FEATURES

- Wide Input Voltage from 2.4V to 6V
- Adjustable Output Voltage from 0.6V to VIN
- Dual 1A Continuous, 1.2A Peak Output Current
- Constant on Time (COT) Control
- Stable with Low ESR Ceramic Capacitors
- Power Saving Mode (PSM) for Excellent Light Load Efficiency
- 100% Duty Cycle Operation for Low Dropout
- Junction Temperature Range from −40°C to 125°C
- Internal Soft-Start Time of 0.5ms
- Cycle-by-Cycle Output Current Limit
- Hiccup Mode for Short Circuit and Over-Load Protection
- Thermal Shutdown Protection
- LGA-17 (3mm×3.1mm×1.2mm) Package
- Pb-Free RoHS Compliant

DESCRIPTION

The M0522-C is a dual 1.2A step-down switching mode Power SoC (System on Chip) with integrated controller, power MOSFETs, and inductor in an LGA-17 package. The input voltage ranges from 2.4V to 6V.

The M0522-C provides high efficiency with COT control mode for fast transient response and good loop stability. It works on Power Saving Mode (PSM) for excellent light load efficiency.

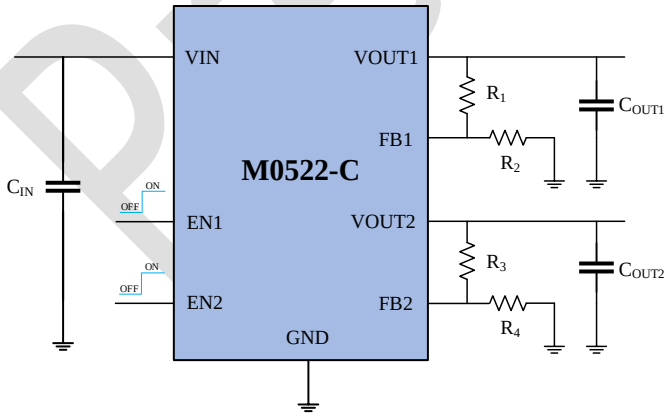
The M0522-C provides rich protection features, including OCP, OTP, and hiccup mode for SCP.

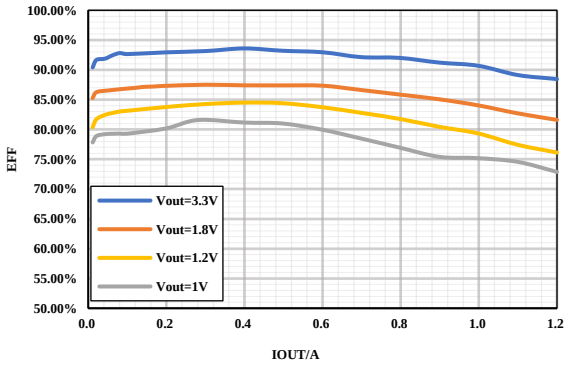
APPLICATIONS

- Optical Modules
- Small/Handheld Devices
- Portable Instruments
- Wireless/Networking Cards
- Low-voltage I/O System Power

TYPICAL APPLICATION&EFFICIENCY

(Vin=5V)





ORDERING INFORMATION

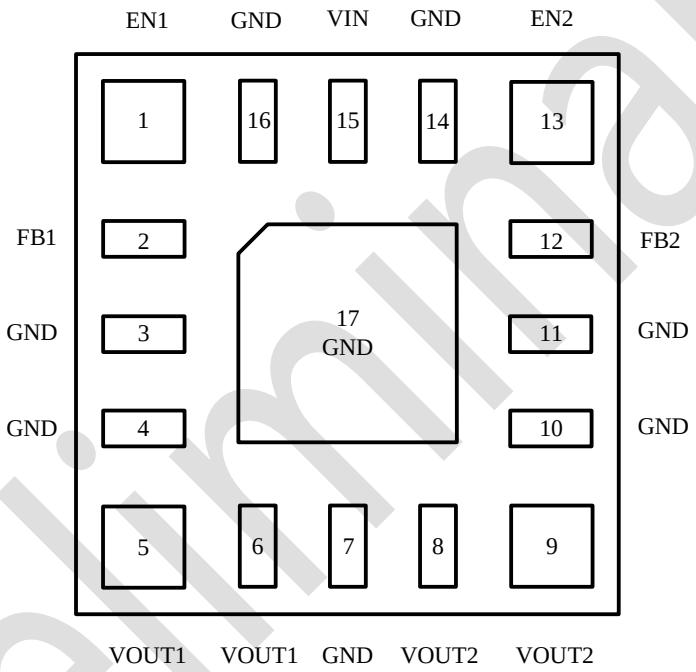
PART NUMBER	TOP MARKING	PACKAGE	MOQ	MSL LEVEL
M0522DLFA-C	M0522 YWWLLL	LGA-17 (3mm×3.1mm×1.2mm)	1000/ Tape & Reel	3

NOTES:

1) Y: Year, WW: Week, LLL: Lot Number.

PACKAGE REFERENCE

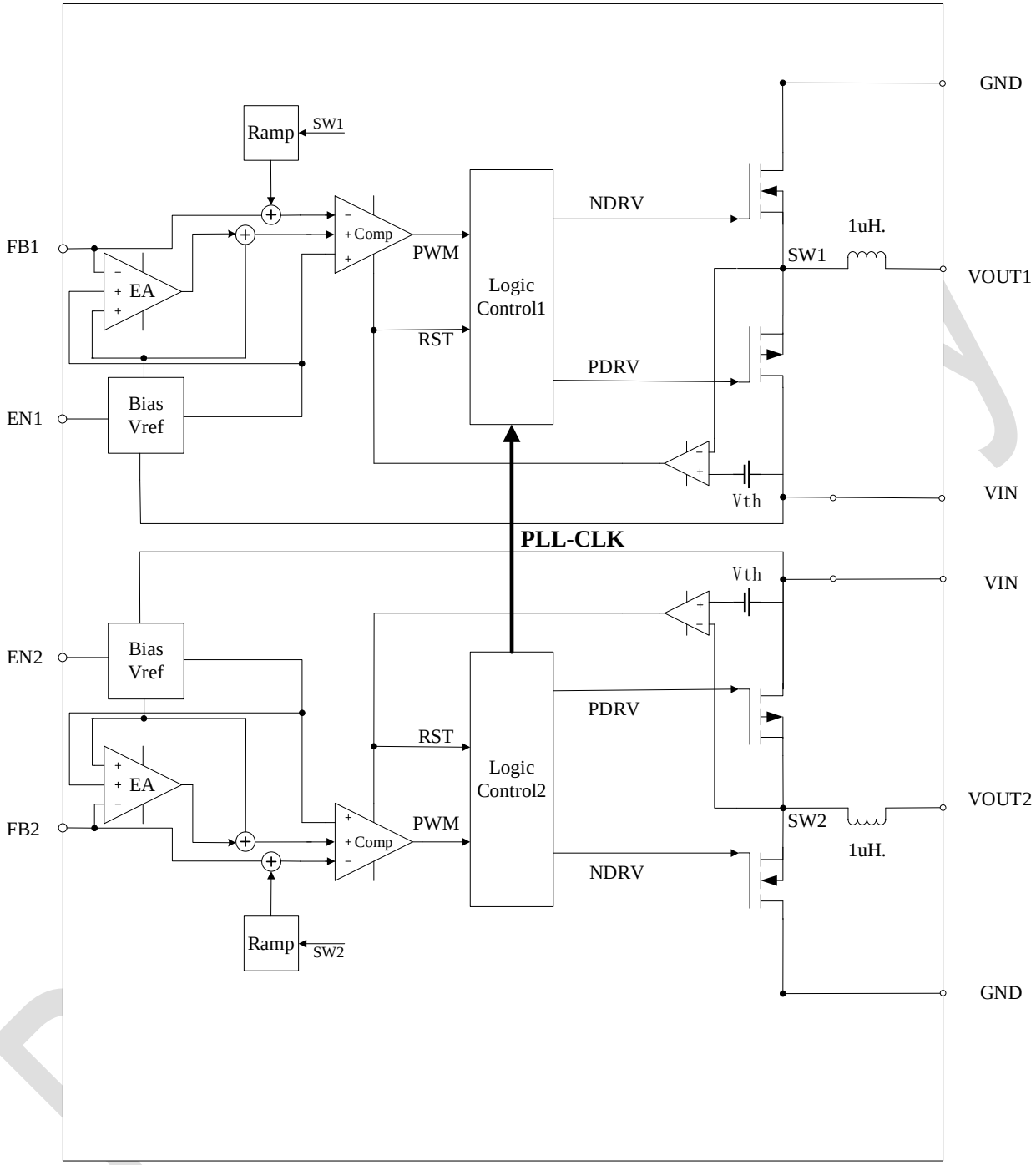
TOP VIEW



PIN FUNCTIONS

PIN #	NAME	DESCRIPTION
3,4,7,10,11,14,16,17	GND	**Ground.**
15	VIN	**Input Voltage.** Input capacitor is recommended to be placed between VIN1 and GND.
1	EN1	**Enable Control of Channel 1**. Pulling this pin low shuts the channel down. Pulling it up enables the channel**.**
5, 6	VOUT1	**Output Voltage of Channel 1.** Connect this pin with the load. Output capacitor is recommended to be placed between VOUT1 and GND.
2	FB1	**Feedback of Channel 1.** Connect this pin with an external resistor divider from the output to GND to set the output voltage.
13	EN2	**Enable Control of Channel 2**. Pulling this pin low shuts the channel down. Pulling it up enables the channel**.**
8, 9	VOUT2	**Output Voltage of Channel 2.** Connect this pin with the load. Output capacitor is recommended to be placed between VOUT2 and GND.
12	FB2	**Feedback of Channel 2.** Connect this pin with an external resistor divider from the output to GND to set the output voltage.

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

	SYMBOL	MIN	MAX	UNIT
Voltage at Vin	V_{IN}	−0.3	6.5	V
Voltage at Other Pins		−0.3	6.5	V
Junction Temperature Range	T_J	−40	125	℃
Storage Temperature Range	T_S	−55	150	℃
Power Dissipation (T_A=_25℃)	P_D Note 1)		2	W
Peak Solder Reflow Body Temperature			245	℃

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN	MAX	UNIT
Input Voltage Range	V_{IN}	2.4	6	V
Output Voltage Range	$V_{OUT1,2}$	0.6	V_{IN}	V
Output Current	I_{OUT}		1.2	A

THERMAL RESISTANCE

	SYMBOL	MIN	MAX	UNIT
Junction to Ambient	θ_{JA} Note 2)		60	℃/W
Junction to Case	θ_{JC} Note 2)		20	℃/W

NOTES:

1) The maximum allowable continuous power dissipation at any ambient temperature (T_A) is calculated by $P_D(max)=(T_J(max)-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the power module will go into thermal shutdown.
2) Measured on EVB, 2-layer PCB 1oZ.

ELECTRICAL CHARACTERISTICS

V_{IN}=5V, T_A=25℃.

PARAMETERS	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
VIN UVLO Rising Threshold	$V_{IN\_UV\_R}$	V_{IN} Rising		2.2	2.4	V
VIN UVLO Hysteresis				200		mV
Shutdown Supply Current	I_S	$V_{EN1/2}$ =0V, T_J =25℃		1		μA
Quiescent Supply Current	I_{Q1}	V_{FB1}=0.8V, V_{IN} =5V, T_J =25℃		50		μA
	I_{Q2}	V_{FB2}=0.8V, V_{IN} =5V, T_J =25℃		30		μA
Enable ON	V_{EN_ON}	EN input logic High voltage	1.1	1.2	1.3	V
Enable OFF	V_{EN_OFF}	EN input logic Low voltage			0.4	V
EN Internal Pull-Down Resistor	R_{EN}			2		MΩ
Feedback Voltage	V_{FB_REF}	2.4V ≤V_{IN} ≤ 6.5V T_J = 25℃	591	600	609	mV
Feedback Leakage	I_{LK_FB}				10	nA
Peak Current limit	I_{LIM_HS}			3		A
Valley Current limit	I_{LIM_LS}			2.3		A
Thermal Shutdown Threshold				150		℃
OTP Hysteresis				20		℃

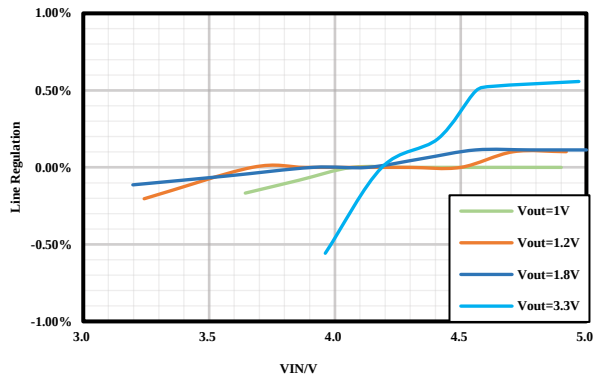
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}=5V, T_A=25℃, V_{OUT}=1.2V, unless otherwise noted.

Line Regulation

V_{OUT}=1V/1.2V/1.8V/3.3V, I_{OUT}=1.2A

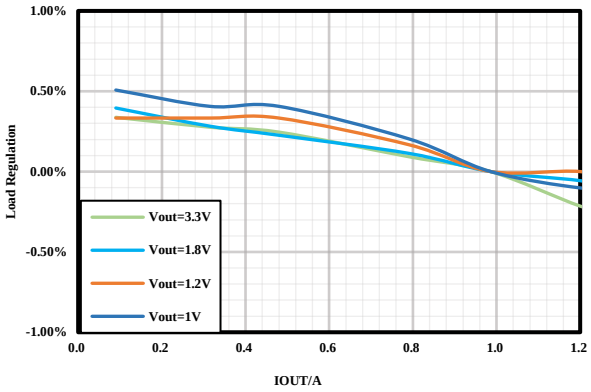
V_{IN}=3.2~5V



Load Regulation

V_{IN}=5V, V_{OUT}=1V/1.2V/1.8V/3.3V

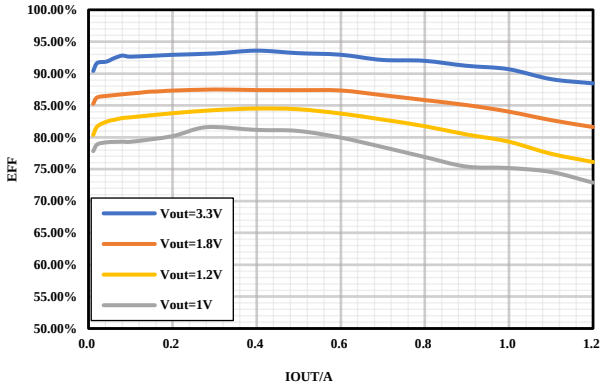
I_{OUT}=0~1.2A



Efficiency

V_{IN}=5V, V_{OUT}=1V/1.2V/1.8V/3.3V

I_{OUT}=0~1.2A

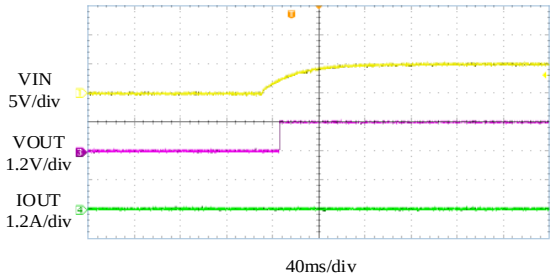


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN}=5V, T_A=25℃, V_{OUT}=1.2V, unless otherwise noted.

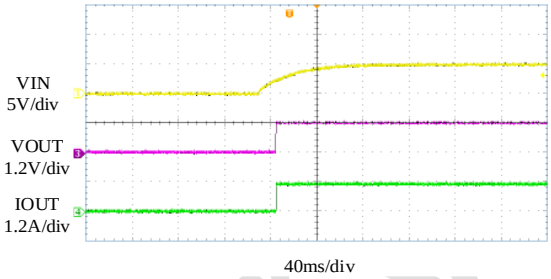
VIN Start-up

I_{OUT}=0A



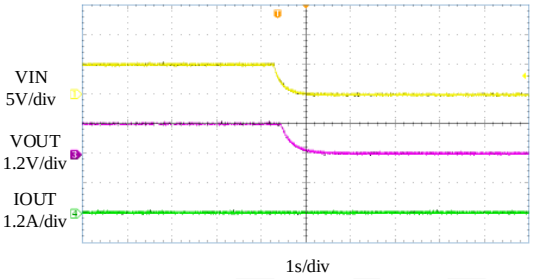
VIN Start-up

I_{OUT}=1.2A



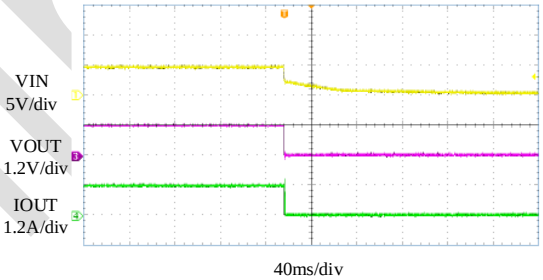
VIN Shutdown

I_{OUT}=0A



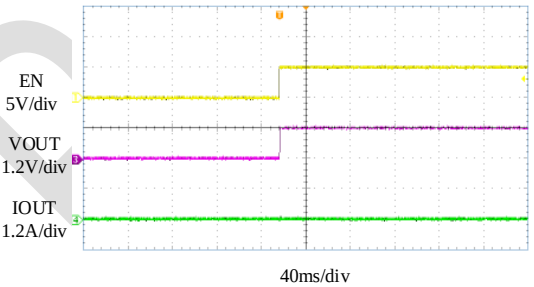
VIN Shutdown

I_{OUT}=1.2A



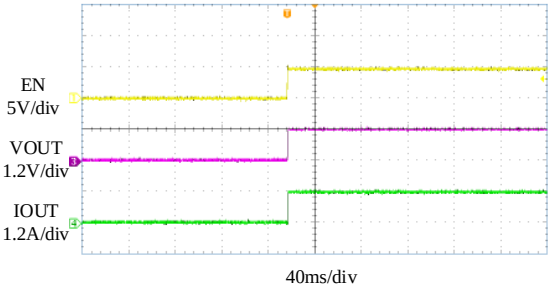
EN Start-up

I_{OUT}=0A



EN Start-up

I_{OUT}=1.2A

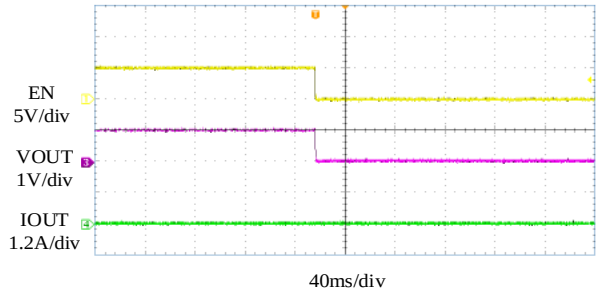


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{IN}=5V, T_A=25°C, V_{OUT}=1.2V, unless otherwise noted.

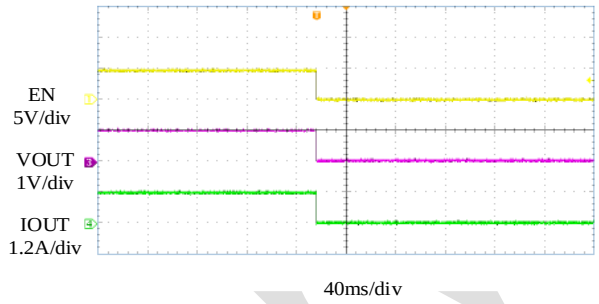
EN Shutdown

I_{OUT}=0A



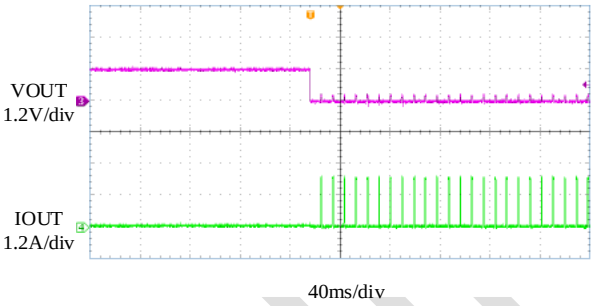
EN Shutdown

I_{OUT}=1.2A



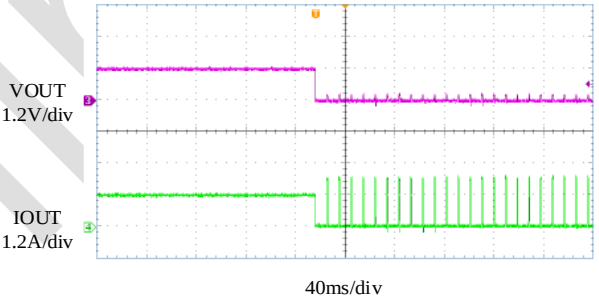
SCP Entry

I_{OUT}=0A



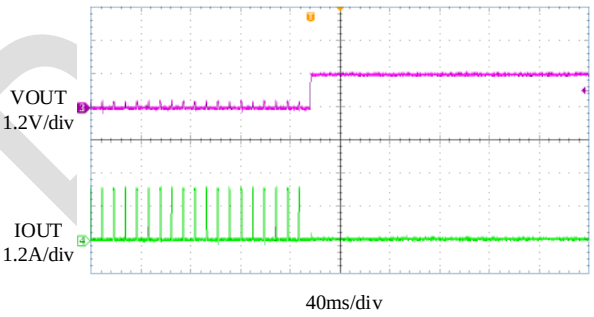
SCP Entry

I_{OUT}=1.2A



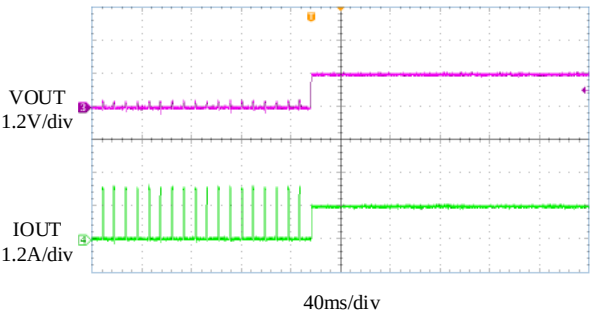
SCP Recovery

I_{OUT}=0A



SCP Recovery

I_{OUT}=1.2A

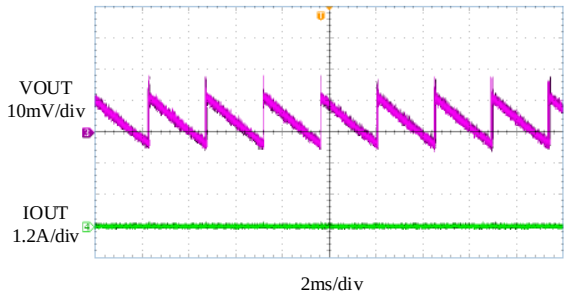


TYPICAL PERFORMANCE CHARACTERISTICS(continued)

V_{IN}=5V, T_A=25℃, V_{OUT}=1.2V, unless otherwise noted.

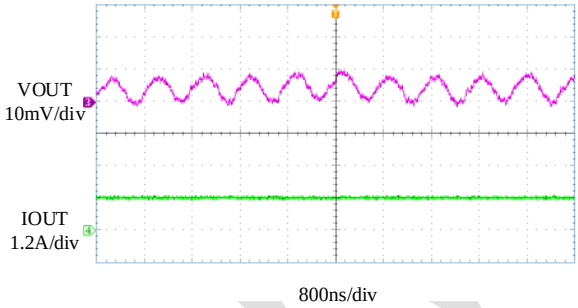
VOUT Ripple

I_{OUT}=0A



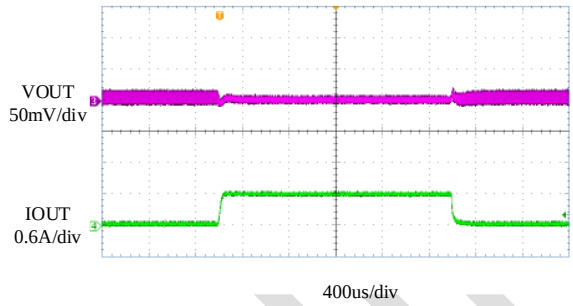
VOUT Ripple

I_{OUT}=1.2A



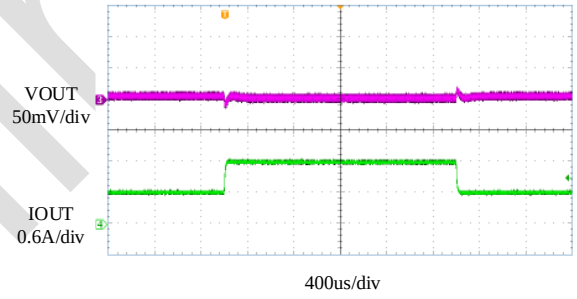
Load Transient

I_{OUT}=0A to 0.6A, 1A/μs



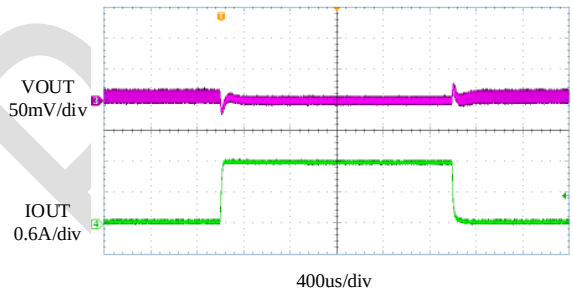
Load Transient

I_{OUT}=0.6A to 1.2A, 1A/μs



Load Transient

I_{OUT}=0A to 1.2A, 1A/μs



OPERATION

The M0522-C is a dual 1.2A synchronous step-down switching mode Power SoC with integrated high-side and low-side power MOSFETs and inductor in an LGA-17 package.

The M0522-C works on COT control mode that offers excellent transient response. M0522-C can provide excellent light load efficiency with Power Saving Mode, and the switching frequency is fixed at 1.4MHz.

Fully integrated protection features include OCP, OVP, UVP, OTP. The protection function details are shown below. M0522-C has a typical 10Ω discharge resistor internally which helps the output current drop down quickly when shutdown.

OVER CURRENT PROTECTION (OCP)

M0522-C has a valley current-limit. If the sensed inductor current reaches the valley current limit, the M0522-C will enter over-current protection mode, and the High Side MOSFET will not be allowed to turn on until the inductor current falls to valley current limit threshold. Meanwhile the M0522-C will start 512 cycles current limit mode. After the 512 cycle ends, M0522-C will enter hiccup mode to restart the part periodically.

OVER TEMPERATURE PROTECTION (OTP)

M0522-C will stop switching when the junction temperature exceeds 150 ℃. The device will power up again when the junction temperature drops below 130℃.

USER GUIDE

Output Voltage

The output voltage is programmed by the external feedback resistor divider as the typical application circuit on Page 1. The bottom feedback resistor R_2 can impact the loop stability, so its recommended value is 2kΩ. The Top feedback resistor R_1 can be calculated as:

$$R_1 = \left(\frac{V_{OUT1}}{V_{FB1}} - 1\right) \times R_2$$

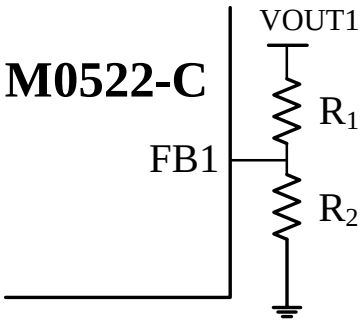


Figure 1: Typical FB Connection of M0522-C

Table 1 lists the recommended feedback resistor values for common output voltages.

Table 1: FB Resistor Values for Common Output Voltages

P/N	V_{OUT} (V)	R_1 (kΩ)	R_2 (kΩ)
M0522-C	1	1.33	2
	1.2	2	2
	1.8	4.02	2
	3.3	9.1	2

Input Capacitor Selection

The input current of the step-down converter is discontinuous with sharp edges, therefore putting filter capacitors is necessary. For better performance, low ESR ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their lowest temperature variations. The RMS current of the input capacitors is calculated:

$$I_{CIN\_RMS} = I_{OUT} \cdot \sqrt{D(1-D)}$$

in which D is the Duty Cycle and when the current is continuous, $D=V_{OUT}/V_{IN}$; I_{OUT} is the output load current.

As the equation above, when D is 0.5, the highest RMS current is approximately:

$$I_{CIN\_RMS} = \frac{I_{OUT}}{2}$$

So, it is recommended to choose the capacitors with the RMS current rating higher than 1/2 I_{OUT}.

The power dissipation on the input capacitors can be estimated with the RMS current and the ESR resistance.

Electrolytic or tantalum capacitors can also be used. The input voltage ripple caused by the capacitors can be calculated as:

$$\Delta V_{CIN} = \frac{I_{OUT}}{F_{SW} \cdot C_{IN}} \cdot \frac{V_{OUT}}{V_{IN}} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

in which, F_{SW} is switching frequency.

Output Capacitor Selection

Output capacitors are required to keep output voltage stable. To minimize the output voltage ripple, low ESR ceramic capacitors should be used. The output voltage ripple can be estimated as:

$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \cdot F_{SW}^2 \cdot C_{OUT} \cdot L} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

In which, L=1.5μH.

If electrolytic or tantalum capacitors are used, the ESR will dominate the output voltage ripple as:

$$\Delta V_{OUT} = R_{ESR} \cdot \frac{V_{OUT}}{F_{SW} \cdot L} \cdot \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

Enable Control

When the input voltage is higher than UVLO threshold (2.2V typically), the M0522-C can be enabled or disabled by EN Pin. Give a voltage higher than 1.2V, the M0522-C will be enabled, pull down (<0.4V) or float EN pin, the M0522-C will be disabled.

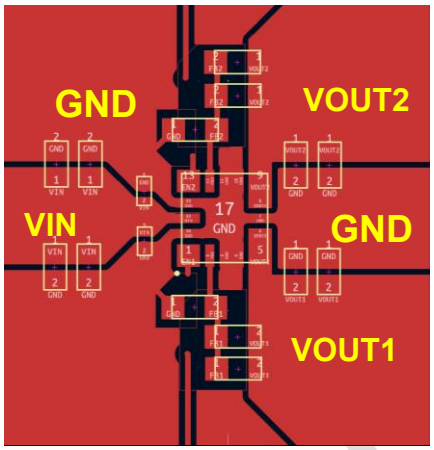
When floating, EN pin is internally pulled down to GND so the chip is disabled. There is an internal resistor about 2MΩ from EN to ground.

PCB Layout Guide

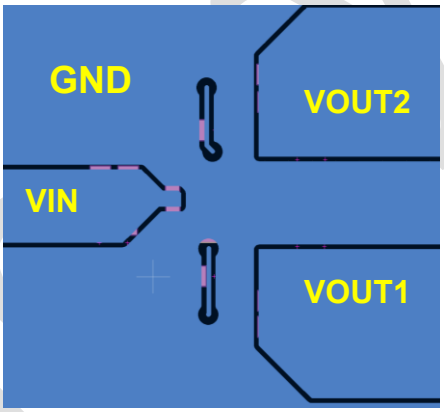
To optimize the electrical and thermal performance, some PCB layout guidelines should be considered as below:

1. Use wide trace for the high current paths and keep it as short as possible. It helps to minimize the PCB conduction loss and thermal stress.
2. Place the input decoupling capacitor close to VIN and GND.
3. Connect all feedback network to FB shortly.
4. The GND should be connected to a strong ground plane for better heat dissipation and noise protection.

Figure 2 gives a good example of the recommended layout.



(a) Top Layer



(b) Bottom Layer

Figure 2. Recommended Layout

TYPICAL APPLICATION

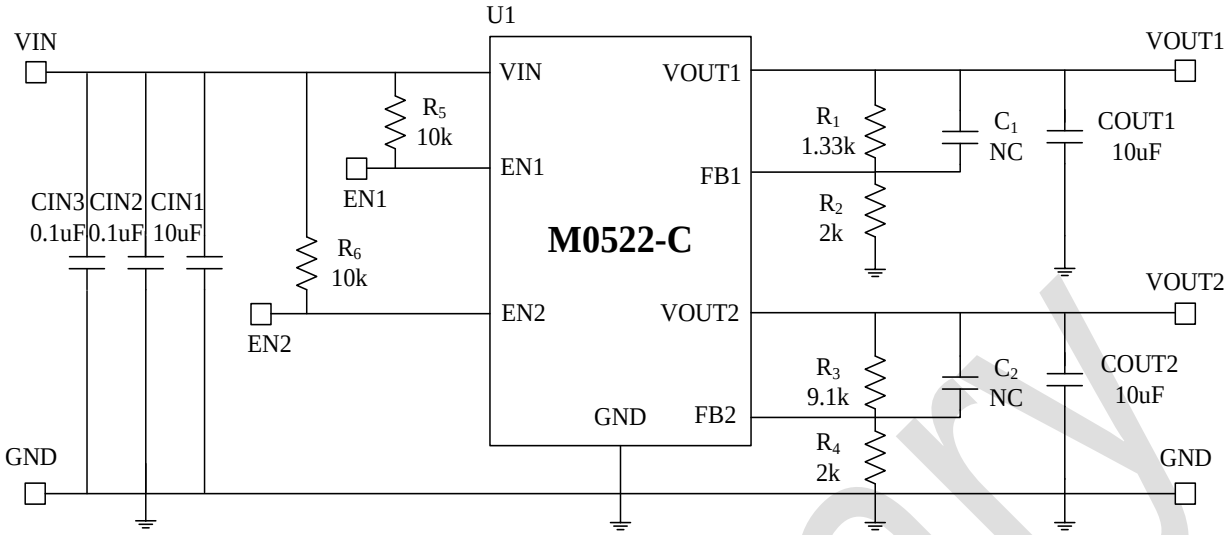


Figure 3. Typical Application Circuits of M0522-C for 1V & 3.3V Output

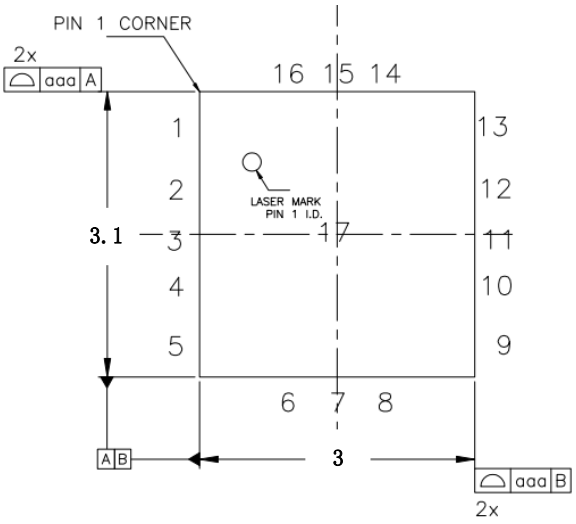
Table 2: M0522-C Reference Design for Typical Positive Output

VOUT	CIN	COUT	R1（kΩ）	R2(kΩ)
1V	1×10uF	1×10uF	1.33	2
1.2V	1×10uF	1×10uF	2	2
1.8V	1×10uF	1×10uF	4	2
3.3V	1×10uF	1×10uF	9.1	2

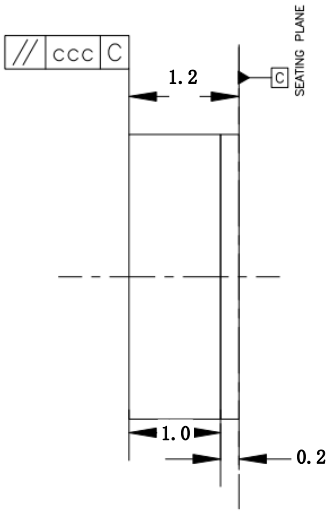
PACKAGE INFORMATION

LGA-17 (3mm×3.1mm×1.2mm) Package

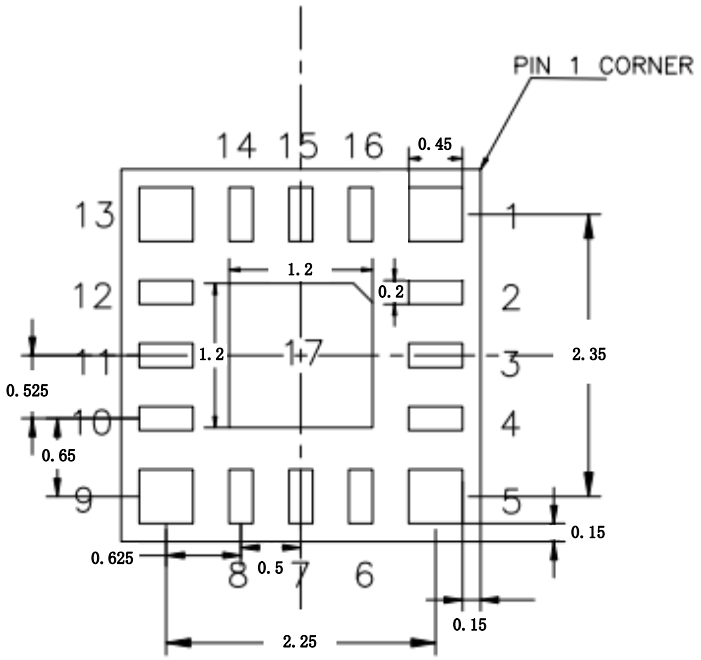
TOP VIEW



SIDE VIEW

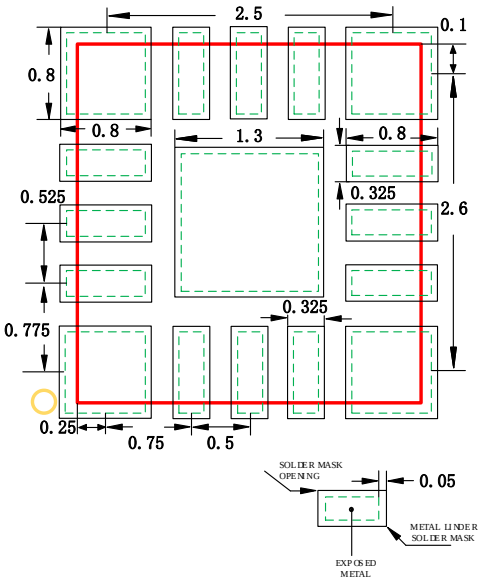


BOTTOM VIEW



RECOMMENDED LAND PATTERN

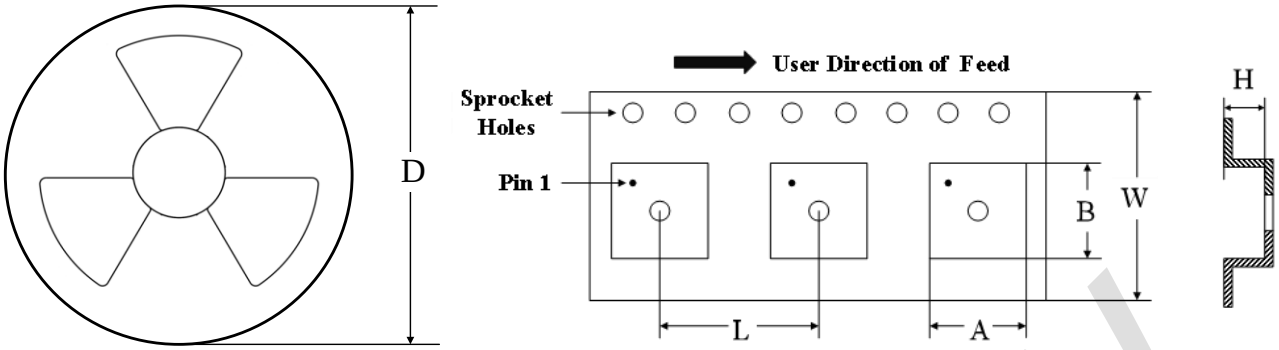
Prefer Solder Mask Defined



NOTES:

All dimensions are in MM.

CARRIER INFORMATION



PART NUMBER	PACKAGE	QUANTITY /REEL	D	A	B	L	W	H
M0522DLFA-C	LGA-17 (3mm×3.1mm×1.2mm)	1000	13 in	4.3mm	6.3mm	12mm	16mm	2.12mm

REVISION HISTORY

REVISION	DATE	RECORD
Rev.0.8	2024/09	Modify the number of MOQs