Data Sheet | July 2004 | FN9028.1

InfiniBand +12V Bulk and +5V Auxiliary Power Controller

The ISL6160 is designed to address the unique power requirements of the InfiniBand (IB) industry initiative providing independent power control of both the VB(bulk) (+12V) and the VA(auxiliary) (+5V) power rails for a single port. This device can be implemented in both IB Class I (non isolated) and Class II (isolated) Power Topology applications.

The ISL6160, along with an N-Channel power MOSFET and a minimal number of passive components provides soft starting ramps of both the VB and VA voltages for an IB module. It also provides accurate and consistent current regulated outputs for a determined period of time before latch-off in the presence of overcurrent (OC) conditions.

In addition the ISL6160 provides the enable signal to the on module DC-DC converter either upon module insertion to chassis or from a wake event request.

See Figure 1 for typical application usage.

Ordering Information

PART NUMBER	TEMP. RANGE (^{O}C)	PACKAGE	PKG. DWG. #
ISL6160CB	-40 to 85	14 Ld SOIC	M14.15
ISL6160CBZA (See Note)	-40 to 85	14 Ld SOIC (Pb-free)	M14.15
ISL6160EVAL2	IB Class I Power Topology Evaluation Platform		

*Add "-T" suffix to part number for tape and reel packaging.

NOTE: Intersil Pb-free products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which is compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J Std-020B.

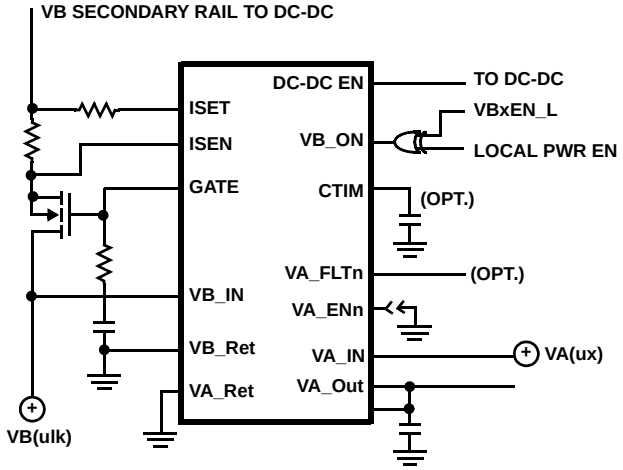


FIGURE 1. TYPICAL APPLICATION USAGE

Features

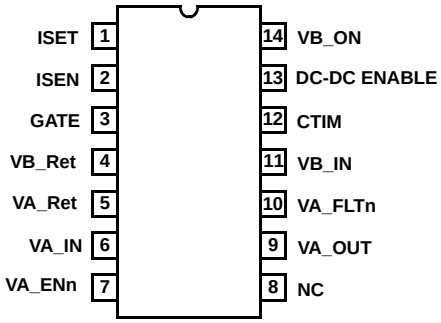
- VB Programmable Overcurrent Protection Regulation Level for 25W and 50W Ports
- Internal Charge Pump Allows the Use of an N-Channel MOSFET for VB Control
- VB Adjustable Turn-On Ramp
- Soft Start Overcurrent Protection During Turn-On
- Two Levels of VB Overcurrent Detection and Protection
- VA and VB Undervoltage Lock-Outs
- 0.125Ω Integrated Power N-Channel MOSFET VA Switch
- Accurate VA Current Sensing and Limiting (1A)
- Timed Current Regulation Period (VB Optional)
- VA Controlled Turn-On Ramp Time
- 1μs Response Time to VB Secondary Rail Dead Short
- Pb-free available

Applications

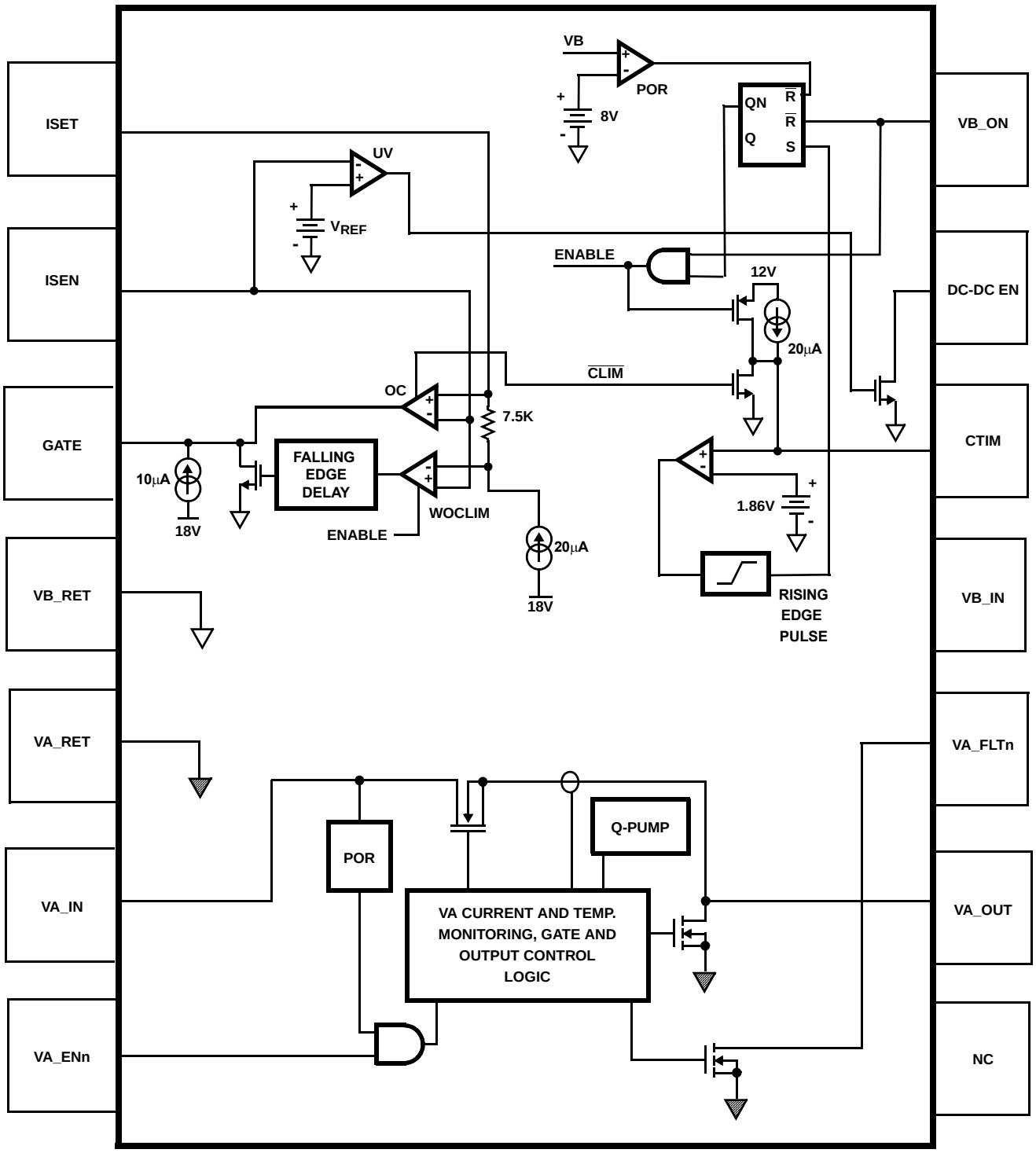
- InfiniBand VB and VA Voltage Control
- -48V and 5V Telecom

Pinout

ISL6160
(14 LEAD SOIC)
TOP VIEW



Simplified Block Diagram



Pin Descriptions

PIN NO.	DESIGNATOR	FUNCTION	DESCRIPTION
1	ISET	Current Set	Connect to the low side of the current sense resistor through the current limiting set resistor. This pin functions as the current regulation level voltage programming pin. CR Vth = R_{ISET} X 20µA
2	ISEN	Current Sense	Connect to the more positive end of sense resistor to measure the voltage drop across this resistor.
3	GATE	External FET Gate Drive Pin	Connect to the gate of the external N-Channel MOSFET. A capacitor from this node to ground sets the turn-on ramp. At turn-on this capacitor will be charged to VB +5V by a 10µA current source.
4	VB_Ret	VB Chip Return	Bulk voltage ground
5	VA_Ret	VA Chip Return	Auxiliary voltage ground
6	VA_IN	VA Bias, Controlled Supply Input, Undervoltage Lock-Out	VA_IN provides the chip with +5V bias voltage. At VA < 2.5V, VA control functionality is disabled, FAULT latch is cleared and floating and VA_OUT is held low.
7	VA_ENn	VA enable / disable	Connected to VA_Ret through the IB connector, VA is asserted on module when VA_ENn is low. Cycle to reset after latch-off. POR also resets latch.
8	NC	NC	
9	VA_OUT	Controlled Supply Output	Upon an OC condition VA_OUT is current limited to 1A. Current limit response time is within 200µs. VA_Out will remain in current limit for ~10mS before being latched off.
10	VA_ FLTn	Over Current Fault Indicator	Over current fault indicator. VA_FLTn floats and is disabled until VA >2.5V. This output is pulled low after the OC time-out period has expired and stays latched until module is removed.
11	VB_IN	VB / Chip Supply	+12V Chip Supply.
12	CTIM	VB Current Regulation Period	Connect a capacitor from this pin to ground. This capacitor determines the time delay between an overcurrent event and chip output shutdown (current limit time-out). The duration of current limit time-out (in seconds) = 93kΩ x C_{TIM} (Farads).
13	DC-DC ENABLE	VB_In Power Good and DC-DC Enable Signal	Indicates that the VB voltage on ISEN pin is within specification and enables the DC-DC converter. DC-DC ENABLE is driven by an open drain N-Channel MOSFET and is pulled low when VB Secondary rail (V_{ISEN}) is not within specification.
14	VB_ON	VB Sequencer Enable Control Signal	VB_ON is used to control and reset the VB supply to IB module. VB is asserted on, when VB_ON pin is driven high or is open. After a latch-off VB is reset by a low level signal applied to this pin. This input has 20µA pull-up capability.

Absolute Maximum Ratings

VB . . . . . +17.0V
GATE . . . . . -0.3V to VB+8V
ISEN, PGOOD, VB_On, ISET . . . . . -0.3V to VB+ 0.3V
VA 6.0V
VA_ENn, VA_FLTn . . . . . -0.3V to 6V
VA_OUT . . . . . GND-0.3V to VA+0.3V
VA_Output Current . . . . . Short Circuit Protected
ESD Classification . . . . . 3kV (HBM)

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} (^{o}C/W)
SOIC Package	90

Maximum Junction Temperature . . . . . 150^{o}C
Maximum Storage Temperature Range . . . . . -65^{o}C to 150^{o}C
Maximum Lead Temperature (Soldering 10s) . . . . . 300^{o}C
(SOIC - Lead Tips Only)

Operating Conditions

VB Supply Voltage Range . . . . . +10V to +14V
VA Supply Voltage Range . . . . . +4.5V to +5.5V
Temperature Range (T_A) . . . . . -40^{o}C to 85^{o}C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. NOTE #1 θ_{JA} is measured with the component mounted on a low effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

2. All voltages are relative to GND, unless otherwise specified.

Electrical Specifications

Nominal VB = +12V, VA = +5V, $T_A = T_J$ = -40^{o}C - 85^{o}C, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
+12V (VB) BULK SUPPLY CONTROL						
ISET Current Source	I_{ISET}		18.5	20	21.5	µA
Current Limit Amp Offset Voltage		V_{ISET} - V_{ISEN}	-4	0	4	mV
Severe Overcurrent Threshold	SOC_Vth	Above set current regulation voltage threshold	-	150	-	mV
Full Temp 25W VB Current Regulation	25W_ilim_ft	R_{ISET} = 2.8kΩ 1%, R_{SENSE} = 20mΩ 1%	2.2	2.8	3.4	A
Full Temp 50W VB Current Regulation	50W_ilim_ft	R_{ISET} = 2.8kΩ 1%, R_{SENSE} = 10mΩ 1%	4.5	5.6	6.7	A
Limited Temp 25W VB Current Regulation	25W_ilim_lt	R_{ISET} = 2.8kΩ 1%, R_{SENSE} = 20mΩ 1%, T_J = 15^{o}C - 45^{o}C	2.6	2.8	3.0	A
Limited Temp 50W VB Current Regulation	50W_ilim_lt	R_{ISET} = 2.8kΩ 1%, R_{SENSE} = 10mΩ 1%, T_J = 15^{o}C - 45^{o}C	5.2	5.6	6.0	A
GATE PARAMETERS						
GATE Response Time to Severe Overcurrent	Tr_gate_soc	V_{RSENSE} = (150mV + CR Vth) to V_{GATE} to 10.8V	-	100	-	nS
GATE Response Time to Overcurrent	Tr_gate_oc	V_{GATE} to 10.8V	-	600	-	ns
GATE Turn-On Current	I_{GATE}	V_{GATE} to = 6V	8.4	10	11.6	µA
GATE Pull-Down Current	Igte_4v_oc	Overcurrent	45	75	-	mA
GATE Pull-Down Current	Igte_4V_soc	Severe Overcurrent	-	0.8	-	A
GATE High Voltage	Vgate_h	GATE Voltage	VB+4.5V	VB+5V	-	V
VB PARAMETERS						
IC Supply Current	I_{VB}		-	3	5	mA
VB POR Rising Threshold	VB_{POR_L2H}	VB Low to High	7.8	8.4	9	V
VB POR Falling Threshold	VB_{POR_H2L}	VB High to Low	7.5	8.1	8.7	V
VB POR Threshold Hysteresis	VB_{POR_HYS}	VB_{POR_L2H} - VB_{POR_H2L}	0.1	0.3	0.6	V
DC-DC Enable Undervoltage Threshold	$DCen_{UV\_VTH}$		9.2	9.6	10	V
VB_On Rising Threshold	PWR_Vth		1.4	1.7	2.0	V
VB_On Hysteresis	PWR_hys		-	170	-	mV
VB_On Pull-Up Voltage	PWRN_V	VB_On Pin Open	2.7	3.2	-	V
VB_On Pull-Up Current	PWRN_I		9	17	25	µA

Electrical Specifications Nominal VB = +12V, VA = +5V, $T_A = T_J = -40^oC$ - 85^oC, Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
CTIM PARAMETERS						
C_{TIM} Charging Current	C_{TIM}_ichg0	V_{CTIM} = 0V	16	20	23	µA
C_{TIM} Fault Pull-Up Current	C_{TIM}_ichg6	V_{CTIM} = 6V	5	8	11	mA
Current Limit Time-Out Threshold Voltage	C_{TIM}_Vth	CTIM Voltage	1.3	1.8	2.3	V
+5V AUXILIARY SUPPLY CONTROL						
VA Integrated Switch On Resistance	$r_{DS(ON)}$	V_{IN} = 5V, I_{OUT} = 0.4A, $T_A = T_J = 25^oC$	-	0.125	0.150	Ω
		$T_A = T_J = 85^oC$	-	0.160	0.200	Ω
Disabled Output Voltage	V_{OUT_DIS}	V_{IN} = 5V, Switch Disabled, No Load	-	300	450	mV
V_{OUT} Rising Rate	t_vout_rt	R_L = 10Ω, C_L = 0.1µF, 10%-90%	-	8	-	V/mS
Slow V_{OUT} turn-off rate	Toff_svout	R_L = 10Ω, C_L = 0.1µF, 90%-10%	-	8	-	V/mS
Fast V_{OUT} turn-off rate	Toff_fvout	R_L = 10Ω, C_L = 0.1µF, 90%-10%	-	4	-	V/uS
CURRENT CONTROL						
Current Limit	Ilim		0.75	1	1.25	A
OC Regulation Settling Time	Tsett_ocr	R_L= 5Ω, C_L= 0.1µF to Within 10% of CR	-	1.5	-	ms
Severe OC Regulation Settling Time	Tsett_socr	R_L< 1Ω, C_L= 0.1µF to Within 10% of CR	-	100	-	µs
Over Current Latch-off Time	t_{OC_loff}		-	12		ms
I/O PARAMETERS						
Fault Output Voltage	Vfault_hi	I_{OUT} = 10mA	-	-	0.3	V
ENABLE High Threshold	Ven_vih	V_{IN} = 5.5V	2.0	-	-	V
ENABLE Low Threshold	Ven_vil	V_{IN} = 4.5V	-	-	0.8	V
ENABLE Input Current	Ien_i	ENABLE = 0V to 5V, V_{IN} = 5V, $T_J > 25^oC$	-0.5	-	0.5	µA
BIAS PARAMETERS						
Enabled VA_Iin Current	I_{en_VA}	Switches Closed, VA_Out = OPEN, $T_J > 0^oC$	-	120	200	µA
Disabled VA_Iin Current	I_{dis_VA}	Switches Open, VA_Out = OPEN	-	1	5	µA
Undervoltage Lockout Threshold	V_{UVLO}	VIN Rising, Switch Enabled	1.7	2.25	2.5	V
UV Hysteresis	UV_{HYS}		50	100	-	mV

ISL6160 Description and Operation

The ISL6160 is the first power supply sequencer for the emerging InfiniBand module (IM) hot swap application. This IC controls both the +12V VB(ulk) and +5V VA(ux) supplies providing soft start during hot insertion and overcurrent (OC) protection during operation.

For VB control and protection, the ISL6160 features include an accurate current detecting comparator, current limiting for the range of both 25W and 50W capable power ports, a current regulated time delay to latch off and soft start turn-on ramp. These features are all programmable with a minimum of external passive components. The ISL6160 also includes severe overcurrent protection that immediately shuts down the MOSFET switch should there be a shorted IM load.

The VB_ON pin provides on-off control of the external VB switch once VB_IN > 9V. Driving this pin high causes the gate pin to charge the external gate capacitor with a 10uA current setting the soft start ramp rate. Large capacitive loads can thus be safely turned on with no inrush current spiking nor disruption of the voltage supply rail.

The VB load current passes through an external current sense resistor. When the voltage across the sense resistor exceeds the user programmed ISET voltage threshold, the controller enters current regulation (CR). The regulated current level is fixed by the R_{ISET} and R_{SENSE} resistors. See Table 1 for R_{ISET} programming resistor value and the resulting nominal CR threshold voltage.

TABLE 1.

		NOMINAL REGULATION LEVEL (R_{SENSE} = 0.020Ω)	
R_{ISET} RESISTOR	NOMINAL OC Vth	CURRENT (A)	POWER (W)
1.0kΩ	20mV	1	12
2.8kΩ	56mV	2.8	33.6
3.48kΩ	70mV	3.5	42
5.6kΩ	112mV	5.6	67.2

NOTE: Nominal Vth = R_{ISET} x 20µA.

During CR, the CTIM pin starts charging the time-out capacitor with a 20µA current source and the controller enters the delay time to latch-off period. This feature allows transient currents that exceed the designed limit to pass without immediately

shutting down the VB supply. The length of this period is set by the value of a capacitor between CTIM and VB_RET. See table 2 for CTIM value and resulting l current regulation period.

TABLE 2.

C_{TIM} CAPACITOR	NOMINAL CURRENT REGULATION PERIOD
0.001µF	93µs
0.01µF	930µs
0.022µF	2ms
0.047µF	4.4ms
0.1µF	9.3ms

NOTE: Nominal time-out period in seconds = C_{TIM} x 93kΩ.

The programmed current level is held until either the OC event passes or the time out period expires. If the former is the case then the N-Channel MOSFET is fully enhanced and the CTIM capacitor is discharged. Once CTIM charges to 1.87V, signaling that the time out period has expired an internal latch is set whereby the FET gate is quickly pulled to 0V turning off the N-Channel MOSFET switch, isolating the faulty load. Monitor the CTIM pin for an OC latch off indication. This pin will rise rapidly from 1.9V to VB once the time out period expires. If no CTIM capacitor is implemented the VB Secondary Rail will immediately latch-off in an OC event.

The ISL6160 responds to a severe overcurrent load (defined as a voltage across the sense resistor >150mV over the CR Vth set point) by immediately, driving the N-Channel MOSFET gate to 0V in ~1µs. The controlled gate voltage is then ramped up turning on the N-Channel MOSFET to the programmed current limit level. This is the start of the time out period.

The VB control circuitry is reset after an OC latch-off condition by a low level on the VB _ON pin and is turned on again by the VB_ON pin being driven high.

The DC-DC_EN pin is used to enable an accompanying DC-DC converter on the IM when the VB Secondary Rail is within specification. This pin pulls up to VB through a pull-up resistor when the V_{ISEN} is > 10V. This pin can also be used as an undervoltage (UV) signal as it will pull low once the V_{ISEN} falls below 9.2V. This signal can also be passed to a system controller chip or used to drive an LED for observation. The state of this signal does not impact the VB current control function.

For the VA supply the ISL6160 features fully integrated current monitoring and regulation, an integrated 125mΩ N-channel MOSFET power switch (Figure 13.) and a current limited delay to latch-off for system protection. The current sense and limiting circuitry sets the CR limit to a nominal 1A, making this device well suited for the VA requirements. See Figure 14. for current regulation performance. The ISL6160 provides VA OC fault notification if needed, accurate current regulation and a consistent timed latch-off thus isolating and protecting the voltage bus in the presence of an OC event or short circuit. The OC event to CR time is inversely related to the OC magnitude, see Figure 15 and the 12mS time (Figure 16) to latch-off is independent of thermal condition .

The ISL6160 VA_ENn pin provides on-off control over the VA_IN supply when VA is greater than 2.5V. The switch is asserted on and starts the soft start ramp once VA_ENn < 0.8V.

Once the VA is latched off due to an OC condition the VA_Fltn pin will go low indicating the faulted state to a control chip, indicator display or alarm.

The ISL6160 VB and VA control circuitries are isolated from each other, thus there are no sequencing restrictions to be considered.

Description of ISL6160 Operation in an InfiniBand Module (IM)

On the IM the ISL6160 is necessarily paired with a DC-DC converter to convert 12V to a lower usable voltage for the application circuitry. Figure 2 shows a block diagram of a complete IM power sequencer and power supply using the ISL6160 and a HIP6006, single output PWM DC-DC converter.

Upon insertion, the InfiniBand (IB) backplane secondary side connector sequences connections between the backplane and the inserted module in the following order:

1. VA_Ret and VB_Ret

2. VA_In and VB_In

3. the 6 InfiniBand Module (IM) control signals and

4. VBx_En_L and IMxPRst due to the staggered lead lengths.

The ISL6160 VA undervoltage lockout feature prevents turn-on of VA until VA_In > 2.5V. It then enables the VA soft start and power up. The VA rising voltage output is a current limited ramp so that both the inrush current and voltage slew rate are limited, (Figure 18) independent of load. This reduces supply droop due to surge and eliminates the need for additional external EMI filters. During operation, once a VA OC condition is detected the output current is limited to 1A for 12mS to allow transient conditions to pass. If the IC is still in current limit mode after the current limit period has elapsed, the output is then latched off. The VA to the IM circuitry is latched off until reset by the disconnection and reconnection of the IM from the chassis backplane.

Once VB_In is connected, it is held off from the VB Secondary Rail until the ISL6160 VB_On pin is signaled high. This is accomplished through the exclusive OR of both the VBx_En_L and the Local_Power_Enable being asserted. At that time the ISL6160 turns on the VB in a soft start mode protecting the primary supply rail from sudden in-rush current. During turn-on, the external gate capacitor of the N-Channel MOSFET (VB switch) is charged with a 20µA current source resulting in a programmable ramp (soft start turn-on). An internal charge pump supplies the gate drive for the 12V VB supply switch driving the MOSFET gate to VB +5V. Once the VB Secondary Rail ramps to 10V the DC-DC_En pin is pulled high thus

enabling the accompanying voltage converter. The DC-DC converter then provides a well regulated output voltage to the IM circuitry.

Available from Intersil is the ISL6160EVAL2. The ISL6160EVAL2 is a complete InfiniBand Class I (non isolated) power topology evaluation platform consisting of the ISL6160 and the HIP6006 single output PWM controller. See Figure 2 for a simplified block diagram of the ISL6160EVAL2 platform. This evaluation platform allows the Infiniband Module (IM) power supply designer to evaluate the concept of this design and apply it to a specific IM power requirement. The evaluation platform is configured for 5V Vout and 3A Iout capability and exhibits a 92% total efficiency. See Figures 19 and 20 for ISL6160EVAL2 turn-on and turn-off waveforms.

Additional information for the ISL6160EVAL2 can be found in application note AN9959.

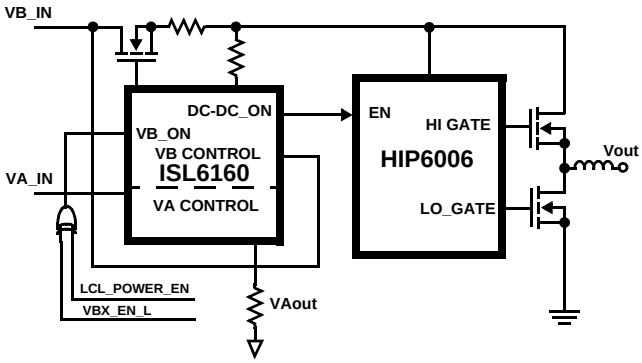


FIGURE 2. SIMPLIFIED ISL6160EVAL2 BLOCK DIAGRAM

Using the ISL6160 beyond IM Applications

-48V, +5V Control Circuit

The ISL6160 can also be used for -48V and +5V telecom power control. The VB portion of the ISL6160 configured as a low side switch controller as shown in Figure 3. is capable of controlling several hundreds of volts, positive or negative and at the same time provide control and protection for the +5V supply with its 1A integrated current regulating function.

Biased by an external 12V reference in the low side switch configuration the ISL6160 retains all of its features except for the DC-DC_EN feature. This is nonfunctional in the low side configuration as V_{ISEN} is always near 0V and will not pull high to indicate that voltage is good.

When controlling a negative voltage the VB_ON control can be implemented through an optocoupler for on-off control or left open for an always on hot pluggable adaptor card application .

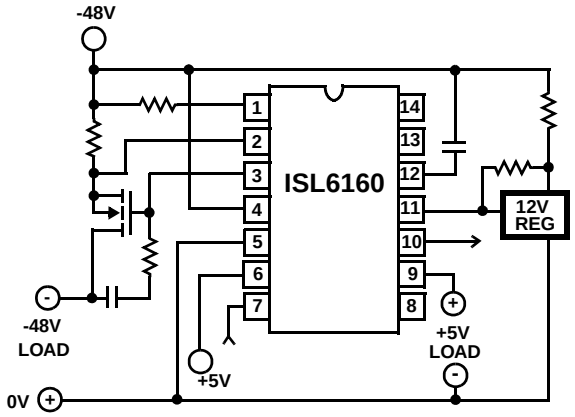


FIGURE 3. -48V/+5V APPLICATION CIRCUIT

Application Considerations

The manufacturers' MOSFET safe operating area (SOA) data should be consulted, as during the soft start ramp and current regulation times, the VGS of the external N-Channel MOSFETs is reduced driving the N-Channel MOSFET switch into the (linear region) high rDS(ON) state. Thus avoid extended soft start and time out periods as the external N-Channel MOSFETs may be damaged or destroyed due to excessive internal power dissipation. Refer to the MOSFET manufacturers' data sheets for SOA information.

With the high levels of inrush current e.g., highly capacitive loads and HDD motor start up currents, choosing the ramp up rate and regulation level of the load current is crucial to provide both protection and still allow for this inrush current without latching off. Consider this in addition to the time out delay when choosing MOSFETs for your design.

Correct physical layout of RSENSE resistor is critical to the accuracy of sensing the VB current. Ideally trace routing between the R_{SENSE} resistors and the ISL6160 is direct and as short as possible with zero current in the sense lines. (See Figure 4.)

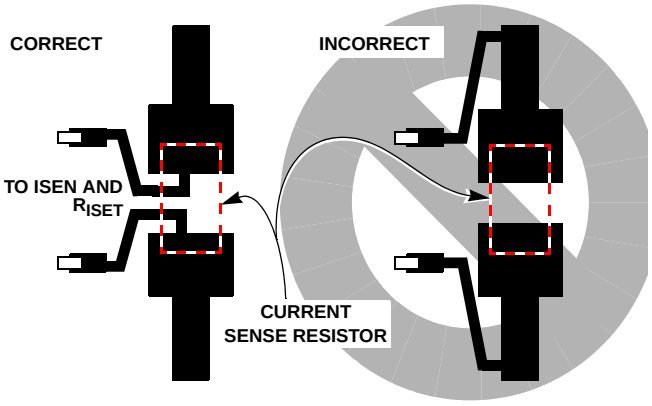


FIGURE 4. SENSE RESISTOR PCB LAYOUT

Typical Performance Curves

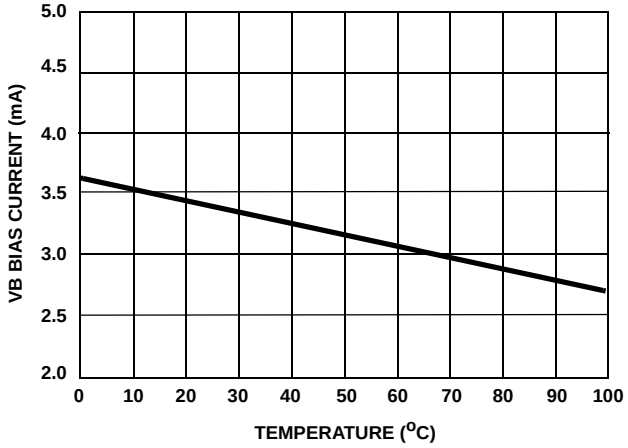


FIGURE 5. VB BIAS CURRENT

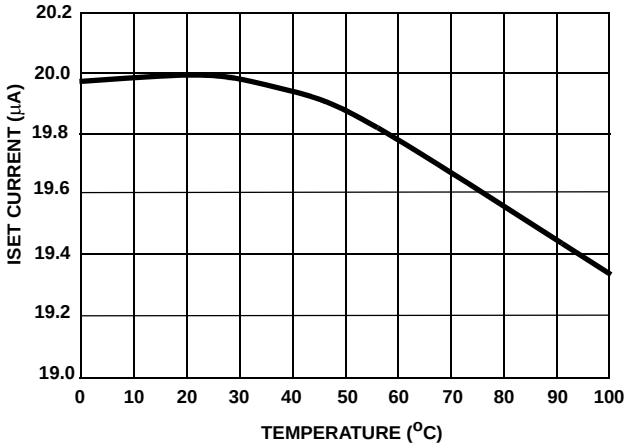


FIGURE 6. ISET SOURCE CURRENT

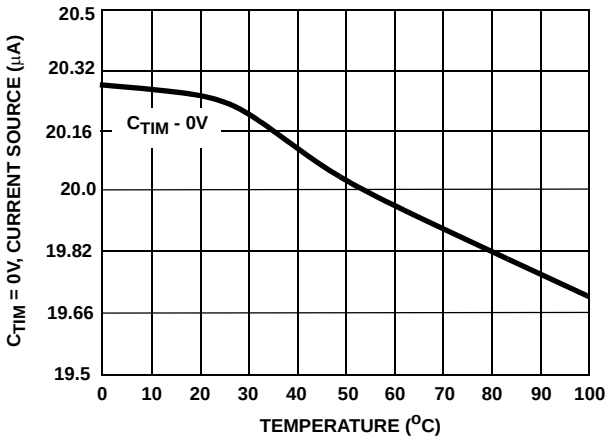


FIGURE 7. C_{TIM} CURRENT SOURCE

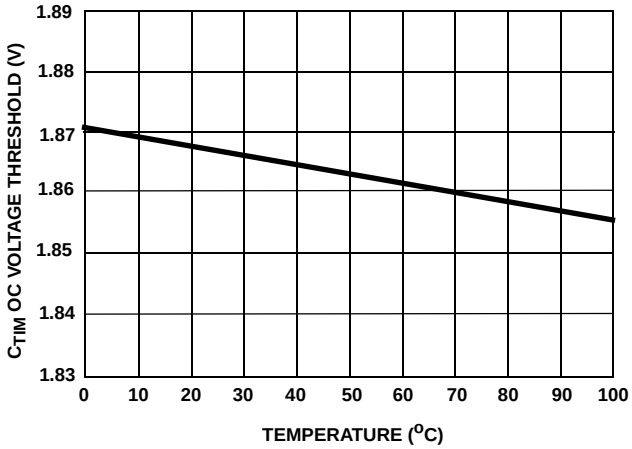


FIGURE 8. C_{TIM} OC VOLTAGE THRESHOLD

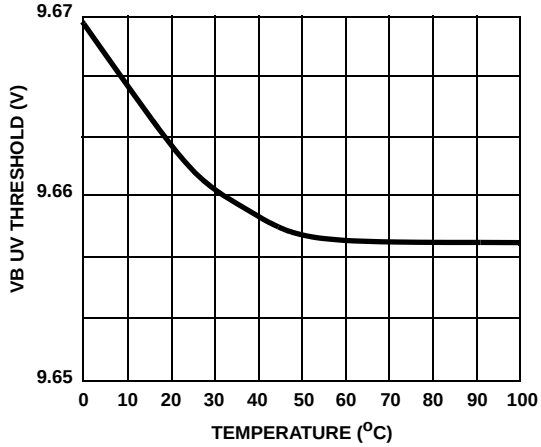


FIGURE 9. VB UV THRESHOLD

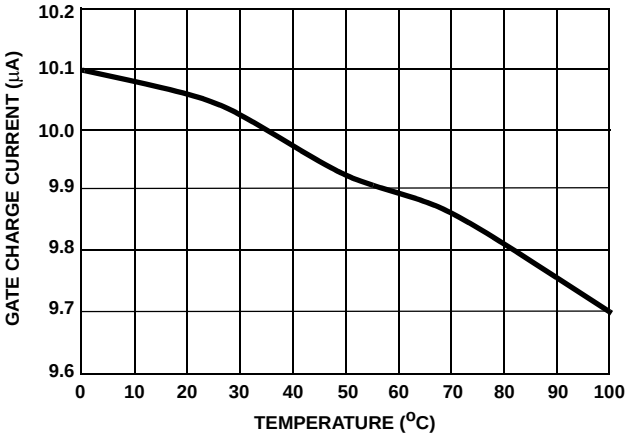


FIGURE 10. GATE CHARGE CURRENT

Typical Performance Curves (Continued)

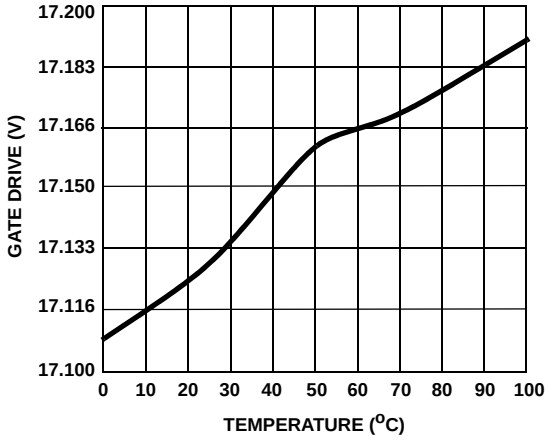


FIGURE 11. GATE DRIVE VOLTAGE, VB = 12V

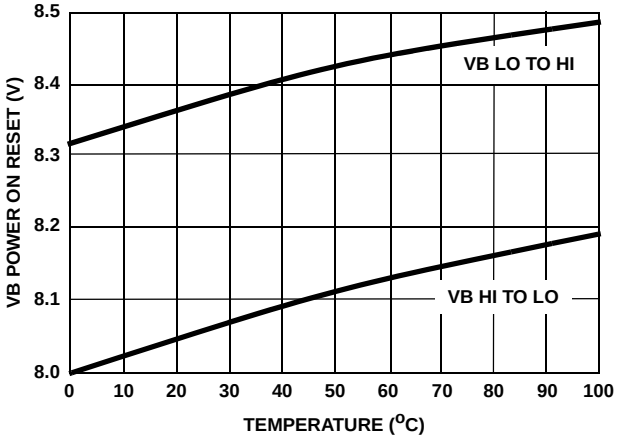


FIGURE 12. VB POWER ON RESET VOLTAGE THRESHOLD

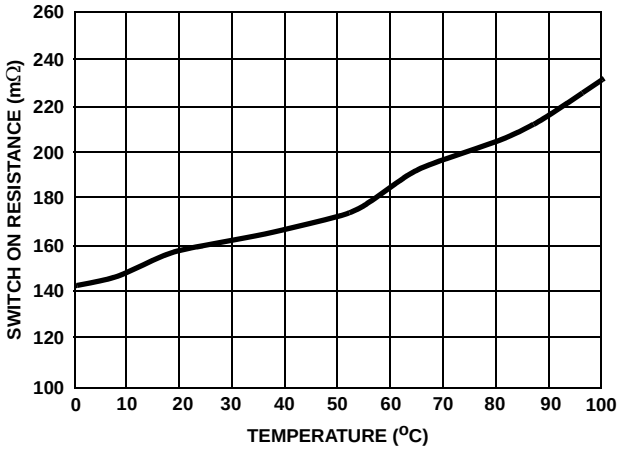


FIGURE 13. VA = 5V SWITCH ON RESISTANCE AT 0.4A

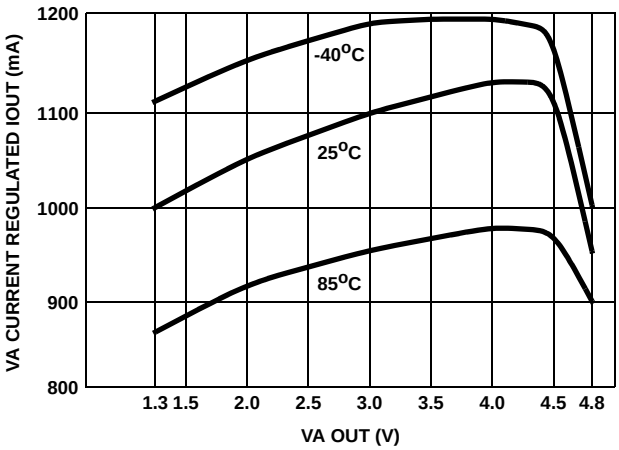


FIGURE 14. VA CURRENT REGULATION vs. VA OUT

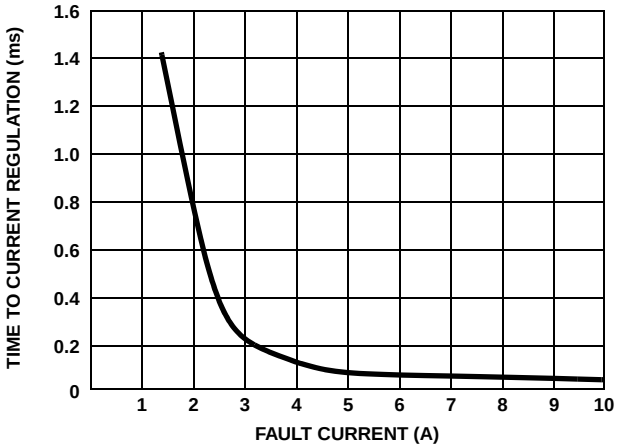


FIGURE 15. CR SETTLING TIME vs. VA I_{OUT}

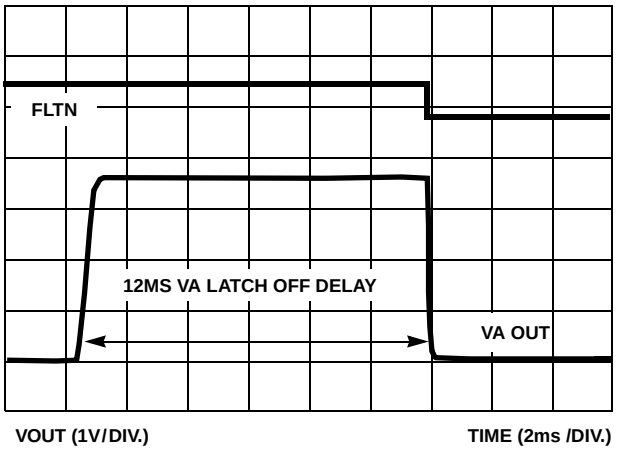


FIGURE 16. -VA TURN-ON INTO 1.5A FAULT

Typical Performance Curves (Continued)

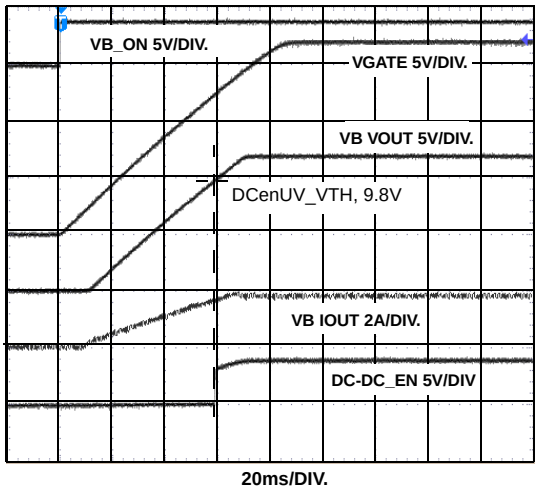


FIGURE 17. VB TURN-ON Cload = 680µF

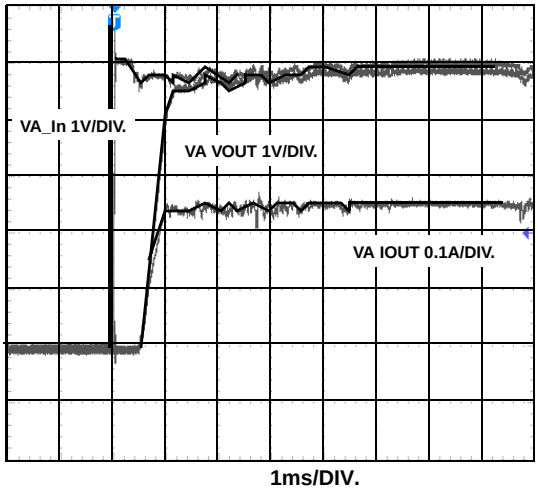


FIGURE 18. VA HOT SWAP TURN-ON

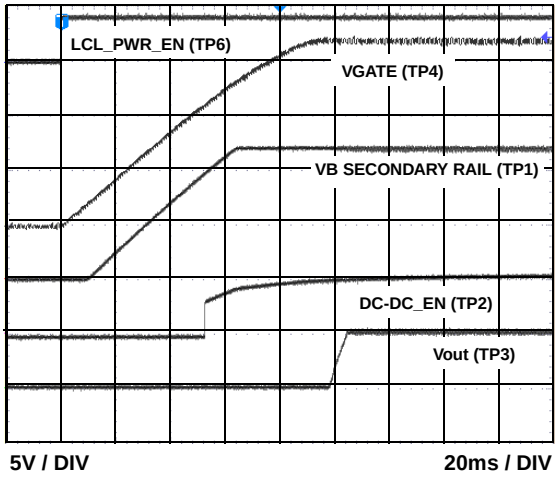


FIGURE 19. ISL6160EVAL2 Vout TURN-ON

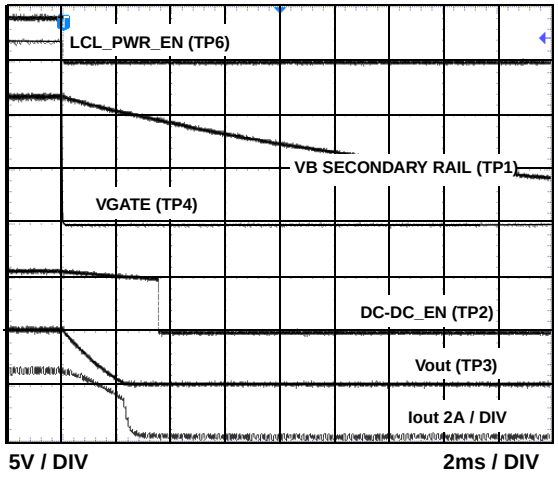
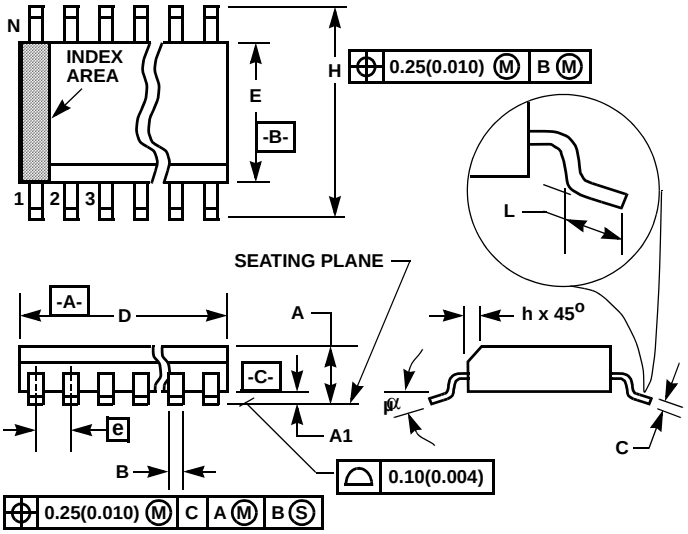


FIGURE 20. ISL6160EVAL2 Vout TURN-OFF

Small Outline Plastic Packages (SOIC)



M14.15 (JEDEC MS-012-AB ISSUE C)
14 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.3367	0.3444	8.55	8.75	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	14		14		7
α	0^o	8^o	0^o	8^o	-

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NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width “B”, as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

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