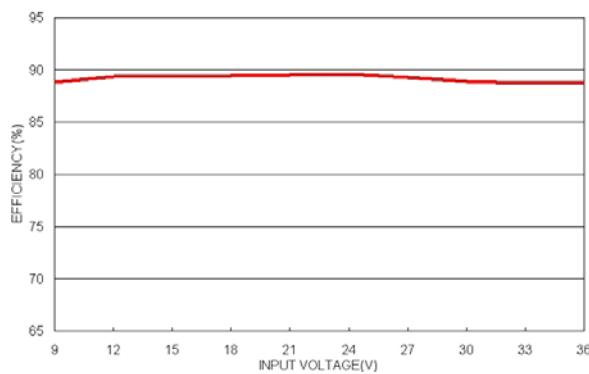
All test conditions are at 25°C. The figures are identical for THN 20-2423WI



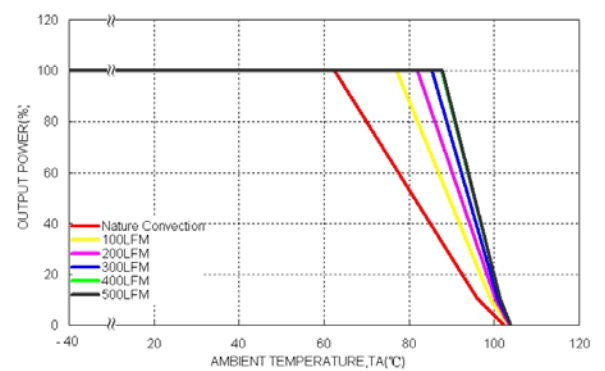
Efficiency versus Output Current



Power Dissipation versus Output Current

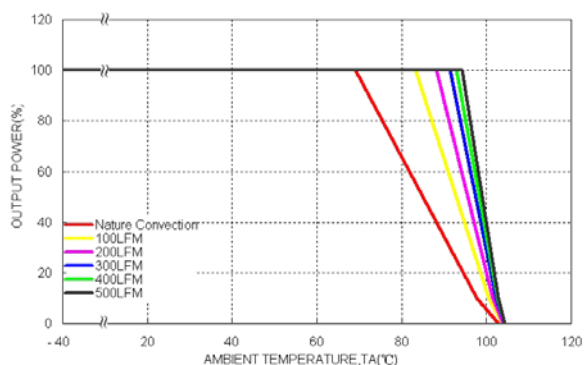


Efficiency versus Input Voltage. Full Load



Derating Output Current versus Ambient Temperature with Airflow

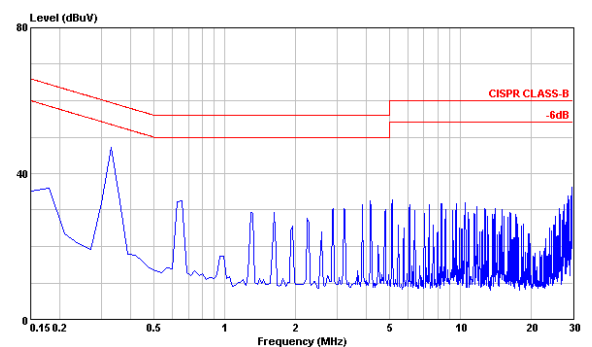
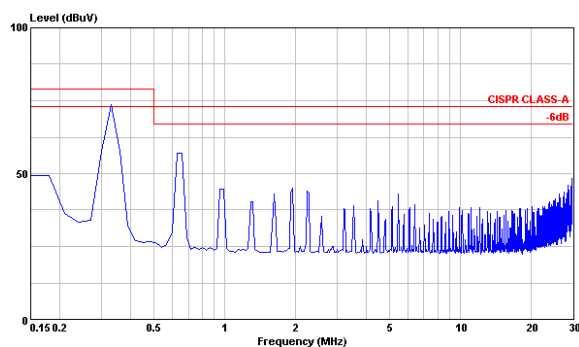
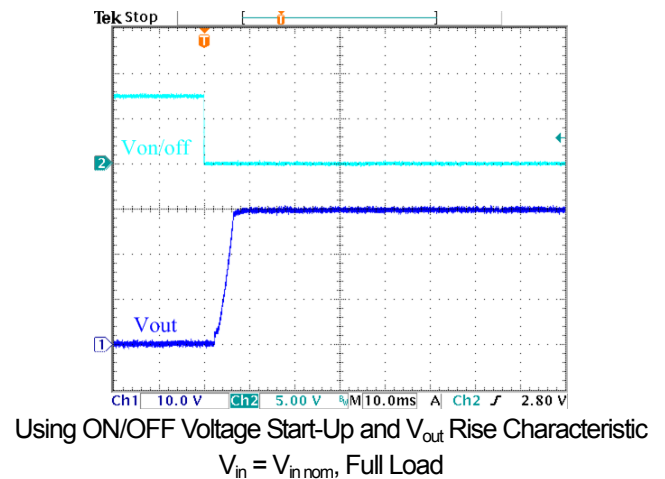
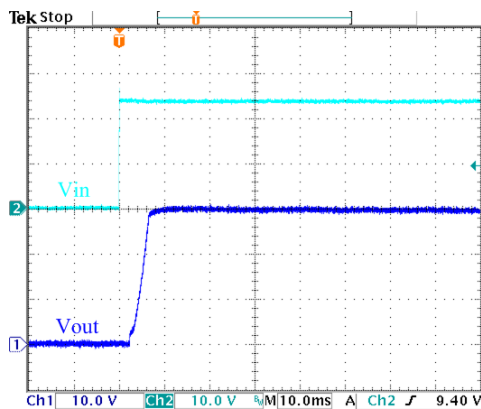
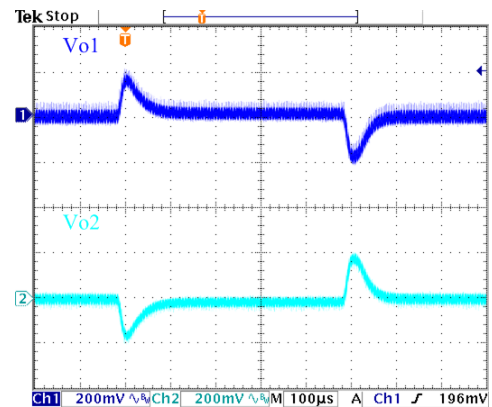
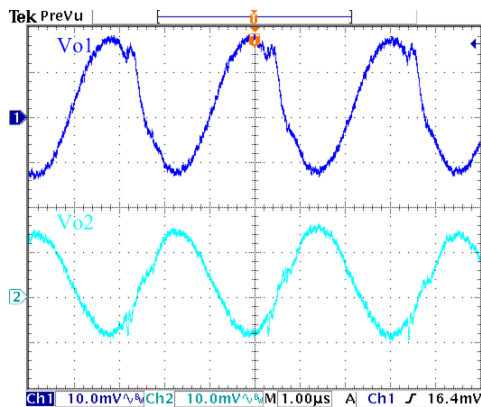
$$V_{in} = V_{in\text{nom}}$$



Derating Output Current Versus Ambient Temperature with  
Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

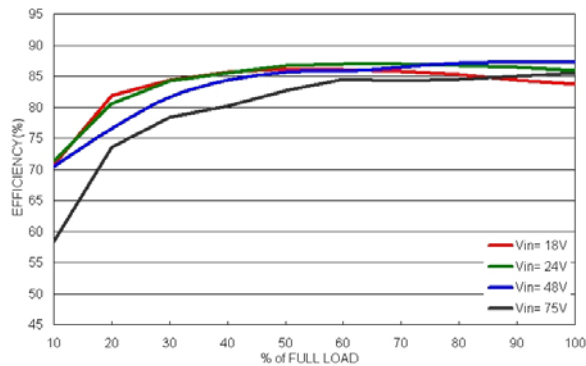
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-2423WI

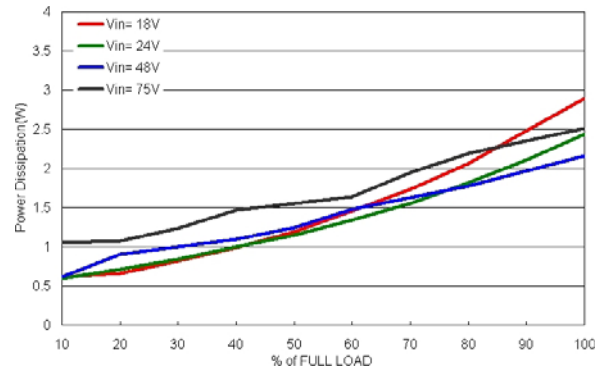


## Characteristic Curves (Continued)

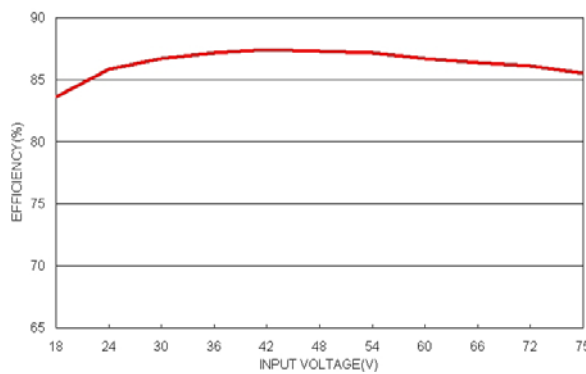
All test conditions are at 25°C. The figures are identical for THN 20-4810WI



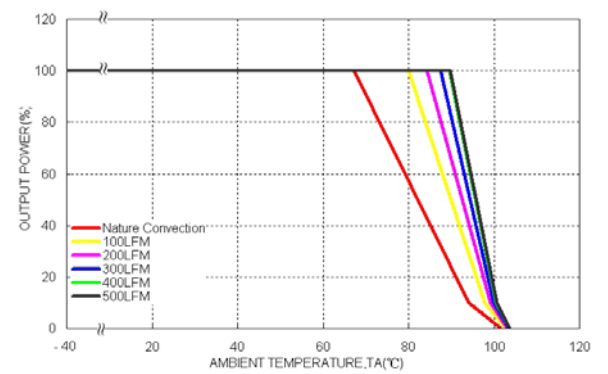
Efficiency versus Output Current



Power Dissipation versus Output Current

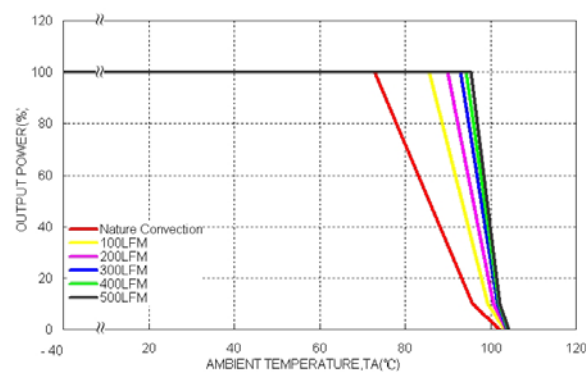


Efficiency versus Input Voltage. Full Load



Derating Output Current versus Ambient Temperature with Airflow,

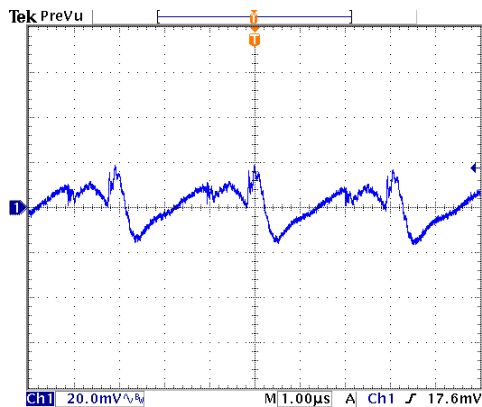
$$V_{in} = V_{in\,nom}$$



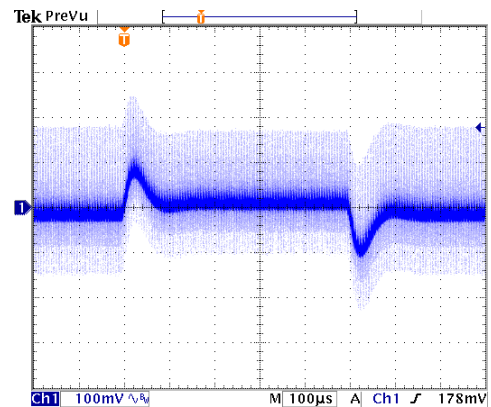
Derating Output Current Versus Ambient Temperature with  
Heat Sink and Airflow,  $V_{in} = V_{in\,nom}$

## Characteristic Curves (Continued)

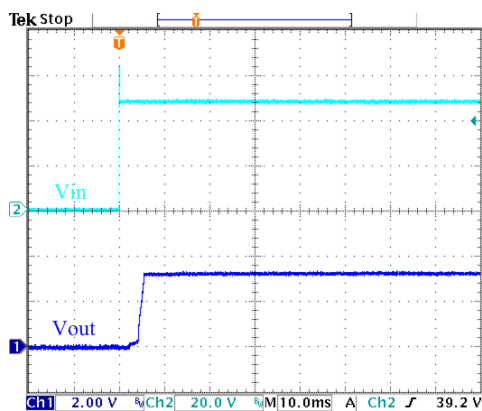
All test conditions are at 25°C. The figures are identical for THN 20-4810WI



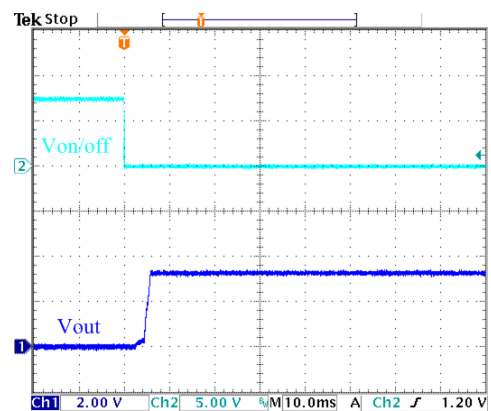
Typical Output Ripple and Noise.  
 $V_{in} = V_{in,nom}$ , Full Load



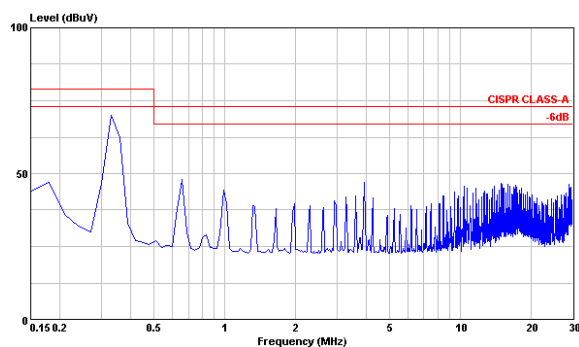
Transient Response to Dynamic Load Change from  
 100% to 75% to 100% of Full Load;  $V_{in} = V_{in,nom}$



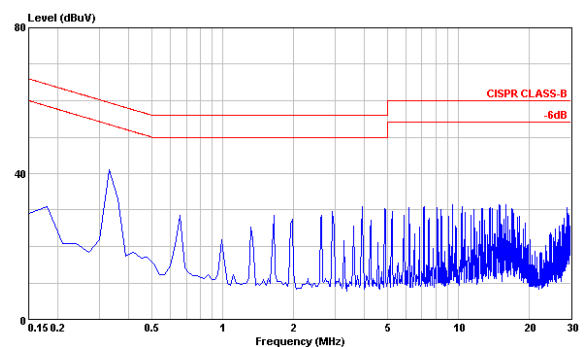
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in} = V_{in,nom}$ , Full Load



Using ON/OFF Voltage Start-Up and  $V_{out}$  Rise Characteristic  
 $V_{in} = V_{in,nom}$ , Full Load



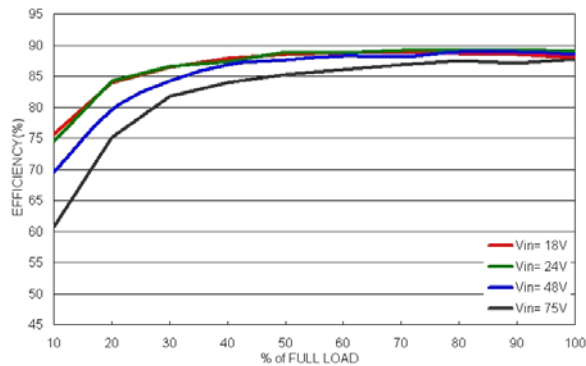
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in,nom}$ , Full Load



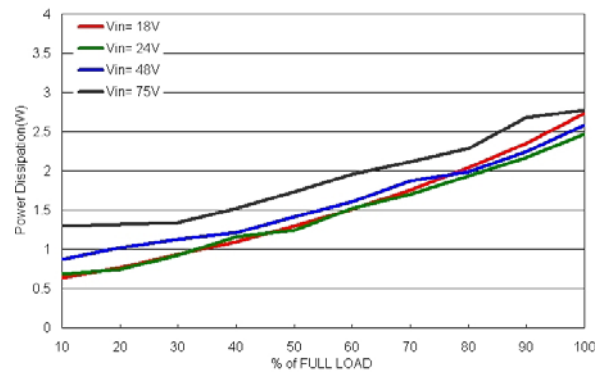
Conduction Emission of EN55022 Class B  
 $V_{in} = V_{in,nom}$ , Full Load

## Characteristic Curves (Continued)

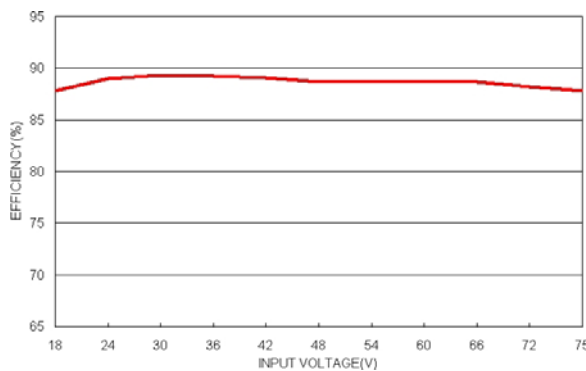
All test conditions are at 25°C. The figures are identical for THN 20-4811WI



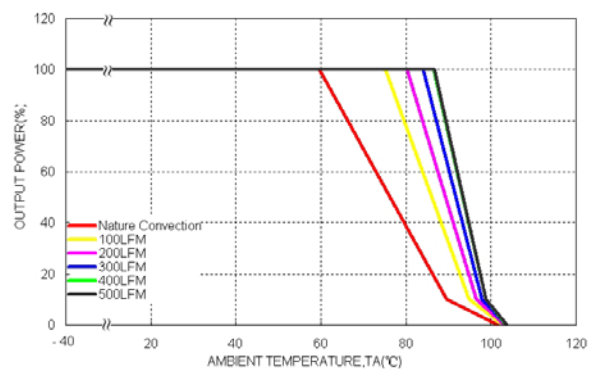
Efficiency versus Output Current



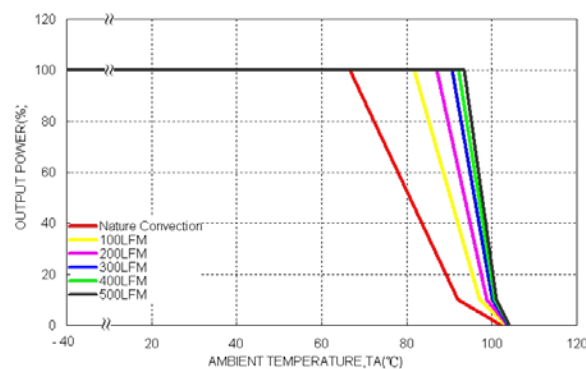
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



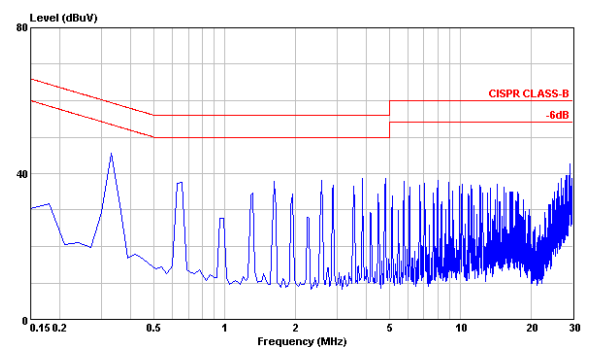
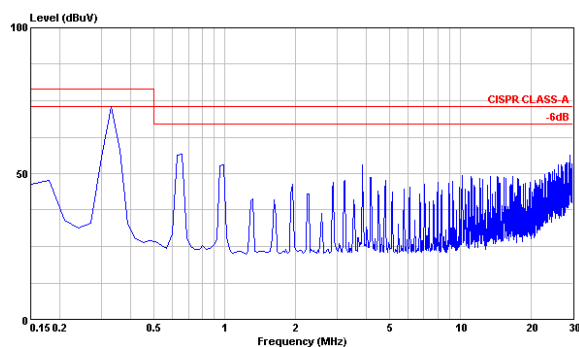
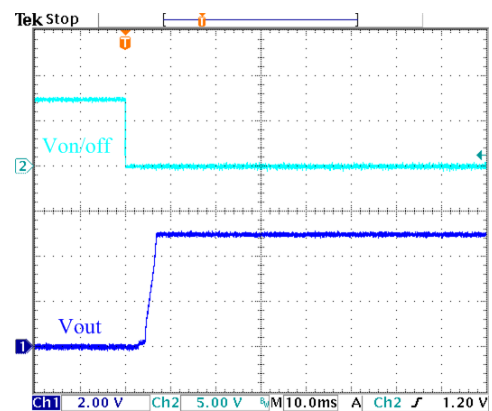
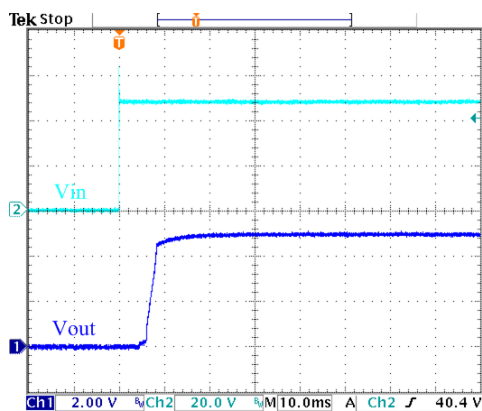
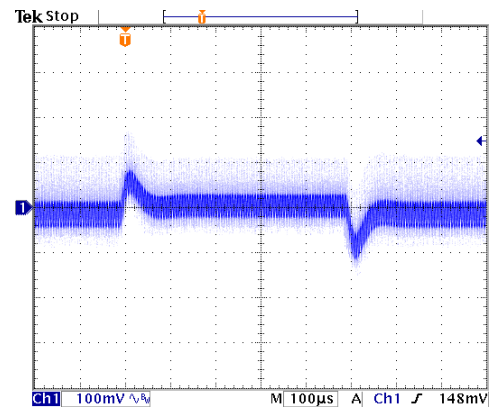
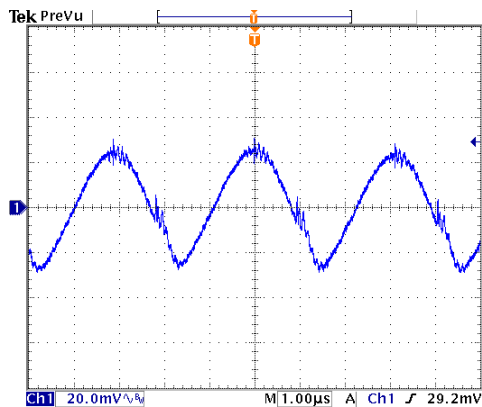
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\text{nom}}$



Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

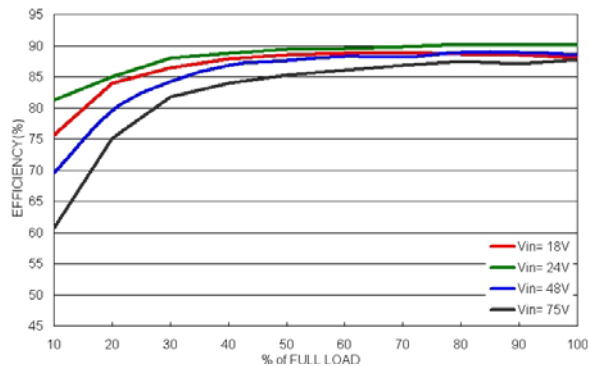
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-4811WI

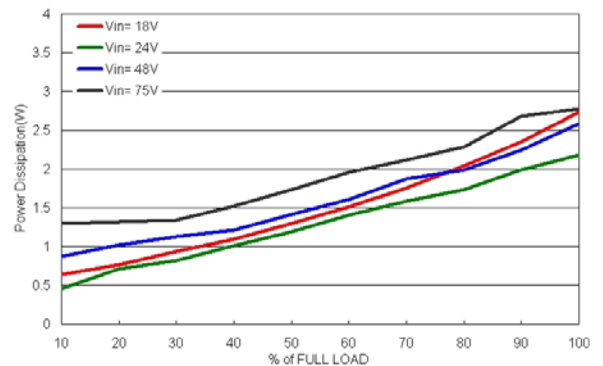


## Characteristic Curves (Continued)

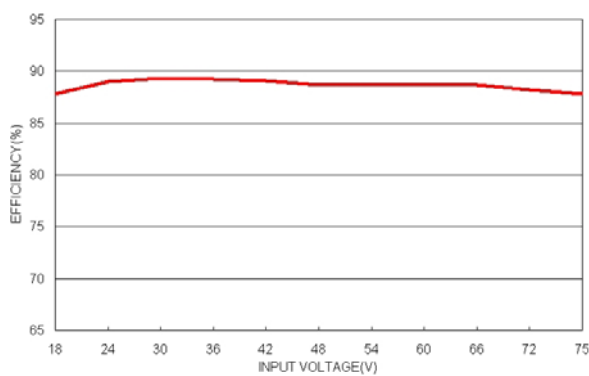
All test conditions are at 25°C. The figures are identical for THN 20-4812WI



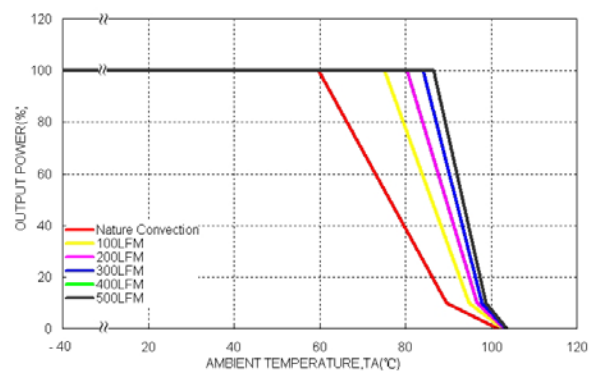
Efficiency versus Output Current



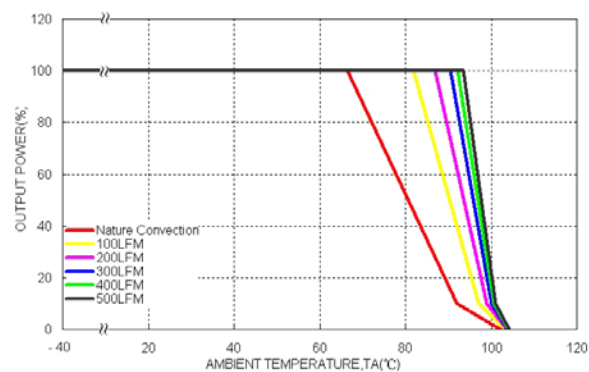
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



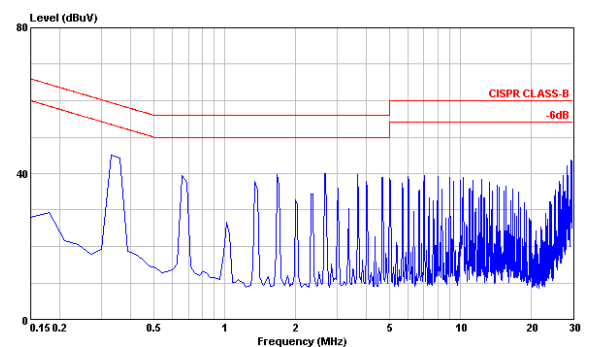
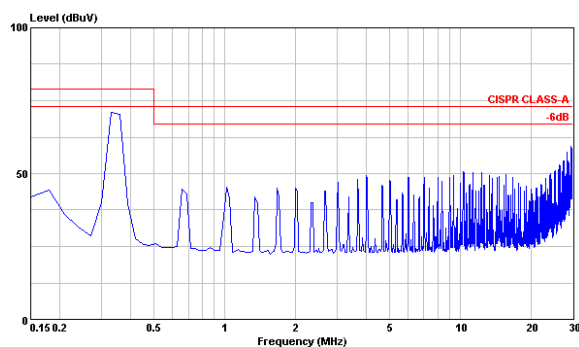
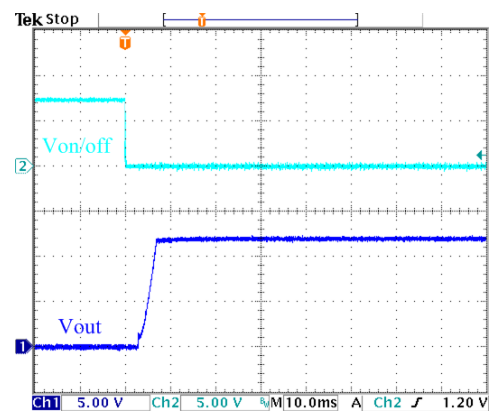
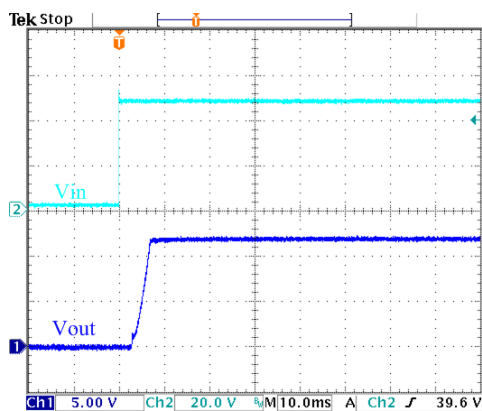
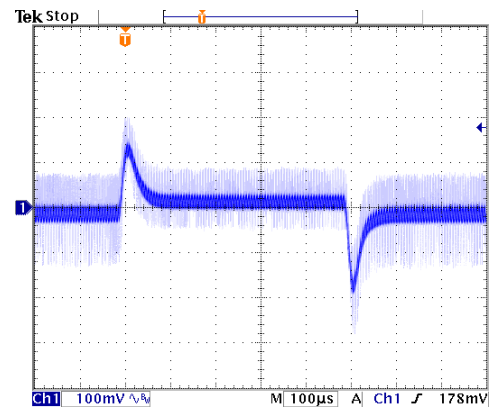
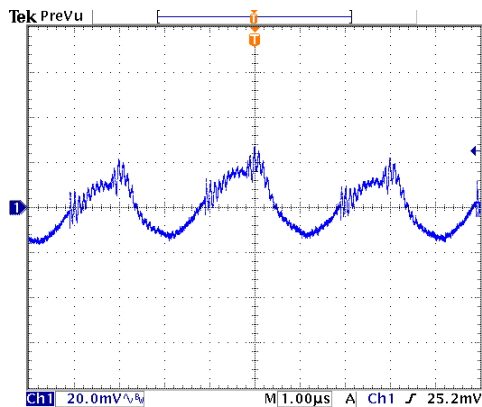
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\text{nom}}$



Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

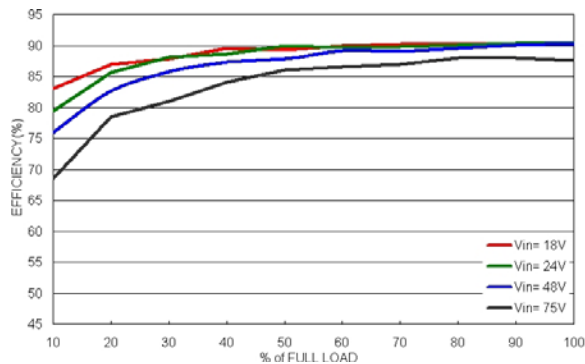
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-4812WI

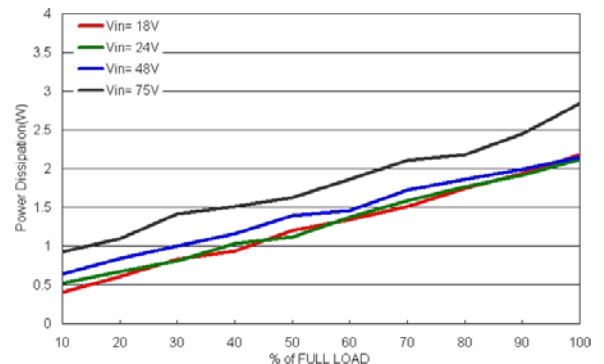


## Characteristic Curves (Continued)

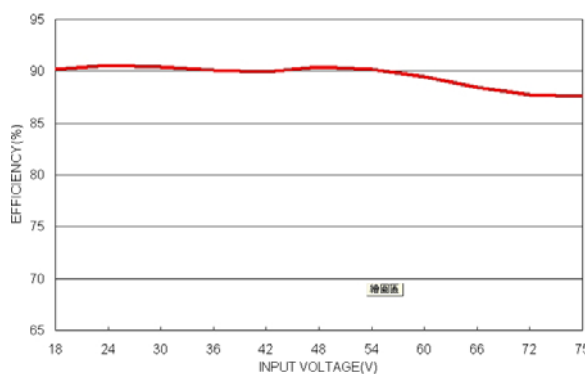
All test conditions are at 25°C. The figures are identical for THN 20-4813WI



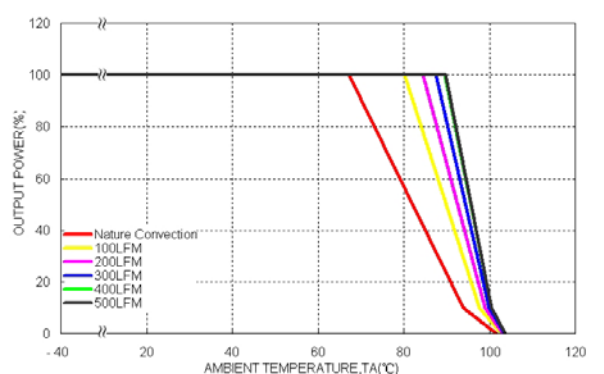
Efficiency versus Output Current



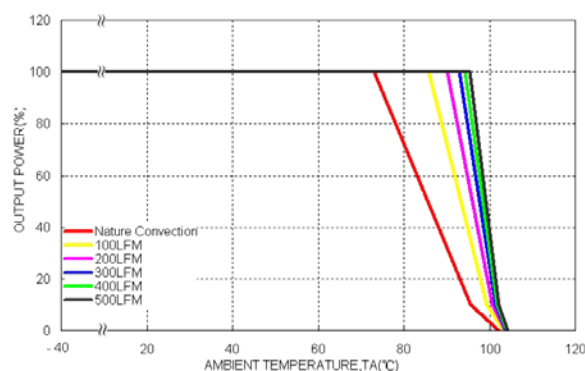
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



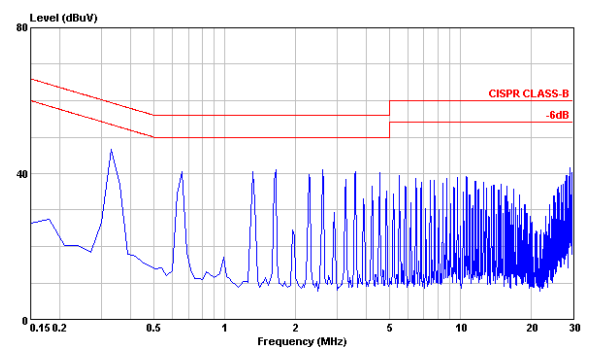
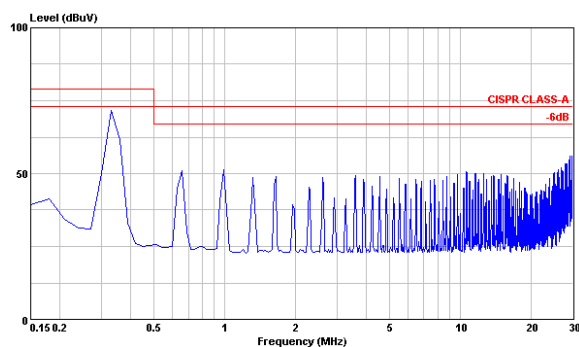
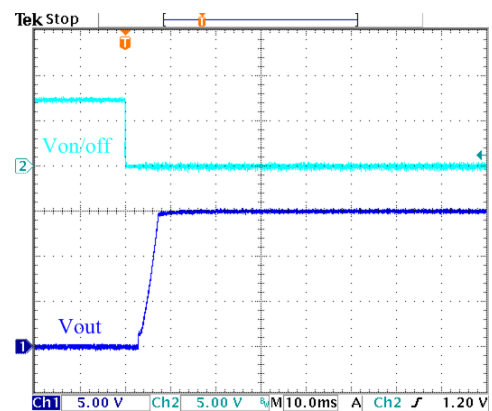
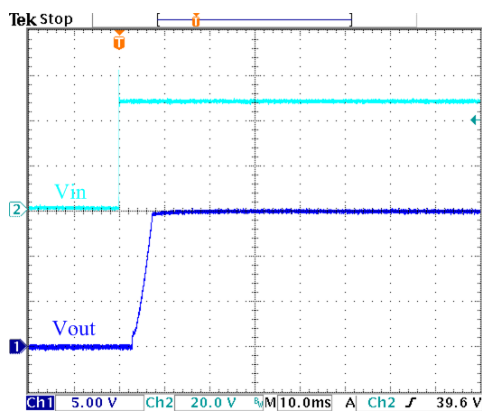
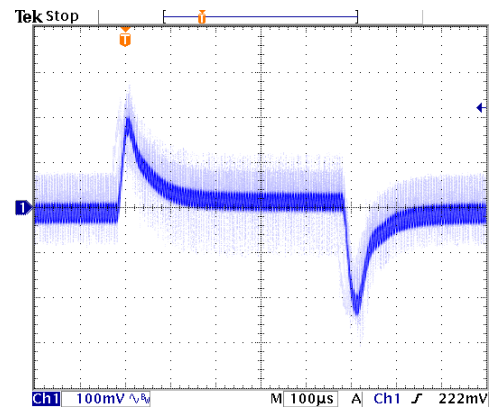
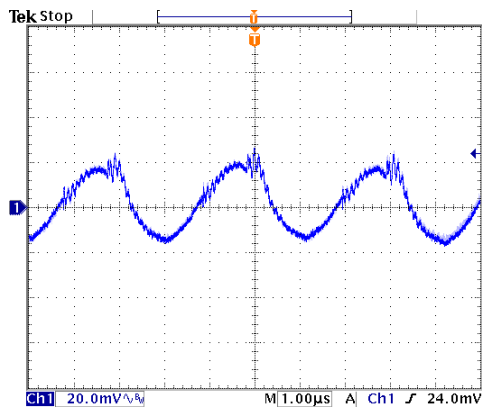
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\,nom}$

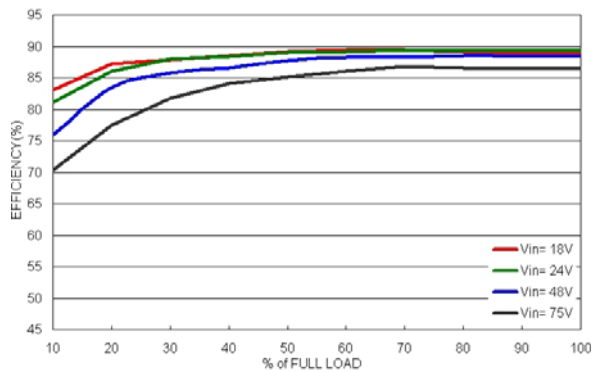
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-4813WI

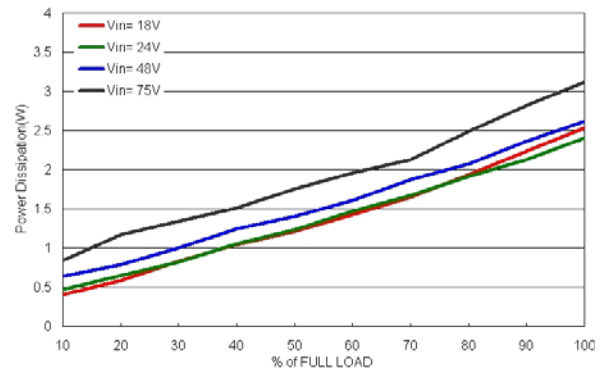


## Characteristic Curves (Continued)

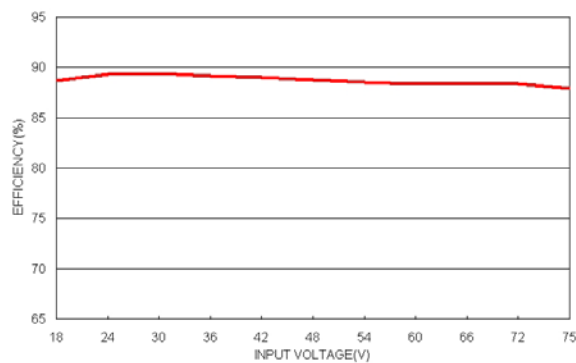
All test conditions are at 25°C. The figures are identical for THN 20-4822WI



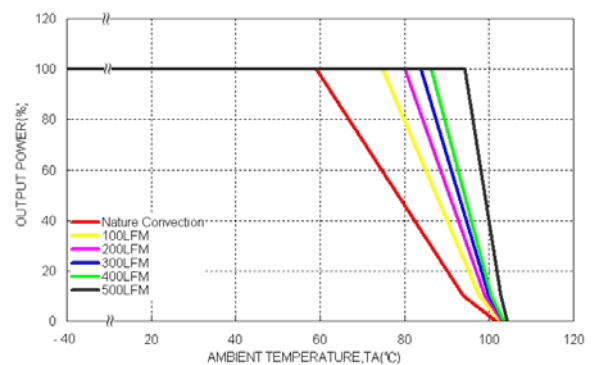
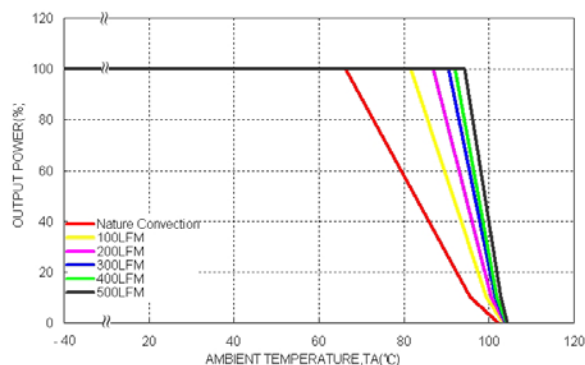
Efficiency versus Output Current



Power Dissipation versus Output Current

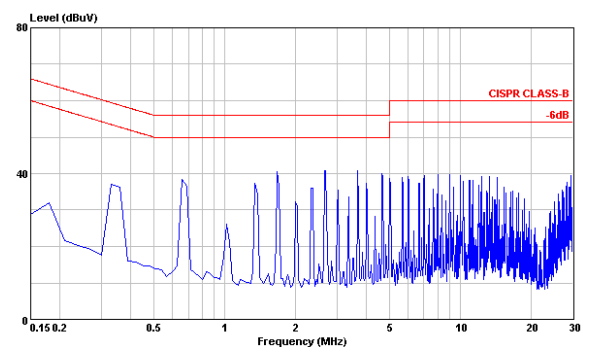
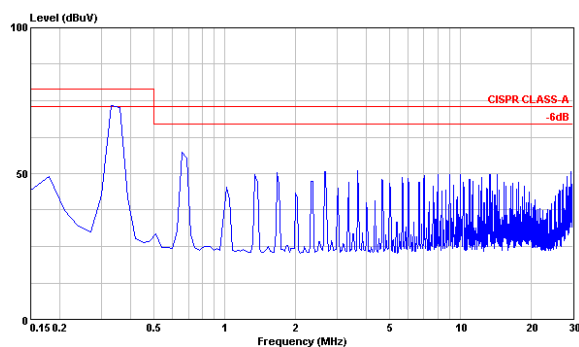
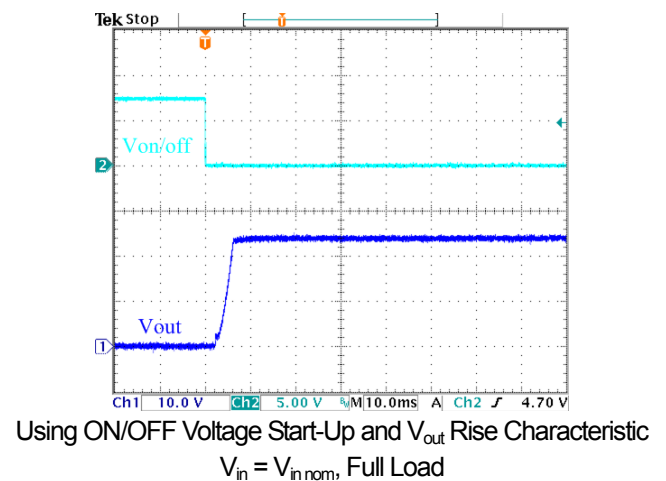
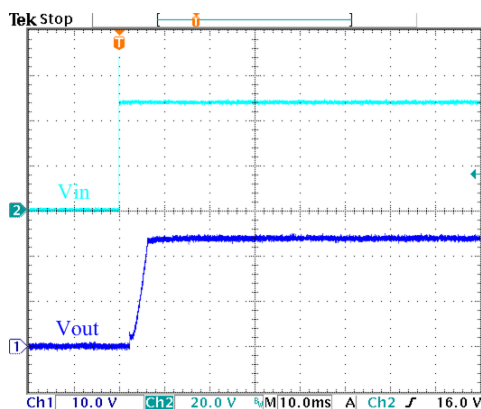
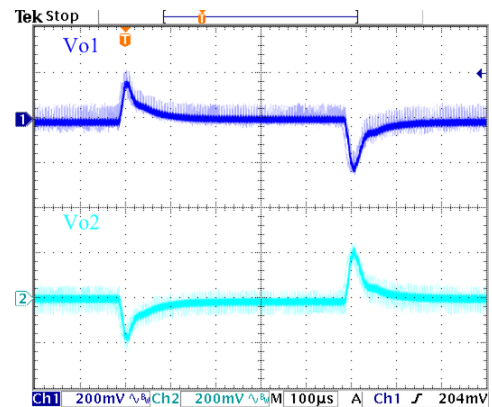
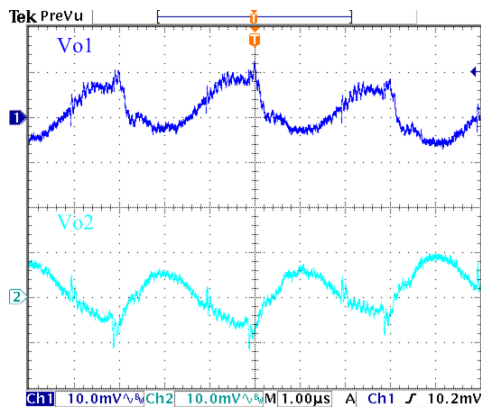


Efficiency versus Input Voltage. Full Load

Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\text{nom}}$ Derating Output Current Versus Ambient Temperature with  
Heat Sink and Airflow,  $V_{in} = V_{in\text{nom}}$

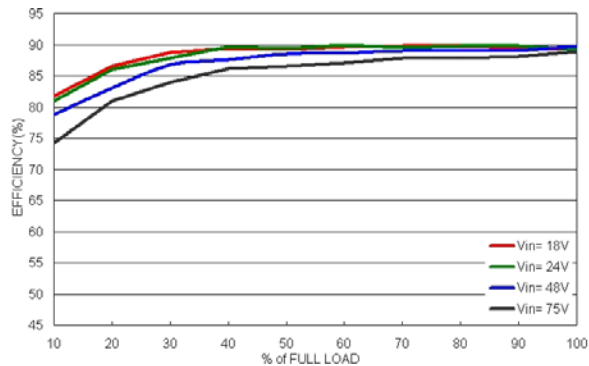
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-4822WI

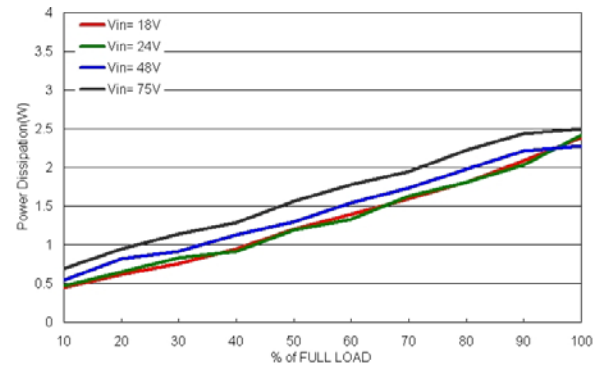


## Characteristic Curves (Continued)

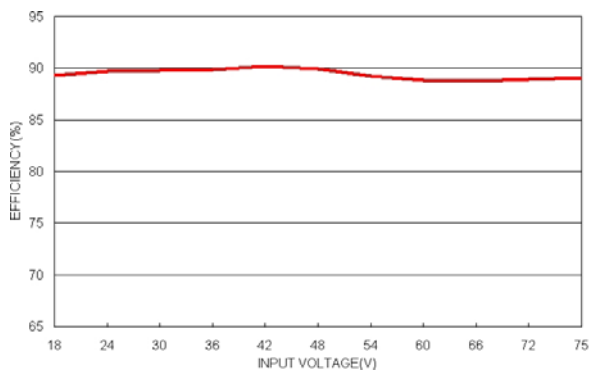
All test conditions are at 25°C. The figures are identical for THN 20-4823WI



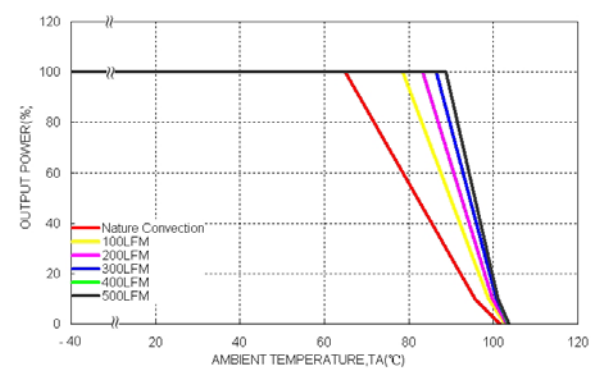
Efficiency versus Output Current



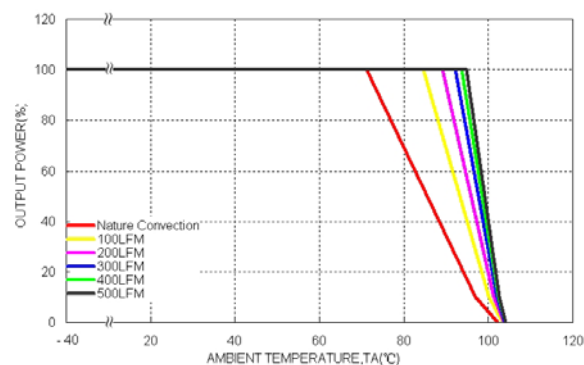
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



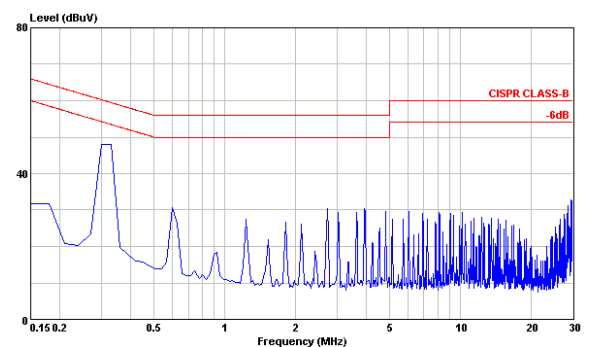
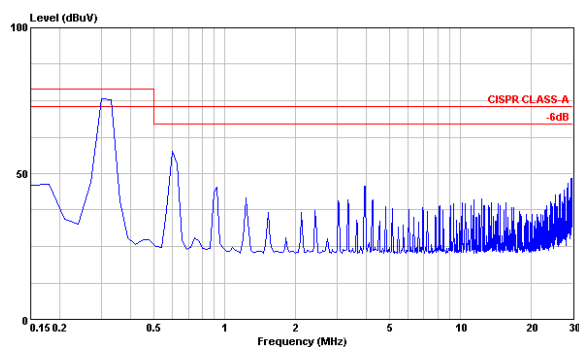
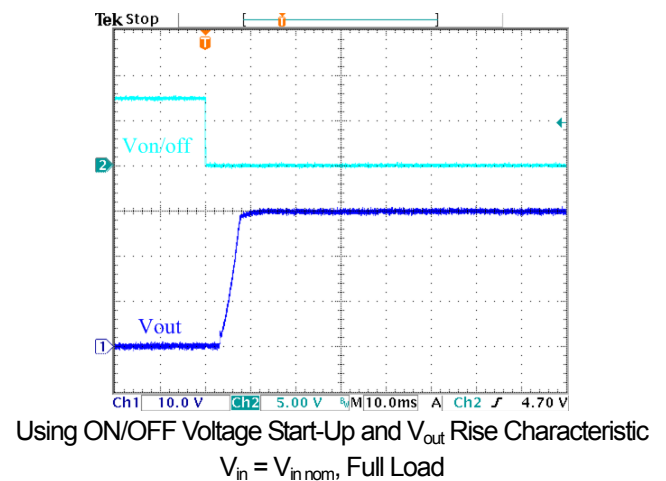
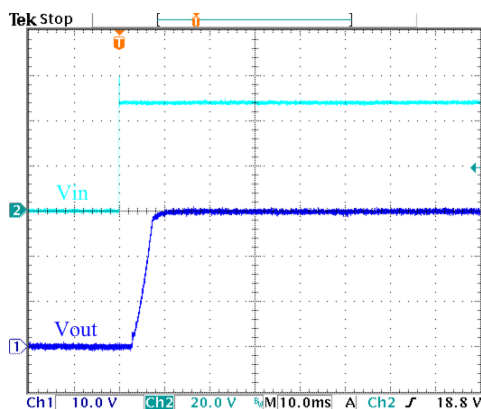
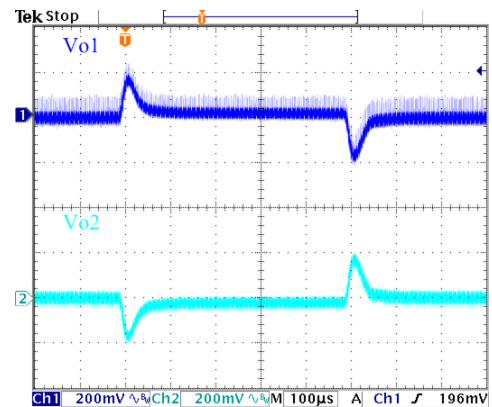
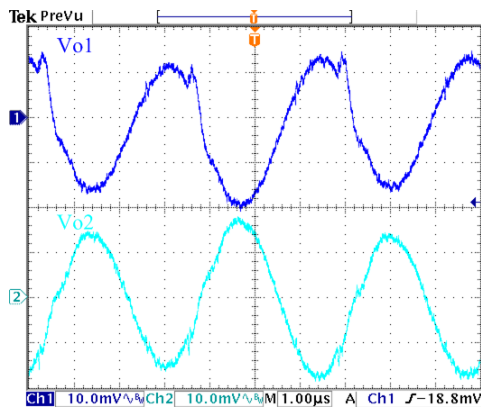
Derating Output Current versus Ambient Temperature with Airflow,  
 $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature with  
 Heat Sink and Airflow,  $V_{in} = V_{in\,nom}$

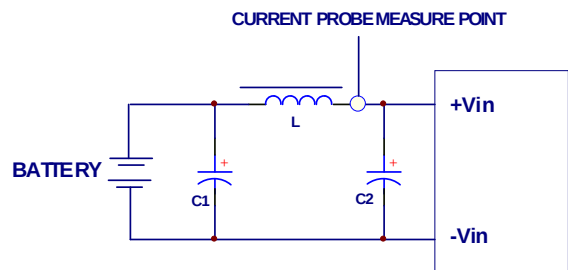
## Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for THN 20-4823WI



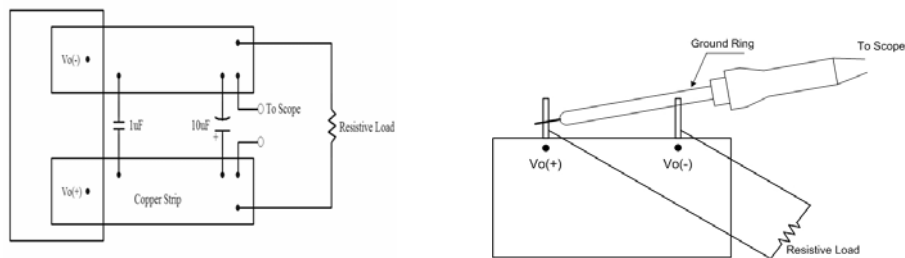
Testing Configurations

Input reflected-ripple current measurement test up

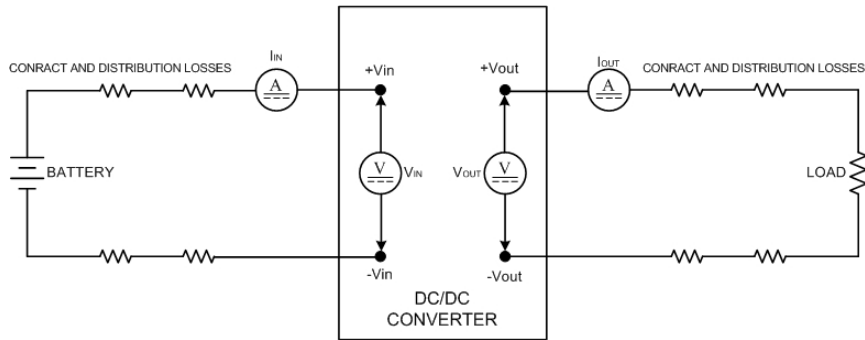


| Component | Value | Voltage | Reference                       |
|-----------|-------|---------|---------------------------------|
| L         | 12μH  | ---     | ---                             |
| C1        | 10μF  | 100V    | Aluminum Electrolytic Capacitor |
| C2        | 10μF  | 100V    | Aluminum Electrolytic Capacitor |

Peak-to-peak output ripple & noise measurement test up



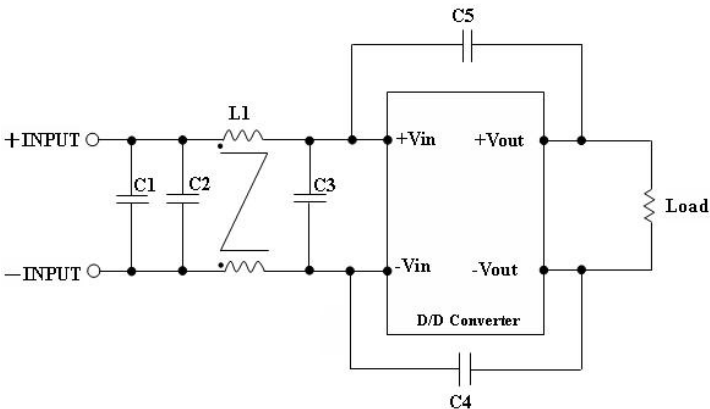
Output voltage and efficiency measurement test up



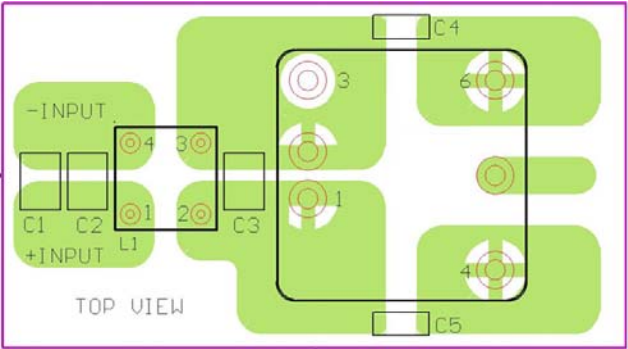
Note: All measurements are taken at the module terminals.

$$Efficiency = \left( \frac{V_o \times I_o}{V_{in} \times I_{in}} \right) \times 100\%$$

EMI Considerations



Suggested schematic to comply with EN55022 Class B limits



Recommended layout with input filter

To comply with EN55022 CLASS B following components are recommended:

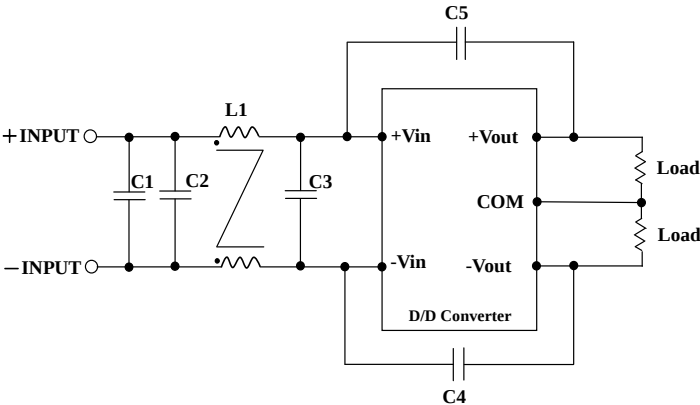
THN 20-24xxWI

| Component | Value | Voltage | Reference                  |
|-----------|-------|---------|----------------------------|
| C1        | 4.7μF | 50V     | 1812 MLCC                  |
| C2, C3    | —     | —       | —                          |
| C4, C5    | 470pF | 2KV     | 1808 MLCC                  |
| L1        | 325μH | —       | Common Choke, P/N: TCK-050 |

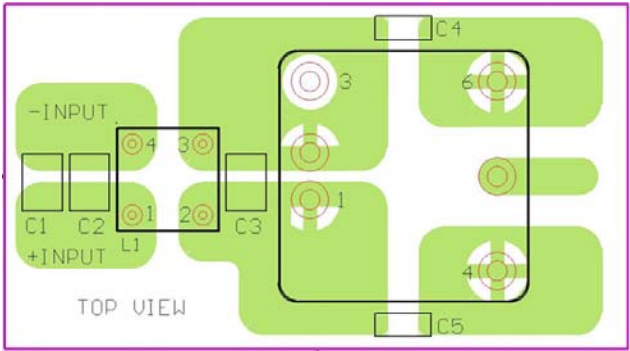
THN 20-48xxWI

| Component | Value  | Voltage | Reference                  |
|-----------|--------|---------|----------------------------|
| C1, C3    | 2.2μF  | 100V    | 1812 MLCC                  |
| C2        | 2.2μF  | 100V    | 1812 MLCC                  |
| C4, C5    | 1000pF | 2KV     | 1808 MLCC                  |
| L1        | 325μH  | —       | Common Choke, P/N: TCK-050 |

EMI Considerations



Suggested schematic to comply with EN55022 Class B limits



Recommended layout with input filter

To comply with EN55022 CLASS B following components are recommended:

THN 20-242xWI

| Component | Value       | Voltage | Reference                  |
|-----------|-------------|---------|----------------------------|
| C1        | 4.7 $\mu$ F | 50V     | 1812 MLCC                  |
| C2, C3    | ---         | ---     | ---                        |
| C4, C5    | 470pF       | 2KV     | 1808 MLCC                  |
| L1        | 325 $\mu$ H | ---     | Common Choke, P/N: TCK-050 |

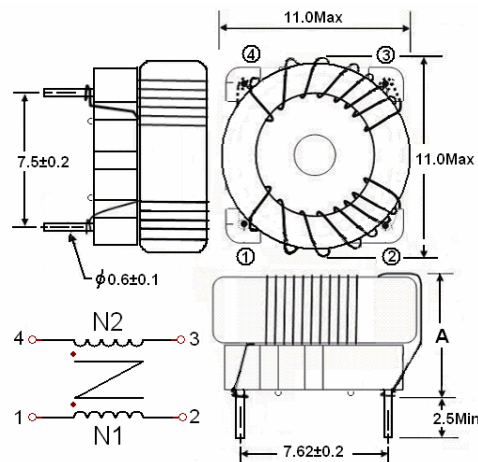
THN 20-482xWI

| Component | Value       | Voltage | Reference                  |
|-----------|-------------|---------|----------------------------|
| C1, C2    | 2.2 $\mu$ F | 100V    | 1812 MLCC                  |
| C3        | 2.2 $\mu$ F | 100V    | 1812 MLCC                  |
| C4, C5    | 1000pF      | 2KV     | 1808 MLCC                  |
| L1        | 325 $\mu$ H | ---     | Common Choke, P/N: TCK-050 |

## EMI Considerations (Continued)

This Common Choke L1 has been define as follow :

- TCK-050
- L: 325mH  $\pm 35\%$  / DCR: 35 $\Omega$ , max
- A (Height): 8.8 mm, Max
- Test condition : 100KHz / 100mV
- Recommended through hole :  $\Phi 0.8\text{mm}$
- All dimensions in millimeters



## Input Source Impedance

The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external C-L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12 $\mu\text{H}$  and capacitor is Nippon Chemi-Con KZE-series 10 $\mu\text{F}/100\text{V}$  & 10 $\mu\text{F}/100\text{V}$ . The capacitor must as close as possible to the input terminals of the power module for lower impedance.

## Output Over Current Protection

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload current is maintained at approximately about 150 percent of rated current for THN 20WI single output series.

Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over-current fault condition. It also enables the power supply to restart when the fault is removed.

One of the problems resulting from over current is that excessive heat may be generated in power devices; especially MOSFET and Schottky diodes and the temperature of those devices may exceed their specified limits. A protection mechanism has to be used to prevent those power devices from being damaged.

## Output Over Voltage Protection

The output over-voltage protection consists of a Zener diode that monitors the output voltage on the feedback loop. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode will send a current signal to the control IC to limiting the output voltage.

## Output Voltage Adjustment

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the Vo (+) or Vo (-) pins. With an external resistor between the TRIM and Vo (-) pin, the output voltage set point increases. With an external resistor between the TRIM and Vo (+) pin, the output voltage set point decreases.

- Trim up equation

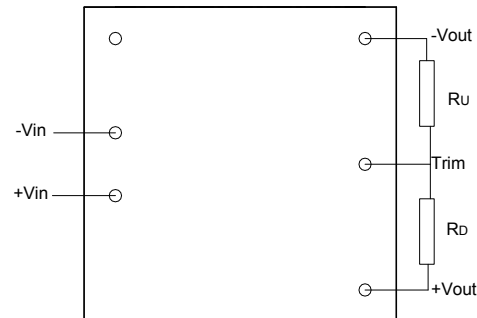
$$R_U = \left[ \frac{G \times L}{(V_{O,up} - L - K)} - H \right] \Omega$$

- Trim down equation

$$R_D = \left[ \frac{(V_{O,down} - L) \times G}{(V_O - V_{O,down})} - H \right] \Omega$$

- Trim constants

| Module        | G     | H    | K    | L   |
|---------------|-------|------|------|-----|
| THN 20-xx10WI | 5110  | 2050 | 0.8  | 2.5 |
| THN 20-xx11WI | 5110  | 2050 | 2.5  | 2.5 |
| THN 20-xx12WI | 10000 | 5110 | 9.5  | 2.5 |
| THN 20-xx13WI | 10000 | 5110 | 12.5 | 2.5 |



TRIM TABLE

THN 20-xx10WI

| Trim up (%)               | 1       | 2       | 3       | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|---------------------------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|
| V <sub>OUT</sub> (Volts)= | 3.333   | 3.366   | 3.399   | 3.432  | 3.465  | 3.498  | 3.531  | 3.564  | 3.597  | 3.630  |
| R <sub>U</sub> (KΩ)=      | 385.071 | 191.511 | 126.990 | 94.730 | 75.374 | 62.470 | 53.253 | 46.340 | 40.963 | 36.662 |
| Trim down (%)             | 1       | 2       | 3       | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
| V <sub>OUT</sub> (Volts)= | 3.267   | 3.234   | 3.201   | 3.168  | 3.135  | 3.102  | 3.069  | 3.036  | 3.003  | 2.970  |
| R <sub>D</sub> (KΩ)=      | 116.719 | 54.779  | 34.133  | 23.810 | 17.616 | 13.486 | 10.537 | 8.325  | 6.604  | 5.228  |

THN 20-xx11WI

| Trim up (%)               | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|---------------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| V <sub>OUT</sub> (Volts)= | 5.050   | 5.100   | 5.150  | 5.200  | 5.250  | 5.300  | 5.350  | 5.400  | 5.450  | 5.500  |
| R <sub>U</sub> (KΩ)=      | 253.450 | 125.700 | 83.117 | 61.825 | 49.050 | 40.533 | 34.450 | 29.888 | 26.339 | 23.500 |
| Trim down (%)             | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
| V <sub>OUT</sub> (Volts)= | 4.950   | 4.900   | 4.850  | 4.800  | 4.750  | 4.700  | 4.650  | 4.600  | 4.550  | 4.500  |
| R <sub>D</sub> (KΩ)=      | 248.340 | 120.590 | 78.007 | 56.715 | 43.940 | 35.423 | 29.340 | 24.778 | 21.229 | 18.390 |

THN 20-xx12WI

| Trim up (%)               | 1       | 2       | 3       | 4       | 5       | 6       | 7      | 8      | 9      | 10     |
|---------------------------|---------|---------|---------|---------|---------|---------|--------|--------|--------|--------|
| V <sub>OUT</sub> (Volts)= | 12.120  | 12.240  | 12.360  | 12.480  | 12.600  | 12.720  | 12.840 | 12.960 | 13.080 | 13.200 |
| R <sub>U</sub> (KΩ)=      | 203.223 | 99.057  | 64.334  | 46.973  | 36.557  | 29.612  | 24.652 | 20.932 | 18.038 | 15.723 |
| Trim down (%)             | 1       | 2       | 3       | 4       | 5       | 6       | 7      | 8      | 9      | 10     |
| V <sub>OUT</sub> (Volts)= | 11.880  | 11.760  | 11.640  | 11.520  | 11.400  | 11.280  | 11.160 | 11.040 | 10.920 | 10.800 |
| R <sub>D</sub> (KΩ)=      | 776.557 | 380.723 | 248.779 | 182.807 | 143.223 | 116.834 | 97.985 | 83.848 | 72.853 | 64.057 |

THN 20-xx13WI

| Trim up (%)               | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8      | 9      | 10     |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|
| V <sub>OUT</sub> (Volts)= | 15.150  | 15.300  | 15.450  | 15.600  | 15.750  | 15.900  | 16.050  | 16.200 | 16.350 | 16.500 |
| R <sub>U</sub> (KΩ)=      | 161.557 | 78.223  | 50.446  | 36.557  | 28.223  | 22.668  | 18.700  | 15.723 | 13.409 | 11.557 |
| Trim down (%)             | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8      | 9      | 10     |
| V <sub>OUT</sub> (Volts)= | 14.850  | 14.700  | 14.550  | 14.400  | 14.250  | 14.100  | 13.950  | 13.800 | 13.650 | 13.500 |
| R <sub>D</sub> (KΩ)=      | 818.223 | 401.557 | 262.668 | 193.223 | 151.557 | 123.779 | 103.938 | 89.057 | 77.483 | 68.223 |

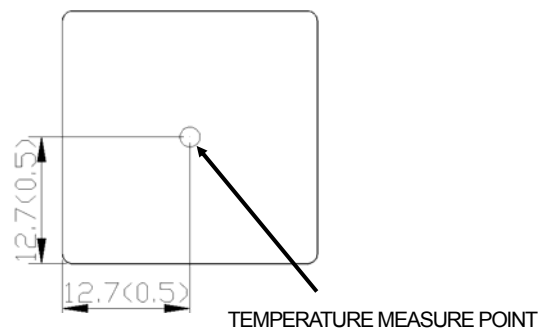
### Short Circuitry Protection

Continuous, hiccup and auto-recovery mode.

During short circuit, converter still shut down. The average current during this condition will be very low and the device can be safely in this condition.

### Thermal Consideration

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding Environment. Proper cooling can be verified by measuring the point as the figure below. The temperature at this location should not exceed 105°C. When Operating, adequate cooling must be provided to maintain the test point temperature at or below 105°C. Although the maximum point Temperature of the power modules is 105°C, you can limit this Temperature to a lower value for extremely high reliability.

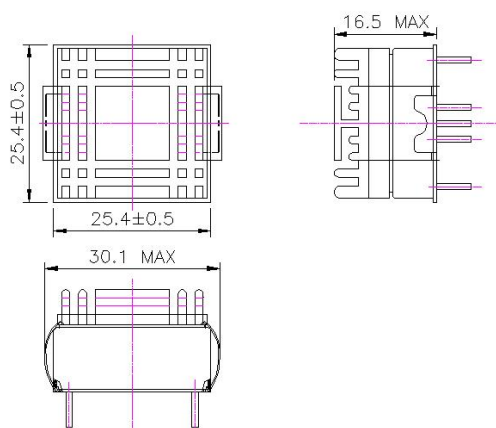


### Heat Sink Consideration

Equip heat sink for lower temperature and higher reliability of the module. Considering space and air-flow is the way to choose which heat sink is needed.

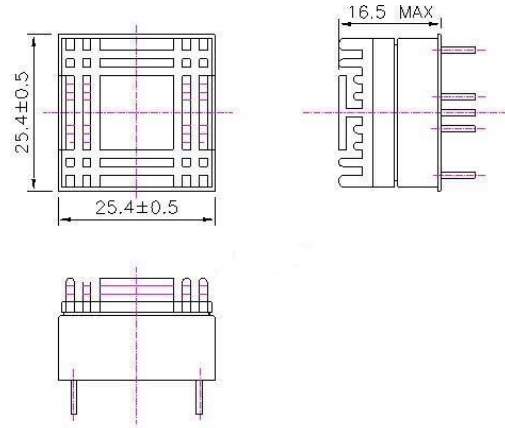
There are two types for choosing.

Suffix –HC: Heat Sink + Clamp



All dimensions in millimeters

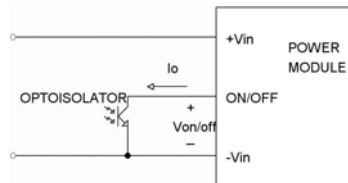
Suffix –HS: Heat Sink



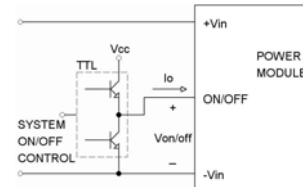
## Remote ON/OFF Control

The Remote ON/OFF Pin is controlled DC/DC power module to turn on and off; the user must use a switch to control the logic voltage high or low level of the pin referenced to  $-V_{in}$ . The switch can be open collector transistor, FET and Photo-Couple. The switch must be capable of sinking up to 1mA at low-level logic Voltage. High-level logic of the ON/OFF signal maximum voltage is allowable leakage current of the switch at 15V is 50 $\mu$ A.

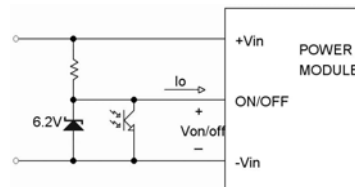
## Remote ON/OFF Implementation Circuits



Isolated-Closure Remote ON/OFF



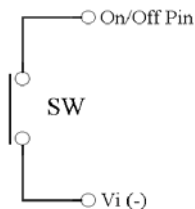
Level Control Using TTL Output



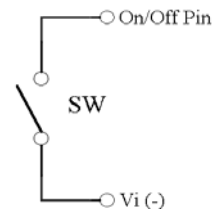
Level Control Using Line Voltage

**There are two remote control options available, positive logic and negative logic.**

a. The Positive logic structure turned on of the DC/DC module when the ON/OFF pin is at high-level logic and low-level logic is turned off it.

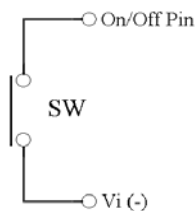


When THN 20WI module is turned off at Low-level logic

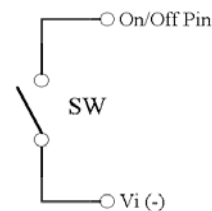


When THN 20WI module is turned on at High-level logic

b. The Negative logic structure turned on of the DC/DC module when the ON/OFF pin is at low-level logic and turned off when at high-level logic.

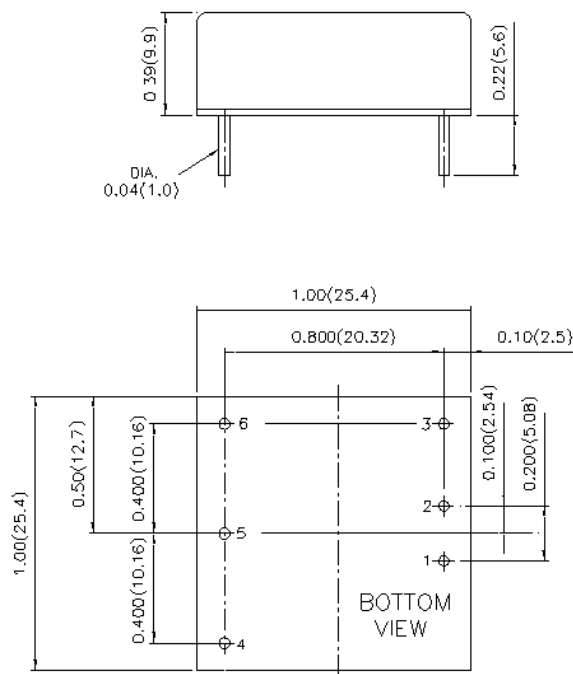


When THN 20WI module is turned on at Low-level logic



When THN 20WI module is turned off at High-level logic

Mechanical Data



| PIN CONNECTION |                 |
|----------------|-----------------|
| PIN            | THN 20WI SERIES |
| 1              | + INPUT         |
| 2              | - INPUT         |
| 3              | ON/OFF          |
| 4              | +VOUT           |
| 5              | TRIM            |
| 6              | -VOUT           |

- 1. All dimensions in Inches (mm)  
Tolerance: X.XX±0.02 (X.X±0.5)  
X.XXX±0.01 (X.XX±0.25)
- 2. Pin pitch tolerance ±0.01(0.25)
- 3. Pin dimension tolerance ±0.004 (0.1)

**EXTERNAL OUTPUT TRIMMING**

Output can be externally trimmed by using the method shown below.

TRIM UP

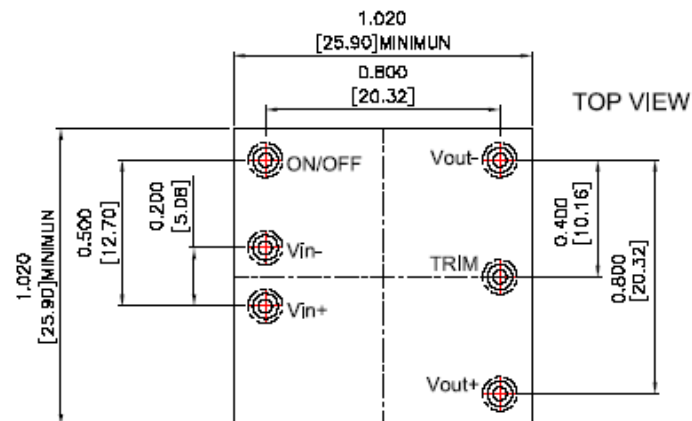
TRIM DOWN

| PRODUCT STANDARD TABLE                  |        |
|-----------------------------------------|--------|
| Option                                  | Suffix |
| Positive remote ON/OFF (Standard)       |        |
| Negative remote ON/OFF                  | -N     |
| Without ON/OFF pin                      | -B     |
| Negative remote ON/OFF without TRIM pin | -C     |
| Without ON/OFF & TRIM pin               | -D     |
| Positive remote ON/OFF without TRIM pin | -E     |

## Recommended Pad Layout

**Recommended Pad Layout**

ALL Dimensions in inches (millimeters)

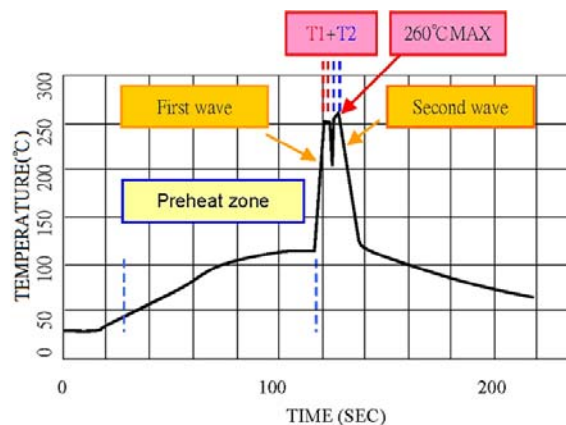
Tolerances:xx.xxx in  $\pm 0.010$  in (xx.xx mm $\pm 0.25$ mm)

PAD SIZE (LEAD FREE RECOMMENDED)

PIN THROUGH HOLE:  $\phi$  0.047in(1.2mm)TOP VIEW PAD:  $\phi$  0.079in(2.0mm)BOTTOM VIEW PAD:  $\phi$  0.118in(3.0mm)

## Soldering Considerations

Lead free wave solder profile for THN 20WI-SERIES



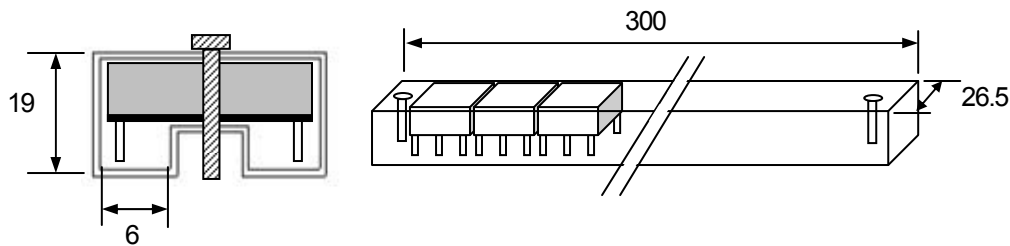
| Zone           | Reference Parameter.                                                   |
|----------------|------------------------------------------------------------------------|
| Preheat zone   | Rise temperature speed: 3°C/sec max.<br>Preheat temperature: 100~130°C |
| Actual heating | Peak temperature: 250~260°C<br>Peak time (T1+T2 time): 4~6 sec         |

**Reference Solder:** Sn-Ag-Cu; Sn-Cu**Hand Welding:** Soldering iron: Power 90W

Welding Time: 2~4 sec

Temperature: 380~400 °C

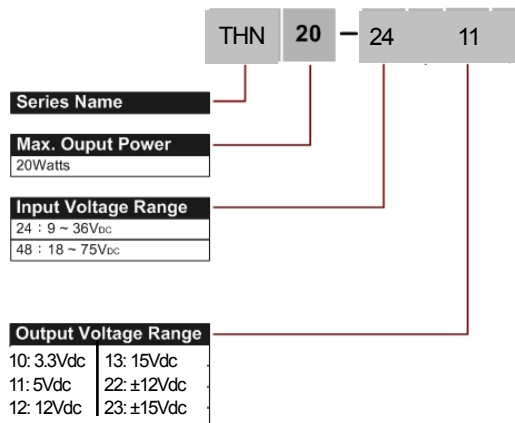
## Packaging Information



All dimensions in millimeters

10 PCS per TUBE

## Part Number Structure



| Model Number  | Input Range | Output Voltage | Output Current | No Load <sup>(1)</sup><br>Input Current | Efficiency <sup>(2)</sup><br>(%) |
|---------------|-------------|----------------|----------------|-----------------------------------------|----------------------------------|
|               |             |                | Full Load      |                                         |                                  |
| THN 20-2410WI | 9 – 36Vdc   | 3.3Vdc         | 4500mA         | 6mA                                     | 86                               |
| THN 20-2411WI | 9 – 36Vdc   | 5Vdc           | 4000mA         | 6mA                                     | 89                               |
| THN 20-2412WI | 9 – 36Vdc   | 12Vdc          | 1670mA         | 6mA                                     | 89                               |
| THN 20-2413WI | 9 – 36Vdc   | 15Vdc          | 1330mA         | 6mA                                     | 89                               |
| THN 20-2422WI | 9 – 36Vdc   | ±12Vdc         | ±833mA         | 6mA                                     | 89                               |
| THN 20-2423WI | 9 – 36Vdc   | ±15Vdc         | ±667mA         | 6mA                                     | 90                               |
| THN 20-4810WI | 18 – 75Vdc  | 3.3Vdc         | 4500mA         | 6mA                                     | 87                               |
| THN 20-4811WI | 18 – 75Vdc  | 5Vdc           | 4000mA         | 6mA                                     | 89                               |
| THN 20-4812WI | 18 – 75Vdc  | 12Vdc          | 1670mA         | 6mA                                     | 89                               |
| THN 20-4813WI | 18 – 75Vdc  | 15Vdc          | 1330mA         | 6mA                                     | 90                               |
| THN 20-4822WI | 18 – 75Vdc  | ±12Vdc         | ±833mA         | 6mA                                     | 89                               |
| THN 20-4823WI | 18 – 75Vdc  | ±15Vdc         | ±667mA         | 6mA                                     | 90                               |

Note 1. Typical value at nominal input voltage and no load.

Note 2. Typical value at nominal input voltage and full load.

## Safety and Installation Instruction

### Fusing Consideration

Caution: This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a slow-blow fuse with maximum rating of 4A for THN 20-24xxWI modules and 2A for THN 20-48xxWI modules. Based on the information provided in this data sheet on Inrush energy and maximum DC input current; the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

## MTBF and Reliability

### The MTBF of THN 20WI SERIES of DC/DC converters has been calculated using

Bellcore TR-NWT-000332 Case I: 50% stress, Operating Temperature at 40°C (Ground fixed and controlled environment). The resulting figure for MTBF is 1'766'000 hours.

MIL-HDBK 217F NOTICE2 FULL LOAD, Operating Temperature at 25°C. The resulting figure for MTBF is 553'000 hours.