GS2231

Dual Input 3A Ultra Low Dropout Voltage Regulator

Product Description

The GS2231 is a high performance positive voltage regulator designed for use in applications requiring very low Input voltage and very low dropout voltage at up to 3A. It operates with a V_{IN} as low as 1.6V and V_{PP} voltage 5V with output voltage programmable as low as 0.8V.

The GS2231 features ultra low dropout, ideal for applications where V_{OUT} is very close to V_{IN}. Additionally, the GS2231 has an enable pin to further reduce power dissipation while shutdown.

The GS2231 provides excellent regulation over variations in line, load and temperature. The GS2231 provides a power OK signal to indicate if the voltage level of VO reaches 92% of its rating value.

The GS2231 is available in the power PSOP-8 package. It is available with adjustable using external resistors.

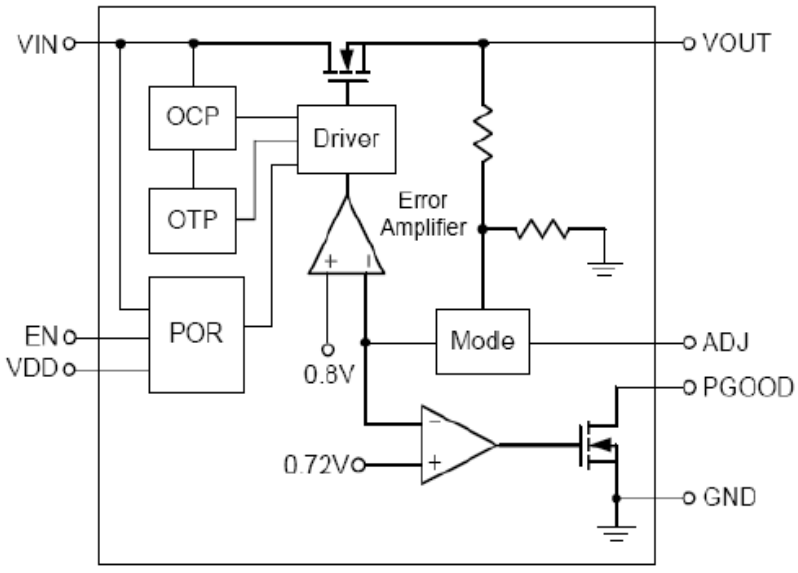
Features

- Adjustable output voltages to 0.8V
- 240mV typical dropout at 3A
- 3A minimum guaranteed output current
- Over current protection
- Over temperature protection
- Enable pin
- Low reverse leakage (Output to input)
- Power OK signal
- V_{OUT} pull low resistance when disable
- RoHS Compliant, 100%Pb & Halogen Free

Applications

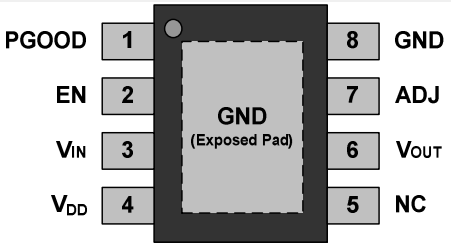
- PC (Motherboard / Notebook / Net book) Applications
- DDR BUS VTT High-efficiency linear power supplies
- SMPS post regulator
- Multimedia and PC processor supplies
- Battery chargers
- Low –Voltage Micro-Controllers and digital logic
- Front Side Bus VTT (1.2V/3A)

Function Block Diagram



Pin Configurations & Description

GS2231PSF (PSOP-8)

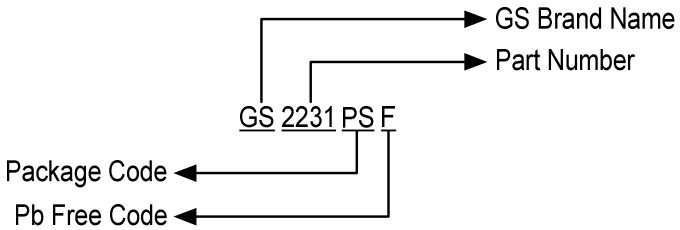


Top View

Pin Name	Pin Function
PGOOD	Power Good Open Drain Output
EN	Chip Enable (Active High)
V_{IN}	Input voltage. Large bulk capacitance should be placed closely to this pin. A 10μF ceramic capacitor is recommended at this pin
V_{DD}	Input voltage for controlling circuit
NC	No Connected
V_{OUT}	The power output of the device
ADJ	Feedback Voltage (Note 1)
GND	Ground

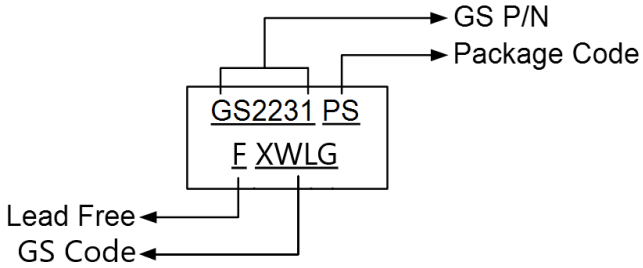
Note1. For adjustable version parts a resistor divider on this pin sets the output voltage according to the relation: V_{OUT}=0.8 X (R1 + R2) / R2.

Ordering Information



Part Number	Enable Pin Function	Package
GS2231PSF	Enable Pin Internal Pull Low, Active High	PSOP-8

Marking Information



Absolute Maximum Ratings

Supply Voltage, V_{IN}		-0.3V ~ 6V
Control Input Voltage, V_{DD}		-0.3V ~ 6V
Output Voltage, V_{OUT}		-0.3V ~ (V_{IN} + 0.3V)
POK to GND Voltage, PGOOD		-0.3V ~ 7V
Other Pins		-0.3V ~ (V_{CNTL} + 0.3V)
Power Dissipation, P_D		Internally Limited
Maximum Junction Temperature, T_J		150°C
Junction-to-Ambient Thermal Resistance, θ_{JA}		50°C/W
Junction-to-Case Thermal Resistance, θ_{JC}		20 ºC/W
Lead Temperature (Soldering, 10 sec)		260°C
Operating Temperature Range		-40°C to 125°C
Storage Temperature Range		-65°C to 150°C
ESD Rating	HBM	2KV
	MM	200V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

Symbol	Parameter		Range	Unit
V_{DD}	V_{CNTL} Supply Voltage		3.0 ~ 5.5	V
V_{IN}	V_{IN} Supply Voltage		1.2 ~ 5.5	V
V_{OUT}	V_{OUT} Output Voltage (when V_{CNTL}-V_{OUT}>1.7V)		0.8 ~ V_{IN} – V_{DROP}	V
I_{OUT}	Output Current		0 ~ 3	A
R2	ADJ to GND		1K ~ 24K	Ω
C_{OUT}	V_{OUT} Output Capacitance	I_{OUT} = 3A at 25% nominal V_{OUT}	8 ~ 770	uF
		I_{OUT} = 1.5A at 25% nominal V_{OUT}	8 ~ 1400	
		I_{OUT} = 0.5A at 25% nominal V_{OUT}	8 ~ 1700	
$ESRC_{OUT}$	ESR of V_{OUT} Output Capacitor		0 ~ 200	mΩ
T_J	Junction Temperature Range		-40 ~ 125	ºC
T_A	Ambient Temperature Range		-40 ~ 85	ºC

Electrical Characteristics

These specifications apply over V_{CNTL}=5V, V_{IN}=1.8V, V_{OUT}=1.2V, and T_A=-40 to 85ºC, unless otherwise specified. Typical values are at T_J=25ºC.

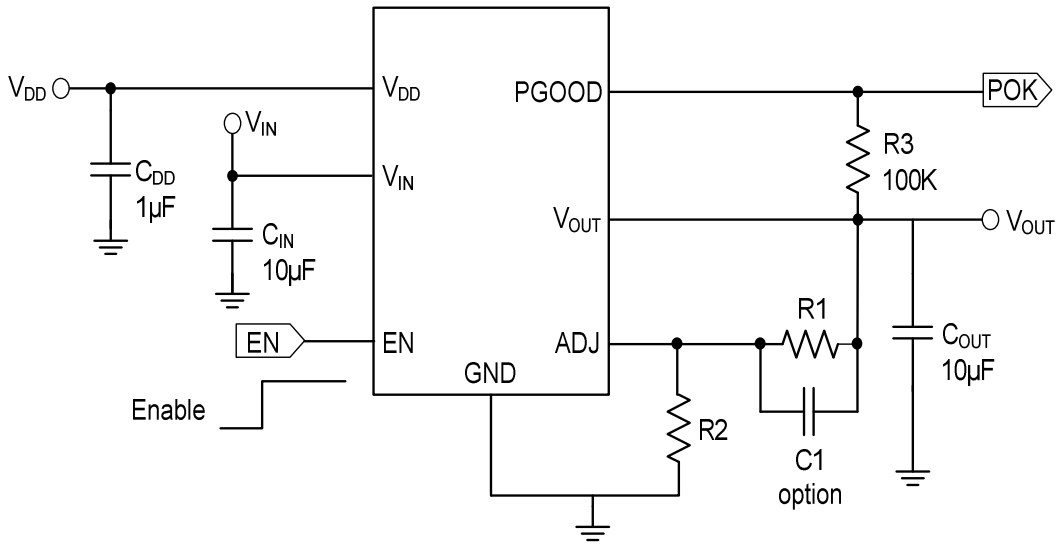
Symbol	Parameters	Condition	Min	Typ	Max	Units
	POR Threshold	-	2.4	2.7	3.0	V
	POR Hysteresis	-	0.15	0.2	-	V
V_{TH_ADJ}	Adjustable Pin Threshold	I_{OUT}=1mA	-	0.2	0.4	V
V_{ADJ}	Reference Voltage	V_{FB}=V_{OUT}, I_{OUT}=1mA	0.784	0.8	0.816	V
REG_{LINE}	Line Regulation	V_{IN}=V_{OUT}+0.5V to 5V I_{OUT}=1mA	-	0.2	0.6	%

Electrical Characteristics (Continue)

These specifications apply over V_{CNTL}=5V, V_{IN}=1.8V, V_{OUT}=1.2V, and T_A=-40 to 85ºC, unless otherwise specified. Typical values are at T_J=25ºC.

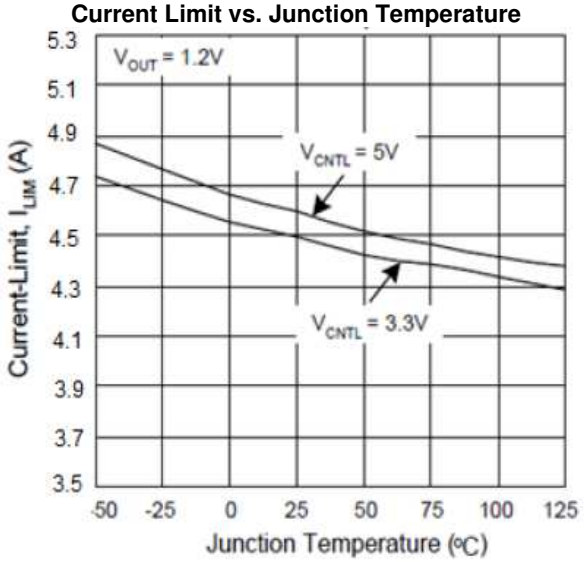
Symbol	Parameters	Condition	Min	Typ	Max	Units
REG_{LOAD}	Load Regulation	V_{IN}=V_{OUT}+1V I_{OUT}=1mA to 3A	-	0.1	1	%
V_{DROP}	Dropout Voltage	I_{OUT}=3A	-	210	350	mV
I_Q	Quiescent Current	V_{DD}=5.5V	-	0.6	1.2	mA
I_{LIM}	Current Limit	-	3.2	4.5	-	A
I_{SHORT}	Short Current	V_{OUT}<0.2V	0.5	1.8	-	A
	V_{OUT} Pull-Low Resistance	V_{EN}=0V	-	150	-	Ω
Enable						
I_{EN}	EN Input Bias Current	V_{EN}=0V	-	12	-	uA
I_{SHDN}	V_{DD} Shutdown Current	-	-	-	1.0	uA
V_{ENL}	Enable Threshold	Logic-Low Voltage	-	-	0.2	V
V_{ENH}		Logic-High Voltage	1.2	-	-	
Power Good						
V_{POKTH}	PGOOD Rising Threshold	-	-	90	93	%
	PGOOD Hysteresis	-	3	10	-	%
	POK Sink Capability	I_{PGOOD}=10mA	-	0.2	0.4	V
	POK Delay	-	0.5	1.5	5	ms
Thermal Protection						
T_{SD}	Thermal Shutdown Temperature	-	-	160	-	ºC
ΔT_{SD}	Thermal Shutdown Hysteresis	-	-	30	-	ºC
	Thermal Shutdown Temperature Fold-back	V_{OUT}<0.4V	-	110	-	ºC

Typical Application Circuit

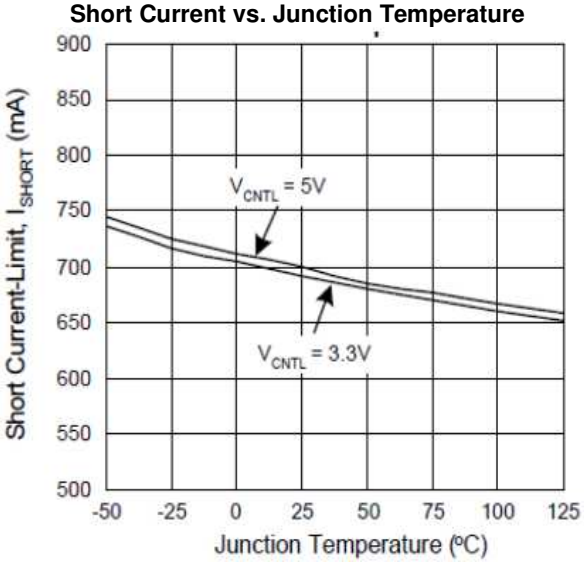


Typical Performance Characteristics

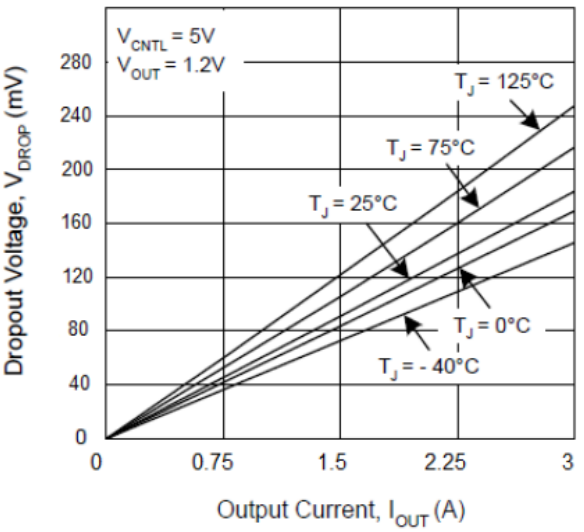
Current Limit vs. Junction Temperature



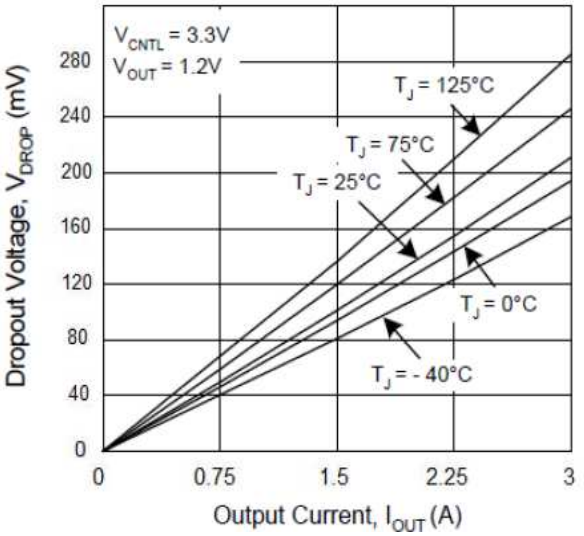
Short Current vs. Junction Temperature



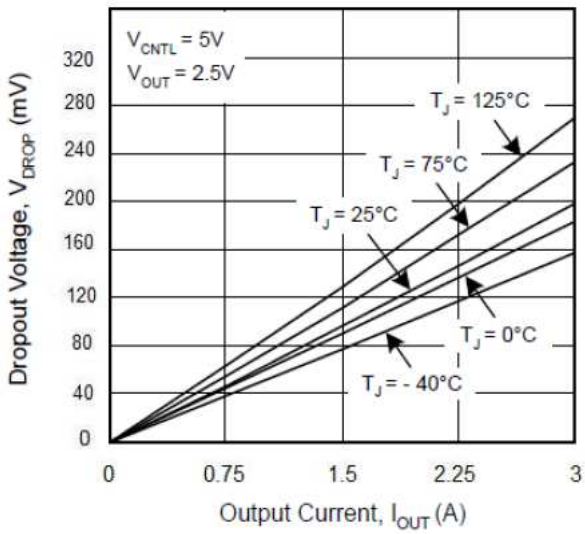
Dropout Voltage vs. Output Current



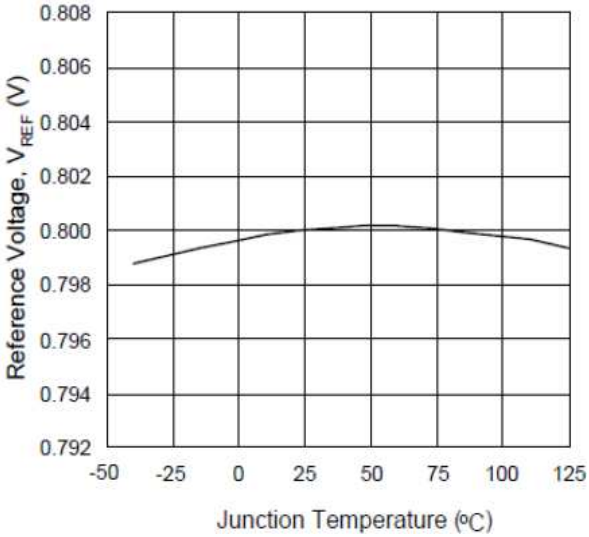
Dropout Voltage vs. Output Current



Dropout Voltage vs. Output Current



Reference Voltage vs. Junction Temperature



Application Information

The GS2231 is a high performance linear regulator specifically designed to deliver up to 3A output current with very low input voltage and ultra low dropout voltage. With dual-supply configuration. The GS2231 operates with a wide input voltage V_{IN} range from 1.2V to 5.5V

Power-On-Reset

A Power-On-Reset (POR) circuit monitors both of supply voltages on V_{CNTL} and V_{IN} pins to prevent wrong logic controls. The POR function initiates a soft-start process after both of the supply voltages exceed their rising POR voltage thresholds during powering on. The POR function also pulls low the PGOOD voltage regardless of the output status when one of the supply voltages falls below its falling POR voltage threshold.

Soft-Start

An internal soft-start function controls rise rate of the output voltage to limit the current surge during start-up. The typical soft-start interval is about 0.6ms.

Current-Limit Protection

The GS2231 monitors the current flowing through the output NMOS and limits the maximum current to prevent load and GS2231 from damages during current overload conditions.

Short Circuit Current-limit Protection

The short current-limit function reduces the current-limit level down to 0.8A (typical) when the voltage on FB pin falls below 0.2V (typical) during current overload or short circuit conditions.
The short current-limit function is disabled for successful start-up during soft-start.

Thermal Shutdown

A thermal shutdown circuit limits the junction temperature of GS2231. When the junction temperature exceeds +170ºC, a thermal sensor turns off the output NMOS, allowing the device to cool down. The regulator regulates the output again through initiation of a new soft-start process after the junction temperature cools by 50ºC, resulting in a pulsed output during continuous thermal overload conditions. The thermal shutdown is designed with a 50ºC hysteresis to lower the average junction temperature during continuous thermal overload conditions, extending lifetime of the device.
For normal operation, the device power dissipation should be externally limited so that junction temperatures will not exceed +125ºC.

Enable Control

A logic low signal applied to this pin shuts down the output. Following a shutdown, a logic high signal re-enables the output through initiation of a new soft-start cycle. When left open, this pin is pulled up by an internal current source (5uA typical) to turn off operation.

Power Sequencing

The power sequencing of V_{IN} and V_{CNTL} is not necessary to be concerned. However, do not apply a voltage to V_{OUT} for a long time when the main voltage applied at V_{IN} is not present. The reason is the internal parasitic diode from V_{OUT} to V_{IN} conducts and dissipates power without protections due to the forward-voltage.

Output Voltage Regulation

An error amplifier working with a temperature compensated 0.8V reference and an output NMOS regulates output to the preset voltage. The error amplifier is designed with high bandwidth and DC gain provides very fast transient response and less load regulation.

Power-OK and Delay

The GS2231 indicates the status of the output voltage by monitoring the feedback voltage (V_{FB}) on FB pin. As the V_{FB} rises and reaches the rising Power-OK voltage threshold (V_{TH_POK}), an internal delay function starts to work. At the end of the delay time, the IC turns off the internal NMOS of the POK to indicate the output is ok. As the V_{FB} falls and reaches the falling Power-OK voltage threshold, the IC turns on the NMOS of the POK (after a de bounce time of 10ms typical).

Output Capacitor

The GS2231 requires a proper output capacitor to maintain stability and improve transient response. The output capacitor selection is dependent upon ESR (equivalent series resistance) and capacitance of the output capacitor over the operating temperature.
Ultra-low-ESR capacitors (such as ceramic chip capacitors) and low-ESR bulk capacitors (such as solid tantalum, POSCap, and Aluminum electrolytic capacitors) can all be used as output capacitors.
During load transients, the output capacitors which is depending on the stepping amplitude and slew rate of load current, are used to reduce the slew rate of the current seen by the GS2231 and help the device to minimize the variations of output voltage for good transient response. For the applications with large stepping load current, the low-ESR bulk capacitors are normally recommended.
Decoupling ceramic capacitors must be placed at the load and ground pins as close as possible and the impedance of the layout must be minimized.

Input Capacitor

Ultra-low-ESR capacitors (such as ceramic chip capacitors) and low-ESR bulk capacitors (such as solid tantalum, POSCap, and Aluminum electrolytic capacitors) can all be used as input capacitor. For most applications, the recommended input capacitance is at least 10µF.
More capacitance reduces the variations of the supply voltage on the V_{IN} pin.

Setting Output Voltage

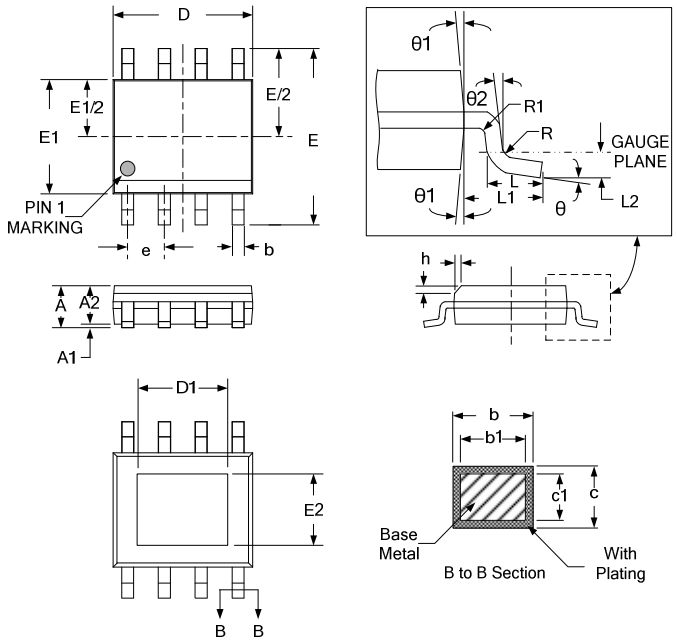
The output voltage is programmed by the resistor divider connected to the FB pin. The preset output voltage is calculated by the following equation :

$$V_{OUT} = 0.8 \cdot \left(1 + \frac{R1}{R2}\right) \quad \text{..... (V)}$$

Where R1 is the resistor connected from V_{OUT} to FB with Kelvin sensing connection and R2 is the resistor connected from FB to GND. A bypass capacitor (C1) may be connected in parallel with R1 to improve load transient response and stability

Package Information

PSOP-8



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.77	-	.070
A1	0.08	0.28	.031	.011
A2	1.20	1.60	.047	.063
b	0.39	0.48	.015	.019
b1	0.38	0.43	.015	.017
c	0.21	0.26	.008	.010
c1	0.19	0.21	.007	.008
D	4.70	5.10	.185	.201
D1	3.30 (TYP)		.130 (TYP)	
E	5.80	6.20	.228	.244
E1	3.70	4.10	.145	.161
E2	2.40 (TYP)		.094 (TYP)	
e	1.27 (TYP)		.050 (TYP)	
L	0.40	1.27	.019	.005
L1	1.05 (TYP)		.041 (TYP)	
R	0.07	-	.003	-
R1	0.07	-	.003	-
h	0.25	0.50	.010	.020
θ	0°	8°	0°	8°
θ1	5°	15°	5°	15°
θ2	0°	-	0°	-

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