

Wide Input Range Step-Down Synchronous DC/DC Converter

FEATURES

- P-MOS+N-MOS Switch Structure
- Wide Input Voltage: 4.5V to 30V
- Up to 3.5A Output Current Limit at 5V Output
- Constant Output Power for QC3.0
- High Efficiency up to 94%@5V/3A
- PFM mode in Light Load Condition
- 120kHz to 380kHz Adjustable Frequency
- Internal Compensation
- Output Line Drop Compensation
- Hiccup Output Short Current Protection
- 2.5% Feedback Voltage Accuracy
- Integrated Soft Start
- Thermal Shutdown
- Duty Cycle up to 100%
- Frequency Jitter for EMI Consideration
- Low BOM Cost
- SOP8 Package

GENERAL DESCRIPTION

TMI2283QE is a wide input voltage, high efficiency active CC step-down DC/DC converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. TMI2283QE provides up to total 3.5A output current limit at 5V output with floating ISET pin. Switching frequency can be set by external resistor. Maximum 100% duty cycle could be obtained. TMI2283QE internal integrate 45mΩ high side and 25mΩ low side power MOSFET. Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

APPLICATIONS

- Car Charger/ Adaptor
- Rechargeable Portable Devices
- General-Purpose CC/CV Power Suppliers

TYPICAL APPLICATION

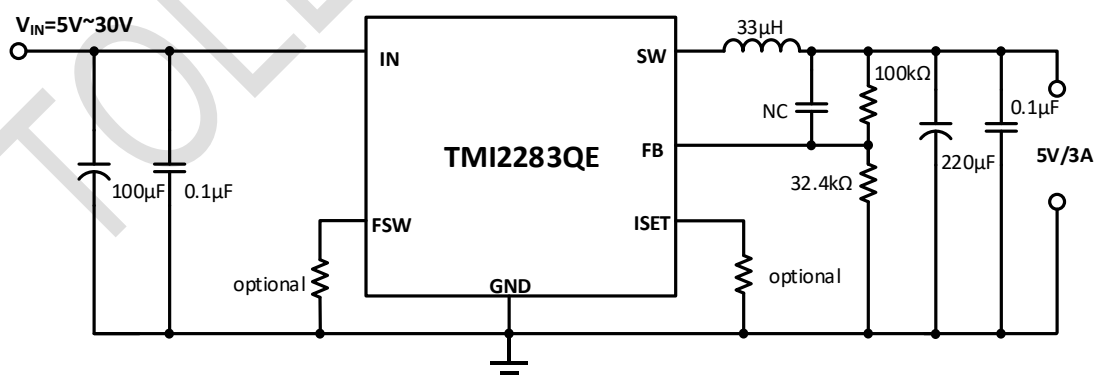


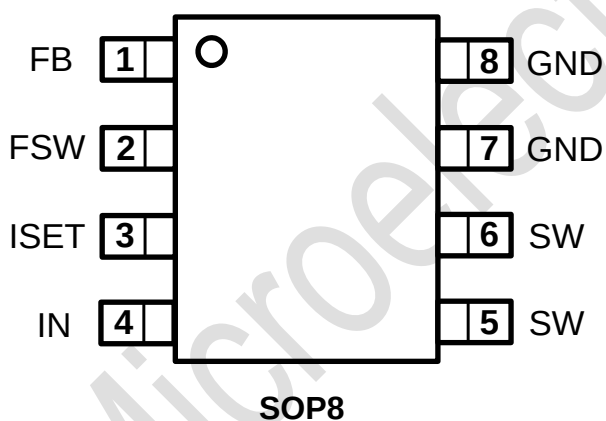
Figure 1. Basic Application Circuit

ABSOLUTE MAXIMUM RATINGS

Parameter	Value	Unit
Input Supply Voltage IN and SW	-0.3~33	V
All Other Pins Voltage Range	-0.3~6	V
Storage Temperature Range	-65~150	°C
Junction Temperature Range	-40~150	°C
Junction-to-ambient Thermal Resistance	60	°C/W
Junction-to-case Thermal Resistance	46	°C/W
Power Dissipation	2	W
Lead Temperature (Soldering, 10s)	260	°C

Over operating free-air temperature range (unless otherwise noted)

PACKAGE/ORDER INFORMATION



Top Mark: T2283QE/XXXXX (T2283QE: Device Code, XXXXX: Inside Code)

Part Number	Package	Top mark	Quantity/ Reel
TMI2283QE	SOP8	T2283QE XXXXX	3000

TMI2283QE devices are Pb-free and RoHS compliant.

PIN FUNCTIONS

Pin	Name	Function
1	FB	Feedback pin.
2	FSW	Switching Frequency set pin. Connected a resistor to ground. If FSW pin is floating: $F_s=120\text{kHz}$.
3	ISSET	Output current limit set pin. Connected a resistor to ground.
4	IN	Power input pin.
5	SW	Switch pin. Connected to external Inductor.
6		
7	GND	Ground.
8		

ESD RATING

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	± 2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Typ	Max	Unit
V_{IN}	IN Voltage Range	4.5		30	V
T_J	Operating Junction Temperature Range	-40		125	°C

ELECTRICAL CHARACTERISTICS(V_{IN}=12V, V_{OUT}=5V, T_A = 25°C, unless otherwise noted.)

Parameter	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		4.5		30	V
Input Voltage Surge				36	V
Input Over Voltage Protection Threshold			32		V
Under Voltage Lockout Threshold	V _{IN} rising		4.0		V
UVLO Hysteresis			0.16		V
Quiescent Current	V _{OUT} =5V, No load		0.8		mA
Feedback Voltage Accuracy		1.19	1.22	1.25	V
FB Pin input current		-50		50	nA
Soft Start Time			4		ms
Switching Current limit	Duty=50%		5		A
SW leakage				10	μA
Maximum Duty Cycle	F _s =130kHz			100	%
Switching Frequency	R _{FSW} =22kΩ		270		kHz
	FSW pin floating		120		kHz
Switch On-Resistance (high side)			45		mΩ
Switch On-Resistance (low side)			25		mΩ
Short circuit Frequency	V _{FB} =0V, FSW pin floating		40		kHz
Minimum On Time			150		ns
Thermal Shutdown Threshold	Guaranteed by design		160		°C
Thermal Shutdown Hysteresis	Guaranteed by design		20		°C

APPLICATION INFORMATION

TMI2283QE is a wide input voltage, high efficiency active CC step-down DC/DC converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. TMI2283QE provides up to total 3.5A output current limit at 5V output with floating ISET pin. In light load condition, TMI2283QE operates in PFM mode for better efficiency. Switching frequency can be set by external resistor. Maximum 100% duty cycle could be obtained. TMI2283QE internal integrate 45mΩ high side and 25mΩ low side power MOSFET. Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

Output Voltage Setting

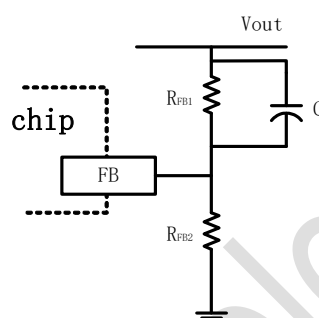


Figure 2. Output Voltage Setting

Figure 2 shows the connection for setting the output voltage. Select the proper ratio of the two feedback resistors R_{FB1} and R_{FB2} based on the output voltage. Adding a capacitor in parallel with R_{FB1} helps the system stability and transient response. Typically, use $R_{FB2} \approx 32.4k\Omega$ and determine R_{FB1} according to the following equation 1:

$$R_{FB1} = R_{FB2} \times \left(\frac{V_{OUT}}{1.22} - 1 \right) \quad (\text{Equation 1})$$

CC/CV Operation Mode and Short Circuits Protection

TMI2283QE operates in either CC mode or CV mode. In the CV mode, the output voltage is regulated and the output voltage is equal to the value set by feedback divider resistors R_{FB1} and R_{FB2} . When output current increases and reaches the CC current threshold set by external resistance on ISET pin to GND, the device enters into CC mode and output current is regulated and output voltage drops down with output current increasing. When output voltage drops until feedback voltage V_{FB} is below the output short voltage threshold V_{OS} which is about 0.765V (typical), TMI2283QE enters into hiccup mode to periodically disable and restart switching operation. The hiccup mode helps to reduce power dissipation and thermal rise during output short to GND condition. The period of TMI2283QE hiccup mode is about 475ms.

ISET Current Limit Calculation

The CC current limit threshold is set by the resistor connected between ISET pin and GND. To determine the proper resistor value for a desired output current limit threshold, please refer to the below Equation 2 for 5V output application:

$$I_{\text{LIM}} (\text{A}) = R_{\text{ISET}} (\text{k}\Omega) \times 0.0605 - 1.24 (\text{A}) \quad (\text{Equation 2})$$

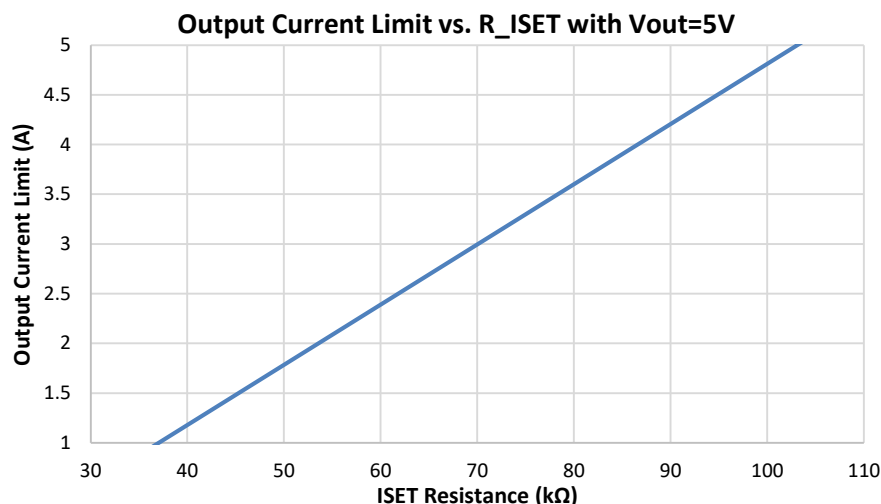


Figure 3. Output Current Limit vs. R_ISET with V_{OUT}=5V

If the ISET pin is floating, the default current limit threshold is typical 3.5A for 5V output voltage.

Constant Output Power

TMI2283QE has constant output power feature for QC3.0 application. It offers constant output power in different output voltage range which can minimizes charging time in real charger application. Figure 4 shows the curve of output voltage and typical output current capability with floating ISET pin.

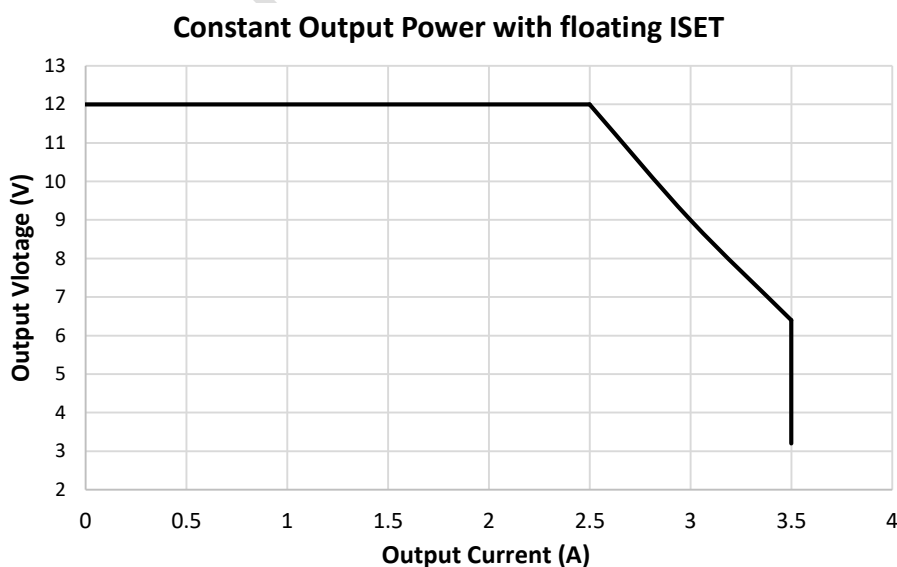


Figure 4. Constant Output Power with Floating ISET

For typical output voltage application condition $V_{OUT}=5V$, 9V and 12V, the below table shows typical output current limit value with floating ISET.

Output voltage	Typical Output Current Limit with floating ISET pin
5V	3.5A
9V	3.0A
12V	2.5A

Programmable Switching Frequency

The switching frequency of the device can be programmed by the resistor connected between FSW and GND. Figure 5 gives the curve of programmable switching frequency vs. resistance of R_{FSW} . If FSW pin is floating: $F_s=120kHz$ (typical).

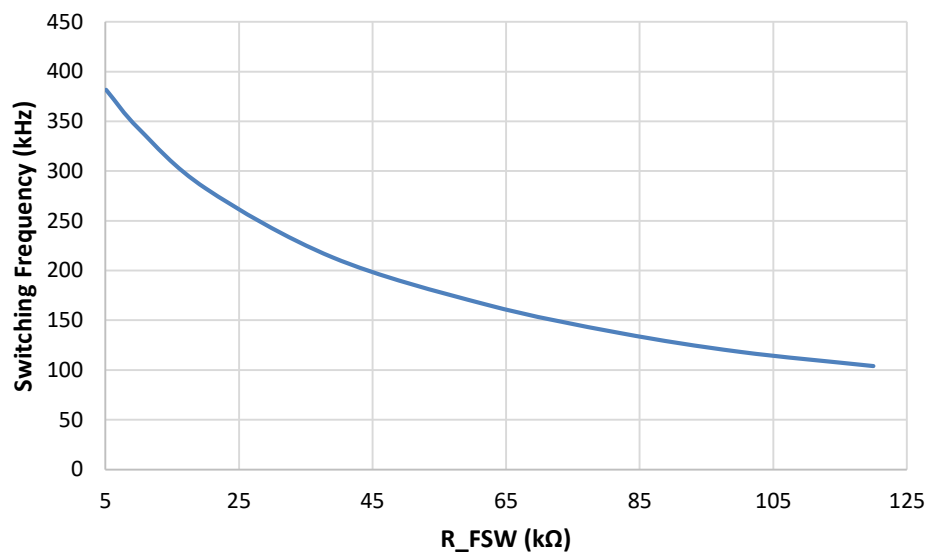


Figure 5. Switching Frequency vs. R_{FSW}

Programmable Output Line Drop compensation

TMI2283QE also provides programmable cable voltage drop compensation by using the impedance at the FB pin to compensate voltage drop across the charger's output cable line. The cable compensation voltage can be expressed as:

$$\Delta V_{OUT} (V) = 5.93 \times 10^{-7} \times I_{OUT} (A) \times R_{FB1} (\Omega) \quad (\text{Equation 3})$$

By adjusting the value of high side feedback divider resistor R_{FB1} , the cable compensation voltage can be programmed.

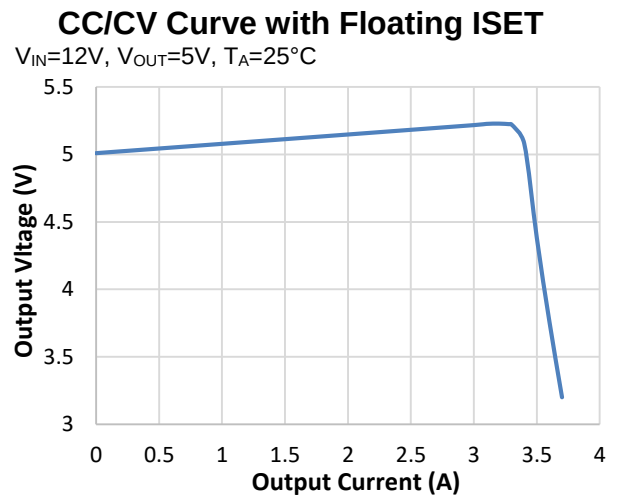
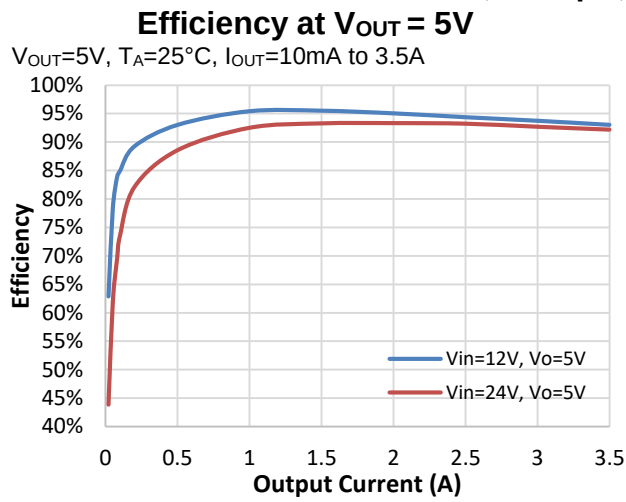
PC Board Layout Guidance

When laying out the printed circuit board, the Following checklist should be used to ensure proper operation of the IC.

- 1) Arrange the power components to reduce the AC loop size consisting of C_{IN} , IN pin, SW pin and the IC power GND.
- 2) Place input decoupling ceramic capacitor C_{IN} as close to IN pin as possible. C_{IN} is connected power GND with via or short and wide path.
- 3) Return FB to signal GND pin, and connect the signal GND to power GND at a single point for best noise immunity.
- 4) Place feedback resistor close to FB pin.

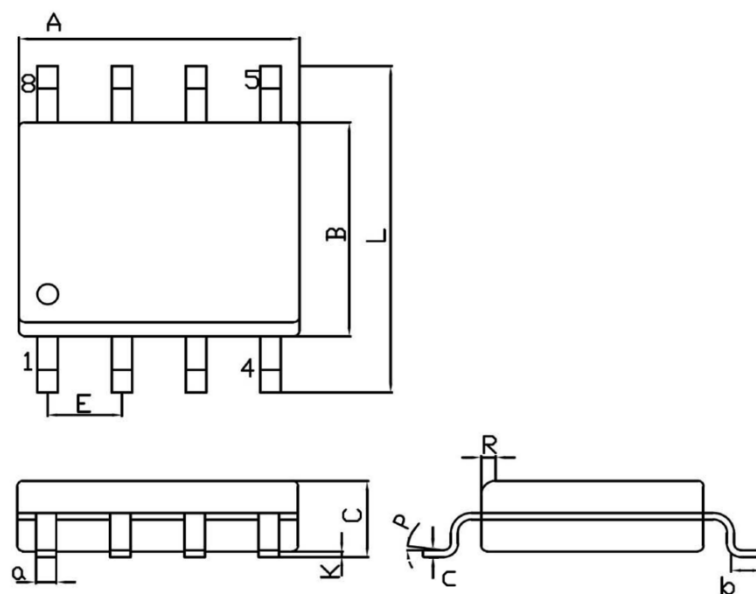
TYPICAL PERFORMANCE CHARACTERISTICS

Test condition: $V_{IN}=12V$, $V_{OUT}=5V$, $L=33\mu H$, $T_A=25^\circ C$, unless other noted.



PACKAGE INFORMATION

SOP8



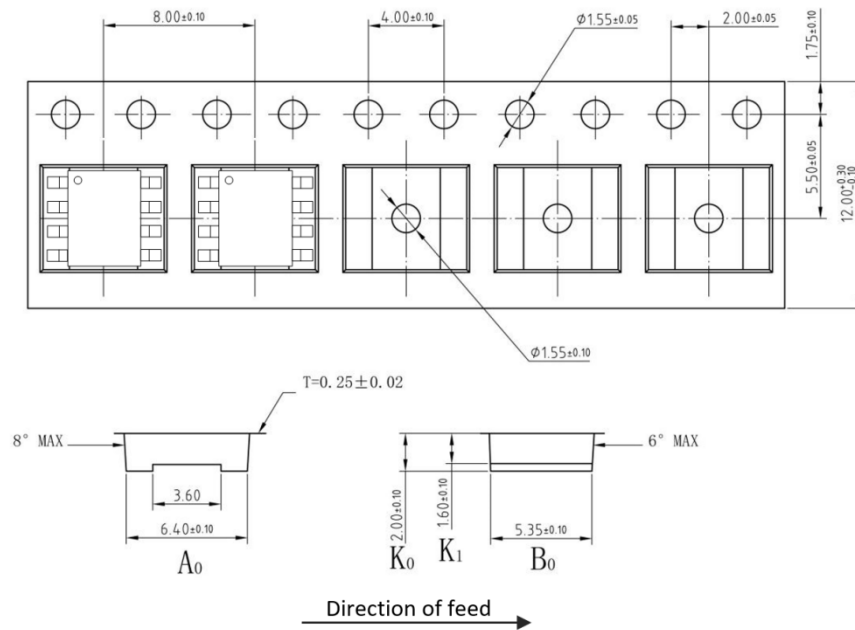
Unit: mm

Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
A	4.70	5.10	C	1.35	1.75
B	3.70	4.10	a	0.35	0.49
L	6.00	6.40	R	0.30	0.60
E	1.27 BSC		P	0°	7°
K	0.12	0.22	b	0.40	1.25
			c	0.203	0.243

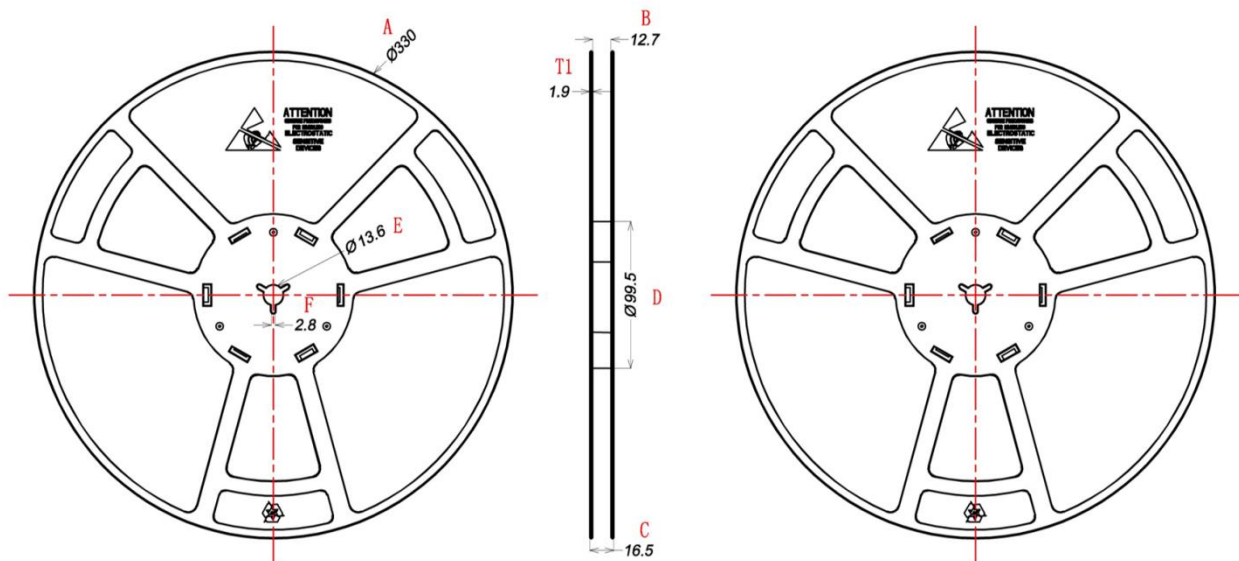
Note:

- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading top mark from left to right.

TAPE AND REEL INFORMATION

TAPE DIMENSIONS: SOP8

REEL DIMENSIONS: SOP8



Unit: mm

A	B	C	D	E	F	T1
Ø 330±1	12.7±0.5	16.5±0.3	Ø 99.5±0.5	Ø 13.6±0.2	2.8±0.2	1.9±0.2

Note:

- 1) All Dimensions are in Millimeter
- 2) Quantity of Units per Reel is 3000
- 3) MSL level is level 3.

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