

# CXE15 48V SERIES

## Single output



High efficiency topology, 87% typical at 5V

Industry standard footprint

Wide operating temperature, up to and exceeding +70°C (natural convection)

90% to 110% output trim

No minimum load

Overvoltage protection

Remote on/off

Approvals to EN60950 and UL/cUL1950

Complies with ETS 300 019-1-3/2-3

Complies with ETS 300 132-2 (input voltage and current requirements)

Complies with ETS 300 386-1

The CXE15 is a new high efficiency open frame isolated 15 Watt converter series in an industry standard footprint. The first four models in the series feature an input voltage range of 33 to 75VDC and are available in output voltages of 5V, 3.3V, 2.5V and 1.8V. The output voltage on each model is adjustable from 90% to 110% of the nominal value. Typical efficiencies for the models are 87% for the 5V, 86% for the 3.3V, 85% for the 2.5V and 83% for the 1.8V version. The CXE15 series also has a remote on/off capability, with active 'HI' or active 'LO' logic options available. Overcurrent and overvoltage

protection features are included as standard. With full international safety approval including EN60950 and cUL1950, the CXE15 reduces compliance costs and time to market.

[ 2 YEAR WARRANTY ]

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Stresses in excess of the maximum ratings can cause permanent damage to the device. Operation of the device is not implied at these or any other conditions in excess of those given in the specification. Exposure to absolute maximum ratings can adversely affect device reliability.

**Absolute Maximum Ratings**

| Characteristic             | Symbol          | Min  | Typ | Max  | Units | Notes and Conditions                             |
|----------------------------|-----------------|------|-----|------|-------|--------------------------------------------------|
| Input voltage - continuous | $V_{in} (cont)$ | -0.3 |     | 75   | V DC  | $V_{in(+)} - V_{in(-)}$                          |
| Input voltage - peak/surge | $V_{surge}$     | -0.3 |     | 80   | V DC  | 2s max, non-repetitive                           |
| Operating temperature      | $T_{op}$        | -40  |     | 115  | °C    | Measured at thermal reference points, see Note 1 |
| Storage temperature        | $T_{storage}$   | -40  |     | 120  | °C    |                                                  |
| Output power (1.8V)        | $P_{out} (max)$ |      |     | 10.8 | W     |                                                  |
| Output power (2.5V)        | $P_{out} (max)$ |      |     | 15   | W     |                                                  |
| Output power (3.3V)        | $P_{out} (max)$ |      |     | 15   | W     |                                                  |
| Output power (5V)          | $P_{out} (max)$ |      |     | 15   | W     |                                                  |

All specifications are typical at nominal input  $V_{in} = 48V$ , full load under any resistive load combination at 25°C unless otherwise stated.

**Input Characteristics**

| Characteristic            | Symbol          | Min | Typ  | Max | Units      | Notes and Conditions                                     |
|---------------------------|-----------------|-----|------|-----|------------|----------------------------------------------------------|
| Input voltage - operating | $V_{in} (oper)$ | 33  | 48   | 75  | V DC       |                                                          |
| Input current - no load   | $I_{in}$        |     | 28   | 35  | mADC       | $V_{in} (min) - V_{in} (max)$ , enabled                  |
| Input current - Quiescent | $I_{in} (off)$  |     | 20   | 25  | mADC       | Converter disabled                                       |
| Input voltage variation   | $dv/dt$         |     |      | 5   | V/ms       | Complies with ETS300 132 Part 4.4                        |
| Inrush current ( $i^2t$ ) | $I_{inrush}$    |     | 300  |     | $\mu A^2s$ | Complies with ETS300 132 Part 4.7, with recommended LISN |
| Inrush current ratio      | $I_t/I_m$       |     | 19.5 |     |            | Complies with ETS300 132 Part 4.7, with recommended LISN |
| Input ripple rejection    |                 |     | 45   |     | dB         | Frequency <1 kHz                                         |
| Input fuse                |                 |     |      | 2   | A          | Slowblow/ant surge HRC recommended, 200V rating          |

**Turn On/Off**

| Characteristic                              | Symbol               | Min | Typ | Max | Units | Notes and Conditions                                                                                                                                                                       |
|---------------------------------------------|----------------------|-----|-----|-----|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input voltage - turn on                     | $V_{in} (on)$        | 30  | 33  | 36  | V DC  |                                                                                                                                                                                            |
| Input voltage - turn off                    | $V_{in} (off)$       | 27  | 30  | 33  | V DC  |                                                                                                                                                                                            |
| Hysteresis                                  |                      |     | 3   |     | V DC  |                                                                                                                                                                                            |
| Turn on delay - enabled, then power applied | $T_{delay} (power)$  |     | 1.5 | 4   | msec  | With the enable signal asserted, this is the time from when the input voltage reaches the minimum specified operating voltage until the output voltage is within the total regulation band |
| Turn on delay - power applied, then enabled | $T_{delay} (enable)$ |     | 2.5 | 4   | msec  | $V_{in} = V_{in} (nom)$ , then enabled. This is the time taken until the output voltage is within the total error band                                                                     |
| Rise time                                   | $T_{rise}$           |     | 0.6 | 1   | msec  | From 10% to 90%; full resistive load, no external capacitance                                                                                                                              |

**Signal Electrical Interface**

| Characteristic - Signal Name                                                                                                                                                                                                                                                         | Symbol                                                                                               | Min                   | Typ                            | Max                                            | Units                                                | Notes and Conditions                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------|------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>At remote/control ON/OFF pin</b><br>Open collector or equivalent compatible<br>Control pin open circuit voltage<br>High level input current<br><br>Acceptable high level leakage current<br><br>Low level input voltage<br><br>Low level input current<br>Low level input current | <br>$V_{ih}$<br>$I_{ih}$<br><br>$I_{ih}$ (leakage)<br><br>$V_{il}$<br><br>$I_{il}$<br>$I_{il}$ (max) | <br><br><br><br><br>0 | <br>12<br><br><br><br><br>-1.4 | <br>13<br>10<br><br>-50<br><br>1.2<br><br>-1.5 | <br>V<br>$\mu$ A<br><br>$\mu$ A<br><br>V<br>mA<br>mA | <b>See Notes 2 and 3</b><br>See Application Note 116 for Remote On/Off details<br>$I_{ih} = 0 \mu$ A; open circuit voltage<br>Current flowing into control pin when pin is pulled high (max. at $V_{ih} = 75$ V)<br>Acceptable leakage current from signal pin into the open collector driver (neg = from converter)<br>Converter guaranteed off when control pin is less than $V_{il}$ (max)<br>$V_{il} = 0.4$ V<br>$V_{il} = 0.0$ V; |

**Reliability and Service Life**

| Characteristic            | Symbol | Min       | Typ | Max | Units | Notes and Conditions                                                                                                |
|---------------------------|--------|-----------|-----|-----|-------|---------------------------------------------------------------------------------------------------------------------|
| Mean time between failure | MTBF   | 600,000   |     |     | Hours | MIL-HDBK-217F,<br>$V_{in} = V_{in}$ (nom); $I_{out} = I_{out}$ (max); ambient 25°C; ground benign environment       |
| Mean time between failure | MTBF   | 1,000,000 |     |     | Hours | per Bellcore TR-NWT-000332 Issue 3, ground benign, temp. = 40°C, $V_{in} = V_{in}$ (nom), $I_{out} = I_{out}$ (max) |
| Mean time between failure | MTBF   | TBD       |     |     | Hours | Demonstrated. This entry will be periodically updated as the number of test hours increase                          |
| Expected service life     |        |           |     |     | Years |                                                                                                                     |

**Isolation**

| Characteristic                    | Symbol | Min | Typ         | Max  | Units      | Notes and Conditions   |
|-----------------------------------|--------|-----|-------------|------|------------|------------------------|
| Input to output test voltage      |        |     |             | 1500 | V DC       | Test duration 1s       |
| Input to output capacitance       |        |     | 1000        |      | pF         |                        |
| Input to output resistance        |        | 100 |             |      | M $\Omega$ | Measured with 500 V DC |
| Input to output insulation system |        |     | Operational |      |            |                        |

## Other Specifications

| Characteristic      | Symbol          | Min | Typ | Max | Units | Notes and Conditions |
|---------------------|-----------------|-----|-----|-----|-------|----------------------|
| Switching frequency | F <sub>SW</sub> |     | 265 |     | kHz   | Fixed frequency      |
| Weight              |                 |     | 12  |     | g     |                      |

## Environmental Specifications

| Characteristic                                                 | Symbol             | Min         | Typ | Max            | Units    | Notes and Conditions                                                                                                                         |
|----------------------------------------------------------------|--------------------|-------------|-----|----------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Thermal performance<br>1V8 and 2V5 models<br>3V5 and 5V models |                    | -40<br>-40  |     | 70<br>65       | °C<br>°C | See Notes 1, 4 and<br>individual derating curves                                                                                             |
| Type                                                           | Parameter          | Reference   |     | Test Level     |          | Notes and Conditions                                                                                                                         |
| Air temperature                                                | Low                | IEC 68-2-1  |     | -40°C          |          | All characteristics and parameters<br>extracted from ETS 300 019<br>classes 3.1, 3.2, 3.3, 3.4 and 3.5<br>T <sub>max.</sub> = +70°C for T3.4 |
|                                                                | High               | IEC 68-2-2  |     | +70°C          |          |                                                                                                                                              |
|                                                                | Change             | IEC 68-2-14 |     | -40°C to +70°C |          |                                                                                                                                              |
| Relative humidity                                              | Low                | -           |     | 10%            |          |                                                                                                                                              |
|                                                                | High               | IEC 68-2-56 |     | 100%           |          |                                                                                                                                              |
|                                                                | Condensation       | IEC 68-2-30 |     | 90 to 100%     |          |                                                                                                                                              |
| Vibration IEC Class 3M5                                        | Freq. velocity     | IEC 68-2-6  |     | 5-9Hz 5mm/s    |          |                                                                                                                                              |
|                                                                | Freq. acceleration | IEC 68-2-6  |     | 9-200Hz 1g     |          |                                                                                                                                              |
| Shocks IEC Class 3M5                                           | Acceleration       | IEC 68-2-29 |     | 10g            |          |                                                                                                                                              |

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## Referenced ETSI standards:

ETS 300 019: Environmental conditions and environmental tests for telecommunications equipment  
ETS 300 019: Part 1-3 (1997) Classification of environmental conditions stationary use at weather protected locations  
ETS 300 019: Part 2-3 (1997) Specification of environmental tests stationary use at weather protected locations

## EMC

## Electromagnetic Compatibility

| Phenomenon       | Port      | Standard    | Test level             | Criteria | Notes and conditions               |
|------------------|-----------|-------------|------------------------|----------|------------------------------------|
| <b>Immunity:</b> |           |             |                        |          |                                    |
| ESD              | Enclosure | EN61000-4-2 | 6kV contact<br>8kV air |          | As per ETS 300 386-1 table 5       |
| EFT              | DC power  | EN61000-4-4 | 2kV<br>4kV             |          | As per ETS 300 386-1 table 5       |
|                  | Signal    | EN61000-4-4 | 1kV<br>2kV             |          | As per ETS 300 386-1 table 5       |
| Radiated field   | Enclosure | EN61000-4-3 | 10V/m                  |          | As per ETS 300 386-1 table 5       |
| Conducted        | DC power  | EN61000-4-6 | 10V                    |          | As per ETS 300 386-1 table 5       |
|                  | Signal    | EN61000-4-6 | 10V                    |          | Signal line assumed < 3m in length |
| Input transients | DC power  |             |                        |          | ETS 300 132, ETR 283               |

### EMC Electromagnetic Compatibility

| Phenomenon                        | Port     | Standard | Test level | Criteria | Notes and conditions                                                                                                                   |
|-----------------------------------|----------|----------|------------|----------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Emission:</b><br><br>Conducted | DC power | EN55022  | Level A    |          | With recommended external filter for compliance bandwidth 20 kHz to 30 MHz, as per ETS 300 386-1. See Application Note 116 for details |
|                                   |          | EN55022  | Level B    |          | With recommended external filter for compliance bandwidth 20 kHz to 30 MHz, as per ETS 300 386-1. See Application Note 116 for details |
|                                   | Signal   | EN55022  | Level B    |          | Bandwidth 150kHz to 30MHz, as per ETS 300 386-1                                                                                        |
| Radiated                          |          | EN55022  | Level B    |          | Bandwidth 30 MHz to 1 GHz, as per ETS 300 386-1                                                                                        |

### Performance criteria:

NP: Normal Performance: EUT shall withstand applied test and operate within relevant limits as specified without damage.

RP: Reduced Performance: EUT shall withstand applied test. Reduced performance is permitted within specified limits, resumption to normal performance shall occur at the cessation of the test.

LFS: Loss of Function (self recovery): EUT shall withstand applied test without damage, temporary loss of function permitted during test. Unit will self recover to normal performance after test.

### Referenced ETSI standards:

ETS 300 386-1 table 5 (1997): Public telecommunication network equipment, EMC requirements

ETS 300 132-2 (1996): Power supply interface at the input to telecommunication equipment: Part 2 operated by direct current (DC)

ETR 283 (1997): Transient voltages at interface A on telecommunication direct current (DC) power distributions

### Standards Compliance List

| Standard      | Category     |
|---------------|--------------|
| EN60950       | 2000         |
| UL/cUL 1950   | 3rd edition  |
| TÜV Rheinland | EN60950:2000 |

### Safety Agency Approvals

| Characteristic                |          |
|-------------------------------|----------|
| UL/cUL 1950 File Number       | E135734  |
| TÜV Rheinland Certificate No. | R2074133 |

### Material Ratings

| Characteristic - Signal Name | Notes and Conditions |
|------------------------------|----------------------|
| Flammability rating          | UL94V-0              |
| Material type                | FR4 PCB              |

### Model Numbers

| Model Number | Input Voltage | Output Voltage | Overvoltage Protection | Output Current (Max.) | Typical Efficiency | Max. Load Regulation |
|--------------|---------------|----------------|------------------------|-----------------------|--------------------|----------------------|
| CXE15-48S1V8 | 33-75 VDC     | 1.8V           | 2.3V                   | 6.0A                  | 83%                | 2.0%                 |
| CXE15-48S2V5 | 33-75 VDC     | 2.5V           | 3.2V                   | 6.0A                  | 85%                | 1.5%                 |
| CXE15-48S3V3 | 33-75 VDC     | 3.3V           | 4.0V                   | 4.5A                  | 86%                | 0.5%                 |
| CXE15-48S05  | 33-75 VDC     | 5.0V           | 6.0V                   | 3.0A                  | 87%                | 0.5%                 |

## CXE15-48S1V8 Model

## Input Characteristics

| Characteristic                      | Symbol            | Min | Typ      | Max   | Units              | Notes and Conditions                                                                             |
|-------------------------------------|-------------------|-----|----------|-------|--------------------|--------------------------------------------------------------------------------------------------|
| Input current - operating           | $I_{in}$          |     | 0.271    | 0.274 | A DC               | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                         |
| Input current - maximum             | $I_{in} (max.)$   |     | 0.399    | 0.404 | A DC               | $V_{in} = V_{in} (min)$ ; $I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$ (measured at converter) |
| Reflected ripple current            | $I_{in} (ripple)$ |     | 1.8<br>5 |       | mA RMS<br>mA pk-pk | $I_{out} = I_{out} (max.)$ , measured with external filter. See Application Note 116 for details |
| Input capacitance - internal filter | $C_{input}$       |     | 1.5      |       | $\mu F$            | Internal to converter                                                                            |
| Input capacitance - external bypass | $C_{bypass}$      | 0   |          |       | $\mu F$            | Recommended customer added capacitance                                                           |

## CXE15-48S1V8 Model

## Electrical Characteristics - O/P

| Characteristic                 | Symbol                 | Min  | Typ      | Max      | Units              | Notes and Conditions                                                                                              |
|--------------------------------|------------------------|------|----------|----------|--------------------|-------------------------------------------------------------------------------------------------------------------|
| Nominal set-point voltage      | $V_o (nom)$            | 1.76 | 1.80     | 1.84     | V DC               | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (nom)$<br>Worst case condition over line, load, temperature and life |
| Total regulation band          | $V_o$                  | 1.74 |          | 1.86     | V DC               | For all line, static load and temperature until end of life.                                                      |
| Line regulation                |                        |      |          | 0.5      | %                  | $I_{out} = I_{out} (nom)$ ; $V_{in} (min)$ to $V_{in} (max)$                                                      |
| Load regulation                |                        |      |          | 2.0      | %                  | $V_{in} = V_{in} (nom)$ ; $I_{out} (min)$ to $I_{out} (max)$                                                      |
| Output current continuous      | $I_{out}$              | 0.00 |          | 6.0      | A DC               |                                                                                                                   |
| Output current - short circuit | $I_{sc}$               |      | 10       | 12       | A rms              | Continuous, unit auto recovers from short, $V_o < 100mV$                                                          |
| Output voltage - noise         | $V_{p-p}$<br>$V_{rms}$ |      | 40<br>14 | 70<br>20 | mV pk-pk<br>mV rms | Measurement bandwidth 20 MHz<br>See Application Note 116 for measurement set-up details                           |

## CXE15-48S1V8 Model

## Electrical Characteristics - O/P

| Characteristic                           | Symbol         | Min | Typ | Max    | Units     | Notes and Conditions                                                            |
|------------------------------------------|----------------|-----|-----|--------|-----------|---------------------------------------------------------------------------------|
| Load transient response - peak deviation | $V_{dynamic}$  |     | 150 |        | mV        | Peak deviation for 50% to 75% step load, $di/dt = 100mA/\mu sec$                |
| Load transient response - recovery       | $T_{recovery}$ |     | 400 |        | $\mu sec$ | Settling time to within 1% of output set point voltage for 50% to 75% step load |
| External load capacitance                | $C_{ext}$      | 0   |     | 10,000 | $\mu F$   |                                                                                 |

## CXE15-48S1V8 Model

## Protection and Control Features

| Characteristic              | Symbol   | Min | Typ | Max | Units | Notes and Conditions                                                   |
|-----------------------------|----------|-----|-----|-----|-------|------------------------------------------------------------------------|
| Overvoltage clamp voltage   | $V_{ov}$ | 2.2 |     | 3.0 | V DC  | Non-latching. Refer to Application Note 116 for details                |
| Overcurrent limit inception | $I_{oc}$ |     | 7.5 | 8.4 | A DC  | $V_o = 90\%$ of $V_o (nom)$                                            |
| Output voltage trim range   |          | 90  |     | 110 | %     | Trim up (% of $V_o (nom)$ )                                            |
|                             |          |     |     |     | %     | Trim down (% of $V_o (nom)$ )                                          |
|                             |          |     |     |     |       | See Application Note 116 for details of trim equations and trim curves |
| Open sense voltage          |          |     |     |     | V DC  | No sense option                                                        |

## CXE15-48S1V8 Model

## Efficiency

| Characteristic | Symbol | Min | Typ | Max | Units | Notes and Conditions                                         |
|----------------|--------|-----|-----|-----|-------|--------------------------------------------------------------|
| Efficiency     | $\eta$ | 82  | 83  |     | %     | $I_{out} = 100\% I_{out (max)}$ ,<br>$V_{in} = V_{in (nom)}$ |
| Efficiency     | $\eta$ | 78  | 80  |     | %     | $I_{out} = 50\% I_{out (max)}$ ,<br>$V_{in} = V_{in (nom)}$  |

## CXE15-48S2V5 Model

## Input Characteristics

| Characteristic                         | Symbol            | Min | Typ      | Max   | Units              | Notes and Conditions                                                                               |
|----------------------------------------|-------------------|-----|----------|-------|--------------------|----------------------------------------------------------------------------------------------------|
| Input current - operating              | $I_{in}$          |     | 0.367    | 0.372 | ADC                | $V_{in} = V_{in} (nom)$ ;<br>$I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                        |
| Input current - maximum                | $I_{in} (max.)$   |     | 0.541    | 0.548 | ADC                | $V_{in} = V_{in} (min)$ ;<br>$I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                        |
| Reflected ripple current               | $I_{in} (ripple)$ |     | 1.8<br>5 |       | mA RMS<br>mA pk-pk | $I_{out} = I_{out} (max.)$ , measured<br>with external filter. See<br>Application Note 116 details |
| Input capacitance -<br>internal filter | $C_{input}$       |     | 1.5      |       | $\mu F$            | Internal to converter                                                                              |
| Input capacitance -<br>External bypass | $C_{bypass}$      | 0   |          |       | $\mu F$            | Recommended customer<br>added capacitance                                                          |

## CXE15-48S2V5 Model

## Electrical Characteristics - O/P

| Characteristic                 | Symbol                 | Min  | Typ      | Max      | Units              | Notes and Conditions                                                                                                 |
|--------------------------------|------------------------|------|----------|----------|--------------------|----------------------------------------------------------------------------------------------------------------------|
| Nominal set-point voltage      | $V_o (nom.)$           | 2.44 | 2.50     | 2.56     | VDC                | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (nom)$<br>Worst case condition over line,<br>load, temperature and life |
| Total regulation band          | $V_o$                  | 2.42 |          | 2.58     | VDC                | For all line, static load and<br>temperature until end of life                                                       |
| Line regulation                |                        |      |          | 0.5      | %                  | $I_{out} = I_{out} (nom)$ ;<br>$V_{in} (min)$ to $V_{in} (max)$                                                      |
| Load regulation                |                        |      |          | 1.5      | %                  | $V_{in} = V_{in} (nom)$ ;<br>$I_{out} (min)$ to $I_{out} (max)$                                                      |
| Output current continuous      | $I_{out}$              | 0.00 |          | 6        | ADC                |                                                                                                                      |
| Output current - short circuit | $I_{sc}$               |      | 10       | 12       | A RMS              | Continuous, unit auto recovers<br>from short, $V_o < 100mV$                                                          |
| Output voltage - noise         | $V_{p-p}$<br>$V_{rms}$ |      | 40<br>14 | 70<br>20 | mV pk-pk<br>mV rms | Measurement bandwidth 20 MHz<br>See Application Note 116 for<br>set-up details                                       |



## CXE15-48S2V5 Model

## Electrical Characteristics - O/P

| Characteristic                           | Symbol         | Min | Typ | Max    | Units           | Notes and Conditions                                                            |
|------------------------------------------|----------------|-----|-----|--------|-----------------|---------------------------------------------------------------------------------|
| Load transient response - peak deviation | $V_{dynamic}$  |     | 150 |        | mV              | Peak deviation for 50% to 75% step load, $di/dt = 100 \text{ mA}/\mu\text{sec}$ |
| Load transient response - recovery       | $T_{recovery}$ |     | 400 |        | $\mu\text{sec}$ | Settling time to within 1% of output set point voltage for 50% to 75% step load |
| External load capacitance                | $C_{ext}$      | 0   |     | 10,000 | $\mu\text{F}$   |                                                                                 |

## CXE15-48S2V5 Model

## Protection and Control Features

| Characteristic                      | Symbol   | Min | Typ | Max  | Units | Notes and Conditions                                                                                                              |
|-------------------------------------|----------|-----|-----|------|-------|-----------------------------------------------------------------------------------------------------------------------------------|
| Overvoltage clamp voltage           | $V_{OV}$ | 2.7 |     | 3.75 | V DC  | Non-latching<br>Refer to Application Note 116                                                                                     |
| Overcurrent limit inception         | $I_{OC}$ |     | 7.5 | 8.4  | A DC  | $V_O = 90\%$ of $V_O(\text{nom})$                                                                                                 |
| Allowable output voltage trim range |          | 90  |     | 110  | %     | Trim up (% of $V_O(\text{nom})$ ). Note that the maximum output power is still 15W. Derate the maximum output current accordingly |
|                                     |          |     |     |      | %     | Trim down (% of $V_O(\text{nom})$ )<br>See Application Note 116 for details of trim equations and trim curves                     |
| Open sense voltage                  |          |     |     |      | V DC  | No sense function                                                                                                                 |

## CXE15-48S2V5 Model

## Efficiency

| Characteristic | Symbol | Min | Typ | Max | Units | Notes and Conditions                                                     |
|----------------|--------|-----|-----|-----|-------|--------------------------------------------------------------------------|
| Efficiency     | $\eta$ | 84  | 85  |     | %     | $I_{out} = 100\% I_{out}(\text{max})$ ,<br>$V_{in} = V_{in}(\text{nom})$ |
| Efficiency     | $\eta$ | 81  | 83  |     | %     | $I_{out} = 50\% I_{out}(\text{max})$ ,<br>$V_{in} = V_{in}(\text{nom})$  |

## CXE15-48S3V3 Model

## Input Characteristics

| Characteristic                      | Symbol            | Min | Typ      | Max   | Units              | Notes and Conditions                                                                             |
|-------------------------------------|-------------------|-----|----------|-------|--------------------|--------------------------------------------------------------------------------------------------|
| Input current - operating           | $I_{in}$          |     | 0.360    | 0.364 | A DC               | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                         |
| Input current - maximum             | $I_{in} (max.)$   |     | 0.529    | 0.536 | A DC               | $V_{in} = V_{in} (min)$ ; $I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$ (measured at converter) |
| Reflected ripple current            | $I_{in} (ripple)$ |     | 1.8<br>5 |       | mA RMS<br>mA pk-pk | $I_{out} = I_{out} (max.)$ , measured with external filter. See Application Note 116 details     |
| Input capacitance - internal filter | $C_{input}$       |     | 1.5      |       | $\mu F$            | Internal to converter                                                                            |
| Input capacitance - external bypass | $C_{bypass}$      | 0   |          |       | $\mu F$            | Recommended customer added capacitance                                                           |

## CXE15-48S3V3 Model

## Electrical Characteristics - O/P

| Characteristic                 | Symbol                 | Min  | Typ      | Max       | Units              | Notes and Conditions                                                                                              |
|--------------------------------|------------------------|------|----------|-----------|--------------------|-------------------------------------------------------------------------------------------------------------------|
| Nominal set-point voltage      | $V_o (nom)$            | 3.24 | 3.30     | 3.38      | V DC               | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (nom)$<br>Worst case condition over line, load, temperature and life |
| Total regulation band          | $V_o$                  | 3.19 |          | 3.41      | V DC               | For all line, static load and temperature until end of life                                                       |
| Line regulation                |                        |      |          | 0.10      | %                  | $I_{out} = I_{out} (nom)$ ; $V_{in} (min)$ to $V_{in} (max)$                                                      |
| Load regulation                |                        |      |          | 0.50      | %                  | $V_{in} = V_{in} (nom)$ ; $I_{out} (min)$ to $I_{out} (max)$                                                      |
| Output current continuous      | $I_{out}$              | 0.00 |          | 4.5       | A DC               |                                                                                                                   |
| Output current - short circuit | $I_{sc}$               |      | 8.0      | 10        | A rms              | Continuous, unit auto recovers from short, $V_o < 100mV$                                                          |
| Output voltage - noise         | $V_{p-p}$<br>$V_{rms}$ |      | 70<br>20 | 100<br>35 | mV pk-pk<br>mV rms | Measurement bandwidth: 20 MHz. See Application Note 116 for measurement set-up details                            |

## CXE15-48S3V3 Model

## Electrical Characteristics - O/P

| Characteristic                           | Symbol         | Min | Typ | Max    | Units           | Notes and Conditions                                                            |
|------------------------------------------|----------------|-----|-----|--------|-----------------|---------------------------------------------------------------------------------|
| Load transient response - peak deviation | $V_{dynamic}$  |     | 100 |        | mV              | Peak deviation for 50% to 75% step load, $di/dt = 100 \text{ mA}/\mu\text{sec}$ |
| Load transient response - recovery       | $T_{recovery}$ |     | 400 |        | $\mu\text{sec}$ | Settling time to within 1% of output set point voltage for 50% to 75% step load |
| External load capacitance                | $C_{ext}$      | 0   |     | 10,000 | $\mu\text{F}$   |                                                                                 |

## CXE15-48S3V3 Model

## Protection and Control Features

| Characteristic                      | Symbol   | Min | Typ | Max | Units | Notes and Conditions                                                                                                               |
|-------------------------------------|----------|-----|-----|-----|-------|------------------------------------------------------------------------------------------------------------------------------------|
| Overvoltage clamp voltage           | $V_{ov}$ | 3.6 |     | 5.0 | V DC  | Non-latching<br>Refer to Application Note 116                                                                                      |
| Overcurrent limit inception         | $I_{oc}$ |     | 5.6 | 6.3 | A DC  | $V_O = 90\%$ of $V_O (\text{nom})$                                                                                                 |
| Allowable output voltage trim range |          | 90  |     | 110 | %     | Trim up (% of $V_O (\text{nom})$ ). Note that the maximum output power is still 15W. Derate the maximum output current accordingly |
|                                     |          |     |     |     | %     | Trim down (% of $V_O (\text{nom})$ )<br>See Application Note 116 for details of trim equations and trim curves                     |
| Open sense voltage                  |          |     |     |     | V DC  | No sense function                                                                                                                  |

## CXE15-48S3V3 Model

## Efficiency

| Characteristic | Symbol | Min | Typ | Max | Units | Notes and Conditions                                                       |
|----------------|--------|-----|-----|-----|-------|----------------------------------------------------------------------------|
| Efficiency     | $\eta$ | 85  | 86  | -   | %     | $I_{out} = 100\% I_{out} (\text{max})$ ,<br>$V_{in} = V_{in} (\text{nom})$ |
| Efficiency     | $\eta$ | 83  | 85  | -   | %     | $I_{out} = 50\% I_{out} (\text{max})$ ,<br>$V_{in} = V_{in} (\text{nom})$  |

## CXE15-48S05 Model

## Input Characteristics

| Characteristic                         | Symbol                 | Min | Typ        | Max   | Units              | Notes and Conditions                                                                               |
|----------------------------------------|------------------------|-----|------------|-------|--------------------|----------------------------------------------------------------------------------------------------|
| Input current - operating              | $I_{in}$               |     | 0.359      | 0.364 | ADC                | $V_{in} = V_{in} (nom)$ ;<br>$I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                        |
| Input current - maximum                | $I_{in} (max.)$        |     | 0.529      | 0.541 | ADC                | $V_{in} = V_{in} (min)$ ;<br>$I_{out} = I_{out} (max.)$ ; $V_o = V_o (nom)$                        |
| Reflected ripple current               | $I_{in} (ripple)$<br>- |     | 1.4<br>5.0 |       | mA RMS<br>mA pk-pk | $I_{out} = I_{out} (max.)$ , measured<br>with external filter. See<br>Application Note 116 details |
| Input capacitance -<br>internal filter | $C_{input}$            |     | 1.5        |       | $\mu F$            | Internal to converter                                                                              |
| Input capacitance -<br>External bypass | $C_{bypass}$           | 0   |            |       | $\mu F$            | Recommended customer<br>added capacitance                                                          |

## CXE15-48S05 Model

## Electrical Characteristics - O/P

| Characteristic                 | Symbol                 | Min  | Typ      | Max       | Units              | Notes and Conditions                                                                                                 |
|--------------------------------|------------------------|------|----------|-----------|--------------------|----------------------------------------------------------------------------------------------------------------------|
| Nominal set-point voltage      | $V_o (nom.)$           | 4.90 | 5.00     | 5.10      | VDC                | $V_{in} = V_{in} (nom)$ ; $I_{out} = I_{out} (nom)$<br>Worst case condition over line,<br>load, temperature and life |
| Total regulation band          | $V_o$                  | 4.83 |          | 5.17      | VDC                | For all line, static load and<br>temperature until end of life                                                       |
| Line regulation                |                        |      |          | 0.1       | %                  | $I_{out} = I_{out} (nom)$ ;<br>$V_{in} (min)$ to $V_{in} (max)$                                                      |
| Load regulation                |                        |      | 0.3      | 0.5       | %                  | $V_{in} = V_{in} (nom)$ ;<br>$I_{out} (min)$ to $I_{out} (max)$                                                      |
| Output current continuous      | $I_{out}$              | 0.00 |          | 3         | ADC                |                                                                                                                      |
| Output current - short circuit | $I_{sc}$               |      | 5.5      | 7.0       | A RMS              | Continuous, unit auto recovers<br>from short, $V_o < 100mV$                                                          |
| Output voltage - noise         | $V_{p-p}$<br>$V_{rms}$ |      | 70<br>20 | 100<br>35 | mV pk-pk<br>mV rms | Measurement bandwidth 20 MHz<br>See Application Note 116 for<br>set-up details                                       |

## CXE15-48S05 Model

## Electrical Characteristics - O/P

| Characteristic                           | Symbol         | Min | Typ | Max    | Units     | Notes and Conditions                                                            |
|------------------------------------------|----------------|-----|-----|--------|-----------|---------------------------------------------------------------------------------|
| Load transient response - peak deviation | $V_{dynamic}$  |     | 100 |        | mV        | Peak deviation for 50% to 75% step load, $di/dt = 100mA/\mu sec$                |
| Load transient response - recovery       | $T_{recovery}$ |     | 400 |        | $\mu sec$ | Settling time to within 1% of output set point voltage for 50% to 75% step load |
| External load capacitance                | $C_{ext}$      | 0   |     | 10,000 | $\mu F$   |                                                                                 |

## CXE15-48S05 Model

## Protection and Control Features

| Characteristic                      | Symbol   | Min | Typ | Max | Units | Notes and Conditions                                                                                                        |
|-------------------------------------|----------|-----|-----|-----|-------|-----------------------------------------------------------------------------------------------------------------------------|
| Overvoltage clamp voltage           | $V_{OV}$ | 5.5 |     | 7.2 | V DC  | Non-latching<br>Refer to Application Note 116                                                                               |
| Overcurrent limit inception         | $I_{OC}$ |     | 3.7 | 4.2 | A DC  | $V_O = 90\%$ of $V_O (nom)$                                                                                                 |
| Allowable output voltage trim range |          | 90  |     | 110 | %     | Trim up (% of $V_O (nom)$ ). Note that the maximum output power is still 15W. Derate the maximum output current accordingly |
|                                     |          |     |     |     | %     | Trim down (% of $V_O (nom)$ )<br>See Application Note 116 for details of trim equations and trim curves                     |
| Open sense voltage                  |          |     |     |     | V DC  | No sense function                                                                                                           |

## CXE15-48S05 Model

## Efficiency

| Characteristic | Symbol | Min | Typ | Max | Units | Notes and Conditions                                         |
|----------------|--------|-----|-----|-----|-------|--------------------------------------------------------------|
| Efficiency     | $\eta$ | 86  | 87  |     | %     | $I_{out} = 100\% I_{out (max)}$ ,<br>$V_{in} = V_{in (nom)}$ |
| Efficiency     | $\eta$ | 82  | 84  |     | %     | $I_{out} = 50\% I_{out (max)}$ ,<br>$V_{in} = V_{in (nom)}$  |

## CXE15-48S1V8 Model

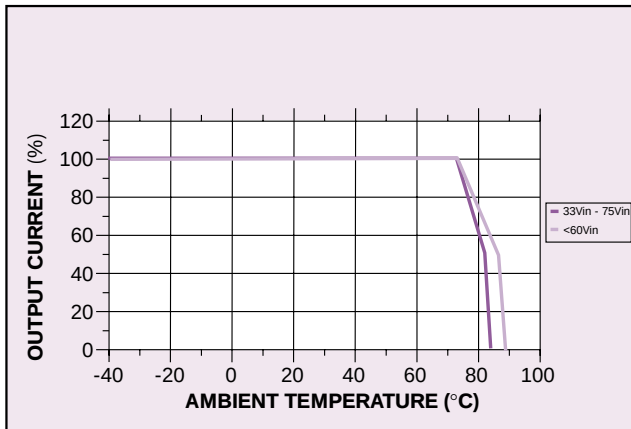


Figure 1: Output Current vs Temperature (Still Air)

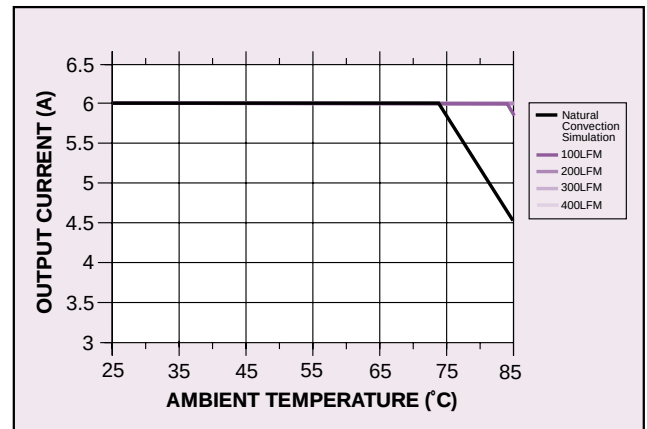


Figure 2: Output Current vs Temperature with Forced Air Cooling

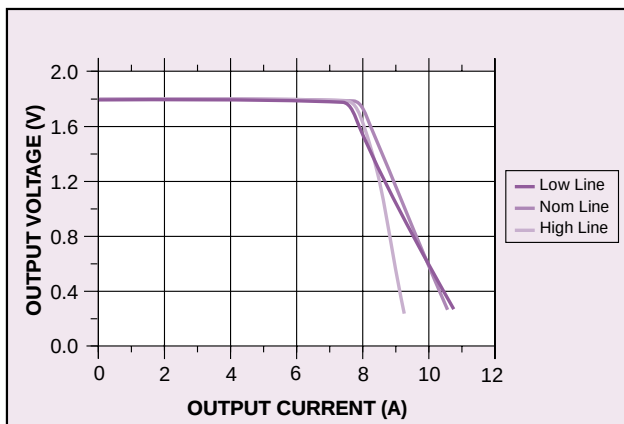


Figure 3: V-1 Characteristic Over Input Line

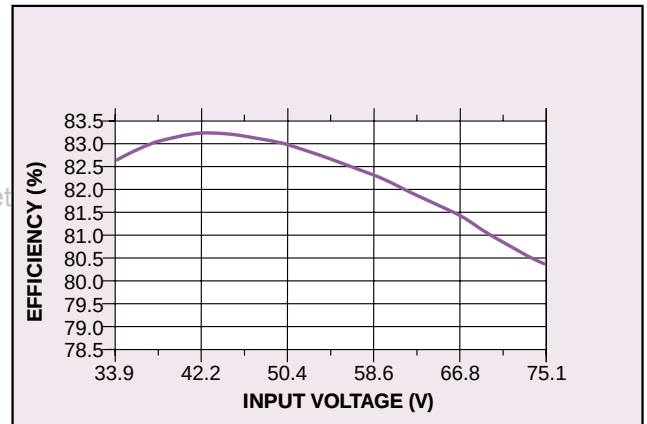


Figure 4: Efficiency vs Line

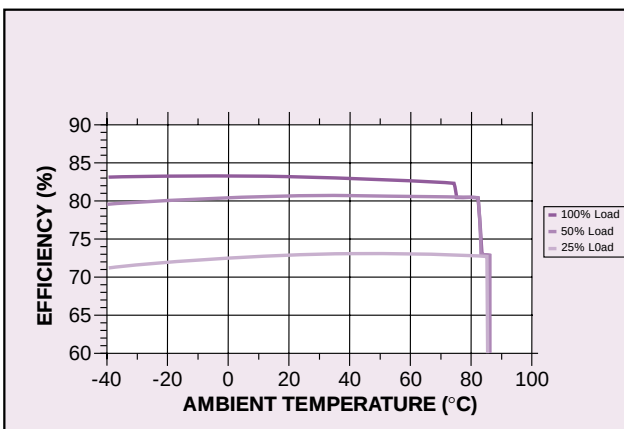


Figure 5: Typical Efficiency vs Ambient Temperature

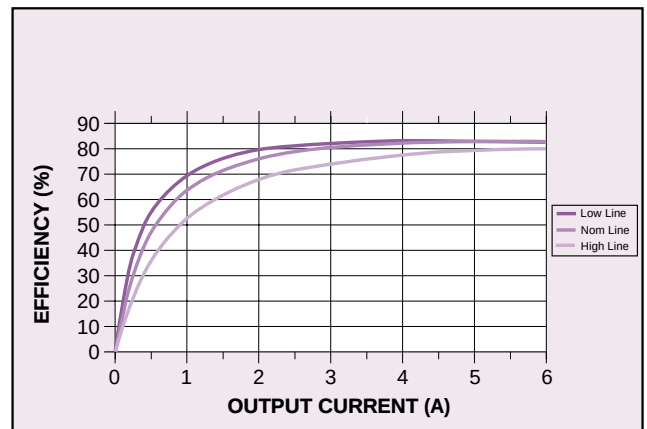


Figure 6: Efficiency vs Load

## CXE15-48S1V8 Model

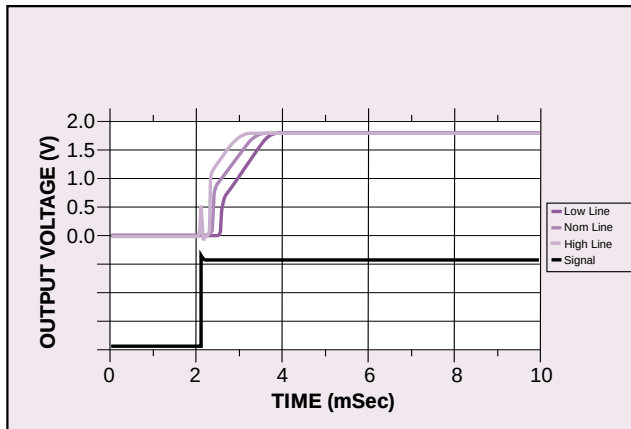


Figure 7: Typical Power-up Characteristic

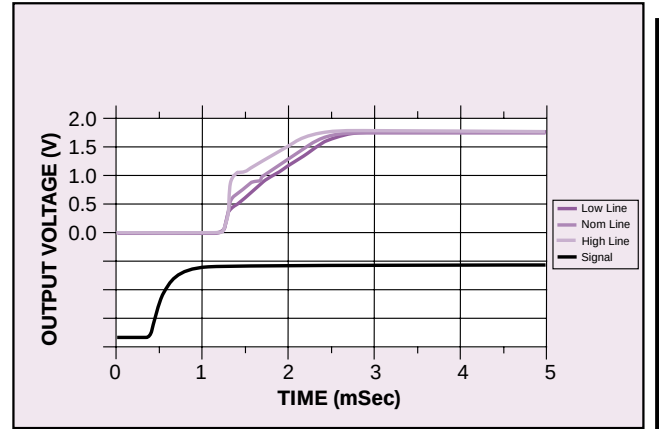


Figure 8: Control On/Off Characteristic

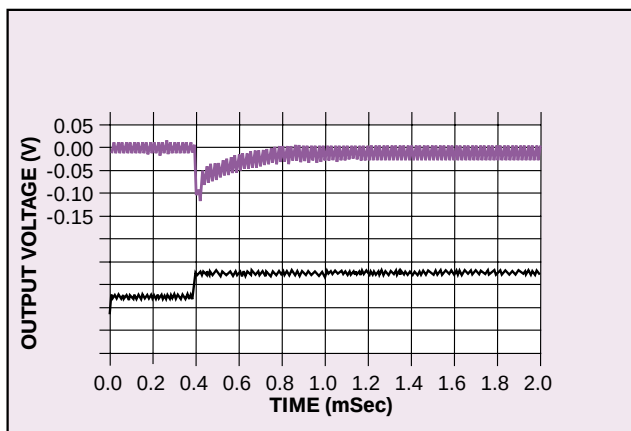


Figure 9: Typical Transient Response 50%-75% Step Load Change

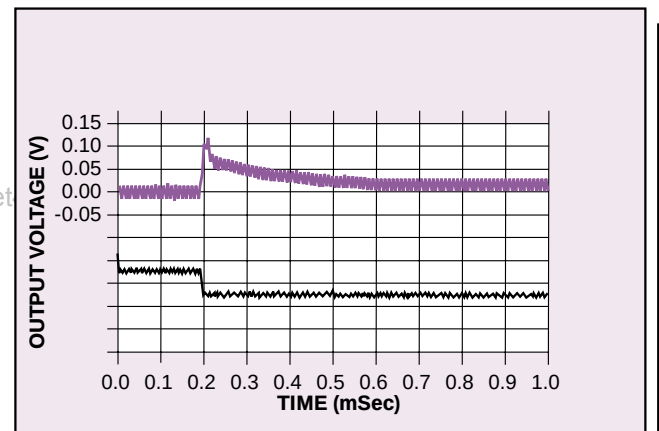


Figure 10: Typical Transient Response 75%-50% Step Load Change

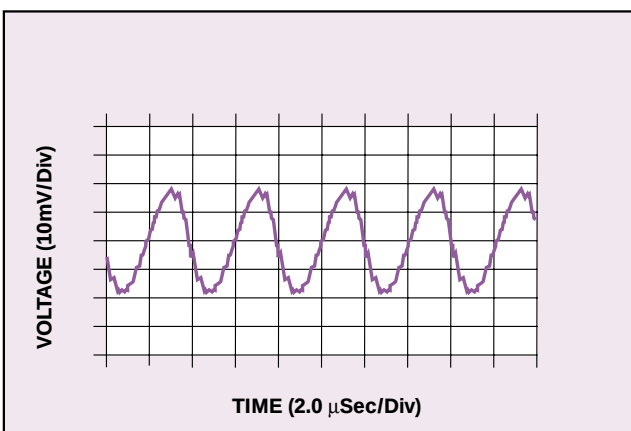


Figure 11: Typical Ripple and Noise Measurement

CXE15-48S2V5 Model

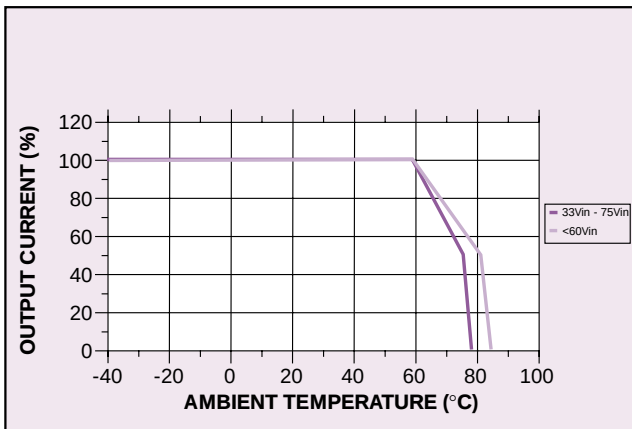


Figure 12: Output Current vs Temperature (Still Air)

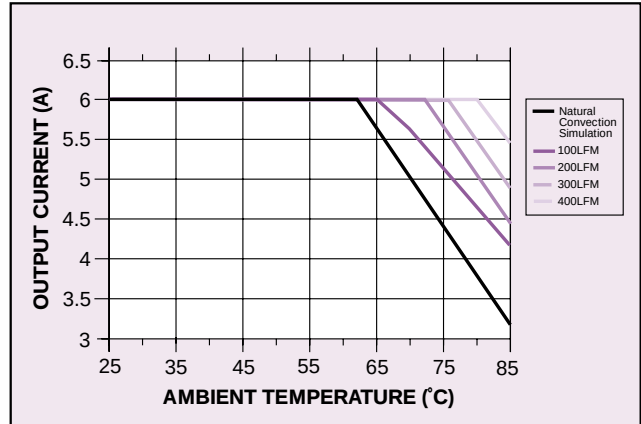


Figure 13: Output Current vs Temperature with Forced Air Cooling

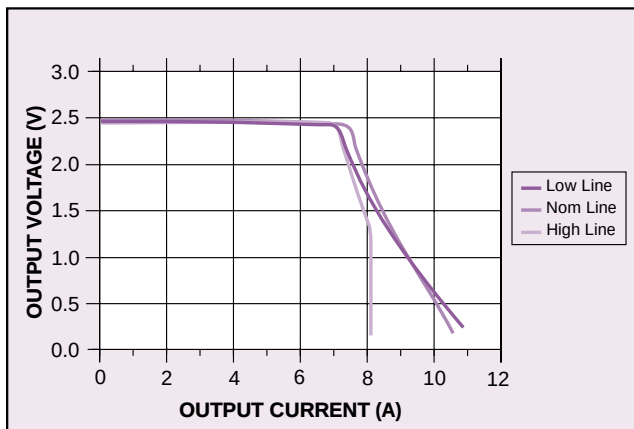


Figure 14: V-I Characteristic Over Input Line

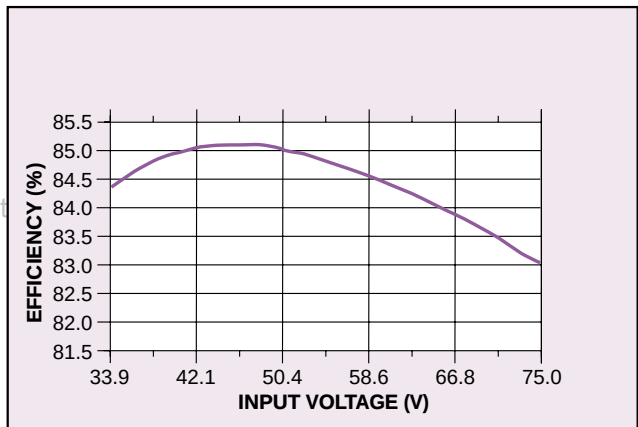


Figure 15: Efficiency vs Line

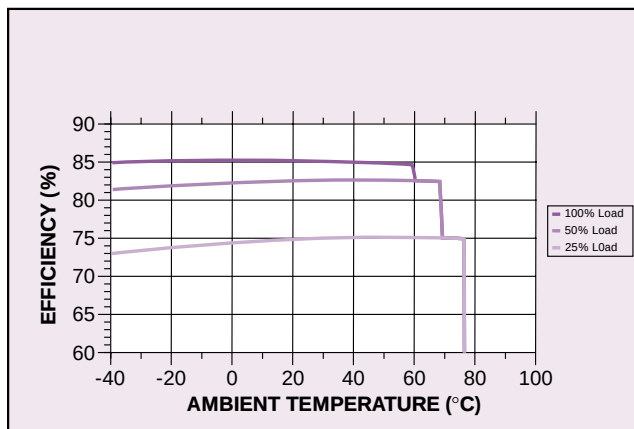


Figure 16: Typical Efficiency vs Ambient Temperature

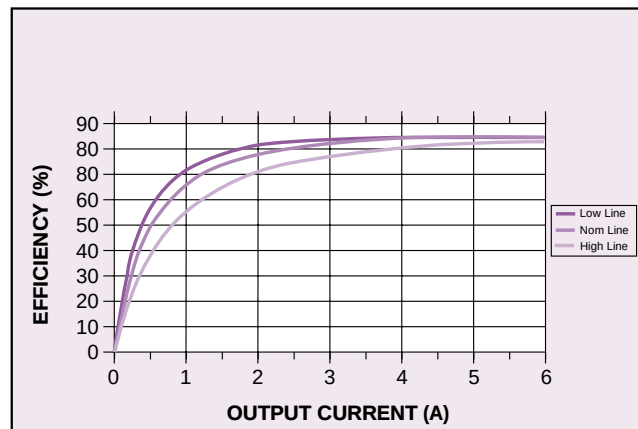


Figure 17: Efficiency vs Load



## CXE15-48S2V5 Model

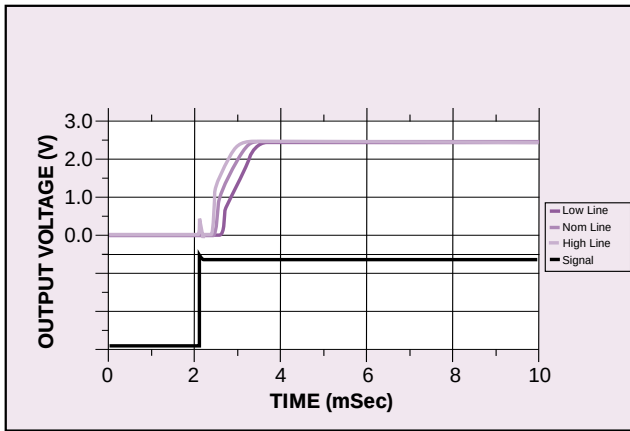


Figure 18: Typical Power-up Characteristic

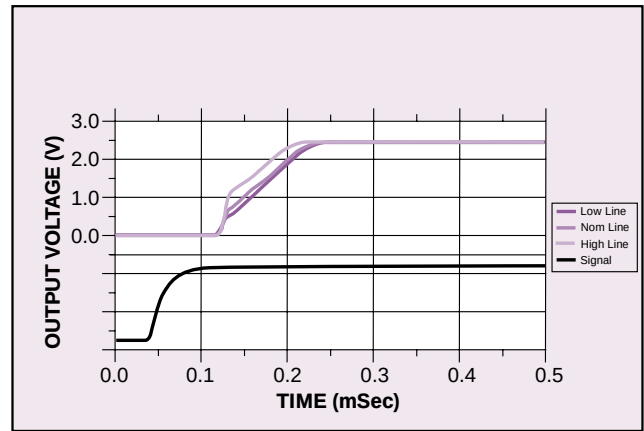


Figure 19: Control On/Off Characteristic

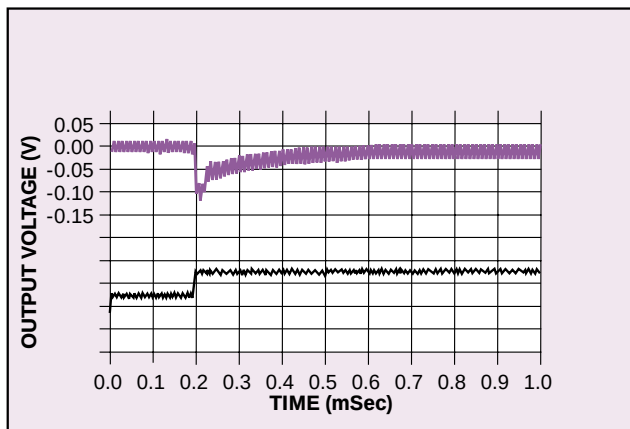


Figure 20: Typical Transient Response 50%-75% Step Load Change

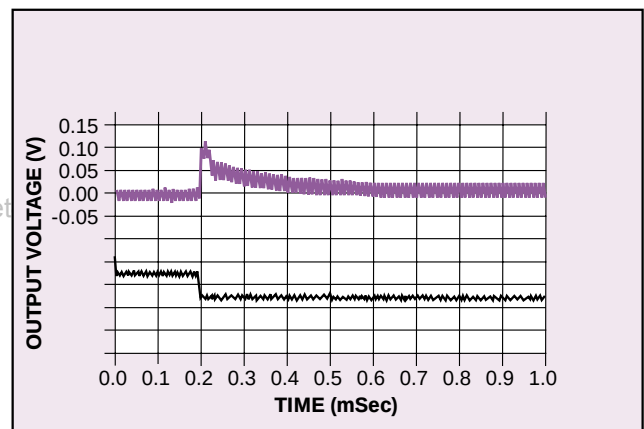


Figure 21: Typical Transient Response 75%-50% Step Load Change

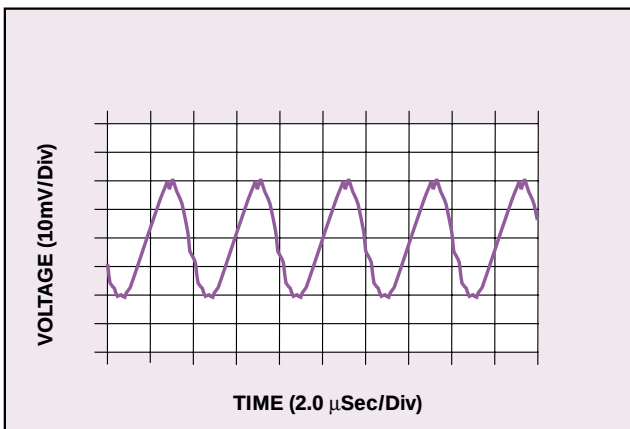


Figure 22: Typical Ripple and Noise Measurement

CXE15-48S3V3 Model

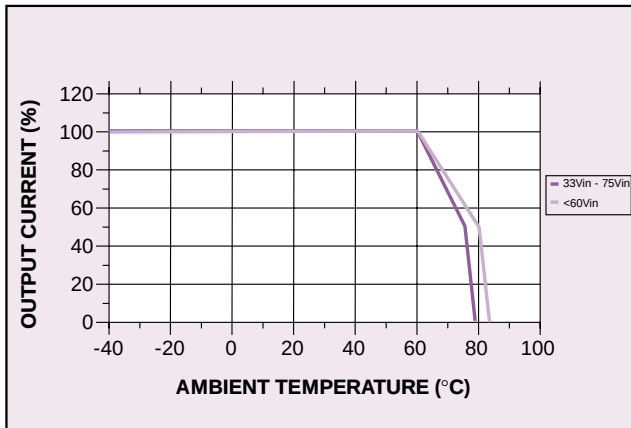


Figure 23: Output Current vs Temperature (Still Air)

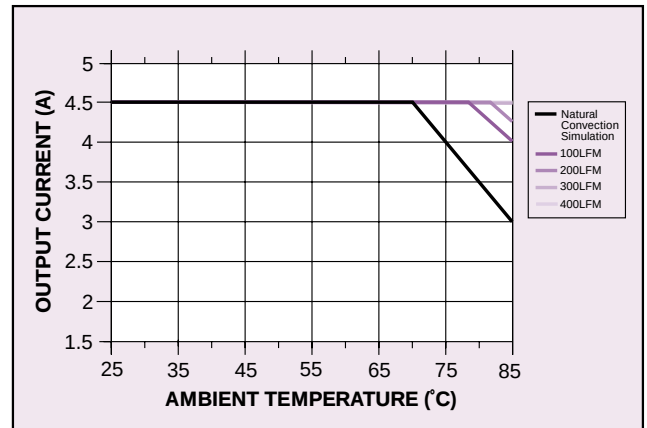


Figure 24: Output Current vs Temperature with Forced Air Cooling

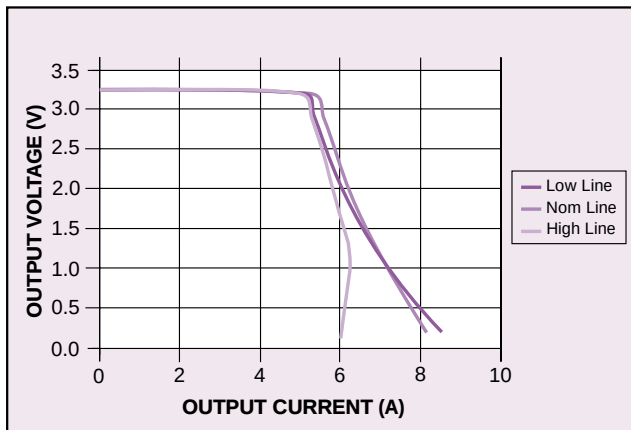


Figure 25: V-1 Characteristic Over Input Line

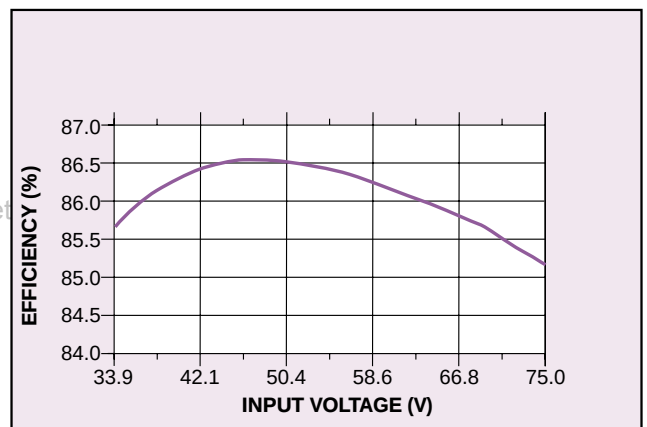


Figure 26: Efficiency vs Line

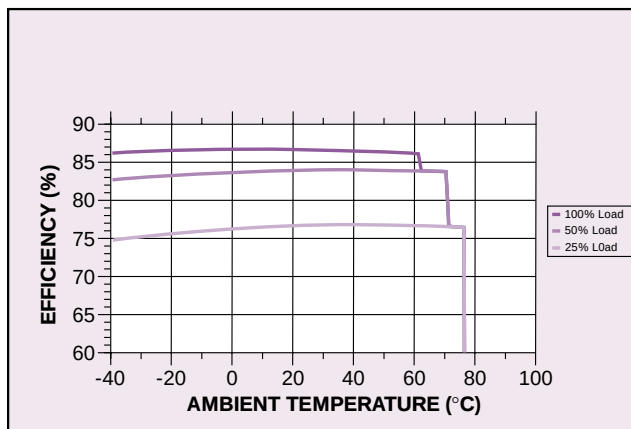


Figure 27: Typical Efficiency vs Ambient Temperature

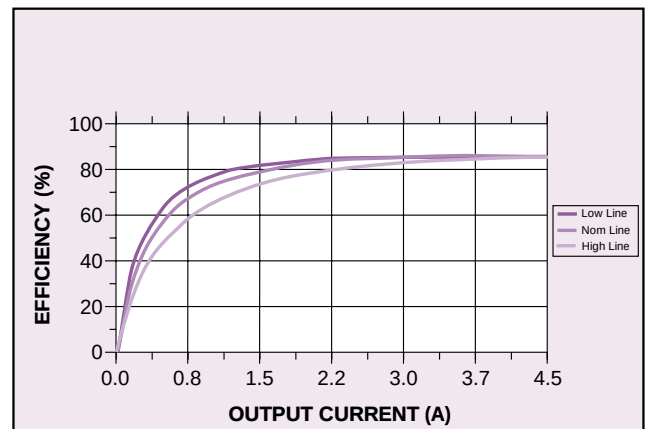


Figure 28: Efficiency vs Load

## CXE15-48S3V3 Model

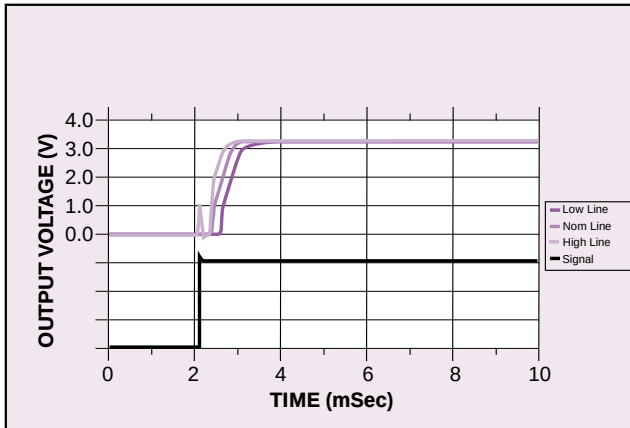


Figure 29: Typical Power-up Characteristic

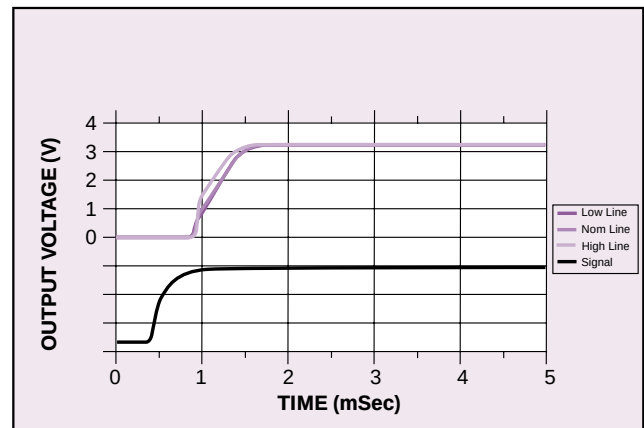


Figure 30: Control On/Off Characteristic

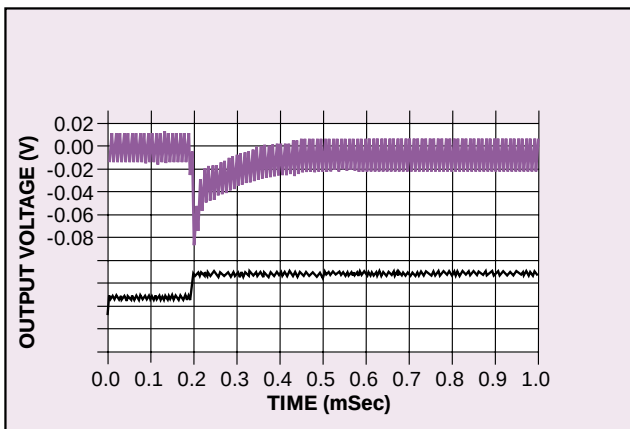


Figure 31: Typical Transient Response 50%-75% Step Load Change

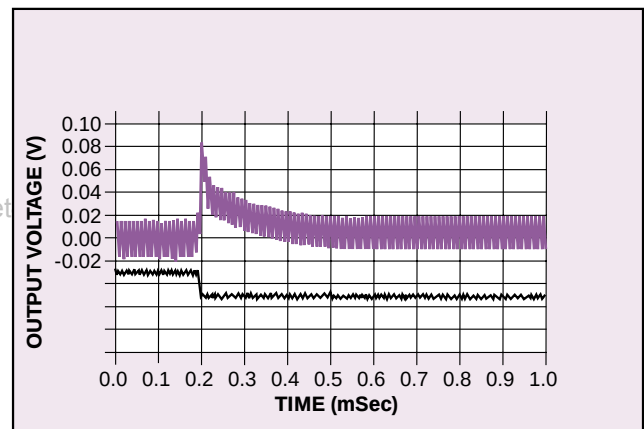


Figure 32: Typical Transient Response 75%-50% Step Load Change

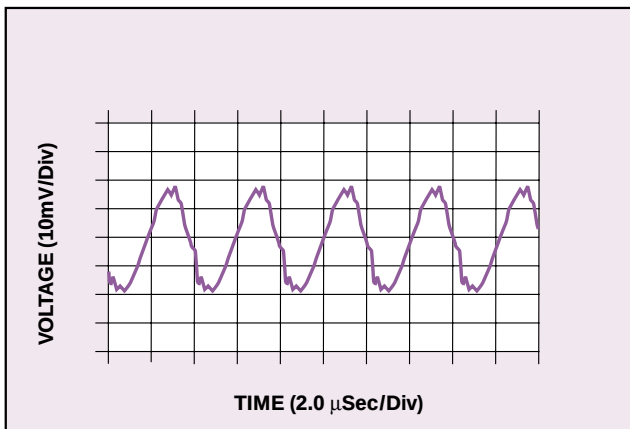


Figure 33: Typical Ripple and Noise Measurement

## CXE15-48S05 Model

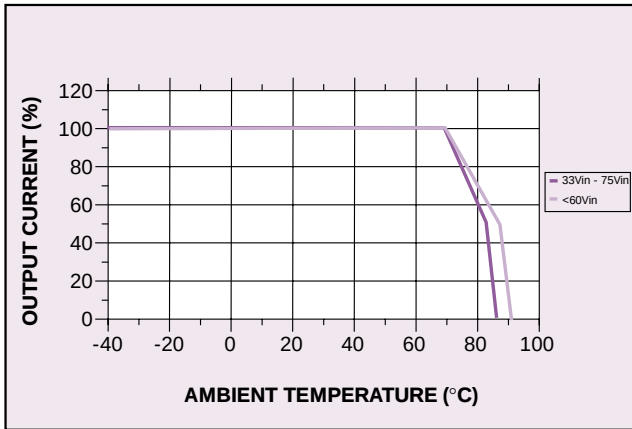


Figure 34: Output Current vs Temperature (Still Air)

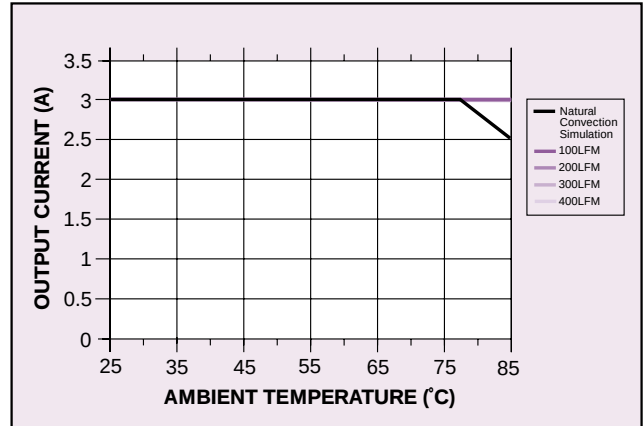


Figure 35: Output Current vs Temperature with Forced Air Cooling

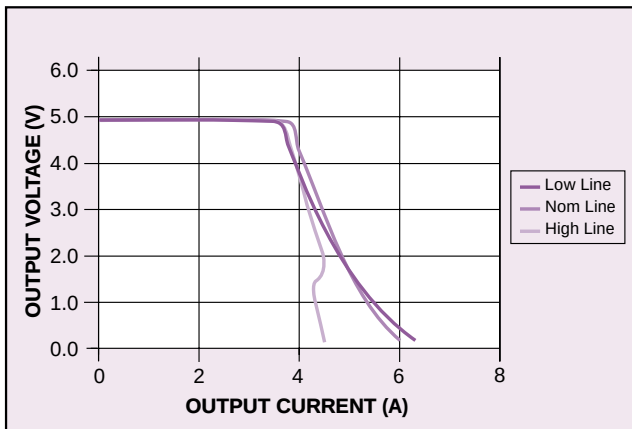


Figure 36: V-1 Characteristic Over Input Line

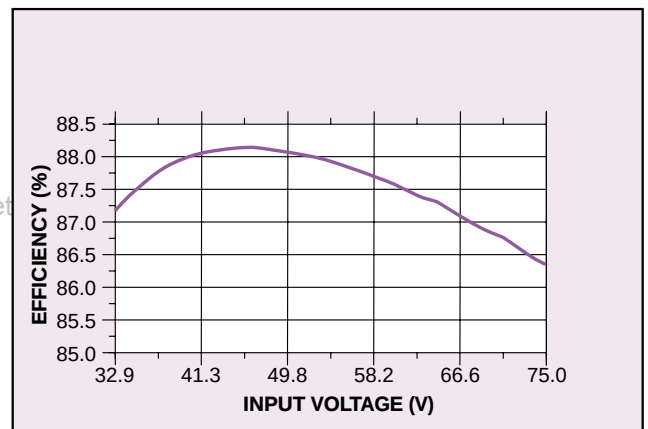


Figure 37: Efficiency vs Line

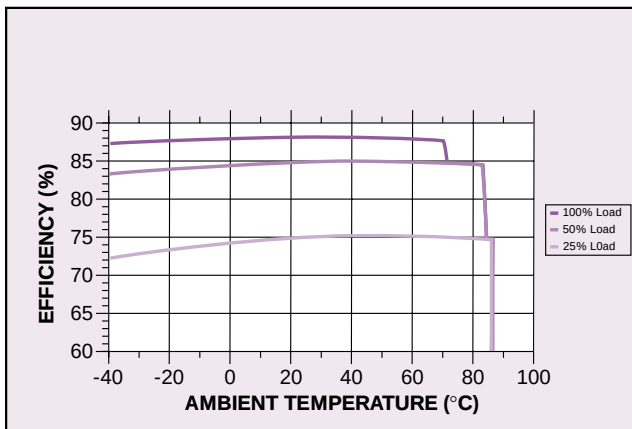


Figure 38: Typical Efficiency vs Ambient Temperature

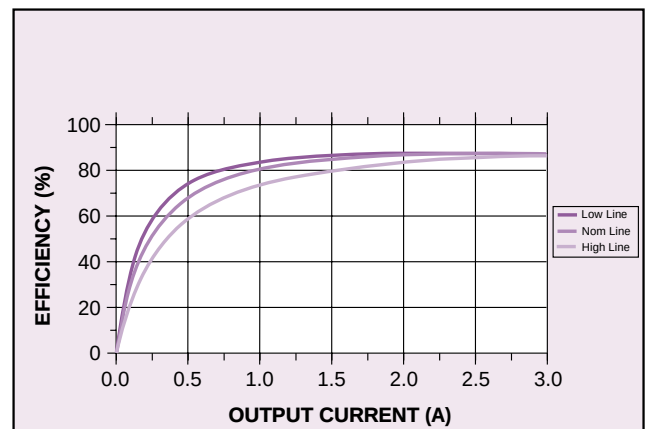


Figure 39: Efficiency vs Load

## CXE15-48S05 Model

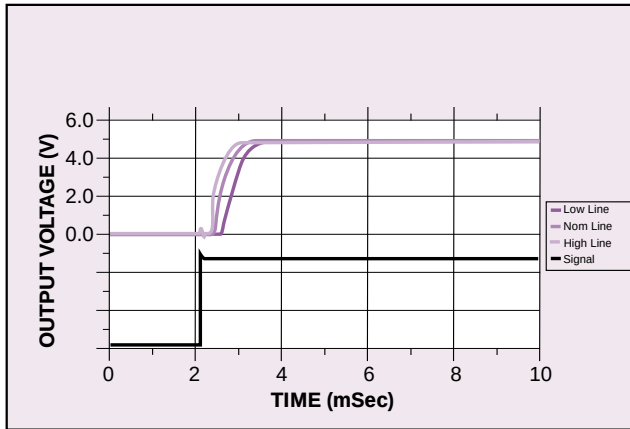


Figure 40: Typical Power-up Characteristic

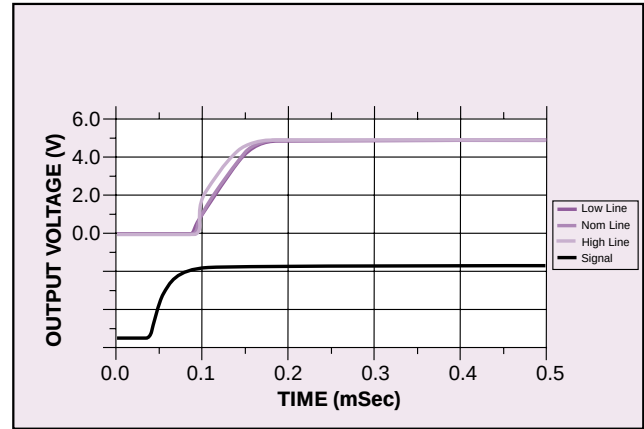


Figure 41: Control On/Off Characteristic

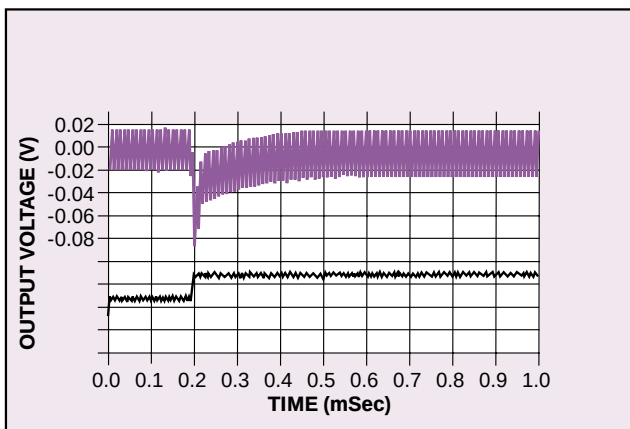
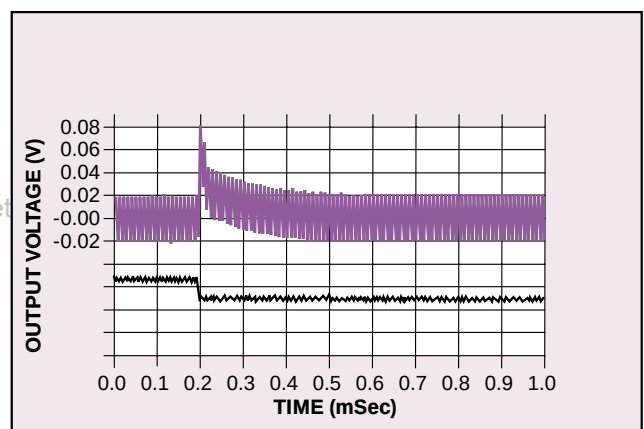
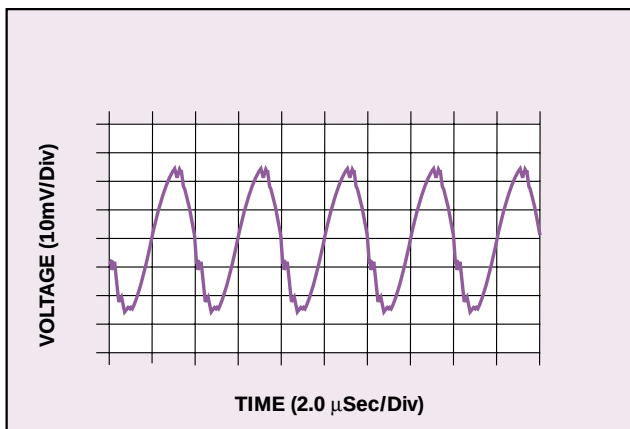
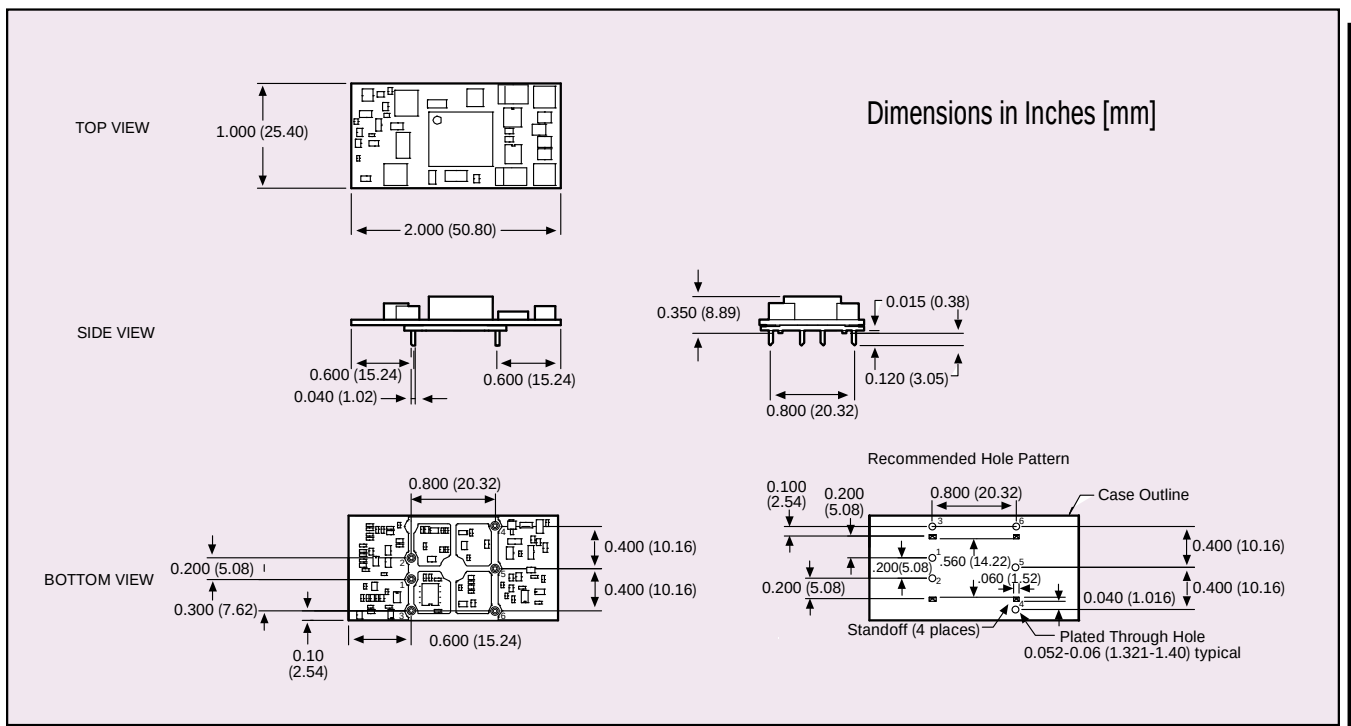
Figure 42: Typical Transient Response 50%-75%  
Step Load ChangeFigure 43: Typical Transient Response 75%-50%  
Step Load Change

Figure 44: Typical Ripple and Noise Measurement



## Pin Connections

| Pin No. | Function          |
|---------|-------------------|
| 1       | Vin -             |
| 2       | Vin+              |
| 3       | On/Off (Optional) |
| 4       | Vout +            |
| 5       | Trim (Optional)   |
| 6       | Vout -            |

Figure 45: Dimensions and Pinout

**Note 1**

Hot spot temperature is defined as the highest temperature measured at any one of the specified hotspot checkpoints. See Figure 46: Hotspot temperature check points.

**Note 2**

The control pin is referenced to Vin-.

**Note 3**

The CXE15 is supplied as standard with active high logic.  
Control input pulled low: Unit disabled.  
Control input left open: Unit enabled.

**Note 4**

Thermal reference set up: Unit mounted on an edge card test board 215mm x 115mm. Test board mounted vertically. For test details and recommended set-up see Application Note 116.

**CAUTION:** Hazardous internal voltages and high temperatures. Ensure that unit is accessible only to trained personnel. The user must provide the recommended fusing in order to comply with safety approvals.

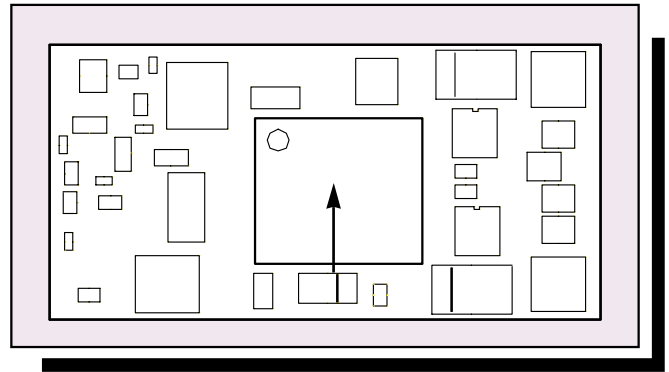


Figure 46: Hot Spot Location on all Models

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