LTC3126UFD
42V, 2.5A Synchronous Step-Down Regulator with Lossless PowerPath

DESCRIPTION

Demonstration Circuit 2215A, features the LTC®3126, a synchronous buck converter with an integrated lossless input PowerPath™. Pin selectable (JP2) ideal diode-OR and priority input modes, with programmable undervoltage lockout thresholds provide control over the transition between input sources. The unique all N-channel architecture provides efficient operation from either of two input sources to a programmable output voltage. In this application the valid input voltage range is set to be from 4.3V to 42V on V_{IN1} and from 6V to 8.4V on V_{IN2} providing flexibility and voltage margin for a variety of applications and power sources. V_{IN2} can operate to 42V. Other input voltage ranges are possible by adjusting $V_{SET1/2}$ accordingly.

The LTC3126 uses a low noise, current mode architecture and a resistor programmable (R13) PWM oscillator frequency which is also synchronizable from 200kHz to 2.2MHz. This minimizes the solution footprint while ensuring high efficiency. For higher efficiency at light loads, the user can select Burst Mode® operation (JP1).

Typical efficiencies for both PWM mode (JP1 = PWM) and Burst Mode operation (JP1 = BURST) are shown in Figure 1. Burst Mode operation allows the automatic transition to PWM operation if the load current increases. This is shown in Figure 5. More information on Burst Mode operation and PWM mode can be found in the data sheet.

In some applications the efficiency can be improved by setting the $EXTV_{CC}$ jumper (JP3) to V_{OUT}. This allows the converter to operate from the fixed V_{OUT} voltage. Typical performance in response to a transient load is shown in Figure 4.

The system can be monitored through $\overline{VALID1}$, $\overline{VALID2}$, $\overline{PRIORITY}$ and PGOOD indicators. There are accurate V_{SET1} and V_{SET2} comparators to program independent UVLO thresholds. Consult the data sheet for information on start-up and shutdown thresholds. Other features include a 1µA shut-down current (ENA pin JP4 = OFF), short-circuit protection, soft-start, inductor current limit and thermal overload protection.

The LTC3126 data sheet has detailed information about the operation, specifications, and applications of the part.

The data sheet should be read in conjunction with this Quick Start Guide.

Design files for this circuit board are available at http://www.linear.com/demo/DC2215A

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Input Voltage Range V_{IN1}	4.3V to 42.0V
Input Voltage Range V_{IN2}	6.0V to 8.4V (Operational to 42V)
V_{OUT}	3.3V
I_{OUT}	2.5A

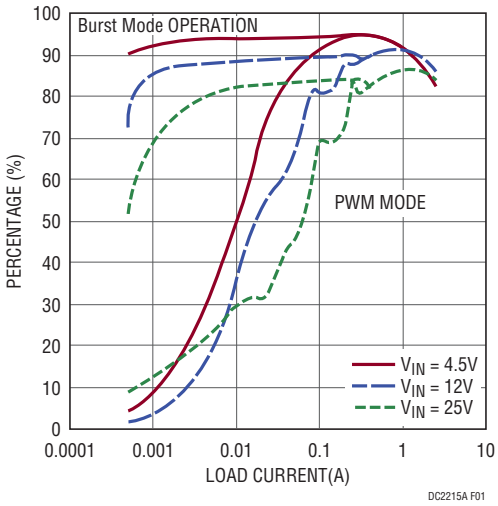


Figure 1. Typical Efficiency as a Function of Input Voltage and Load Current

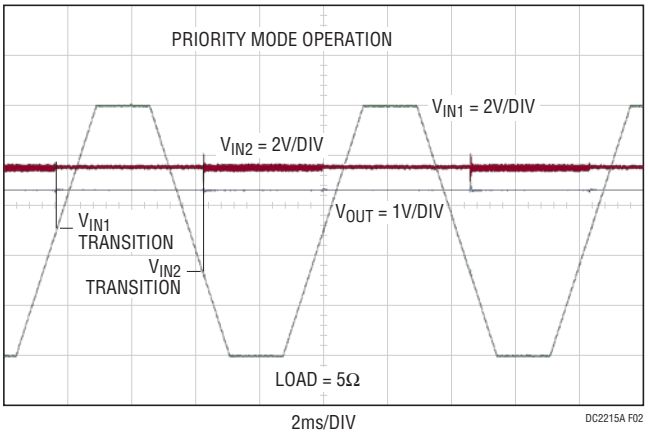


Figure 2. Demonstration of Priority Operation Where the Source of the Converter's Power Is Switched to V_{IN1} When V_{IN1} Exceeds the Preset Threshold

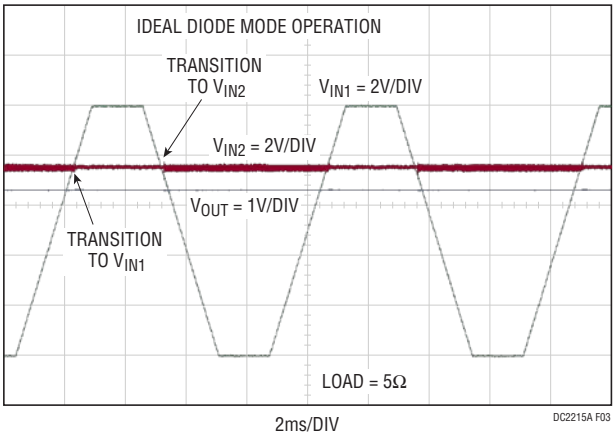


Figure 3. The LTC3126 Monitors the Voltage on V_{IN1} and V_{IN2} and Selects the Higher of These Voltages in Ideal Diode

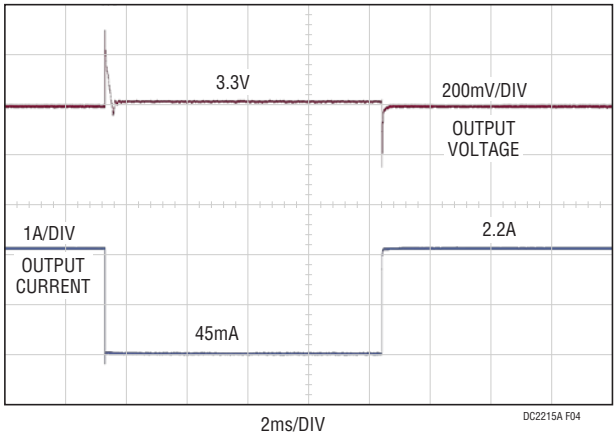


Figure 4. Typical 2.2A to 45mA to 2.2A Load Transient on a 3.3V Output with V_{IN} = 12V

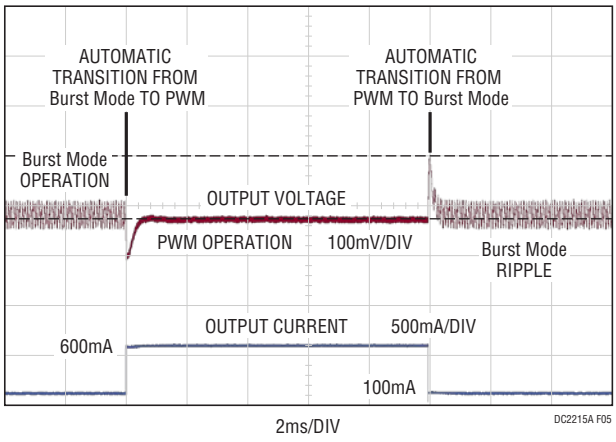


Figure 5. Output Ripple and Transients in Burst Mode Operation and Transitioning from and into Burst Mode Operation

QUICK START PROCEDURE

Using short twisted pair leads for any power connections and with all loads and power supplies off, refer to Figure 6 for the proper measurement and equipment setup. The power supplies should not be connected to the circuit until told to do so in the procedure below.

When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe.

The indicators for $\overline{\text{PRIORITY}}$, $\overline{\text{VALID1}}$ and $\overline{\text{VALID2}}$ are negative logic while the indicator for PGOOD is positive logic. PGOOD indicates the output voltage is good if it is pulled to V_{CC} and $\overline{\text{VALID1}}$ and $\overline{\text{VALID2}}$ indicate that the input voltage on the respective sources are good if the pins are pulled to ground. With the unit enabled (JP4, (ENA = ON) and JP2 (DIODE = $\overline{\text{PRIORITY}}$)) the unit is operating in PRIORITY mode. This means that if there is enough voltage on V_{IN1} then V_{IN1} will be supplying power to the converter independent of the voltage on V_{IN2} and $\overline{\text{VALID1}}$ will be low.

If JP2 (DIODE) is connected to IDEAL DIODE the unit is operating in IDEAL DIODE mode and power will be drawn from whichever source has enough voltage to be enabled and is the higher voltage. Both $\overline{\text{VALID1}}$ and $\overline{\text{VALID2}}$ will be low if V_{IN1} and V_{IN2} are above their operating thresholds.

Turrets

Left side of board:

V_{IN1}: 4.3V to 42V supply input: do not exceed +42V.

GND: Ground connection for input supply.

V_{IN2}: 6V to 8.4V supply input: operational to +42V.

Right side of board:

GND: Ground connection for LOAD.

V_{OUT}: 3.3V/2.5A first of two terminals in parallel.

V_{OUT}: 3.3V/2.5A second of two terminals in parallel.

GND: Ground connection for LOAD.

Jumpers

JP1/PWM/SYNCH: Selects PMW or Burst Mode operation. Leaving the jumper open and applying a square wave signal to the SYNC pin allows the converter to be synchronized. Default position is PWM which puts the unit in fixed frequency PWM operation.

JP2/DIODE: Selects PRIORITY or DIODE-OR mode.

JP3/$EXTV_{CC}$: connects $EXTV_{CC}$ to V_{OUT} through a diode or leaves $EXTV_{CC}$ open. If $EXTV_{CC}$ is open, the LTC3126 derives bias from V_{IN}. The default position is V_{OUT}.

JP4/ENA: Selects ENA = ON/OFF. The default position is "ON".

1. JP1 through JP4 settings to start:

JP1	PWM/SYNC	=	PWM
JP2	DIODE	=	$\overline{\text{PRIORITY}}$
JP3	EXTVcc	=	VOUT
JP4	ENA	=	ON

2. With the power supplies (V_{IN1}, V_{IN2}) OFF connect them as shown in Figure 6. If accurate current measurements are desired (for efficiency calculations for example) then connect the ammeters in series with the supplies as shown. The ammeters, however, are not required.
3. Connect the load, set at 5Ω, (660mA) to V_{OUT} as shown in Figure 6. Again, connect an ammeter if accurate current measurement or monitoring is desired.
4. Turn on the Power Supply, V_{IN1}, and increase the voltage. The converter will start at approximately 4.3V.
5. Verify V_{OUT} is ~3.3V.
6. V_{IN1} can now be varied between 4.3V and 42V. V_{OUT} will remain in regulation for load currents up to 2.5A.
7. Set V_{IN1} to 0V and turn off V_{IN1}.

QUICK START PROCEDURE

8. Repeat steps 4 to 6 with V_{IN2}. With V_{IN1} off increase V_{IN2} from 0V to 8.4V. The part will turn on when V_{IN2} is approximately 6V. Once on, V_{IN2} can be varied between 6V and 8.4V. 8.4V symbolizes a 2-cell Li-Ion battery range. However, V_{IN2} is rated for operation up to 42V.
9. Set the load to 5.0Ω (660mA).
10. Set V_{IN2} to 7.5V and turn on V_{IN1} slowly increasing the V_{IN1} voltage from 0V to 10V. Note that V_{IN1} starts to supply the power as the voltage of V_{IN1} exceeds its turn on set point of 4.3V (see Figure 2).
11. By adjusting the voltage on V_{IN1} from 10V to 0V and back the converter operates from V_{IN1} while V_{IN1} is above approximately 4.3V and when V_{IN1} is below approximately 4.2V it operates from $V_{IN2.}$ (See Figure 2).
12. Change JP2 to “DIODE”. By adjusting the voltage on V_{IN1} from 10V to 0V and back the converter operates from V_{IN1} while V_{IN1} is above approximately 7.5V and from V_{IN2} when V_{IN1} is below approximately 7.5V. (See Figure. 3).

QUICK START PROCEDURE

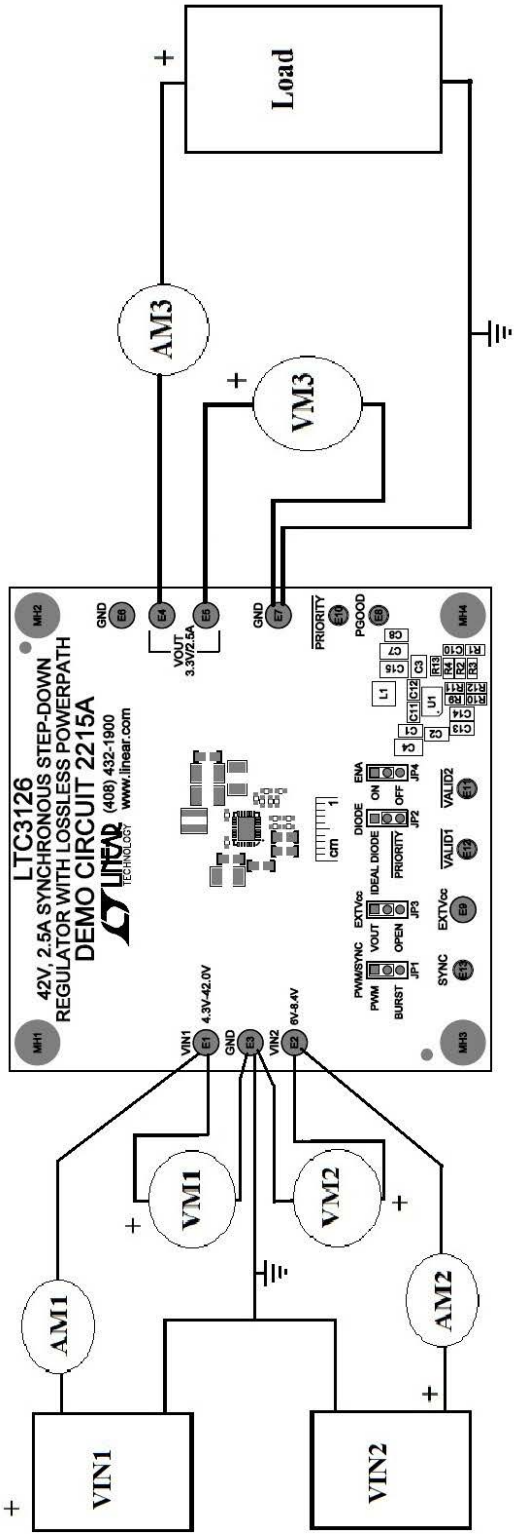
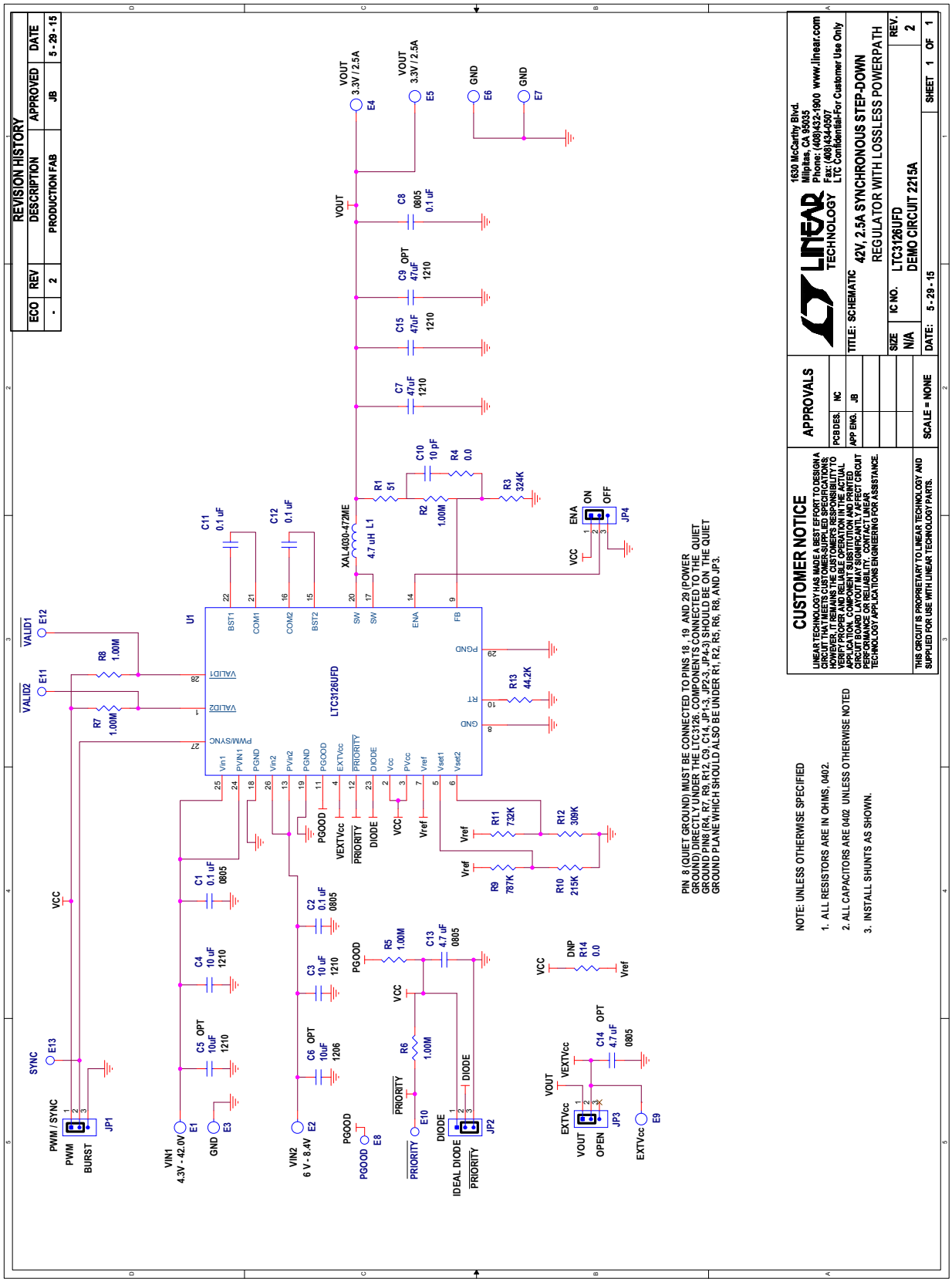


Figure 6. Measurement Setup

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, C2, C8	CAP CER 0.1µF 50V 10% X7R 0805	MURATA, GRM21BR71H104KA01L
2	2	C3, C4	CAP CER 10µF 50V 10% X7R 1210	MURATA, GRM32ER71H106KA12L
3	2	C7, C15	CAP CER 47µF 10V 10% X7R 1210	MURATA, GRM32ER71A476KE15L
4	1	C10	CAP CER 10pF 50V 5% NP0 0402	MURATA, GRM1555C1H100JA01D
5	2	C11, C12	CAP CER 0.1µF 16V 10% X7R 0402	MURATA, GRM155R71C104KA88D
6	1	C13	CAP CER 4.7µF 10V 10% X7R 0805	MURATA, GRM21BR71A475KA73K
7	1	L1	INDUCTOR, 4.7µH	COILCRAFT, XAL4030-472ME
8	1	R1	RES 51Ω 1% 1/10W 0402	PANASONIC, ERJ-2RKF51R0X
9	5	R2, R5, R6, R7, R8	RES 1MΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF1004X
10	1	R3	RES 324kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF3243X
11	1	R4	RES 0Ω 1% JUMPER 1/10W 0402	PANASONIC, ERJ-2GE0R00X
12	1	R9	RES 787kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF7873X
13	1	R10	RES 215kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF2153X
14	1	R11	RES 732kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF7323X
15	1	R12	RES 309kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF3093X
16	1	R13	RES 44.2kΩ 1% 1/10W 0402	PANASONIC, ERJ-2RKF4422X
17	1	U1	42V, 2.5A SYNCHRONOUS BUCK WITH LOSSLESS POWERPATH	LINEAR TECH;, LTC3126EUFD #TRBPF
Additional Demo Board Circuit Components				
18	0	C5, C6	CAP CER 10µF 50V 10% X7R 1210	MURATA, GRM32ER71H106KA12L
19	0	C9	CAP CER 47µF 10V 10% X7R 1210	MURATA, GRM32ER71A476KE15L
20	0	C14	CAP CER 4.7µF 10V 10% X7R 0805	MURATA, GRM21BR71A475KA73K
21	0	R14	RES 0Ω 1% JUMPER 1/10W 0402	PANASONIC, ERJ-2GE0R00X
Hardware: For Demo Board Only				
22	8	E1-E7, E9	TURRET, 0.09 DIA	MILL-MAX, 2501-2-00-80-00-00-07-0
23	5	E8, E10-E13	TURRET, 0.061 DIA	MILL-MAX, 2308-2-00-80-00-00-07-0
24	4	JP1, JP2, JP3, JP4	JMP, 3-PIN 1 ROW .079CC	Wurth Elektronik, 62000311121
25	4	XJP1, XJP2, XJP3, XJP4	SHUNT, .079" CENTER	Wurth Elektronik, 60800213421
26	4	STAND OFF	STAND-OFF, NYLON 0.375" TALL	Wurth Elektronik, 702933000

SCHEMATIC DIAGRAM



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