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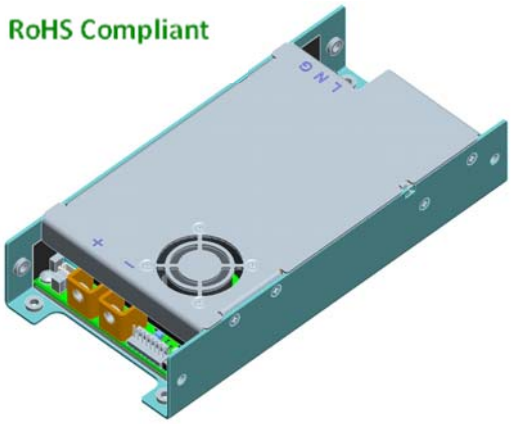
# CAR0424FP front-end

**Input: 90Vac to 264Vac; Output: 24Vdc @ 400W; 5Vdc @ 1A Standby**

RoHS Compliant



## Applications

- 24Vdc distributed power architectures
- Routers/ VoIP/Soft and other Telecom Switches
- Mid to high-end Servers, ATE Equipment

## Features

- Efficiency: exceeds 80plus "Gold" criteria
- Universal input with PFC
- No power de-rating at low range input
- ON/OFF control of the 24Vdc output
- Remote sense on the 24Vdc output
- No minimum load requirements
- 5Vdc @ 1A Standby
- Auto recoverable OC & OT protection
- Operating temperature: 0 - 70°C (de-rated above 50°C)
- Provisions for securing the power supply from either side or the bottom
- Forced air cooling
- EN60950-1 2006 +A12,2011
- UL60950-1, 2007
- IEC60950-1, 2005 +A1:2009 +A2:2013
- CE mark§
- CB certificate available
- Meets FCC part 15, EN55022 Class B standards
- Meets EN61000 immunity and transient standards
- Shock & vibration: Meets IPC 9592 Class II standards

## Description

The CAR0424FP Front-End provides highly efficient isolated power from worldwide input mains in a compact form factor. This power supply is ideal for applications where mid to light load efficiency is of key importance in order to reduce system power consumption during 'typical' operational conditions.

* UL is a registered trademark of Underwriters Laboratories, Inc.
† CSA is a registered trademark of Canadian Standards Association.
‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.
§ Intended for integration into end-user equipment. All the required procedures for CE marking of end-user equipment should be followed. (The CE mark is placed on selected products.)
** ISO is a registered trademark of the International Organization of Standards.

imagination at work

# CAR0424FP front-end

**Input: 90Vac to 264Vac; Output: 24Vdc @ 400W; 5Vdc @ 5W Standby**

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Input Voltage: Continuous | $V_{IN}$ | 0 | 264 | $V_{AC}$ |
| Operating Ambient Temperature | $T_A$ | 0 | 70[1] | °C |
| Storage Temperature | Tstg | -40 | 85 | °C |
| I/O Isolation voltage to Frame (100% factory Hi-Pot tested) | | | 2121 | $V_{DC}$ |

## Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, load, and temperature conditions.

**INPUT**

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Operational Range | $V_{IN}$ | 90 | 115/230 | 264 | $V_{AC}$ |
| Frequency Range (ETSI 300-132-1 recommendation) | $F_{IN}$ | 47 | 50/60 | 63 | Hz |
| Main Output Turn OFF | $V_{IN}$ | 70 | | 80 | $V_{AC}$ |
| Main Outptut Turn ON | | 75 | | 85 | |
| Hysteresis between turn OFF and turn ON | | 5 | | | |
| Maximum Input Current ($V_O$= $V_{O, set}$, $I_O$=$I_{O, max}$) $V_{IN}$= 100$V_{AC}$<br>$V_{IN}$= 208$V_{AC}$ | $I_{IN}$ | | | 4.6<br>2.2 | $A_{AC}$ |
| Cold Start Inrush Current (Excluding x-caps, 25°C, <10ms, per ETSI 300-132) | $I_{IN}$ | | | 37 | $A_{PEAK}$ |
| Efficiency ($T_{amb}$=25°C, $V_O$= 24V) 100% load | $V_{IN}$<br>η | | **115V / 230V**<br>88 / 91 | | % |
| Holdup time ($V_{OUT}$≥ 23.52$V_{DC}$, $T_{AMB}$ 25°C, $I_O$=$I_{O, max}$) $V_{in}$= 230$V_{AC}$ | T | | 20 | | ms |
| Leakage Current ($V_{IN}$= 250$V_{AC}$, $F_{IN}$ = 60Hz) | $I_{IN}$ | | | 3.5 | $mA_{RMS}$ |
| Isolation Input/Output | | 3000 | | | $V_{AC}$ |
| Input/Frame | | 2121 | | | $V_{DC}$ |
| Output/Frame | | 100 | | | $V_{DC}$ |

**24$V_{dc}$ MAIN OUTPUT**

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Output Power fan cooled<br>convection cooled | W | 0 | - | 400[2]<br>300 | W |
| Factory Set default set point (full load, 115$V_{AC}$, 25°C) | $V_O$ | 23.95 | 24.00 | 24.05 | $V_{DC}$ |
| Overall regulation (Line, load, temperature) | | -2 | | +2 | % |
| Ripple and noise[3] | | | | 120 | mVP-P |
| Turn-ON overshoot | | | | +3.5 | % |
| Turn-ON delay | | | | 2 | sec |
| ON/OFF delay time | | | | 40 | ms |
| Turn-ON rise time (10 – 90% of $V_{OUT}$) | | | | 500 | ms |

[1] See accompanying power derating table
[2] 450W for 1 minute, 10% duty cycle max
[3] Measured across a 10µf tantalum and a 0.1µf ceramic capacitors in parallel. 20MHz bandwidth

| $24V_{dc}$ MAIN OUTPUT (continued) | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typ** | **Max** | **Unit** |
| Transient response 50% step [10%-60%, 50% - 100%] (dI/dt – 1A/µs, recovery 500µs) | $V_O$ | -3.5 | | +3.5 | $\%V_O$ |
| Maximum voltage drop of remote sense | | | | 0.25 | $V_{DC}$ |
| Overvoltage protection, latched (recovery by cycling OFF/ON via hardware) | | 25.5 | | 27.5 | $V_{DC}$ |
| Output current | $I_O$ | 0 | | 16.7 | $A_{DC}$ |
| Current limit | | | 19 | | $A_{DC}$ |

| STANDBY OUTPUT | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typ** | **Max** | **Unit** |
| Set point | $V_O$ | | 5.0 | | $V_{DC}$ |
| Overall regulation (load, temperature, aging) | $V_O$ | -5 | | +5 | % |
| Ripple and noise | | | | 50 | $mV_{P-P}$ |
| Output current | $I_O$ | 0 | | 1 | $A_{DC}$ |
| Overload protection - | | 110 | | 150 | % of FL |

## General Specifications

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Calculated Reliability, 25°C<br>Demonstrated Relability | | 125,000<br>250,000 | | Hrs | Full load, ; MTBF per TR-NWT-000332 method I, case III, |
| Service Life | | 10 | | Yrs | Full load, excluding fans |
| Weight | | | | | |

## Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Control and Status for additional information. ($I_H$ < 20uA, $I_L$ < 4mA)

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **ON/OFF** (pulled up internally to $V_{stdby}$ by a 10kΩ resistor) | | | | | |
| Logic High ($24V_{DC}$ OFF) | $V_{IH}$ | $0.7V_{DD}$ | — | $V_{stdby}$ | $V_{DC}$ |
| Logic Low ($24V_{DC}$ ON) | $V_{IL}$ | 0 | — | 0.8 | $V_{DC}$ |
| **Interlock** [short pin controlling presence of the $24V_{DC}$ output] (pulled up internally to $V_{stdby}$ by a 10kΩ resistor) | | | | | |
| 24V output ON | $V_I$ | 0.7 $V_{stdby}$ | — | $V_{stdby}$ | $V_{DC}$ |
| 24V output OFF | $V_I$ | 0 | — | 0.4 | $V_{DC}$ |
| **Power-OK** (pulled up internally to $V_{stdby}$ by a 10kΩ resistor) | | | | | |
| Logic High (Output voltage is present) | $V_{OH}$ | 0.7 $V_{stdby}$ | — | $V_{stdby}$ | $V_{DC}$ |
| Logic Low (Output voltage is not present) | $V_{OL}$ | 0 | — | 0.4 | $V_{DC}$ |
| (Output transitions LO 4ms before 24V drops below regulation) | | | | | |
| **DC-OK** (pulled up internally to $V_{stdby}$ by a 10kΩ resistor) | | | | | |
| Logic High ($24V_{DC}$ Output is > 92% of nominal) | $V_{OH}$ | 0.7 $V_{stdby}$ | — | $V_{stdby}$ | $V_{DC}$ |
| Logic Low (Input out of range) | $V_{OL}$ | 0 | — | 0.4 | $V_{DC}$ |

# CAR0424FP front-end

**Input: 90Vac to 264Vac; Output: 24Vdc @ 400W; 5Vdc @ 5W Standby**

## Environmental Specifications

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Ambient Temperature, fan cooled | 0 | | 50 | °C | |
| Storage Temperature | -30 | | 60 | °C | |
| Operating Altitude | -152/500 | | 3k/10k | m/ft | |
| Non-operating Altitude | -152/500 | | 12k/40k | m / ft | |
| Power Derating with Temperature | | | 2.5 | %/°C | 50°C to 70°C |
| Power Derating with Altitude | | | 2.0 | °C/301m<br>°C/1k ft | Above 1524 m/5000 ft |
| Acoustic noise | | 45 | | dbA | A distance of 1m @ 30°C, linearly increases to < 50dbA @ 50°C. |
| Humidity Operating<br>Storage | 30<br>10 | | 95<br>95 | % | Relative humidity, non-condensing |
| Shock and Vibration | Meet IPC 9592 Class II, Section 5 requirements | | | | |

## EMC Compliance

| Parameter | Function | Standard | Level | Criteria | Test |
|---|---|---|---|---|---|
| AC input | Conducted emissions | EN55022, FCC part 15, CISP22 | B | | 0.15 – 30MHz |
| | Radiated emissions[4] | EN55022, FCC part 15, CISP22 | B[5] | | 30 – 10000MHz |
| | Conducted harmonics | EN61000-3-2 | | Compliant | |
| | Flicker | EN61000-3-3 | | Compliant | |
| AC input immunity | Voltage dips | EN61000-4-11 | | A | -30%, 10ms |
| | | | | B | -60%, 100ms |
| | | | | B | -100%, 5sec |
| | Voltage surge | EN61000-4-5 | | A | 3.4kV, 1.2/50µs, common mode |
| | | | | A | 2.4kV, 1.2/50µs, differential mode |
| | Fast transients | EN61000-4-4 | | B | 5/50ns, 2kV (common mode) |
| Enclosure immunity | Conducted RF fields | EN61000-4-6 | | A | 130dBµV, 0.15-80MHz, 80% AM |
| | Radiated RF fields | EN61000-4-3 | | A | 10V/m, 80-1000MHz, 80% AM |
| | ESD | EN61000-4-2 | | B | 4kV contact, 8kV air |

| Criteria | Performance |
|---|---|
| A | No performance degradation |
| B | Temporary loss of function or degradation not requiring manual intervention |
| C | Temporary loss of function or degradation that may require manual intervention |
| D | Loss of function with possible permanent damage |

[4] Radiated emissions compliance is contingent upon the final system configuration.
[5] Schaffner FN9222-15 external filter or equivalent may be used

## Characteristic Curves

The following figures provide typical characteristics at 25ºC.

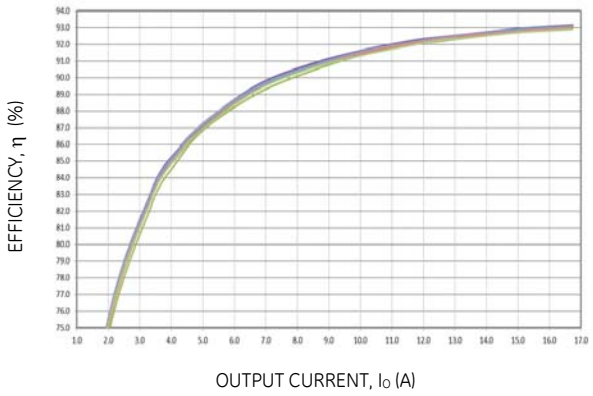



**Figure 1. Efficiency $V_{IN}$: 230V, Freq: 60Hz.**

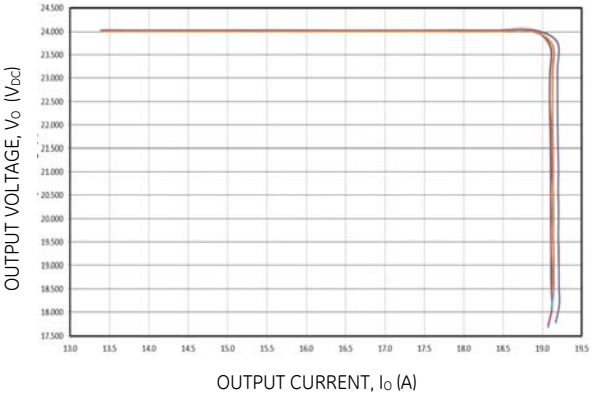



**Figure 2. Output current limit profile**

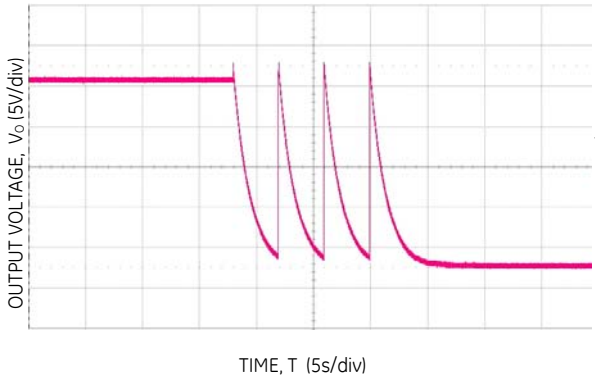



**Figure 3. Overvoltage shutdown**

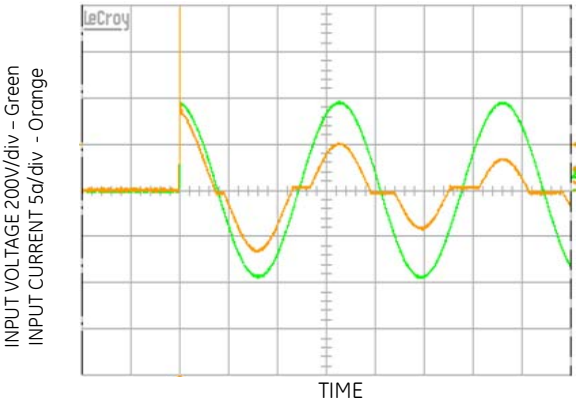



**Figure 4. Inrush performance 5ms/div.**

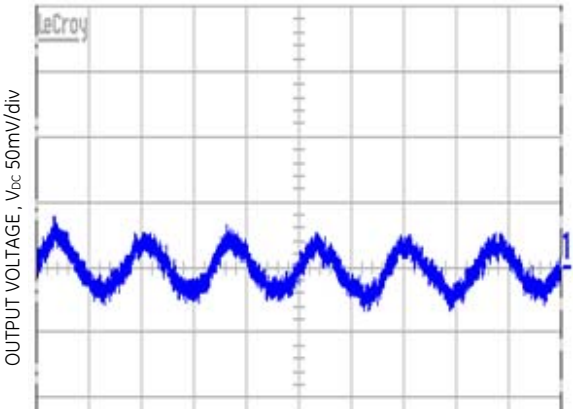



**Figure 5. 24$V_{DC}$ output PARD, full load, $V_{IN}$ = 240$V_{AC}$.**

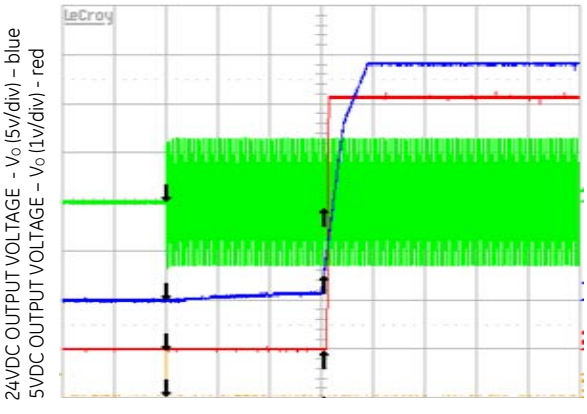



**Figure 6. Start up $V_{IN}$ 90 $V_{AC}$**

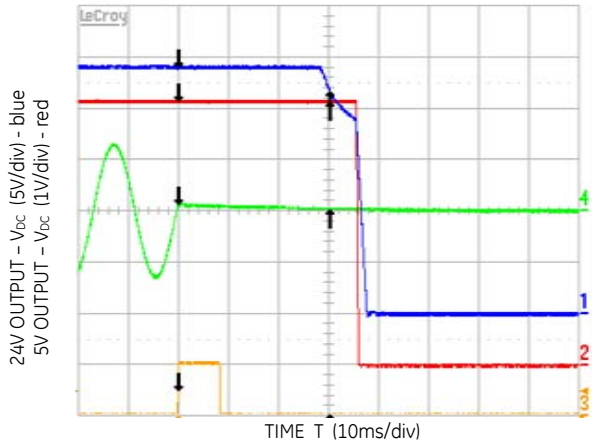



**Figure 7. Holdup $V_{IN}$ – 90$V_{AC}$**

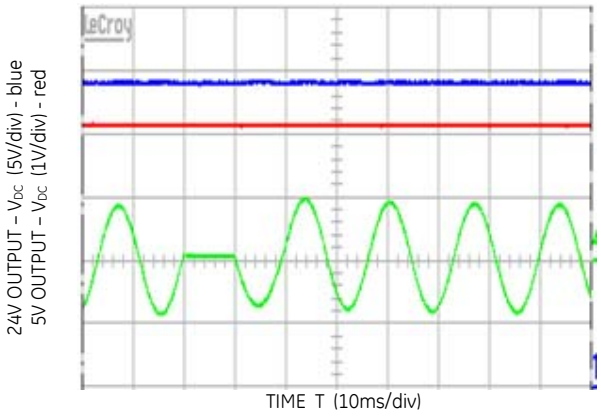



**Figure 8. ½ cycle ride-through $V_{IN}$ 140 $V_{AC}$**

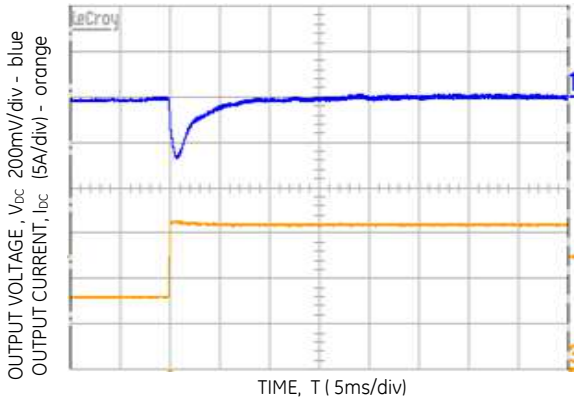



**Figure 9. 24V Transient response 50% load step (50 – 100%)**

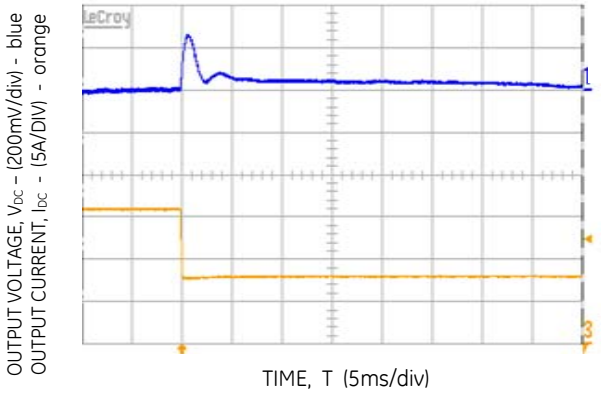



**Figure 10. 24V Transient response 50% load step (100 – 50%)**

.

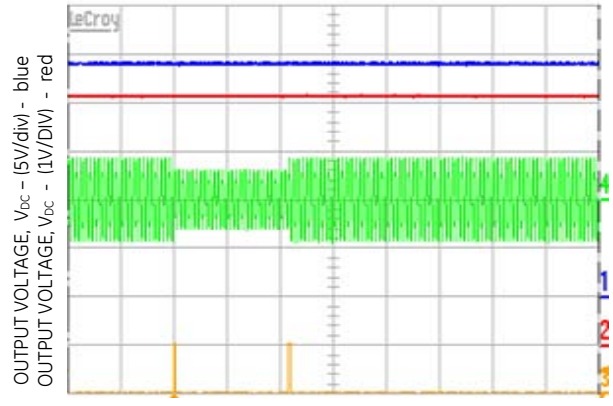



**Figure 11. 30% dip ride-through $V_{IN}$ 115 $V_{AC}$**

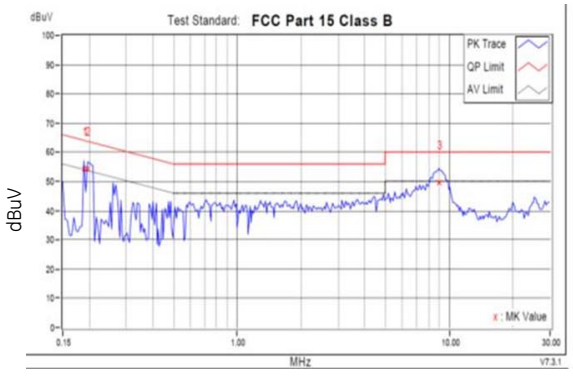
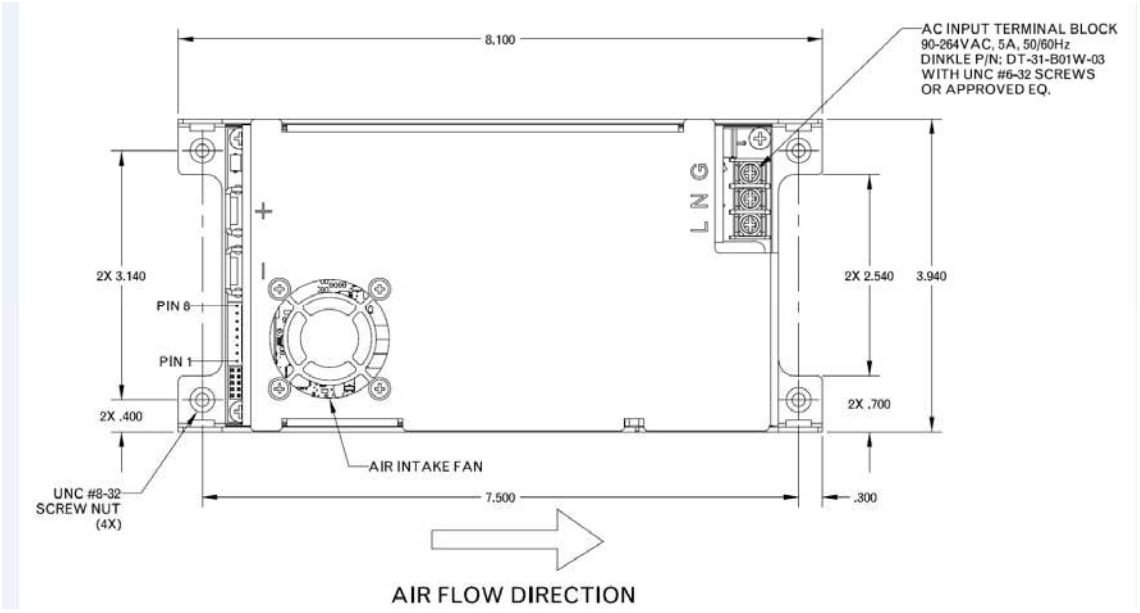


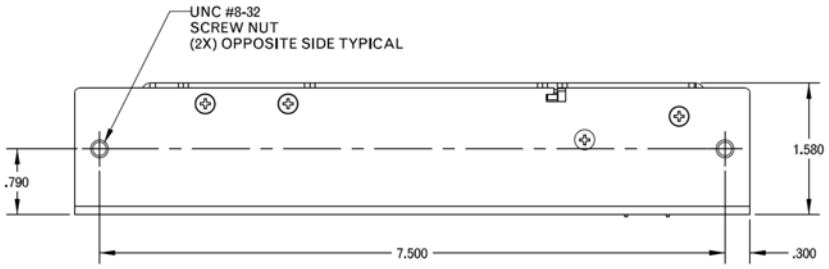

**Figure 12. Conducted Emissions**

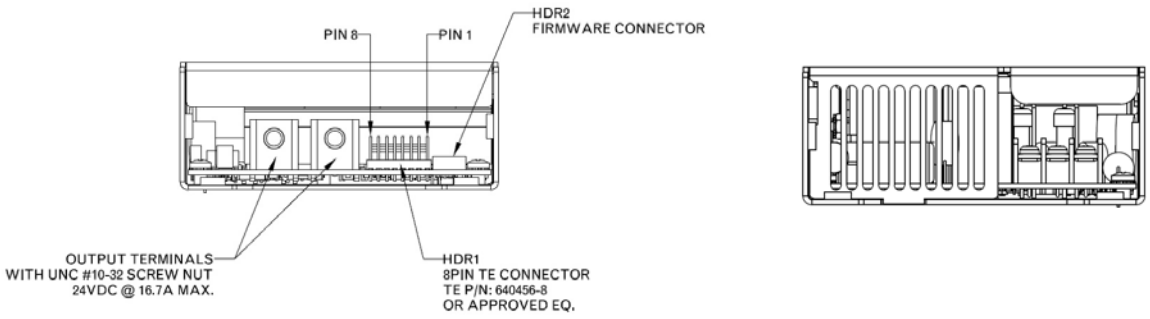
# CAR0424FP front-end

**Input: 90Vac to 264Vac; Output: 24Vdc @ 400W; 5Vdc @ 5W Standby**

## Outline Drawing



## Connector Pin Assignments

**Input Connector:** 3 position terminal block
screw size #6-32

**Output Connector:** 2 separate bus bars
screw size: #10-32

**Signal Connector** 8 pin connector TE: 640456-8
Mating connector TE: MTA Series

| Pin | Function |
|---|---|
| 1 | ON/OFF |
| 2 | Inhibit |
| 3 | Power-OK |
| 4 | DC-OK |
| 5 | Signal return |
| 6 | $+5V_{DC}$ |
| 7 | Remote Sense (-) |
| 8 | Remote Sense (+) |

## Ordering Information

Please contact your GE Sales Representative for pricing, availability and optional features.

| PRODUCT | DESCRIPTION | PART NUMBER |
|---|---|---|
| CAR0424FPXXXZ01A | Input: 90Vac to 264Vac; Output: 24Vdc @ 400W; 5Vdc @ 1A Standby | CAR0424FPXXXZ01A |
| | | |

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