

## Multi-Purpose Precision Multi-Phase PWM Controller With Optional Active Voltage Positioning

The ISL6558 is a multi-phase PWM controller, which in combination with the HIP6601B, HIP6602B, HIP6603B, or ISL6605 companion gate drivers form a complete solution for high-current, high slew-rate applications. The ISL6558 regulates output voltage, balances load currents and provides protective functions for two to four synchronous rectified buck converter channels.

A novel approach to current sensing is used to reduce overall solution cost and improve efficiency. The voltage developed across the lower MOSFET during conduction is sampled and fed back to the controller. This lossless current-sensing approach enables the controller to maintain phase-current balance between the power channels, provide overcurrent protection, and permit droop compensation.

Optional output voltage “droop” or active voltage positioning is supported via the DROOP pin. Taking advantage of this feature reduces the size and cost of the output capacitors required to support a load transient.

In the event of an overvoltage, the controller monitors and responds to reduce the risk of damage to load devices. Undervoltage conditions are indicated through a PGOOD transition. Overcurrent conditions cause the converter to shutdown limiting the exposure of load devices. These integrated monitoring and protection features provide a safe environment for microprocessors and other advanced low voltage circuits.

## Features

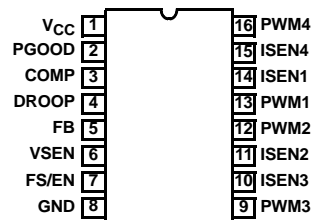
- Pb-Free Plus Anneal Available (RoHS Compliant)
- Multi-Phase Power Conversion
  - 2-, 3-, or 4-Phase Operation
- Optional Output Voltage Droop
- Precision Channel-Current Balance
- Lossless Current Sensing
- Precision Reference Voltage
  - $0.8V \pm 1.5\%$  Over  $-40^{\circ}C - 85^{\circ}C$  Range
  - $0.8V \pm 1.0\%$  Over  $0^{\circ}C - 70^{\circ}C$  Range
- Fast Transient Response
- Overcurrent and Overvoltage Protection
- Digital Soft-start
- Power Good Indication
- High Ripple Frequency (80kHz to 1.5MHz)
- QFN Package
  - Compliant to JEDEC PUB95 MO-220 QFN-Quad Flat No Leads-Product Outline
  - Near Chip-Scale Package Footprint; Improves PCB Efficiency and Thinner in Profile

## Applications

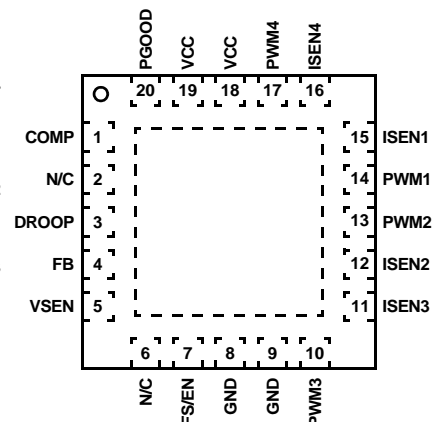
- Power Supply Control for Microprocessors
- Low Output Voltage, High Current DC-DC Converters
- Voltage Regulator Modules
- Servers and Workstations
- Memory and Accelerated Graphics Port Supplies
- Communication Processor and Personal Computer Peripherals

## Pinouts

ISL6558 (16 LEAD SOIC)  
TOP VIEW



ISL6558 (20 LEAD 5X5 QFN)  
TOP VIEW



## Ordering Information

PART NUMBER	TEMP. (°C)	PACKAGE	PKG. DWG. #
ISL6558CB	0 to 70	16 Ld SOIC	M16.15
ISL6558CB-T	16 Ld SOIC Tape and Reel		M16.15
ISL6558CBZ (See Note)	0 to 70	16 Ld SOIC (Pb-free)	M16.15
ISL6558CBZA (Note)	0 to 70	16 Ld SOIC (Pb-free)	M16.15
ISL6558CBZA-T (Note)	16 Ld SOIC Tape and Reel (Pb-free)		M16.15
ISL6558CR	0 to 70	20 Ld 5x5 QFN	L20.5x5
ISL6558CR-T	20 Ld 5x5 QFN Tape and Reel		L20.5x5
ISL6558CRZ (Note)	0 to 70	20 Ld 5x5 QFN (Pb-free)	L20.5x5
ISL6558CRZ-T (Note)	20 Ld 5x5 QFN Tape and Reel (Pb-free)		L20.5x5
ISL6558CRZA (Note)	0 to 70	20 Ld 5x5 QFN (Pb-free)	L20.5x5
ISL6558CRZA-T (Note)	20 Ld 5x5 QFN Tape and Reel (Pb-free)		L20.5x5
ISL6558IB	-40 to 85	16 Ld SOIC	M16.15
ISL6558IB-T	16 Ld SOIC Tape and Reel		M16.15
ISL6558IBZ (See Note)	-40 to 85	16 Ld SOIC (Pb-free)	M16.15
ISL6558IBZ-T (See Note)	16 Ld SOIC Tape and Reel (Pb-free)		M16.15
ISL6558IBZA (See Note)	-40 to 85	16 Ld SOIC (Pb-free)	M16.15
ISL6558IBZA-T (See Note)	16 Ld SOIC Tape and Reel (Pb-free)		M16.15
ISL6558IR	-40 to 85	20 Ld 5x5 QFN	L20.5x5
ISL6558IR-T	20 Ld 5x5 QFN Tape and Reel		L20.5x5
ISL6558IRZ (Note)	-40 to 85	20 Ld 5x5 QFN (Pb-free)	L20.5x5
ISL6558IRZ-T (Note)	20 Ld 5x5 QFN Tape and Reel (Pb-free)		L20.5x5
ISL6558IRZA (See Note)	-40 to 85	20 Ld 5x5 QFN (Pb-free)	L20.5x5
ISL6558IRZA-T (See Note)	20 Ld 5x5 QFN Tape and Reel (Pb-free)		L20.5x5
ISL6558EVAL1	Evaluation Platform 1 (SOIC Package, ISL6558CB + HIP6601BCB)		
ISL6558EVAL2	Evaluation Platform 2 (QFN Package, ISL6558CR + ISL6605CR)		

NOTE: intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and 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-020.

**Absolute Maximum Ratings**

Supply Voltage, VCC	.....+7V
Input, Output, or I/O Voltage	.....GND -0.3V to V <sub>CC</sub> +0.3V
ESD Classification	
Human Body Model	.....3kV
Machine Model	.....250V

**Thermal Information**

Thermal Resistance (Typical Notes 1, 2, 3) $\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)
SOIC Package (Note 1)	70 N/A
QFN Package (Notes 2, 3)	35 5
Maximum Junction Temperature	150°C
Maximum Storage Temperature Range	-65°C to 150°C
Maximum Lead Temperature (Soldering 10s)	300°C (SOIC - Lead Tips Only)

**Recommended Operating Conditions**

Supply Voltage	.....+5V ±5%
Ambient Temperature	.....-40°C to 85°C
Maximum Operating Junction Temperature	.....125°C

*CAUTION: Stress 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 section of this specification is not implied.*

**NOTES:**

1.  $\theta_{JA}$  is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
2.  $\theta_{JA}$  is measured in free air with the component mounted on a high effective thermal conductivity test board with "direct attach" features. See Tech Brief TB379 for details.
3.  $\theta_{JC}$ , "case temperature" location is at the center of the exposed metal pad on the package underside.

**Electrical Specifications** Operating Conditions: V<sub>CC</sub> = 5V, T<sub>A</sub> = -40°C to 85°C. Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>INPUT SUPPLY POWER</b>					
Input Supply Current	V <sub>CC</sub> = 5VDC; R <sub>T</sub> = 100kΩ ±1%	-	10	15	mA
<b>POWER-ON RESET (POR)</b>					
VCC Rising Threshold		4.25	4.38	4.5	V
VCC Falling Threshold		3.75	3.88	4.00	V
<b>REFERENCE VOLTAGE</b>					
Reference Voltage	ISL6558CB, ISL6558CR, T <sub>A</sub> = 0°C to 70°C	0.792	0.8	0.808	V
	ISL6558IB, ISL6558IR, T <sub>A</sub> = -40°C to 85°C	0.788	0.8	0.812	V
System Accuracy	ISL6558CB, ISL6558CR, T <sub>A</sub> = 0°C to 70°C	-1.0	-	1.0	%
	ISL6558IB, ISL6558IR, T <sub>A</sub> = -40°C to 85°C	-1.5	-	1.5	%
<b>OSCILLATOR</b>					
Channel Frequency Accuracy	R <sub>T</sub> = 100kΩ. ±1%	224	280	336	kHz
Adjustment Range	See Figure 3	0.08	-	1.5	MHz
Disable Voltage	Maximum voltage at FS/EN to disable controller. I <sub>FS/EN</sub> = 1mA	-	1.2	1.0	V
Sawtooth Amplitude		-	1.33	-	V <sub>P-P</sub>
Channel Maximum Duty Cycle, by Design (GBD)		-	75	-	%
<b>ERROR AMPLIFIER</b>					
DC Gain (GNT)	R <sub>L</sub> = 10K to ground	-	72	-	dB
Gain-Bandwidth Product (GNT)	C <sub>L</sub> = 100pF, R <sub>L</sub> = 10K to ground	-	18	-	MHz
Slew Rate	C <sub>L</sub> = 100pF, Load = ±400μA	-	5.3	-	V/μs
Maximum Output Voltage	R <sub>L</sub> = 10K to ground	3.6	4.1	-	V
<b>ISEN</b>					
Recommended Full Scale Input Current		-	50	-	μA
Overcurrent Trip Level		67	-	85	μA

**Electrical Specifications** Operating Conditions:  $V_{CC} = 5V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$ . Unless Otherwise Specified. (Continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>POWER GOOD MONITOR</b>					
Undervoltage Threshold	VSEN Rising	-	0.92	-	$V_{REF}$
Undervoltage Threshold	VSEN Falling	-	0.90	-	$V_{REF}$
PGOOD Low Output Voltage	$I_{PGOOD} = 4mA$	-	0.18	0.4	V
<b>PROTECTION</b>					
Overvoltage Threshold	VSEN Rising, ISL6558CB, ISL6558CR, $T_A = 0^{\circ}C$ to $70^{\circ}C$	1.12	1.15	1.2	$V_{REF}$
	VSEN Rising, ISL6558IB, ISL6558IR, $T_A = -40^{\circ}C$ to $85^{\circ}C$	1.085	1.15	1.2	$V_{REF}$
Percent Overvoltage Hysteresis (GNT)	VSEN Falling after Overvoltage	-	2	-	%

GBD = Guaranteed By Design  
 GNT = Guranteed Not Tesed

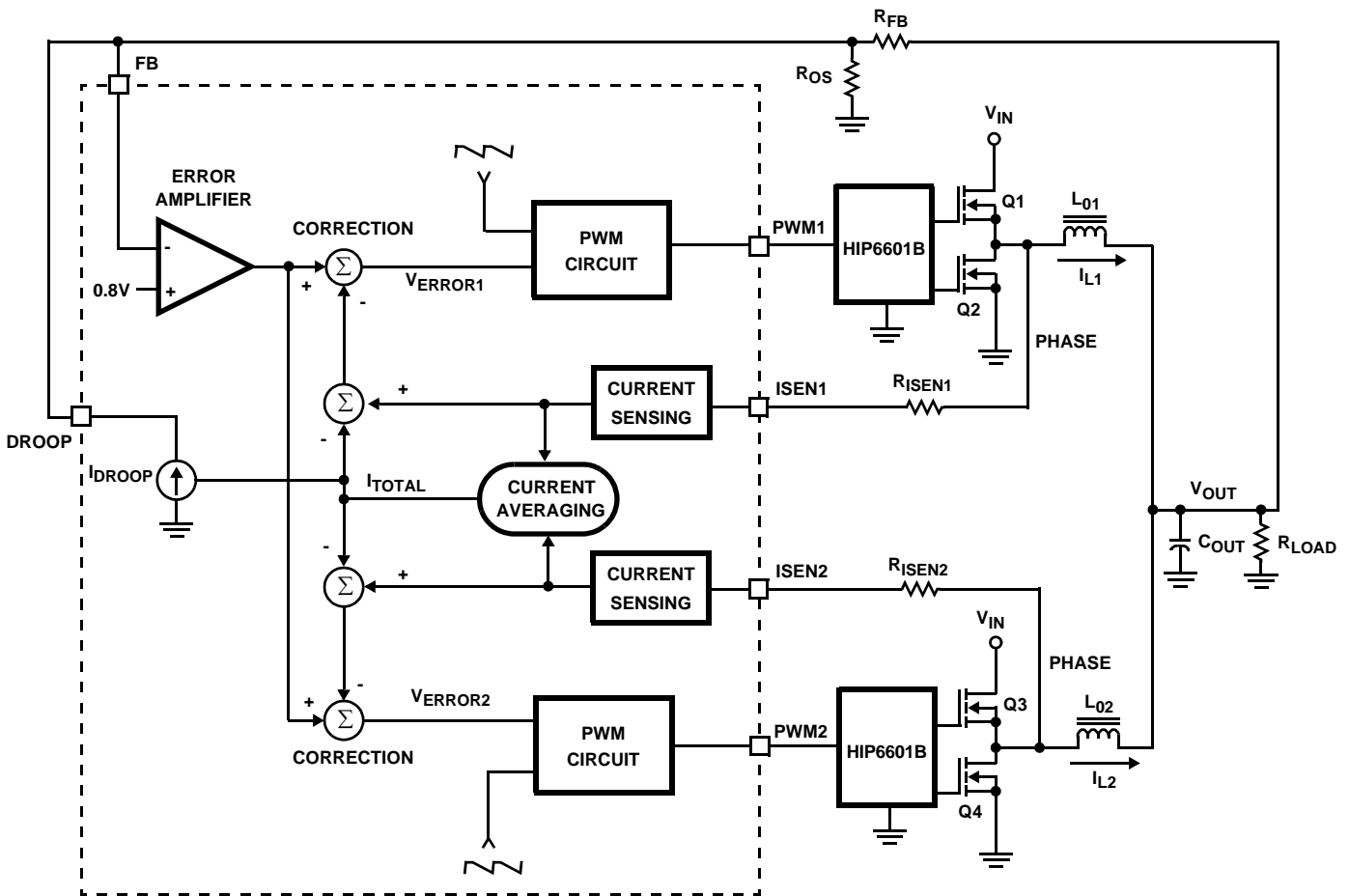
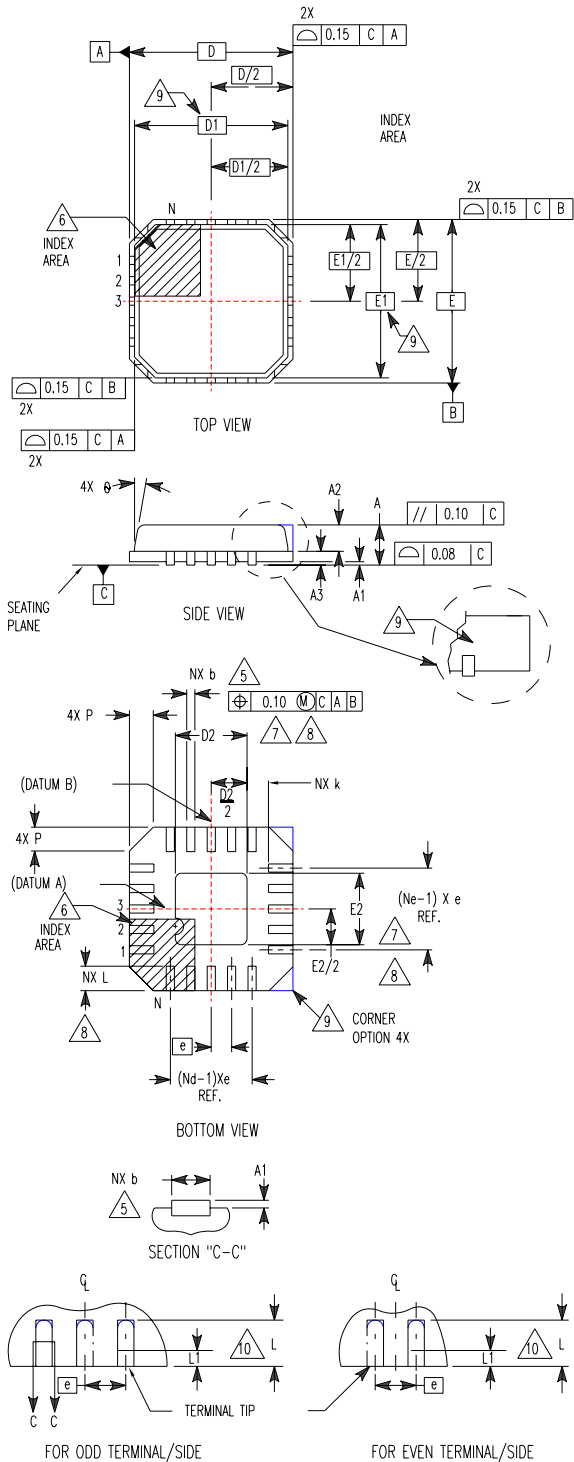


FIGURE 1. SIMPLIFIED BLOCK DIAGRAM OF THE ISL6558 VOLTAGE AND CURRENT CONTROL LOOPS CONFIGURED FOR A TWO CHANNEL CONVERTER

**Quad Flat No-Lead Plastic Package (QFN)  
Micro Lead Frame Plastic Package (MLFP)**

**L20.5x5  
20 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE**



SYMBOL	MILLIMETERS			NOTES
	MIN	NOMINAL	MAX	
A	0.80	0.90	1.00	-
A1	-	0.02	0.05	-
A2	-	0.65	1.00	9
A3	0.20 REF			9
b	0.23	0.30	0.38	5, 8
D	5.00 BSC			-
D1	4.75 BSC			9
D2	2.95	3.10	3.25	7, 8
E	5.00 BSC			-
E1	4.75 BSC			9
E2	2.95	3.10	3.25	7, 8
e	0.65 BSC			-
k	0.20	-	-	-
L	0.35	0.60	0.75	8
N	20			2
Nd	5			3
Ne	5			3
P	-	-	0.60	9
θ	-	-	12	9

Rev. 4 11/04

**NOTES:**

1. Dimensioning and tolerancing conform to ASME Y14.5-1994.
2. N is the number of terminals.
3. Nd and Ne refer to the number of terminals on each D and E.
4. All dimensions are in millimeters. Angles are in degrees.
5. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.
7. Dimensions D2 and E2 are for the exposed pads which provide improved electrical and thermal performance.
8. Nominal dimensions are provided to assist with PCB Land Pattern Design efforts, see Intersil Technical Brief TB389.
9. Features and dimensions A2, A3, D1, E1, P & θ are present when Anvil singulation method is used and not present for saw singulation.
10. Compliant to JEDEC MO-220VHHC Issue I except for the "b" dimension.