

2.5A 150KHz 40V Synchronous Buck DC to DC Converter

XL9021

Features

- Operation Voltage: 5V~36V
- Output Adjustable from 1.25V to 30V
- Maximum Duty Cycle up to 90%
- Feedback Voltage Accuracy $\pm 2\%$
- Fixed 150KHz Switching Frequency
- 2.5A Constant Output Current Capability
- Internal Optimize Power MOSFET
- High efficiency up to 95%
- Max. Output power up to 10W
- Excellent line and load regulation
- EN PIN TTL shutdown capability
- Built in thermal shutdown function
- Built in current limit protection function
- Built in output short protection function
- Temperature Grade 1: -40°C to 125°C
Ambient Operating Temperature Range
- Device HBM ESD Classification Level Class3B
- Available in SOP8 package

General Description

The XL9021 is a 150KHz fixed frequency PWM synchronous buck DC/DC converter, capable of driving a 2.5A load with high efficiency, low ripple and excellent line and load regulation. XL9021 supports wide input operating voltage range of 5V ~ 36V and a maximum duty cycle of 90% output. A built-in loop compensation module reduces components in the system, lowering power system cost and reducing printed circuit board space.

The XL9021 has built-in thermal shutdown, current limit protection and output short protection function and so on. When the output short protection function happens, the operation frequency will be reduced about from 150KHz to 40KHz.

Applications

- Automotive Electronics
- Industrial Control
- Networking Equipment
- Internet of Things

Typical application schematic

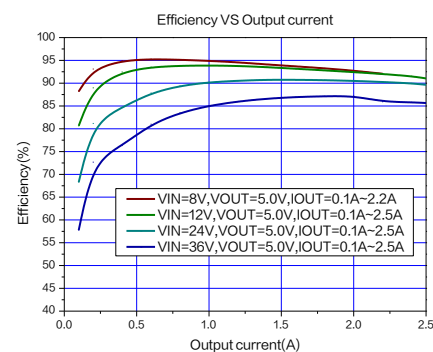
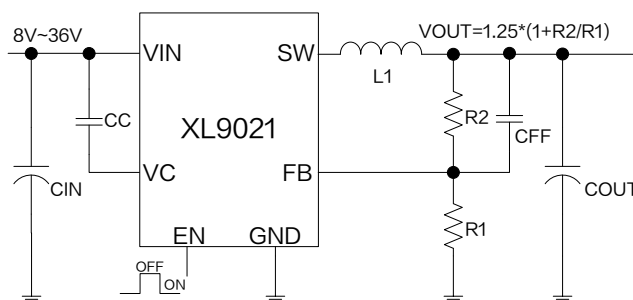


Figure1. XL9021 Typical application schematic and efficiency curve

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Pin Configurations

FB	1	8	GND
EN	2	7	GND
VC	3	6	SW
VIN	4	5	SW

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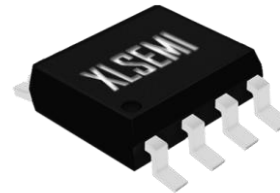


Figure2. Pin Configuration of XL9021

Table 1 Pin Description

Pin Number	Pin Name	Description
1	FB	Feedback Pin (FB). Through an external resistor divider network, Feedback senses the output voltage and regulates it. The feedback threshold voltage is 1.25V.
2	EN	Enable Pin. Drive EN pin high to turn off the device, drive it low to turn it on. Floating is default low. Connect to GND to enable the voltage regulator.
3	VC	Internal Voltage Regulator Bypass Capacity. In typical system application, The VC pin connect a 1uF capacitor to VIN.
4	VIN	Supply Voltage Input Pin. XL9021 operates from 5V to 36V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
5,6	SW	Power Switch Output Pin (SW). Output is the switch node that supplies power to the output.
7,8	GND	Ground Pin.

Ordering Information

Order Information	Marking ID	Package Type	Eco Plan	Packing Type Supplied As
XL9021E1	XL9021E1	SOP8	RoSH & HF	4000 Units on Reel

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Function Block

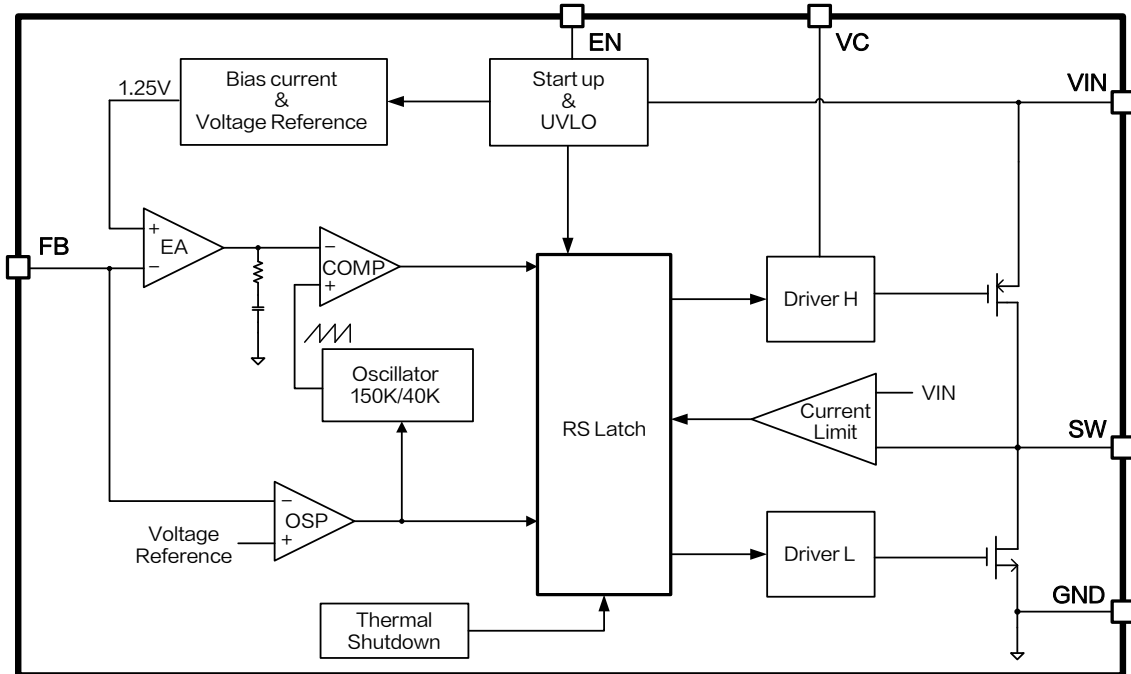


Figure3. Function Block Diagram of XL9021

Absolute Maximum Ratings (Note1)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3~40	V
EN Pin Voltage	V_{EN}	-0.3~7	V
Feedback Pin Voltage	V_{FB}	-0.3~7	V
Output Switch Pin Voltage	V_{SW}	-0.3~ V_{IN}	V
VC Pin Voltage	V_C	-0.3~ V_{IN}	V
Power Dissipation	P_D	Internally limited	mW
Thermal Resistance (SOP8) (Junction to Ambient, No Heatsink, Free Air)	R_{JA}	100	°C/W
Operating Junction Temperature	T_J	-40~150	°C
Storage Temperature	T_{STG}	-65~150	°C
Lead Temperature (Soldering, 10 sec)	T_{LEAD}	260	°C
ESD (HBM)		>8000	V

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.

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XL9021 Electrical Characteristics

$T_A = 25^\circ\text{C}$; system parameters test circuit figure6, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{FB}	Feedback Voltage	$V_{IN}=12\text{V}, V_{OUT}=5.0\text{V}$ $I_{OUT}=0.5\text{A}$	1.225	1.25	1.275	V
η	Efficiency	$V_{IN}=12\text{V}, V_{OUT}=3.3\text{V}$ $I_{OUT}=1.0\text{A}$	-	91.1	-	%
η	Efficiency	$V_{IN}=12\text{V}, V_{OUT}=5.0\text{V}$ $I_{OUT}=1.0\text{A}$	-	93.5	-	%
η	Efficiency	$V_{IN}=24\text{V}, V_{OUT}=12\text{V}$ $I_{OUT}=0.5\text{A}$	-	93.4	-	%

Electrical Characteristics (DC Parameters)

$T_A=25^\circ\text{C}, V_{IN}=12\text{V}, V_{EN}=0\text{V}$; system parameters test circuit figure6, unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	V_{IN}		5		36	V
Shutdown Supply Current	I_S	$V_{EN}=2\text{V}$		77	200	μA
Quiescent Supply Current	I_Q	$V_{FB}=2\text{V}$		2.5	5	mA
Oscillator Frequency	F_{OSC}		127	150	172	KHz
Switch Current Limit	I_L	$V_{FB}=0$		2.7		A
EN Pin Threshold	V_{EN}	High(OFF)	1.4			V
		Low(ON)			0.8	V
EN Pin Current	I_{EN}	$V_{EN}=2.0\text{V}$		5		μA
High side MOS On-resistance	$R_{DS(ON)H}$			68		$\text{m}\Omega$
Low side MOS On-resistance	$R_{DS(ON)L}$			50		$\text{m}\Omega$
Thermal Shutdown Temperature	T_{SD}			160		$^\circ\text{C}$
Thermal Shutdown Hysteresis	T_D			30		$^\circ\text{C}$

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Typical System Application Schematic ($V_{OUT}=3.3V, I_{OUT}=0\sim 2.5A$)

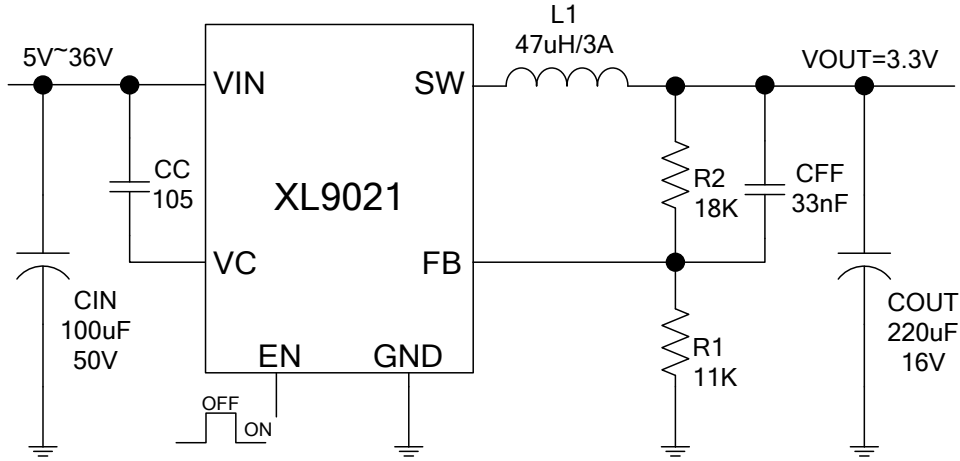


Figure4. XL9021 System Application ($V_{IN}=5V\sim 36V, V_{OUT}=3.3V, I_{OUT}=0\sim 2.5A$)

Typical System Application Transfer Efficiency

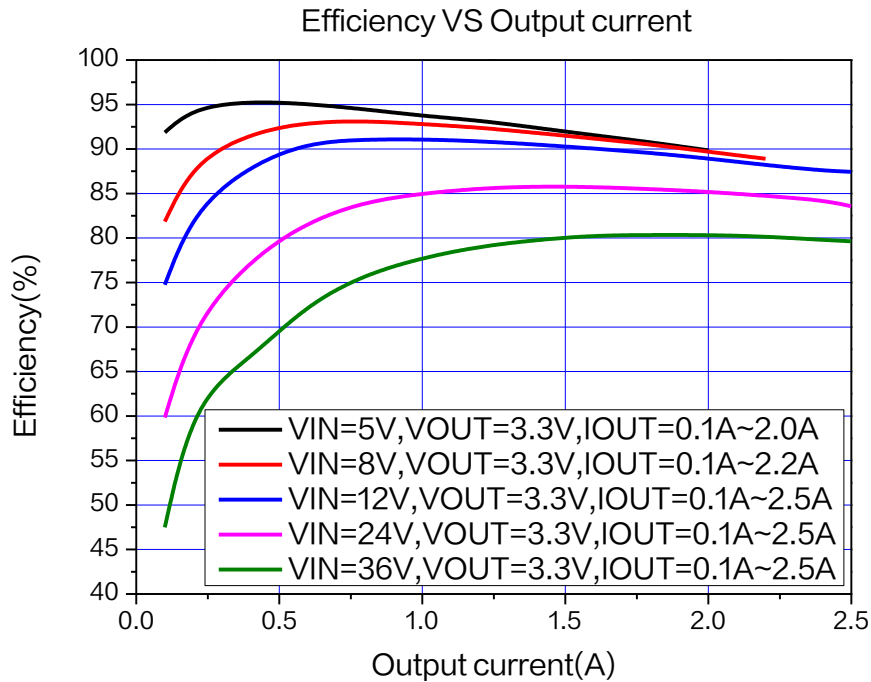


Figure5. XL9021 System Efficiency Curve ($V_{OUT}=3.3V$)

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Typical System Application Schematic ($V_{OUT}=5.0V$, $I_{OUT}=0\sim 2.5A$)

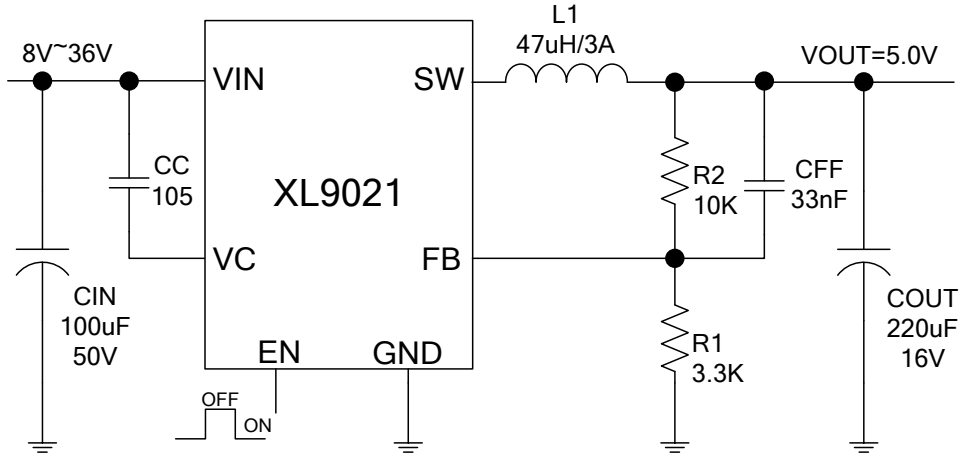


Figure6. XL9021 System Application ($V_{IN}=8V\sim 36V$, $V_{OUT}=5.0V$, $I_{OUT}=0\sim 2.5A$)

Typical System Application Transfer Efficiency

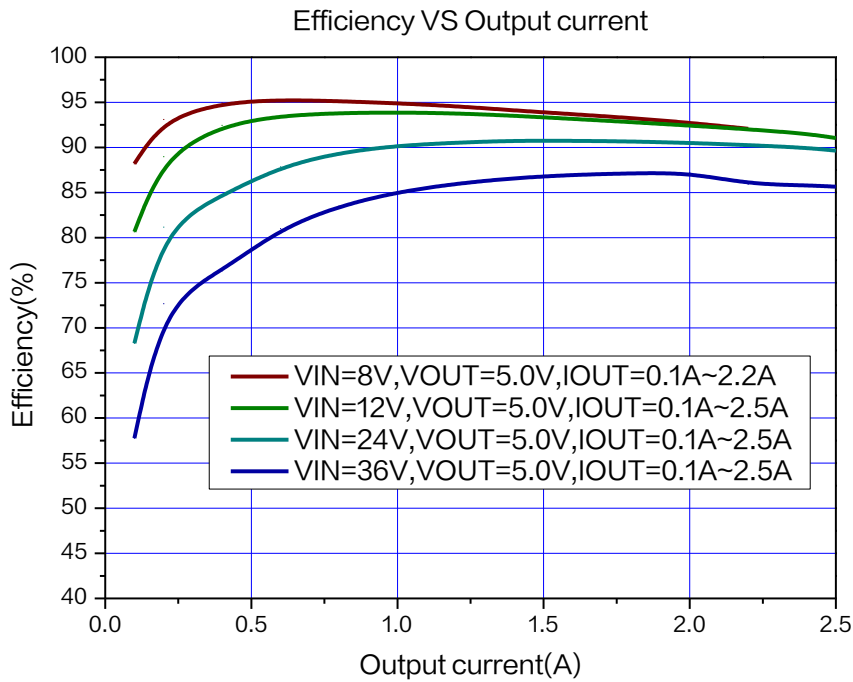


Figure7. XL9021 System Efficiency Curve ($V_{OUT}=5.0V$)

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Typical System Application Schematic ($V_{OUT}=12V, I_{OUT}=0\sim 1.0A$)

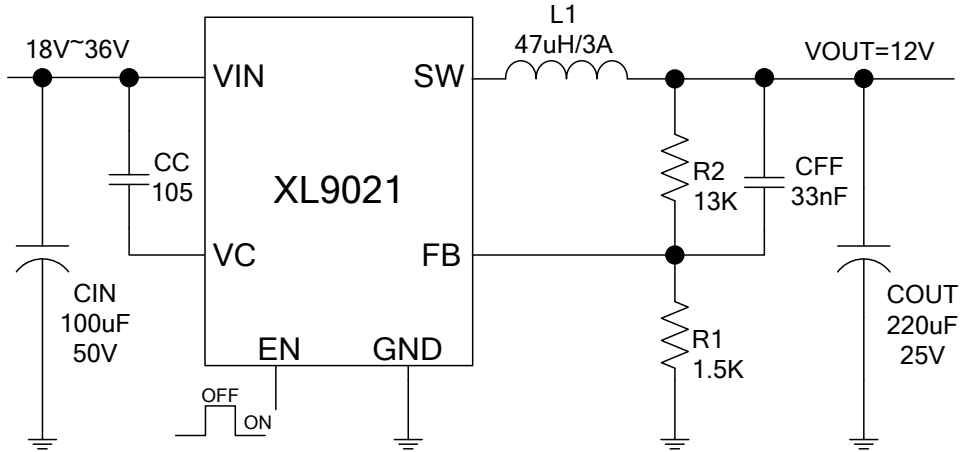


Figure8. XL9021 System Parameters Test Circuit ($V_{IN}=18V\sim 36V, V_{OUT}=12V, I_{OUT}=0\sim 1.0A$)

Typical System Application Transfer Efficiency

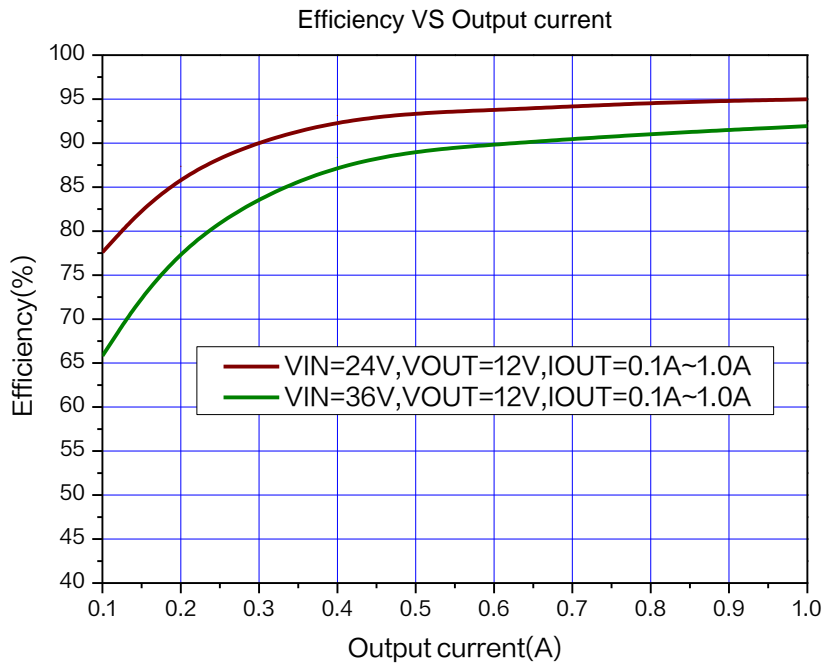


Figure9. XL9021 System Efficiency Curve ($V_{OUT}=12V$)

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Typical System Application Schematic ($V_{OUT}=15V, I_{OUT}=0\sim 1.0A$)

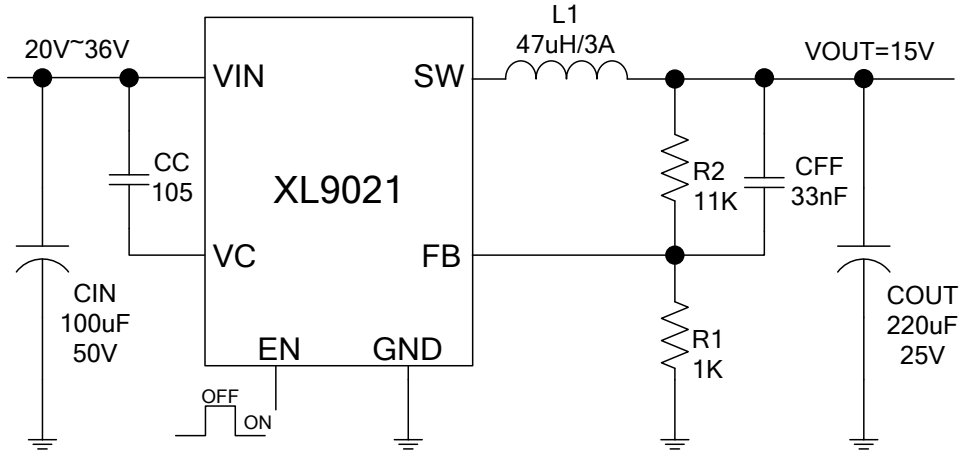


Figure10. XL9021 System Parameters Test Circuit ($V_{IN}=20V\sim 36V, V_{OUT}=15V, I_{OUT}=0\sim 1.0A$)

Typical System Application Transfer Efficiency

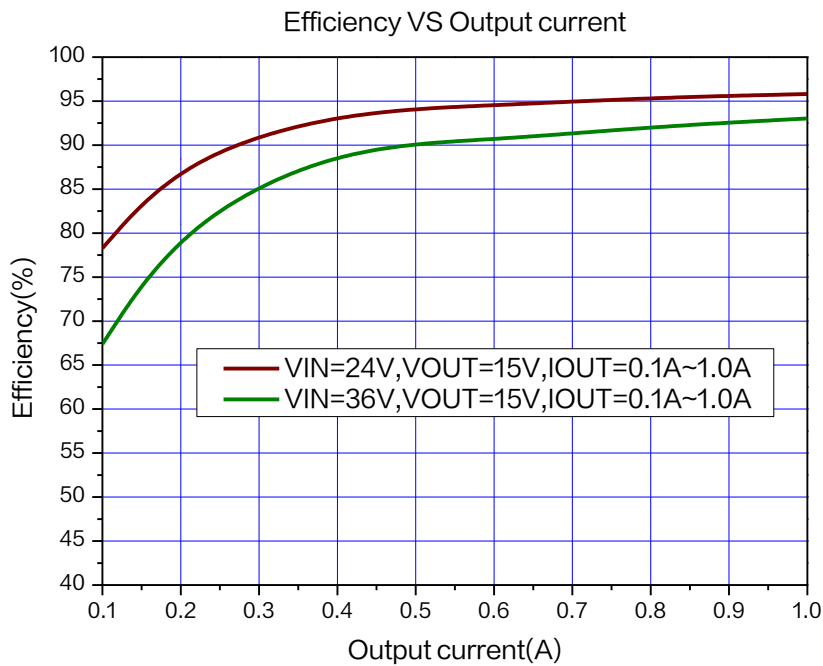


Figure11. XL9021 System Efficiency Curve ($V_{OUT}=15V$)

Typical Characteristics

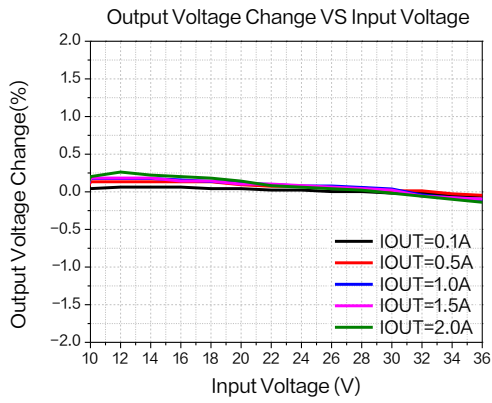


Figure12.Line Regulation

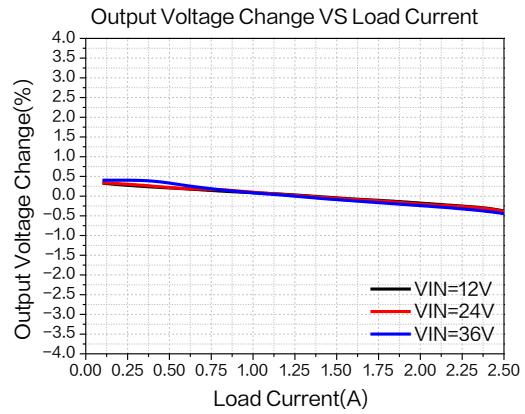


Figure13.Load Regulation

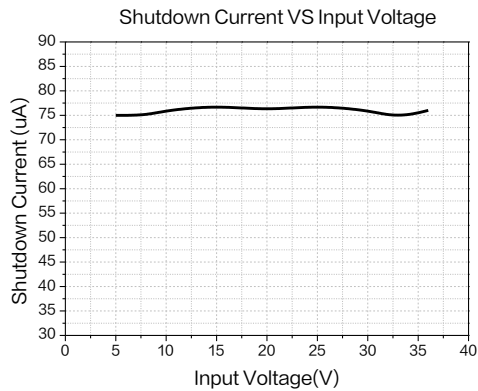


Figure14.Shutdown Current

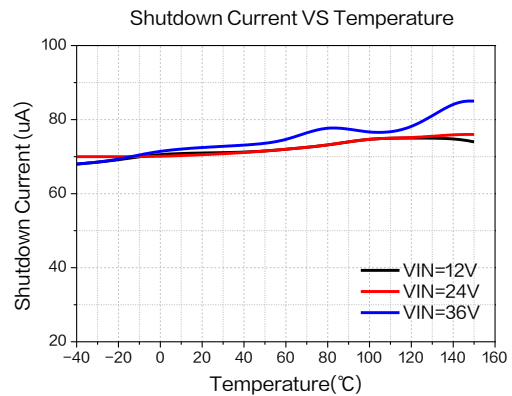


Figure15.Shutdown Current

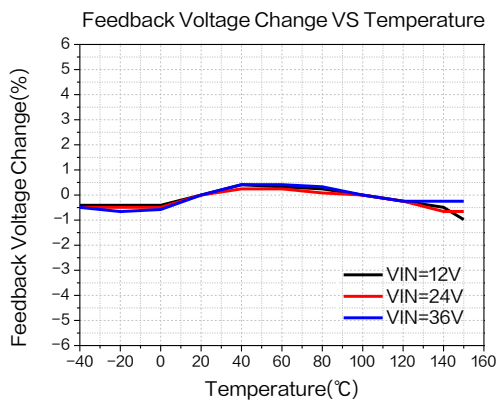


Figure16.Feedback Voltage Regulation

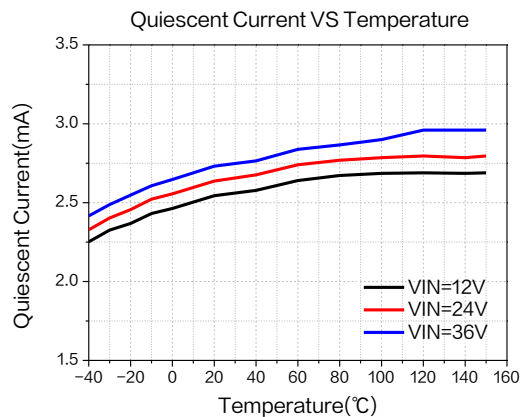


Figure17.Quiescent Current

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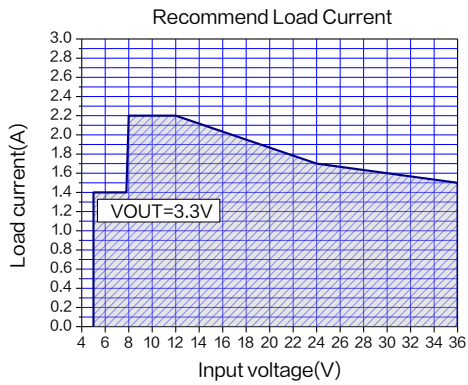


Figure 18.Max Output Current
(V_{OUT}=3.3V, T_A=25°C)

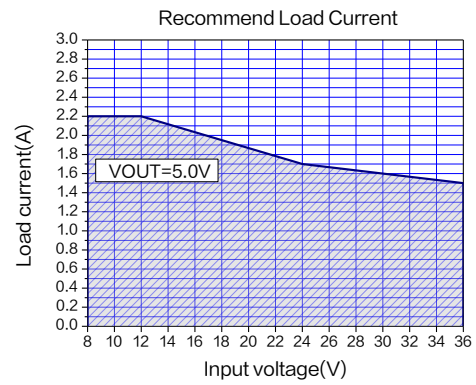


Figure 19.Max Output Current
(V_{OUT}=5.0V, T_A=25°C)

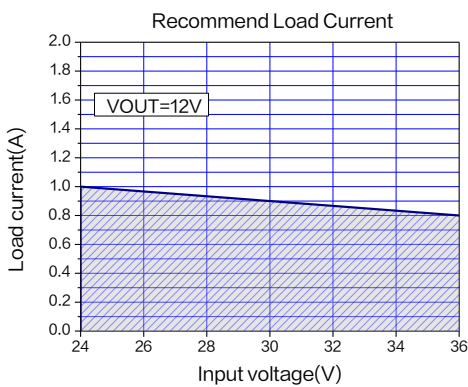


Figure 20.Max Output Current
(V_{OUT}=12V, T_A=25°C)

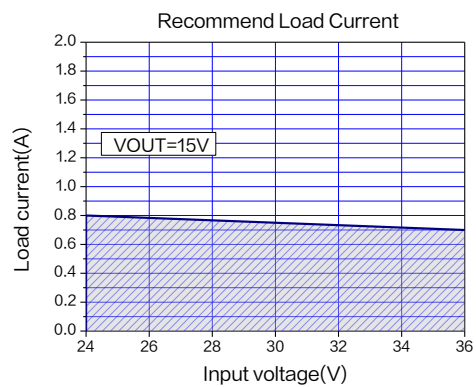


Figure 21.Max Output Current
(V_{OUT}=15V, T_A=25°C)

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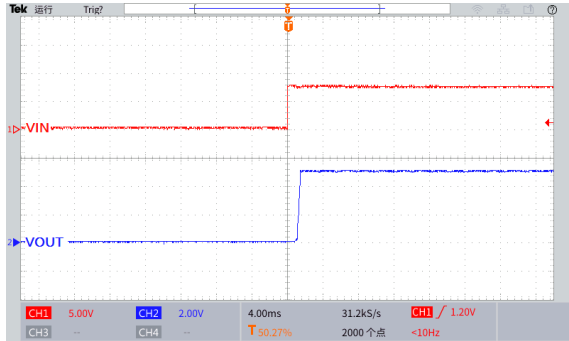


Figure 22. Start-Up Characteristic
($V_{IN}=8V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

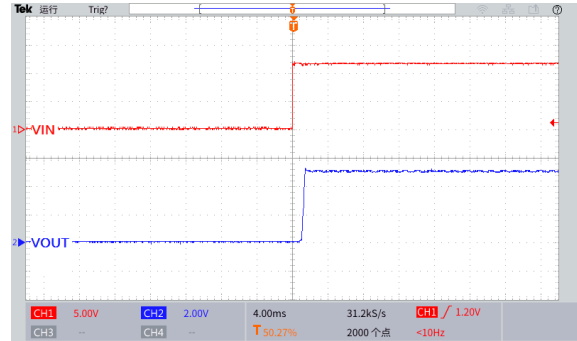


Figure 23. Start-Up Characteristic
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

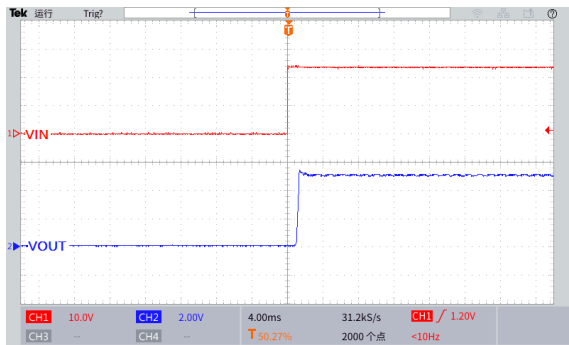


Figure 24. Start-Up Characteristic
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

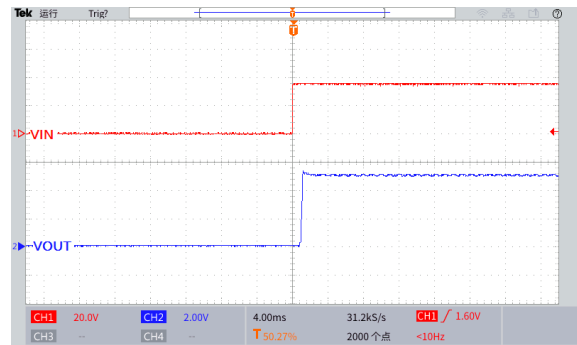


Figure 25. Start-Up Characteristic
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1A$)

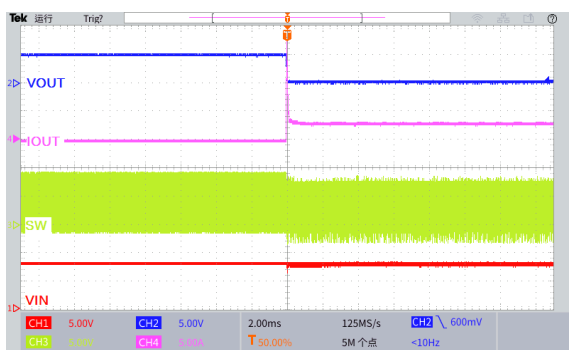


Figure 26. Output Short Circuit Waveform
($V_{IN}=8V$, $V_{OUT}=5.0V$)

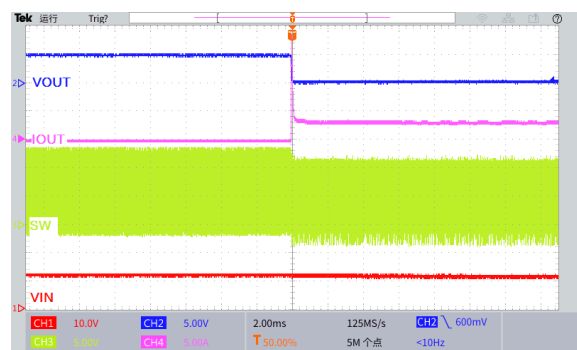


Figure 27. Output Short Circuit Waveform
($V_{IN}=12V$, $V_{OUT}=5.0V$)

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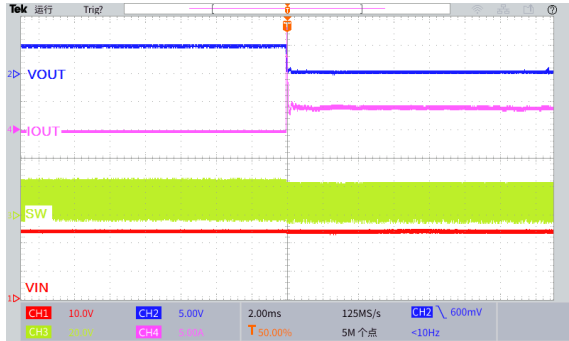


Figure 28. Output Short Circuit Waveform
($V_{IN}=24V$, $V_{OUT}=5.0V$)

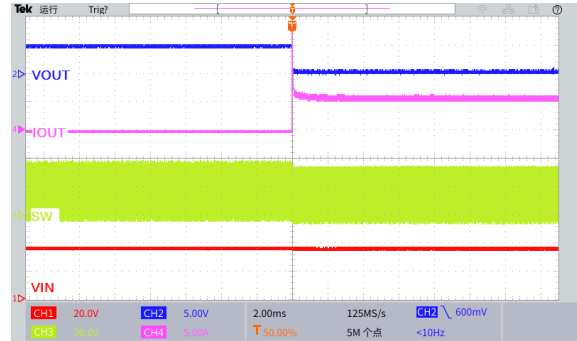


Figure 29. Output Short Circuit Waveform
($V_{IN}=36V$, $V_{OUT}=5.0V$)

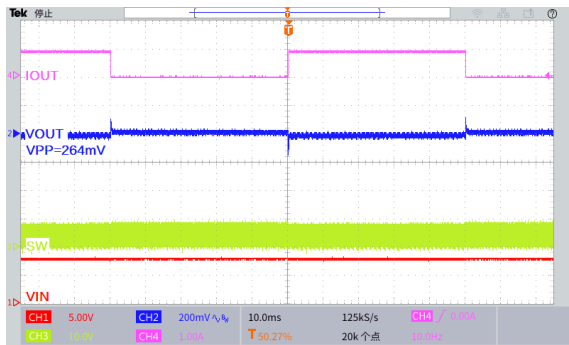


Figure30. Load Transient Response
($V_{IN}=8V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to $1A$)

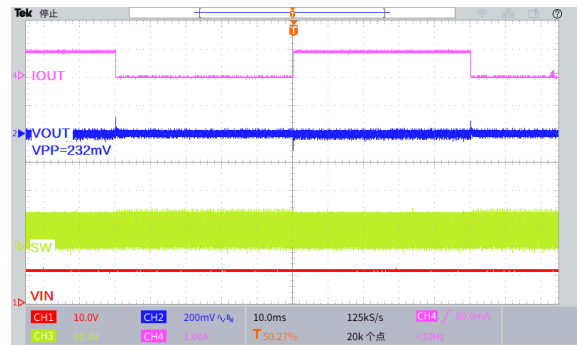


Figure31. Load Transient Response
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to $1A$)

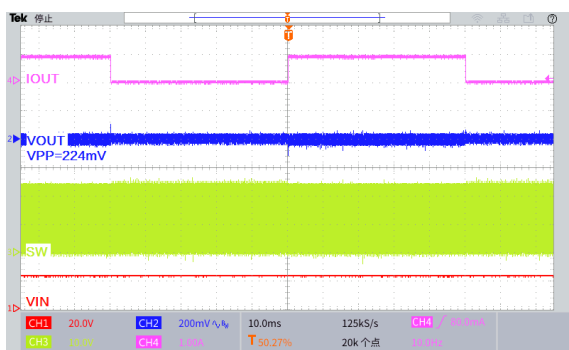


Figure32. Load Transient Response
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to $1A$)

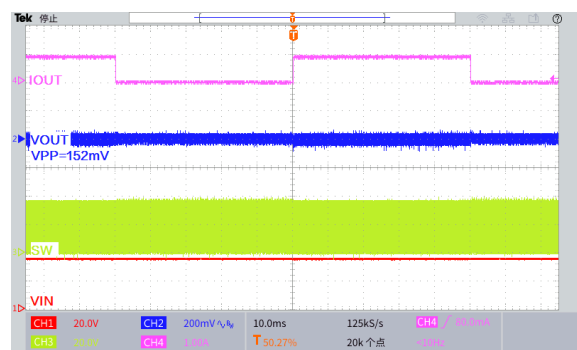


Figure33. Load Transient Response
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.1$ to $1A$)

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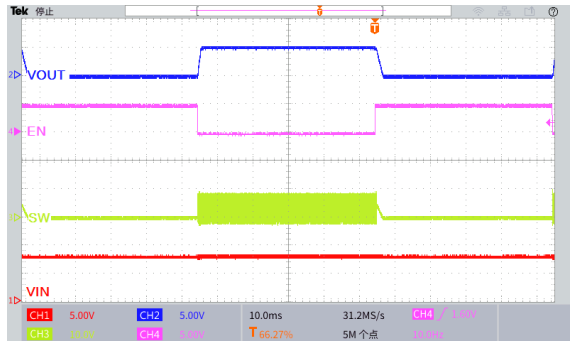


Figure34. Start or Shutdown Using EN Pin
($V_{IN}=8V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

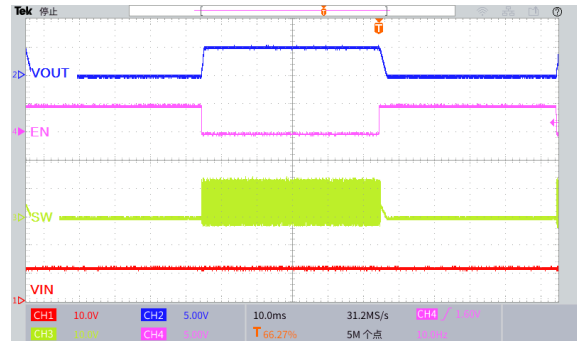


Figure35. Start or Shutdown Using EN Pin
($V_{IN}=12V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

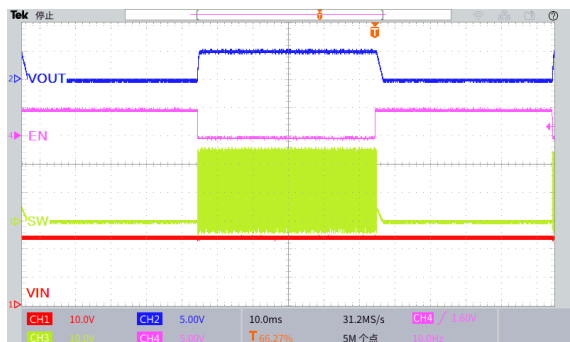


Figure36. Start or Shutdown Using EN Pin
($V_{IN}=24V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

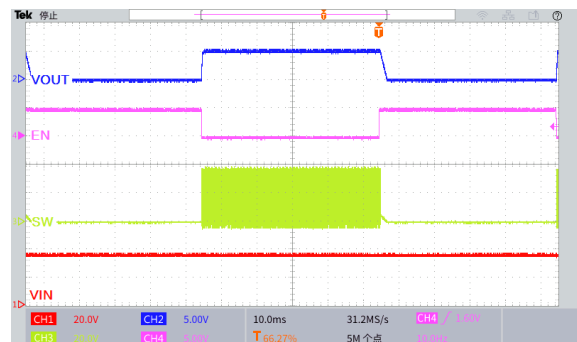


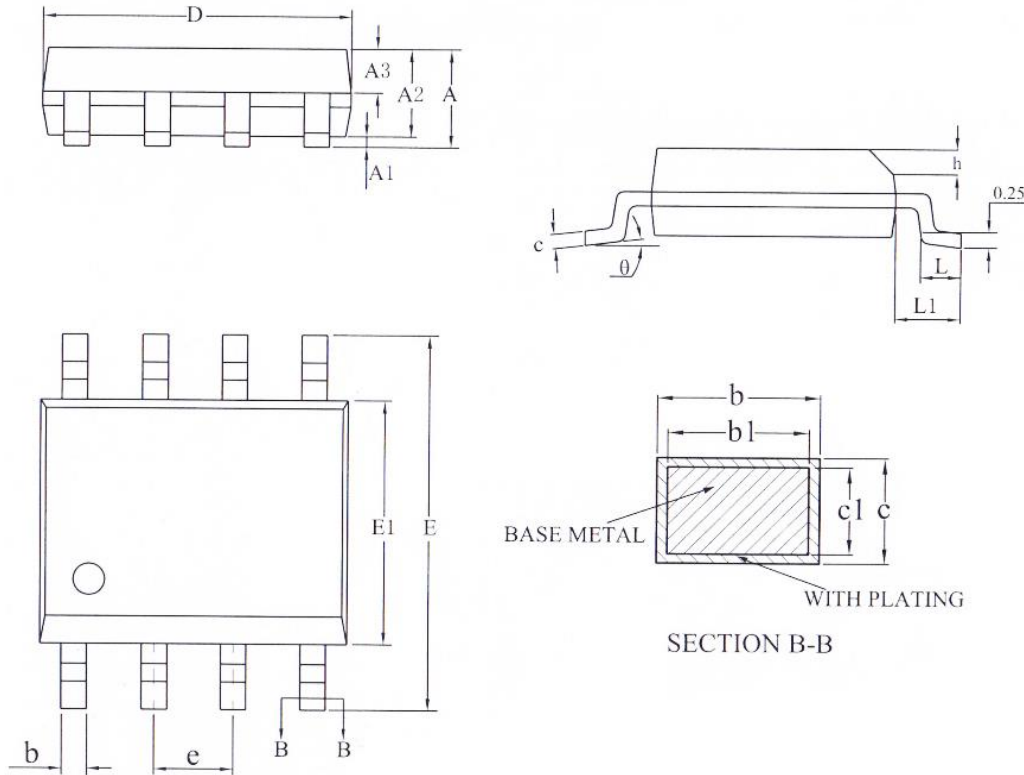
Figure37. Start or Shutdown Using EN Pin
($V_{IN}=36V$, $V_{OUT}=5.0V$, $I_{OUT}=0.5A$)

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Package Information

SOP8



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.47
b1	0.38	0.41	0.44
c	0.20	-	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	-	0.50
L	0.50	-	0.80
L1	1.05REF		
θ	0	-	8°

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