Silicon Carbide (SiC) MOSFET – EliteSiC, 20 mohm, 900 V, M2, TO-247-4L

NTH4L020N090SC1

V$_{(BR)DSS}$	R$_{DS(ON)}$ MAX	I$_D$ MAX
900 V	28 mΩ @ 15 V	118 A

S1: Kelvin Source
S2: Power Source

N–CHANNEL MOSFET

Features
- Typ. R$_{DS(on)}$ = 20 mΩ @ V$_{GS}$ = 15 V
  Typ. R$_{DS(on)}$ = 16 mΩ @ V$_{GS}$ = 18 V
- Ultra Low Gate Charge (Q$_{G(tot)}$ = 196 nC)
- Low Effective Output Capacitance (C$_{oss}$ = 296 pF)
- 100% UIL Tested
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb–Free 2LI (on second level interconnection)

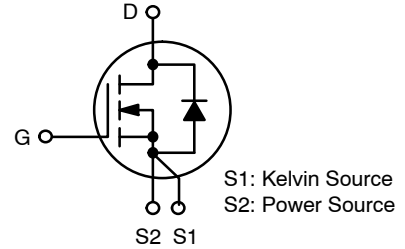### Typical Applications
- UPS
- DC-DC Converter
- Boost Inverter

**TO–247–4L
CASE 340CJ**

MARKING DIAGRAM
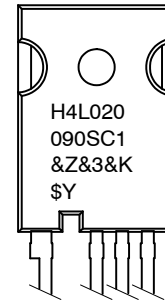
H4L020
090SC1
&Z&3&K
$Y

H4L020090SC1	= Specific Device Code
&Z	= Assembly Plant Code
&3	= Date Code (Year & Week)
&K	= Lot
$Y	= **onsemi** Logo

ORDERING INFORMATION

MAXIMUM RATINGS (T$_J$ = 25°C unless otherwise noted)

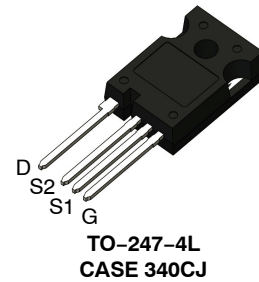| Parameter			Symbol	Value	Unit
Drain–to–Source Voltage			V$_{DSS}$	900	V
Gate–to–Source Voltage			V$_{GS}$	+22/−8	V
Recommended Operation Values of Gate–Source Voltage	T$_C$ < 175°C		V$_{GSop}$	+15/−5	V
Continuous Drain Current R$_{θJC}$	Steady State	T$_C$ = 25°C	I$_{DC}$	116	A
Power Dissipation R$_{θJC}$			P$_{DC}$	484	W
Continuous Drain Current R$_{θJC}$	Steady State	T$_C$ = 100°C	I$_{DC}$	82	A
Power Dissipation R$_{θJC}$			P$_{DC}$	242	W
Pulsed Drain Current (Note 2)	T$_A$ = 25°C		I$_{DM}$	504	A
Operating Junction and Storage Temperature Range			T$_J$, T$_{stg}$	−55 to +175	°C
Source Current (Body Diode)			I$_S$	106	A
Single Pulse Drain–to–Source Avalanche Energy (I$_L$ = 23 A$_{pk}$, L = 1 mH) (Note 3)			E$_{AS}$	264	mJ

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.
1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. E$_{AS}$ of 162 mJ is based on starting T$_J$ = 25°C; L = 1 mH, I$_{AS}$ = 23 A, V$_{DD}$ = 100 V, V$_{GS}$ = 15 V.

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Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Thermal Resistance Junction–to–Case (Note 1)	$R_{\theta JC}$	0.31	°C/W
Thermal Resistance Junction–to–Ambient (Note 1)	$R_{\theta JA}$	40	°C/W

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain–to–Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA		900			V
Drain–to–Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = 1 mA, refer to 25°C			500		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 900 V	T_J = 25°C			100	μA
			T_J = 175°C			250	μA
Gate–to–Source Leakage Current	I_{GSS}	V_{GS} = +22/–8 V, V_{DS} = 0 V				±1	μA
ON CHARACTERISTICS							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS} , I_D = 20 mA		1.8	2.7	4.3	V
Recommended Gate Voltage	V_{GOP}			−5		+15	V
Drain–to–Source On Resistance	$R_{DS(on)}$	V_{GS} = 15 V, I_D = 60 A, T_J = 25°C			20	28	mΩ
		V_{GS} = 18 V, I_D = 60 A, T_J = 25°C			16		
		V_{GS} = 15 V, I_D = 60 A, T_J = 175°C			27		
Forward Transconductance	g_{FS}	V_{DS} = 20 V, I_D = 60 A			49		S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 450 V			4415		pF
Output Capacitance	C_{OSS}				296		
Reverse Transfer Capacitance	C_{RSS}				24		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −5/15 V, V_{DS} = 720 V, I_D = 60 A			196		nC
Threshold Gate Charge	$Q_{G(TH)}$				42		
Gate–to–Source Charge	Q_{GS}				78		
Gate–to–Drain Charge	Q_{GD}				55		
Gate–Resistance	R_G	f = 1 MHz			1.6		Ω
SWITCHING CHARACTERISTICS							
Turn–On Delay Time	$t_{d(ON)}$	V_{GS} = −5/15 V, V_{DS} = 720 V, I_D = 60 A, R_G = 2.5 Ω, Inductive Load			29		ns
Rise Time	t_r				28		
Turn–Off Delay Time	$t_{d(OFF)}$				54		
Fall Time	t_f				14		
Turn–On Switching Loss	E_{ON}				611		μJ
Turn–Off Switching Loss	E_{OFF}				293		
Total Switching Loss	E_{TOT}				904		
DRAIN–SOURCE DIODE CHARACTERISTICS							
Continuous Drain–Source Diode Forward Current	I_{SD}	V_{GS} = −5 V, T_J = 25°C				106	A
Pulsed Drain–Source Diode Forward Current (Note 2)	I_{SDM}	V_{GS} = −5 V, T_J = 25°C				504	A
Forward Diode Voltage	V_{SD}	V_{GS} = −5 V, I_{SD} = 30 A, T_J = 25°C			3.8		V

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −5/15 V, I_{SD} = 60 A, dI_S/dt = 1000 A/μs, V_{DS} = 720 V		30		ns
Reverse Recovery Charge	Q_{RR}			244		nC
Reverse Recovery Energy	E_{REC}			11		μJ
Peak Reverse Recovery Current	I_{RRM}			16		A
Charge Time	Ta			17		ns
Discharge Time	Tb			13		ns

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.

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TYPICAL CHARACTERISTICS
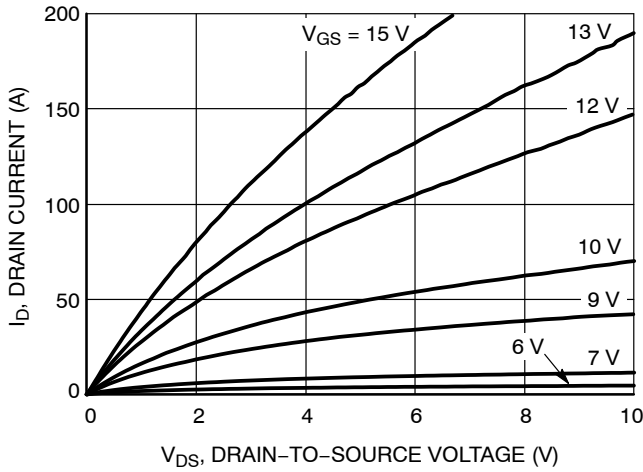
Figure 1. On−Region Characteristics
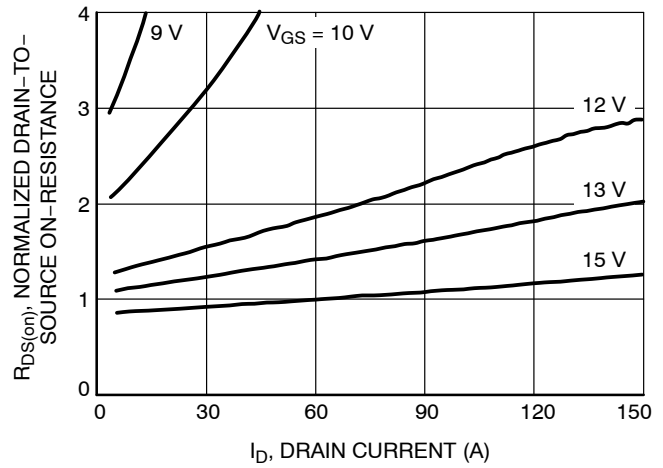
Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage
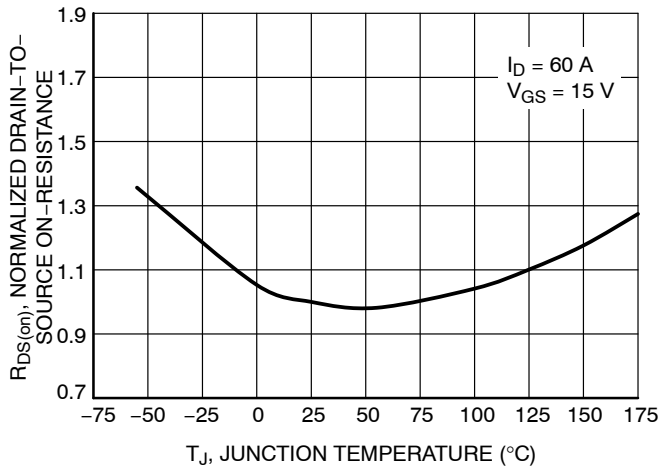
Figure 3. On−Resistance Variation with Temperature
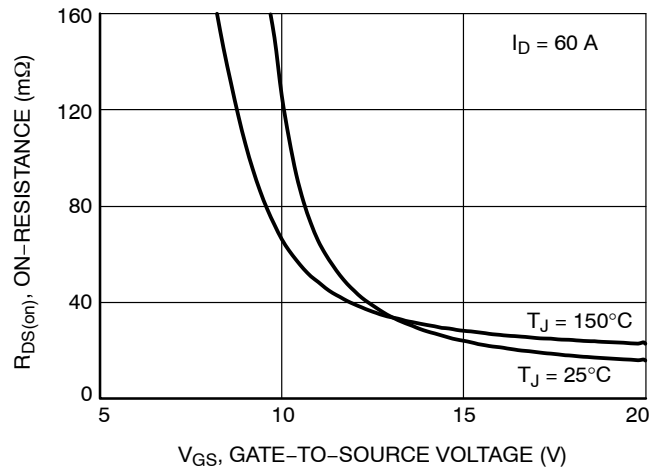
Figure 4. On−Resistance vs. Gate−to−Source Voltage
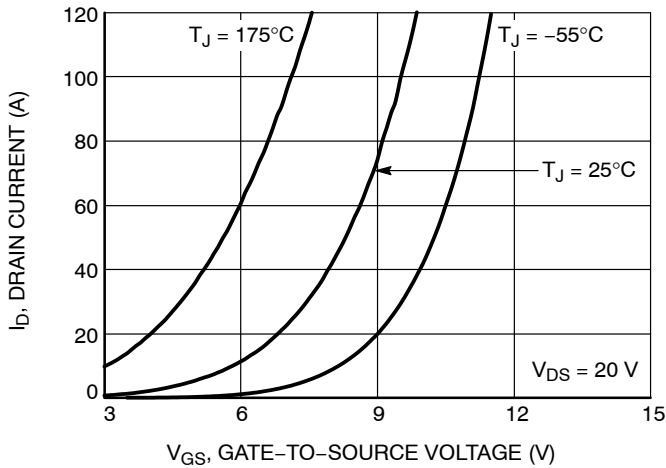
Figure 5. Transfer Characteristics
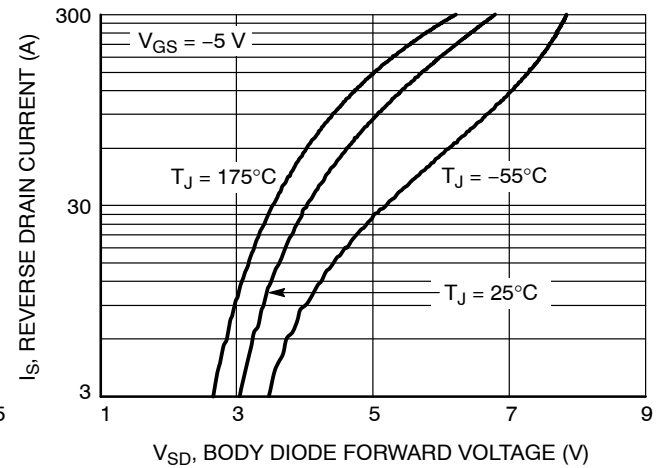
Figure 6. Diode Forward Voltage vs. Current

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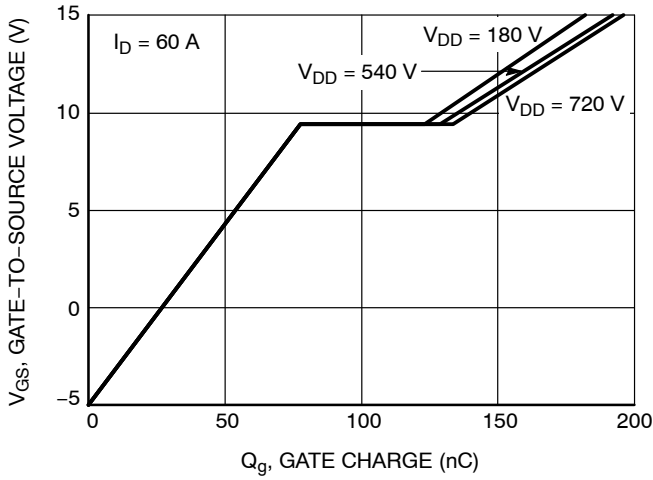
Figure 7. Gate–to–Source Voltage vs. Total Charge
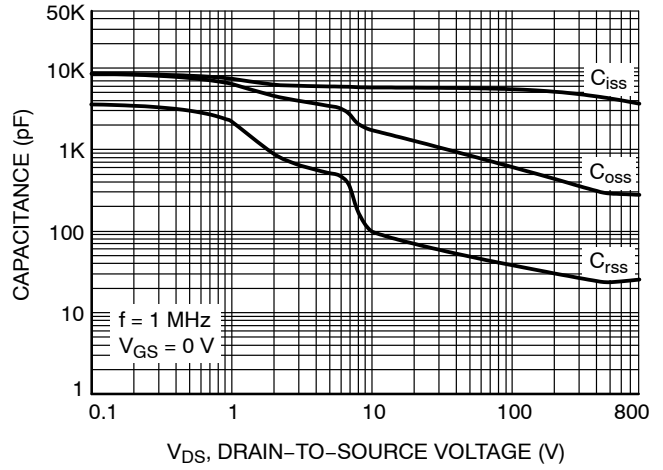
Figure 8. Capacitance vs. Drain–to–Source Voltage
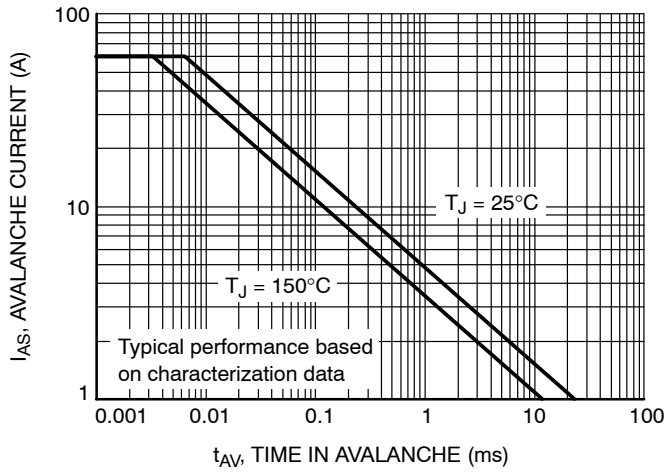
Figure 9. Unclamped Inductive Switching Capability
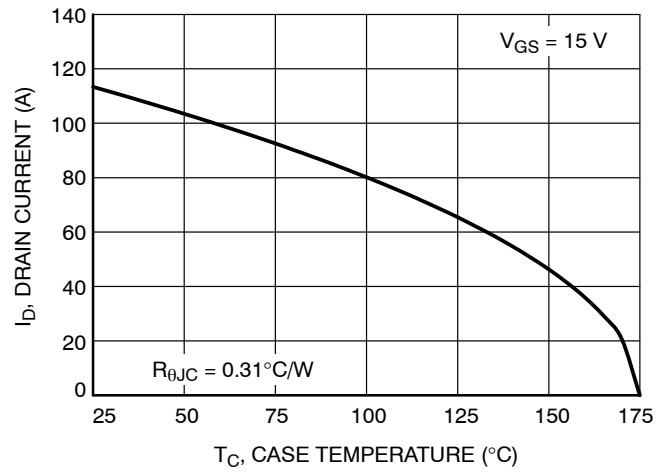
Figure 10. Maximum Continuous Drain Current vs. Case Temperature
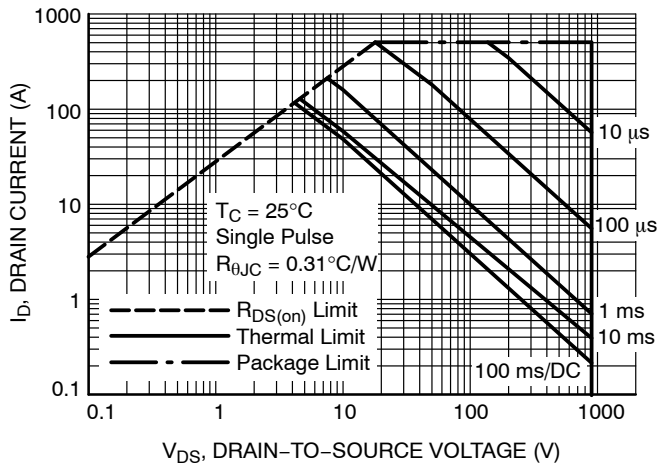
Figure 11. Safe Operating Area
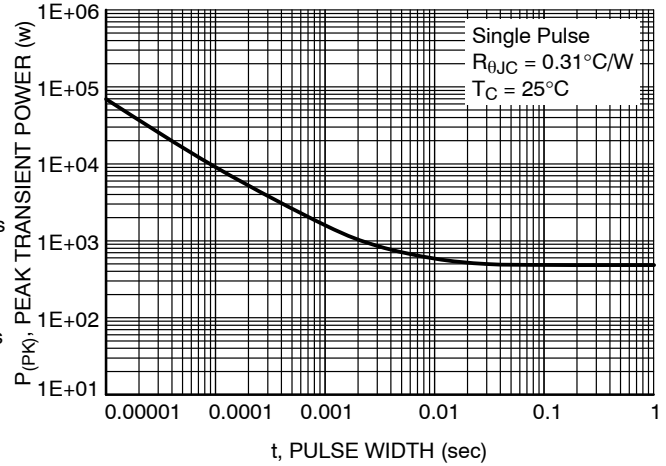
Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (continued)

Notes:
$Z_{\theta JC}(t) = r(t) \times R_{\theta JC}$
$R_{\theta JC} = 0.31°C/W$
Peak $T_J = P_{DM} \times Z_{\theta JC}(t) + T_C$
Duty Cycle, $D = t_1/t_2$
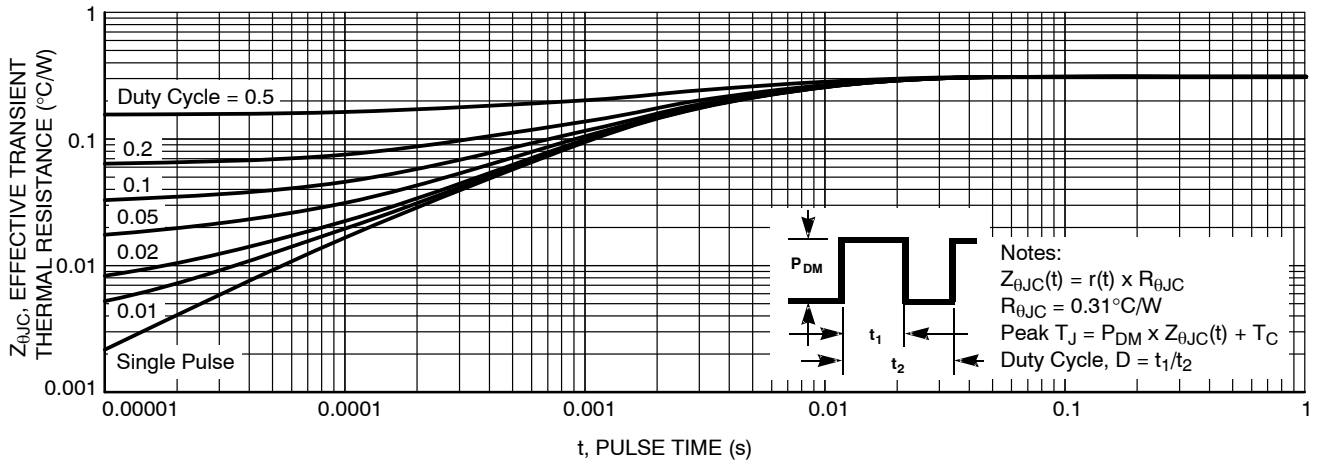
Figure 13. Junction−to−Ambient Transient Thermal Response Curve

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Quantity
NTH4L020N090SC1	H4L020090SC1	TO−247−4L	Tube	30 Units

TO−247−4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

NOTES:

A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

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