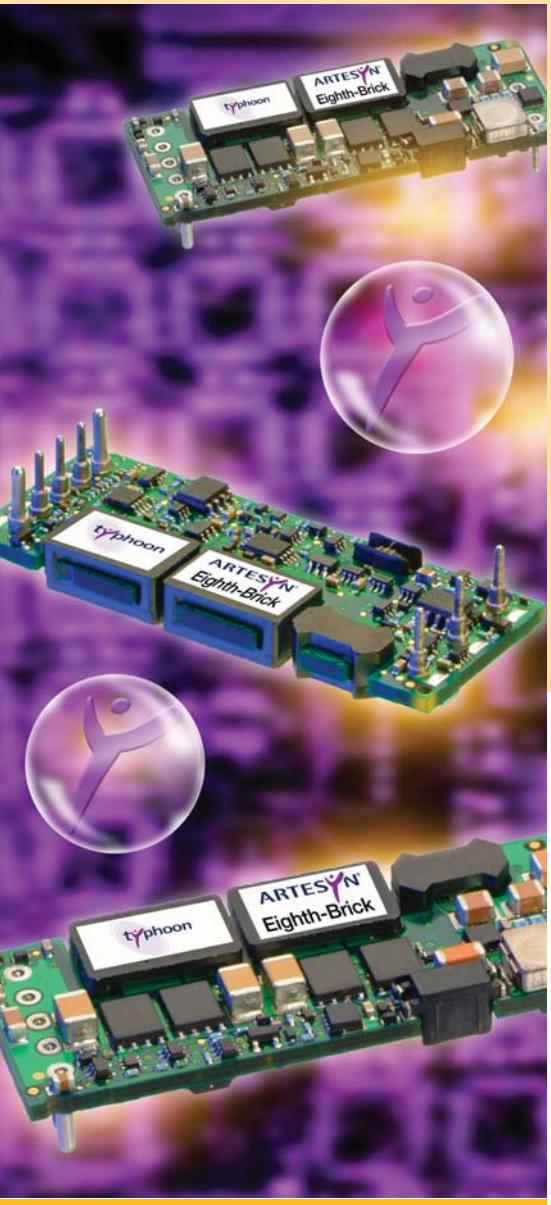
typhoon

EIGHTH-BRICK SERIES

Single Output Value Products



- High efficiency topology and high output current
- Low profile, 0.300in (7.62mm) height
- Industry standard 1/8 brick footprint (identical to 1/4 brick pinout)
- 38% savings in space over industry standard 1/4 brick converters
- Wide operating ambient temperature range, -40°C to +85°C
- 80% to 110% output trim
- Basic insulation
- Overvoltage and overtemperature protection
- Remote ON/OFF
- Approvals to EN60950 VDE and UL/cUL60950
- 100V, 100mSec input voltage transients rated
- Monotonic startup into normal and prebiased loads
- Secondary side control, no optocouplers, fast transient response

The Eighth-Brick Value series is a new low cost, high efficiency, open frame, isolated, up to 25A converter in an industry standard eighth-brick footprint and operates from a 36 to 75VDC supply. This new series elevates the power density threshold for high-end application design requirements where high output current at low voltages are required. The converter architecture takes advantage of open-frame construction to provide low mass and a low thermal impedance for a single board design.

Additionally, a patent pending, full wave coupled inductor topology yields some of the highest full load efficiencies in the industry. All Eighth-Brick converters have, as standard features, remote ON/OFF capability, adjustable output voltage trim from 80 to 110% of nominal, over-current/under-voltage protection, and full international safety approval including EN60950 VDE and cUL1950.

[2 YEAR WARRANTY]

c UL us VDE

ARTESYN TECHNOLOGIES

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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	$V_{in\ (peak)}$	-0.3		100	V DC	Transients of 100mSec or less, in duration
Input voltage - remote pin	$V_{rem\ (peak)}$	-0.3		75	V DC	Peaks of any duration
Operating temperature	T_{op}	-40		85	°C	Measured at ambient
Storage temperature	$T_{storage}$	-55		125	°C	
Output power (LES25A48-1V2)	Pout (max)			30	W	
Output power (LES25A48-1V5)	Pout (max)			37.5	W	
Output power (LES25A48-1V8)	Pout (max)			45	W	
Output power (LES20A48-2V5)	Pout (max)			50	W	
Output power (LES20A48-3V3)	Pout (max)			66	W	
Output power (LES10A48-5V0)	Pout (max)			50	W	

All specifications are typical at nominal input Vin = 48V and full rated resistive load at 25°C ambient unless otherwise specified.

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input voltage - operating	$V_{in\ (oper)}$	36	48	75	V DC	
Input current - no load	I_{in}			50	mADC	$V_{in\ (min)} - V_{in\ (max)}$, enabled
Input current - Quiescent	$I_{in\ (off)}$		6		mADC	Converter disabled
Inrush current (i^2t)	Iinrush		0.01		A^2s	
Inrush current ratio	I_t/I_m		22			
Input ripple rejection			50		dB	Frequency <1 kHz
Input fuse				10	A	Slow Blow/Antisurge HRC recommended 200V Rating. See Application Note 138

Turn On/Off

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input voltage - turn on	$V_{in\ (on)}$		35.5	36	V DC	
Input voltage - turn off	$V_{in\ (off)}$	33	33.5		V DC	
Turn on delay - enabled, then power applied	T_{delay} (power)		10	15	msec	With the Remote ON/OFF signal asserted, time from when $V_{in} > V_{in}$ (oper) until Vout is within total regulation band
Turn on delay - power applied, then enabled	T_{delay} (enable)		10	15	msec	With $V_{in} = V_{in\ (nom)}$, then Remote ON/OFF asserted, time until Vo is within total error band
Rise time	T_{rise}		2	3	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
At remote ON/OFF (control) pin Open collector or equivalent compatible						**See Notes 1 and 2**
Control pin open circuit voltage	V_{ih}		2.8	3.5	V	I_{ih} = 0µA; open circuit voltage
High level input voltage	V_{ih}	2.4			V	Converter guaranteed ON when control pin is greater than V_{ih} (min)
High level input current	I_{ih}			10	µA	Current flowing into control pin when pin is pulled high (max. at V_{ih} = 75V)
Acceptable high level leakage current	I_{ih} (leakage)			-10	µA	Acceptable leakage current from signal pin into the open collector driver (neg = from converter)
Low level input voltage	V_{il}	-0.3		0.4	V	Converter guaranteed off when control pin is less than V_{il} (max)
Low level input current	I_{il} (max)		-0.45	-0.5	mA	V_{il} = 0.0 V, maximum source current from converter with short circuit

Common Protection/Control

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overtemperature shutdown threshold	Tots	120	125	130	°C	Hotspot temperature, non-latching shutdown protection. See Application Note 138
Remote sense compensation				10	%	% of Vo (nom), compensation includes trim.

Reliability and Service Life

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Mean time between failure	MTBF		4,034,120		Hours	Telcordia Tech. SR-332 Tamb = 25°C, Tcase = 20°C rise airflow = 400LFM, V_{in} = V_{in} (nom), I_{out} = 50% I_{out} (max)

Isolation

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input to output test voltage				2250	V DC	Test duration 1s
Input to output capacitance			1500		pF	
Input to output resistance		100			MΩ	Measured with 500VDC
Input to output insulation system			Basic			

Other Specifications

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Switching frequency	f_{sw}		480		kHz	Fixed frequency (all models)

Environmental Requirements

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Thermal performance		-40		120	°C	Hotspot temperature
Altitude				3000	m	Derate total max. output current by 20%
				9843	ft	Derate total max. output current by 20%
				10000	m	Derate total max. output current by 50%
				32808	ft	Derate total max. output current by 50%

Type	Parameter	Reference	Test Level
Air temperature		IEC 60068-2-1 Ab/Ad: Cold	-40°C, 16h
		IEC 680068-2-2 Bb/Bd: Dry heat	+70°C, 16h
		IEC 68-2-14 Nb: Rate of change	-5°C/+45°C, 0.5°C/min 2 cycles, 3h ea
Relative humidity		IEC60068-2-56 Cb: damp heat, steady state	+35°C, 93% RH, 4 days 50% of samples powered at 10% load and 50% unpowered
Vibration		IEC60068-2-6 Fc: sinusoidal	3 axes, 5 sweeps per axis unpowered on test card. Freq. range and displacement 5-9Hz, 1.2mm. Freq. range and acceleration 9-200Hz, 10m/s²
Shock and Bump		IEC 60068-2-29 Eb: bump	100 bumps each of 6 directions, mounted on powered on test card, shock spectrum half-sine, duration

EMC Electromagnetic Compatibility

Phenomenon	Port	Standard	Test level	Notes and conditions
Immunity:				
ESD	Enclosure	EN61000-4-2	6kV contact 8kV air	Level 3, (output within specification) Level 3, (output within specification
Radiated field	Enclosure	EN61000-4-3	10V/m	Level 3, (output within specification) X and Y axes
Conducted	DC power	EN61000-4-6	10V	
Input transients	DC power	ETR 283		With recommended Class B external filter, no load, 10J (output remains within ±9%)

Standards Compliance List

Characteristic	
EN60950 UL/cUL 1950 VDE	3rd edition

Safety Agency Approvals

Standard	Category
UL/cUL 1950 File Number	E135734
VDE Certificate No.	10401-3336-0197

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
LES25A48-1V2	36-75VDC	1.2V	1.4V	25A	88.0%
LES25A48-1V5	36-75VDC	1.5V	1.8V	25A	89.5%
LES25A48-1V8	36-75VDC	1.8V	2.2V	25A	90.5%
LES20A48-2V5	36-75VDC	2.5V	3.0V	20A	90.0%
LES20A48-3V3	36-75VDC	3.3V	4.0V	20A	91.0%
LES10A48-5V0	36-75VDC	5.0V	6.0V	10A	92.0%

LES25A48-1V2 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		0.71		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			0.97	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 150		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES25A48-1V2 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	1.18	1.20	1.22	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	1.16		1.24	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		25	A DC	
Output current - short circuit	I_{sc}		10		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		20 70		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec)
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		40,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		20 10	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES25A48-1V2 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	1.38		1.56	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	26.25	28.5	31.25	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 30 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			1.20		V DC	

LES25A48-1V2 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	87.0	88.0		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		89.5		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

LES25A48-1V5 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		0.88		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			1.20	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 150		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES25A48-1V5 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	1.48	1.50	1.52	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	1.45		1.55	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		25	A DC	
Output current - short circuit	I_{sc}		10		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		20 70		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec)
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		40,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		20 10	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES25A48-1V5 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	1.72		1.95	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	26.25	28.5	31.25	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 37.5 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			1.50		V DC	

LES25A48-1V5 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	88.0	89.5		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		90.5		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

LES25A48-1V8 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		1.04		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			1.42	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 150		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES25A48-1V8 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	1.77	1.80	1.83	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	1.75		1.85	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		25	A DC	
Output current - short circuit	I_{sc}		10		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		20 70		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec)
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		40,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		20 10	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES25A48-1V8 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	2.07		2.25	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	26.25	28.5	31.25	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 45 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			1.80		V DC	

LES25A48-1V8 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	89.0	90.5		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		91.5		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

LES20A48-2V5 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		1.16		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			1.59	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 150		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES20A48-2V5 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	2.46	2.50	2.54	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	2.42		2.58	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		20	A DC	
Output current - short circuit	I_{sc}		7		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		20 90		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec)
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		10,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		25 5	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES20A48-2V5 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	2.87		3.12	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	21	23	25	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 50 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			2.50		V DC	

LES20A48-2V5 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	88.5	90.0		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		90.8		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

LES20A48-3V3 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		1.51		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			2.12	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 150		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES20A48-3V3 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	3.25	3.30	3.35	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	3.20		3.40	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		20	A DC	
Output current - short circuit	I_{sc}		7		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		25 90		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		10,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		25 5	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES20A48-3V3 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	3.80		4.13	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	21	23	25	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 66 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			3.30		V DC	

LES20A48-3V3 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	89.5	91.0		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		92.0		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

LES10A48-5V0 Model

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		1.13		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$
Input current - maximum	$I_{in\ (max.)}$			1.55	A DC	$V_{in} = V_{in\ (min)}$; $I_{out} = I_{out\ (max)}$; $V_o = V_{o\ (nom)}$, measured at converter
Input Capacitor ripple current	$I_{in\ (ripple)}$		50 100		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured without standard filter. See Application Note 138
Reflected ripple current	$I_{in\ (refl)}$		2 7.5		mA RMS mA pk-pk	$I_{out} = I_{out\ (max)}$, measured with standard filter. See Application Note 138
Input capacitance - Internal	C_{input}		1.75		µF	Internal to converter
Input capacitance - External bypass	C_{bypass}		33		µF	Recommended customer added capacitance, <0.7Ω ESR

LES10A48-5V0 Model

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	4.92	5.00	5.08	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (nom)}$
Total regulation band	V_o	4.85		5.15	V DC	For all line, static load and temperature until end of life.
Line regulation			0.01	0.1	%	$I_{out} = I_{out\ (nom)}$, $V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation			0.02	0.2	%	$V_{in} = V_{in\ (nom)}$, $I_{out\ (min)}$ to $I_{out\ (max)}$
Temperature regulation				0.02	±%/°C	$V_{in} = V_{in\ (nom)}$, $I_{out} = I_{out\ (max)}$
Output current continuous	Iout	0		10	A DC	
Output current - short circuit	I_{sc}		6		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Load transient response - peak deviation	$V_{dynamic}$/ Vo (nom)		40 120		mV mV	Peak deviation for 50% to 75% step load, di/dt = 100mA/µsec, step load, di/dt = 1A/µsec
Load transient response - recovery	$T_{recovery}$		20		µsec	Settling time to within 1% of output set point voltage for 50% to 75% load step
External load capacitance	C_{ext}	0		10,000	µF	Higher load capacitance values may be possible. Contact Artesyn Technologies for details
Output voltage - noise	V_{p-p} V_{rms}		25 5	60 20	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 138 for test set-up

LES10A48-5V0 Model

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overvoltage setpoint	V_{ov}	5.75		6.25	V DC	Non-latching. See Application Note 138 for details
Overcurrent limit inception	I_{oc}	10.5	11.5	12.5	A DC	V_o = 90% of V_o (nom)
Output voltage trim range				110	%	Trim up (% of $V_{o\ nom}$) Limit O/P to 50 Watts
		80			%	Trim down (% of $V_{o\ nom}$) See Application Note 138 for details of trim equations and trim curves
Open sense voltage			5.0		V DC	

LES10A48-5V0 Model

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	90.5	92.0		%	I_{out} = 100% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$
Efficiency	η		93.0		%	I_{out} = 50% $I_{out\ (max)}$, V_{in} = $V_{in\ (nom)}$

File Name: lf_eighth_brick_value.pdf Rev (03): 13 May 2004

LES25A48-1V2 Model

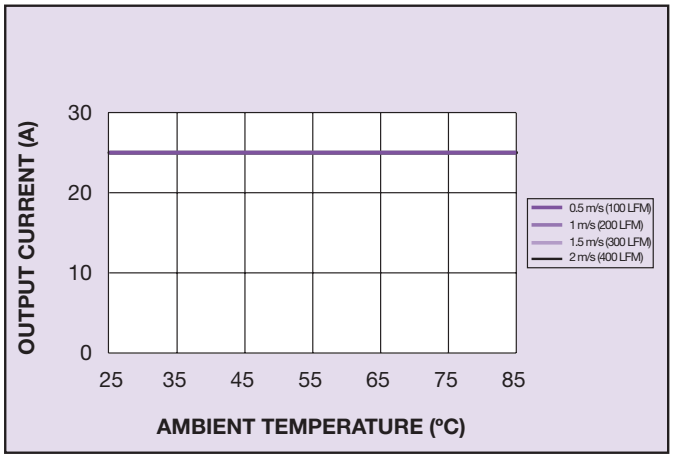


Figure 1: Derating Curve with Forced Air

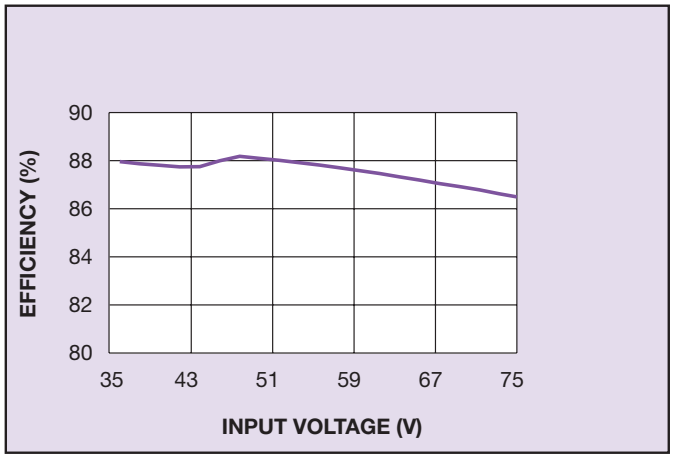


Figure 2: Efficiency vs. Line

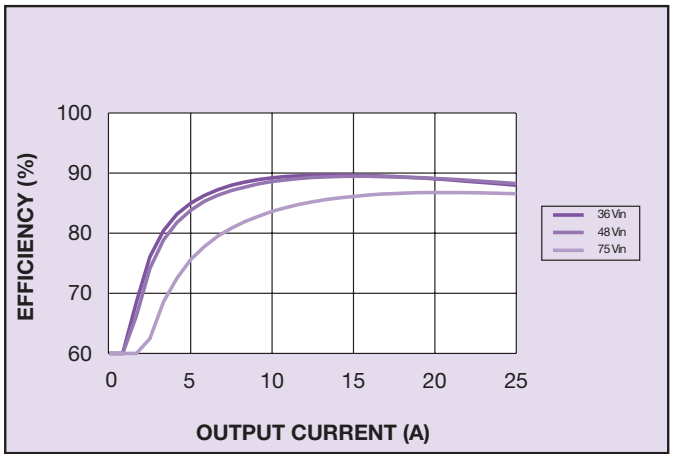


Figure 3: Efficiency vs. Load

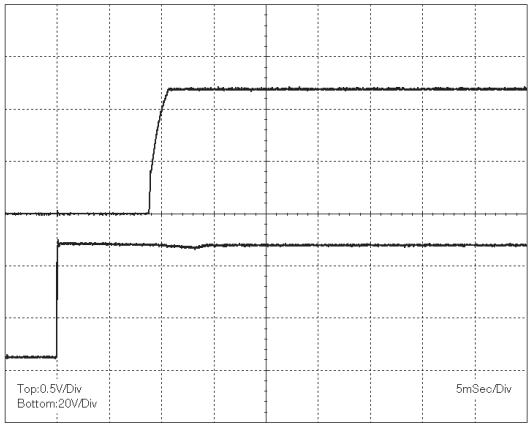


Figure 4: Turn-On Characteristic,
Top (Vout), Bottom (Vin)

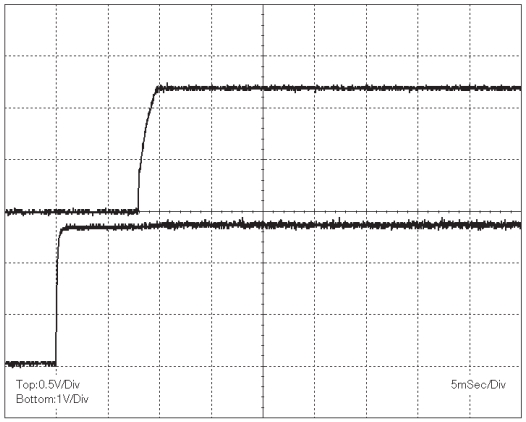


Figure 5: Control On/Off Characteristic,
Top (Vout), Bottom (Remote ON/OFF)

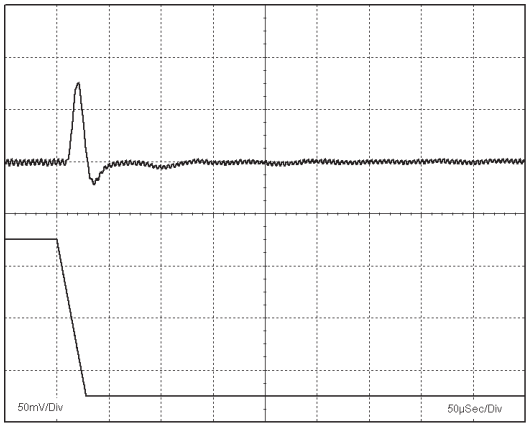


Figure 6: Typical Transient Response 75-50%
Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES25A48-1V2 Model

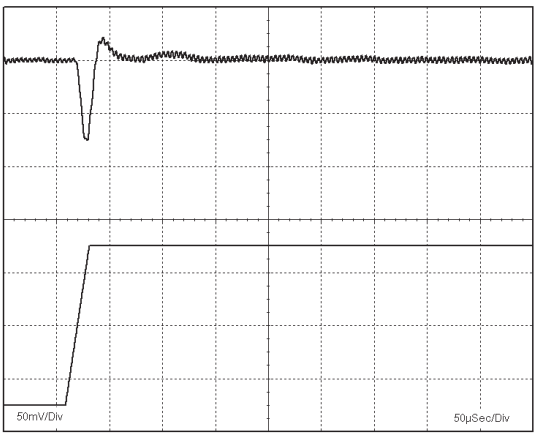


Figure 7: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

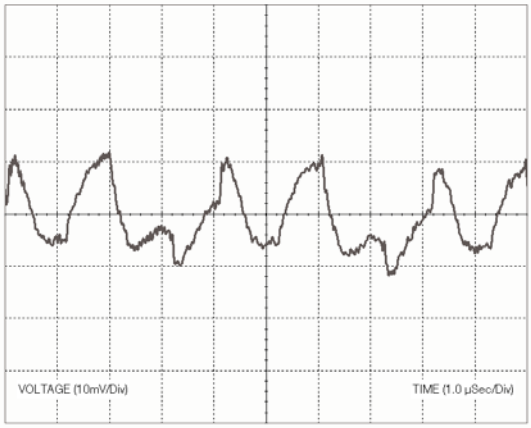


Figure 8: Typical Output Ripple and Noise Measurement

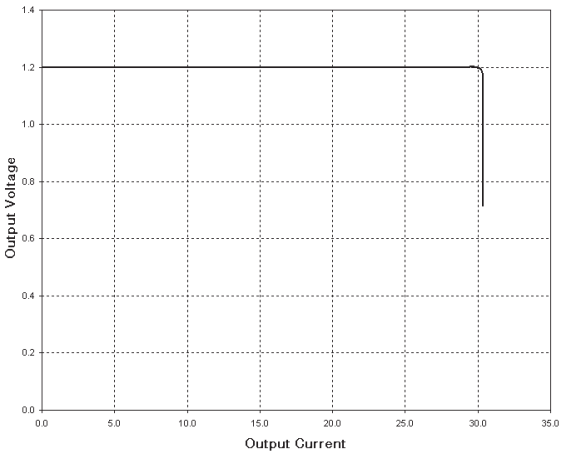


Figure 9: Current Limit Characteristic

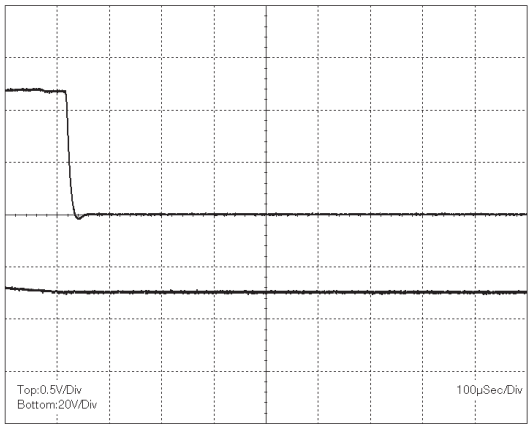


Figure 10: Turn-Off Characteristic

LES25A48-1V5 Model

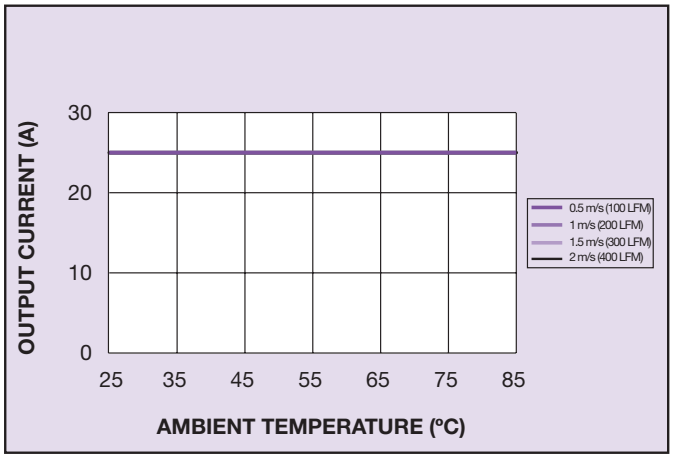


Figure 11: Derating Curve with Forced Air

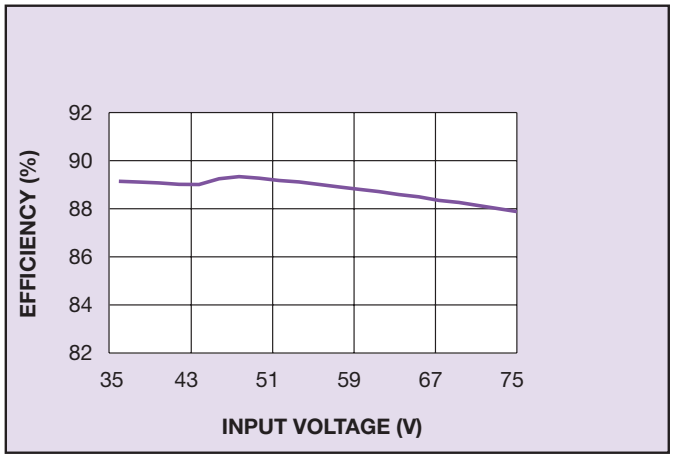


Figure 12: Efficiency vs. Line

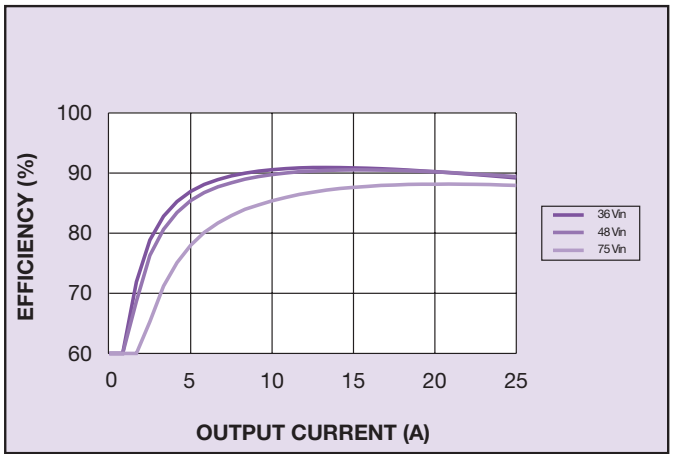


Figure 13: Efficiency vs. Load

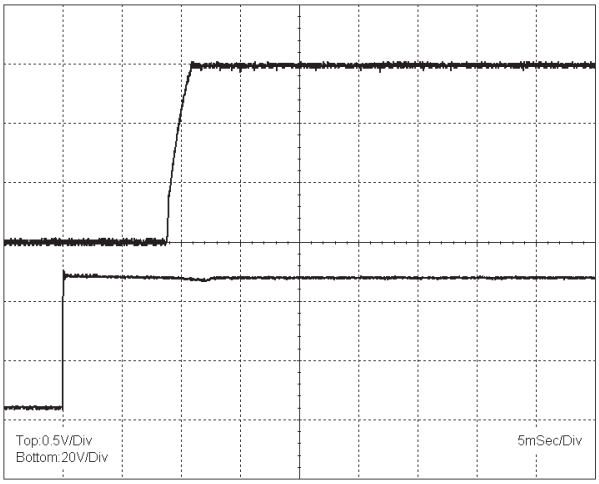


Figure 14: Turn-On Characteristic,
Top (Vout), Bottom (Vin)

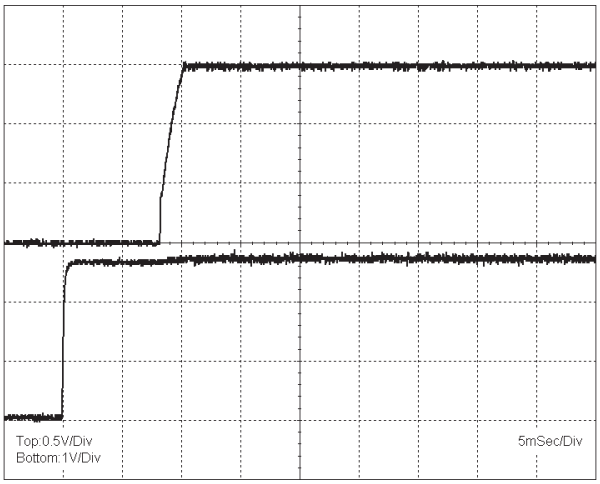


Figure 15: Control On/Off Characteristic,
Top (Vout), Bottom (Remote ON/OFF)

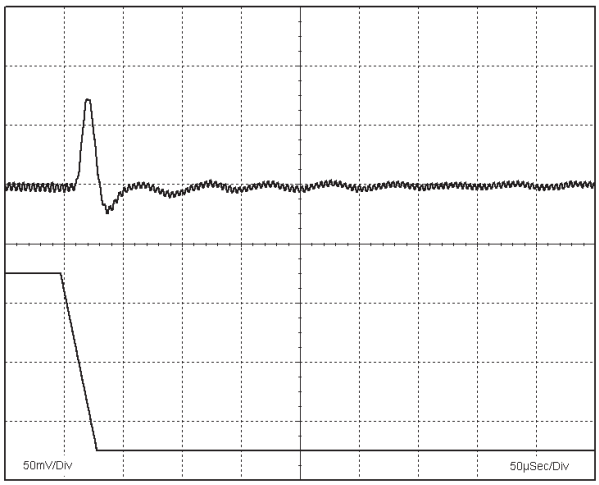


Figure 16: Typical Transient Response 75-50%
Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES25A48-1V5 Model

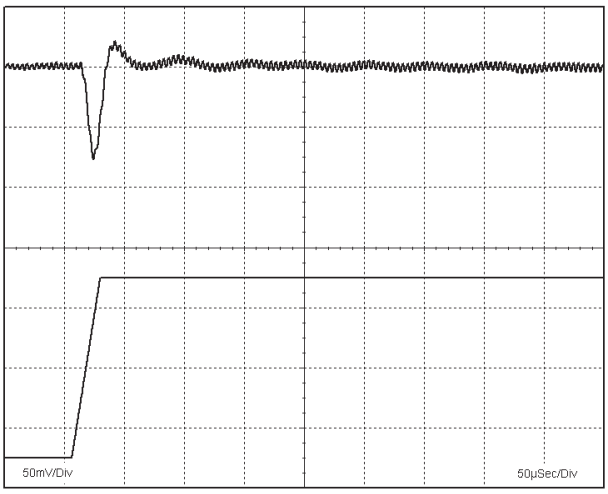


Figure 17: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

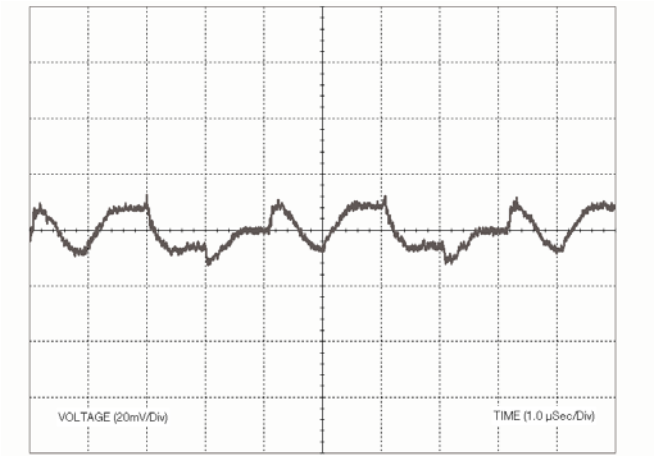


Figure 18: Typical Output Ripple and Noise Measurement

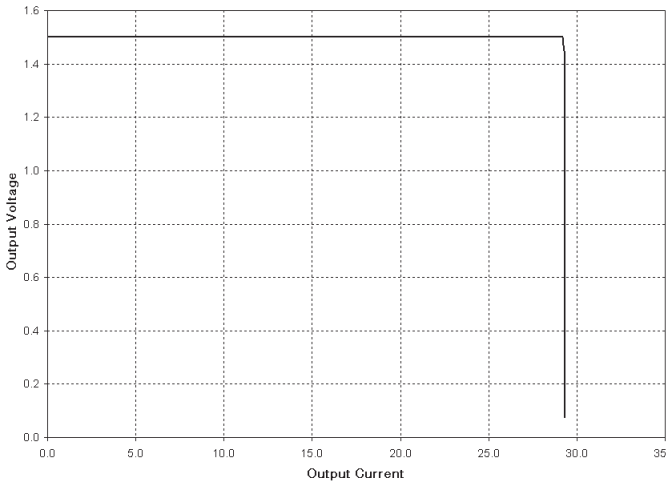


Figure 19: Current Limit Characteristic

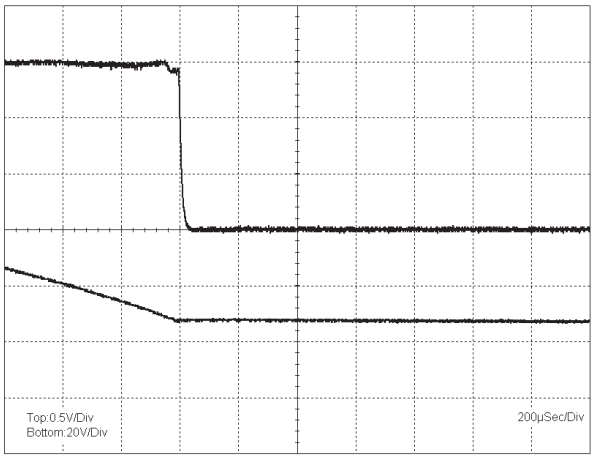


Figure 20: Turn-Off Characteristic

LES25A48-1V8 Model

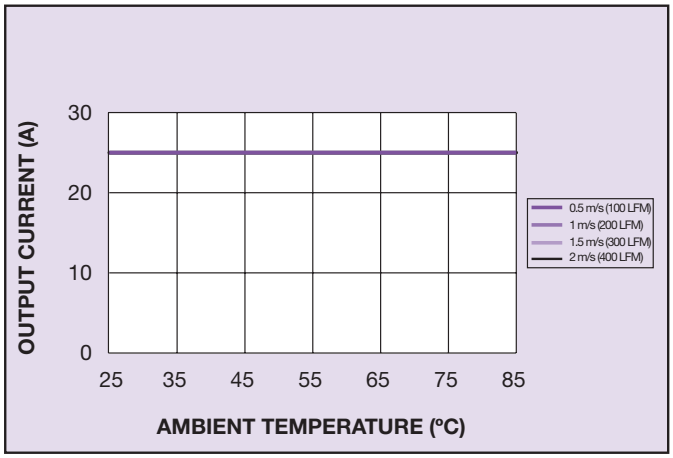


Figure 21: Derating Curve with Forced Air

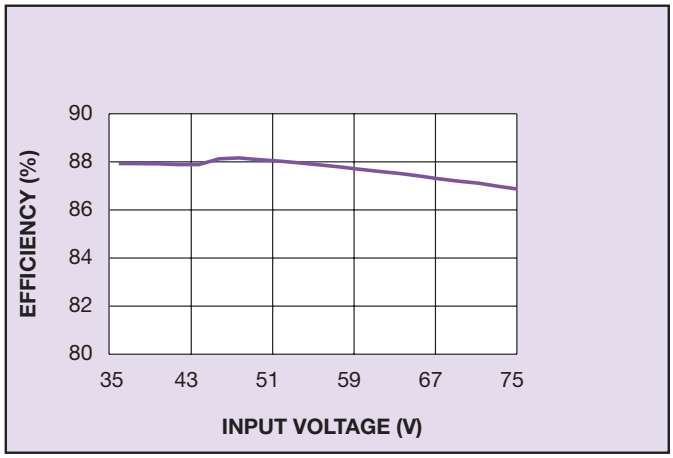


Figure 22: Efficiency vs. Line

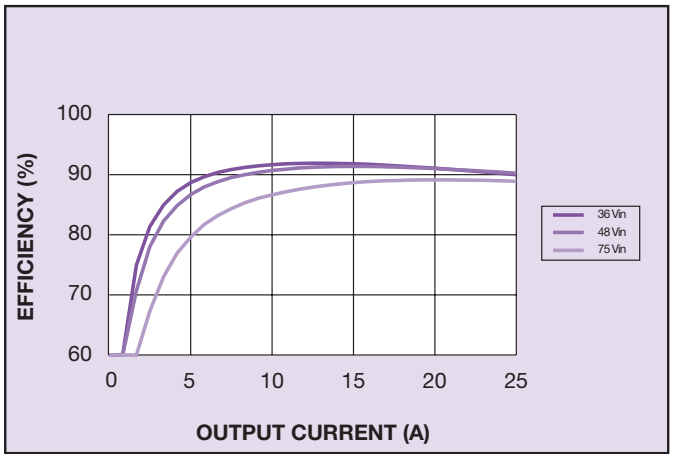


Figure 23: Efficiency vs. Load

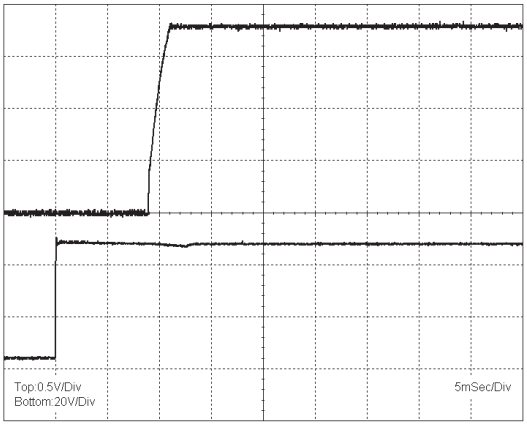


Figure 24: Turn-On Characteristic, Top (Vout), Bottom (Vin)

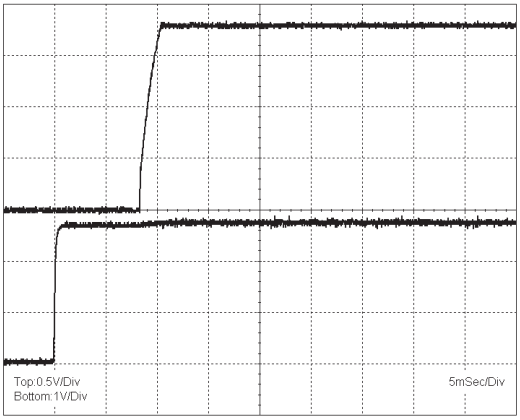


Figure 25: Control On/Off Characteristic, Top (Vout), Bottom (Remote ON/OFF)

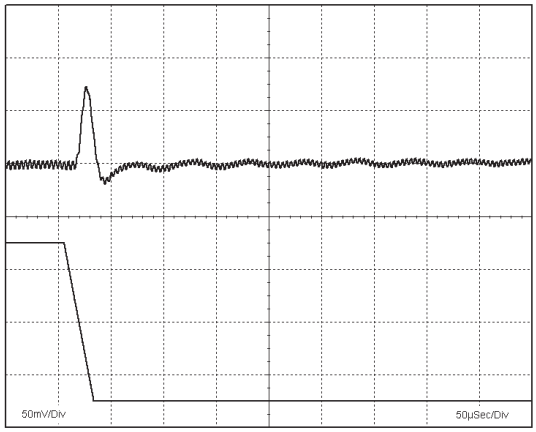


Figure 26: Typical Transient Response 75-50% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES25A48-1V8 Model

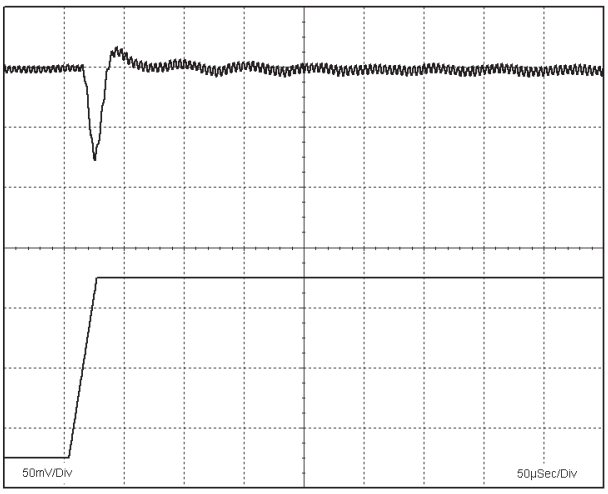


Figure 27: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

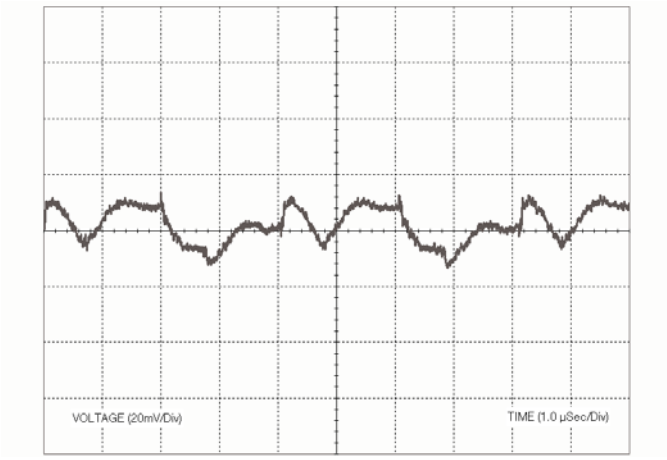


Figure 28: Typical Output Ripple and Noise Measurement

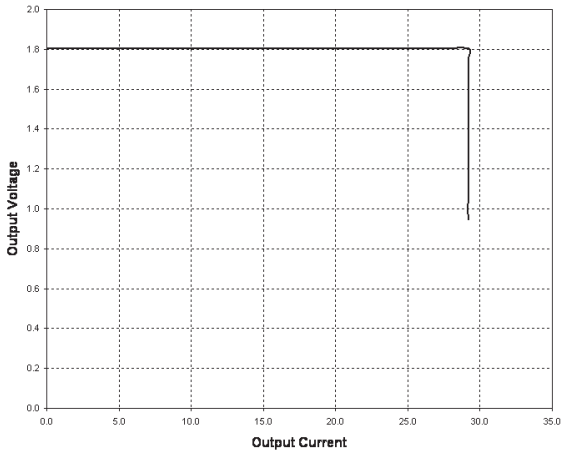


Figure 29: Current Limit Characteristic

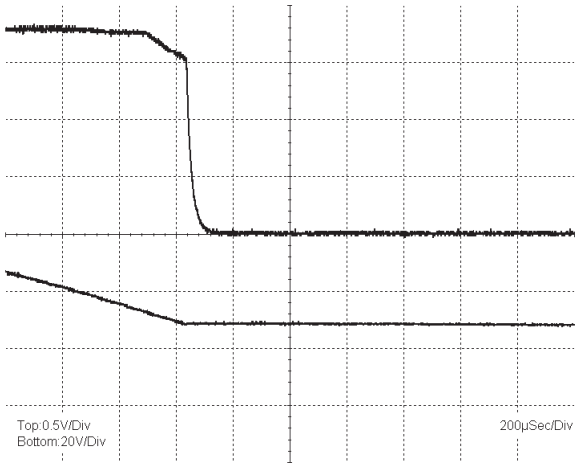


Figure 30: Turn-Off Characteristic

LES20A48-2V5 Model

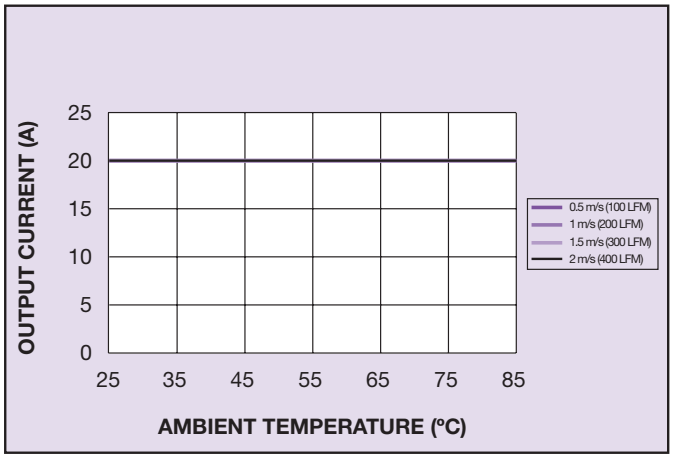


Figure 31: Derating Curve with Forced Air

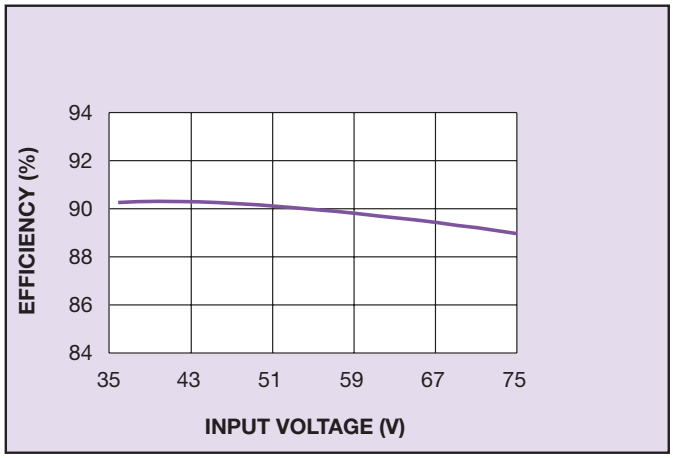


Figure 32: Efficiency vs. Line

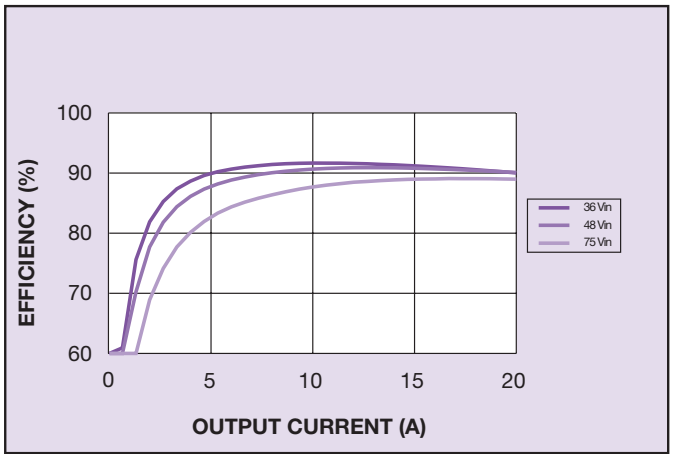


Figure 33: Efficiency vs. Load

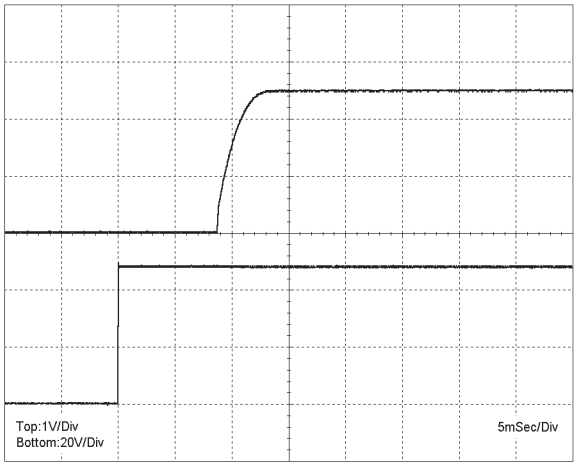


Figure 34: Turn-On Characteristic,
Top (Vout), Bottom (Vin)

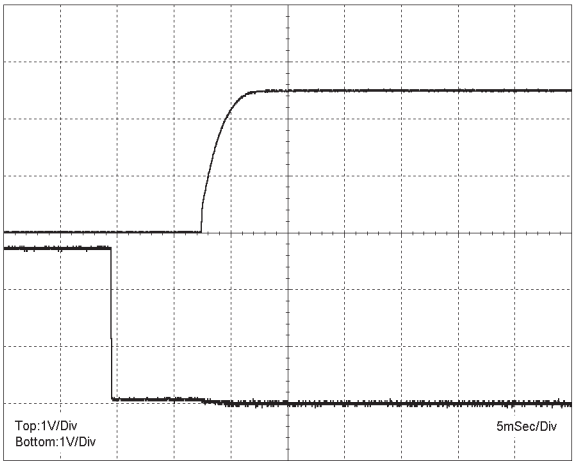


Figure 35: Control On/Off Characteristic,
Top (Vout), Bottom (Remote ON/OFF)

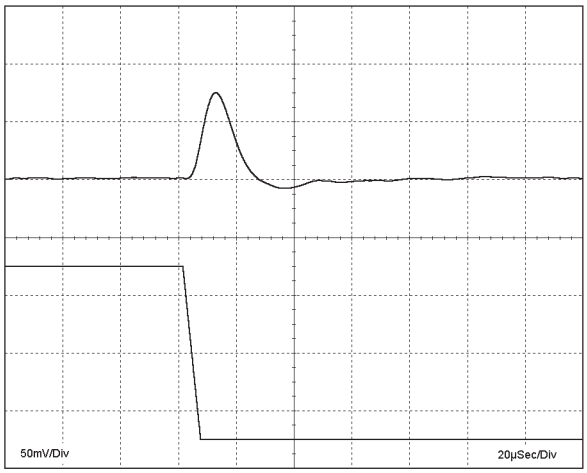


Figure 36: Typical Transient Response 75-50%
Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES20A48-2V5 Model

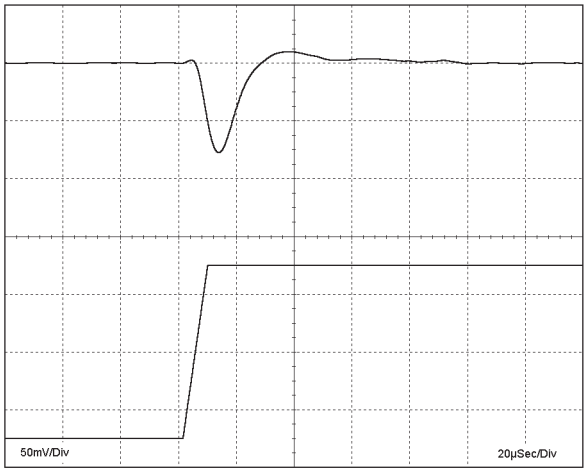


Figure 37: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

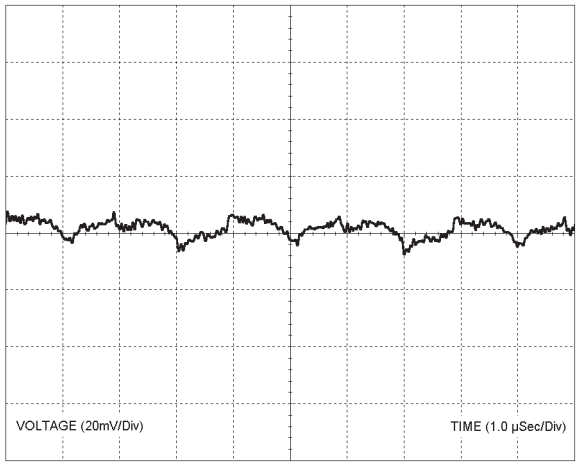


Figure 38: Typical Output Ripple and Noise Measurement

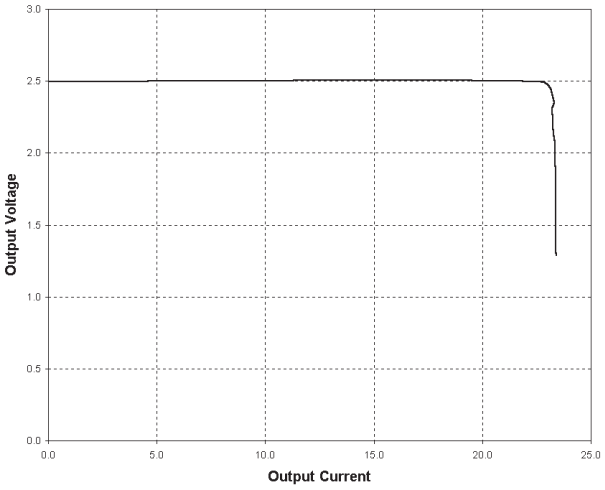


Figure 39: Current Limit Characteristic

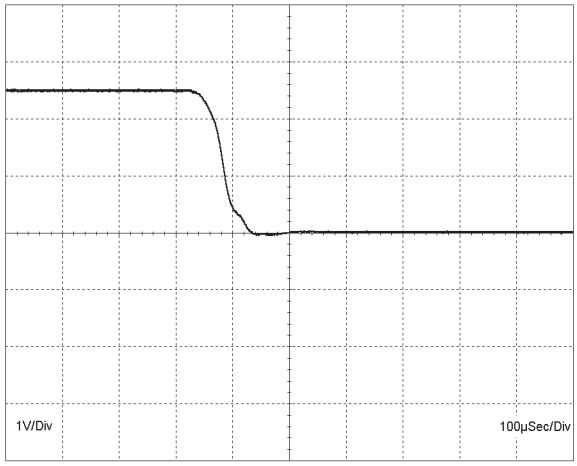


Figure 40: Turn-Off Characteristic

LES20A48-3V3 Model

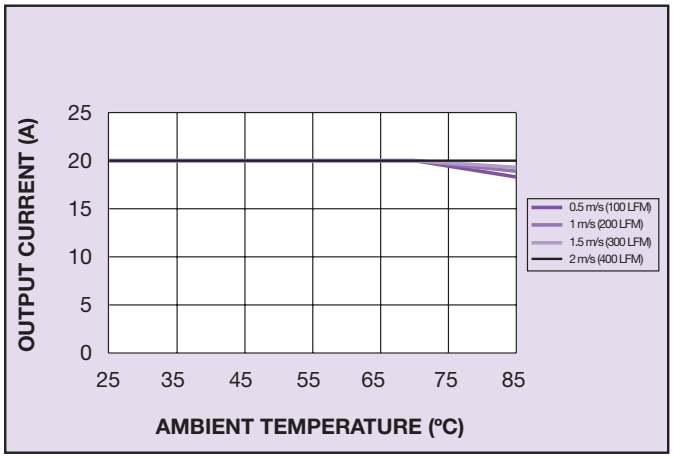


Figure 41: Derating Curve with Forced Air

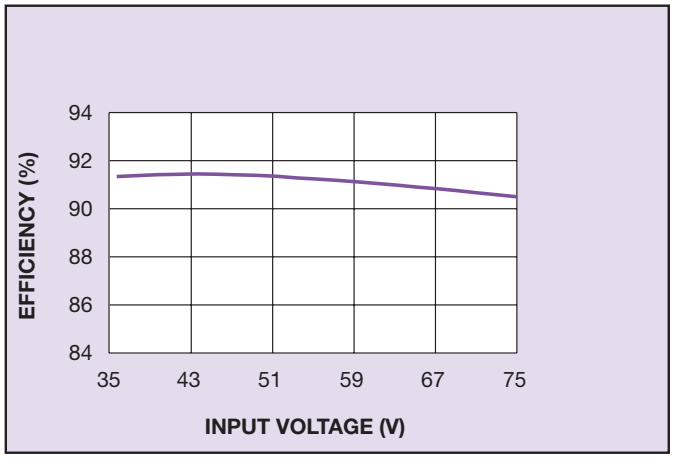


Figure 42: Efficiency vs. Line

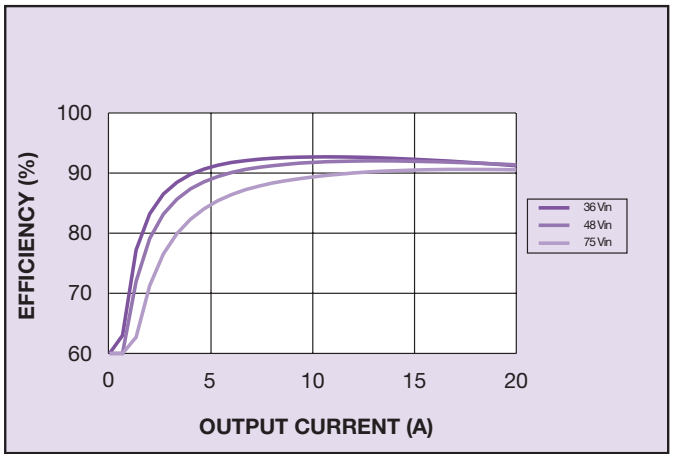


Figure 43: Efficiency vs. Load

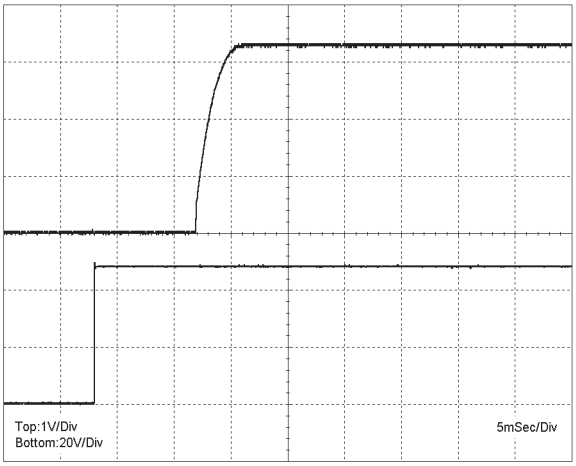


Figure 44: Turn-On Characteristic,
Top (Vout), Bottom (Vin)

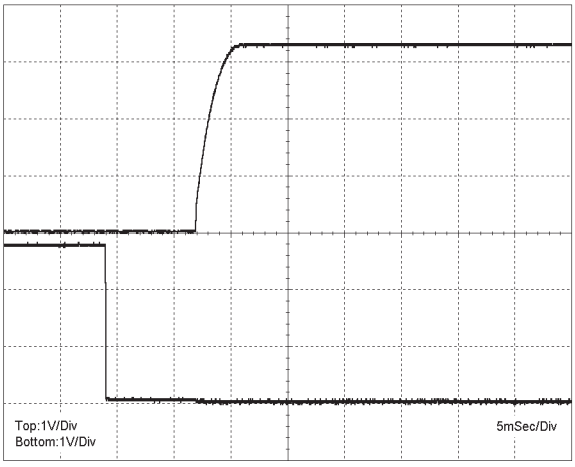


Figure 45: Control On/Off Characteristic,
Top (Vout), Bottom (Remote ON/OFF)

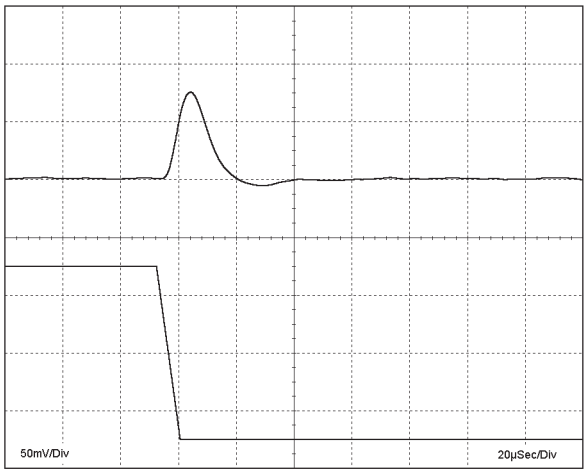


Figure 46: Typical Transient Response 75-50%
Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES20A48-3V3 Model

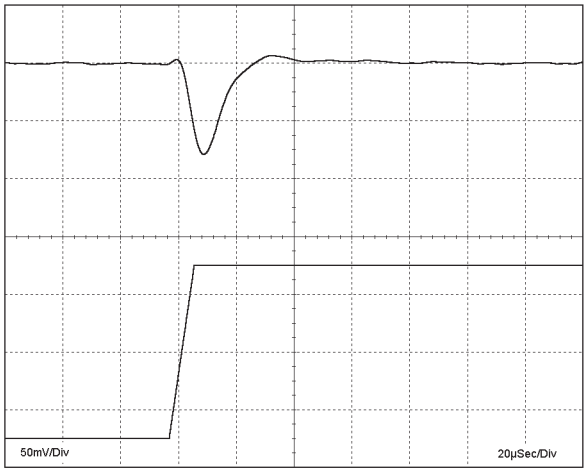


Figure 47: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

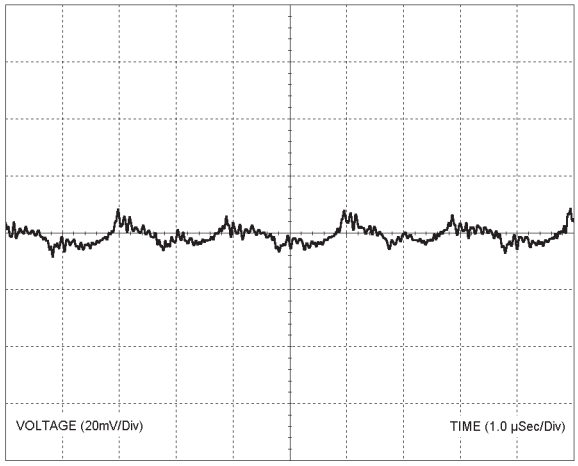


Figure 48: Typical Output Ripple and Noise Measurement

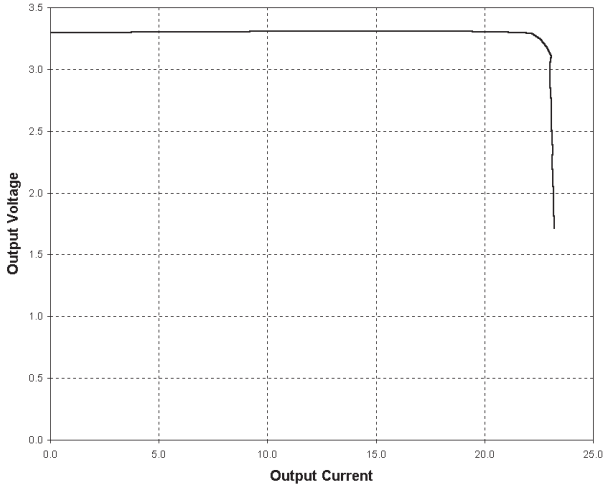


Figure 49: Current Limit Characteristic

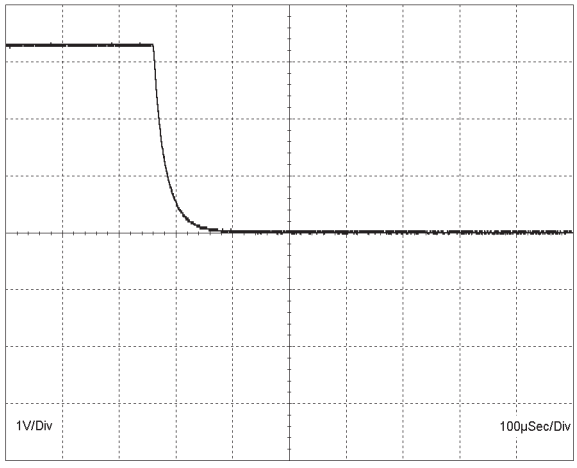


Figure 50: Turn-Off Characteristic

LES10A48-5V0 Model

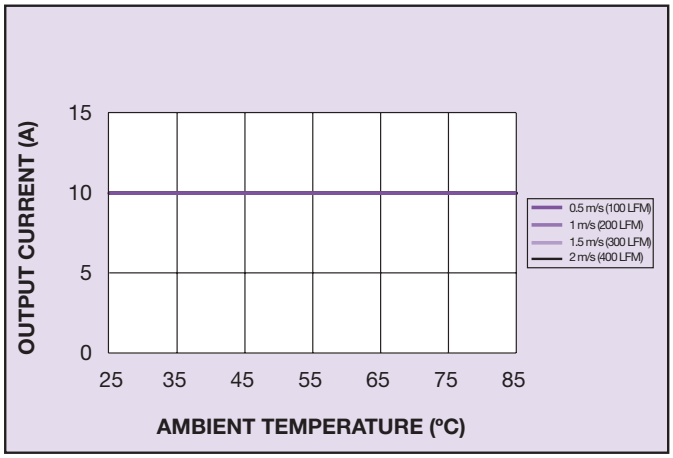


Figure 51: Derating Curve with Forced Air

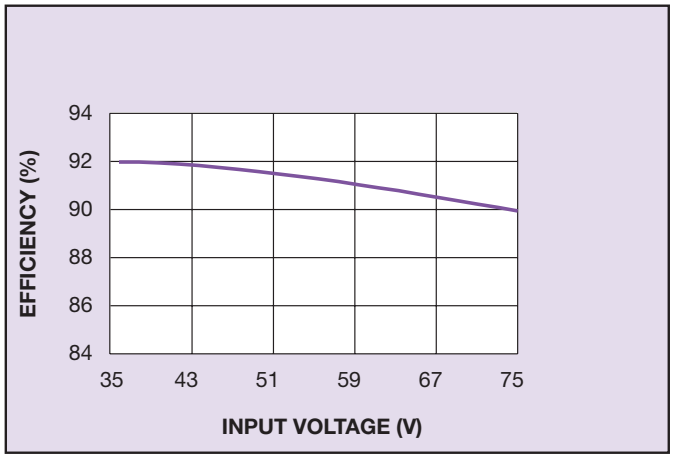


Figure 52: Efficiency vs. Line

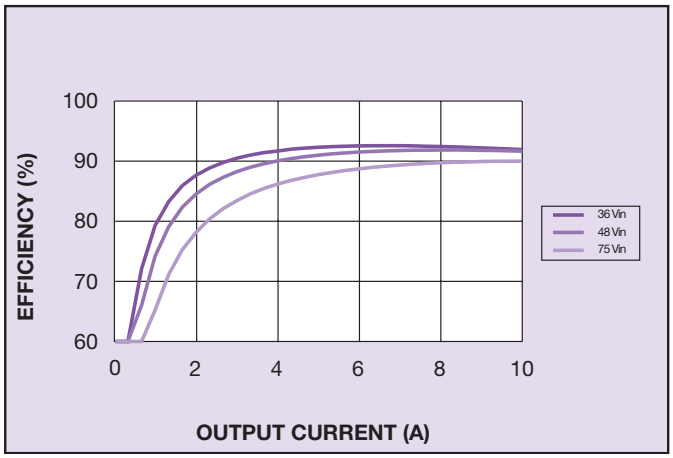


Figure 53: Efficiency vs. Load

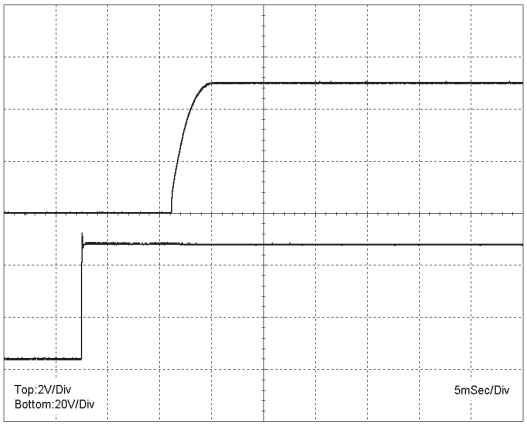


Figure 54: Turn-On Characteristic, Top (Vout), Bottom (Vin)

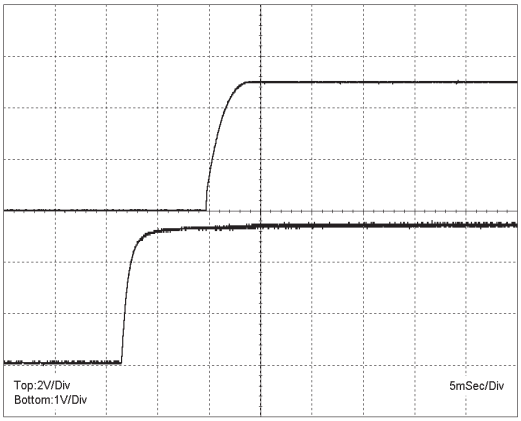


Figure 55: Control On/Off Characteristic, Top (Vout), Bottom (Remote ON/OFF)

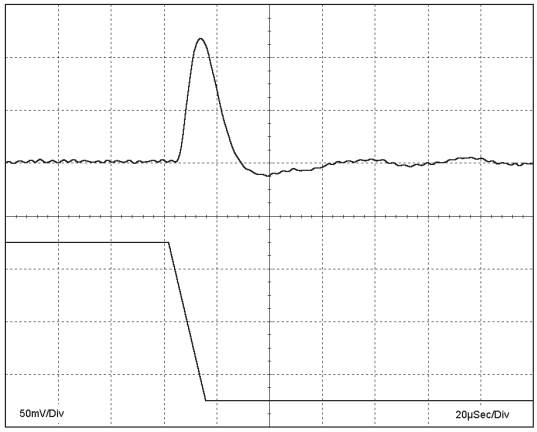


Figure 56: Typical Transient Response 75-50% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

LES10A48-5V0 Model

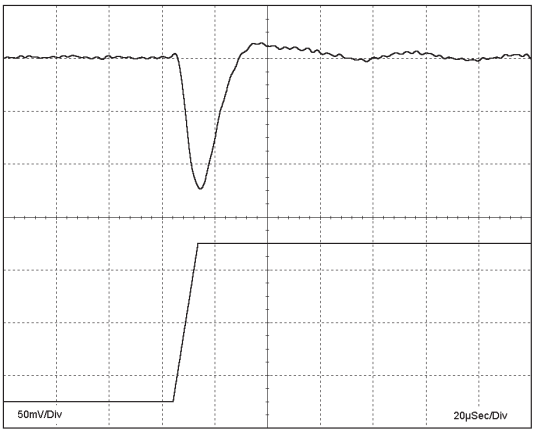


Figure 57: Typical Transient Response 50-75% Step Load Change (1A/µsec), Top (Vout) Bottom (Iout)

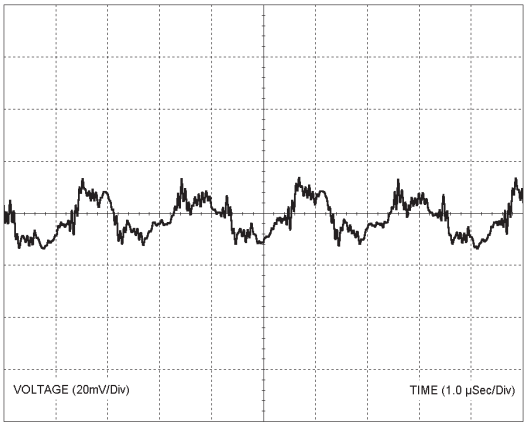


Figure 58: Typical Output Ripple and Noise Measurement

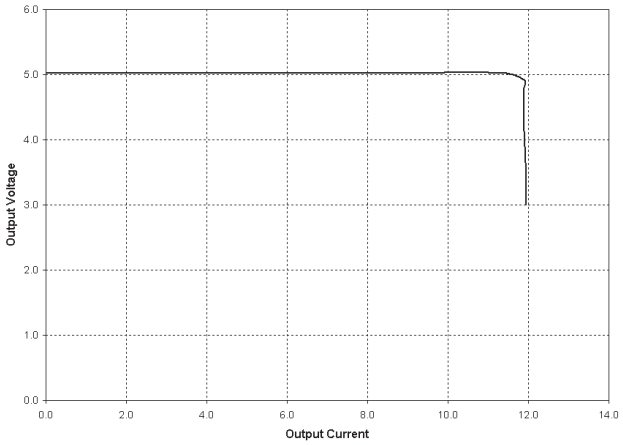


Figure 59: Current Limit Characteristic

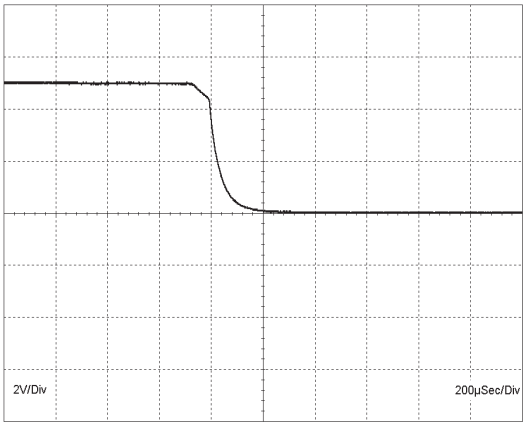
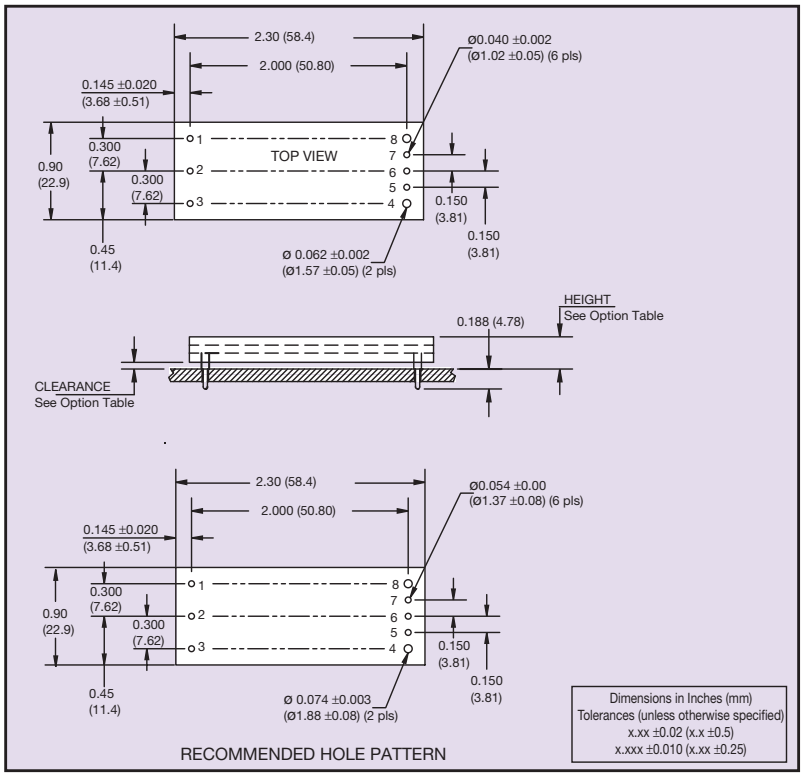


Figure 60: Turn-Off Characteristic



Pin Connections

Pin No.	Function
1	Vin+
2	ON/OFF
3	Vin-
4	Vout-
5	Sense-
6	Trim
7	Sense+
8	Vout+

Dimension Options

Option	Clearance	Height
A	0.030 (0.76) min.	0.300 (7.62) max.
E	0.070 (1.78) min.	0.340 (8.64) max.

Figure 61: Dimensions and Pinout

Note 1

The remote ON/OFF pin is referenced to Vin-.

Note 2

Active low Remote ON/OFF is available. Standard product is active high. When ordering active low parts, designate with the Suffix R e.g. LES20A48-2V5RA. See Application Note 138 for detailed information regarding ON/OFF control implementation.

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.

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