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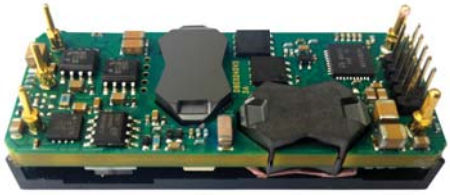
Murata Power Solutions

DBE/DVE Series

Up to 300W Digital Fully Regulated Intermediate DC-DC Bus Converter



Typical unit

Output (V)	Current (A)	Input (Vdc)
3.3	40	V2 = 36-75Vdc
5	40	
12	25	

FEATURES

- Advanced Bus Converter industry standard eighth-brick with digital PMBus interface
- Optional standard five pin Eighth-brick
- High efficiency
- Fast dynamic response
- ± 1% Vout Setting accuracy
- 2250 Vdc input to output isolation voltage
- Optional baseplate (B option)
- Voltage droop load sharing for parallel operation
- Certified to UL/EN/IEC 60950-1, CAN/CSA-C22.2 No. 60950-1, 2nd Edition, safety approvals and EN55022/CISPR22 standards

PRODUCT OVERVIEW

Murata Power Solutions is introducing the first in a series of digitally controlled DC-DC converters that are based on a 32-bit ARM processor. The DBE series provides a fully regulated, digitally controlled DC output in an eighth-brick format that will support the evolving, Advanced Bus Converter (ABC) industry standard footprint for isolated board mounted power modules. The DBE series supports advances in power conversion technology including a digital interface supporting the PMBus protocol for communications to power modules.

The DBE series products are eighth-brick DC-DC converter with a digital interface supporting the PMBus standard for communicating with power devices. The DBE series also supports the TNV standard for input Voltage with a 36–75Vin specified Vin range and was designed to provide payload power in distributed power architectures. The DBE offers a “droop” load sharing option for paralleling modules in the most demanding, power hungry applications or to provide redundancy in high reliability applications. The converter also offers high input to output isolation of 2250 VDC as required for Power over Ethernet (PoE) applications. The DBE series is suitable for applications covering MicroTCA, servers and storage applications, networking equipment, Power over Ethernet (PoE), fan trays, wireless networks, wireless pre-amplifiers, industrial and test equipment along with other applications requiring a regulated 12V and 5V.

Power Management (PMBus Options)

- Configurable soft-start/stop
- Configurable output voltage (Vout) and voltage margins (Margin low and Margin high)
- Configurable protection limits for OVP, input over voltage, input under voltage, over current, on/off, and temperature
- Module Status monitor Vout, Iout, Vin, Temp, Power good, and On/Off
- System status monitor (Vout, Iout, Vin and Temp over time)

Applications

- Distributed power architectures
- Intermediate bus voltage applications
- Servers and storage applications
- Network equipment

RoHS COMPLIANT

25

For full details go to www.murata-ps.com/rohs

c UL us

PMBus

PERFORMANCE SPECIFICATIONS SUMMARY AND ORDERING GUIDE ①

Root Model	Output							Input				Efficiency		Open Frame Package Dimensions (max.)	
	V_{OUT} (V)	I_{OUT} (A, max)	Total Power (W)	Ripple & Noise (mVp-p) Typ.	Ripple & Noise (mVp-p) Max.	Regulation (max.) Line (%)	Regulation (max.) Load (%)	V_{IN} Nom. (V)	Range (V)	I_{IN}, min. load (mA)	I_{IN}, full load (A)	Min.	Typ.	(inches, max.)	(mm)
DBE0340V2	3.3	40	132	60	100	±0.3	±0.25	48	36-75	90	2.96	91%	92.5%	2.3x0.9x0.45	58.4x22.9x11.4
DBE0240V2	5	40	200	50	100	±0.25	±0.25	48	36-75	90	4.46	93%	94%	2.3x0.9x0.45	58.4x22.9x11.4
DBE0125V2	12	25	300	80	150	±0.25	±0.25	48	36-75	110	9.25	93%	94.6%	2.3x0.9x0.46	58.4x22.9x11.7
DVE0340V2 ②	3.3	40	132	60	100	±0.3	±0.25	48	36-75	90	2.96	91%	92.5%	2.3x0.9x0.45	58.4x22.9x11.4
DVE0240V2 ②	5	40	200	50	100	±0.25	±0.25	48	36-75	90	4.46	93%	94%	2.3x0.9x0.45	58.4x22.9x11.4
DVE0125V2 ②	12	25	300	80	150	±0.25	±0.25	48	36-75	110	9.25	93%	94.6%	2.3x0.9x0.46	58.4x22.9x11.7

① Typical at TA = +25°C under nominal line voltage and full-load conditions. All models are specified with an external 1µF multi-layer ceramic and 10µF capacitors across their output pins.
② DVE models do not have the PMBus feature.

DIGITAL CONTROL BRICK PART NUMBER FORMAT

Description	Part Number Structure																Definition and Options
Product Family	D	X															DB = Full Featured Digital Bus converter, DV = NO PMBus, NO Sense & Trim Pins
Form Factor			E														E = Eighth Brick
Vout ①				0	1												01 = 12Vout, 02 = 5Vout, 03=3.3Vout (Without PMBus Vout cannot be changed)
Output Current						2	5										Max Iout in Amps
Vin Range								V	2								V2 = 36-75V
Logic ①										N							N = Negative, P = Positive
Pin Length ②											x						1 = 0.110" (cut), 2 = 0.145" (cut). Omit for standard shown in the mechanical drawings
Mechanical Configuration												B					B = Baseplate, Omit for Open Frame (Standard Configuration)
Load Sharing													S				S = Load Sharing, Omit for Standard (Standard Configuration) ④
Paste In Hole (PIH) Processable ③														R			R = MSL-3 compliant Packaging, Blank for Standard Configuration / Packaging
Specific Customer Configuration															x	x	Customer Code; Omit for Standard
RoHS																	C RoHS 6/6 Compliant

① PMBus Configurable
② Minimum order quantity is required. Samples available with standard pin length only.
③ PIH parts are special order only.
④ Load Sharing is not available on the 3.3Vout and 5Vout models.
Note: Some model number combinations may not be available. See website or contact your local Murata sales representative.

Part Number Examples

DBE0125V2NBSC = Full Featured Digital 1/8th Brick, 12Vout, 25A, 36-75Vin, Negative logic, Baseplate, Load Sharing, RoHS 6/6 compliant
DVE0240V2NBC = No PMBus, No Sense & Trim 1/8th Brick, 5Vout, 40A, 36-75Vin, Negative logic, Baseplate, RoHS 6/6 compliant

EVALUATION BOARD AVAILABLE FROM MURATA POWER SOLUTIONS

Part Number	Application Note	USB Adaptor Part Number	GUI Software Application Note
MPS-TD001	www.murata-ps.com/data/apnotes/dcan-63.pdf	MPS-AD001	www.murata-ps.com/data/apnotes/dcan-63.pdf

Contact your local Murata sales representative for ordering details.

FUNCTIONAL SPECIFICATIONS, DBE0340 (3.3V, 40A)

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		
On/Off Remote Control	Power on, referred to -Vin	0		13.50	Vdc
Output Power		0		132	W
Output Current	Current-limited, no damage, short-circuit protected	0		40	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied nor recommended.					
INPUT					
Operating voltage range (V2)		36	48	75	Vdc
Start-up threshold	(Default, Conf via PMBUS)	32	34	36	Vdc
Undervoltage shutdown	(Default, Conf via PMBUS)	30	32	34	Vdc
Internal Filter Type			Pi		
External Input Fuse (Recommended)			10		A
Input current					
Full Load Conditions	Vin = nominal		2.96	3.02	A
Low Line input current	Vin = minimum		3.92	4.03	A
Inrush Transient	Vin = 48V.			0.05	A^2-Sec.
Short Circuit input current			0.05	0.10	A
No Load input current	Iout = minimum, unit=ON		90	120	mA
Shut-Down input currrent(Off, UV, OT)			20	40	mA
GENERAL and SAFETY					
Efficiency	Vin=48V, full load	91	92.5		%
	Vin=min.	91	92		%
Isolation Voltage	Input to output, continuous		2250		Vdc
	Input to Baseplate, continuous		1500		Vdc
	Output to Baseplage, continuous		1500		Vdc
Insulation Safety Rating			Functional		
Isolation Resistance			10		MΩ
Isolation Capacitance			1000		pF
Safety	Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition		Yes		
Calculated MTBF	Per Telcordia SR-332, issue 1, class 3, ground fixed, Tcase=+25°C		2200		Hours x 10^3
DYNAMIC CHARACTERISTICS					
Fixed Switching Frequency			180		KHz
Turn on Time	(Default, Conf via PMBUS) Vin On to Vout regulated			50	mS
Ramp-up time	Remote On to Vout regulated			30	mS
Vout Rise Time	Conf via PMBUS, from 0% to 100%	9	15	20	mS
Vout Fall Time	Conf via PMBUS, from 100% to 0%	7	10	13	mS
Dynamic Load Response	25-75-25% load step to 1% error band, 1A/uS, with 470uF output external Cap		100	200	µSec
Dynamic Load Peak Deviation	same as above		500	700	mVdc
FEATURES and OPTIONS					
Remote On/Off Control					
Primary On/Off control (designed to be driving with an open collector logic, Voltages referenced to -Vin)					
"P" suffix:					
Positive Logic, ON state	ON = pin open or external voltage	3.5		13.50	V
Positive Logic, OFF state	OFF = ground pin or external voltage	0		0.80	V
Control Current	open collector/drain		1	2	mA
"N" suffix:					
Negative Logic, ON state	ON = pin open or external voltage	-0.1		0.80	V
Negative Logic, OFF state	OFF = ground pin or external voltage	3.5		13.50	V
Control Current	open collector/drain		1	2	mA

FUNCTIONAL SPECIFICATIONS, DBE0340 (3.3V, 40A, CONT.)

OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	132	133.32	W
Voltage					
Setting Accuracy	At 100% load, no trim	3.27	3.3	3.33	Vdc
Overvoltage Protection	Conf via PMBUS, Magnetic Feedback	4.0	4.5	5.0	Vdc
Voltage Droop (Conf via PMBUS)			0		MΩ
Current					
Output Current Range		0	40	40	A
Minimum Load			No minimum load		
Current Limit Inception ②	90% of Vnom., after warmup, Conf via PMBUS	44	49	53	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within 1% of Vout		2.5	3.0	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ③					
Line Regulation	Vin=min. to max., Vout=nom., full load			±0.3	%
Load Regulation	Iout=min. to max., Vin=nom.			±0.25	%
Ripple and Noise	5 Hz- 20 MHz BW, Cout=1μF MLCC paralleled with 10μF			100	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vnom./°C
Output Capacitance	Low ESR	220		7500	μF
Power Good—Negative logic (Conf via PMBUS)					
Power good high stage voltage		2.4		3.6	Vdc
Power good low stage voltage		-0.1		0.40	Vdc
Out voltage for power good off triggering	Conf via PMBUS	2	2.3	2.5	Vdc
Out Voltage for power good on triggering	Conf via PMBUS	2.6	2.8	3	Vdc
PMBus					
PMBUS GENERAL					
PMBUS REV. 1.2. SMBALERT# is supported. PEC is supported. Linear data format used.					
Bus speed				400	Khz
Logic high input		2		3.3	Vdc
Logic low input		-0.1		0.8	Vdc
Logic high output		2.4		3.6	Vdc
Logic low output		-0.1		0.4	Vdc
PMBUS ADDRESSING					
If the calculated PMBus address is 0d, 11d or 12d, SA0 or SA1 lefts open, default PMBus address 119d is assigned instead. PMBUS address = 8*SA0 + SA1. SA0/SA1 value VS resistor connected to GND.					
0			10		kΩ
1			22		kΩ
2			33		kΩ
3			47		kΩ
4			68		kΩ
5			100		kΩ
6			150		kΩ
7			220		kΩ

FUNCTIONAL SPECIFICATIONS, DBE0340 (3.3V, 40A, CONT.)

PMBus	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
PMBus MONITORING ACCURACY					
VIN_READ		-2		2	%
VOUT_READ		-2		2	%
IOUT_READ (> = 10A)		-5		5	%
IOUT_READ (<10A)		-1		1	A
TEMP_READ		-5		5	°C
DIGITAL INTERFACE SPECIFICATIONS (PMBUS MONITORING & FUNCTIONAL DESCRIPTION)					
Fault Protection Specifications					
Output Voltage, Over Voltage protection, OVP	Factory default		4.5		V
VOUT_OV_FAULT_LIMIT, Configurable via PMBus	>VOUT_OV_WARM_LIMIT	4.0		5.0	V
	Fault response time		200		µS
Input Voltage, Input Over Voltage Protection	Factory default		80		V
	Setpoint accuracy	-2		2	%
VIN_OV_FAULT_LIMIT (Configurable via PMBus) ④	>VIN_OV_WARM_LIMIT		34	110	V
	Delay		300		µS
Input Voltage, Input Under Voltage Protection, UVLV	Factory default		32		V
	Setpoint accuracy	-2		2	%
VIN_FAULT_LIMIT_LIMIT(Configurable via PMBus) ④	<VIN_UV_WARM_LIMIT <VIN_OV_FAULT_LIMIT <VIN_OFF		32	75	V
	Delay		300		µS
Over Current Protection, OCP	Setpoint accuracy (Io)	-3		3	%
	(factory default)		48		A
IOUT_OC_FAULT_LIMIT (Configurable via PMBus) ④	>IOUT_OC_WARN_LIMT	0		50	A
	Fault response time		200		µS
Over Temperature Protection, OTP	OT_FAULT_LIMIT (factory default)		125		°C
OT_FAULT_LIMIT (Configurable via PMBus) ④	>OT_WARM_LIMIT	0		150	°C
	OTP accuracy (factory default)	5		5	°C
	Fault response time		300		µS
MECHANICAL (Through Hole Models)					
Outline Dimensions—open frame			2.3x0.9x0.45		Inches
	WxLxH		58.4x22.9x11.4		mm
Outline Dimensions—with baseplate			2.3x0.9x0.52		Inches
	WxLxH		58.4x22.9x13.2		mm
Weight	Open frame		34		Grams
	With baseplate		45		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range	with derating	-40		85	°C
Operating Baseplate Temperature		-40		110	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured at hotspot		125		°C
Electromagnetic Interference Conducted, EN55022/CISPR22	External filter required		B		Class
RoHS rating			RoHS-6		

Notes

① Typical at TA = +25°C under nominal line voltage and full-load conditions. All models are specified with an external 1µF multi-layer ceramic and 10µF capacitors across their output pins.

② Over-current protection is non-latching with auto recovery (Hiccup)

③ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

FUNCTIONAL SPECIFICATIONS, DBE0240 (5V, 40A)

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		
On/Off Remote Control	Power on, referred to -Vin	0		13.50	Vdc
Output Power		0		200	W
Output Current	Current-limited, no damage, short-circuit protected	0		40	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied nor recommended.					
INPUT					
Operating voltage range (V2)		36	48	75	Vdc
Start-up threshold	(Default, Conf via PMBUS)	32	34	36	Vdc
Undervoltage shutdown	(Default, Conf via PMBUS)	30	32	34	Vdc
Internal Filter Type			Pi		
External Input Fuse (Recommended)			10		A
Input current					
Full Load Conditions	Vin = nominal		4.43	4.53	A
Low Line input current	Vin = minimum		5.94	6.03	A
Inrush Transient	Vin = 48V.			0.05	A^2-Sec.
Short Circuit input current			0.05	0.10	A
No Load input current	Iout = minimum, unit=ON		90	120	mA
Shut-Down input currrent(Off, UV, OT)			20	40	mA
GENERAL and SAFETY					
Efficiency	Vin=48V, full load	93	94		%
	Vin=min.	93	93.5		%
Isolation Voltage	Input to output, continuous		2250		Vdc
	Input to Baseplate, continuous		1500		Vdc
	Output to Baseplage, continuous		1500		Vdc
Insulation Safety Rating			Functional		
Isolation Resistance			10		MΩ
Isolation Capacitance			1000		pF
Safety	Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition		Yes		
Calculated MTBF	Per Telcordia SR-332, issue 1, class 3, ground fixed, Tcase=+25°C		2200		Hours x 10^3
DYNAMIC CHARACTERISTICS					
Fixed Switching Frequency			180		KHz
Turn on Time	(Default, Conf via PMBUS) Vin On to Vout regulated			50	mS
Ramp-up time	Remote On to Vout regulated			30	mS
Vout Rise Time	Conf via PMBUS, from 0% to 100%	9	15	20	mS
Vout Fall Time	Conf via PMBUS, from 100% to 0%	7	10	13	mS
Dynamic Load Response	25-75-25% load step to 1% error band, 1A/uS, with 470uF output external Cap		100	200	µSec
Dynamic Load Peak Deviation	same as above		500	700	mVdc
FEATURES and OPTIONS					
Remote On/Off Control					
Primary On/Off control (designed to be driving with an open collector logic, Voltages referenced to -Vin)					
"P" suffix:					
Positive Logic, ON state	ON = pin open or external voltage	3.5		13.50	V
Positive Logic, OFF state	OFF = ground pin or external voltage	0		0.80	V
Control Current	open collector/drain		1	2	mA
"N" suffix:					
Negative Logic, ON state	ON = pin open or external voltage	-0.1		0.80	V
Negative Logic, OFF state	OFF = ground pin or external voltage	3.5		13.50	V
Control Current	open collector/drain		1	2	mA

FUNCTIONAL SPECIFICATIONS, DBE0240 (5V, 40A, CONT.)

OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	200	202	W
Voltage					
Setting Accuracy	At 100% load, no trim	4.95	5	5.05	Vdc
Overvoltage Protection	Conf via PMBUS, Magnetic Feedback	5.6	6	7	Vdc
Voltage Droop (Conf via PMBUS)			0		MΩ
Current					
Output Current Range		0	40	40	A
Minimum Load			No minimum load		
Current Limit Inception ②	90% of Vnom., after warmup, Conf via PMBUS	44	49	53	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within 1% of Vout		2.5	3.0	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ③					
Line Regulation	Vin=min. to max., Vout=nom., full load			±0.3	%
Load Regulation	Iout=min. to max., Vin=nom.			±0.25	%
Ripple and Noise	5 Hz- 20 MHz BW, Cout=1µF MLCC paralleled with 10µF			100	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vnom./°C
Output Capacitance	Low ESR	220		7500	µF
Power Good—Negative logic (Conf via PMBUS)					
Power good high stage voltage		2.4		3.6	Vdc
Power good low stage voltage		-0.1		0.40	Vdc
Out voltage for power good off triggering	Conf via PMBUS	3	3.5	4	Vdc
Out Voltage for power good on triggering	Conf via PMBUS	3.75	4.25	4.75	Vdc
PMBus					
PMBUS GENERAL					
PMBUS REV. 1.2. SMBALERT# is supported. PEC is supported. Linear data format used.					
Bus speed				400	Khz
Logic high input		2		3.3	Vdc
Logic low input		-0.1		0.8	Vdc
Logic high output		2.4		3.6	Vdc
Logic low output		-0.1		0.4	Vdc
PMBUS ADDRESSING					
If the calculated PMBus address is 0d, 11d or 12d, SA0 or SA1 lefts open, default PMBus address 119d is assigned instead. PMBUS address = 8*SA0 + SA1. SA0/SA1 value VS resistor connected to GND.					
0			10		kΩ
1			22		kΩ
2			33		kΩ
3			47		kΩ
4			68		kΩ
5			100		kΩ
6			150		kΩ
7			220		kΩ

FUNCTIONAL SPECIFICATIONS, DBE0240 (5V, 40A, CONT.)

PMBus	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
PMBus MONITORING ACCURACY					
VIN_READ		-2		2	%
VOUT_READ		-2		2	%
IOUT_READ (> = 10A)		-5		5	%
IOUT_READ (<10A)		-1		1	A
TEMP_READ		-5		5	°C
DIGITAL INTERFACE SPECIFICATIONS (PMBUS MONITORING & FUNCTIONAL DESCRIPTION)					
Fault Protection Specifications					
Output Voltage, Over Voltage protection, OVP	Factory default		6		V
VOUT_OV_FAULT_LIMIT, Configurable via PMBus	>VOUT_OV_WARM_LIMIT	5.6		7	V
	Fault response time		200		µS
Input Voltage, Input Over Voltage Protection	Factory default		80		V
	Setpoint accuracy	-2		2	%
VIN_OV_FAULT_LIMIT (Configurable via PMBus) ④	>VIN_OV_WARM_LIMIT		34	110	V
	Delay		300		µS
Input Voltage, Input Under Voltage Protection, UVLV	Factory default		32		V
	Setpoint accuracy	-2		2	%
VIN_FAULT_LIMIT_LIMIT(Configurable via PMBus) ④	<VIN_UV_WARM_LIMIT <VIN_OV_FAULT_LIMIT <VIN_OFF		32	75	V
	Delay		300		µS
Over Current Protection, OCP	Setpoint accuracy (Io)	-3		3	%
	(factory default)		48		A
IOUT_OC_FAULT_LIMIT (Configurable via PMBus) ④	>IOUT_OC_WARN_LIMT	0		50	A
	Fault response time		200		µS
Over Temperature Protection, OTP	OT_FAULT_LIMIT (factory default)		125		°C
OT_FAULT_LIMIT (Configurable via PMBus) ④	>OT_WARM_LIMIT	0		150	°C
	OTP accuracy (factory default)	5		5	°C
	Fault response time		300		µS
MECHANICAL (Through Hole Models)					
Outline Dimensions—open frame			2.3x0.9x0.45		Inches
	WxLxH		58.4x22.9x11.4		mm
Outline Dimensions—with baseplate			2.3x0.9x0.52		Inches
	WxLxH		58.4x22.9x13.2		mm
Weight	Open frame		34		Grams
	With baseplate		45		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range	with derating	-40		85	°C
Operating Baseplate Temperature		-40		110	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured at hotspot		125		°C
Electromagnetic Interference Conducted, EN55022/CISPR22	External filter required		B		Class
RoHS rating			RoHS-6		

Notes

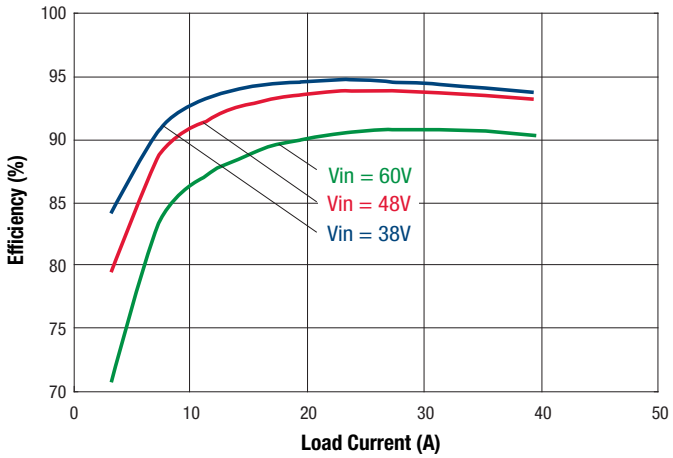
① Typical at TA = +25°C under nominal line voltage and full-load conditions. All models are specified with an external 1µF multi-layer ceramic and 10µF capacitors across their output pins.

② Over-current protection is non-latching with auto recovery (Hiccup)

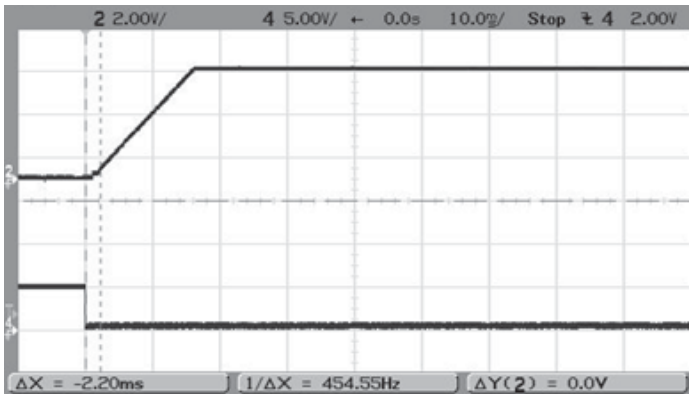
③ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

TYPICAL PERFORMANCE DATA, DBE0240 (5V, 40A)

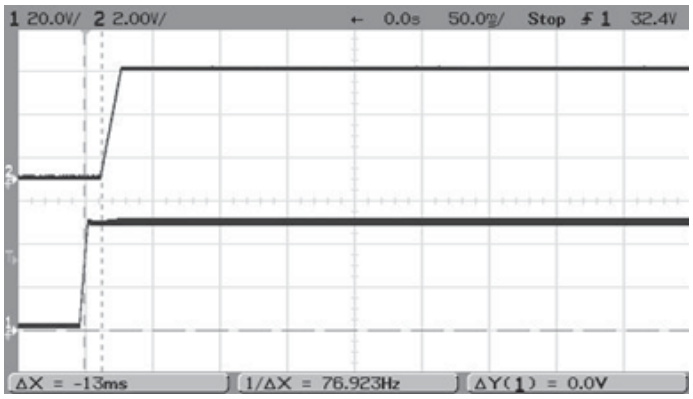
Efficiency vs. Load Current @ 25°C, with baseplate



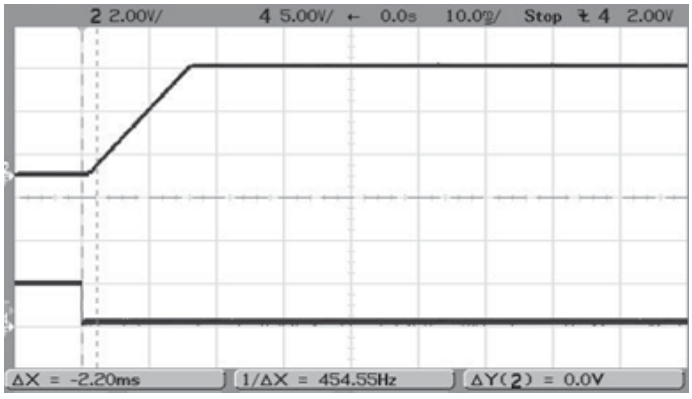
On/Off Enable Start-up (Vin = 48V, Vout = nom, Iout = 40A, Cload = 10000µf, Ta = +25°C)
ch2 = Vout, ch4 = Enable



Start-up Delay (Vin = 48V, Vout = nom, Iout = 40A Cload = 10000µf, Ta = +25°C)
ch1 = Vin, ch2 = Vout



On/Off Enable Start-up (Vin = 48V, Vout = nom, Iout = 40A, Cload = 0, Ta = +25°C)
ch2 = Vout, ch4 = Enable

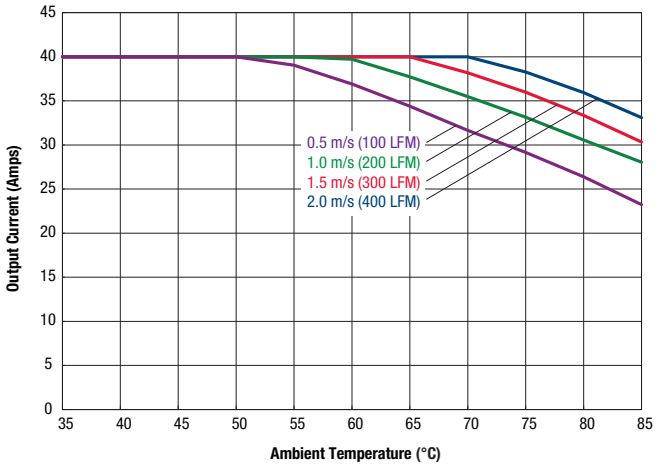


Start-up Delay (Vin = 48V, Vout = nom, Iout = 40A, Cload = 0, Ta = +25°C)ch1 = Vin,
ch2 = Vout

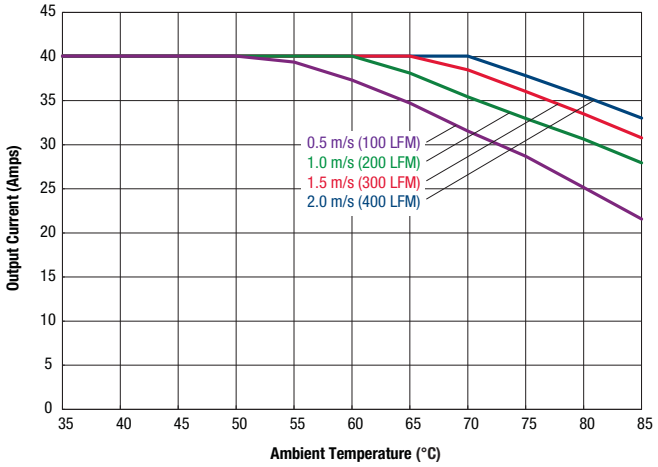
DBE0240 (5V, 40A) PERFORMANCE DATA: TEMPERATURE DERATING WITH BASEPLATE

Transverse

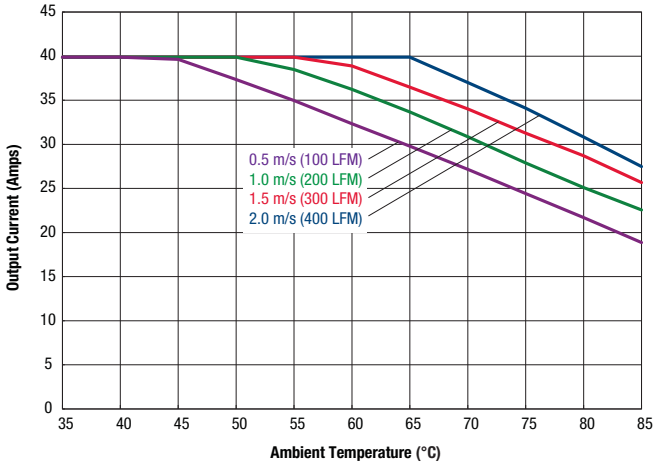
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin- to Vin+)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin- to Vin+)

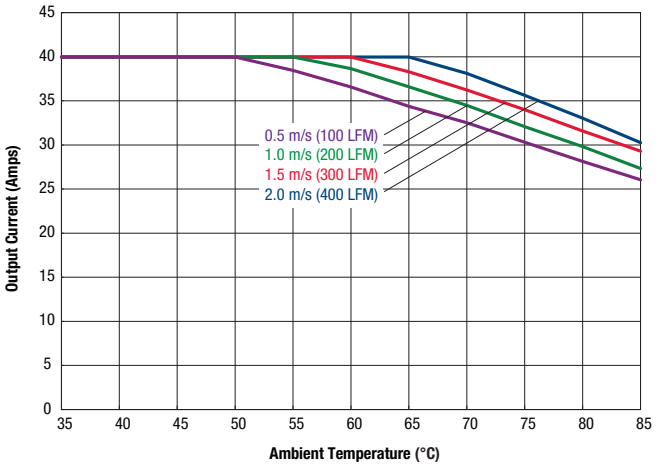


Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin- to Vin+)

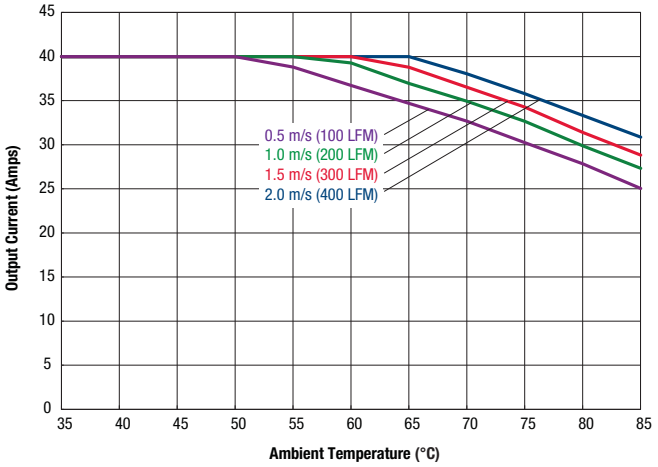


Longitudinal

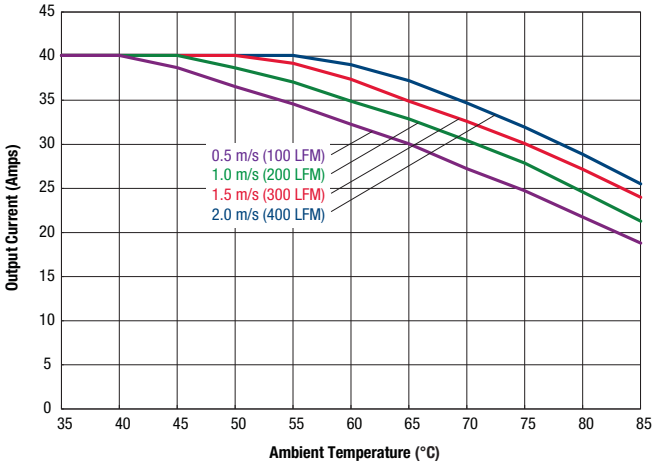
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin to Vout)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin to Vout)



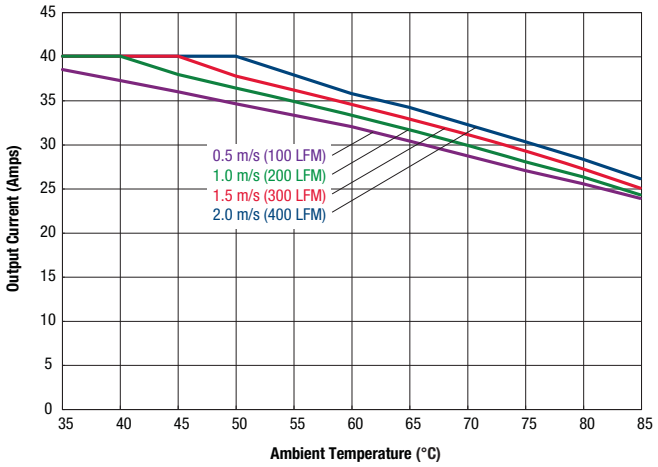
Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin- to Vin+)



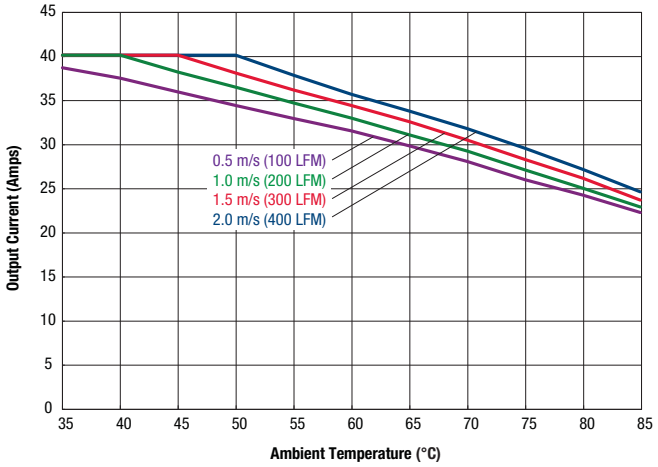
DBE0240 (5V, 40A) PERFORMANCE DATA: TEMPERATURE DERATING WITHOUT BASEPLATE

Transverse

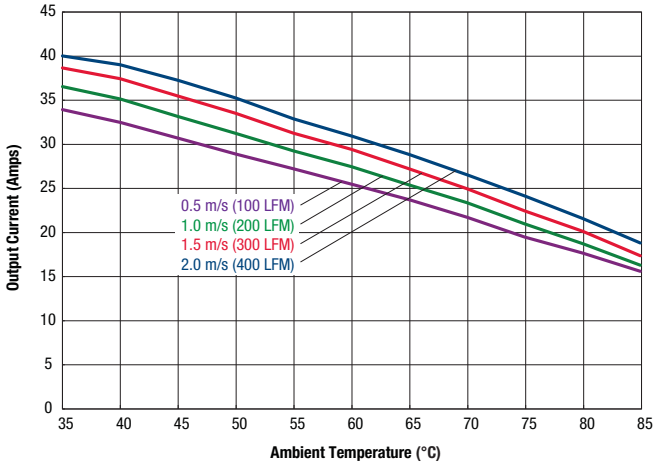
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin- to Vin+)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin- to Vin+)

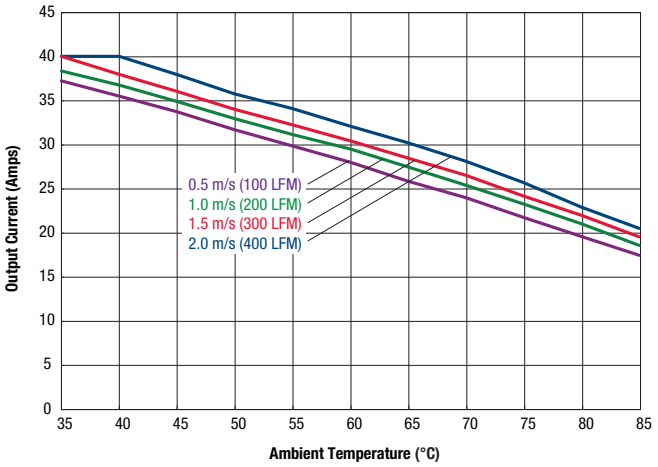


Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin- to Vin+)

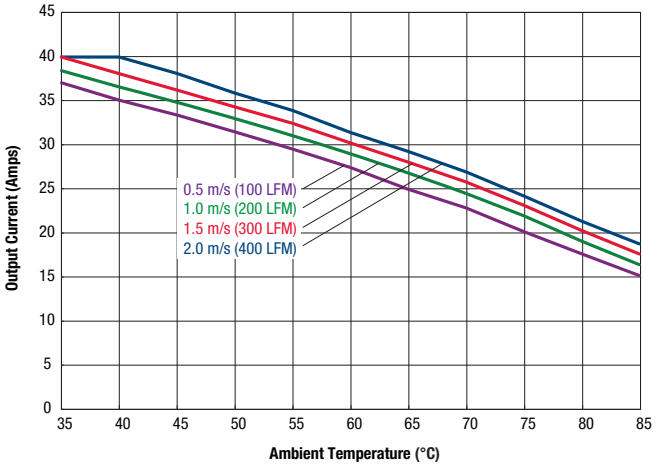


Longitudinal

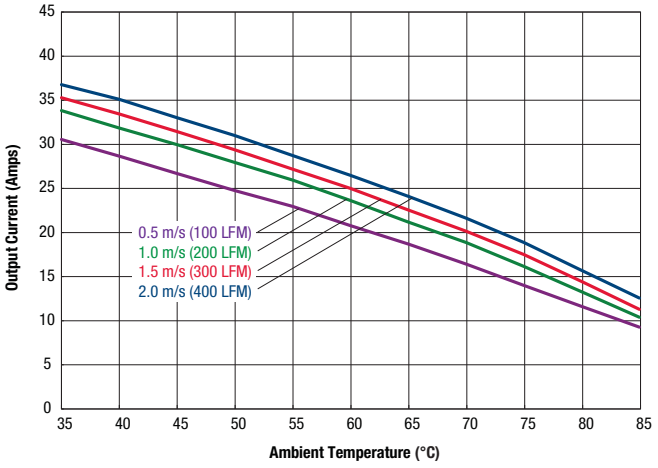
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin to Vout)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin to Vout)



Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin to Vout)



FUNCTIONAL SPECIFICATIONS, DBE0125 (12V, 25A)

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		
On/Off Remote Control	Power on, referred to -Vin	0		13.50	Vdc
Output Power		0		306	W
Output Current	Current-limited, no damage, short-circuit protected	0		25	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied nor recommended.					
INPUT					
Operating voltage range		36	48	75	Vdc
Start-up threshold	(Default, Conf via PMBUS)	32	34	36	Vdc
Undervoltage shutdown	(Default, Conf via PMBUS)	30	32	34	Vdc
Internal Filter Type			Pi		
External Input fuse			20		A
Input current					
Full Load Conditions	Vin = nominal		9.25	9.6	A
Low Line input current	Vin = minimum		12.28	12.8	A
Inrush Transient	Vin = 48V.			0.05	A^2-Sec.
Short Circuit input current			0.03	0.10	A
No Load input current	Iout = minimum, unit=ON		110	150	mA
Shut-Down input currrent (Off, UV, OT)			20	40	mA
Back Ripple Current	Measured at the input of module with a simulated source impedance of 4.7µH, 220µF, 100V, across source, 33µF, 100V external capacitors across input pins		2000	3000	mAp-p
Back Ripple Current (no filtering)			620	1000	mAp-p
GENERAL and SAFETY					
Efficiency	Vin=48V, full load	93	94.6		%
	Vin=min.	93	95		%
Isolation Voltage	Input to output, continuous		2250		Vdc
	Input to Baseplate, continuous		1500		Vdc
	Output to Baseplage, continuous		1500		Vdc
Insulation Safety Rating			Functional		
Isolation Resistance			10		MΩ
Isolation Capacitance			1500		pF
Safety	Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition		Yes		
Calculated MTBF	Per Telcordia SR-332, issue 1, class 3, ground fixed, Tcase=+25°C		1800		Hours x 10^3
DYNAMIC CHARACTERISTICS					
SWITCHING FREQUENCY (Configurable via PMBUS)			180		kHz
TURN ON TIME (Default, Configurable via PMBUS)					
Vin On to Vout Regulated (100% Vout)				60	ms
Remote On to Vout Regulated (100% Vout)				30	ms
Vin Start up delay time			25	40	ms
Enable Start up delay time				10	ms
VOUT RISE TIME (Default, Configurable via PMBUS)					
From 0%~100%		16	20	23	ms
From 10%~90%		12.8	16	18.4	ms
VOUT FALL TIME OF REGULATED OFF (Default, Configurable via PMBUS)					
From 100%~0%		16	20	23	ms
From 90%~10%		12.8	16	18.4	ms
Dynamic Load Response	25-75-25% load step to 1% error band		150	300	µSec
Dynamic Load Peak Deviation	same as above		400	500	mVdc

FUNCTIONAL SPECIFICATIONS, DBE0125 (12V, 25A, CONT.)

FEATURES and OPTIONS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Remote On/Off Control					
Primary On/Off control (designed to be driving with an open collector logic, Voltages referenced to -Vin)					
"P" suffix:					
Positive Logic, ON state	ON = pin open or external voltage	3.5		13.5	V
Positive Logic, OFF state	OFF = ground pin or external voltage	0		0.8	V
Control Current	open collector/drain		1	2	mA
"N" suffix:					
Negative Logic, ON state	ON = pin open or external voltage	-0.1		0.8	V
Negative Logic, OFF state	OFF = ground pin or external voltage	3.5		13.5	V
Control Current	open collector/drain		1	2	mA
Secondary On/Off control (Pull up to 3.3V internally, Voltages referenced to -Vout)					
"P" suffix:					
Positive Logic, ON state	ON = pin open or external voltage	1.5		3.3	V
Positive Logic, OFF state	OFF = ground pin or external voltage	0		0.8	V
Control Current	open collector/drain		1	2	mA
"N" suffix:					
Negative Logic, ON state	ON = pin open or external voltage	0		0.8	V
Negative Logic, OFF state	OFF = ground pin or external voltage	1.5		3.3	V
Control Current	open collector/drain		1	2	mA
Remote Sense Compliance	Sense pins connected externally to respective Vout pins			10	%
OUTPUT					
Total Output Power		0	300	306	W
Voltage					
Setting Accuracy	At 100% load, no trim	11.76	12	12.24	Vdc
Overvoltage Protection	Conf via PMBUS, Magnetic Feedback	13.8	14.4	15.6	Vdc
Voltage Droop (Conf via PMBUS)	without "S" suffix		0		MΩ
	with "S" suffix		10		MΩ
Current					
Output Current Range		0		25	A
Minimum Load			No minimum load		
Current Limit Inception ②	98% of Vnom., after warmup, Conf via PMBUS	27	29	31	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within 1% of Vout		0.4	1	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ③					
Line Regulation	Vin=min. to max., Vout=nom., full load			±75	mV
Load Regulation	Iout=min. to max., Vin=nom.			±45	mV
Ripple and Noise	5 Hz- 20 MHz BW, Cout=1μF MLCC paralleled with 10μF		80	150	mV pk-pk
Temperature Coefficient	At all outputs		0.01	0.02	% of Vnom./°C
Maximum Output Capacitance	Low ESR	100		10,000	μF
Power Good—Negative logic (Conf via PMBUS)					
Power good high stage voltage		2.4		3.6	Vdc
Power good low stage voltage		-0.1		0.4	Vdc
Out voltage for power good off triggering	Conf via PMBUS	8.64	9.6	10.56	Vdc
Out Voltage for power good on triggering	Conf via PMBUS	9.72	10.8	11.88	Vdc
PMBUS					
PMBUS GENERAL					
PMBUS REV. 1.2. SMBALERT# is supported. PEC is supported. Linear data format used.					
Bus speed				400	Khz
Logic high input		2		3.3	Vdc
Logic low input		0		0.8	Vdc
Logic high output		2.4		3.6	Vdc
Logic low output		-0.1		0.4	Vdc

FUNCTIONAL SPECIFICATIONS, DBE0125 (12V, 25A, CONT.)

PMBus	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
PMBUS ADDRESSING					
If the calculated PMBus address is 0d, 11d or 12d, SA0 or SA1 lefts open, default PMBus address 119d is assigned instead. PMBUS address = 8*SA0 + SA1. SA0/SA1 value VS resistor connected to GND.					
0			10		kΩ
1			22		kΩ
2			33		kΩ
3			47		kΩ
4			68		kΩ
5			100		kΩ
6			150		kΩ
7			220		kΩ
PMBus MONITORING ACCURACY					
VIN_READ		-3		3	%
VOUT_READ		-2		2	%
IOUT_READ		-1.5		1.5	A
TEMP_READ		-5		5	°C
DIGITAL INTERFACE SPECIFICATIONS (PMBUS MONITORING & FUNCTIONAL DESCRIPTION)					
Fault Protection Specifications					
Output Voltage, Over Voltage protection, OVP	Factory default		14.4		V
VOUT_OV_FAULT_LIMIT, Configurable via PMBus	>VOUT_OV_WARM_LIMIT	8.1		15.6	V
	Fault response time		200		µS
Input Voltage, Input Over Voltage Protection	Factory default		80		V
	Setpoint accuracy	-2		2	%
VIN_OV_FAULT_LIMIT (Configurable via PMBus) ④	>VIN_OV_WARM_LIMIT		34	110	V
	Delay		300		µS
Input Voltage, Input Under Voltage Protection, UVLV	Factory default		32		V
	Setpoint accuracy	-2		2	%
VIN_FAULT_LIMIT_LIMIT(Configurable via PMBus) ④	<VIN_UV_WARM_LIMIT <VIN_OV_FAULT_LIMIT <VIN_OFF		32	75	V
	Delay		300		µS
Over Current Protection, OCP	Setpoint accuracy (Io)	-3		3	%
	(factory default)		29		A
IOUT_OC_FAULT_LIMIT (Configurable via PMBus) ④	>IOUT_OC_WARN_LIMT	0		34	A
	Fault response time		200		µS
Over Temperature Protection, OTP	OT_FAULT_LIMIT (factory default)		120/125		°C
OT_FAULT_LIMIT (Configurable via PMBus) ④	>OT_WARM_LIMIT	30		130	°C
	OTP accuracy (factory default)	5		5	°C
	Fault response time		300		µS
MECHANICAL (Through Hole Models)					
Outline Dimensions—open frame			2.3x0.9x0.46		Inches
	WxLxH		58.4x22.7x11.7		mm
Outline Dimensions—with baseplate			2.3x0.9x0.52		Inches
	WxLxH		58.4x22.7x13.2		mm
Weight—open frame			0.98		Ounces
			28		Grams
Weight—with baseplate			1.37		Ounces
			39		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches

FUNCTIONAL SPECIFICATIONS, DBE0125 (12V, 25A, CONT.)

ENVIRONMENTAL	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Operating Ambient Temperature Range	With derating	-40		85	°C
Operating Baseplate Temperature	No derating according to IPC 9592	-40		110	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown—open frame	Measured at hotspot		140		°C
Thermal Protection/Shutdown with baseplate ④			130		°C
Electromagnetic Interference Conducted, EN55022/CISPR22	External filter required		B		Class
Radiated, EN55022/CISPR22			B		Class
RoHS rating			RoHS-6		

Notes

① Typical at TA = +25°C under nominal line voltage and full-load conditions. All models are specified with an external 1µF multi-layer ceramic and 10µF capacitors across their output pins.

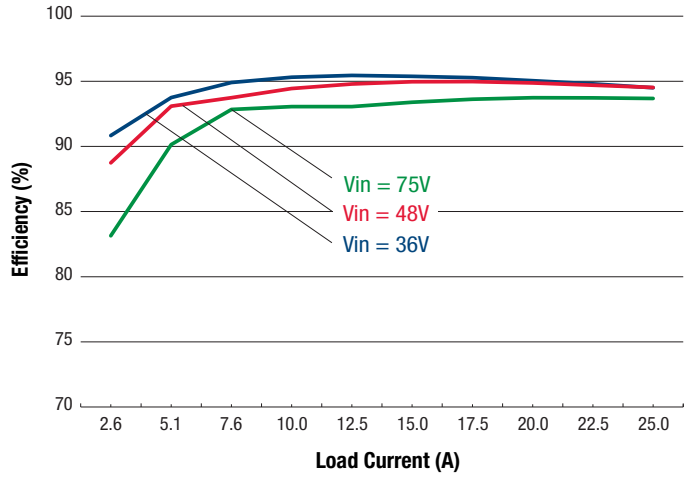
② Over-current protection is non-latching with auto recovery (Hiccup)

③ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

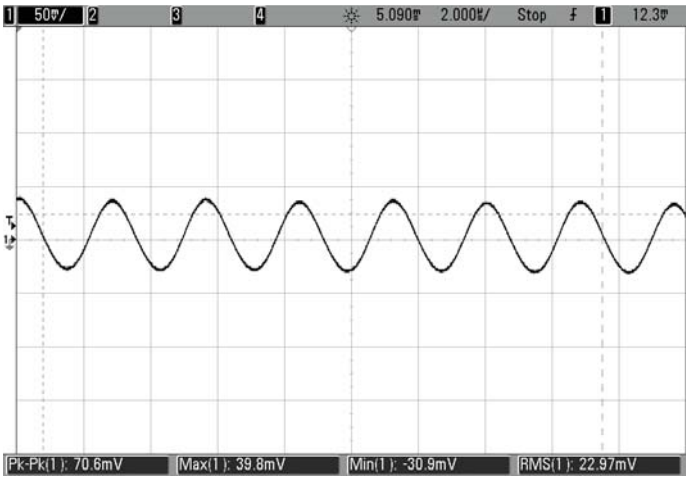
④ When baseplate temperature is above the maximum operating baseplate temperature of 110°C and below thermal protection temperature of 130°C, the module will continue working but the thermal stress will be above the IPC9592 guide limit for long-term operation. It is not recommended to run in such a situation long-term.

TYPICAL PERFORMANCE DATA, DBE0125 (12Vout, 25A)

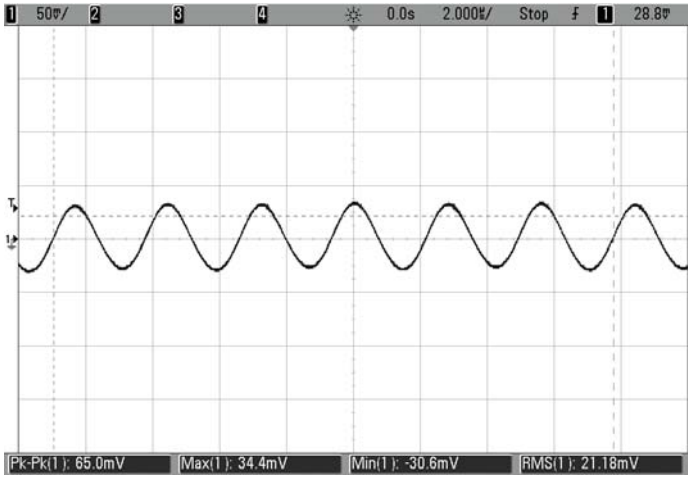
Efficiency vs. Load Current @ 25°C, with baseplate



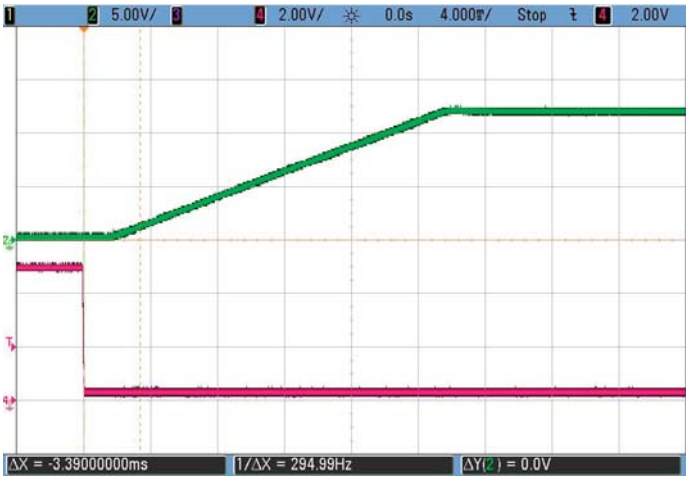
Ripple & Noise @ 20MHz, Vin=48V, Iout=0A, Cout=0µf



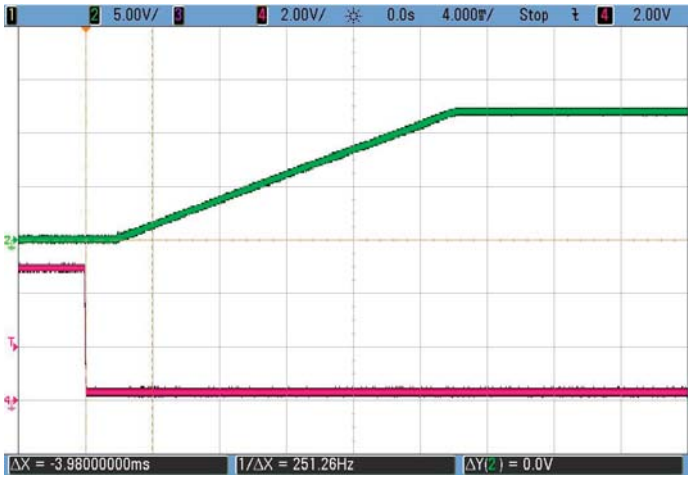
Ripple & Noise @ 20MHz, Vin=48V, Iout=25A, Cout=0µf



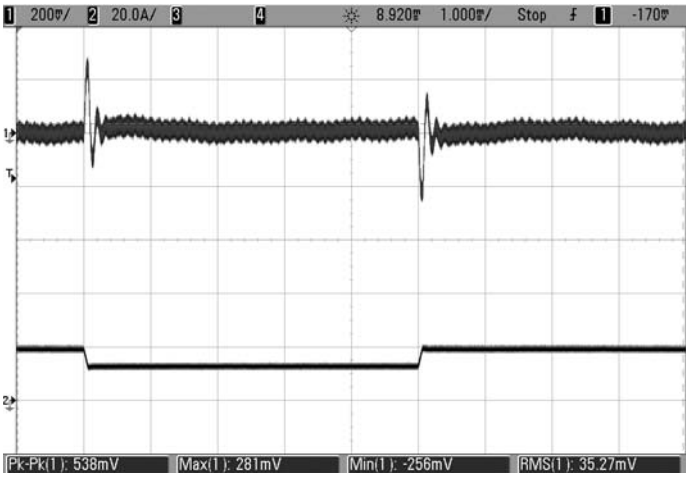
Enable Startup Delay, 48Vin, 0Aout, 10000µf



Enable Startup Delay, 48Vin, 25Aout, 10000µf



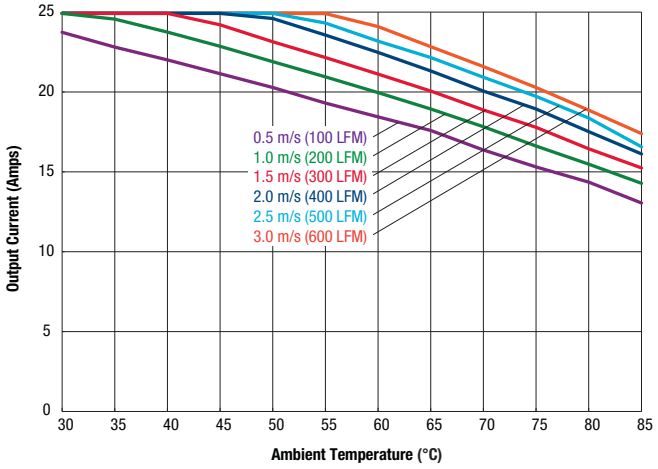
Transient Response, 50%-75%, 0.1Avs µs, 48Vin, Cout=0µf



DBE0125 (12Vout, 25A) PERFORMANCE DATA: TEMPERATURE DERATING WITH BASEPLATE

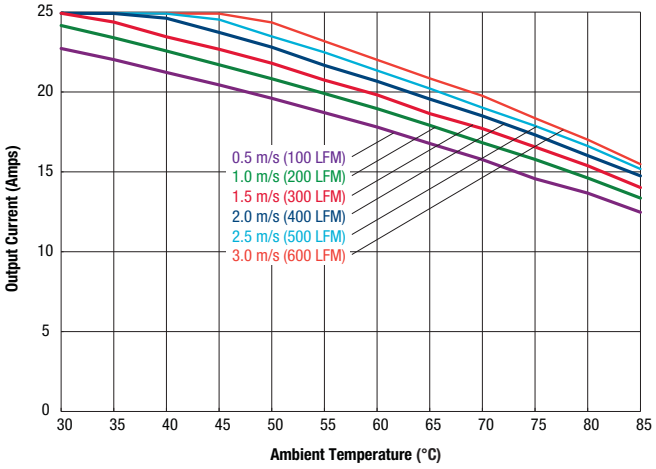
Transverse

Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin- to Vin+)

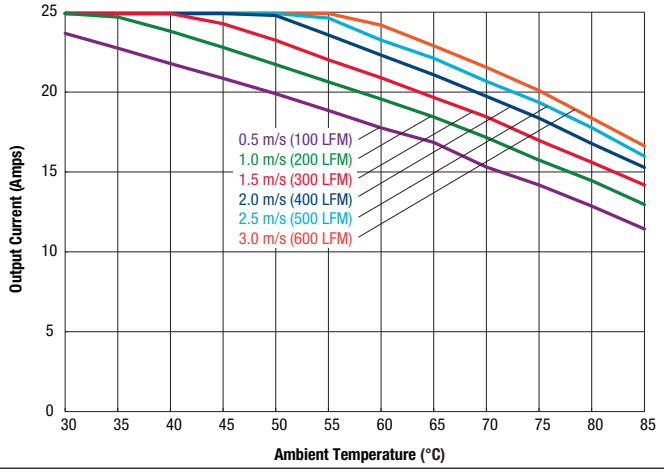


Longitudinal

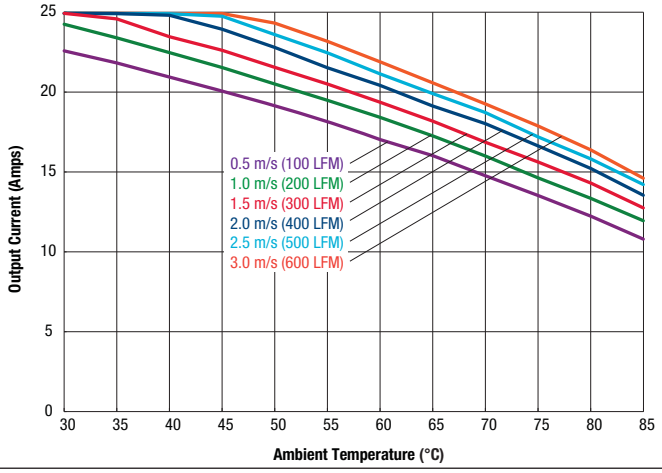
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin to Vout)



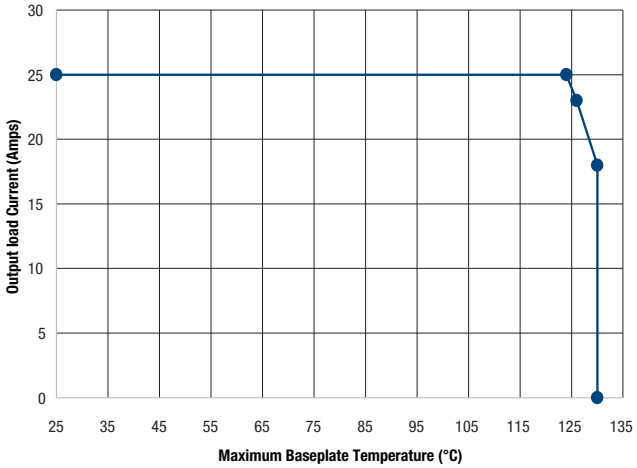
Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin- to Vin+)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin to Vout)



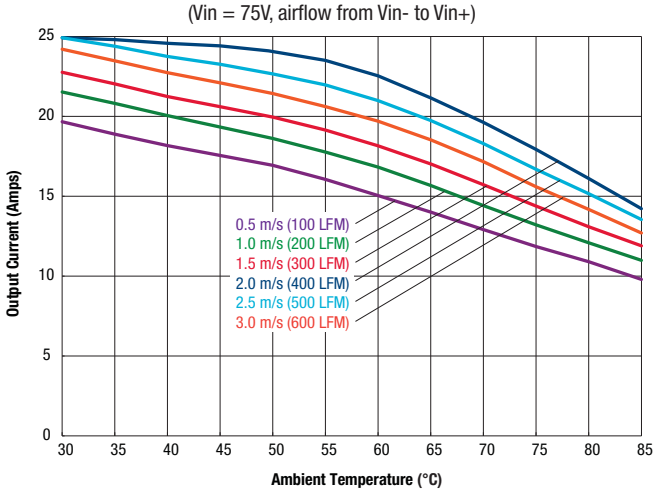
DBE / DVE0125V2 Baseplate
Current Derating Max Baseplate Temperature
Vin= 48V (tested on 10x10 inch PCB)



DBE0125 (12Vout, 25A) PERFORMANCE DATA: TEMPERATURE DERATING WITH BASEPLATE

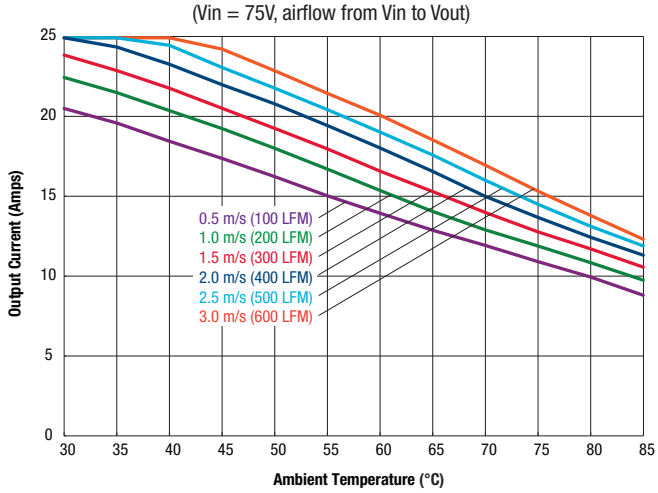
Transverse

Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin- to Vin+)



Longitudinal

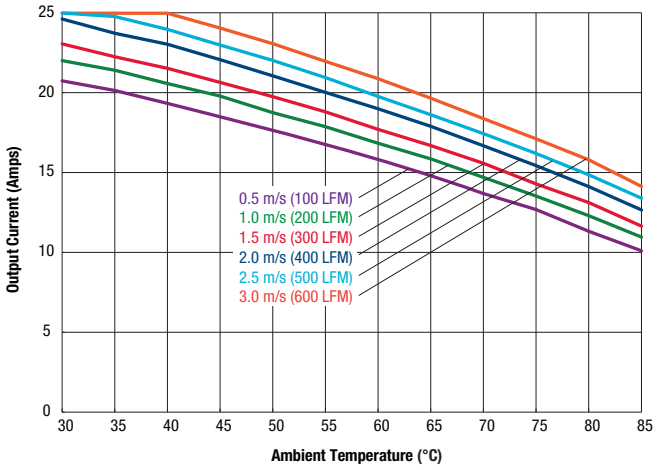
Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin to Vout)



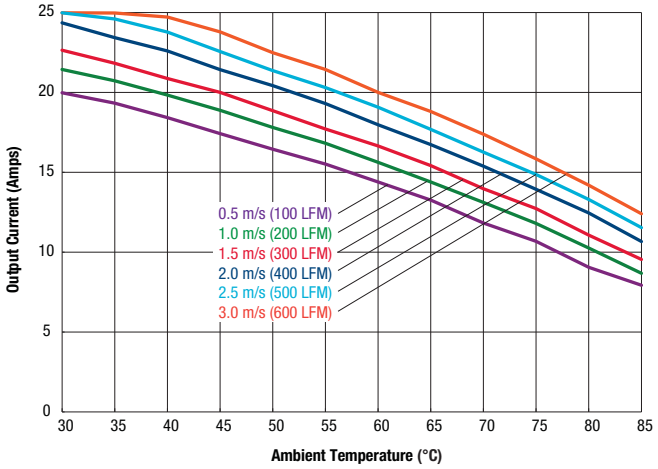
DBE0125 (12Vout, 25A) PERFORMANCE DATA: TEMPERATURE DERATING WITHOUT BASEPLATE

Transverse

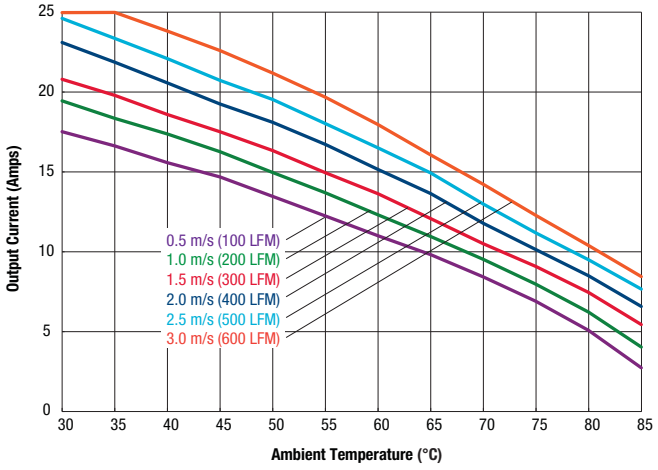
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin- to Vin+)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin- to Vin+)

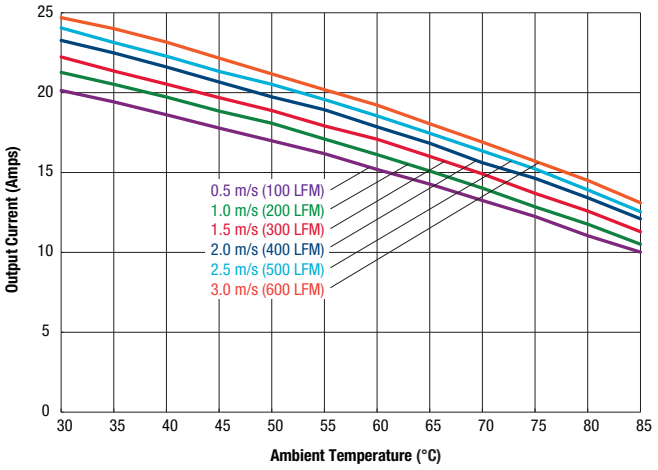


Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin- to Vin+)

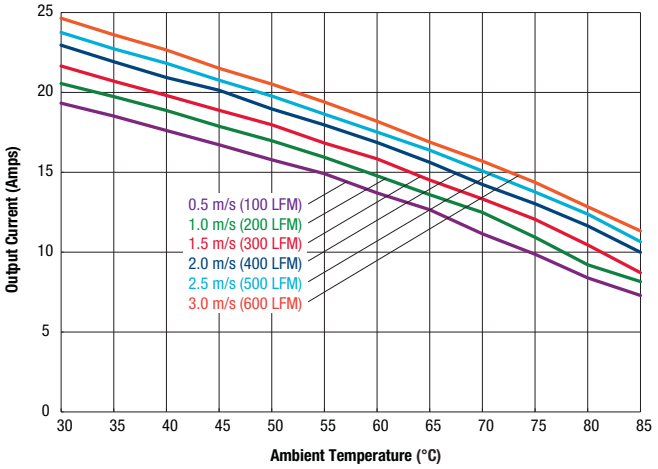


Longitudinal

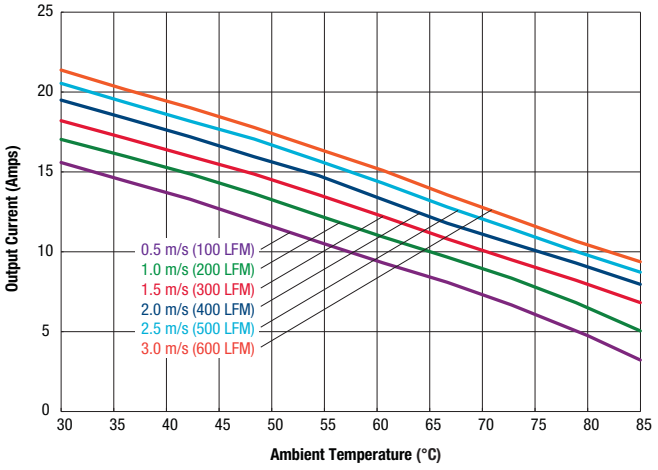
Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from Vin to Vout)



Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from Vin to Vout)

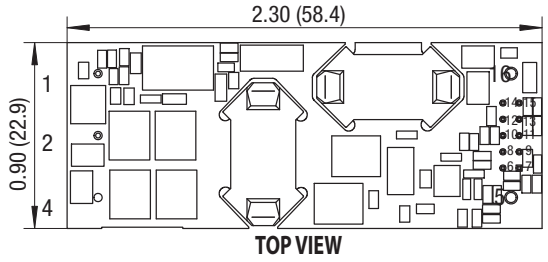


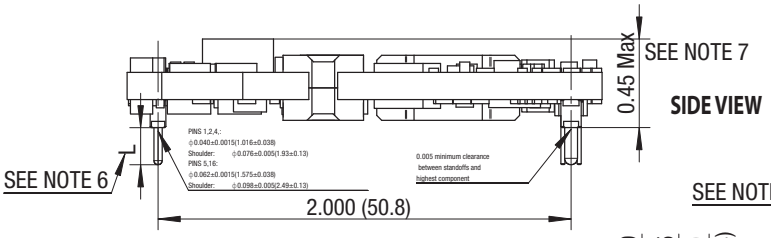
Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from Vin to Vout)

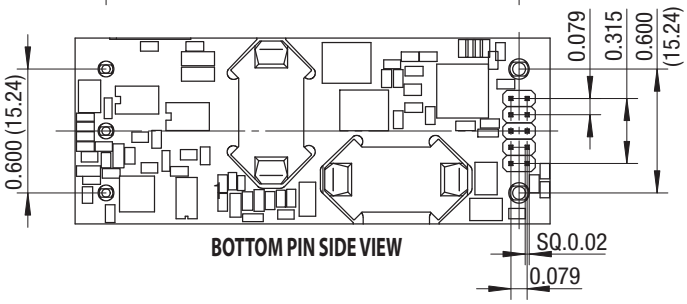


MECHANICAL SPECIFICATIONS

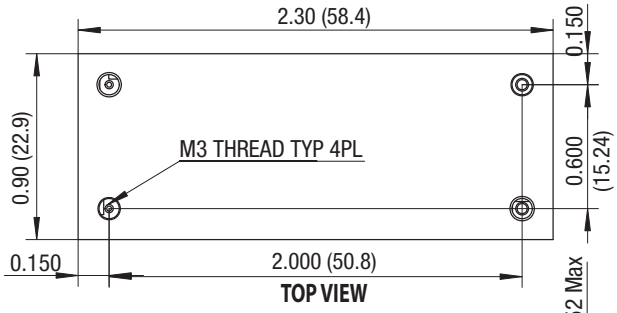
OPEN FRAME

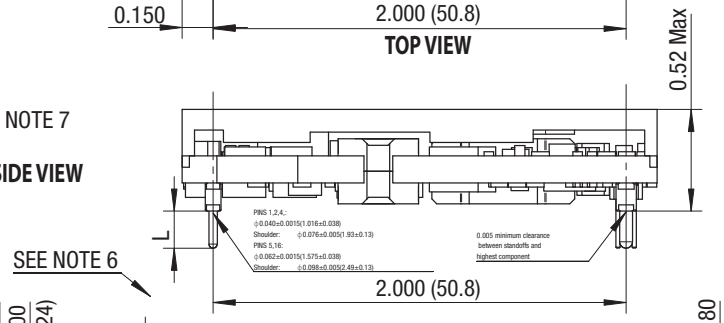


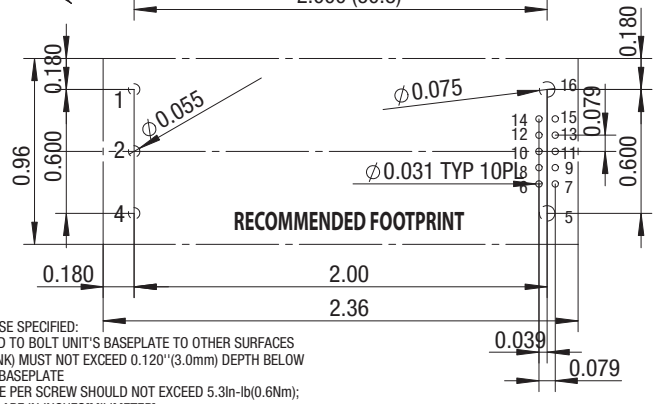




WITH BASEPLATE OPTION



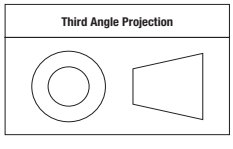




NOTES:
UNLESS OTHERWISE SPECIFIED:
1:M3 SCREW USED TO BOLT UNIT'S BASEPLATE TO OTHER SURFACES (SUCH AS HEATSINK) MUST NOT EXCEED 0.120"(3.0mm) DEPTH BELOW THE SURFACE OF BASEPLATE
2:APPLIED TORQUE PER SCREW SHOULD NOT EXCEED 5.3ln-lb(0.6Nm);
3:ALL DIMENSION ARE IN INCHES[MILIMETER];
4:ALL TOLERANCES: ×.××in ,±0.02in(×.×mm,±0.5mm)
×.×××in ,±0.01in(×.××mm,±0.25mm)
5:COMPONENT WILL VARY BETWEEN MODELS
6:STANDARD PIN LENGTH: 0.180 Inch
FOR 1 PIN LENGTH OPTION IN MODEL NAME,
THE LENGTH SHOULD BE 0.110 INCH
FOR 2 PIN LENGTH OPTION, PLEASE SEE THE PART NUMBER STRUCTURE ON P. 2;
USE STANDARD 2 PIN WITH PIN LENGTH TO 0.145 Inch
7:0.45" (Max) for the DBE0340 & DBE0540
0.46" (Max) for the DBE0125

INPUT/OUTPUT CONNECTIONS		
Pin	**Designation**	**Function**
1	+VIN	Positive Input
2	RC	Remote Control
4	–VIN	Negative Input
5	–VOUT	Negative Output
6	+S	Positive Remote Sense
7	–S	Negative Remote Sense
8	SA0	Address Pin 0
9	SA1	Address Pin 1
10	SCL	PMBus Clock
11	SDA	PMBus Data
12	PG	Power Good Output
13	DGND	PMBus Ground
14	SMBALERT	PMBus Alert Signal
15	CTRL	Secondary Remote Control
16	+VOUT	Positive Output

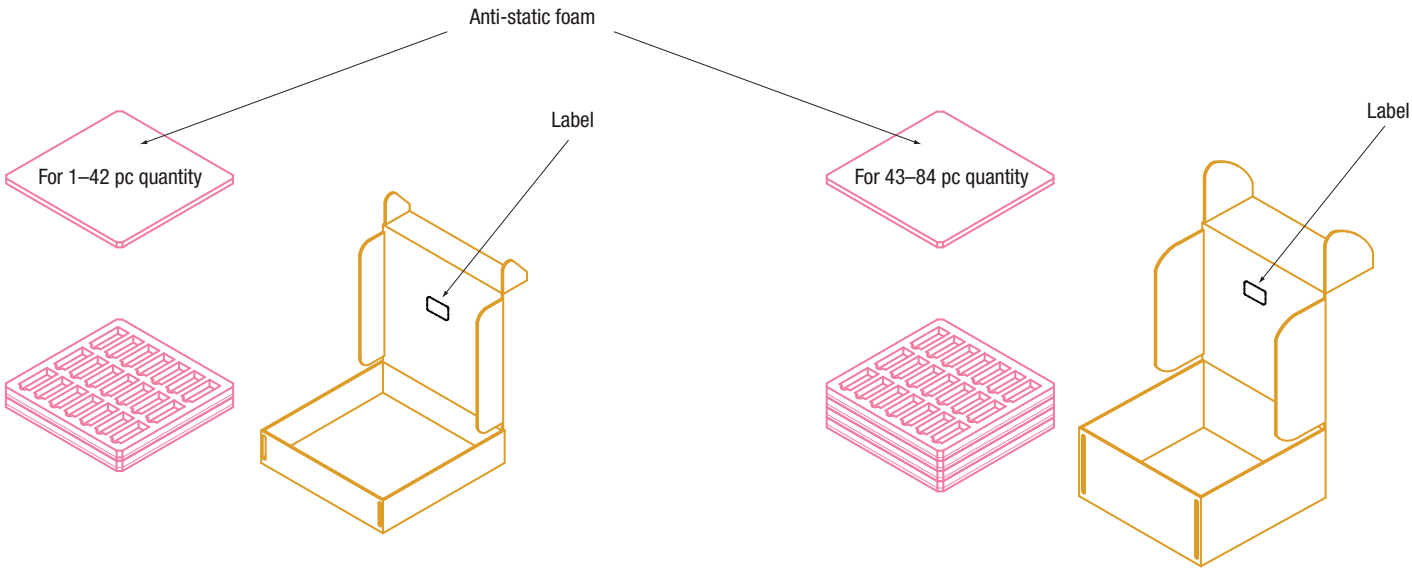
Dimensions are in inches (mm shown for ref. only).



Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2˚

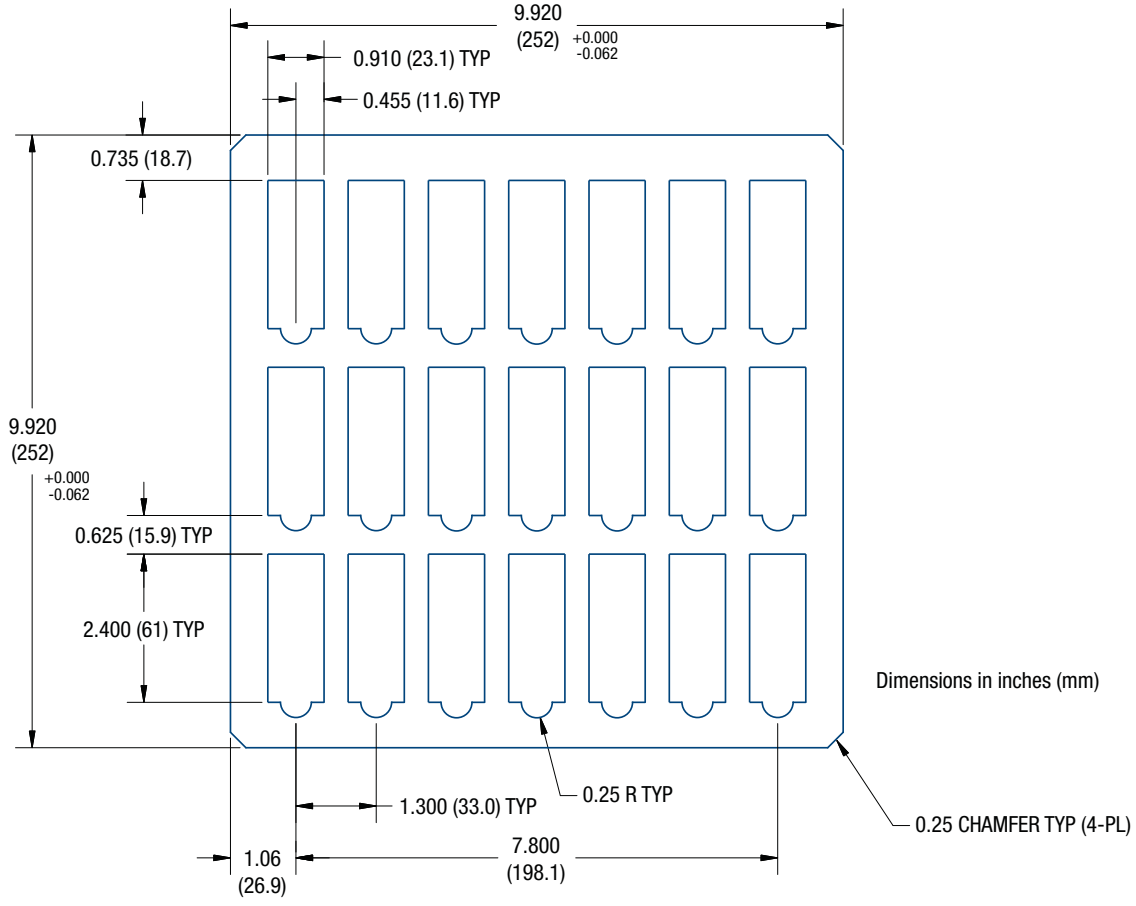
Components are shown for reference only and may vary between units.

SHIPPING TRAYS AND BOXES

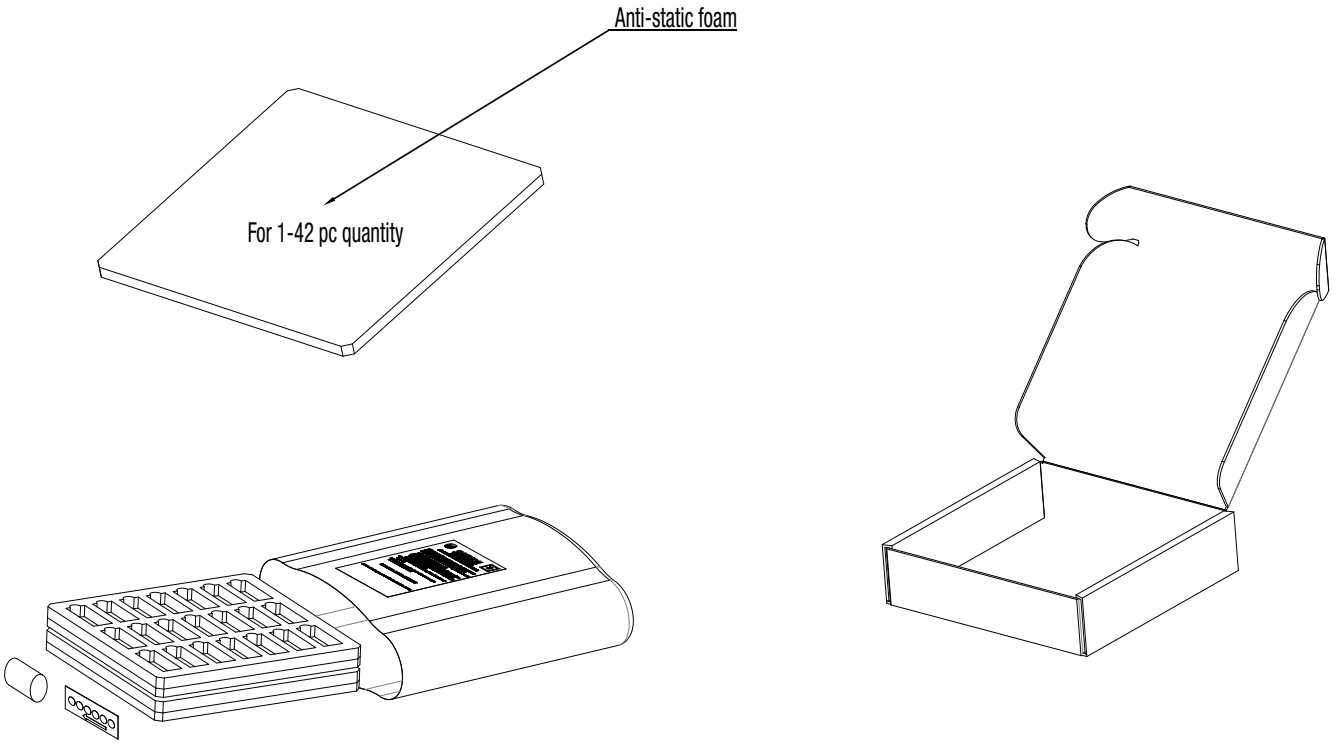


SHIPPING TRAY

DBE/DVE modules are supplied in a 21-piece (3-by-7) shipping tray. The tray is an anti-static closed-cell polyethylene foam. Dimensions are shown below.



PIH SHIPPING TRAYS AND BOXES



TECHNICAL NOTES

Power Management Overview

The module includes a wide range of readable and configurable power management features that are easy to implement with a minimum of external components. Furthermore, the module includes protection features that continuously protect the load from damage due to unexpected system faults. The SMBALERT pin alerts the host if there is a fault in the module. The following product parameters can continuously be monitored by a host: Vout, Iout, Vin, Temperature, and Power Good. The module is distributed with a default configuration suitable for a wide range operation in terms of Vin, Vout, and load. All power management functions can be reconfigured using the PMBus interface. The product provides a PMBus digital interface that enables the user to configure many aspects of the device operation as well as monitor the input and output parameters. Please contact Murata-PS for design support of special configurations.

Soft-start Power Up

The default rise time of the ramp up is 20 ms. When starting by applying input voltage the control circuit boot-up time adds an additional 10 ms delay. The soft-start power up of the module can be reconfigured using the PMBus interface.

Over Voltage Protection (OVP)

The module includes over voltage limiting circuitry for protection of the load. The default OVP limit is 20% above the nominal output voltage. If the output voltage surpasses the OVP limit, the module can respond in different ways. The default response from an over voltage fault is to immediately shut down. The device will continuously check for the presence of the fault condition, and when the fault condition no longer exists the device will be re-enabled. The OVP fault level and fault response can be reconfigured using the PMBus interface.

Over Current Protection (OCP, Current limit)

The module includes current limiting circuitry for protection at continuous over load. The default setting for the product is hicup mode. The current limit could be configured by simply setting the IOUT_OC_FAULT_LIMIT to be greater than the IOUT_OC_WARN_LIMIT. The maximum value that the current limit could be set is 50A.

Power Good

The module provides Power Good (PG) flag in the Status Word register that indicates the output voltage is within a specified tolerance of its target level and no fault condition exists. The Power Good pin default logic is negative and it can be configured by MFR_PGOOD_POLARITY.

Switching Frequency Adjust Using PMBus

By default the switching frequency is set to 175-250 KHz variable frequency control. The product is optimized at this frequency but it can be changed to 175 KHz fixed frequency control. The thermal performance can be affected if the switching frequency is changed when Vin is above 50 Vdc. The following graph shows Frequency vs. Vin.

PMBus Interface

This module offers a PMBus digital interface that enables the user to configure many characteristics of the device operation as well as to monitor the input and output voltages, output current and device temperature. The module can be used with any standard two-wire I2C or SMBus host device. In addition, the module is compatible with PMBus version 1.2 and includes an SMBALERT line to help alleviate bandwidth limitations related to continuous fault monitoring. The module supports 100 kHz and 400 kHz bus clock frequency only.

Monitoring via PMBus

A system controller (host device) can monitor a wide variety of parameters through the PMBus interface. The controller can monitor fault conditions by monitoring the SMBALERT pin, which will be asserted when any number of pre-configured fault or warning conditions occur. The system controller can also continuously monitor any number of power conversion parameters including but not limited to the following:

- Input voltage
- Output voltage
- Output current
- Module temperature

Software Tools for Design and Production

For these modules Murata-PS provides software for configuring and monitoring via the PMBus interface. For more information please contact your local Murata-PS representative.

PMBus Addressing

Figure 1 and the accompanying table display the recommended resistor values for hard-wiring PMBus addresses (1% tolerance resistors recommended): The address is set in the form of two octal (0 to 7) digits, with each pin setting one digit. The SA1 pin sets the high order digit and SA0 sets the low order digit. The resistor values for each digit is shown below.

The SA0 and SA1 pins can be configured with a resistor to GND according to the following equation.

PMBus Address = 8 x (SA0value) + (SA1 value)

If the calculated PMBus address is 0d, 11d or 12d, default PMBus address is assigned instead. From a system point of view, the user shall also be aware of further limitations of the addresses as stated in the PMBus Specification. It is not recommended to keep the SA0 and SA1 pins left open.

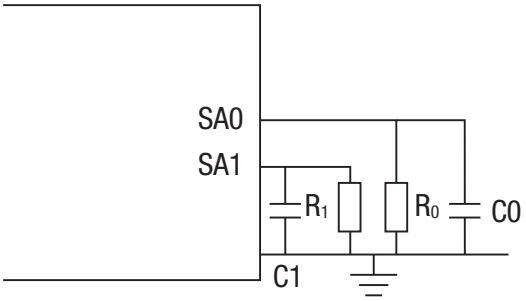


Figure 1. Schematic of Connection of Address Resistors

Digit (SA0, SA1 index)	Resistor Value [kΩ]
0	10
1	22
2	33
3	47
4	68
5	100
6	150
7	220

PMBus Commands

The products are designed to be PMBus compliant. The following tables list the implemented PMBus read commands. For more detailed information see "PMBus Power System Management Protocol Specification, Part I – General Requirements, Transport and Electrical Interface" and "PMBus Power System Management Protocol, Part II – Command Language."

OVERALL

CMD	Command Name[1]	SMBus Transaction Type: Writing Data	SMBus Transaction Type: Reading Data
01h	OPERATION[2]	Write Byte	Read Byte
02h	ON_OFF_CONFIG[3]	Write Byte	Read Byte
03h	CLEAR_FAULTS	Send byte	N/A
10h	WRITE_PROTECT	Write Byte	Read Byte
11h	STORE_DEFAULT_ALL[4]	Send byte	N/A
12h	RESTORE_DEFAULT_ALL[4]	Send byte	N/A
15h	STORE_USER_ALL[4]	Send byte	N/A
16h	RESTORE_USER_ALL[4]	Send byte	N/A
19h	CAPABILITY	N/A	Read Byte
20h	VOUT_MODE	N/A	Read Byte
21h	VOUT_COMMAND	Write Word	Read Word
22h	VOUT_TRIM	Write Word	Read Word
25h	VOUT_MARGIN_HIGH	Write Word	Read Word
26h	VOUT_MARGIN_LOW	Write Word	Read Word
28h	VOUT_DROOP	Write Word[11]	Read Word
40h	VOUT_OV_FAULT_LIMIT	Write Word	Read Word
41h	VOUT_OV_FAULT_RESPONSE[5]	Write Byte	Read Byte
42h	VOUT_OV_WARN_LIMIT	Write Word	Read Word
46h	IOUT_OC_FAULT_LIMIT	Write Word	Read Word
47h	IOUT_OC_FAULT_RESPONSE[6]	Write Byte	Read Byte
4Ah	IOUT_OC_WARN_LIMIT	Write Word	Read Word
4Fh	OT_FAULT_LIMIT	Write Word	Read Word
50h	OT_FAULT_RESPONSE[5]	Write Byte	Read Byte
51h	OT_WARN_LIMIT	Write Word	Read Word
55h	VIN_OV_FAULT_LIMIT	Write Word	Read Word
56h	VIN_OV_FAULT_RESPONSE[7]	Write Byte	Read Byte
57h	VIN_OV_WARN_LIMIT	Write Word	Read Word
58h	VIN_UV_WARN_LIMIT	Write Word	Read Word
59h	VIN_UV_FAULT_LIMIT	Write Word	Read Word
5Ah	VIN_UV_FAULT_RESPONSE[7]	Write Byte	Read Byte
5Eh	POWER_GOOD_ON	Write Word	Read Word
5Fh	POWER_GOOD_OFF	Write Word	Read Word

OVERALL (CONT.)

CMD	Command Name[1]	SMBus Transaction Type: Writing Data	SMBus Transaction Type: Reading Data
60h	TON_DELAY	Write Word[11]	Read Word
61h	TON_RISE[12]	Write Word[11]	Read Word
64h	TOFF_DELAY	Write Word[11]	Read Word
65h	TOFF_FALL[12]	Write Word[11]	Read Word
78h	STATUS_BYTE	Write Byte	Read Byte
79h	STATUS_WORD	Write Word	Read Word
7Ah	STATUS_VOUT	Write Byte	Read Byte
7Bh	STATUS_IOUT	Write Byte	Read Byte
7Ch	STATUS_INPUT	Write Byte	Read Byte
7Dh	STATUS_TEMPERATURE	Write Byte	Read Byte
7Eh	STATUS_CML	Write Byte	Read Byte
88h	READ_VIN	N/A	Read Word
8Bh	READ_VOUT	N/A	Read Word
8Ch	READ_IOUT	N/A	Read Word
8Dh	READ_TEMPERATURE_1[8]	N/A	Read Word
8Eh	READ_TEMPERATURE_2[9]	N/A	Read Word
94h	READ_DUTY_CYCLE	N/A	Read Word
95h	READ_FREQUENCY	N/A	Read Word
96h	READ_POUT	N/A	Read Word
98h	PMBUS_REVISION	N/A	Read Byte
99h	MFR_ID	N/A	Block Read
9Ah	MFR_MODEL[10]	Block Write	Block Read
9Bh	MFR_REVISION[10]	Block Write	Block Read
9Dh	MFR_DATE[10]	Block Write	Block Read
9Eh	MFR_SERIAL[10]	Block Write	Block Read
A0h	MFR_VIN_MIN	N/A	Read Word
A1h	MFR_VIN_MAX	N/A	Read Word
A2h	MFR_IIN_MAX	N/A	Read Word
A3h	MFR_PIN_MAX	N/A	Read Word
A4h	MFR_VOUT_MIN	N/A	Read Word
A5h	MFR_VOUT_MAX	N/A	Read Word
A6h	MFR_IOUT_MAX	N/A	Read Word
A7h	MFR_POUT_MAX	N/A	Read Word
A8h	MFR_TAMBIENT_MAX	N/A	Read Word
A9h	MFR_TAMBIENT_MIN	N/A	Read Word
B0h	USER_DATA_00	Block Write	Block Read
B1h	USER_DATA_01	Block Write	Block Read
C0h	MFR_MAX_TEMP_1	N/A	Read Word
D0h	MFR_VARIABLE_FREQUENCY_DISABLE	Write Byte	Read Byte
DBh	MFR_CURRENT_SHARE_CONFIG	Write Byte	Read Byte
DDh	MFR_PRIMARY_ON_OFF_CONFIG	Write Byte	Read Byte
DEh	MFR_PGOOD_POLARITY	Write Byte	Read Byte
E8h	MFR_VIN_OV_FAULT_HYS	Write Word	Read Word
E9h	MFR_VIN_UV_FAULT_HYS	Write Word	Read Word
EAh	MFR_OT_FAULT_HYS	Write Word	Read Word
F6h	MFR_CALIBRATION_STATUS	N/A	Read Byte
F9h	MFR_VIN_SENSE_CALIBRATION	Write byte	N/A
FAh	MFR_IOUT_SENSE_CALIBRATION	Write Word	N/A
FBh	MFR_VOUT_SET_POINT_CALIBRATION	Write Word	N/A
FCh	MFR_SUPERVISOR_PASSWORD	Block Write	N/A