Low-Voltage Output 400mA LDO

General Description

The ET542XXY1B Series are low voltage 400mA voltage regulator. The input voltage is as low as Min. 1.1V and the output voltage can be set from 0.7V. The output voltage accuracy has been improved to ±2% and due to a built-in transistor with low on-resistance. It consists of a voltage reference unit, an error amplifier, a resistor-net for voltage setting, and a current limit circuits for over-current prevention.

The ET542XXY1B uses a type of outstanding CMOS process to minimize the supply current. A low on-resistance PMOS pass device is equipped for lower dropout voltage. ET542XXY1B also possess the EN function to save more energy and extend the battery life. The EN pin can switch the regulator to standby mode.

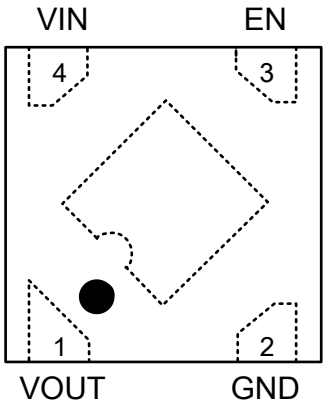
Features

- Wide Input Voltage Range from 1.1V to 5.0V
- Very Low I_Q is 55μA Typ
- Max Output Current up to 400mA
- Output Voltage Range from 0.7V to 3.8V
- Output Voltage Accuracy is ±2%
- Dropout Voltage is Typ 280mV@400mA (V_{OUT}=1.5V)
- Excellent Load/Line Transient Response
- Line Regulation is 0.1%/V Typ
- Built-in Fold Back Protection Circuit
- Built-in Constant Slope Circuit
- Built-in Auto-discharging Circuit
- MSL is Level1
- Small DFN4(1×1) Package

Applications

- Constant-Voltage Power Supply for Battery-Powered Device
- Constant-Voltage Power Supply for TV, Notebook PC and Home Electric Appliance
- Constant-Voltage Power Supply for Portable Equipment

Pin Configuration

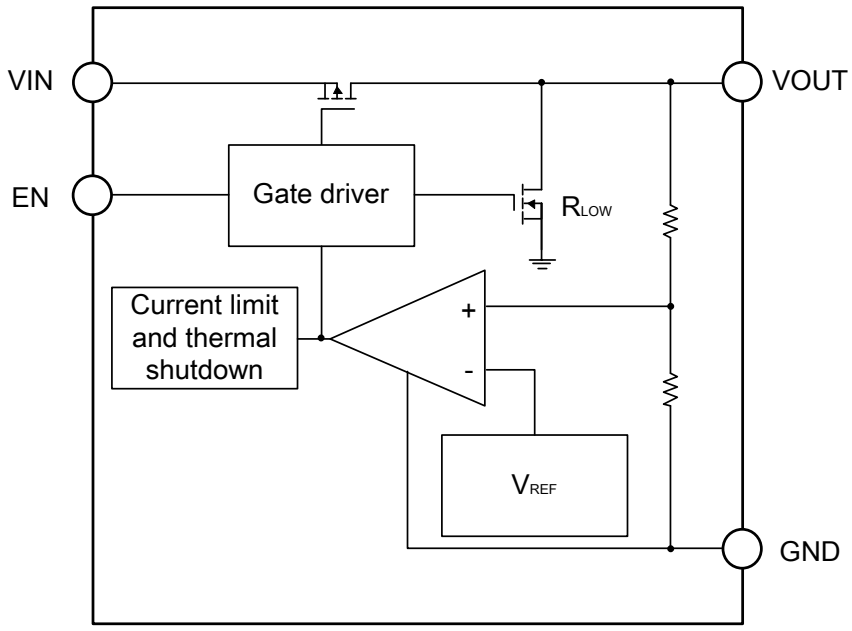


DFN4

Pin Function

Pin No.	Symbol	Pin Description
2	GND	Ground Pin
3	EN	Chip Enable Pin,"H" Enable
4	VIN	Input Pin
1	VOUT	Output Pin

Block Diagram



Functional Description

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is 0.47μF to 10μF(usually 1μF), Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ. Ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to V_{OUT} and GND pins.

EN Pin Operation

The ET542XXY1B is turned on by setting the EN pin to “H”. The EN pin do not set it in floating status. When the EN pin is not used, connect the EN pin with V_{IN} to keep the LDO in operating mode.

Current Limit Protection

When output current of V_{OUT} pin is higher than current limit threshold, the current limit protection will be triggered and clamp the output current at a predesigned level to prevent over-current and thermal damage.

Auto Discharging

When EN pin set to “L”, the output circuit will be disable immediately, and the Auto-Discharging circuit will be turned on to discharge the electric charge on output capacitor and decrease the V_{OUT} voltage in very short time.

Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
V_{IN}	Input Voltage Range		-0.3 to +6	V
V_{EN}	Enable Voltage Range		-0.3 to +6	V
V_{OUT}	Output Voltage Range		-0.3 to (V_{IN} + 0.3) ≤ 6	V
I_{OUT}	Maximum Load Current		400	mA
T_J	Maximum Junction Temperature		-40 to +150	°C
T_{STG}	Storage Temperature		-65 to +150	°C
T_{SLOD}	Lead Temperature (Soldering, 10 sec)		300	°C
ESD	HBM (EIA/JESD22-A114-A)		±4.0	KV
	CDM (EIA/JESD22-C101-A)		±1.5	KV
L_U	Latch up Current Maximum Rating (JESD78E)		±200	mA
P_{DMAX}[(1)]	Maximum Power Dissipation	DFN4 1.0×1.0	400	mW

Note 1: Rating at mounting on a board (PCB board dimension: 40mm x 40mm (4layer), copper: 1oz).

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Input voltage range	V_{OUT} +V_{DO} to 5.5	V
I_{OUT}	Output Current	0 to 400	mA
T_A	Operating Ambient Temperature	-40 to +85	ºC
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 10	µF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 10	µF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

(V_{IN}=V_{SET}+1.0V, I_{OUT}=1mA,T_A = -40°C ~85°C , C_{IN}=C_{OUT}=1μF; Typical values are at T_A = 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN} (2)		1.1		5	V
Supply Quiescent Current	I_{Q_ON}	Active mode: V_{EN}=V_{IN}, I_{OUT}= 0mA	30	55	75	μA
Supply Shutdown Current	$I_{Q\ OFF}$	V_{EN}=0V		0.1	2	μA
Output Voltage	V_{OUT}	I_{OUT} = 1mA,T_A = 25°C	-2		+2	%
		I_{OUT} = 1mA,T_A = -40°C~85°C	-2.5		+2.5	%
Line Regulation	Reg_{LINE}	V_{SET} + 1.0V ≤ V_{IN} ≤ 5.0V, I_{OUT} = 10mA		0.10	0.25	%/V
Load Regulation	Reg_{LOAD}	1mA ≤ I_{OUT} ≤ 400mA		25	45	mV
Line Transient (The absolute value of the output change)	V_{TRLN} (3)	I_{OUT} = 1mA, V_{IN} =V_{SET} + 1.0V to 5V in 10us,T_A = 25°C		15	30	mV
		I_{OUT} = 1mA, V_{IN} = 5V to V_{SET} + 1.0V in 10us,T_A = 25°C		15	30	
Load Transient (The absolute value of the output change)	V_{TRLD} (3)	I_{OUT} from 1mA to 400mA in 10us,T_A = 25°C		85	120	mV
		I_{OUT} from 400mA to 1mA in 10us,T_A = 25°C		50	100	
Output Current	I_{OUT}		400			mA
Over Current Limit	I_{LMT}	V_{IN}=2.2V, T_A = 25°C	500	700	1000	mA
Short Current Limit	I_{SHORT}	V_{OUT}=0V, T_A = 25°C	70	110	180	mA
Power Supply Rejection Ratio	PSRR(3)	f=1kHz, ,I_{OUT}=20mA, V_{IN}=1.85V, T_A = 25°C	60	80		dB
Output Noise	e_N(3)	10Hz to 100kHz, I_{OUT} = 30mA, T_A = 25°C		40* V_{OUT}	70* V_{OUT}	μV_{RMS}
EN Low Threshold	V_{IL}	V_{IN}=1.1 to 5V			0.4	V
EN High Threshold	V_{IH}	V_{IN}=1.1 to 5V	0.9			V
EN Pull-down Current	I_{EN}	V_{EN}=V_{IN},T_A = 25°C	0.2	0.7	1	μA
Output Turn-on Delay Time	T_{ON}	From V_{EN} SET to V_{OUT} = 95% of $V_{OUT(NOM)}$	20	60	150	us
Output Resistance of Auto -Discharge at Off State	R_{LOW}	V_{EN}=0V,V_{IN}=2V,I_{OUT}=10mA	20	40	80	Ω
Thermal Shutdown Temperature, Detection	T_{TSD}(3)	Junction Temperature		150		°C
Thermal Shutdown Temperature, Released	T_{TSR}(3)	Junction Temperature		130		°C

Note 2:The maximum input voltage should take into account the maximum power consumption ($P_{D(MAX)}$).The calculation formula is as follows:

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT}) \times I_{OUT}$$

The maximum power consumption of the DFN4 is 400mW.

$$V_{IN(MAX)} = 400mW / I_{OUT} + V_{OUT}$$

For example:

If V_{OUT}= 1.2V, I_{OUT}=400mA, The maximum input voltage is $V_{IN(MAX)}$=400mW / 400mA+1.2=2.2V

Note 3: Guaranteed by design and characterization. not a FT item.

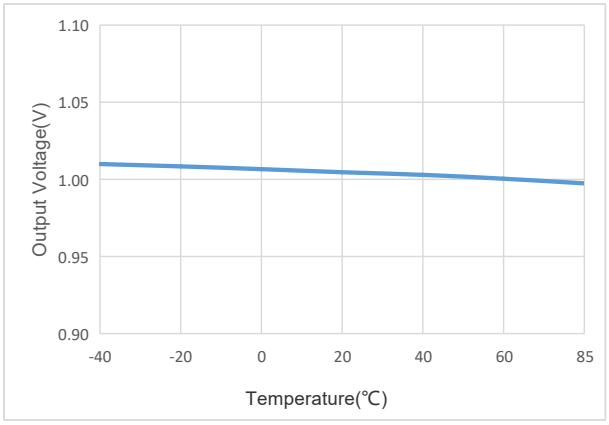
Dropout Voltage by Output Voltage

Output Voltage V_{OUT}(V)	Dropout Voltage V_{DROP} (V)[4]		
	Condition	Typ	Max
0.7 ≤ V_{OUT} < 0.8	I_{OUT}=400mA	0.70	0.85
0.8 ≤ V_{OUT} < 0.9		0.58	0.72
0.9 ≤ V_{OUT} < 1.0		0.50	0.62
1.0 ≤ V_{OUT} < 1.2		0.43	0.55
1.2 ≤ V_{OUT} < 1.5		0.35	0.45
1.5 ≤ V_{OUT}		0.28	0.36

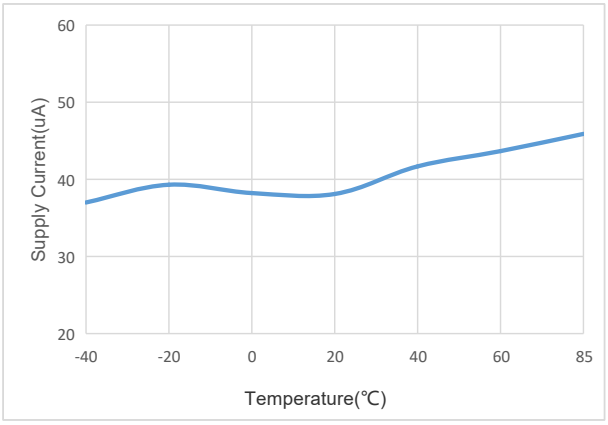
Note 4 :V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} +$V_{DROPMAX}$ with output current.

Typical Characteristics

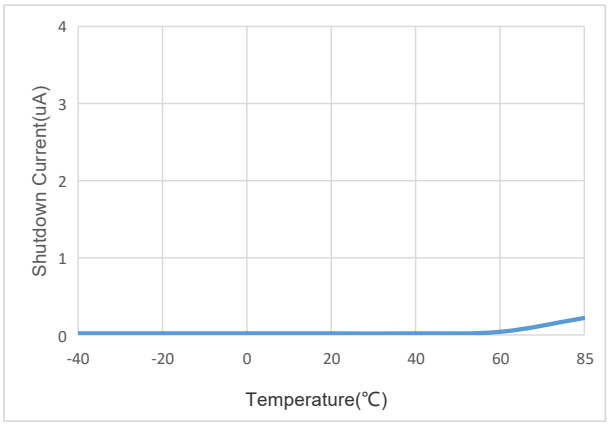
(V_{OUT}=1.0V,V_{IN}=2.0V,C_{IN}=C_{OUT}=1μF,T_A= -40ºC~+85ºC)



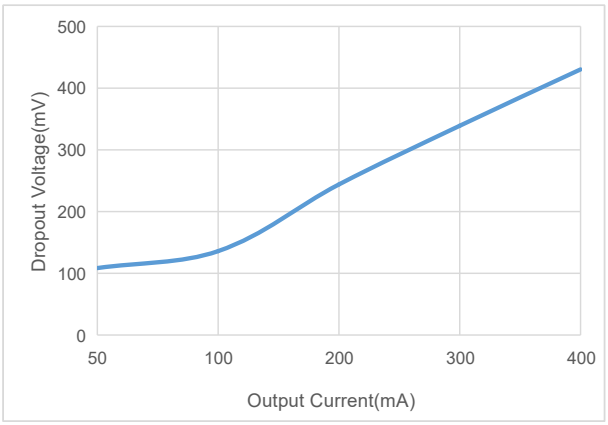
Output Voltage VS Temperature



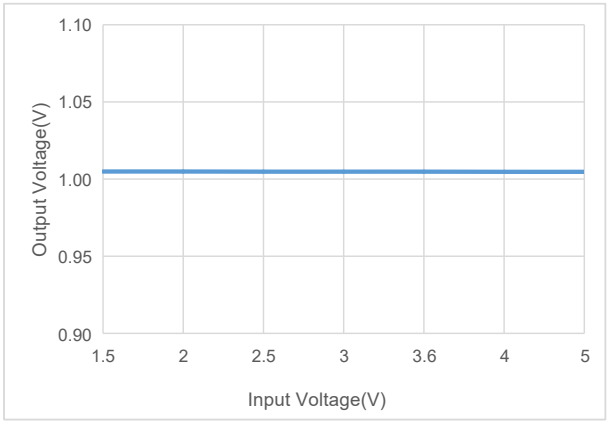
Supply Current VS Temperature



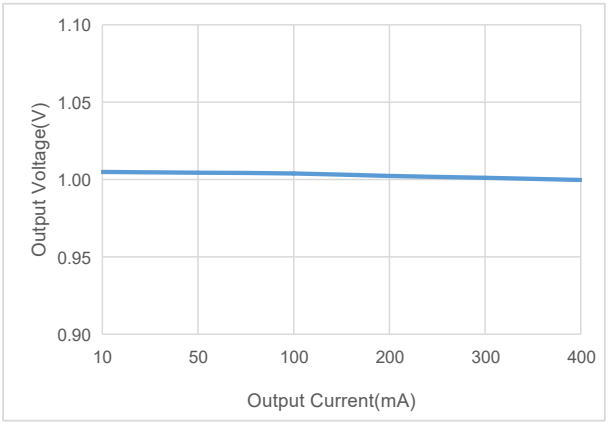
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



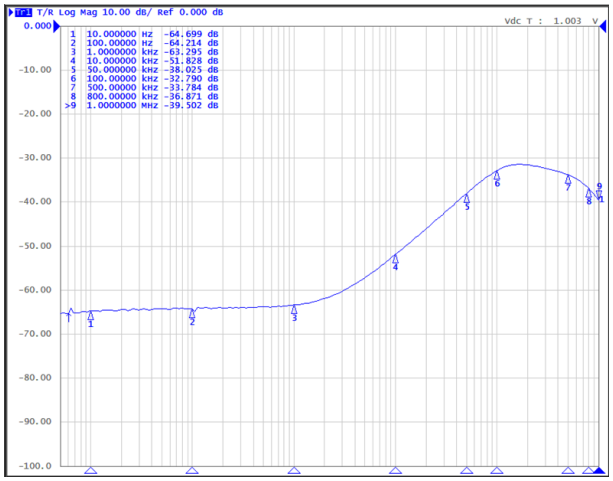
Output Voltage VS VIN Input Voltage



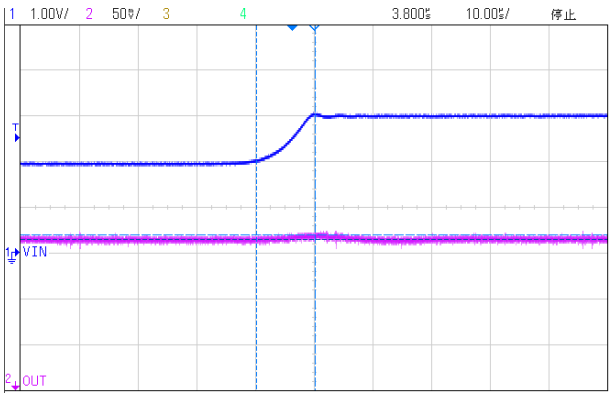
Output Voltage VS Output Current

Typical Characteristics(Continued)

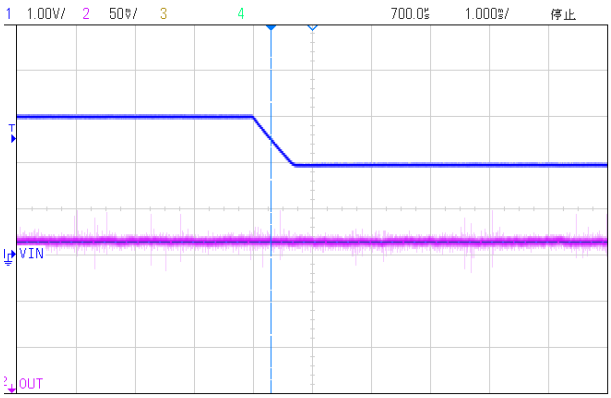
(V_{OUT}=1.0V,V_{IN}=2.0V,C_{IN}=C_{OUT}=1μF,T_A= -40ºC~+85ºC)



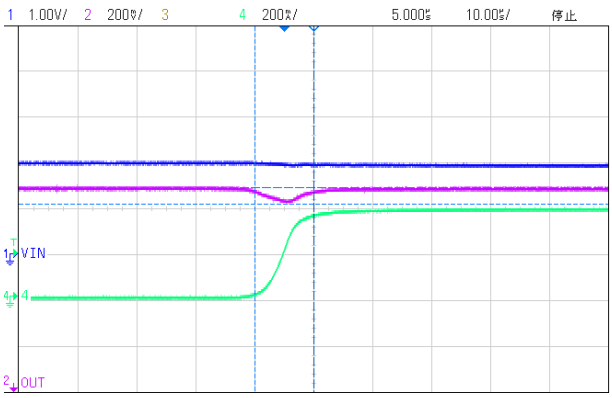
VIN=2.0V PSRR



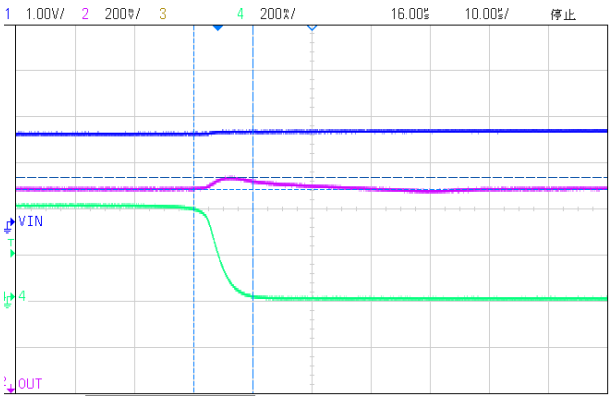
Line Transient(2.0V~3.0V 10us ΔV= 5 mV)



Line Transient(3.0V~2.0V 10us ΔV= 5 mV)

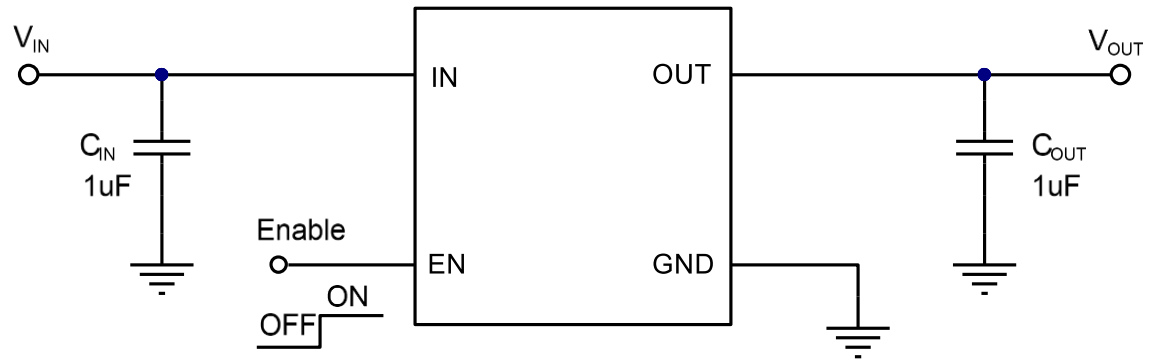


Load Transient(1mA~0.4A 10us ΔV= 72.5 mV)



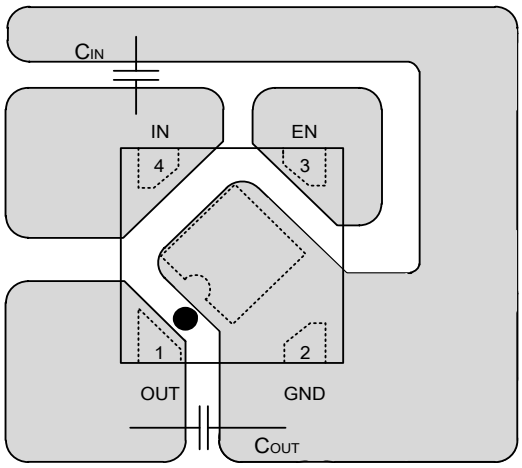
Load Transient(0.4A~1mA 10us ΔV= 55 mV)

Application Circuits



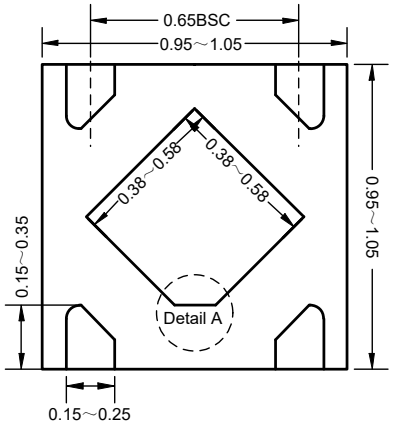
PCB Layout Guide

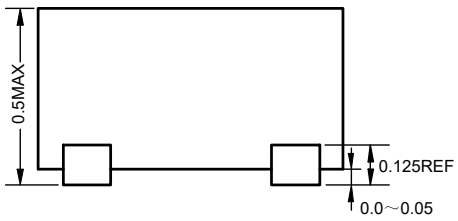
DFN4

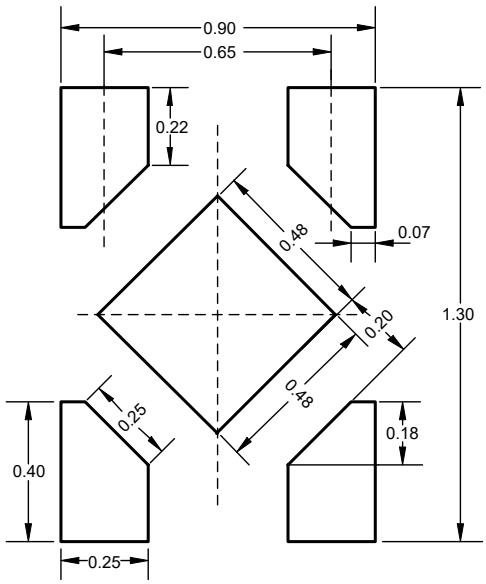


Package Dimension

DFN4

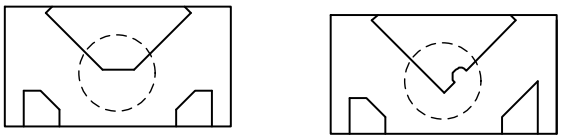






Recommended Land Pattern

Detail A: (PIN1 shape)



Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2018-06-27	Original Version	Liu Yi Guo	Liu Yi Guo	Liu Jia Ying
1.1	2018-08-01	Update EC table	Liu Yi Guo	Liu Yi Guo	Liu Jia Ying
1.2	2019-01-24	Add T_J and note in AMR	Liu Yi Guo	Liu Yi Guo	Liu Jia Ying
1.3	2019-05-10	Update recommend layout	Shib	Shib	Liujy
1.4	2019-06-27	Add more Min. Max. Values and Typical Characteristics	Liu Yi Guo	Liu Yi Guo	Liu Jia Ying
1.5	2021-11-05	Add Marking	Liu Yi Guo	Liu Yi Guo	Liu Jia Ying
1.6	2023-10-03	Update Typeset	Shib	Liu Yi Guo	Liujy