

# FDS4141

## P-Channel PowerTrench® MOSFET

-40V, -10.8A, 13.0mΩ

### Features

- Max  $r_{DS(on)}$  = 13.0mΩ at  $V_{GS} = -10V$ ,  $I_D = -10.5A$
- Max  $r_{DS(on)}$  = 19.0mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -8.4A$
- High performance trench technology for extremely low  $r_{DS(on)}$
- RoHS Compliant

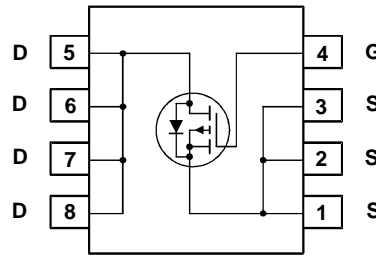
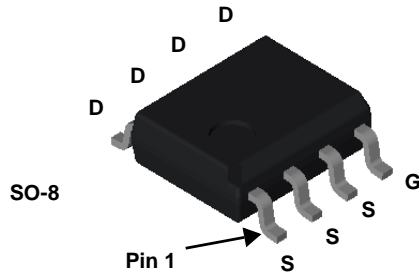


### General Description

This P-Channel MOSFET has been produced using Fairchild Semiconductor's proprietary PowerTrench® technology to deliver low  $r_{DS(on)}$  and optimized  $BV_{DSS}$  capability to offer superior performance benefit in the applications and optimized switching performance capability reducing power dissipation losses in converter/inverter applications.

### Applications

- Control switch in synchronous & non-synchronous buck
- Load switch
- Inverter



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

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	-40	V
$V_{GS}$	Gate to Source Voltage	±20	V
$I_D$	Drain Current -Continuous	-10.8	A
	-Pulsed	-36	
$E_{AS}$	Single Pulse Avalanche Energy (Note 3)	294	mJ
$P_D$	Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a)	5	W
	Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1b)	2.5	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case (Note 1)	25	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	50	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDS4141	FDS4141	SO-8	13"	12mm	2500units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$	-40			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		-33		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -32\text{V}$ ,			-1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$			$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$	-1.0	-1.6	-3.0	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		5.3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = -10\text{V}, I_D = -10.5\text{A}$		11.0	13.0	m $\Omega$
		$V_{GS} = -4.5\text{V}, I_D = -8.4\text{A}$		15.2	19.0	
		$V_{GS} = -10\text{V}, I_D = -10.5\text{A}, T_J = 125^\circ\text{C}$		16.8	19.9	
$g_{FS}$	Forward Transconductance	$V_{DD} = -5\text{V}, I_D = -10.5\text{A}$		37		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -20\text{V}, V_{GS} = 0\text{V},$ $f = 1\text{MHz}$		2005	2670	pF
$C_{oss}$	Output Capacitance			355	475	pF
$C_{riss}$	Reverse Transfer Capacitance			190	285	pF
$R_g$	Gate Resistance		$f = 1\text{MHz}$		5	

### Switching Characteristics

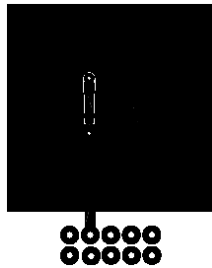
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -20\text{V}, I_D = -10.5\text{A},$ $V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$		10	20	ns	
$t_r$	Rise Time			5	10	ns	
$t_{d(off)}$	Turn-Off Delay Time			42	68	ns	
$t_f$	Fall Time			12	22	ns	
$Q_g$	Total Gate Charge		$V_{GS} = 0\text{V to } -10\text{V}$		35	49	nC
$Q_g$	Total Gate Charge		$V_{GS} = 0\text{V to } -5\text{V}$	$V_{DD} = -20\text{V},$ $I_D = -10.5\text{A}$	19	27	nC
$Q_{gs}$	Gate to Source Charge			6		nC	
$Q_{gd}$	Gate to Drain "Miller" Charge			7		nC	

### Drain-Source Diode Characteristics

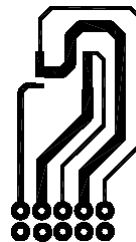
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = -10.5\text{A}$ (Note 2)		-0.8	-1.3	V
		$V_{GS} = 0\text{V}, I_S = -2.1\text{A}$ (Note 2)		-0.7	-1.2	
$t_{rr}$	Reverse Recovery Time	$I_F = -10.5\text{A}, di/dt = 100\text{A}/\mu\text{s}$		26	42	ns
$Q_{rr}$	Reverse Recovery Charge			14	26	nC

#### NOTES:

1.  $R_{\theta JA}$  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)  $50^\circ\text{C}/\text{W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper.

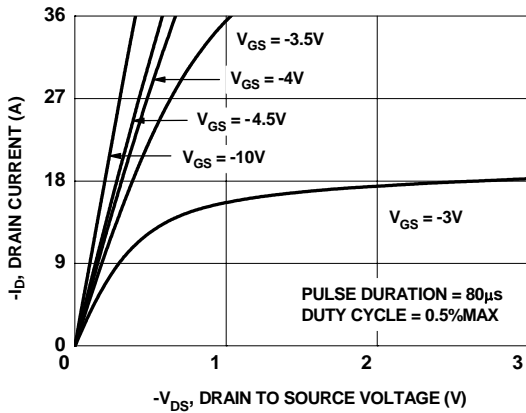


b)  $125^\circ\text{C}/\text{W}$  when mounted on a minimum pad.

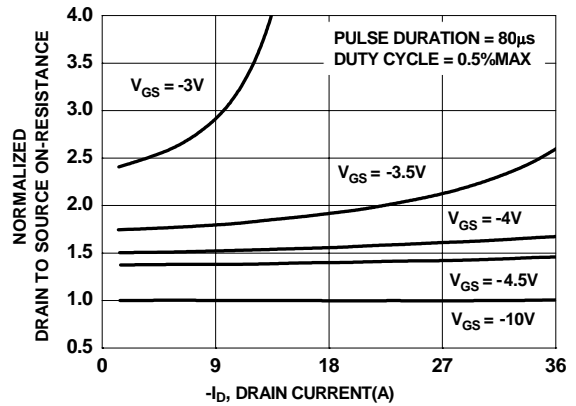
2. Pulse Test: Pulse Width <  $300\mu\text{s}$ , Duty cycle < 2.0%.

3. UIL condition: Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = -14\text{A}$ ,  $V_{DD} = -40\text{V}$ ,  $V_{GS} = -10\text{V}$ .

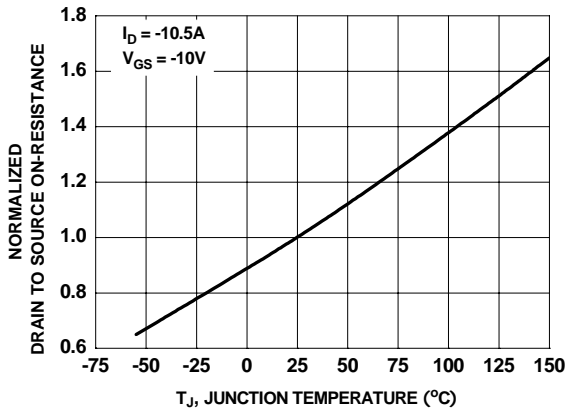
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



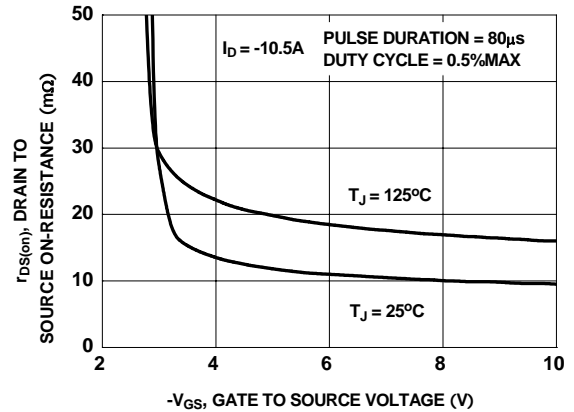
**Figure 1. On-Region Characteristics**



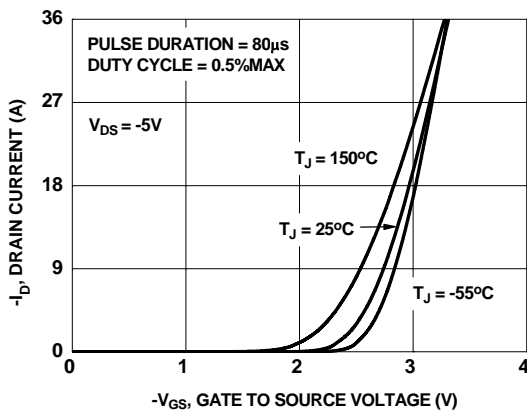
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



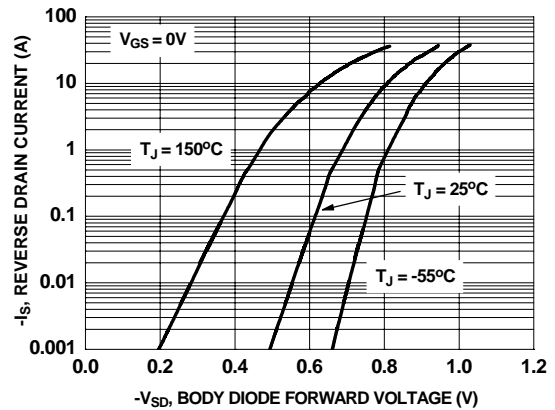
**Figure 3. Normalized On-Resistance vs Junction Temperature**



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

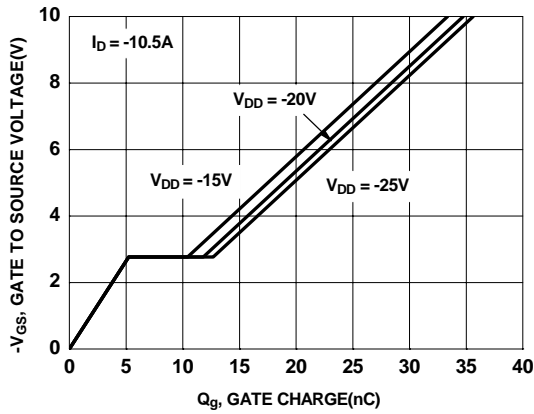


**Figure 5. Transfer Characteristics**

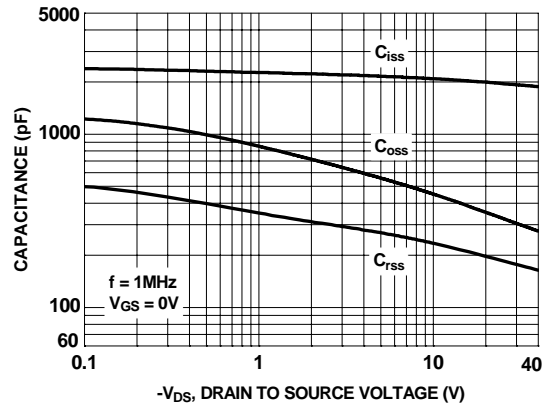


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

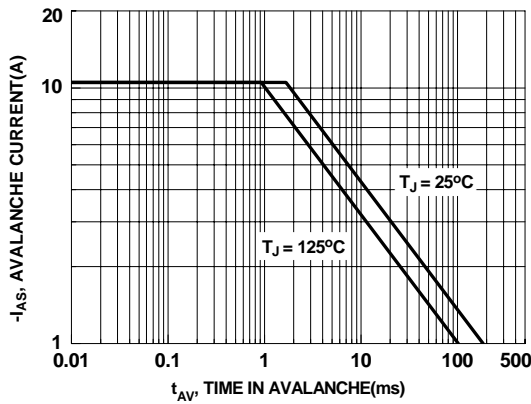
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



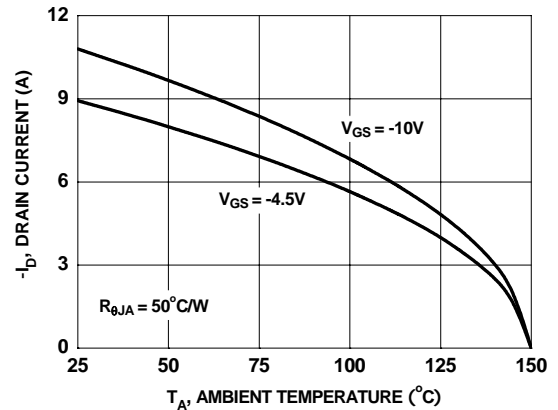
**Figure 7. Gate Charge Characteristics**



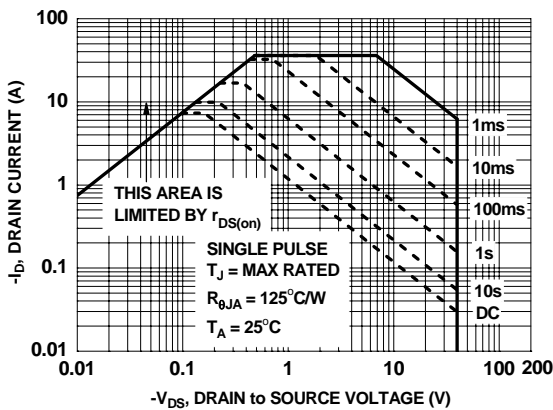
**Figure 8. Capacitance vs Drain to Source Voltage**



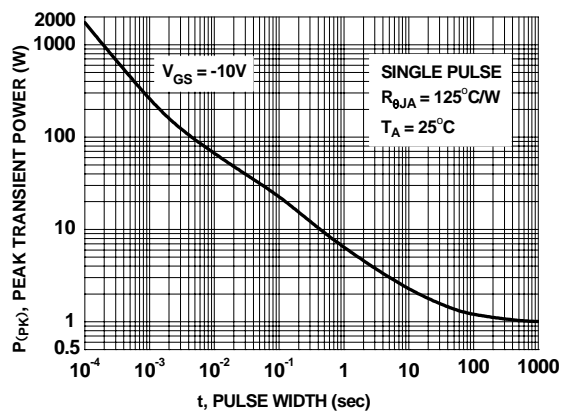
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs Ambient Temperature**

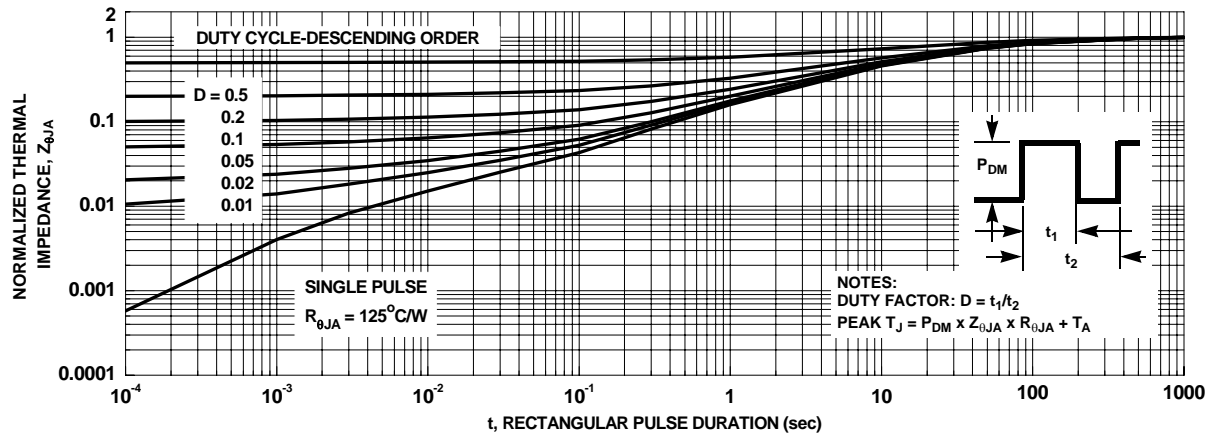


**Figure 11. Forward Bias Safe Operating Area**



**Figure 12. Single Pulse Maximum Power Dissipation**

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



**Figure 13. Transient Thermal Response Curve**



**TRADEMARKS**

The following are registered and unregistered trademarks and service marks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

- |                                      |  |  |                                  |
|--------------------------------------|--|--|----------------------------------|
| ACEx <sup>®</sup>                    | Green FPS <sup>™</sup>   | Power247 <sup>®</sup>                  | SuperSOT <sup>™</sup> -8         |
| Build it Now <sup>™</sup>            | Green FPS <sup>™</sup> e-Series <sup>™</sup>   | POWEREDGE <sup>®</sup>                 | SyncFET <sup>™</sup>             |
| CorePLUS <sup>™</sup>                | GTO <sup>™</sup>   | Power-SPM <sup>™</sup>                 | The Power Franchise <sup>®</sup> |
| CROSSVOLT <sup>™</sup>               | <i>i-Lo</i> <sup>™</sup>   | PowerTrench <sup>®</sup>               | the <b>power</b>                 |
| CTL <sup>™</sup>                     | IntelliMAX <sup>™</sup>  | Programmable Active Droop <sup>™</sup> | franchise                        |
| Current Transfer Logic <sup>™</sup>  | ISOPLANAR <sup>™</sup>   | QFET <sup>®</sup>                      | TinyBoost <sup>™</sup>           |
| EcoSPARK <sup>®</sup>                | MegaBuck <sup>™</sup>  | QST <sup>™</sup>                       | TinyBuck <sup>™</sup>            |
| <b>F</b> <sup>®</sup>                | MICROCOUPLER <sup>™</sup>  | QT Optoelectronics <sup>™</sup>        | TinyLogic <sup>®</sup>           |
| Fairchild <sup>®</sup>               | MicroFET <sup>™</sup>  | Quiet Series <sup>™</sup>              | TINYOPTO <sup>™</sup>            |
| Fairchild Semiconductor <sup>®</sup> | MicroPak <sup>™</sup>  | RapidConfigure <sup>™</sup>            | TinyPower <sup>™</sup>           |
| FACT Quiet Series <sup>™</sup>       | MillerDrive <sup>™</sup>   | SMART START <sup>™</sup>               | TinyPWM <sup>™</sup>             |
| FACT <sup>®</sup>                    | Motion-SPM <sup>™</sup>  | SPM <sup>®</sup>                       | TinyWire <sup>™</sup>            |
| FAST <sup>®</sup>                    | OPTOLOGIC <sup>®</sup>   | STEALTH <sup>™</sup>                   | µSerDes <sup>™</sup>             |
| FastvCore <sup>™</sup>               | OPTOPLANAR <sup>®</sup>  | SuperFET <sup>™</sup>                  | UHC <sup>®</sup>                 |
| FPS <sup>™</sup>                     |  <sup>®</sup> | SuperSOT <sup>™</sup> -3               | UniFET <sup>™</sup>              |
| FRFET <sup>®</sup>                   | PDP-SPM <sup>™</sup>   | SuperSOT <sup>™</sup> -6               | VCX <sup>™</sup>                 |
| Global Power Resource <sup>SM</sup>  | Power220 <sup>®</sup>  |  |                                  |

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. I31