



ON Semiconductor®

# FDMC0223S, FDMC0223S-P

## N-Channel Power Trench® SyncFET™

1.5 V, 14.8 A, 6.0 mΩ

### Features

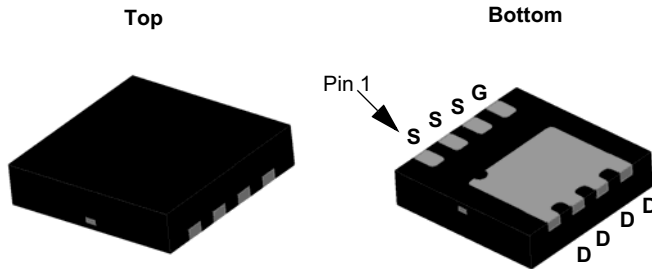
- Max  $r_{DS(on)}$  = 6.0 mΩ at  $V_{GS} = 10\text{ V}$ ,  $I_D = 14.8\text{ A}$
- Max  $r_{DS(on)}$  = 7.1 mΩ at  $V_{GS} = 4.5\text{ V}$ ,  $I_D = 12.4\text{ A}$
- High performance technology for extremely low  $r_{DS(on)}$
- Termination is Lead-free and RoHS Compliant

### General Description

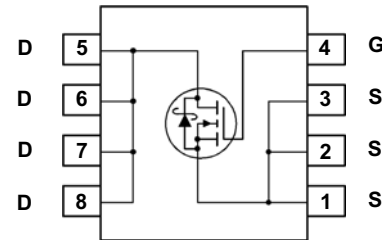
This FDMC0223S is produced using ON Semiconductor's advanced Power Trench® process that has been especially tailored to minimize the on-state resistance. This device is well suited for Power Management and load switching applications common in Notebook Computers and Portable Battery packs.

### Applications

- DC - DC Buck Converters
- Notebook battery power management
- Load switch in Notebook



MLP 3.3x3.3



### MOSFET Maximum Ratings $T_A = 25\text{ °C}$ unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	30	V
$V_{GS}$	Gate to Source Voltage	±20	V
$I_D$	Drain Current -Continuous $T_C = 25\text{ °C}$	18	A
	-Continuous $T_A = 25\text{ °C}$ (Note 1a)	14.8	
	-Pulsed	45	
$E_{AS}$	Single Pulse Avalanche Energy (Note 3)	60	mJ
$P_D$	Power Dissipation $T_A = 25\text{ °C}$ (Note 1a)	2.3	W
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	53	°C/W
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### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMC0223S	FDMC0223S, FDMC0223S-P	MLP 3.3X3.3	13 "	12 mm	3000 units

## Electrical Characteristics $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , referenced to $25\text{ }^\circ\text{C}$		12		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$			1	mA
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$			100	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1\text{ mA}$	1.2	1.6	3.0	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , referenced to $25\text{ }^\circ\text{C}$		-6		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 14.8\text{ A}$		5.0	6.0	m $\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 12.4\text{ A}$		6.1	7.1	
		$V_{GS} = 10\text{ V}, I_D = 14.8\text{ A}$ $T_J = 125\text{ }^\circ\text{C}$		5.9	9.0	
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 14.8\text{ A}$		78		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$		1895	2520	pF
$C_{oss}$	Output Capacitance			770	1025	pF
$C_{rss}$	Reverse Transfer Capacitance			85	130	pF
$R_g$	Gate Resistance			1.2	3.2	$\Omega$

### Switching Characteristics

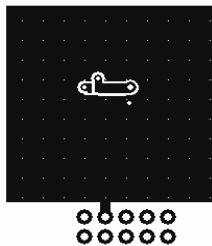
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}, I_D = 14.8\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$		11	21	ns
$t_r$	Rise Time			4	10	ns
$t_{d(off)}$	Turn-Off Delay Time			26	42	ns
$t_f$	Fall Time			3	10	ns
$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V to }10\text{ V}$	$V_{DD} = 15\text{ V}$ $I_D = 14.8\text{ A}$	30	42	nC
$Q_g$	Total Gate Charge	$V_{GS} = 0\text{ V to }4.5\text{ V}$		14	20	nC
$Q_{gs}$	Gate to Source Gate Charge			5.3		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			4.0		nC

### Drain-Source Diode Characteristics

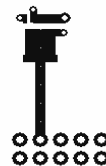
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 14.8\text{ A}$ (Note 2)		0.8	1.3	V
		$V_{GS} = 0\text{ V}, I_S = 1.9\text{ A}$ (Note 2)		0.5	1.2	
$t_{rr}$	Reverse Recovery Time	$I_F = 14.8\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$		29	45	ns
$Q_{rr}$	Reverse Recovery Charge			28	44	nC

#### Notes:

- $R_{\theta JA}$  is determined with the device mounted on a  $1\text{ in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{ in.}$  board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a.  $53\text{ }^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.



b.  $125\text{ }^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width  $< 300\text{ }\mu\text{s}$ , Duty cycle  $< 2.0\%$ .

- $E_{AS}$  of  $60\text{ mJ}$  is based on starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 1\text{ mH}$ ,  $I_{AS} = 11\text{ A}$ ,  $V_{DD} = 23\text{ V}$ ,  $V_{GS} = 10\text{ V}$ . 100% test at  $L = 3\text{ mH}$ ,  $I_{AS} = 4.8\text{ A}$ .

**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted

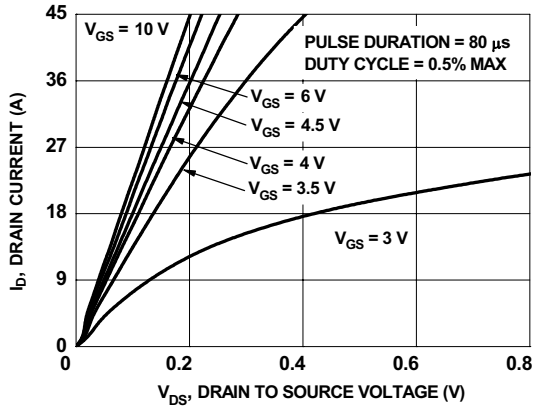


Figure 1. On-Region Characteristics

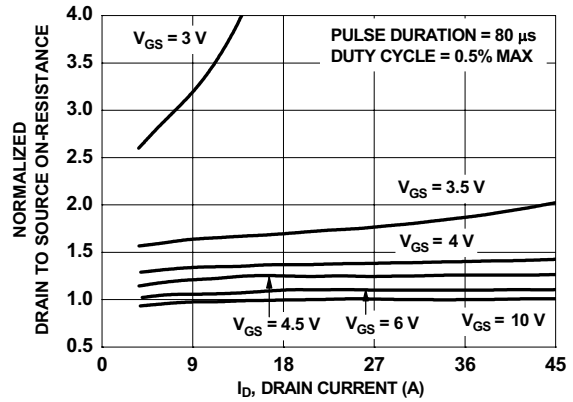


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

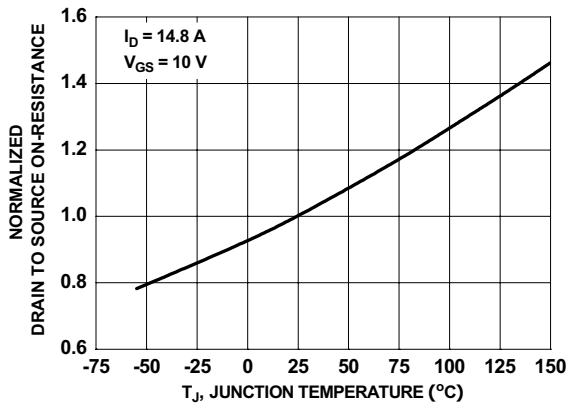


Figure 3. Normalized On-Resistance vs. Junction Temperature

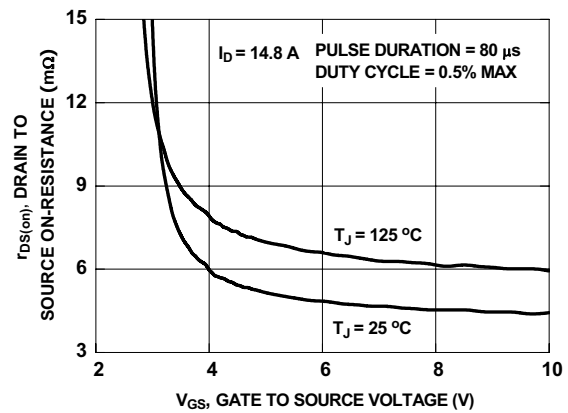


Figure 4. On-Resistance vs. Gate to Source Voltage

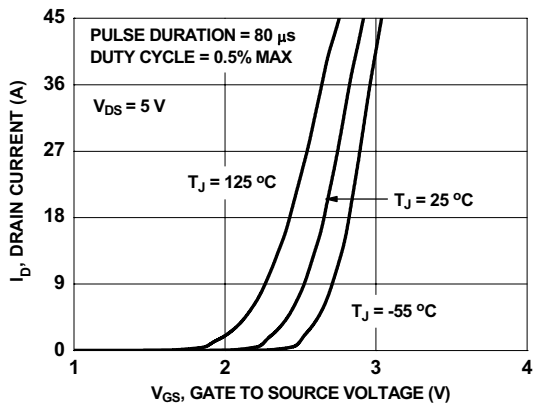


Figure 5. Transfer Characteristics

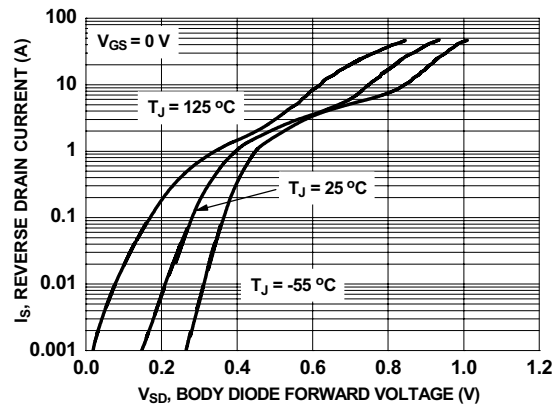
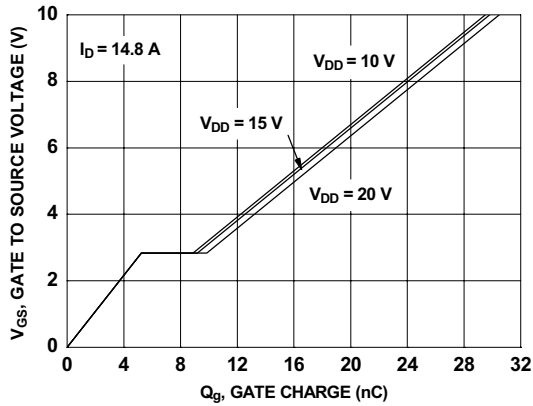
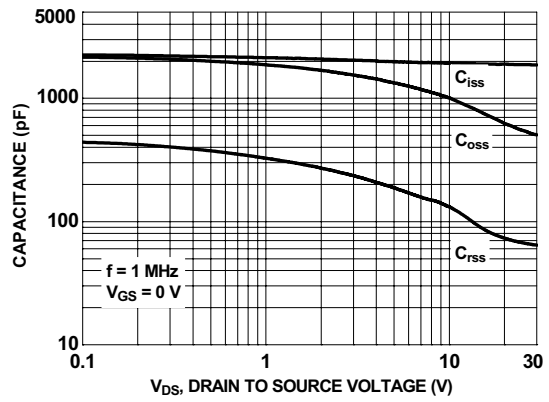


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

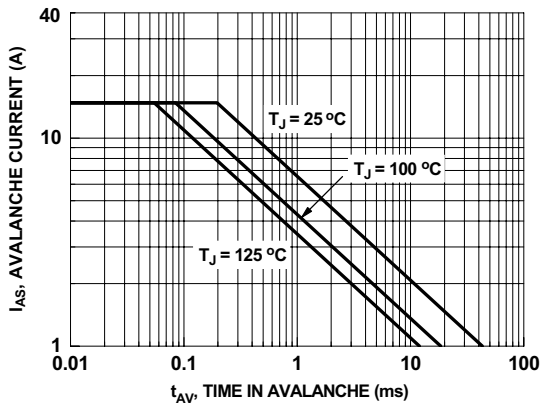
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



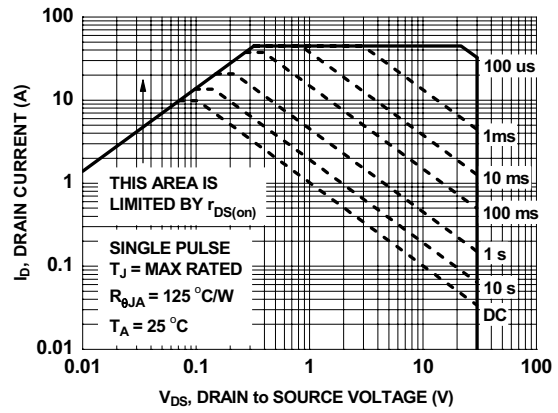
**Figure 7. Gate Charge Characteristics**



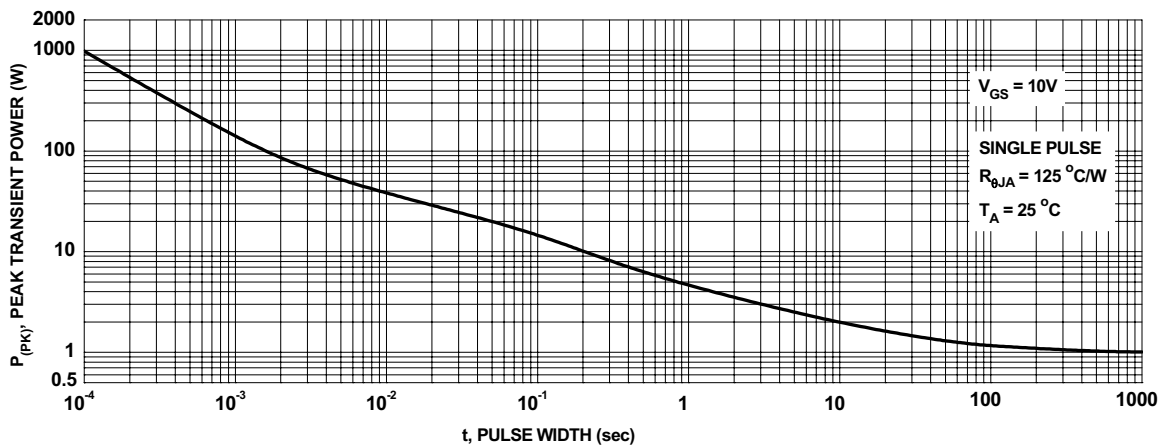
**Figure 8. Capacitance vs. Drain to Source Voltage**



**Figure 9. Unclamped Inductive Switching Capability**

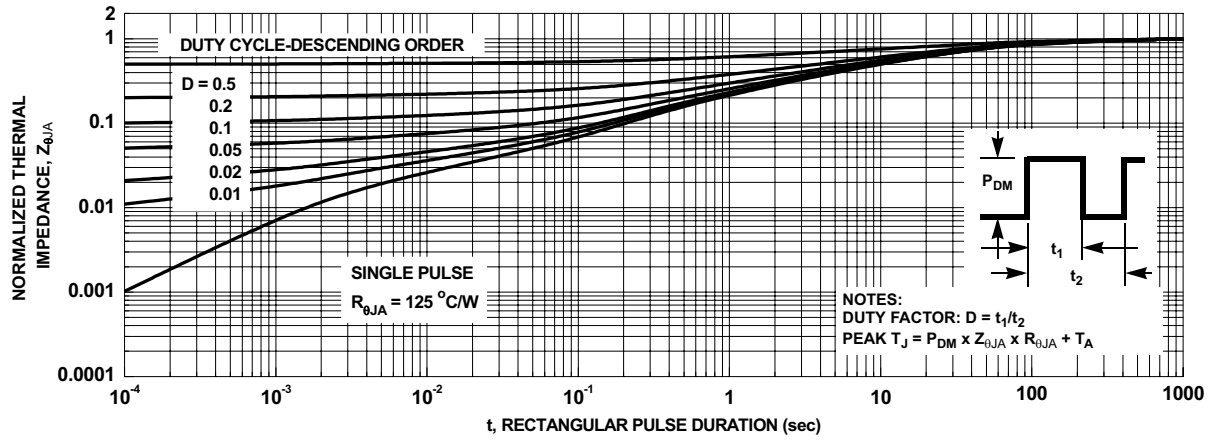


**Figure 10. Forward Bias Safe Operating Area**



**Figure 11. Single Pulse Maximum Power Dissipation**

**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



**Figure 12. Junction-to-Ambient Transient Thermal Response Curve**

## Typical Characteristics (continued)

### SyncFET<sup>™</sup> Schottky body diode Characteristics

ON Semiconductor's SyncFET process embeds a Schottky diode in parallel with PowerTrench MoSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 13 shows the reverse recovery characteristic of the FDMC0223S.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

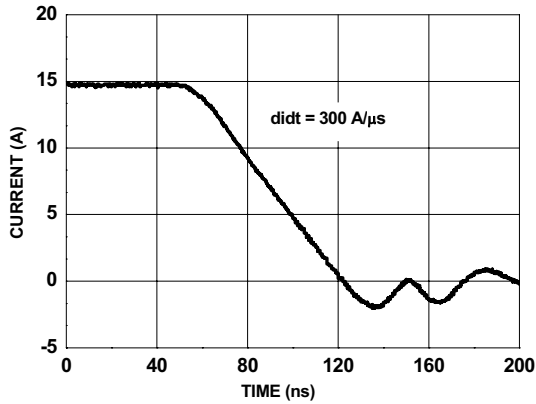


Figure 13. SyncFET<sup>™</sup> Body Diode Reverse Recovery Characteristic

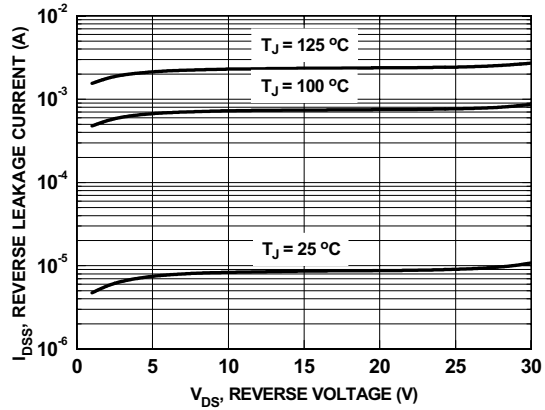
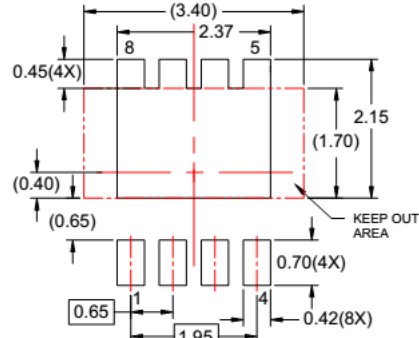
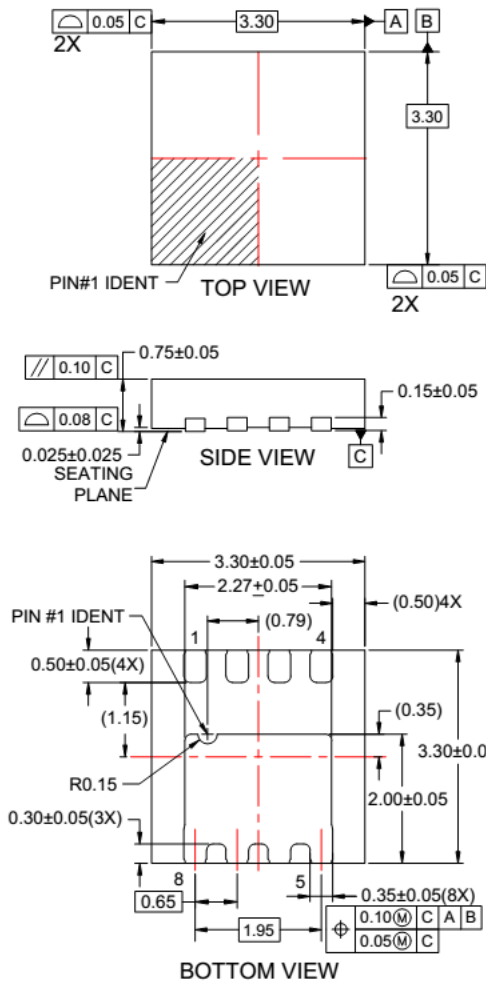


Figure 14. SyncFET<sup>™</sup> Body Diode Reverse Leakage vs. Drain-Source Voltage

## Dimensional Outline and Pad Layout



### NOTES:

- A. DOES NOT CONFORM TO JEDEC REGISTRATION MO-229
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
- D. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.
- E. DRAWING FILENAME: MKT-MLP08Srev3.

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