

# MOSFET – N-Channel, UniFET™

**200 V, 39 A, 66 mΩ**

**FDP39N20, FDPF39N20**

## Description

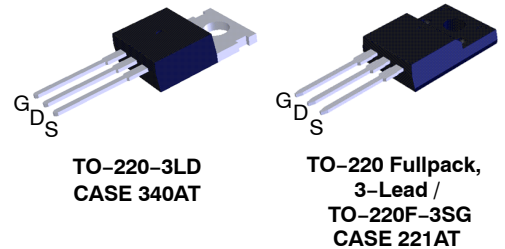
UniFET™ MOSFET is onsemi's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

## Features

- $R_{DS(on)} = 66 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 19.5 \text{ A}$
- Low Gate Charge (Typ. 38 nC)
- Low  $C_{rss}$  (Typ. 57 pF)
- 100% Avalanche Tested

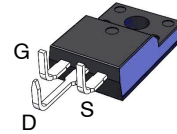
## Applications

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply



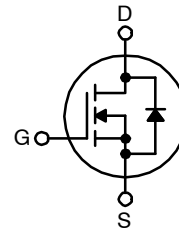
TO-220-3LD  
CASE 340AT

TO-220 Fullpack,  
3-Lead /  
TO-220F-3SG  
CASE 221AT

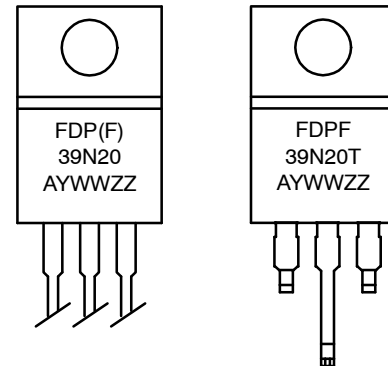


TO-220 FULLPAK 3LD L-FORMED  
CASE 340BM

## N-CHANNEL MOSFET



## MARKING DIAGRAMS



FDP(F)39N20(T) = Specific Device Code  
A = Assembly Location  
YWW = Date Code (Year and Week)  
ZZ = Assembly Lot

## ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 9 of this data sheet.

# FDP39N20, FDPF39N20

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	FDP39N20	FDPF39N20 / FDPF39N20TLDUTU	Unit
V <sub>DSS</sub>	Drain–Source Voltage	200	200	V
I <sub>D</sub>	Drain Current	– Continuous (T <sub>C</sub> = 25°C) – Continuous (T <sub>C</sub> = 100°C)	39* 23.4*	A A
I <sub>DM</sub>	Drain Current	– Pulsed (Note 1)	156*	A
V <sub>GSS</sub>	Gate–Source Voltage	±30	±30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	860	860	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	39	39	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	25.1	25.1	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	4.5	V/ns
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C) – Derate Above 25°C	37 0.29	W W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	–55 to +150	–55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	300	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## THERMAL CHARACTERISTICS

Symbol	Parameter	FDP39N20	FDPF39N20 / FDPF39N20TLDUTU	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction–to–Case, Max.	0.5	3.4	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction–to–Ambient, Max.	62.5	62.5	°C/W

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain–Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	200	–	–	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	–	0.2	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 200 V, V <sub>GS</sub> = 0 V V <sub>DS</sub> = 160 V, T <sub>C</sub> = 125°C	– –	– –	1 10	μA μA
I <sub>GSSF</sub>	Gate–Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	–	–	100	nA
I <sub>GSSR</sub>	Gate–Body Leakage Current, Reverse	V <sub>GS</sub> = –30 V, V <sub>DS</sub> = 0V	–	–	–100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3.0	–	5.0	V
R <sub>DS(on)</sub>	Static Drain–Source On–Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19.5 A	–	0.056	0.066	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 19.5 A	–	28.5	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	1640	2130	pF
C <sub>oss</sub>	Output Capacitance		–	400	520	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		–	57	85	pF

# FDP39N20, FDPF39N20

## ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)(continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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### SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 100\text{ V}$ , $I_D = 39\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 25\ \Omega$ (Note 4)	–	30	70	ns
$t_r$	Turn-On Rise Time		–	160	330	ns
$t_{d(off)}$	Turn-Off Delay Time		–	150	310	ns
$t_f$	Turn-Off Fall Time		–	150	310	ns
$Q_g$	Total Gate Charge	$V_{DS} = 160\text{ V}$ , $I_D = 39\text{ A}$ , $V_{GS} = 10\text{ V}$ (Note 4)	–	38	49	nC
$Q_{gs}$	Gate-Source Charge		–	11	–	nC
$Q_{gd}$	Gate-Drain Charge		–	16.5	–	nC

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

$I_S$	Maximum Continuous Drain-Source Diode Forward Current		–	–	39	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		–	–	156	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 39\text{ A}$	–	–	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}$ , $I_S = 39\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	–	152	–	ns
$Q_{rr}$	Reverse Recovery Charge		–	1.1	–	$\mu\text{C}$

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $L = 0.85\text{ mH}$ ,  $I_{AS} = 39\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 39\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

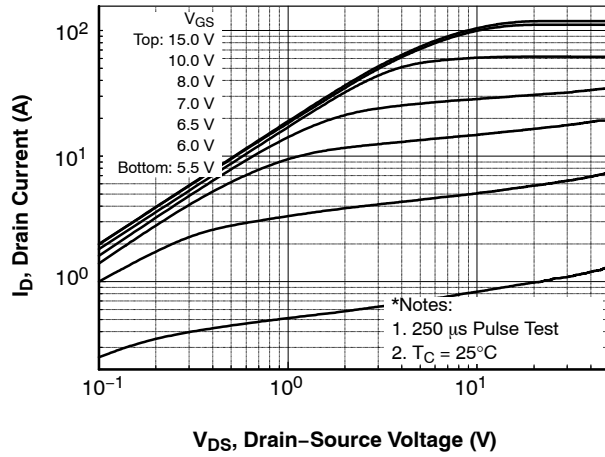


Figure 1. On-Region Characteristics

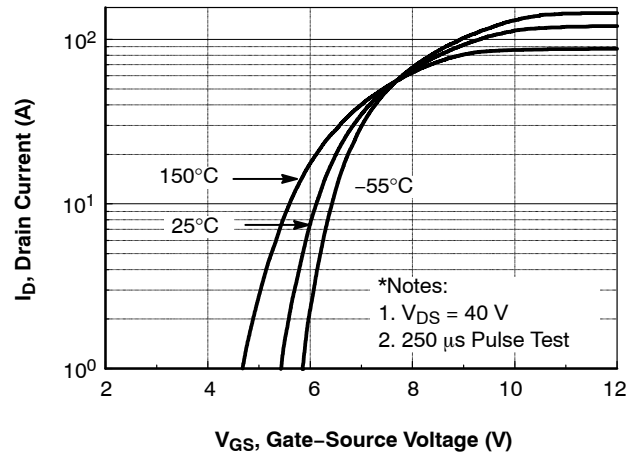


Figure 2. Transfer Characteristics

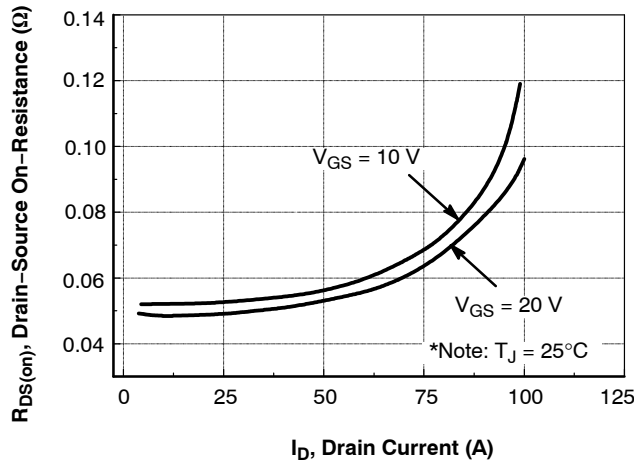


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

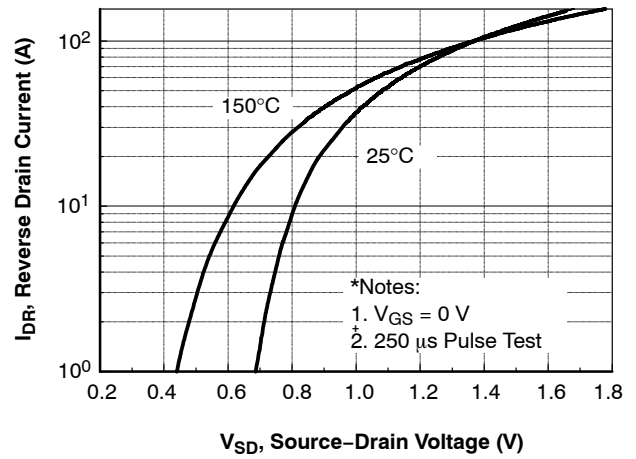


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

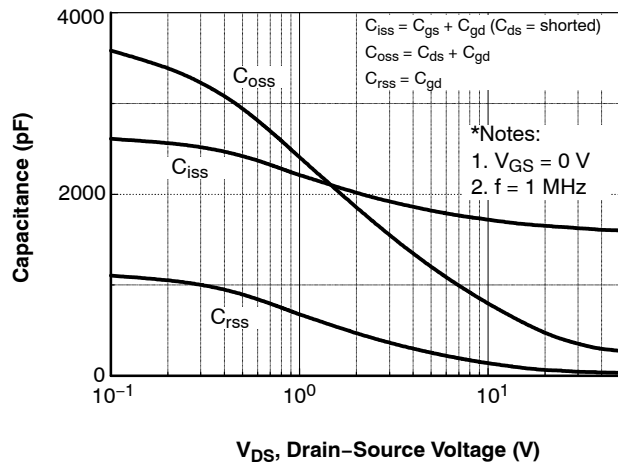


Figure 5. Capacitance Characteristics

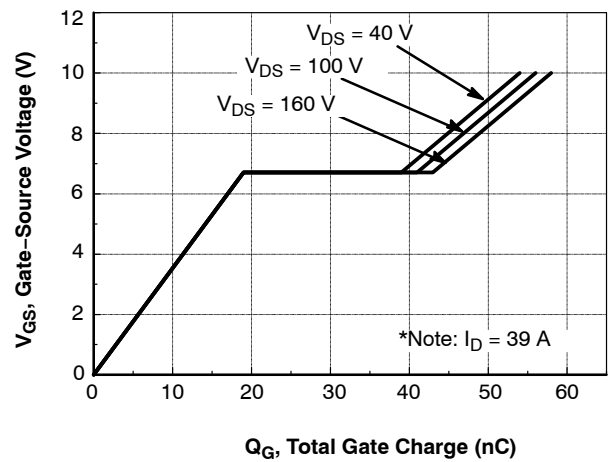
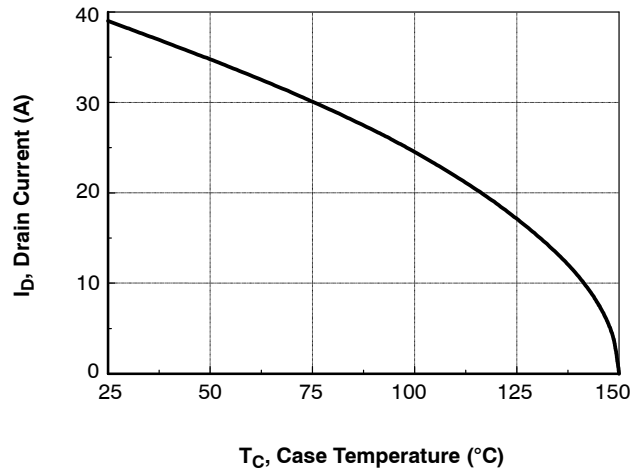
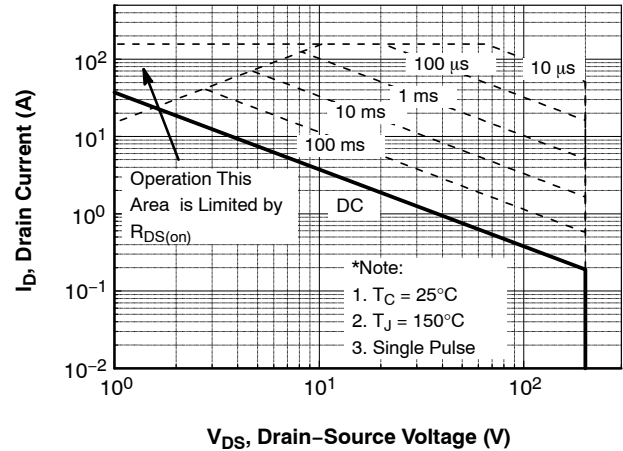
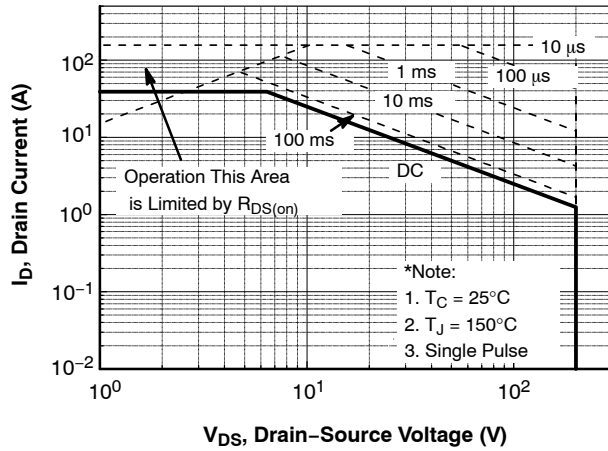
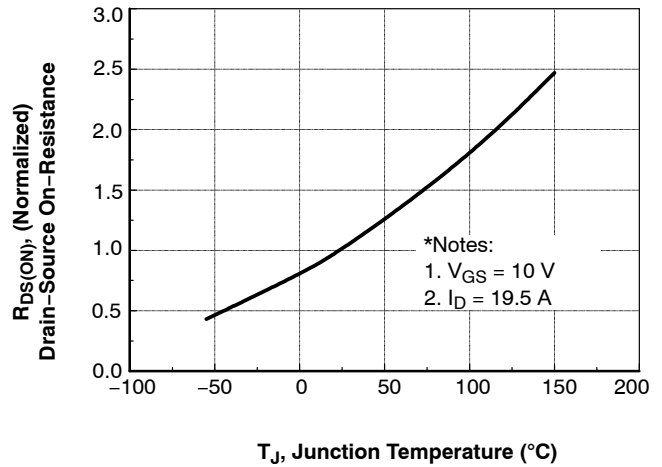
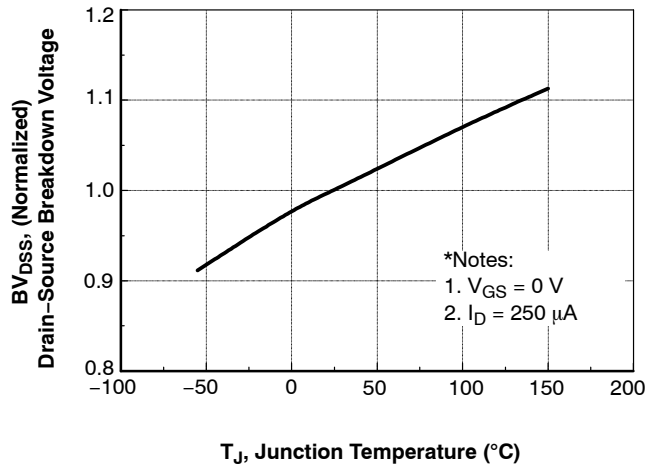


Figure 6. Gate Charge Characteristics

# FDP39N20, FDPF39N20

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



# FDP39N20, FDPF39N20

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

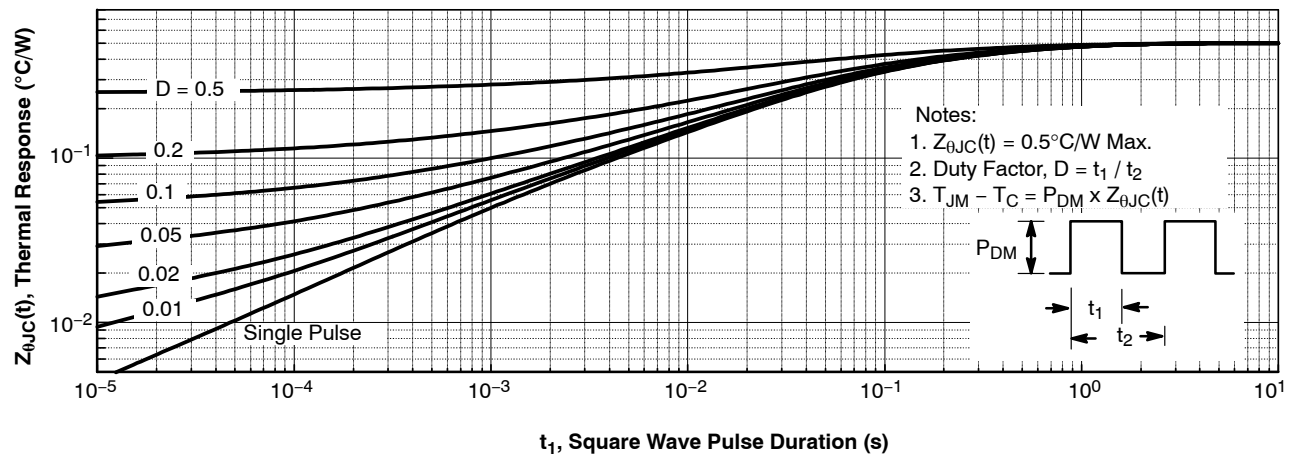


Figure 12. Transient Thermal Response Curve – FDP39N20

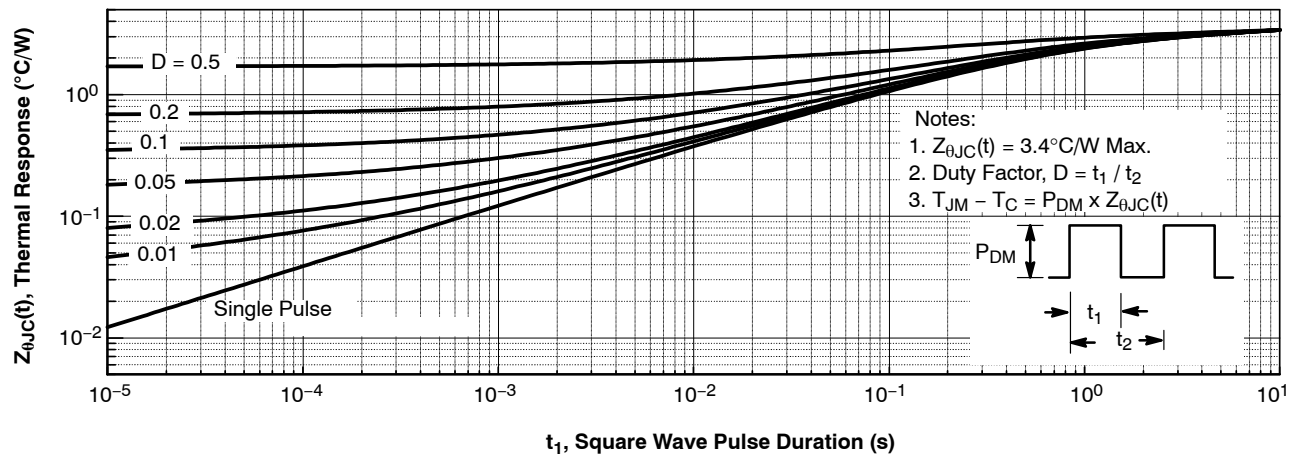


Figure 13. Transient Thermal Response Curve – FDPF39N20

# FDP39N20, FDPF39N20

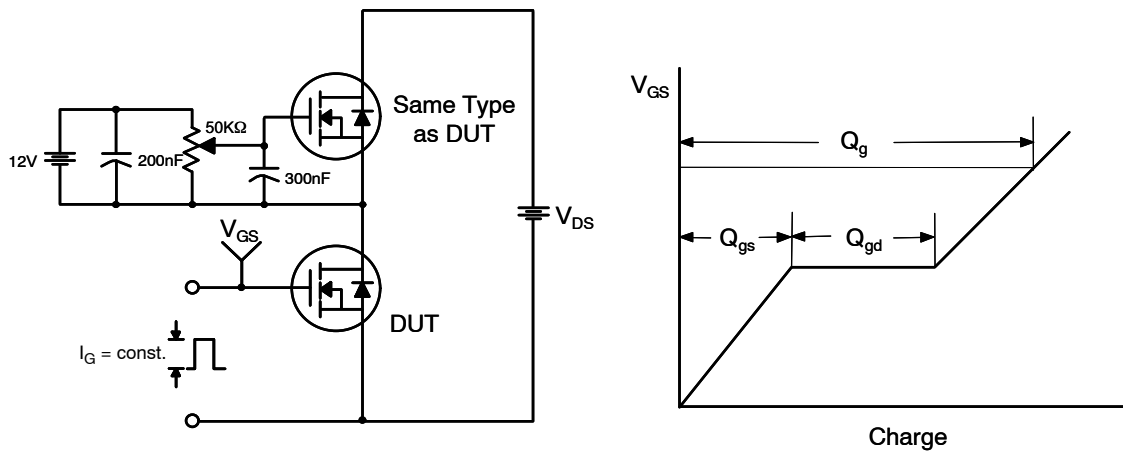


Figure 14. Gate Charge Test Circuit & Waveform

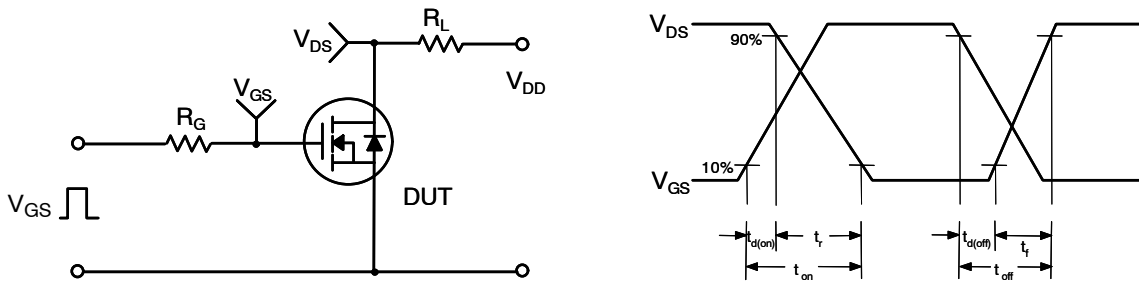


Figure 15. Resistive Switching Test Circuit & Waveforms

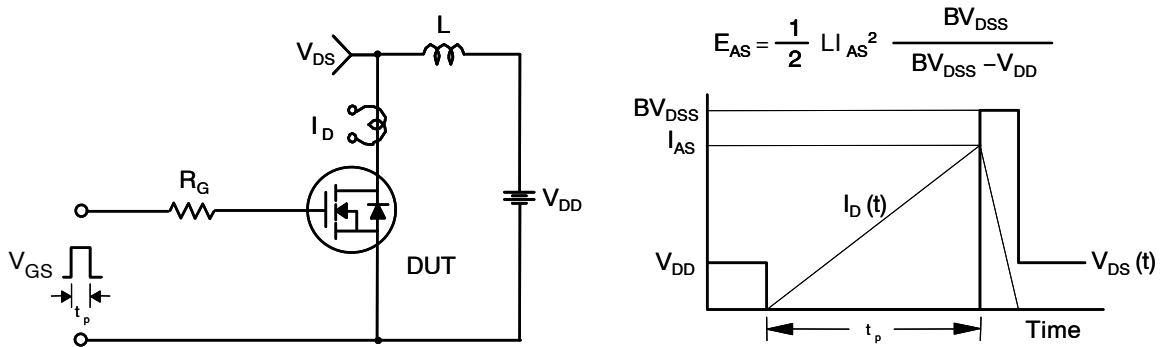


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

# FDP39N20, FDPF39N20

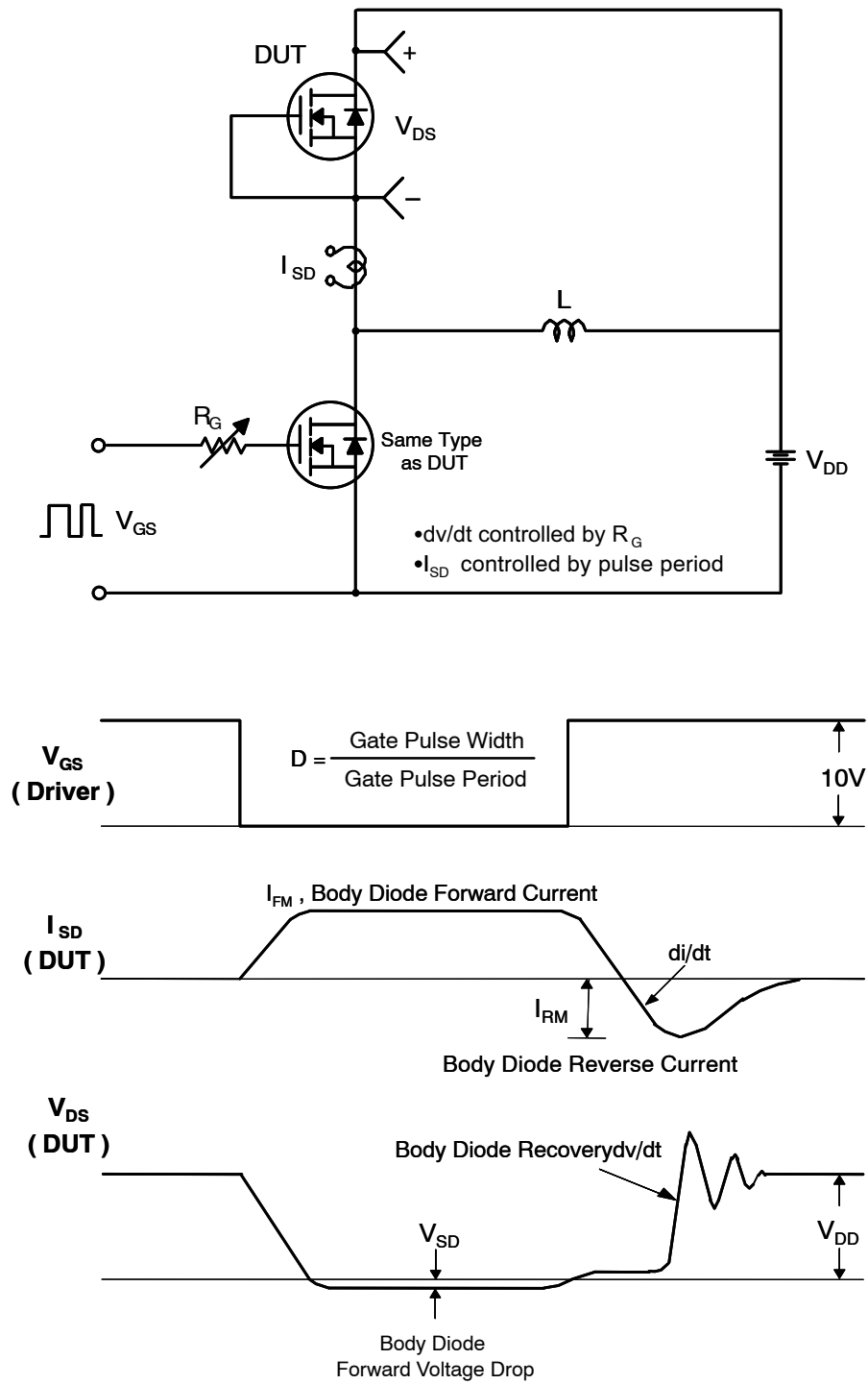


Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## FDP39N20, FDPF39N20

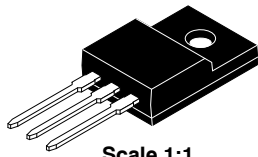
### ORDERING INFORMATION

Device	Device Marking	Package	Shipping
FDP39N20	FDP39N20	TO-220	1000 Units / Tube
FDPF39N20	FDPF39N20	TO-220F	1000 Units / Tube
FDPF39N20TLDTU	FDPF39N20T	TO-220F (L-formed)	800 Units / Tube

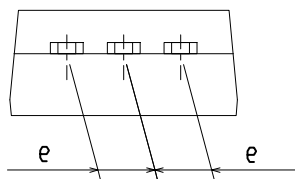
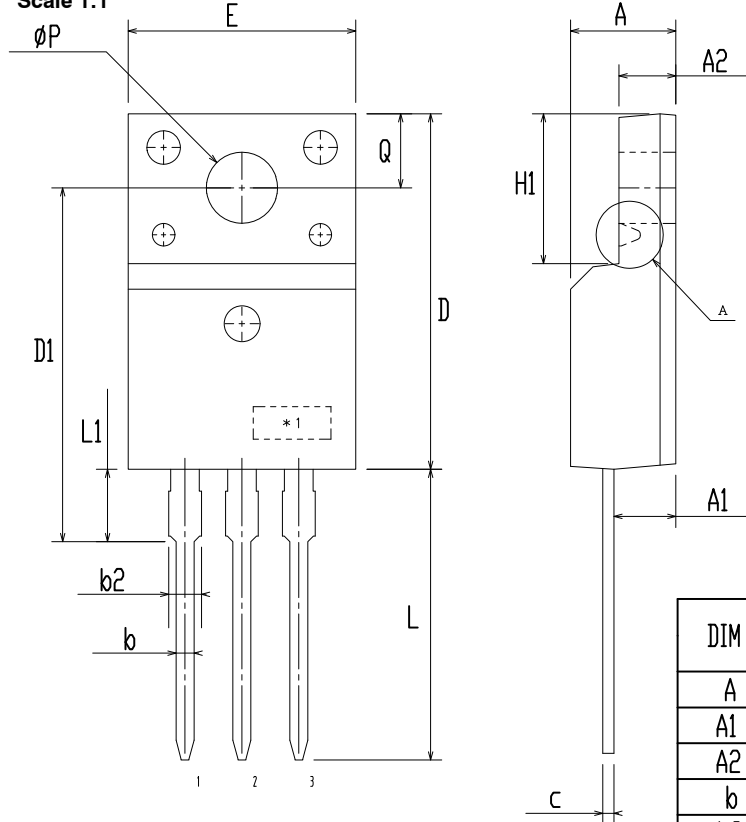
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**TO-220 Fullpack, 3-Lead / TO-220F-3SG**  
**CASE 221AT**  
**ISSUE B**

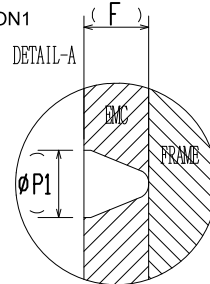
DATE 19 JAN 2021



Scale 1:1



OPTION1



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
Ø P	2.98	3.18	3.38
Ø P1	~	1.00	~
Q	3.20	3.30	3.40

**NOTES:**

A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009

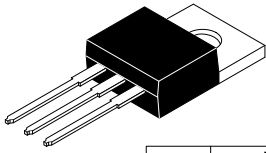
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCTIONS.

C. OPTION 1 - WITH SUPPORT PIN HOLE

OPTION 2 - NO SUPPORT PIN HOLE

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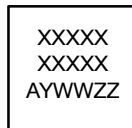
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**TO-220-3LD**  
**CASE 340AT**  
**ISSUE B**

DATE 08 AUG 2022

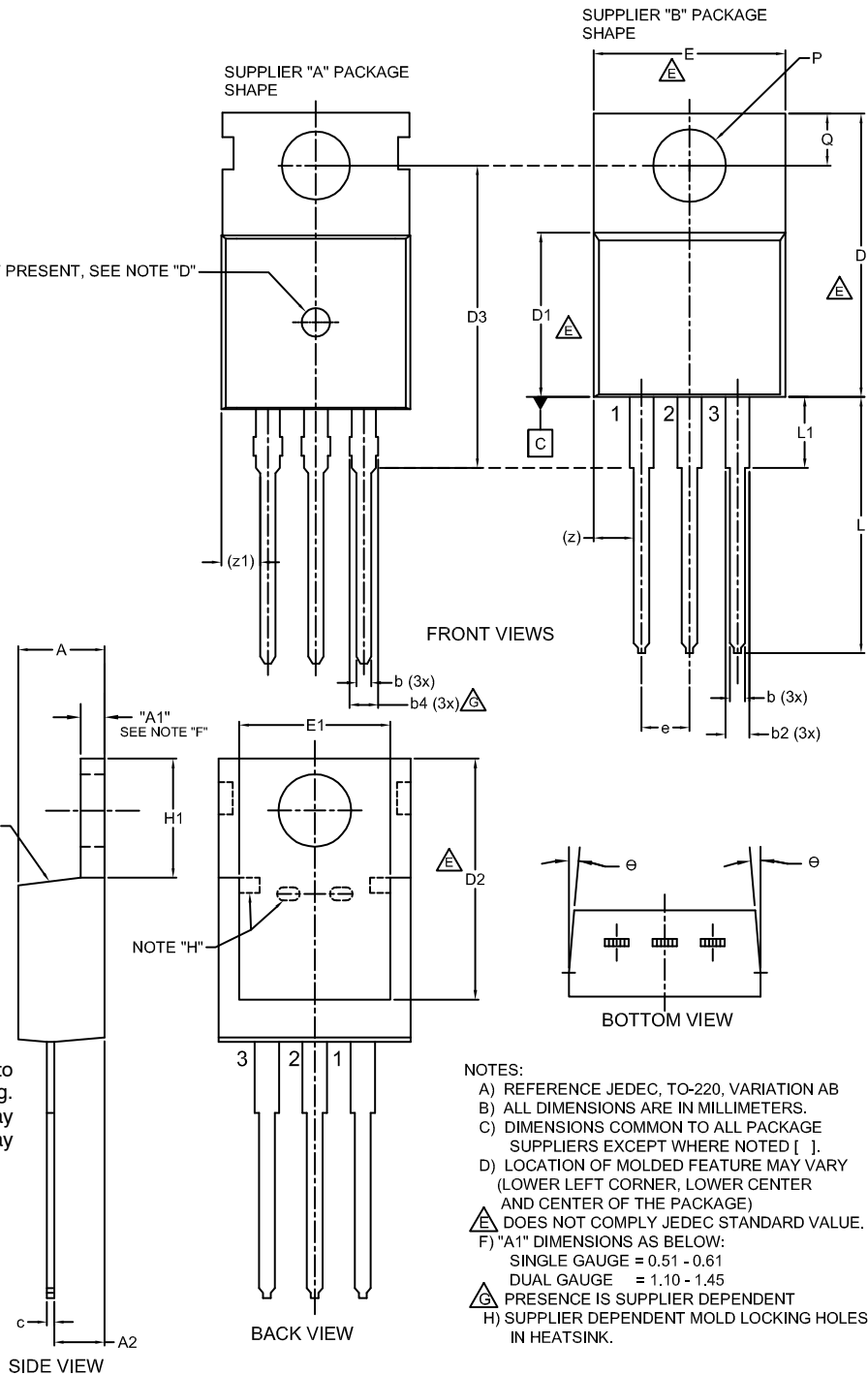
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.00	--	4.70
A1	SEE NOTE "F"		
A2	2.10	--	2.85
b	0.55	--	1.00
b2	1.10	--	1.62
b4	1.42	--	1.62
c	0.36	--	0.60
D	13.90	--	16.30
D1	8.13	--	9.40
D2	11.50	--	14.30
D3	15.42	--	16.51
E	9.65	--	10.67
E1	7.59	--	8.65
e	2.40	--	2.67
H1	6.06	--	6.69
L	12.70	--	14.04
L1	2.70	--	4.10
P	3.50	--	4.00
Q	2.50	--	3.40
z	2.13 REF		
z1	2.06 REF		
θ	3°	--	5°

IF PRESENT, SEE NOTE "D"

**GENERIC**  
**MARKING DIAGRAM\***


XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.


**NOTES:**

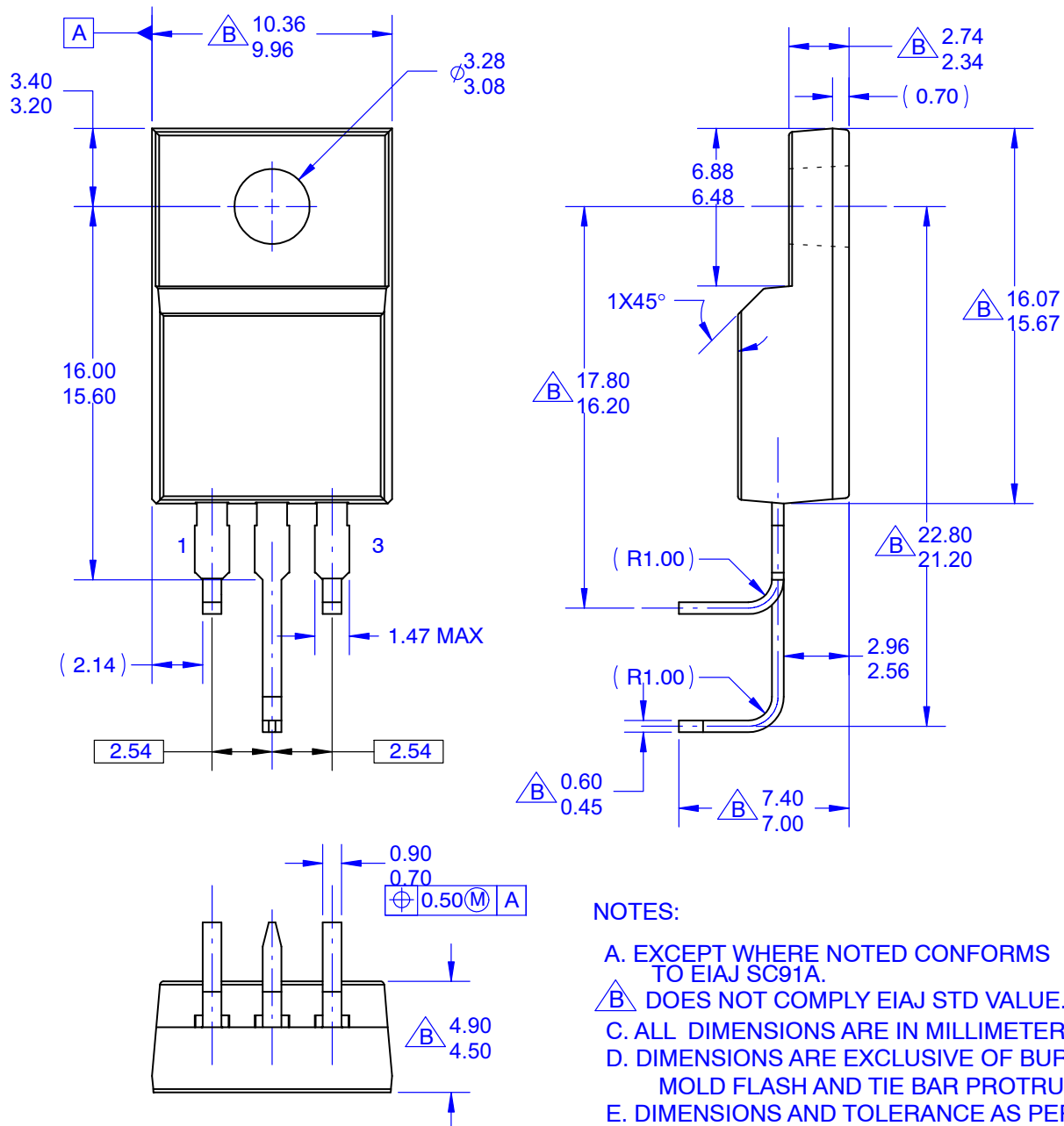
- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- E) DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:  
SINGLE GAUGE = 0.51 - 0.61  
DUAL GAUGE = 1.10 - 1.45
- PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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**TO-220 FULLPAK 3LD LF**  
**CASE 340BM**  
**ISSUE O**

DATE 31 AUG 2016



**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSIONS AND TOLERANCE AS PER ASME Y14.5-1994

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