

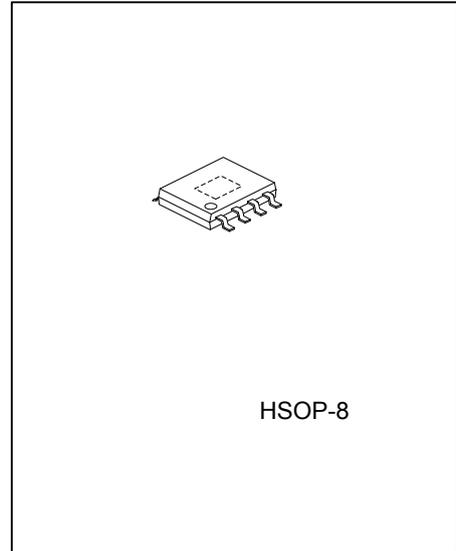


## LXXLD15

Preliminary

CMOS IC

### 0.8V REFERENCE ULTRA LOW DROPOUT LINEAR REGULATOR



#### DESCRIPTION

The UTC **LXXLD15** is a typical LDO with the feature of very low dropout voltage as low as 0.2V at output current 1.5A.

For normal operation, two supply voltages are necessary. One called control voltage from other equipment can shutdown the output voltage and it should pull and hold the voltage of EN pin less than 0.3V. Another one is the main supply voltage whose purpose is for main power conversion to keep the power dissipation low and to make the dropout voltage lower.

Internally, in the UTC **LXXLD15**, there're many functions which can be seen in the block figure to prevent the IC from being damaged. Internal Power-On-Reset (POR) circuit can control the two supply voltages to prevent fault operations of the circuit. And the thermal shutdown circuit is able to protect the device from over thermal operation and a current limit function will keep the device work safely under current over-load.

The UTC **LXXLD15** can be used as an ideal to provide well supply voltage in the applications, such as front-side-bus termination on motherboard, NB applications, front side bus  $V_{TT}$  (1.2V/1.5A) and note book PC applications.

#### FEATURES

- \* Low Dropout  $V_D=0.2V$  (typ.) @  $I_{OUT}=1.5A$
- \* Low ESR Output Capacitor
- \*  $V_{REF}=0.8V$
- \*  $\pm 1.5\%$  over Line, Load and Temperature Output Accuracy
- \* Fast Transient Response
- \* Output Voltage Adjustable through External Resistors
- \* POR (Power-On-Reset) controlling  $V_{CNTL}$  and  $V_{IN}$
- \* With internal Soft-Start
- \* Internal Current Limit Protection
- \* Internal Under Voltage Protection
- \* Hysteretic Thermal Shutdown
- \* With Power-OK Output (with a Delay Time)
- \* For Standby or Suspend Mode: Shutdown

#### ORDERING INFORMATION

| Ordering Number |                | Package | Packing   |
|-----------------|----------------|---------|-----------|
| Lead Free       | Halogen Free   |         |           |
| LXXLD15L-SH2-R  | LXXLD15G-SH2-R | HSOP-8  | Tape Reel |

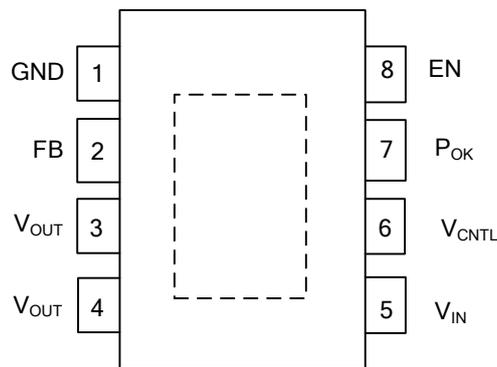
Note: XX: Output Voltage, refer to Marking Information.

|                       |   |   |
|-----------------------|---|---|
| <p>LXXLD15L-SH2-R</p> | <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Lead Free</p> <p>(4) Output Voltage Code</p> | <p>(1) R: Tape Reel</p> <p>(2) SH2: HSOP-8</p> <p>(3) G: Halogen Free, L: Lead Free</p> <p>(4) XX: refer to Marking Information</p> |
|-----------------------|---|---|

MARKING INFORMATION

| PACKAGE | VOLTAGE CODE | MARKING |
|---------|--------------|---------|
| HSOP-8  | AD :ADJ      |         |

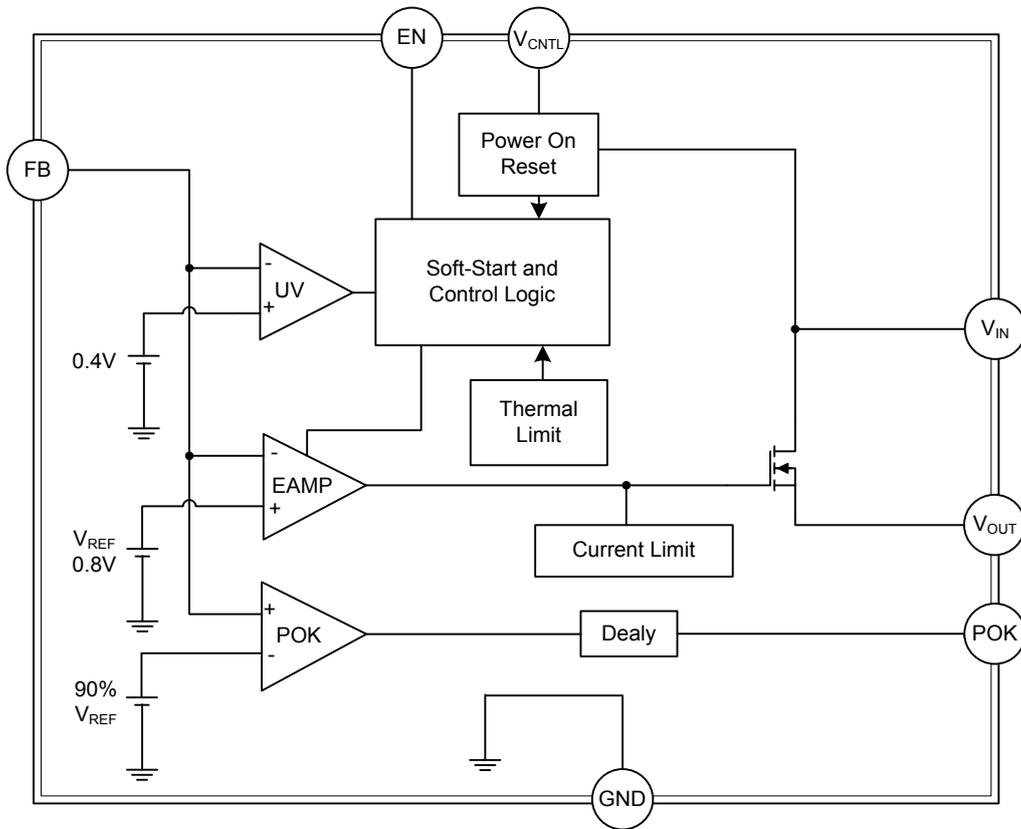
PIN CONFIGURATION



PIN DESCRIPTION

| PIN NO. | PIN NAME    | DESCRIPTION   |
|---------|-------------|---|
| 1       | GND         | Ground pin.   |
| 2       | FB          | There's an external resistor divider connected to this pin which is necessary to give the feedback voltage to the regulator. The external circuit is combined as the follow: between $V_{OUT}$ and FB is $R1$ (connected with a bypass capacitor which can improve the load transient response),and between FB and ground is $R2$ .The value of $R2$ and $R1$ are recommended between $100\Omega\sim 10k\Omega$ .So the output voltage is equals:<br>$V_{OUT}=0.8\cdot(1+\frac{R1}{R2})(V)$ |
| 3       | $V_{OUT}$   | The output voltage pin of the regulator. There should be set an output capacitor to compensate for closed-loop and also to improve transient responses. It's necessary to connect Pin 3 and Pin 4 together by wide tracks.  |
| 4       | VOUT        |   |
| 5       | $V_{IN}$    | This pin is the main supply input.<br>It's necessary to connect the Exposed Pad and $V_{IN}$ together for lower dropout voltage. Monitoring this pin's voltage can reset Power-On.  |
| 6       | $V_{CNTRL}$ | Power input pin of the control circuitry. Connecting this pin to a +5V (recommended) supply voltage provides the bias for the control circuitry. The voltage at this pin is monitored for Power-On Reset purpose.   |
| 7       | POK         | Output pin for Power-OK signal output.<br>Being an open drain output, through senescing FB voltage, this pin can show the users the output voltage's states. That's this pin will be low under any of these two situations: the rising FB voltage is not above the $V_{POK}$ threshold; the falling FB voltage is below the $V_{PNOK}$ threshold. That indicates the output voltage is not ready for users.   |
| 8       | EN          | Input Enable control pin. The output voltage can be shut down when this pin is below 0.3V. This pin's voltage can be set higher than $V_{CNTRL}$ voltage by an internal $10\mu A$ current source, and then the regulator will begin working normally.   |

■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

| PARAMETER                              | SYMBOL     | RATINGS               | UNIT |
|--|------------|-----------------------|------|
| Supply Voltage ( $V_{CNTL}$ to GND)    | $V_{CNTL}$ | -0.3 ~ +7             | V    |
| Supply Voltage ( $V_{IN}$ to GND)      | $V_{IN}$   | -0.3 ~ +3.9           | V    |
| EN and FB to GND                       | $V_{I/O}$  | -0.3 ~ $V_{CNTL}+0.3$ | V    |
| POK to GND                             | $V_{POK}$  | -0.3 ~ +7             | V    |
| Power Dissipation                      | $P_D$      | 2.8                   | W    |
| Lead Soldering Temperature, 10 Seconds | $T_{SDR}$  | 260                   | °C   |
| Junction Temperature                   | $T_J$      | 150                   | °C   |
| Storage Temperature                    | $T_{STG}$  | -65 ~ +150            | °C   |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ THERMAL CHARACTERISTICS

| PARAMETER                                | SYMBOL        | RATINGS | UNIT |
|--|---------------|---------|------|
| Junction to Ambient in Free Air (Note 1) | $\theta_{JA}$ | 44      | °C/W |
| Junction to Case (Note 2)                | $\theta_{JC}$ | 19      | °C/W |

Notes: 1.  $\theta_{JA}$  is measured with the component mounted on a high effective thermal conductivity test board in free air.

The exposed pad of HSOP-8 is soldered directly on the PCB.

2. The Thermal Pad Temperature is measured on the PCB copper area connected to the thermal pad of package.

### ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER            | SYMBOL               | RATINGS    | UNIT               |   |
|----------------------|----------------------|------------|--------------------|---|
| Supply Voltage       | Control              | $V_{CNTL}$ | 3.1 ~ 6            | V |
| Supply Voltage       | Input                | $V_{IN}$   | 1.1 ~ 3.5          | V |
| Output Voltage       | $V_{CNTL}=3.3\pm5\%$ | $V_{OUT}$  | 0.8 ~ 1.2          | V |
|                      | $V_{CNTL}=5.0\pm5\%$ |            | 0.8 ~ $V_{IN}-0.2$ | V |
| Output Current       | $I_{OUT}$            | 0 ~ 1.5    | A                  |   |
| Junction Temperature | $T_J$                | -40 ~ +125 | °C                 |   |

## ■ ELECTRICAL CHARACTERISTICS

(Refer to the typical application circuit. These specifications apply over,  $V_{\text{CNTL}} = 5\text{V}$ ,  $V_{\text{IN}} = 1.5\text{V}$ ,  $V_{\text{OUT}} = 1.2\text{V}$  and  $T_{\text{A}} = -40 \sim 85^{\circ}\text{C}$ , unless otherwise specified. Typical values refer to  $T_{\text{A}} = 25^{\circ}\text{C}$ ).

| PARAMETER                                | SYMBOL   | TEST CONDITIONS  | MIN   | TYP  | MAX  | UNIT               |
|--|--|--|-------|------|------|--------------------|
| $V_{\text{CNTL}}$ Nominal Supply Current | $I_{\text{CNTL}}$  | EN= $V_{\text{CNTL}}$ , $V_{\text{FB}}$ is well regulated  | 0.4   | 1    | 2    | mA                 |
| $V_{\text{CNTL}}$ Shutdown Current       | $I_{\text{SD}}$  | EN=GND   |       | 180  | 380  | $\mu\text{A}$      |
| POR Threshold                            | $V_{\text{THR}}$   | $V_{\text{CNTL}}$ Rising   | 2.7   | 2.9  | 3.1  | V                  |
|  |  | $V_{\text{IN}}$ Rising   | 0.8   | 0.9  | 1.0  | V                  |
| POR Hysteresis                           | $V_{\text{HYS}}$   |  |       | 0.4  |      | V                  |
|  |  |  |       | 0.5  |      | V                  |
| Reference Voltage                        | $V_{\text{REF}}$   | FB= $V_{\text{OUT}}$   |       | 0.8  |      | V                  |
| Output Voltage Accuracy                  |  | $I_{\text{OUT}}=0\text{A} \sim 1.5\text{A}$ , $T_{\text{J}} = -40 \sim 125^{\circ}\text{C}$  | -1.5  |      | +1.5 | %                  |
| Line Regulation                          | $\frac{\Delta V_{\text{OUT}}}{\Delta V_{\text{IN}} \times V_{\text{OUT}}}$ | $V_{\text{CNTL}}=3.3 \sim 5.5\text{V}$   | -0.13 |      | 0.13 | %/V                |
| Load Regulation                          | $\frac{\Delta V_{\text{OUT}}}{V_{\text{OUT}}}$                             | $I_{\text{OUT}}=0\text{A} \sim 1.5\text{A}$  |       | 0.06 | 0.15 | %                  |
| Dropout Voltage                          | $V_{\text{D}}$   | $V_{\text{CNTL}}=5\text{V}$ , $I_{\text{OUT}}=1.5\text{A}$ , $T_{\text{J}}=25^{\circ}\text{C}$ , $V_{\text{OUT}}=1.2\text{V}$            |       | 0.12 | 0.18 | V                  |
|  |  | $V_{\text{CNTL}}=5\text{V}$ , $I_{\text{OUT}}=1.5\text{A}$ , $T_{\text{J}}=25^{\circ}\text{C}$ , $V_{\text{OUT}}=2.5\text{V}$            |       | 0.17 | 0.23 | V                  |
|  |  | $V_{\text{CNTL}}=5\text{V}$ , $I_{\text{OUT}}=1.5\text{A}$ , $T_{\text{J}}=-40 \sim +125^{\circ}\text{C}$ , $V_{\text{OUT}}=1.2\text{V}$ |       |      | 0.25 | V                  |
|  |  | $V_{\text{CNTL}}=5\text{V}$ , $I_{\text{OUT}}=1.5\text{A}$ , $T_{\text{J}}=-40 \sim +125^{\circ}\text{C}$ , $V_{\text{OUT}}=2.5\text{V}$ |       |      | 0.3  | V                  |
| Current Limit                            | $I_{\text{LIM}}$   | $V_{\text{CNTL}}=5\text{V}$ , $T_{\text{J}}=25^{\circ}\text{C}$  | 2.1   | 2.8  | 3.5  | A                  |
|  |  | $V_{\text{CNTL}}=5\text{V}$ , $I_{\text{OUT}}=1.5\text{A}$ , $T_{\text{J}}=-40 \sim +125^{\circ}\text{C}$                                | 1.8   |      |      | A                  |
| Over Temperature Shutdown                | $O_{\text{TS}}$  | $T_{\text{J}}$ Rising  |       | 150  |      | $^{\circ}\text{C}$ |
| Over Temperature Hysteresis              | $O_{\text{TH}}$  |  |       | 50   |      | $^{\circ}\text{C}$ |
| Under-Voltage Threshold                  |  | $V_{\text{FB}}$ Falling  |       | 0.4  |      | V                  |
| EN Logic High Threshold Voltage          |  | $V_{\text{EN}}$ Rising   | 0.3   | 0.4  | 0.5  | V                  |
| EN Hysteresis                            |  |  |       | 30   |      | mV                 |
| EN Pin Pull-Up Current                   |  | EN=GND   |       | 10   |      | $\mu\text{A}$      |
| Soft-Start Interval                      | $T_{\text{SS}}$  |  |       | 2    |      | ms                 |
| POK Threshold Voltage for Power OK       | $V_{\text{POK}}$   | VFB Rising   | 90%   | 92%  | 94%  | $V_{\text{REF}}$   |
| POK Threshold Voltage for Power Not OK   | $V_{\text{PNOK}}$  | VFB Falling  | 79%   | 81%  | 83%  | $V_{\text{REF}}$   |
| POK Low Voltage                          |  | POK sinks 5mA  |       | 0.25 | 0.4  | V                  |
| POK Delay Time                           | $T_{\text{DELAY}}$   |  | 1     | 3    | 10   | ms                 |

## ■ APPLICATION INFORMATION

### 1. Power Sequencing

When there's no main voltage applied at  $V_{IN}$ , it is suggested not to apply a voltage to  $V_{OUT}$  for a long time. Because the internal parasitic diode (between  $V_{OUT}$  to  $V_{IN}$ ) will conduct and dissipate power, there's no protection.

### 2. Output Capacitor

A proper output capacitor to maintain stability and improve transient response over temperature and current is necessary. Proper ESR (equivalent series resistance) and capacitance of the output capacitor should be selected properly for stability of the normal operation and good load transient response.

Many kinds of capacitors can be used as an output capacitor, such as ultra-low-ESR capacitors (like ceramic chip capacitors), low-ESR bulk capacitors (like solid Tantalum, POSCap, and Aluminum electrolytic capacitors). And also the value of the output capacitors' can be increased without limit.

In the applications with large stepping load current, the low-ESR bulk capacitors are normally recommended.

Decoupling ceramic capacitors are recommended to be placed at the load and ground pins very closely and also the impedance of the layout must be minimized.

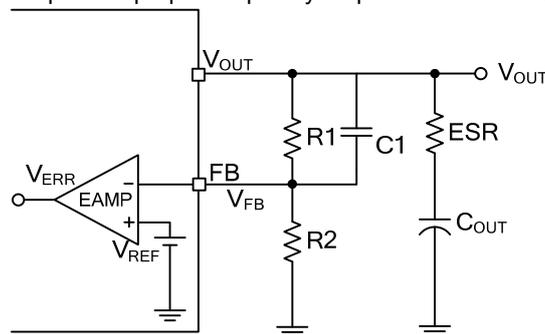
### 3. Input Capacitor

In order to prevent the input rail from dropping, the proper input capacitor to supply current surge during stepping load transients is required. Because the limited slew rate of the surge currents, more parasitic inductance needs more input capacitance.

Ultra-low-ESR capacitors ( $> 100\text{mF}$ ,  $\text{ESR} < 300\text{m}\Omega$ ) is recommended for the input capacitor.

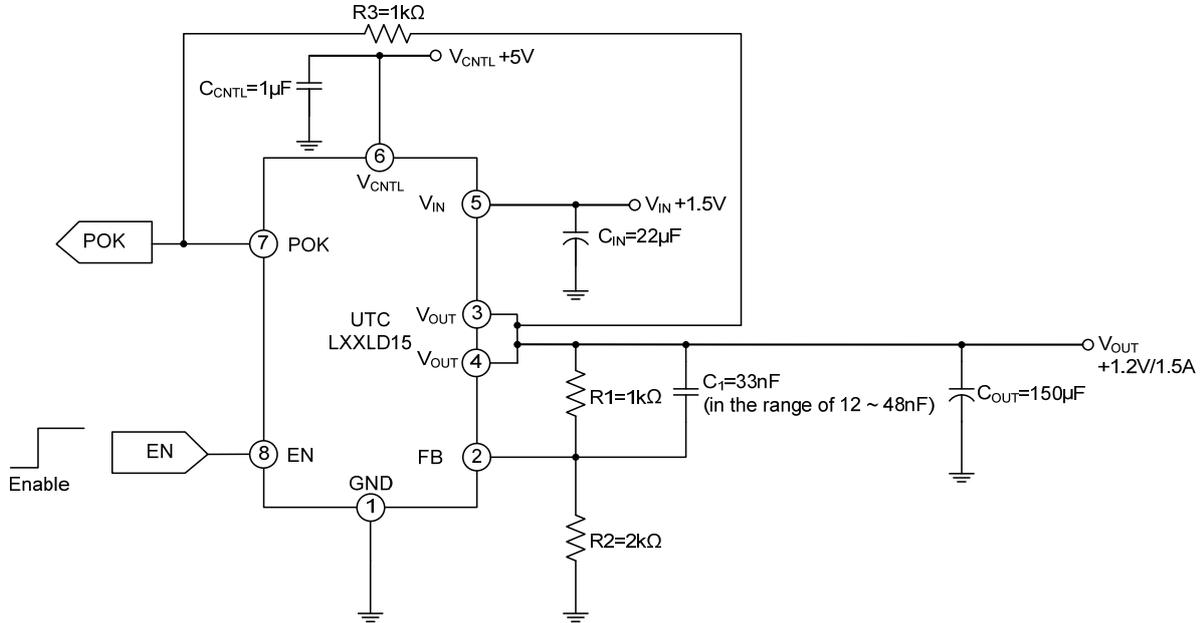
### 4. Feedback Network

The following figure shows the feedback network between  $V_{OUT}$  GND and FB pins. Working with the internal error amplifier, the feedback network can provide proper frequency response for the UTC LXXLD15.

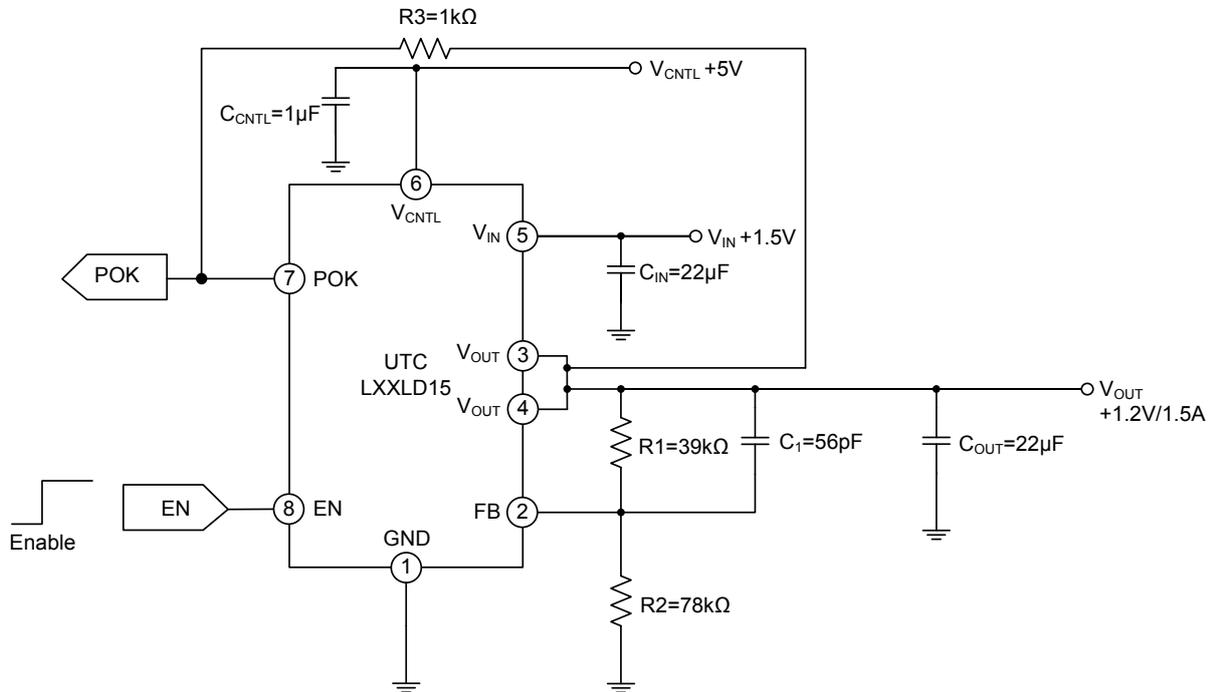


■ TYPICAL APPLICATION CIRCUITS

1. Using an Output Capacitor with  $ESR \geq 18m\Omega$



2. Using an MLCC as the Output Capacitor



| $V_{OUT}$ (V) | $R1$ (kΩ) | $R2$ (kΩ) | $C1$ (pF) |
|---------------|-----------|-----------|-----------|
| 1.05          | 43        | 137.6     | 47        |
| 1.5           | 27        | 30.86     | 82        |
| 1.8           | 15        | 12        | 150       |

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