LCB35 Series

Up to 38.4 Watts

AC/DC Converter

Total Power: Up to 38.4 Watts
Input Voltage: 88 to 264 Vac
125 to 373 Vdc

# of Outputs: Single

Special Features

- Universal AC input/full range
- Green design, No load power consumption<0.5W
- Protections:Short circuit/Over load/Over voltage
- Brown-out (Low AC input voltage)
- Cooling by free air convection
- Power ON with LED indicator
- All using 105^{O}C long life electrolytic capacitors
- High operation temperature up to 70^{O}C
- 100% full load burn-in test
- Withstand 5G vibration test
- High efficiency, long life and high reliability
- 2 Years Warranty

Safety

UL /cUL 60950-1
TUV EN60950-1
CE

Product Descriptions

The LCB35 series features a universal 88-264Vac input – enabling it to be used anywhere in the world – and is also capable of operating from a 125-373Vdc Input. The LCB35 series offers a power rating up to 38.4W with convection cooling, and it provide precisely regulated output voltages of 3.3V, 5V, 12V, 15V, 24V and 48Vdc.

The LCB35 series power supply is comprehensively protected against over voltage, over load and short-circuit conditions.

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Model	Output Voltage (Vdc)	Minimum Load (A)	Maximum Load (A)	Efficiency[1] (%)
LCB35D	3.3	0	7	78
LCB35E	5	0	7	83
LCB35L	12	0	3	89
LCB35N	15	0	2.4	89
LCB35Q	24	0	1.5	88
LCB35W	48	0	0.8	90

Note 1 - Typical value at nominal input voltage(230Vac) and maximum load.

Options

None

Electrical Specifications

Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

Table 1. Absolute Maximum Ratings:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage AC continuous operation DC continuous operation	 All models All models	 $V_{IN,AC}$ $V_{IN,DC}$	 88 125	 - -	 264 373	 Vac Vdc
Maximum Output Power Convection continuous operation	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	$P_{O,max}$	- - - - - -	- - - - - -	23.1 35 36 36 36 38.4	W W W W W W
Isolation Voltage Input to Output Input to Safety Ground Output to Earth Ground	 All models All models All models		 - - -	 - - -	 3000 1500 707	 Vac Vac Vdc
Ambient Operating Temperature	All models	T_A	-25	-	+70[1]	^{O}C
Storage Temperature	All models	T_{STG}	-40	-	+85	^{O}C
Humidity (non-condensing) Operating Non-operating	 All models All models		 20 10	 - -	 90 95	 % %

Note 1 - Derate each output at 2.5% per degree C from 50 ^{O}C to 70 ^{O}C.

Input Specifications

Table 2. Input Specifications:

Parameter		Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC[1]		All	$V_{IN,AC}$	88	115/230	264	Vac
Operating Input Voltage, DC		All	$V_{IN,DC}$	125	-	373	Vdc
Input AC Frequency		All	f_{IN}	47	50/60	63	Hz
Input Current		$V_{IN,AC}$ = 115Vac $V_{IN,AC}$ = 230Vac	$I_{IN,max}$	- -	0.8 0.4	- -	A_{PK}
No Load Input Power (V_O = ON, I_O = 0A)		$V_{IN,AC}$ = 115/230Vac	$P_{IN,no-load}$	-	-	0.5	W
Harmonic Line Currents		All	THD	EN61000-3-2/EN61000-3-3			
Startup Surge Current (Inrush) @ 25°C		$V_{IN,AC}$ = 230Vac	$I_{IN,surge}$	-	35	-	A_{PK}
Efficiency (T_A = 25°C, free air convection cooling)	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	$V_{IN,AC}$ = 230Vac $I_O = I_{O,max}$	η	- - - - - -	78 83 89 89 88 90	- - - - - -	%
Hold Up Time		$V_{IN,AC}$ = 115Vac $P_O = P_{O,max}$	$t_{Hold-Up}$	10	-	-	mSec
		$V_{IN,AC}$ = 230Vac $P_O = P_{O,max}$	$t_{Hold-Up}$	32	-	-	mSec
Turn On Delay		$V_{IN,AC}$ = 115Vac $P_O = P_{O,max}$	$t_{Turn-On}$	-	1000	-	mSec
		$V_{IN,AC}$ = 230Vac $P_O = P_{O,max}$	$t_{Turn-On}$	-	800	-	mSec
Leakage Current to safety ground		V_{IN} = 240Vac f_{IN} = 50/60Hz	$I_{IN,leakage}$	-	-	2000	µA

Note 1 - Withstand 300Vac surge for 5sec, without damage.

Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	Inclusive of setpoint, line, load change	V_O	-3 -2 -1 -1 -1 -1	- - - - - -	+3 +2 +1 +1 +1 +1	%
Output Adjust Range	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	All	V_O	2.97 4.5 10.8 13.5 21.6 43.2	3.3 5 12 15 24 48	3.63 5.5 13.2 16.5 26.4 52.8	V
Output Ripple, pk-pk	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	Measure with a 0.1µF ceramic capacitor in parallel with a 47µF aluminum electrolytic capacitor	V_O	- - - - - -	- - - - - -	100 100 120 120 120 200	mV_{PK-PK}
Convection Output Current, continuous	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	Convection cooling	$I_{O,max}$	0 0 0 0 0 0	- - - - - -	7 7 3 2.4 1.5 0.8	A
Line Regulation	All Modules	$V_{IN,DC=}V_{IN,min}$ to $V_{IN,max}$ $I_O=I_{O,max}$	V_O	-0.5	-	+0.5	%
Load Regulation	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	All	V_O	-2.0 -1.0 -0.5 -0.5 -0.5 -0.5	- - - - - -	+2.0 +1.0 +0.5 +0.5 +0.5 +0.5	%
Temperature Coefficient		All		-0.03	-	+0.03	$\%/^{O}C$
V_O Over Voltage Protection		Latch off (AC recycle to reset)	V_O	115	-	150	%
Load Capacitance	LCB35D LCB35E LCB35L LCB35N LCB35Q LCB35W	Start up		- - - - - -	- - - - - -	2200 2200 1500 1000 470 220	uF
V_O Over Current Protection [1]		All	I_O	110	-	-	$\%I_{O,max}$

Note 1 - Hiccup Mode and Auto recovery after full load is remove.

LCB35D Performance Curves

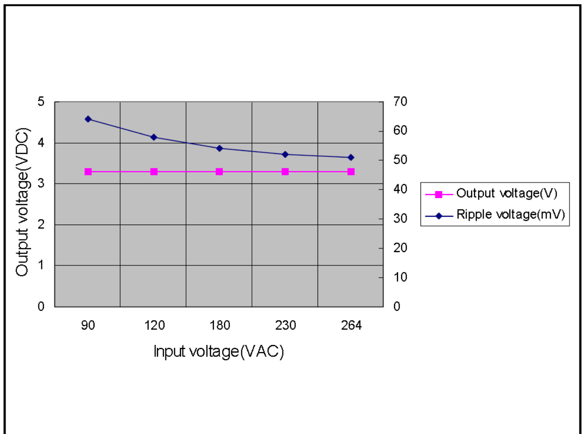


Figure 1: LCB35D Output Ripple Voltage Versus Input Voltage
Vin = 90 to 264Vac Ta = 25 °C

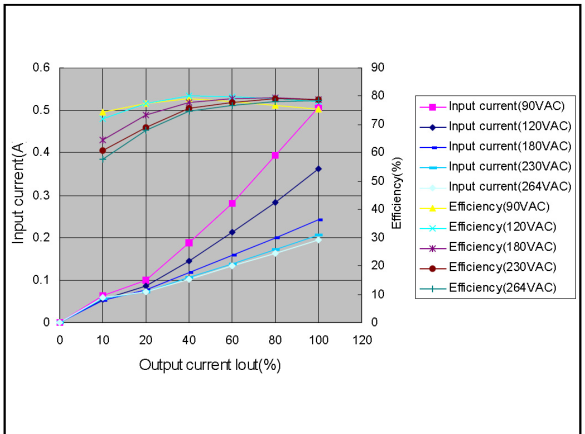


Figure 2: LCB35D Efficiency And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-7A Ta = 25 °C

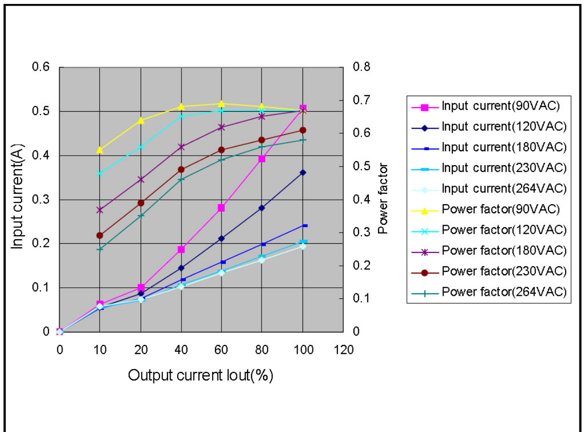


Figure 3: LCB35D Power Factor And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-7A Ta = 25 °C

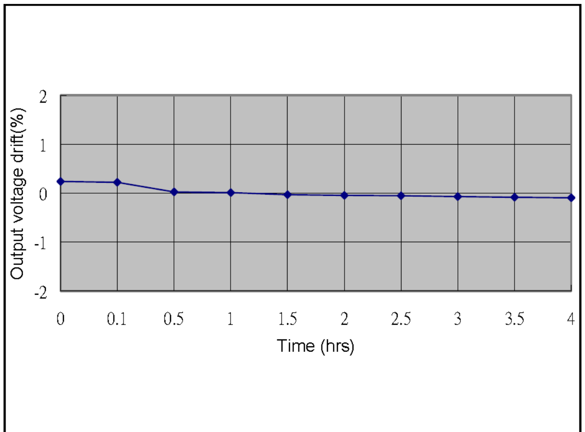


Figure 4: LCB35D Warm Up Voltage Drift Characteristics
Vin = 230Vac Load: Io = 7A Ta = 25 °C

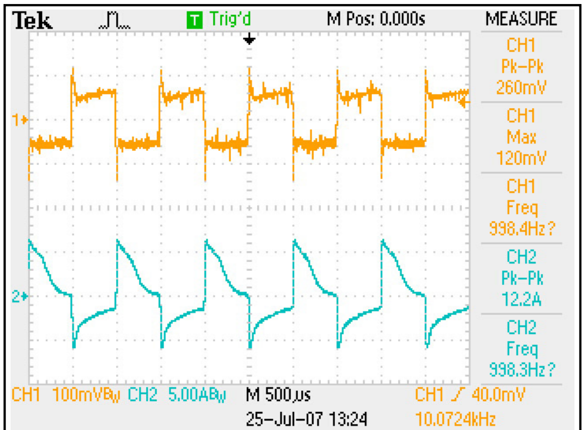


Figure 5: LCB35D Transient Response
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

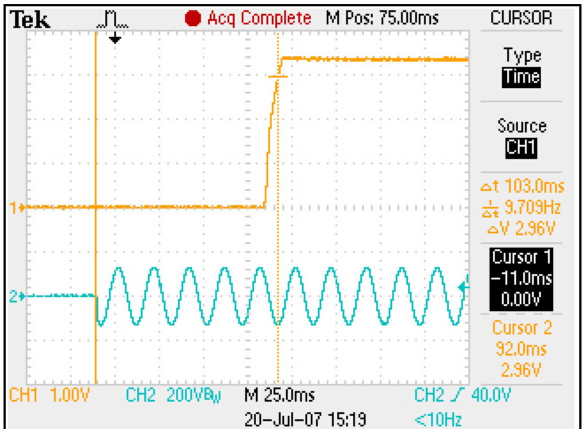


Figure 6: LCB35D Turn On Delay
Vin = 90Vac Load: Io = 7A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35D Performance Curves

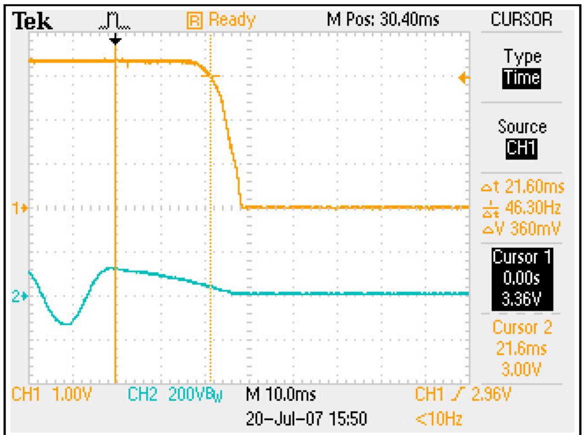


Figure 7: LCB35D Hold-up Time
Vin = 90Vac Load: Io = 7A
Ch 1: Vo Ch 2: AC Mains

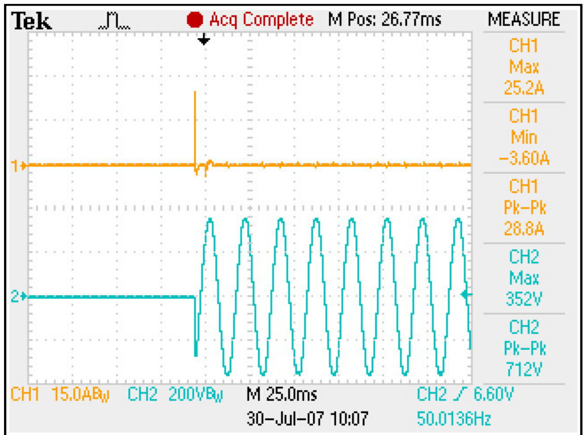


Figure 8: LCB35D Inrush Current
Vin = 264Vac Load: Io = 7A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

LCB35E Performance Curves

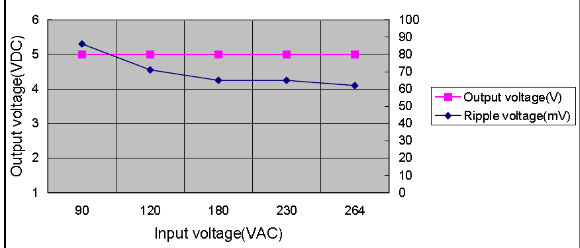


Figure 9: **LCB35E Output Ripple Voltage Versus Input Voltage**
Vin = 90 to 264Vac Ta = 25 °C

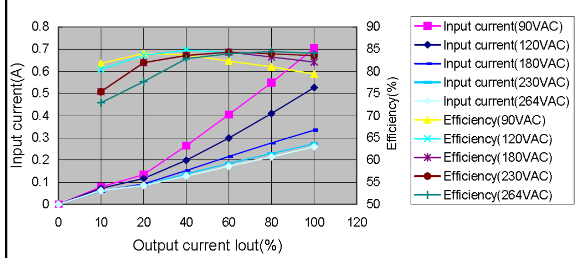


Figure 10: **LCB35E Efficiency And Input Current Versus Output Current**
Vin = 90 to 264Vac Load: Io = 0-7A Ta = 25 °C

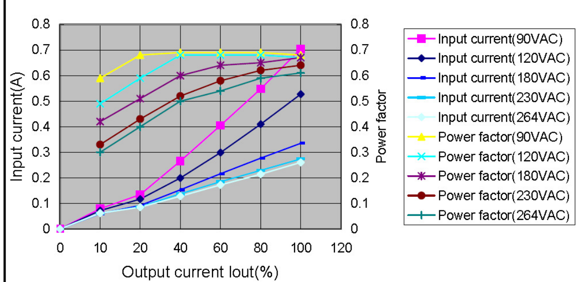


Figure 11: **LCB35E Power Factor And Input Current Versus Output Current**
Vin = 90 to 264Vac Load: Io = 0-7A Ta = 25 °C

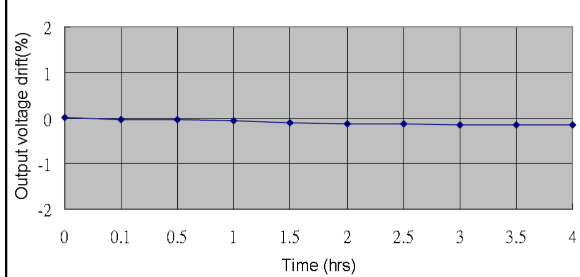


Figure 12: **LCB35E Warm Up Voltage Drift Characteristics**
Vin = 230Vac Load: Io = 7A Ta = 25 °C

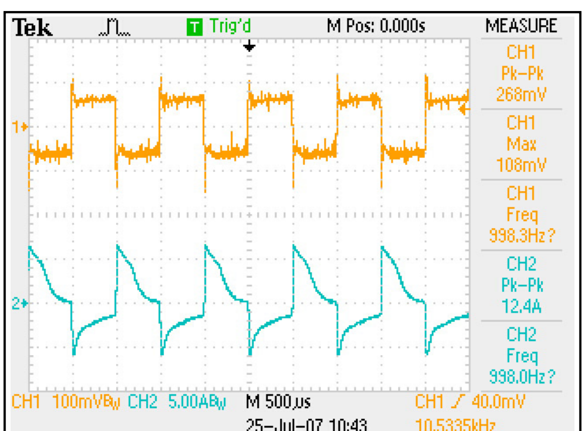


Figure 13: **LCB35E Transient Response**
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

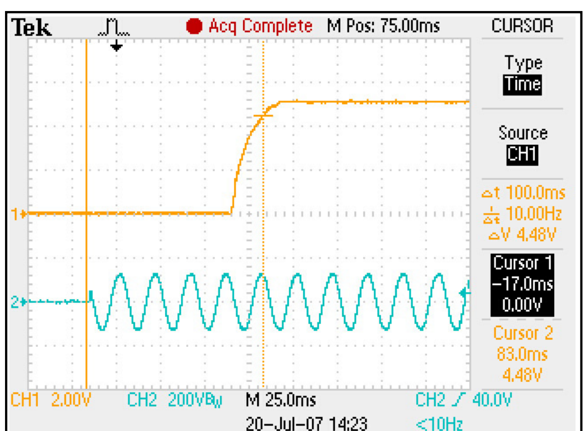


Figure 14: **LCB35E Turn On Delay**
Vin = 90Vac Load: Io = 7A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35E Performance Curves

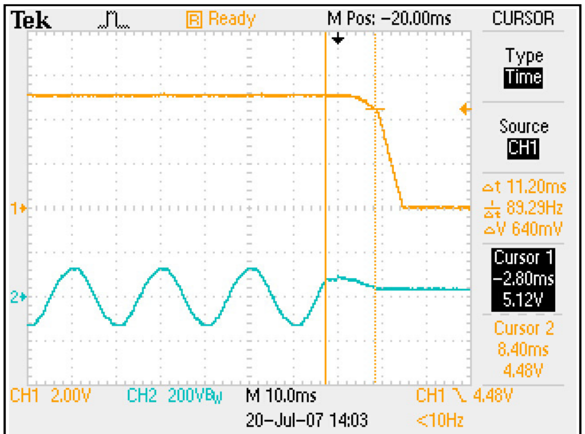


Figure 15: LCB35E Hold-up Time
Vin = 90Vac Load: Io = 7A
Ch 1: Vo Ch 2: AC Mains

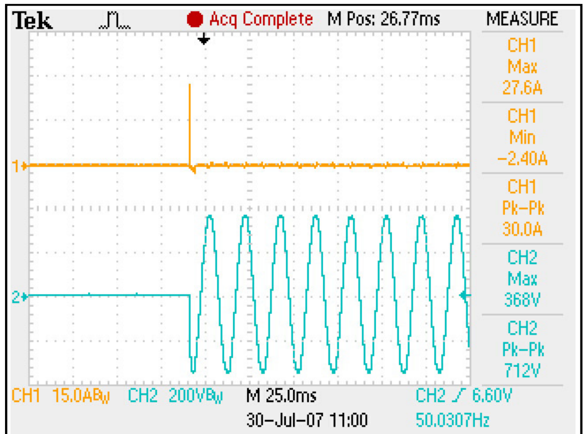


Figure 16: LCB35E Inrush Current
Vin = 264Vac Load: Io = 7A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

LCB35L Performance Curves

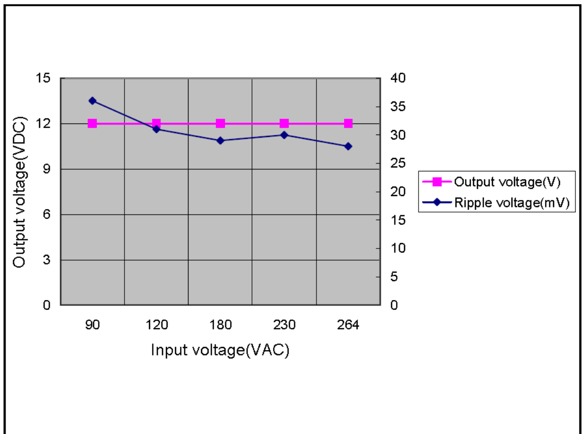


Figure 17: LCB35L Output Ripple Voltage Versus Input Voltage
Vin = 90 to 264Vac Ta = 25 °C

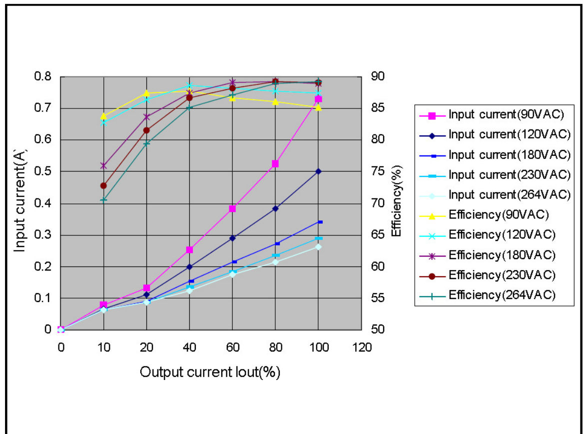


Figure 18: LCB35L Efficiency And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-3A Ta = 25 °C

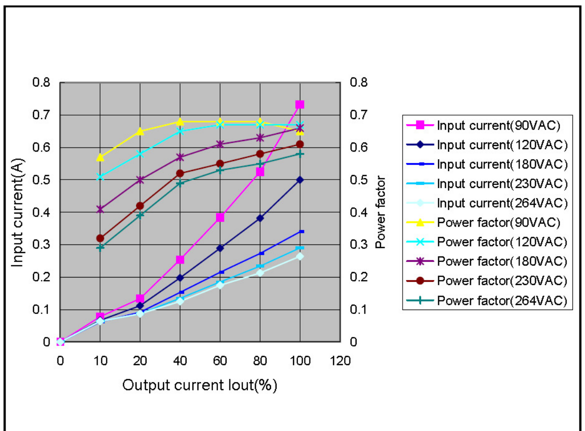


Figure 19: LCB35L Power Factor And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-3A Ta = 25 °C

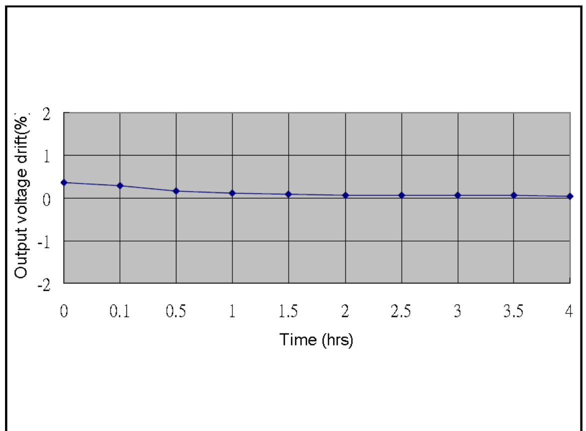


Figure 20: LCB35L Warm Up Voltage Drift Characteristics
Vin = 230Vac Load: Io = 3A Ta = 25 °C

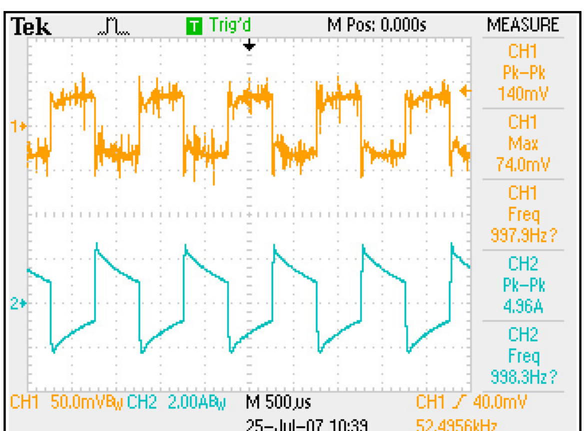


Figure 21: LCB35L Transient Response
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

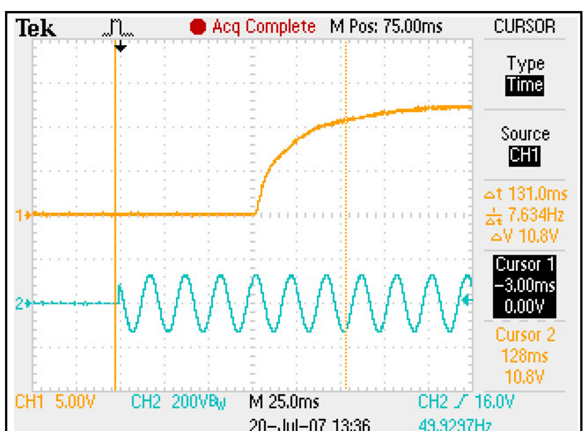


Figure 22: LCB35L Turn On Delay
Vin = 90Vac Load: Io = 3A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35L Performance Curves

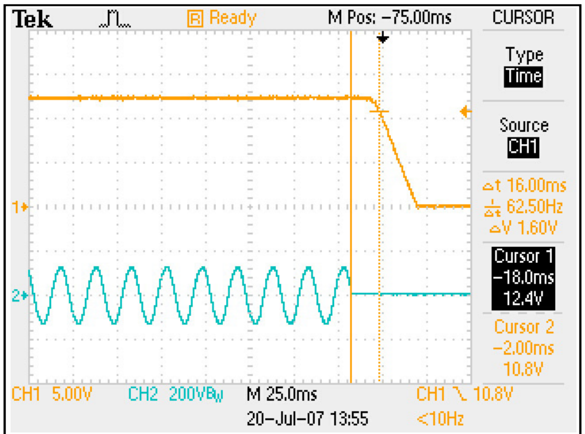


Figure 23: LCB35L Hold-up Time
Vin = 90Vac Load: Io = 3A
Ch 1: Vo Ch 2: AC Mains

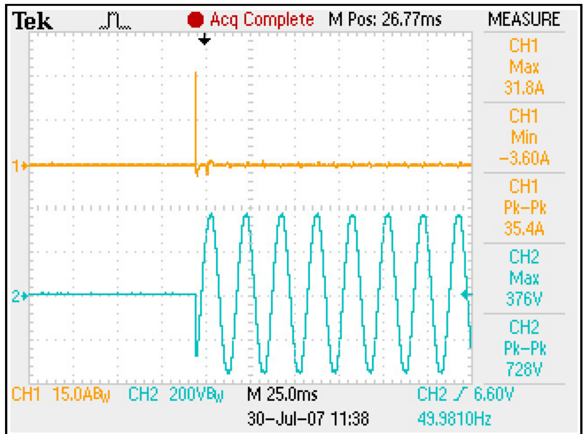


Figure 24: LCB35L Inrush Current
Vin = 264Vac Load: Io = 3A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

LCB35N Performance Curves

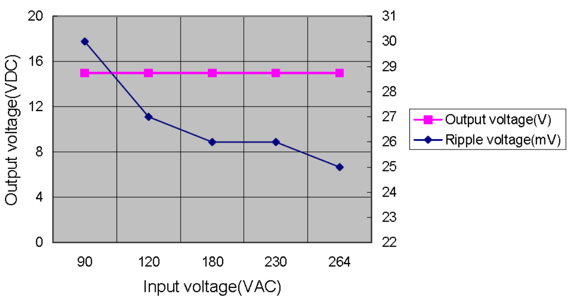


Figure 25: LCB35N Output Ripple Voltage Versus Input Voltage
Vin = 90 to 264Vac Ta = 25 °C

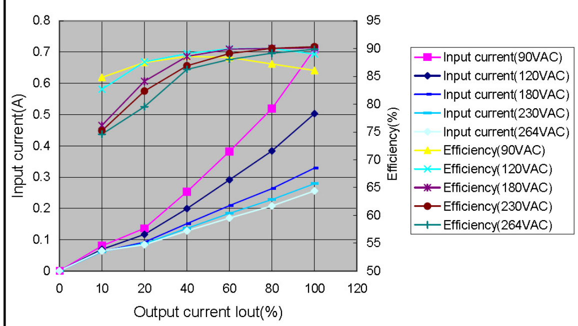


Figure 26: LCB35N Efficiency And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-2.4A Ta = 25 °C

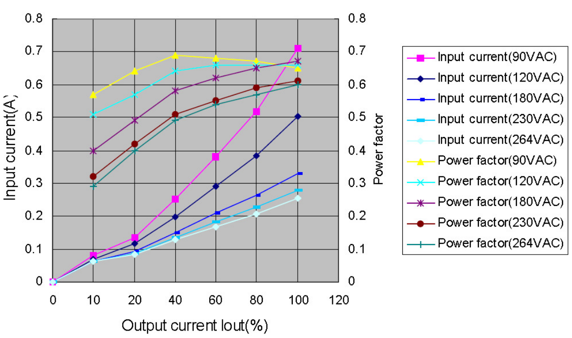


Figure 27: LCB35N Power Factor And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-2.4A Ta = 25 °C

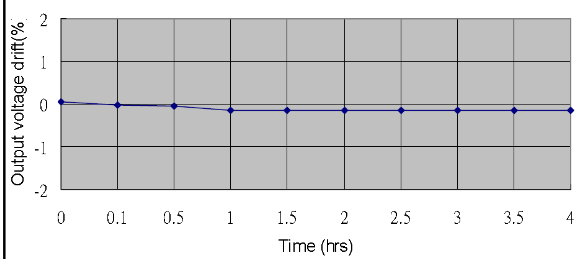


Figure 28: LCB35N Warm Up Voltage Drift Characteristics
Vin = 230Vac Load: Io = 2.4A Ta = 25 °C

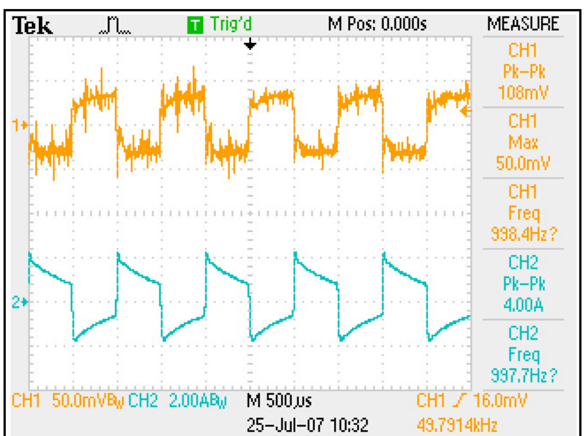


Figure 29: LCB35N Transient Response
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

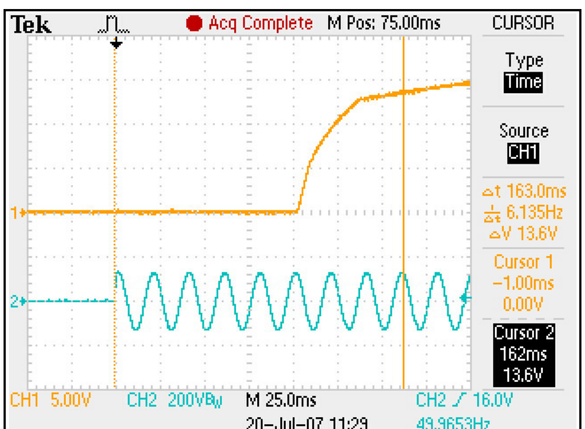


Figure 30: LCB35N Turn On Delay
Vin = 90Vac Load: Io = 2.4A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35N Performance Curves

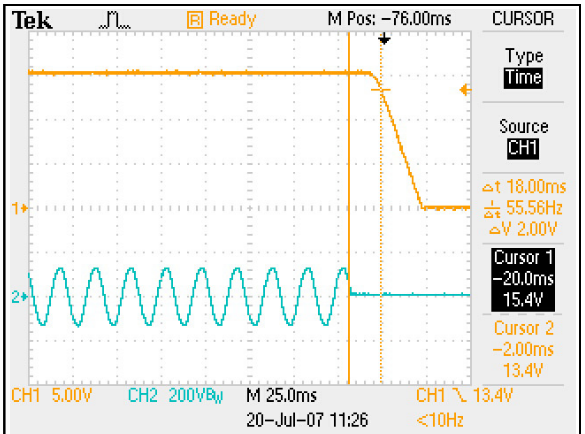


Figure 31: LCB35N Hold-up Time
Vin = 90Vac Load: Io = 2.4A
Ch 1: Vo Ch 2: AC Mains

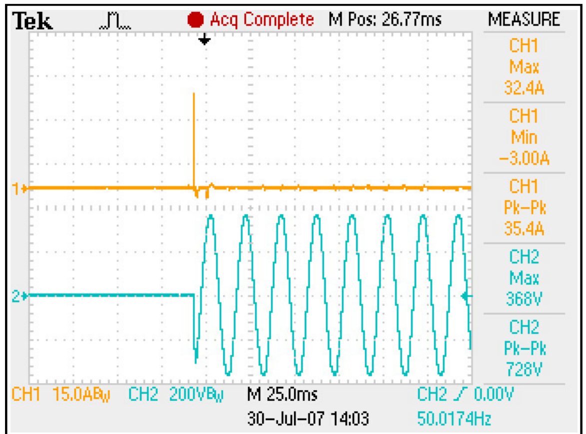


Figure 32: LCB35N Inrush Current
Vin = 264Vac Load: Io = 2.4A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

LCB35Q Performance Curves

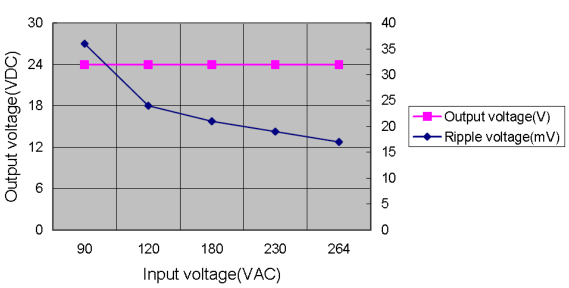


Figure 33: LCB35Q Output Ripple Voltage Versus Input Voltage
Vin = 90 to 264Vac Ta = 25 °C

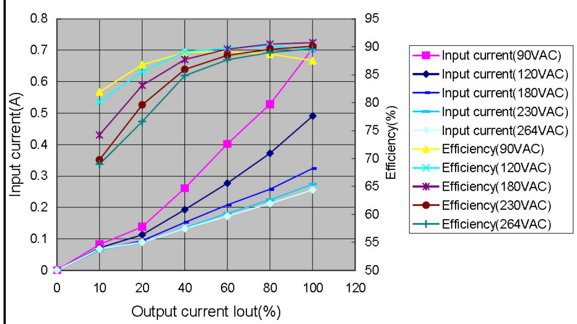


Figure 34: LCB35Q Efficiency And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-1.5A Ta = 25 °C

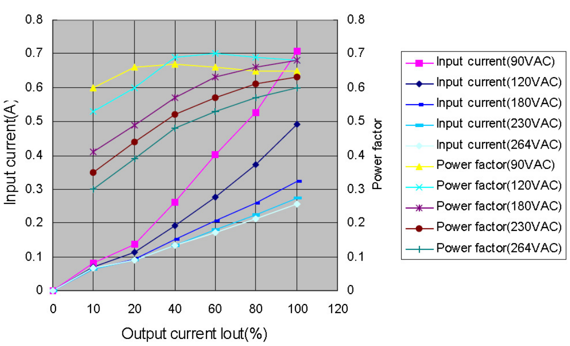


Figure 35: LCB35Q Power Factor And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-1.5A Ta = 25 °C

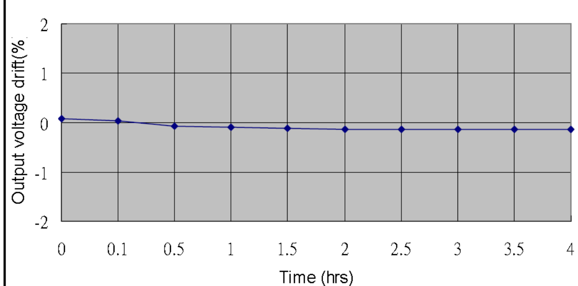


Figure 36: LCB35Q Warm Up Voltage Drift Characteristics
Vin = 230Vac Load: Io = 1.5A Ta = 25 °C

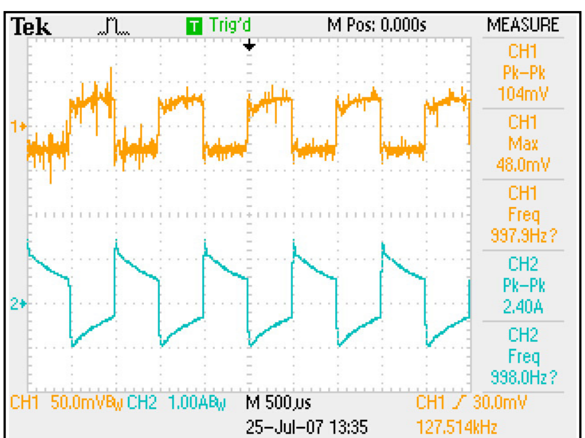


Figure 37: LCB35Q Transient Response
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

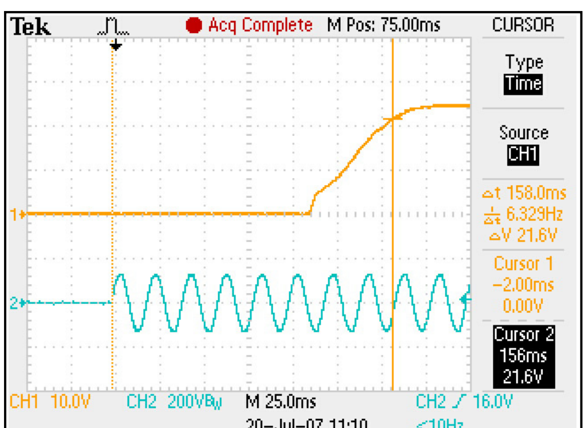


Figure 38: LCB35Q Turn On Delay
Vin = 90Vac Load: Io = 1.5A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35Q Performance Curves

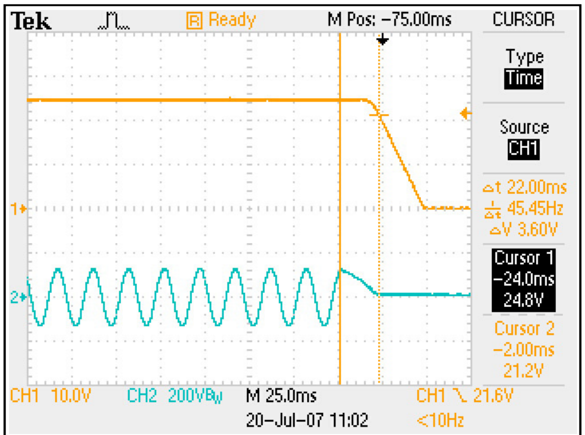


Figure 39: LCB35Q Hold-up Time
Vin = 90Vac Load: Io = 1.5A
Ch 1: Vo Ch 2: AC Mains

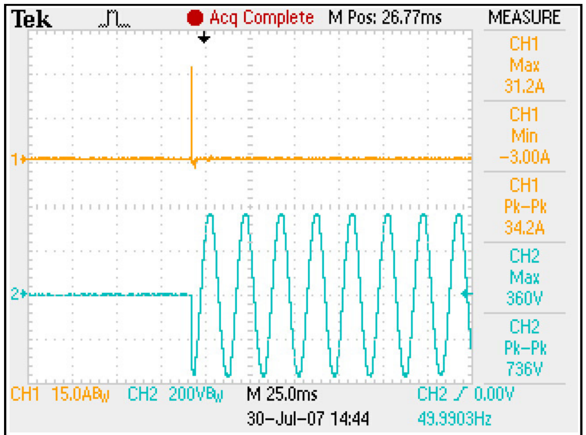


Figure 40: LCB35Q Inrush Current
Vin = 264Vac Load: Io = 1.5A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

LCB35W Performance Curves

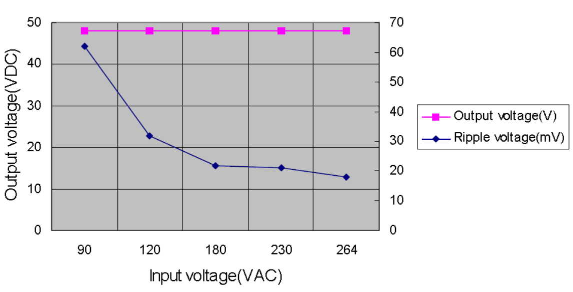


Figure 41: LCB35W Output Ripple Voltage Versus Input Voltage
Vin = 90 to 264Vac Ta = 25 °C

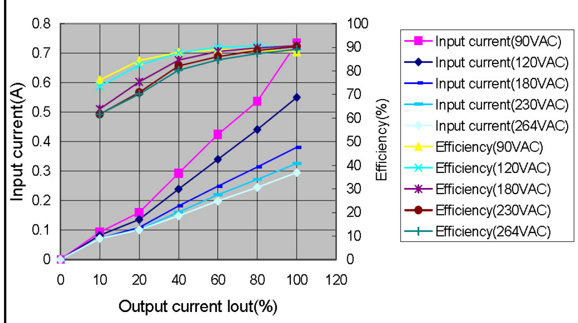


Figure 42: LCB35W Efficiency And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-0.8A Ta = 25 °C

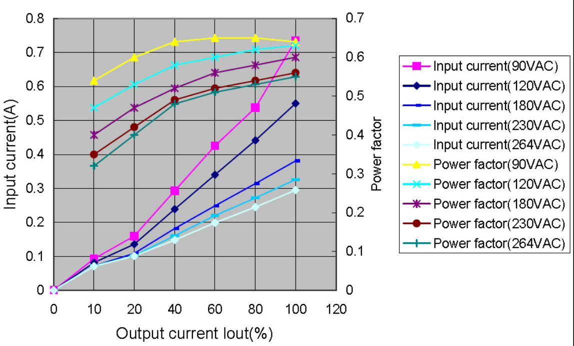


Figure 43: LCB35W Power Factor And Input Current Versus Output Current
Vin = 90 to 264Vac Load: Io = 0-0.8A Ta = 25 °C

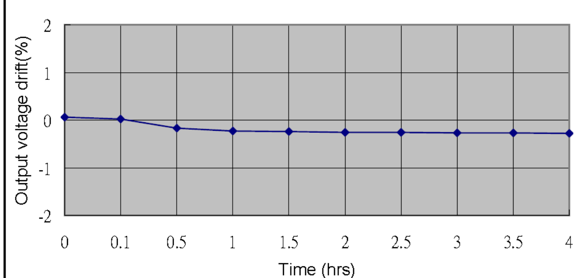


Figure 44: LCB35W Warm Up Voltage Drift Characteristics
Vin = 230Vac Load: Io = 0.8A Ta = 25 °C

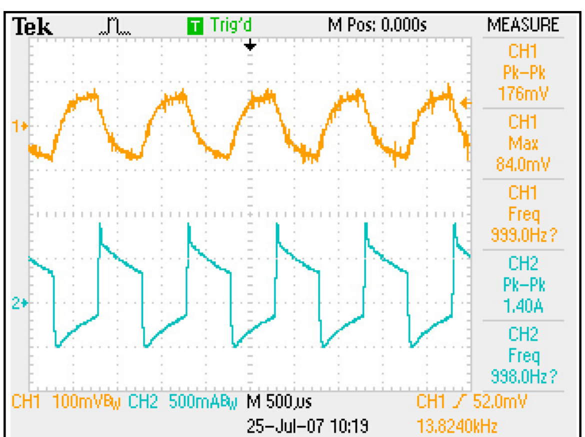


Figure 45: LCB35W Transient Response
Vin = 230Vac Load: Io = 10% to 90% load change
Ch 1: Vo Ch 2: Io

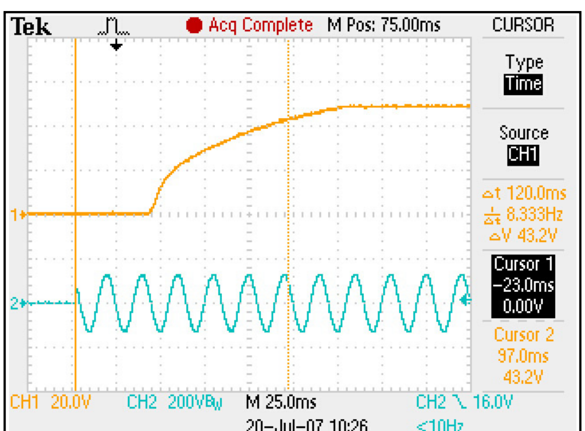


Figure 46: LCB35W Turn On Delay
Vin = 90Vac Load: Io = 0.8A Ta = 25 °C
Ch1: Vo Ch2: Vin

LCB35W Performance Curves

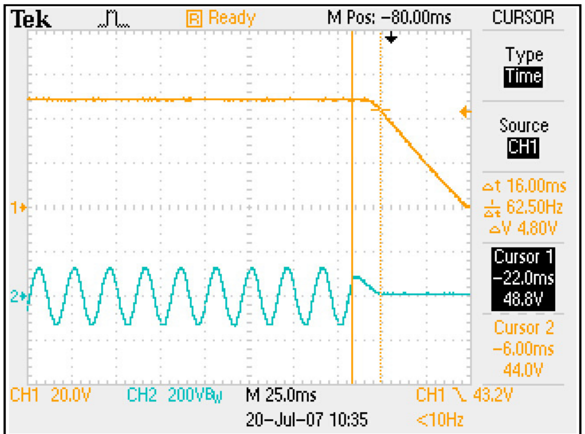


Figure 47: LCB35W Hold-up Time
Vin = 90Vac Load: Io = 0.8A
Ch 1: Vo Ch 2: AC Mains

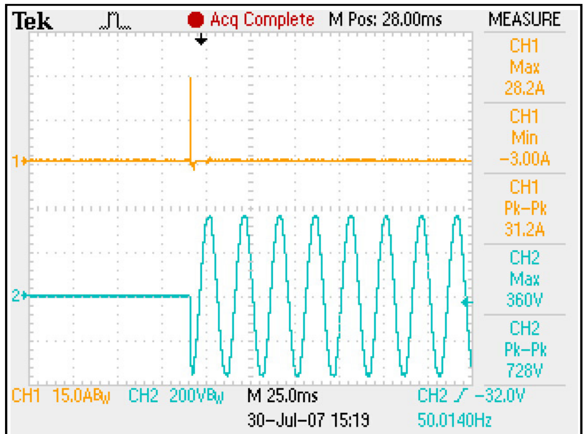


Figure 48: LCB35W Inrush Current
Vin = 264Vac Load: Io = 0.8A Turn on Angle = 90 deg
Ch 1: Iin Ch 2: AC Mains

Protective Function Specifications

Over Voltage Protection (OVP)

The power supply output voltage latches off during output overvoltage with the AC line recycled to reset the latch.

LCB35D

Parameter	Min	Nom	Max	Unit
3.3Vo Output Overvoltage	3.79	/	4.95	V

LCB35E

Parameter	Min	Nom	Max	Unit
5Vo Output Overvoltage	5.75	/	7.5	V

LCB35L

Parameter	Min	Nom	Max	Unit
12Vo Output Overvoltage	13.8	/	18	V

LCB35N

Parameter	Min	Nom	Max	Unit
15Vo Output Overvoltage	17.25	/	22.5	V

LCB35Q

Parameter	Min	Nom	Max	Unit
24Vo Output Overvoltage	27.6	/	36	V

LCB35W

Parameter	Min	Nom	Max	Unit
48Vo Output Overvoltage	55.2	/	72	V

Over Current Protection (OCP)

LCB35 series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. In the event of overloads, the output voltage may deviate from the regulation band but recovery is automatic when the load is reduced to within specified limits.

LCB35D

Parameter	Min	Nom	Max	Unit
3.3Vo Output Overcurrent	7.7	/	/	A

LCB35E

Parameter	Min	Nom	Max	Unit
5Vo Output Overcurrent	7.7	/	/	A

LCB35L

Parameter	Min	Nom	Max	Unit
12Vo Output Overcurrent	3.3	/	/	A

LCB35N

Parameter	Min	Nom	Max	Unit
15Vo Output Overcurrent	2.64	/	/	A

LCB35Q

Parameter	Min	Nom	Max	Unit
24Vo Output Overcurrent	1.65	/	/	A

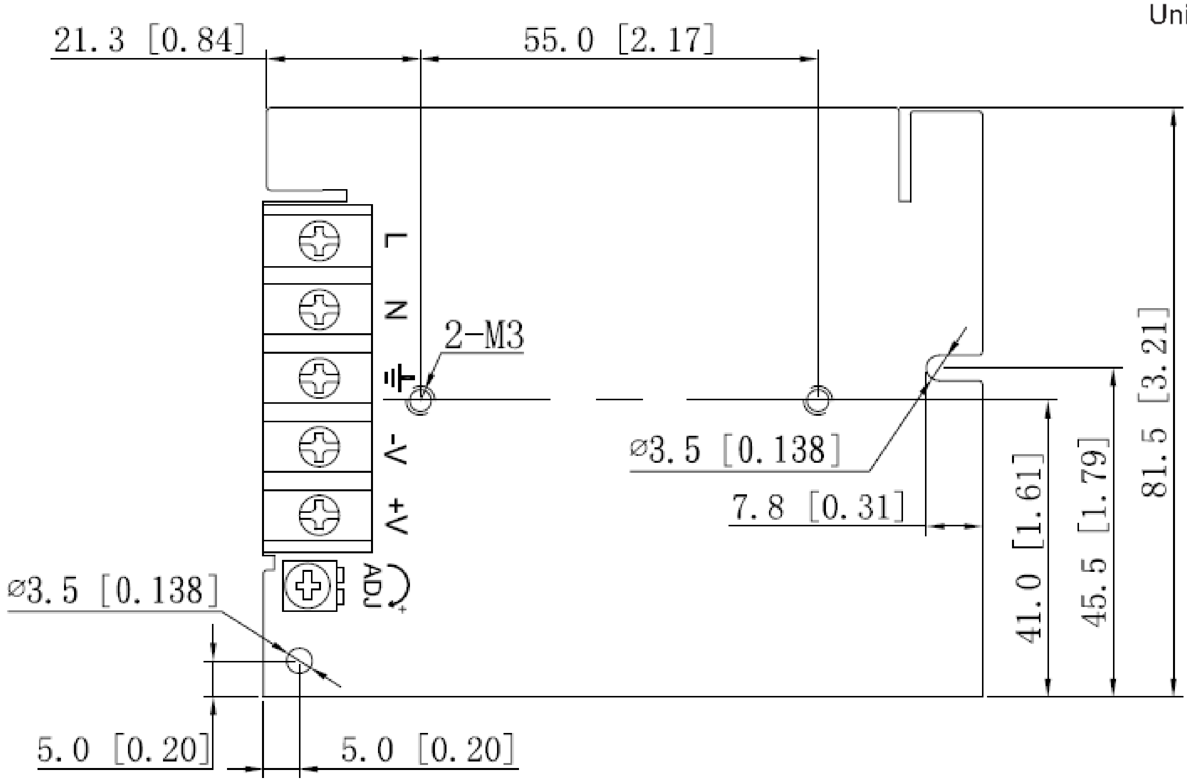
LCB35W

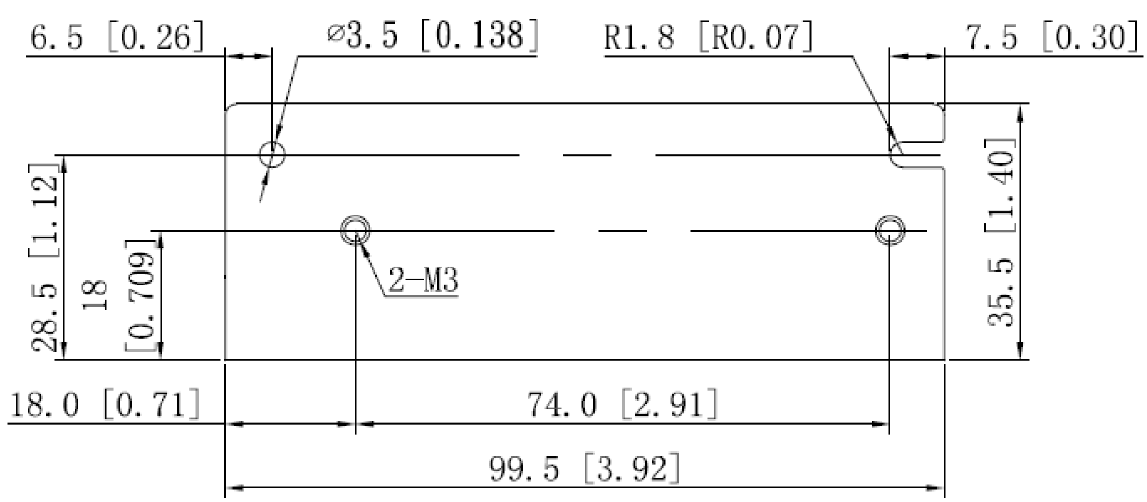
Parameter	Min	Nom	Max	Unit
48Vo Output Overcurrent	0.88	/	/	A

Mechanical Specifications

Mechanical Drawing (Dimensioning and Mounting Locations)

Unit : mm[inch]





Weight

The LCB35 Series packing weight is 0.62lb/0.28kg typical.

Environmental Specifications

EMC Immunity

LCB35 series power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:

Document	Description
EN 55022	Conducted Level B and Radiated Level B (stand alone)
EN 61000-3-2	Harmonic Distortion
EN 61000-3-3	Harmonic Distortion
EN 61204-3	EMS immunity
EN 55024	EMS immunity

Safety Certifications

The LCB35 series power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Table 5. Safety Certifications for LCB35 series power supply system:

Document	Description
UL 60950-1	US and Canada Requirements
TUV EN 60950-1	Germany and European Requirements (All CENELEC Countries)

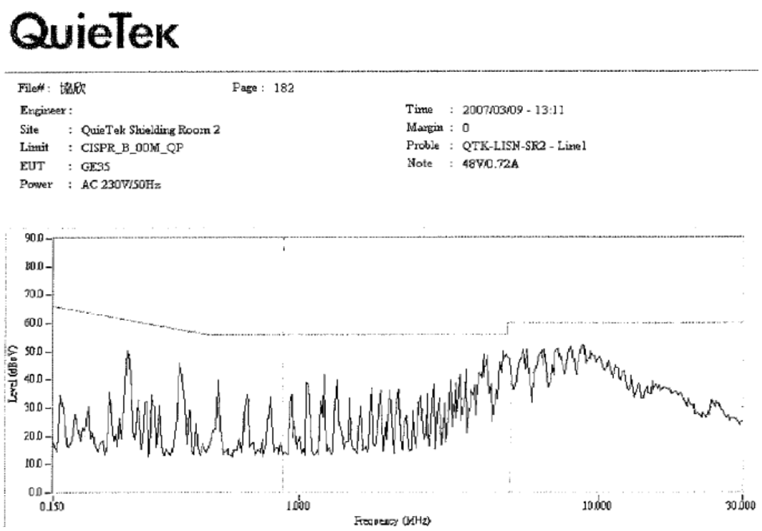
EMI Emissions

The LCB35 series has been designed to comply with the Class B limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 22 (EN55022) for emissions and relevant sections of EN61000 (IEC 61000) for immunity.

The unit is enclosed inside a metal box, tested at full load using resistive load.

Conducted Emissions

The applicable standard for conducted emissions is EN55022 (FCC Part 15). Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.



The LCB35 series power supply have internal EMI filters to ensure the convertor's conducted EMI levels comply with EN55022 (FCC Part 15) Class B and EN55022 (CISPR 22) Class B limits. The EMI measurements are performed with resistive loads under forced air convection at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 230Vac input.

Note: Red Line refers to Artesyn Quasi Peak margin, which is 6dB below the CISPR international limit. Blue Line refers to the Artesyn Average margin, which is 6dB below the CISPR international limit.

Table 6. Conducted EMI emission specifications of the LCB35 series

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class B	All	Margin	-	-	6	dB
CISPR 22 (EN55022) class B	All	Margin	-	-	6	dB

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55022 Class B (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that ‘an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample’.

MTBF and Reliability

The MTBF of LCB35 series of AC/DC converters has been calculated using MIL-HDBK 217F.
Operating Temperature @25 ^{O}C, Ground Benign.

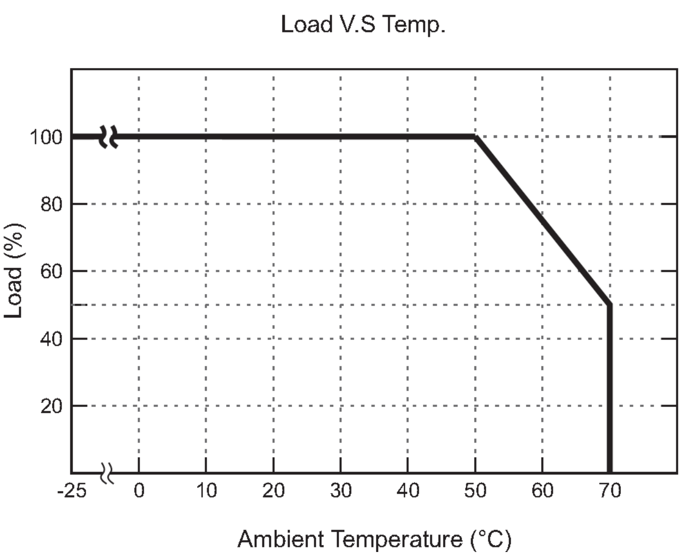
Model	MTBF	Unit
LCB35E	460	K Hrs
LCB35D	460	
LCB35L	460	
LCB35N	460	
LCB35Q	460	
LCB35W	460	

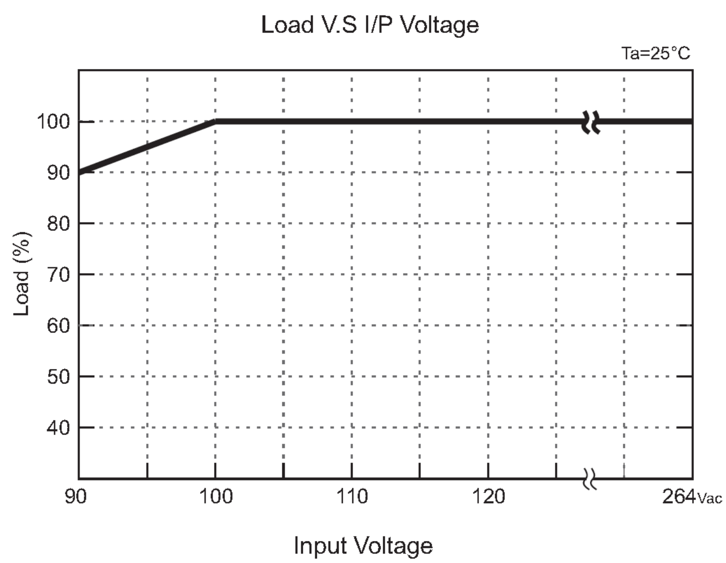
Operating Temperature

The LCB35 series start and operate within stated specifications at an ambient temperature from -25 ^{O}C to 70 ^{O}C under all load conditions (see below derating curves for other amount of convection and orientation. Derate output current and power by 2.5% per degree above 50 ^{O}C. Maximum operating ambient temperature is 70 ^{O}C (which implies a 50% derating at max 70 ^{O}C ambient).

Under convection cooling condition, the maximum output power derates linearly from full load. When input voltage is 90Vac, the maximum output power will derate to 90% full load.

Derating Curve





Storage and Shipping Temperature / Humidity

The LCB35 series can be stored or shipped at temperatures between -40 ^{O}C to +85 ^{O}C and relative humidity from 10% to 95%, non-condensing.

Humidity

The LCB35 series will operate within specifications when subjected to a relative humidity from 20% to 90% non-condensing. The LCB35 series can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

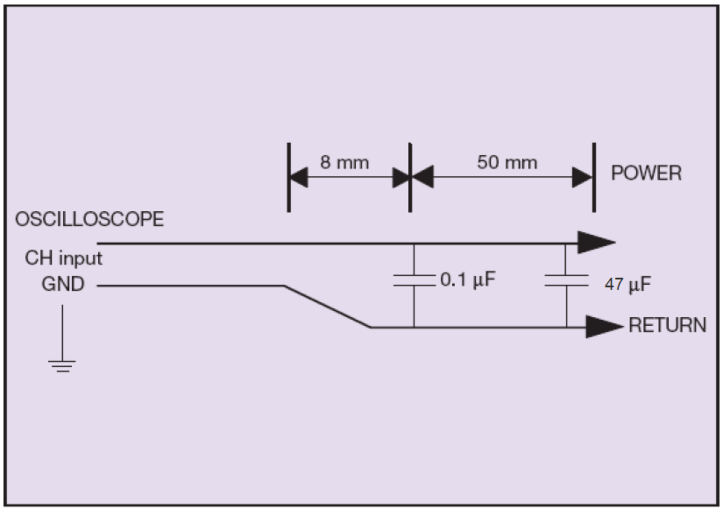
The LCB35 series will pass the following vibration specifications:

Acceleration	5	gRMS
Frequency Range	10-500	Hz
Duration	60 min per Axis, 180 min total	mins
Direction	3 mutually perpendicular axis	
PSD Profile	**FREQ** 10-500 Hz / **SLOPE dB/oct** ---	**PSD g^2/Hz** ---

Application Notes

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the LCB35 series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 47uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20MHz bandwidth for this measurement.



Record of Revision and Changes

Issue	Date	Description	Originators
1.0	08.05.2015	First Issue	S.Dong
1.1	07.21.2017	Update the vibration	A.Zhang

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