

2A, 1.6MHz, COT Synchronous Step-Down Converter

Features

- Low Quiescent Current at Light Load
- Efficiency Up to 95%
- VIN Range 2.55V to 6V
- VREF 0.6V with $\pm 1\%$ Accuracy
- Constant-On-Time Control Scheme Design for Fast Transient Response, Stability with MLCC Output Capacitor
- Fixed Soft-Start 0.5ms
- Cycle-by-Cycle Over Current Protection
- Input Under Voltage Lockout
- Output Under Voltage Protection (UVP Hiccup)
- Thermal Shutdown Protection

Applications

- Portable and Mobile Devices
- Wireless and Networking Devices
- LCD TV Power Supply

General Description

The G2262 is a high efficiency synchronous step-down DC/DC converter. G2262 provides an adjustable regulated output voltage from 0.6V to VIN while delivering up to 2A of output current with input voltage from 2.55V to 6V.

The Constant-On-Time control scheme in G2262 provides fast transient response to be optimized over a wide range of loads and output capacitors. Thermal shutdown and cycle-by-cycle current limiting are used for protection.

The G2262 is available in small ADFN1X1.5-6 and SOT-563 packages.

Ordering Information

ORDER NUMBER	MARKING	OUT VOLTAGE	TEMP. RANGE	PACKAGE (Green)
G2262AU1U	2Ax	Adjustable	-40°C to +105°C	ADFN1X1.5-6
G2262-12AU1U	2Bx	1.2V	-40°C to +105°C	ADFN1X1.5-6
G2262-15AU1U	2Cx	1.5V	-40°C to +105°C	ADFN1X1.5-6
G2262-18AU1U	2Dx	1.8V	-40°C to +105°C	ADFN1X1.5-6
G2262-25AU1U	2Ex	2.5V	-40°C to +105°C	ADFN1X1.5-6
G2262-33AU1U	2Fx	3.3V	-40°C to +105°C	ADFN1X1.5-6
G2262TR1U	2Ax	Adjustable	-40°C to +105°C	SOT-563
G2262-12TR1U	2Bx	1.2V	-40°C to +105°C	SOT-563
G2262-15TR1U	2Cx	1.5V	-40°C to +105°C	SOT-563
G2262-18TR1U	2Dx	1.8V	-40°C to +105°C	SOT-563
G2262-25TR1U	2Ex	2.5V	-40°C to +105°C	SOT-563
G2262-33TR1U	2Fx	3.3V	-40°C to +105°C	SOT-563

Note: AU: ADFN1X1.5-6 TR: SOT-563

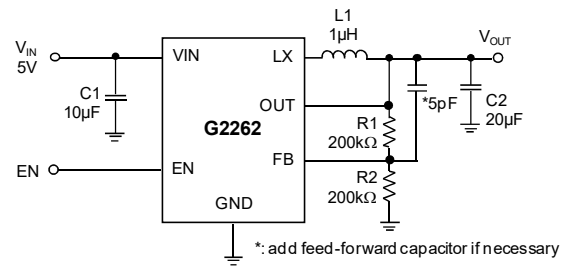
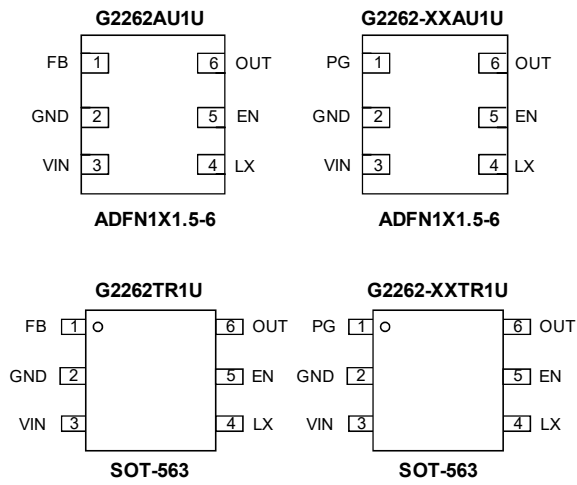
1: Bonding Code

U : Tape & Reel

Green: Lead Free / Halogen Free

Pin Configuration

Typical Application Circuit



Absolute Maximum Ratings

VIN, LX, EN, FB, OUT. -0.3V to 6V
 LX (AC, less than 10nS) -3V to 10V
 Thermal Resistance of Junction to Ambient, (θ_{JA})
 ADFN1X1.5-6. 220°C/W
 SOT-563 130°C/W
 Continuous Power Dissipation ($T_A = +25^\circ\text{C}$)
 ADFN1X1.5-6. 0.6W
 SOT-563. 0.9W
 Thermal Resistance of Junction to Ambient, (θ_{JC})
 ADFN1X1.5-6. 110°C/W
 SOT-563. 60°C/W

Junction Temperature -40°C to 150°C
 Storage Temperature -65°C to 150°C
 Reflow Temperature (soldering, 10sec) 260°C
 ESD (HBM) 2KV

Recommended Operating Conditions

Supply Input Voltage. 2.5V to 6V
 Ambient Temperature Range. -40°C to 105°C
 Junction Temperature Range. -40°C to 125°C

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

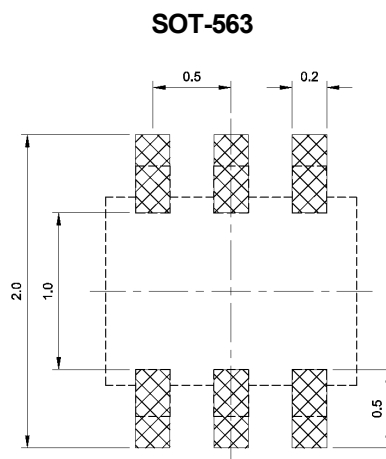
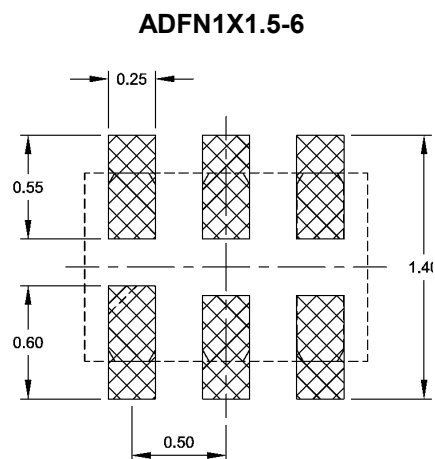
Electrical Characteristics

($V_{IN}=3.6V$, $T_A=25^\circ\text{C}$)

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage	V_{IN}		2.55	---	6	V
Feedback Reference Voltage	V_{REF}		0.594	0.6	0.606	V
Feedback Leakage Current	I_{FB}	$V_{FB} = 3.3V$	---	---	1	μA
DC Bias Current		Active, $V_{FB} = 0.63V$, not switching	---	20	25	μA
		$V_{EN}=0V$, shutdown	---	---	0.5	
Switching Leakage Current			---	---	1	μA
Switching Frequency			---	1.6	---	MHz
Switch On Resistance, High	R_{PMOS}	$V_{IN} = 3.6V$, $I_{LX} = 0.3A$	---	95	---	$m\Omega$
Switch On Resistance, Low	R_{NMOS}	$V_{IN} = 3.6V$, $I_{LX} = 0.3A$	---	75	---	$m\Omega$
PFET Switch Current Limit	$I_{LIM(P)}$		---	3.4	---	A
NFET Switch Current Limit	$I_{LIM(N)}$		---	2.5	---	A
VIN Under Voltage Lockout Threshold	V_{UVLO}	V_{IN} falling	---	2.4	2.45	V
VIN Under Voltage Lockout Hysteresis	V_{UVLO_HYS}	V_{IN} rising	---	100	---	mV
Over-Temperature Threshold			---	150	---	$^\circ\text{C}$
Thermal Hysteresis			---	30	---	$^\circ\text{C}$
EN Input Logic High Voltage	V_{IH}		1.2	---	---	V
EN Input Logic Low Voltage	V_{IL}		---	---	0.4	
EN Input Current	I_{EN}	$V_{EN}=2V$	---	1.2	---	μA
		$V_{EN}=0V$	---	0	---	μA
LX Discharge Resistor	R_{DIS}		---	20	50	Ω
Soft-Start Time	T_{SS}	VOUT rising from 10% to 90%	---	0.5	---	ms
Minimum Off Time	$T_{MIN-OFF}$		---	80	---	ns

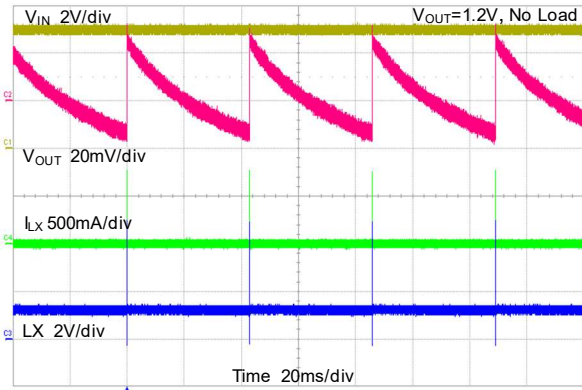
Minimum Footprint PCB Layout Section



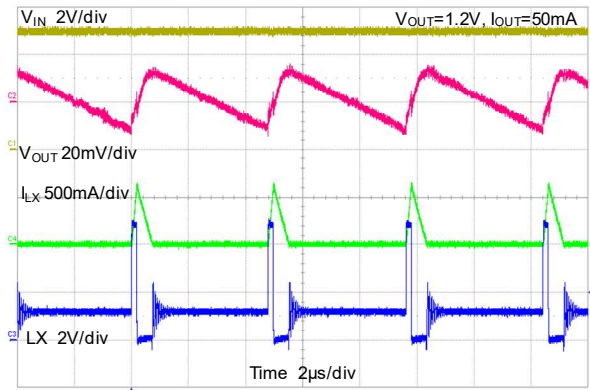
Typical Performance Characteristics

($V_{IN}=5V$, $V_{OUT}=1.2V$, $C_{IN}=10\mu F$, $C_{OUT}=10\mu F$, $L=1\mu H$, $T_A=25^\circ C$)

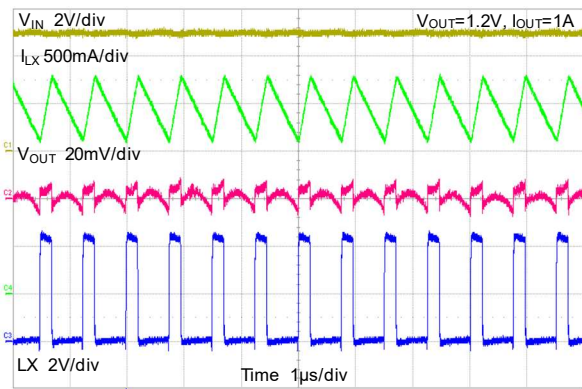
Steady State Operation



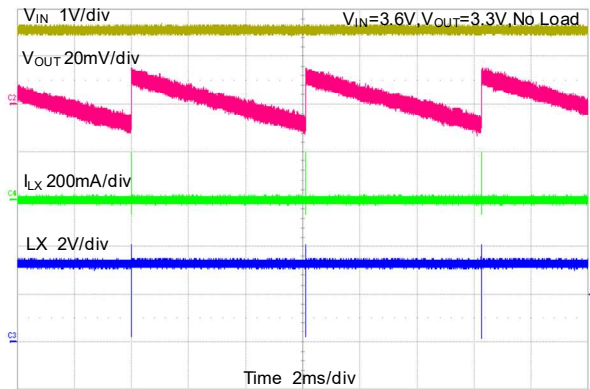
Steady State Operation



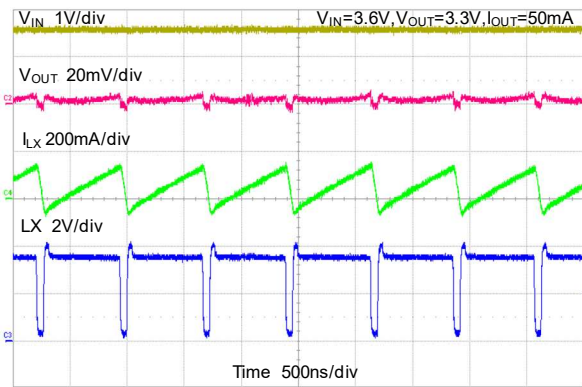
Steady State Operation



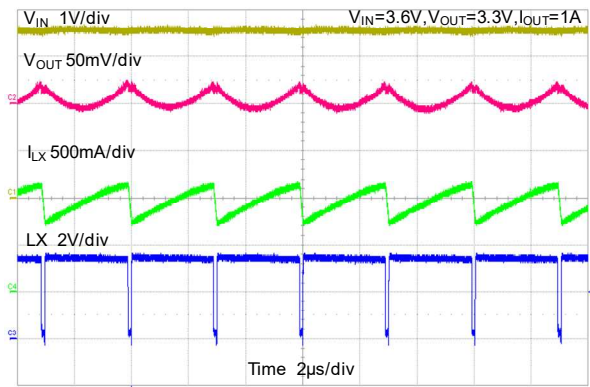
Steady State Operation



Steady State Operation

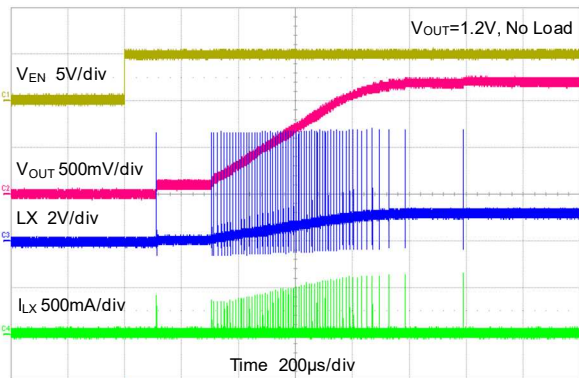


Steady State Operation

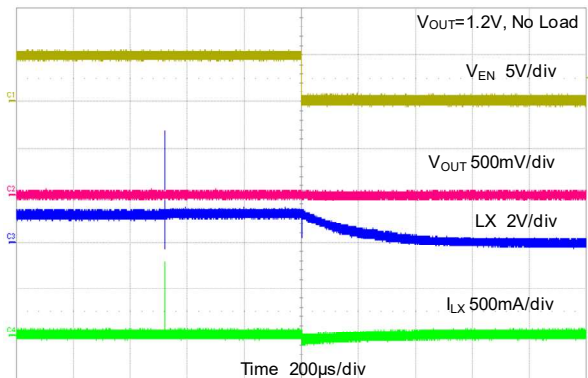


Typical Performance Characteristics (continued)

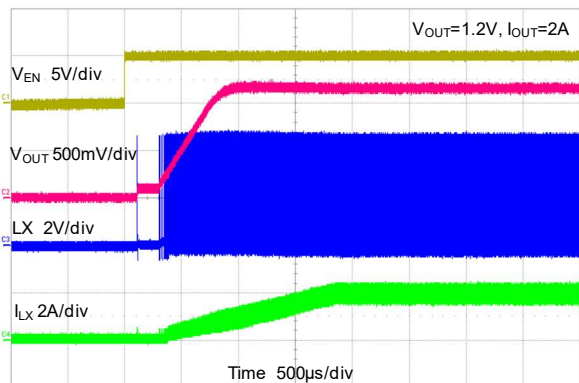
Start-up Through Enable



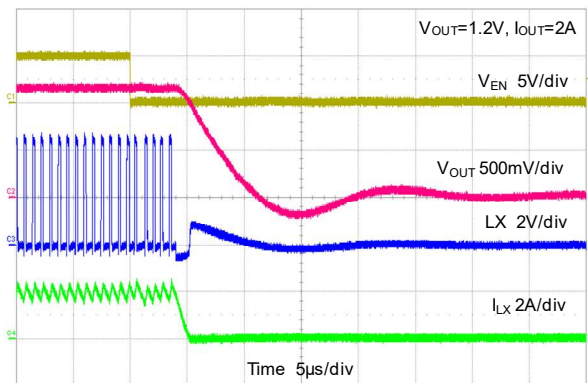
Start-down Through Enable



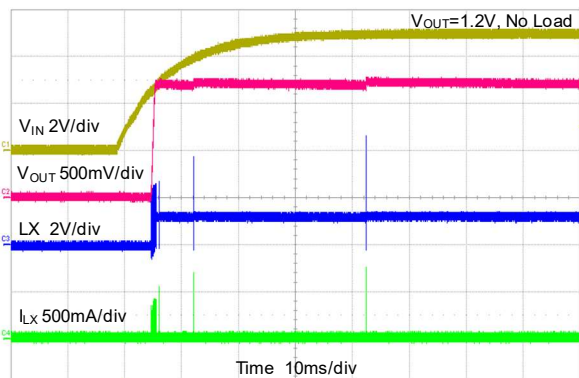
Start-up Through Enable



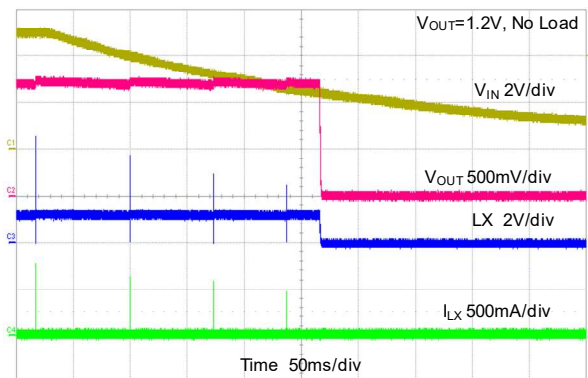
Start-down Through Enable



Start-up Through VIN

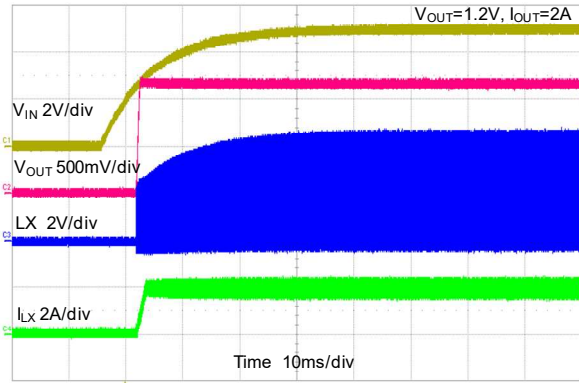


Start-down Through VIN

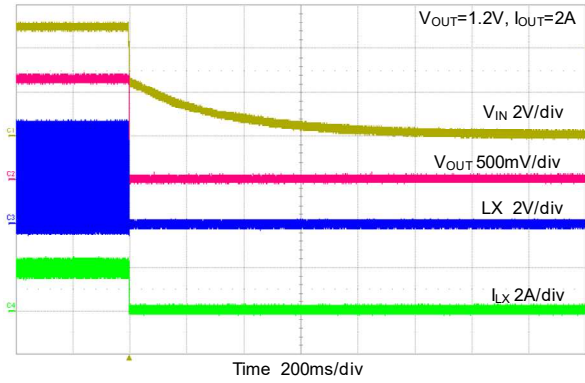


Typical Performance Characteristics (continued)

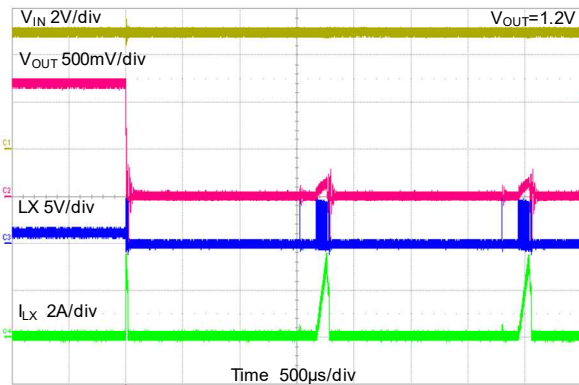
Start-up Through VIN



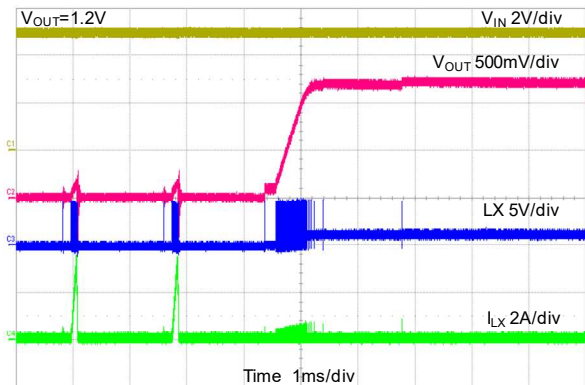
Start-down Through VIN



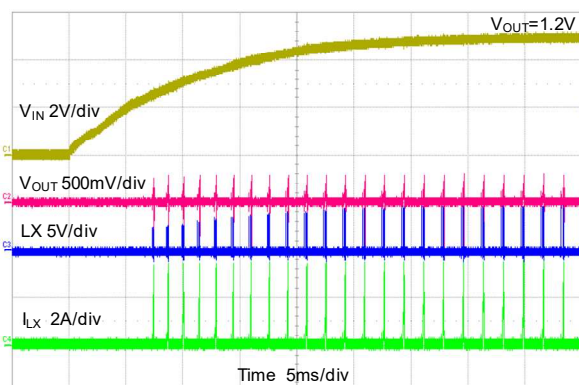
Short Circuit



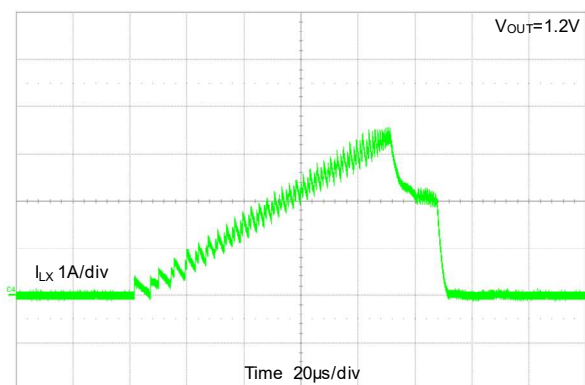
Short Circuit Recovery



Short Circuit

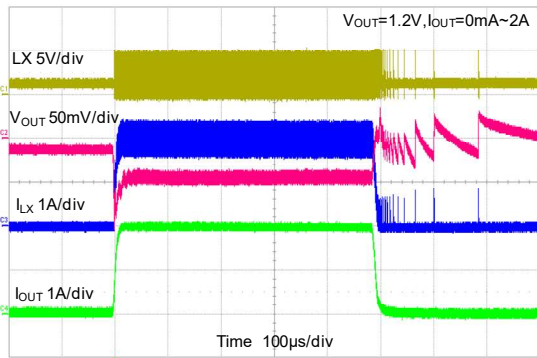


Current Limit

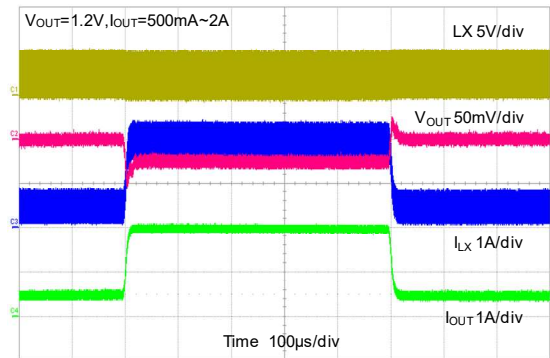


Typical Performance Characteristics (continued)

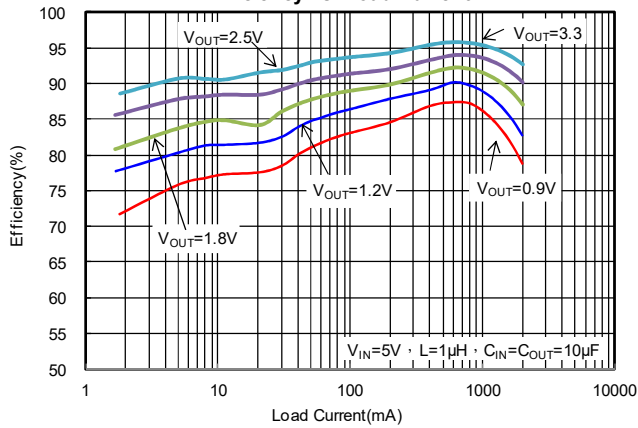
Load Transient Response



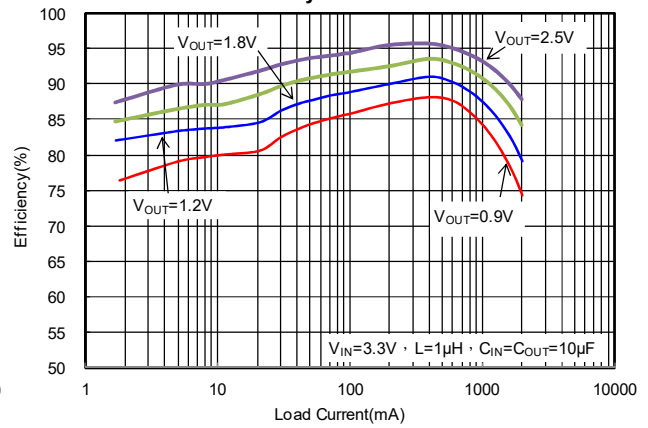
Load Transient Response



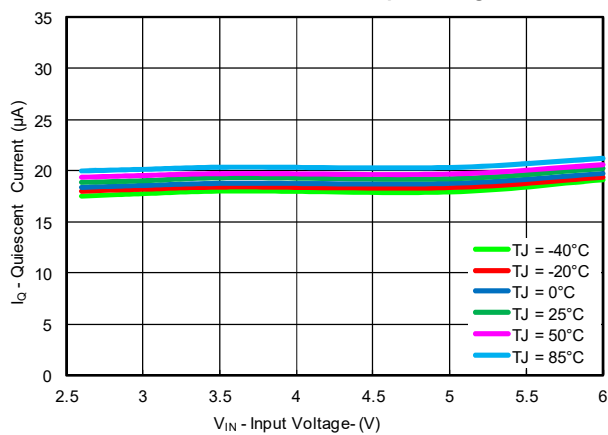
Efficiency vs. Load Current



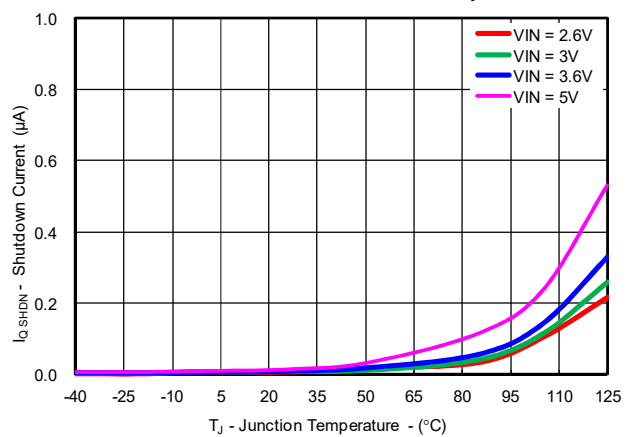
Efficiency vs. Load Current



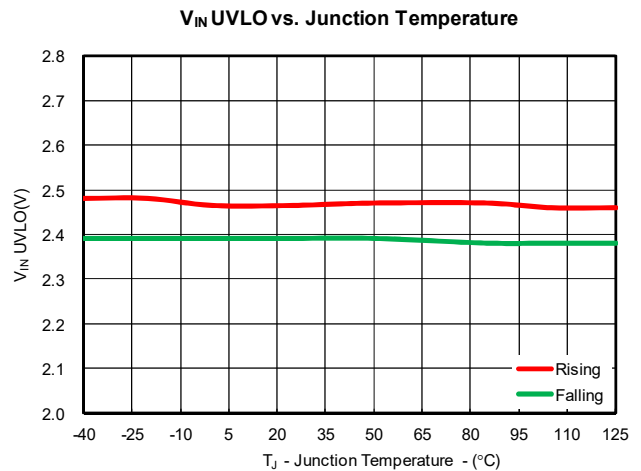
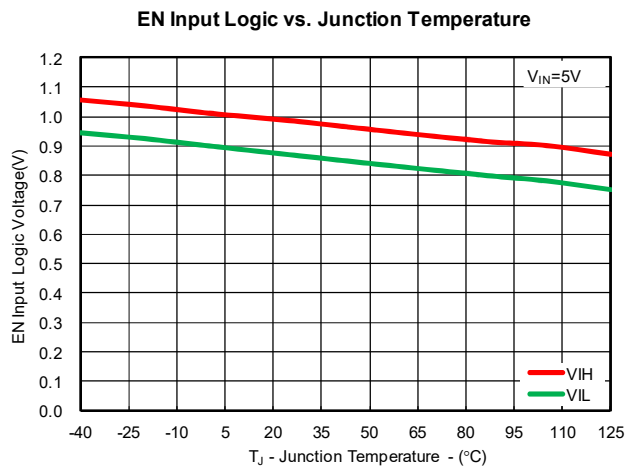
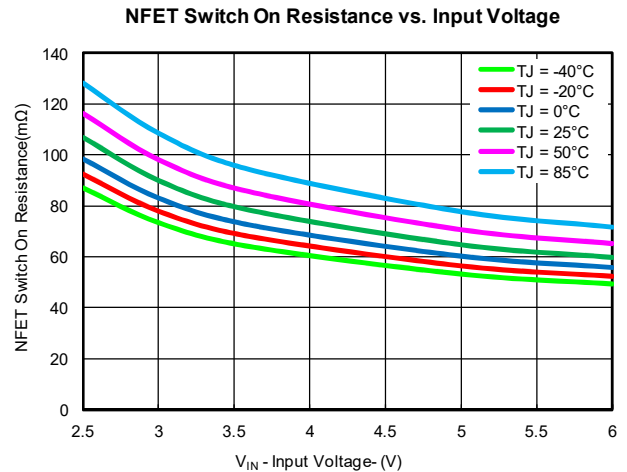
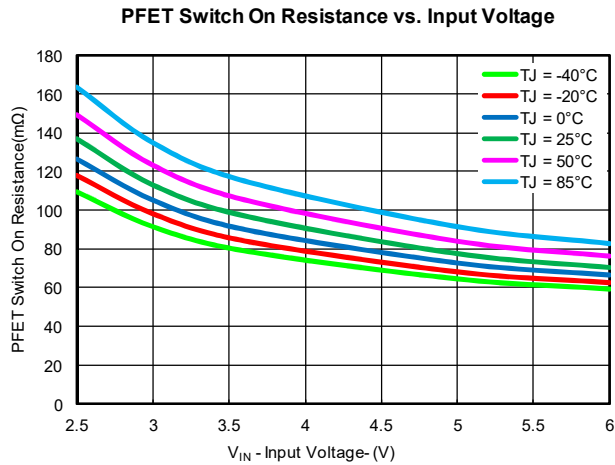
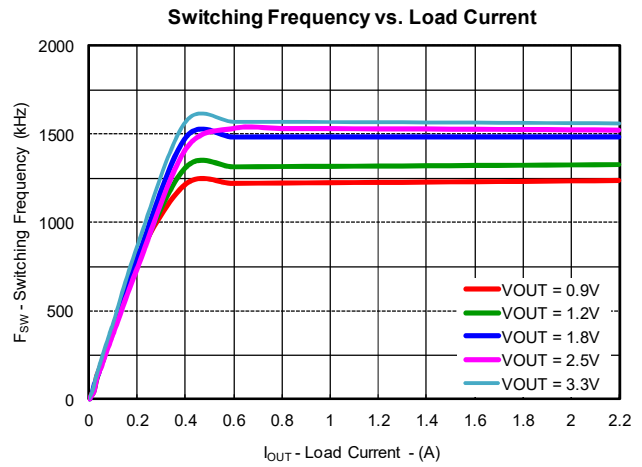
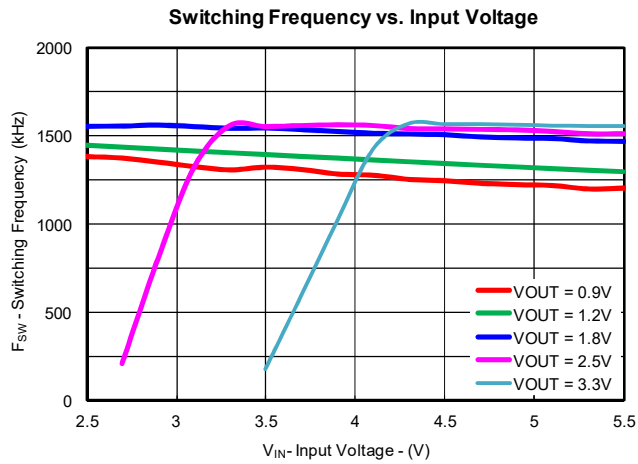
Quiescent Current vs. Input Voltage



Shutdown Current vs. Junction Temperature



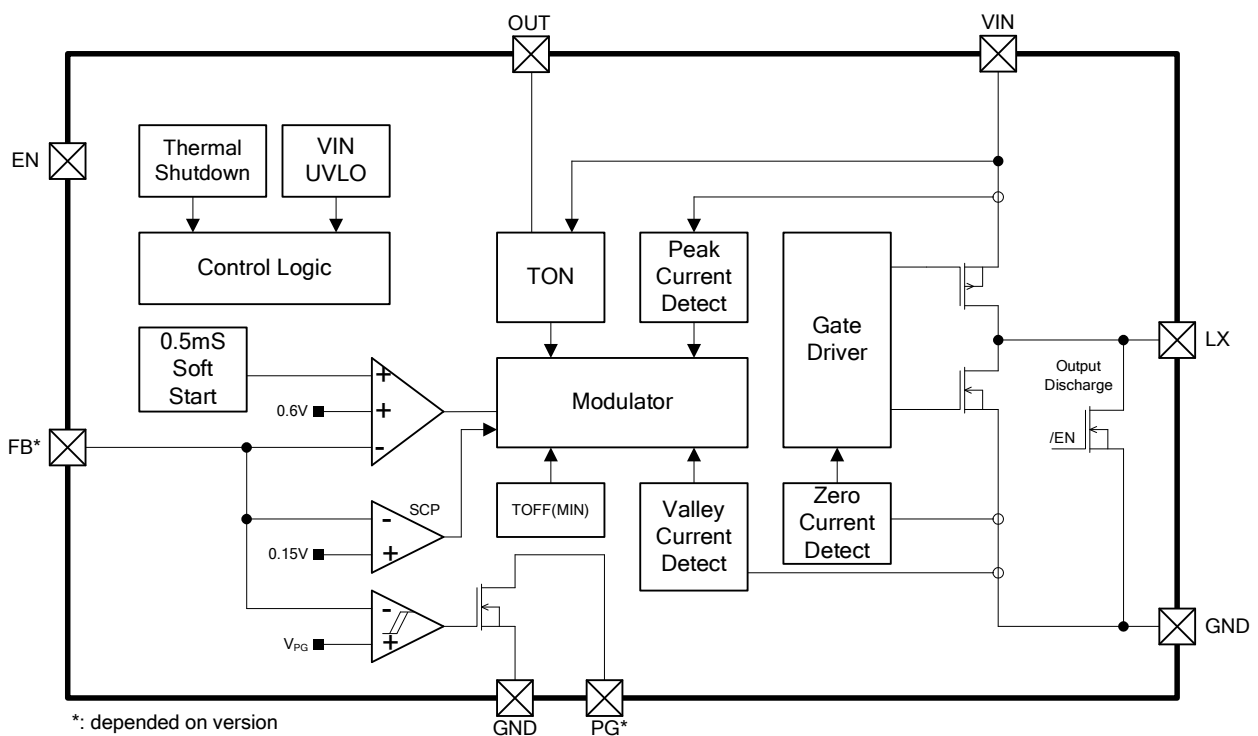
Typical Performance Characteristics (continued)



Pin Description

PIN				NAME	FUNCTION
G2262 AU1U	G2262 -XXAU1U	G2262 TR1U	G2262 -XXTR1U		
1	---	1	---	FB	An external resistor divider from the output to GND, tapped to the FB pin, sets the output voltage.
---	1	---	1	PG	Power Good Indicator. The output of this pin is an open drain output. Keep PG pulls up voltage is lower than Vin..
2	2	2	2	GND	Ground.
3	3	3	3	VIN	Supply Voltage Input. The G2262 operates from a 2.55V to 6V input.
4	4	4	4	LX	Switch Node.
5	5	5	5	EN	Enable Control Input.
6	6	6	6	OUT	Output Voltage Sense pin.

Block Diagram



Operation

The G2262 is a high efficiency synchronous step-down DC/DC converter. G2262 provides an adjustable regulated output voltage from 0.6V to V_{IN} while delivering up to 2A of output current with input voltage from 2.55V to 6V.

The G2262 uses the constant on-time control scheme. The high side P-MOSFET is turned on and off by the Ton circuit block.

By comparing the feedback voltage (V_{FB}) from the output voltage with the internal 0.6V reference, COMP voltage of the error amplifier output is adjusted. When the load current increases, it causes a drop in the feedback voltage relative to 0.6V reference, then the COMP voltage rises to allow higher inductor current for the load current.

Enable

When the input voltage is greater than the under voltage lockout threshold, a logic-high (>1.2V) enables the converter; a logic-low (<0.4V) or floating forces the IC into shutdown mode. There is an internal 1.6Meg Ohm resistor from EN pin to GND.

When the device is disabled, there is a 10 Ohm resistive discharge path from LX pin.

Soft-Start (SS)

There is an internal built-in soft-start to ramp the output voltage at a fixed slew rate to avoid in-rush current. The typical soft-start time is 0.5ms.

Over Current Protection (OCP)

The G2262 provides the over current protection by detecting the high side MOSFET peak inductor current (3.4A typ.) and the low-side MOSFET valley inductor current (2.5A typ.). If the inductor current is over the peak current limit threshold, the high-side MOSFET is turned off and the low-side MOSFET is turned on. Once the inductor current is larger than the valley current limit, the next switching cycle is not allowed. This avoids increasing the inductor current and protects the components.

HICCUP Protection

When the inductor current limit is triggered 8 times, the inductor current limit is reduced to half for the next 8 cycles, and then the device stops switching to protect the components. After a delay of 1ms, G2262 automatically starts a new start-up procedure. Therefore, Hiccup protection is achieved and repeated until the high load condition is removed.

Power Good

G2262 has an open drain and needs an external pull up resistor for the power good indicator. When V_{FB} is high than 90% of regulated voltage, PG will be pulled high by the external pull up resistor. If V_{FB} drops lower than 85% of regulated voltage, PG will be pulled low by the internal NMOS. Please keep PG pull up voltage is lower than V_{IN} .

Thermal Shutdown (OTP)

When the junction temperature exceeds 150°C, the thermal shutdown protection is triggered to stop switching. Once the die temperature decreases below the hysteresis of 30°C, the device start the power up sequence again.

Application Information

The G2262 is a single-phase buck converter. It provides single feedback loop, constant on-time control with fast transient response, and high efficiency. An internal 0.6V reference allows the low output voltage application. Over current protection, under voltage protection, and over temperature protection are all provided by G2262.

Output Voltage Setting

Connect a resistive voltage divider at the FB between V_{OUT} and GND to adjust the output voltage. The output voltage is set by the following equation:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R1}{R2} \right)$$

where V_{REF} is the feedback reference voltage 0.6V (typ.).

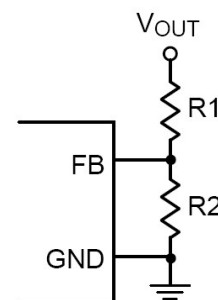


Figure 1. Setting V_{OUT} with a Voltage Divider

Inductor Selection

For high efficiency application, an inductor with a DC resistance less than 15mOhm is recommended. Estimate the inductor value by the following equation :

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{f_{SW} \times LIR \times I_{LOAD(MAX)} \times V_{IN}}$$

where LIR is the ratio of the peak-to-peak ripple current to the average inductor current. Find a low loss inductor with the lowest possible DC resistance leading to high performance.

To avoid inductor saturation, the core must be large enough for the peak inductor current (I_{PEAK}) :

$$I_{PEAK} = I_{LOAD(MAX)} + \left(\frac{LIR}{2} \times I_{LOAD(MAX)} \right)$$

Input Capacitor Selection

High quality ceramic input decoupling capacitor, such as X5R or X7R, with values greater than 10uF are recommended for the input capacitor. Ceramic capacitors with X5R and X7R are highly recommended due to the low ESR, less capacitance variation, and more temperature stability.

Voltage rating and current rating are the key parameters when selecting an input capacitor. Generally, selecting an input capacitor with voltage rating 1.5 times greater than the maximum input voltage is a conservatively safe design.

The input capacitor is used to supply the input RMS current, which can be approximately calculated using the following equation :

$$I_{IN_RMS} = I_{LOAD} \times \sqrt{\frac{V_{OUT}}{V_{IN}} \times \left(1 - \frac{V_{OUT}}{V_{IN}} \right)}$$

The input capacitor requires an adequate ripple current rating due to the absorption of the input switching current. The input capacitance value determines the input ripple voltage of the regulator. The input voltage ripple caused by capacitor can be approximately calculated using the following equation:

$$\Delta V_{IN} = \frac{I_{OUT(MAX)}}{C_{IN} \times f_{SW}} \times \frac{V_{OUT}}{V_{IN}} \times \left(1 - \frac{V_{OUT}}{V_{IN}} \right)$$

Output Capacitor Selection

The output voltage ripple (V_{P-P}) can be calculated by the following equation:

$$V_{P_P} = LIR \times I_{LOAD(MAX)} \times \left(ESR + \frac{1}{8 \times C_{OUT} \times f_{SW}} \right)$$

Selecting the low ESR capacitor is preferred to limit the output voltage ripple. Generally, a 10uF output ceramic capacitor will be sufficient. For a higher output voltage condition ($V_{OUT} > 2.5V$), a 20uF output capacitor is necessary for a more stable system.

During load transient, the output capacitor supplies the load current before the control loop can response. Therefore, the ESR will dominate the output voltage sag during load transient. The output voltage undershoot (V_{SAG}) can be calculated by the following equation:

$$V_{SAG} = \Delta I_{LOAD} \times ESR$$

For a given output voltage sag specification, the ESR value can be determined.

The equivalent series inductance (ESL) also has influence on V_{SAG} when the rapid change in load current results in di/dt during transient. Using a capacitor with low ESL can obtain better transient performance.

Thermal Considerations

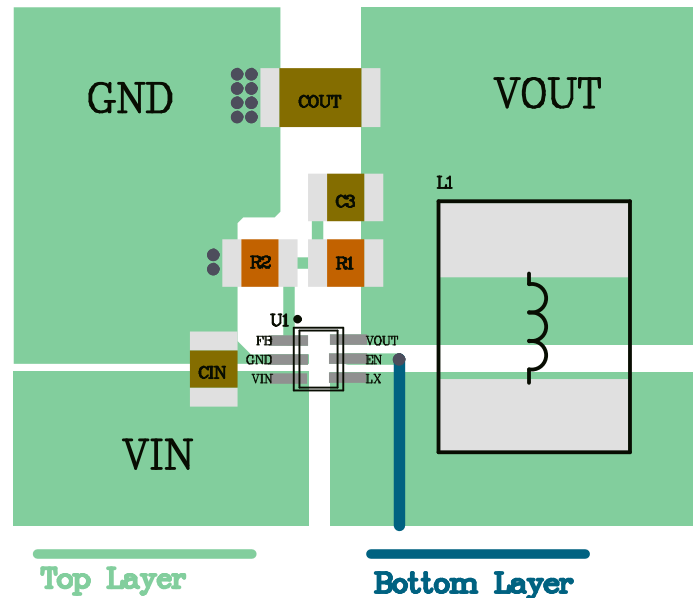
The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance. θ_{JA} , is layout dependent.

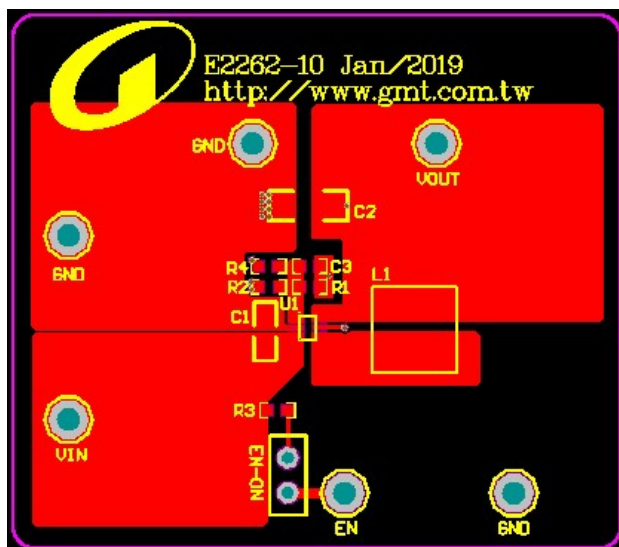
PCB Layout guidelines

1. Place the CIN as close to the VIN pin as possible.
2. Minimize the copper area of LX trace to lower electrical and magnetic field radiation but make the trace wide enough to carry the output current.
3. Put the COUT near to the inductor and the IC. Tie the ground connection to the IC ground with GND plane.
4. Keep the trace for the FB away from the switching high current paths and first go through the regulator output capacitors.

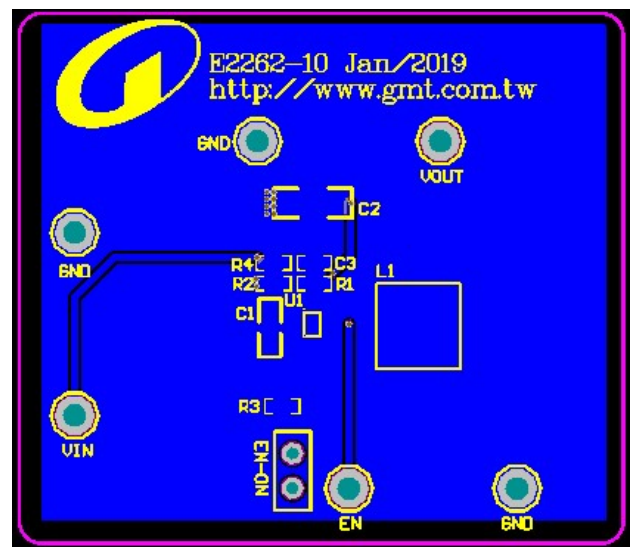


EV Board PCB Layout Section

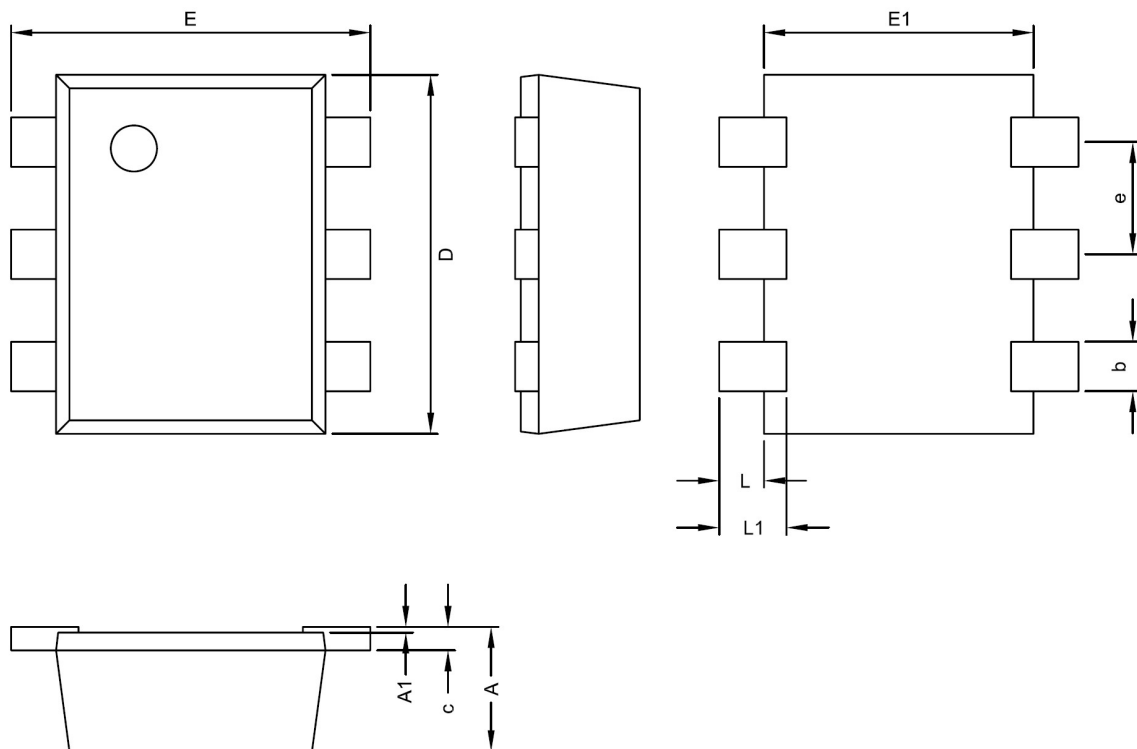
Top Layer



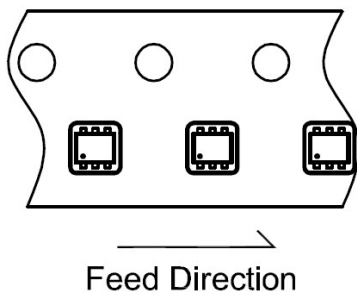
Bottom Layer



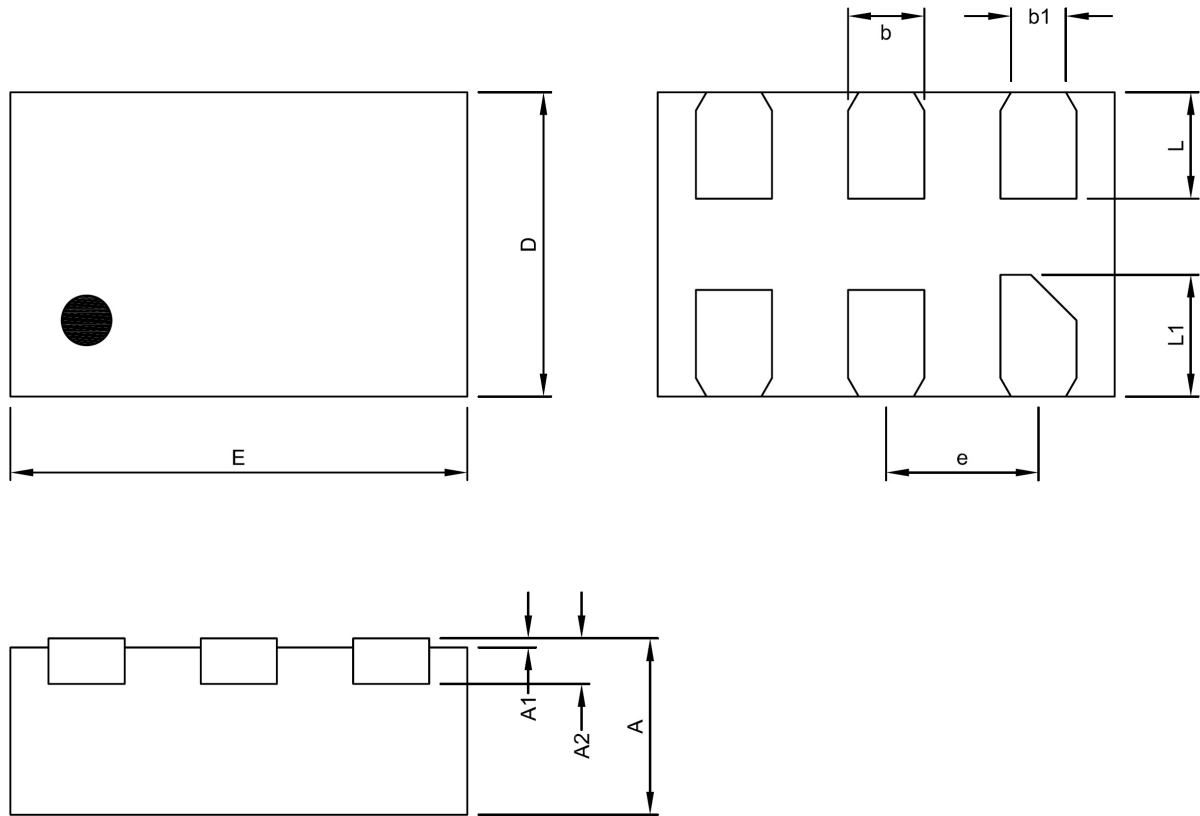
EV2262 PCB	Information
Board Material	FR4
Size	36.83mm*41.93mm
Board Thickness	1.6mm
Layers	2
Copper Thickness	1oz

Package Information

SOT-563 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.525	---	0.600	0.021	---	0.024
A1	0.00	---	0.05	0.000	---	0.002
e	0.500 BSC			0.0197 BSC		
c	0.090	---	0.180	0.004	---	0.007
D	1.500	1.600	1.700	0.059	0.063	0.067
b	0.170	0.220	0.270	0.007	0.009	0.011
E1	1.100	1.200	1.300	0.043	0.047	0.051
E	1.500	1.600	1.700	0.059	0.063	0.067
L	0.100	0.200	0.300	0.004	0.008	0.012
L1	0.200	0.300	0.400	0.008	0.012	0.016

Taping Specification


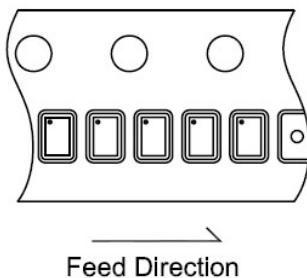
PACKAGE	Q'TY/REEL
SOT-563	3,000ea



ADFN1X1.5-6 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.0197	0.0217	0.0236
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.152 REF			0.0060 REF		
D	0.95	1.00	1.05	0.0374	0.0394	0.0413
E	1.45	1.50	1.55	0.0571	0.0591	0.0610
b	0.20	0.25	0.30	0.0079	0.0098	0.0118
b1	0.18 REF			0.0071 REF		
e	0.50 BSC			0.0197 BSC		
L	0.30	0.35	0.40	0.0118	0.0138	0.0157
L1	0.35	0.40	0.45	0.0138	0.0157	0.0177

Taping Specification



PACKAGE	Q'TY/REEL
ADFN1.0X1.5-6	5,000ea

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