

# Silicon Carbide (SiC) Module – EliteSiC, 11 mohm, 1200 V, SiC M3S MOSFET, Full Bridge, F2 Package

Product Preview

## NXH011F120M3F2PTHG

The NXH011F120M3F2PTHG is a power module containing 11 mΩ / 1200 V SiC MOSFET full-bridge and a thermistor with HPS DBC in an F2 package.

### Features

- 11 mΩ / 1200 V M3S SiC MOSFET Full-Bridge
- HPS DBC
- Thermistor
- Options with Pre-Applied Thermal Interface Material (TIM) and without Pre-Applied TIM
- Press-Fit Pins
- These Devices are Pb-Free, Halide Free and are RoHS Compliant

### Typical Applications

- Solar Inverter
- Uninterruptible Power Supplies
- Electric Vehicle Charging Stations
- Industrial Power

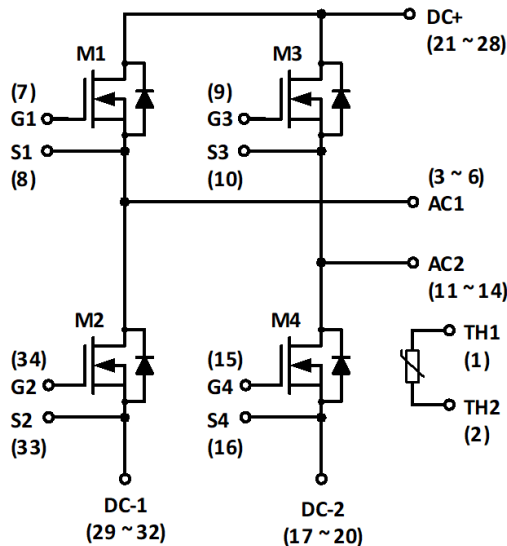
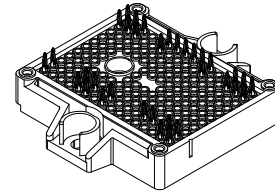


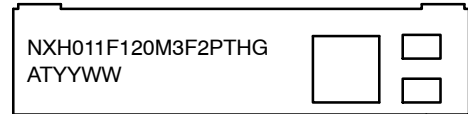
Figure 1. NXH011F120M3F2PTHG Schematic Diagram

This document contains information on a product under development. onsemi reserves the right to change or discontinue this product without notice.



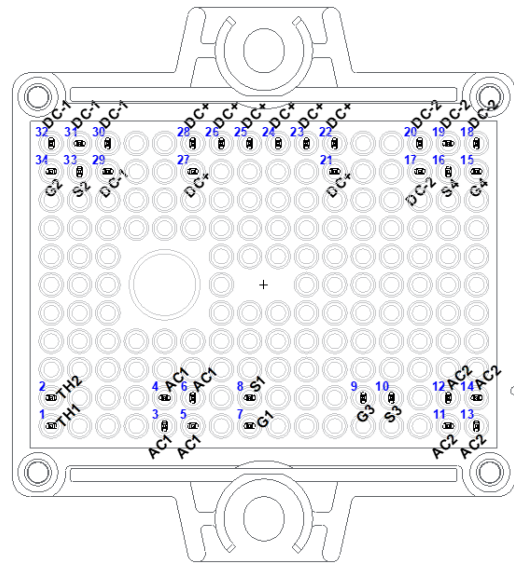
PIM34 56.7x42.5 (PRESS FIT)  
CASE 180HU

### MARKING DIAGRAM



NXH011F120M3F2PTHG = Specific Device Code  
AT = Assembly & Test Site Code  
YWW = Year and Work Week Code

### PIN CONNECTIONS



See Pin Function Description for pin names

### ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

# NXH011F120M3F2PTHG

## PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	TH1	Thermistor Connection 1
2	TH2	Thermistor Connection 2
3	AC1	Center point of full bridge 1
4	AC1	Center point of full bridge 1
5	AC1	Center point of full bridge 1
6	AC1	Center point of full bridge 1
7	G1	M1 Gate (High side switch)
8	S1	M1 Kelvin Emitter (High side switch)
9	G3	M3 Gate (High side switch)
10	S3	M3 Kelvin Emitter (High side switch)
11	AC2	Center point of full bridge 2
12	AC2	Center point of full bridge 2
13	AC2	Center point of full bridge 2
14	AC2	Center point of full bridge 2
15	G4	M4 Gate (Low side switch)
16	S4	M4 Kelvin Emitter (Low side switch)
17	DC-2	DC Negative Bus connection
18	DC-2	DC Negative Bus connection
19	DC-2	DC Negative Bus connection
20	DC-2	DC Negative Bus connection
21	DC+	DC Positive Bus connection
22	DC+	DC Positive Bus connection
23	DC+	DC Positive Bus connection
24	DC+	DC Positive Bus connection
25	DC+	DC Positive Bus connection
26	DC+	DC Positive Bus connection
27	DC+	DC Positive Bus connection
28	DC+	DC Positive Bus connection
29	DC-1	DC Negative Bus connection
30	DC-1	DC Negative Bus connection
31	DC-1	DC Negative Bus connection
32	DC-1	DC Negative Bus connection
33	S2	Q2 Kelvin Emitter (Low side switch)
34	G2	Q2 Gate (Low side switch)

# NXH011F120M3F2PTHG

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
<b>SiC MOSFET</b>			
Drain–Source Voltage	$V_{DSS}$	1200	V
Gate–Source Voltage	$V_{GS}$	+22/–10	V
Continuous Drain Current @ $T_c = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )	$I_D$	105	A
Pulsed Drain Current ( $T_J = 175^\circ\text{C}$ )	$I_{Dpulse}$	316	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{tot}$	244	W
Minimum Operating Junction Temperature	$T_{JMIN}$	–40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{JMAX}$	175	$^\circ\text{C}$

## THERMAL PROPERTIES

Storage Temperature Range	$T_{stg}$	–40 to 150	$^\circ\text{C}$
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## INSULATION PROPERTIES

Isolation Test Voltage, $t = 1$ s, 60 Hz	$V_{is}$	4800	$V_{RMS}$
Creepage Distance		12.7	mm
CTI		600	
Substrate Ceramic Material		HPS	
Substrate Ceramic Material Thickness		0.38	mm

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. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

## RECOMMENDED OPERATING RANGES

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	$T_J$	–40	150	$^\circ\text{C}$

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>SiC MOSFET CHARACTERISTICS</b>						
Zero Gate Voltage Drain Current	$V_{GS} = 0$ V, $V_{DS} = 1200$ V, $T_J = 25^\circ\text{C}$	$I_{DSS}$	–	–	300	$\mu\text{A}$
Drain–Source On Resistance	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 25^\circ\text{C}$	$R_{DS(ON)}$	–	11.3	16	m $\Omega$
	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 125^\circ\text{C}$		–	19.3	–	
	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 150^\circ\text{C}$		–	21.9	–	
Gate–Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 60$ mA	$V_{GS(TH)}$	2.04	2.72	4.4	V
Gate Leakage Current	$V_{GS} = -10$ V / 22 V, $V_{DS} = 0$ V	$I_{GSS}$	–2	–	2	$\mu\text{A}$
Input Capacitance	$V_{GS} = 0$ V, $f = 1$ MHz, $V_{DS} = 800$ V	$C_{ISS}$	–	6211.6	–	pF
Reverse Transfer Capacitance		$C_{RSS}$	–	33.1	–	
Output Capacitance		$C_{OSS}$	–	345.4	–	
Total Gate Charge	$V_{GS} = -3/18$ V, $V_{DS} = 800$ V, $I_D = 40$ A	$Q_{G(TOTAL)}$	–	284	–	nC
Gate–Source Charge		$Q_{GS}$	–	26	–	nC
Gate–Drain Charge		$Q_{GD}$	–	74	–	nC
Internal Gate Resistance	$f = 1$ MHz	$R_{GINT}$	–	0.75	–	$\Omega$

# NXH011F120M3F2PTHG

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>SiC MOSFET CHARACTERISTICS</b>						
Turn-on Delay Time	$T_J = 25^\circ\text{C}$ $V_{DS} = 800\text{ V}$ , $I_D = 100\text{ A}$ $V_{GS} = -3\text{ V}$ / $18\text{ V}$ , $R_G = 3.9\ \Omega$	$t_{d(on)}$	–	30.9	–	ns
Rise Time		$t_r$	–	12.7	–	
Turn-off Delay Time		$t_{d(off)}$	–	110.5	–	
Fall Time		$t_f$	–	12.6	–	
Turn-on Switching Loss per Pulse		$E_{ON}$	–	1.52	–	mJ
Turn-off Switching Loss per Pulse		$E_{OFF}$	–	0.5	–	
Turn-on Delay Time	$T_J = 150^\circ\text{C}$ $V_{DS} = 800\text{ V}$ , $I_D = 100\text{ A}$ $V_{GS} = -3\text{ V}$ / $18\text{ V}$ , $R_G = 3.9\ \Omega$	$t_{d(on)}$	–	30	–	ns
Rise Time		$t_r$	–	11.2	–	
Turn-off Delay Time		$t_{d(off)}$	–	123	–	
Fall Time		$t_f$	–	13.8	–	
Turn-on Switching Loss per Pulse		$E_{ON}$	–	2.04	–	mJ
Turn off Switching Loss per Pulse		$E_{OFF}$	–	0.59	–	
Diode Forward Voltage	$I_D = 100\text{ A}$ , $T_J = 25^\circ\text{C}$	$V_{SD}$	–	5.21	6.2	V
	$I_D = 100\text{ A}$ , $T_J = 125^\circ\text{C}$		–	5.11	–	
	$I_D = 100\text{ A}$ , $T_J = 150^\circ\text{C}$		–	5.02	–	
Thermal Resistance – Chip-to-Case	M1, M2, M3, M4	$R_{thJC}$	–	0.39	–	$^\circ\text{C/W}$
Thermal Resistance – Chip-to-Heatsink		$R_{thJH}$	–	0.61	–	$^\circ\text{C/W}$

## Thermistor Characteristics

Nominal Resistance	$T = 25^\circ\text{C}$	$R_{25}$	–	5	–	k $\Omega$
	$T = 100^\circ\text{C}$	$R_{100}$	–	493	–	$\Omega$
	$T = 150^\circ\text{C}$		–	159.5	–	$\Omega$
Deviation of $R_{100}$	$T = 100^\circ\text{C}$	R/R	-5	–	5	%
Power Dissipation – Recommended Limit	0.15 mA, Non-self-heating Effect	$P_D$	–	0.1	–	mW
Power Dissipation – Absolute Maximum	5 mA	$P_D$		34.2		
Power Dissipation Constant			–	1.4	–	mW/K
B-value	B(25/50), tolerance $\pm 3\%$		–	3375	–	K
B-value	B(25/100), tolerance $\pm 3\%$		–	3436	–	K

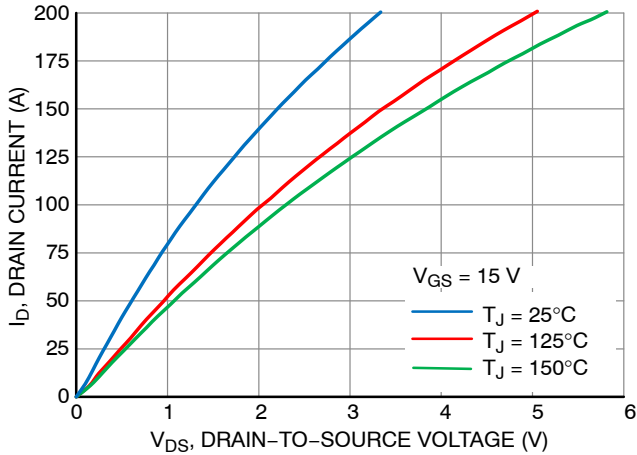
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## ORDERING INFORMATION

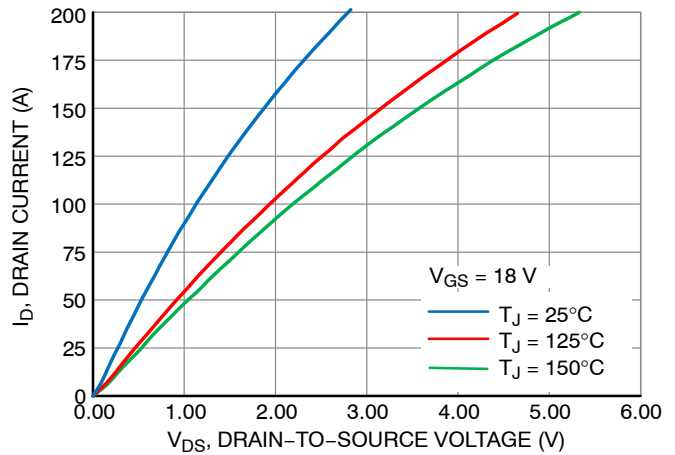
Orderable Part Number	Marking	Package	Shipping
NXH011F120M3F2PTHG	NXH011F120M3F2PTHG	F2FULLBR: Case 180HU Press-fit Pins with pre-applied thermal interface material (TIM) (Pb-Free / Halide Free)	20 Units / Blister Tray

# NXH011F120M3F2PTHG

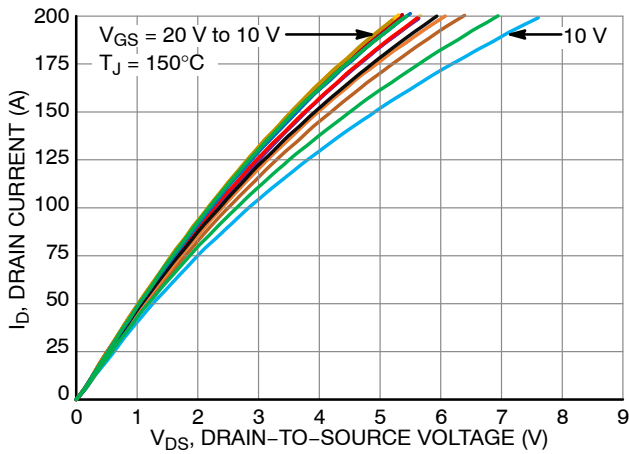
## TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)



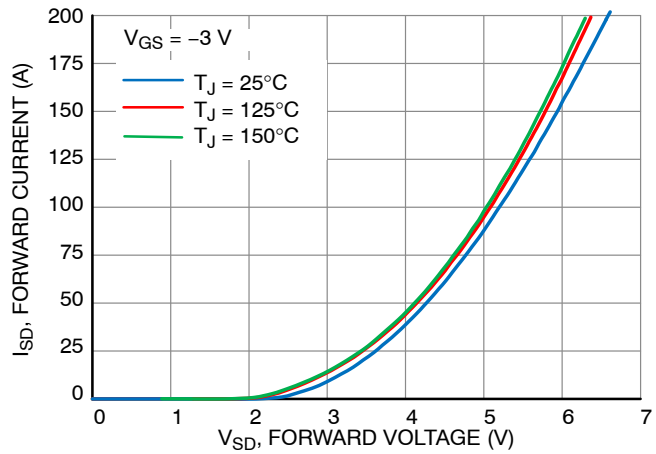
**Figure 2. MOSFET Typical Output Characteristic  $V_{GS} = 15\text{ V}$**



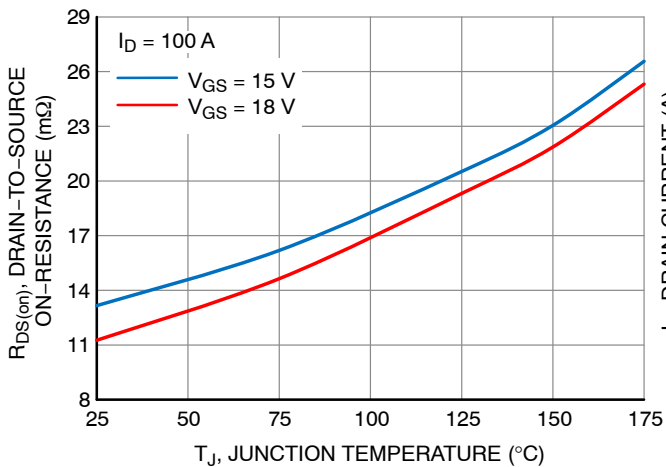
**Figure 3. MOSFET Typical Output Characteristic  $V_{GS} = 18\text{ V}$**



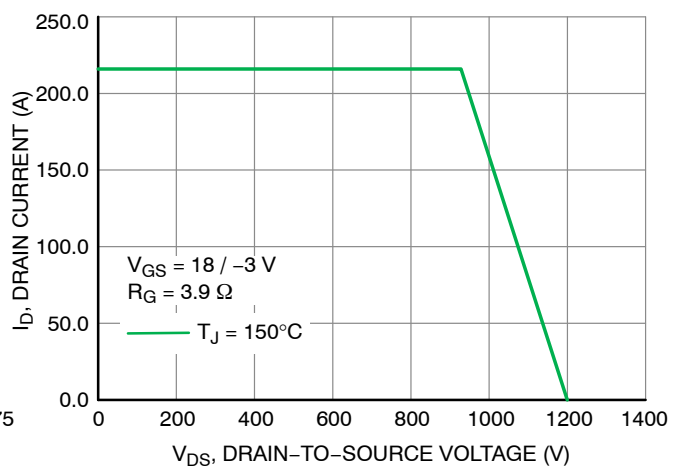
**Figure 4. MOSFET Typical Output Characteristic  $V_{GS} = \text{Var.}$**



**Figure 5. Body Diode Forward Characteristic**



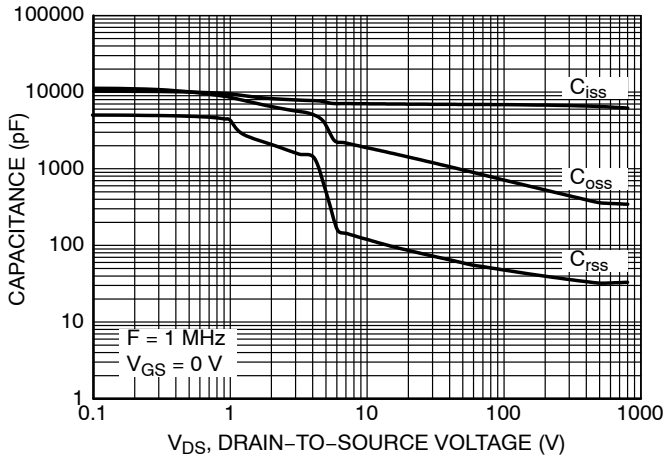
**Figure 6.  $R_{DS(on)}$  Drain-to-Source ON Resistance vs. Junction Temperature**



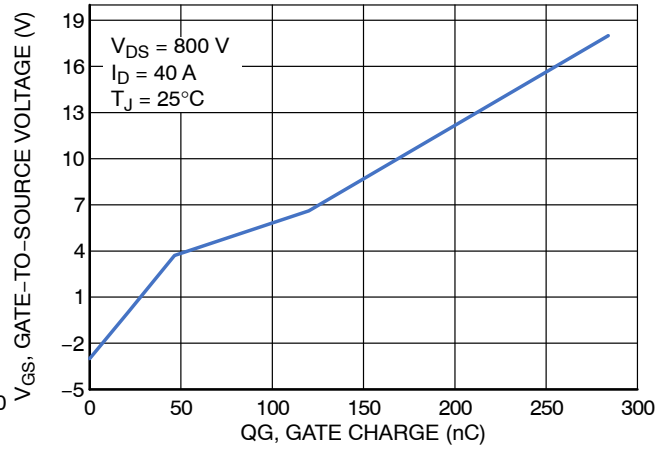
**Figure 7. Reverse Bias Safe Operating Area (RBSOA)**

# NXH011F120M3F2PTHG

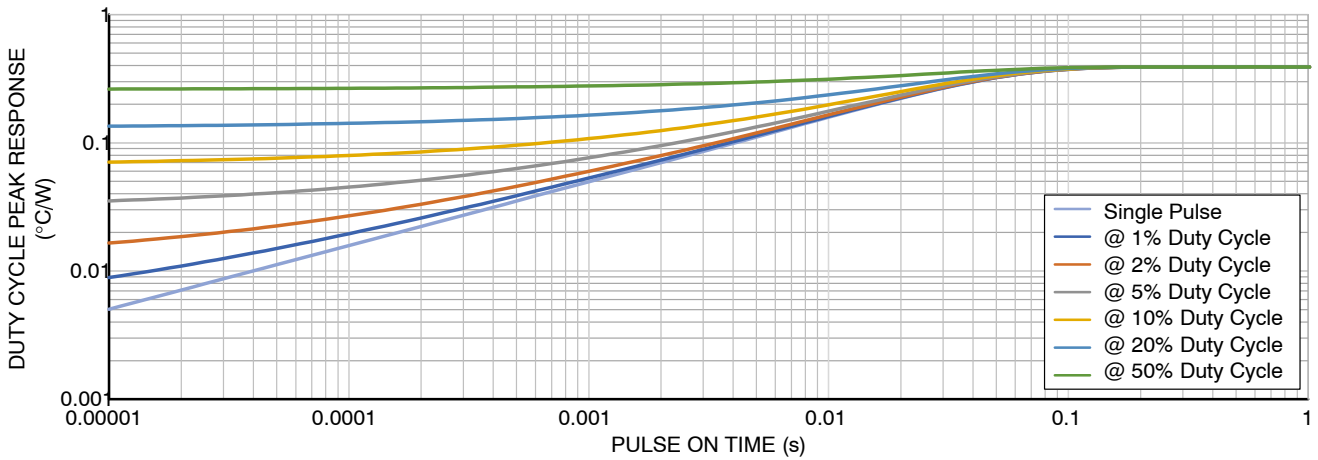
## TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)



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



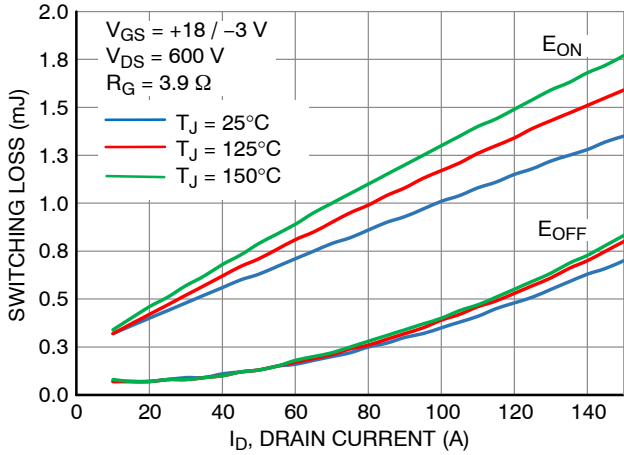
**Figure 9. Gate-to-Source Voltage vs. Gate Charge**



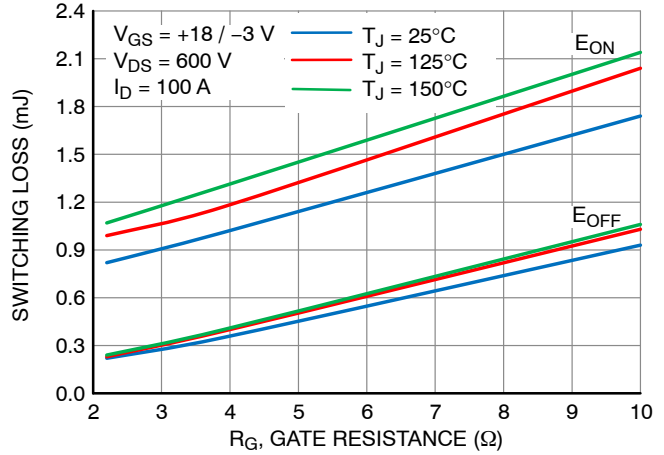
**Figure 10. Duty Cycle Peak Response vs. Pulse on Time**

# NXH011F120M3F2PTHG

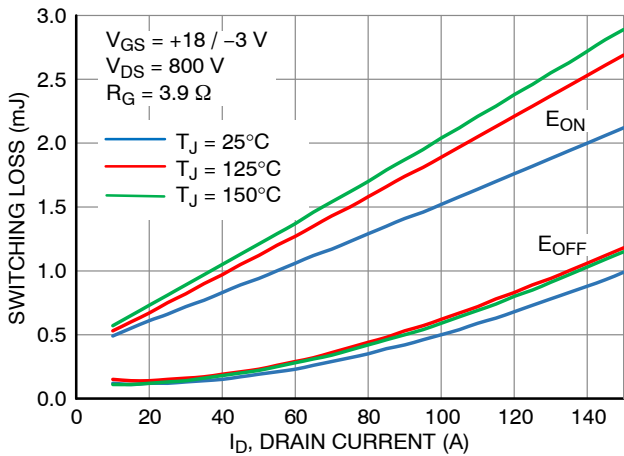
## TYPICAL CHARACTERISTICS M1/M2 SIC MOSFET CHARACTERISTIC



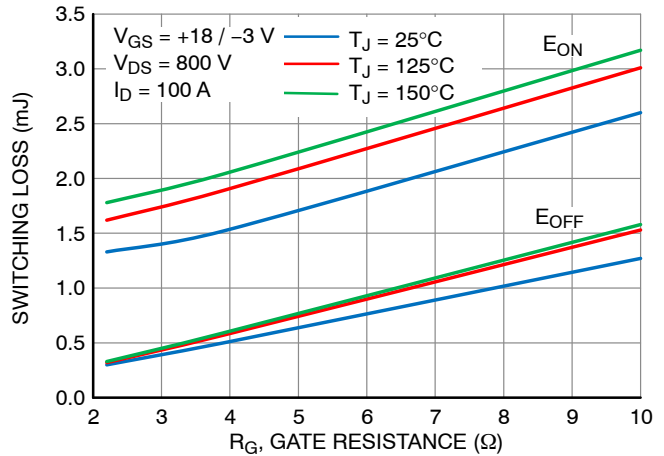
**Figure 11. Switching Loss vs. Drain Current**  
 $V_{DS} = 600 \text{ V}$



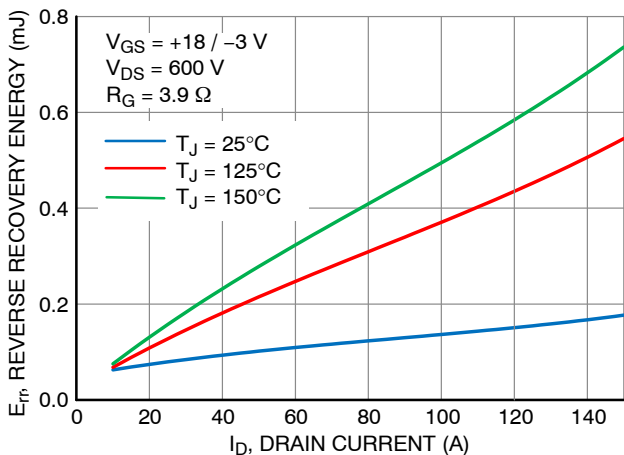
**Figure 12. Switching Loss vs. Gate Resistance**  
 $V_{DS} = 600 \text{ V}$



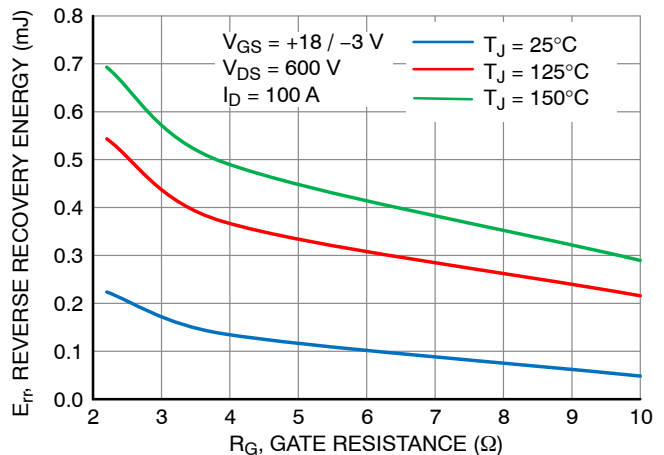
**Figure 13. Switching Loss vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$



**Figure 14. Switching Loss vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$



**Figure 15. Reverse Recovery Energy vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$

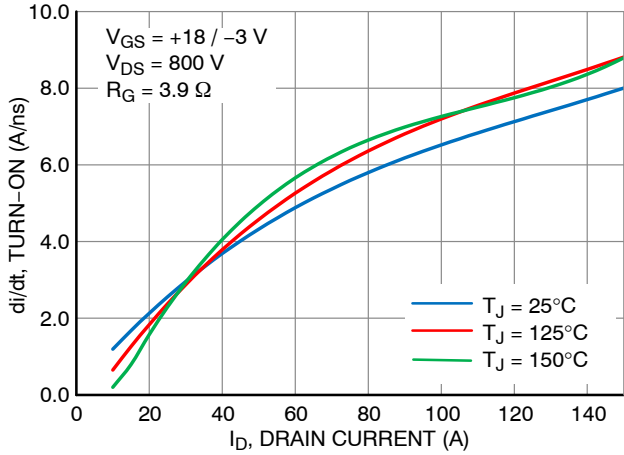


**Figure 16. Reverse Recovery Energy vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$

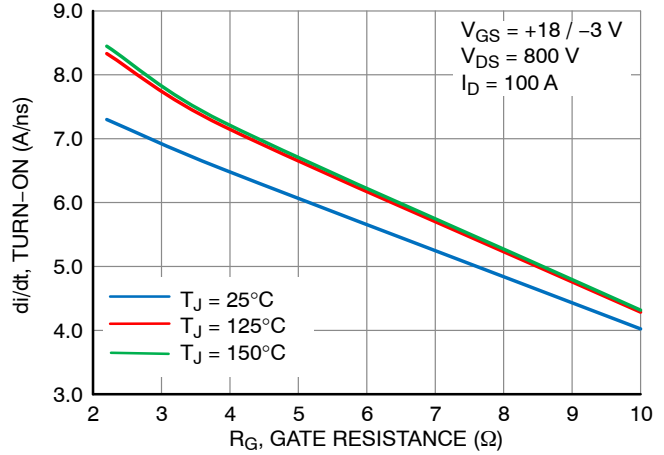
# NXH011F120M3F2PTHG

## TYPICAL CHARACTERISTICS

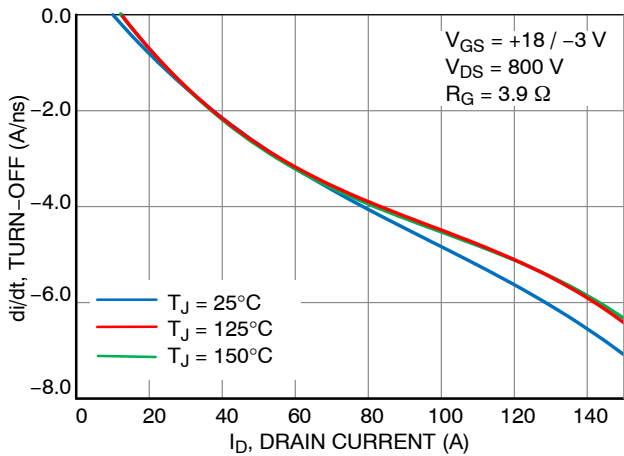
M1/M2 SIC MOSFET CHARACTERISTIC



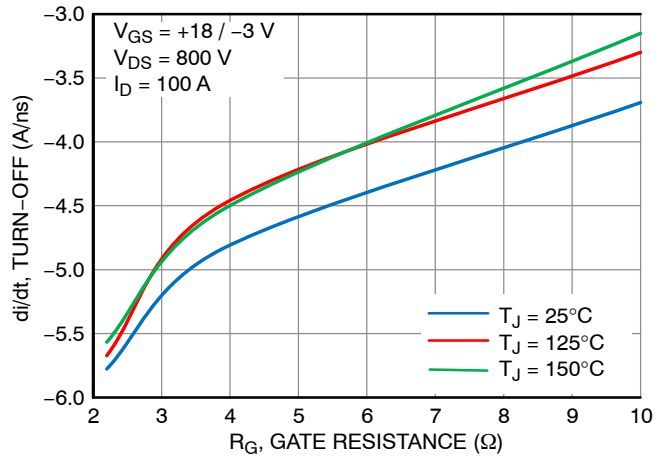
**Figure 17. di/dt Turn ON vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$



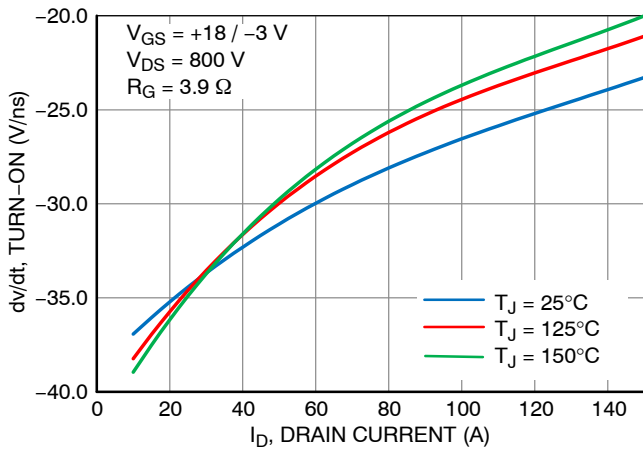
**Figure 18. di/dt Turn ON vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$



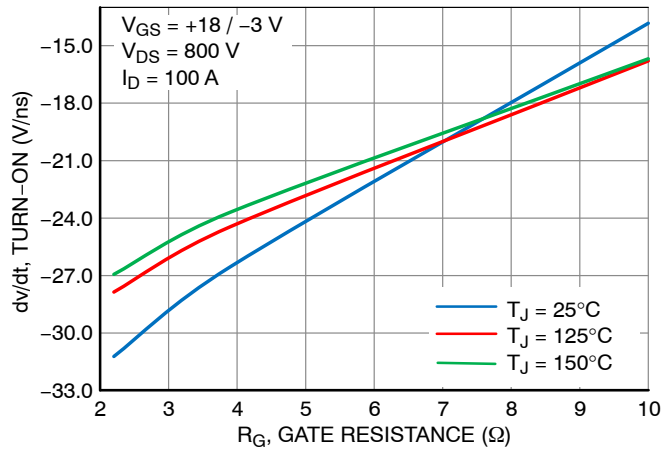
**Figure 19. di/dt Turn OFF vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$



**Figure 20. di/dt Turn OFF vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$



**Figure 21. dv/dt Turn ON vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$



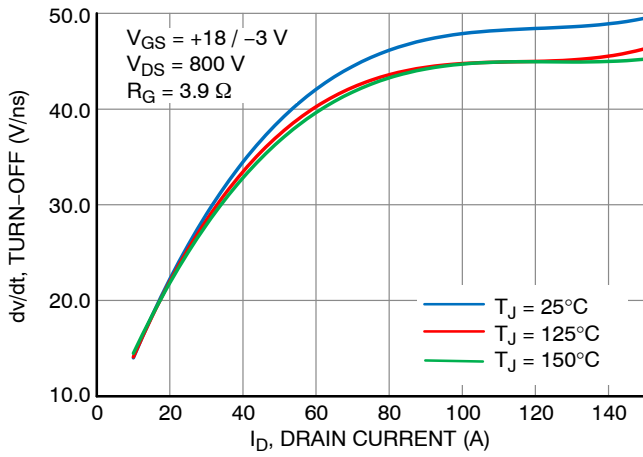
**Figure 22. dv/dt Turn ON vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$



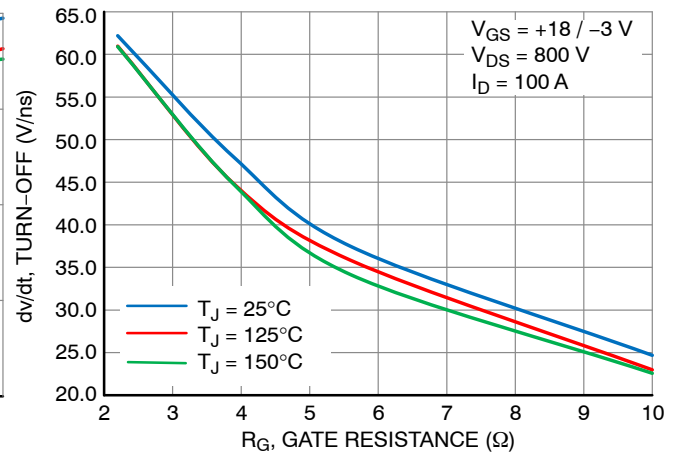
# NXH011F120M3F2PTHG

## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC



**Figure 23. dv/dt Turn OFF vs. Drain Current**  
 $V_{DS} = 800 \text{ V}$



**Figure 24. dv/dt Turn OFF vs. Gate Resistance**  
 $V_{DS} = 800 \text{ V}$

**Table 1. CAUER NETWORKS**

Cauer Element #	Rth (K/W)	Cth (Ws/K)
1	0.0022462	0.002014
2	0.0073332	0.00085002
3	0.03082	0.003288
4	0.091713	0.013039
5	0.16207	0.073797
6	0.033629	4.7279

# NXH011F120M3F2PTHG

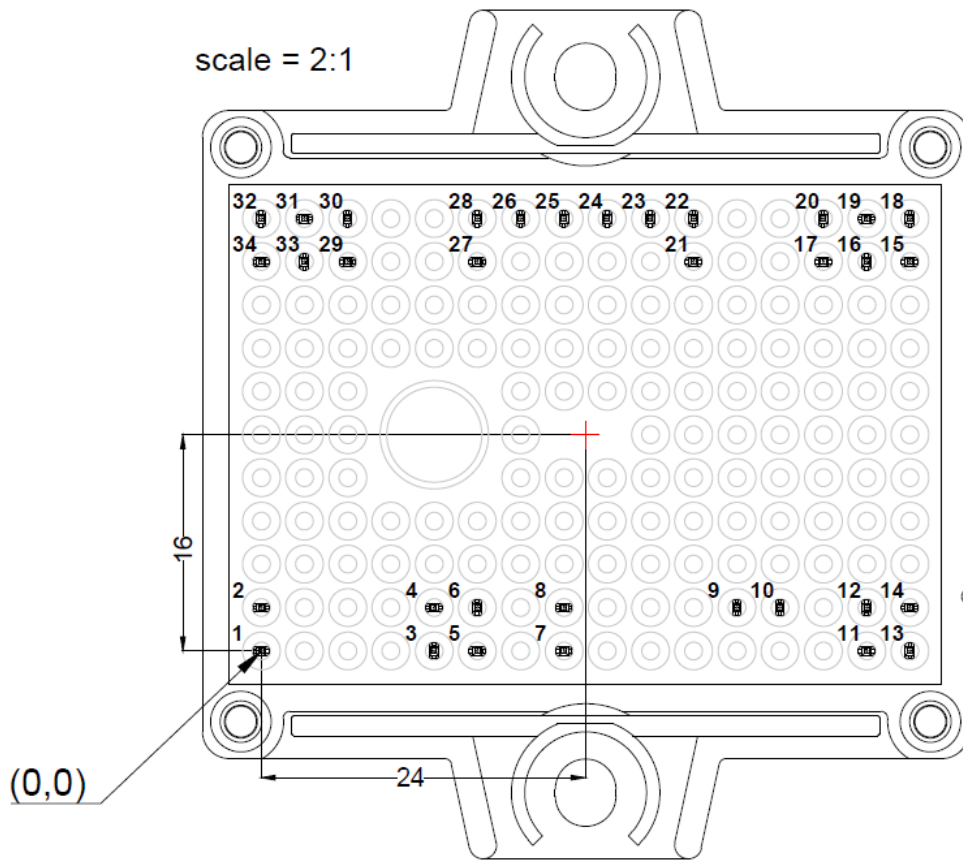


Figure 25.

## Pin position

Pin #	X	Y	Function	Pin #	X	Y	Function
1	0	0	TH1	18	48	32	DC-2
2	0	3.2	TH2	19	44.8	32	DC-2
3	12.8	0	AC1	20	41.6	32	DC-2
4	12.8	3.2	AC1	21	32	28.8	DC+
5	16	0	AC1	22	32	32	DC+
6	16	3.2	AC1	23	28.8	32	DC+
7	22.4	0	G1	24	25.6	32	DC+
8	22.4	3.2	S1	25	22.4	32	DC+
9	35.2	3.2	G3	26	19.2	32	DC+
10	38.4	3.2	S3	27	16	28.8	DC+
11	44.8	0	AC2	28	16	32	DC+
12	44.8	3.2	AC2	29	6.4	28.8	DC-1
13	48	0	AC2	30	6.4	32	DC-1
14	48	3.2	AC2	31	3.2	32	DC-1
15	48	28.8	G4	32	0	32	DC-1
16	44.8	28.8	S4	33	3.2	28.8	S2
17	41.6	28.8	DC-2	34	0	28.8	G2

Figure 26.

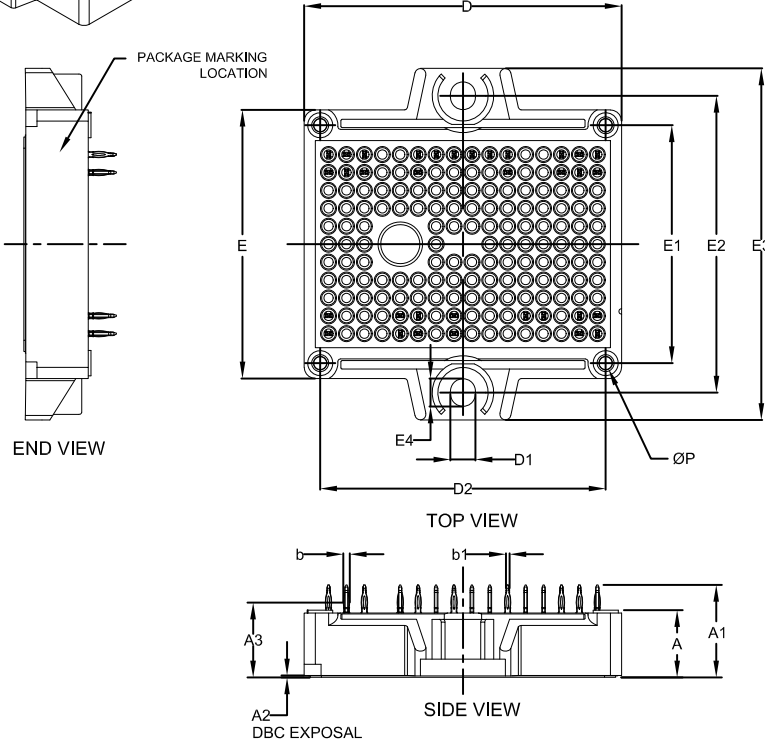
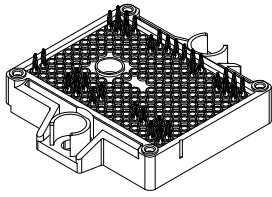
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



**PIM34 56.70x42.50x12.00**  
**CASE 180HU**  
**ISSUE A**

DATE 07 FEB 2024

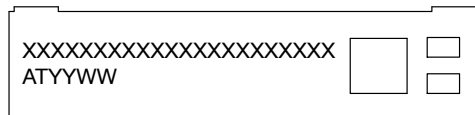


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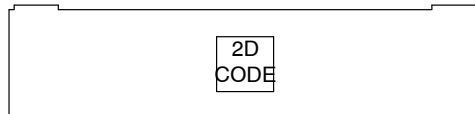
1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS  $\pm 0.4\text{mm}$
3. PRESS FIT PIN

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.65	12.00	12.35
A1	16.10	16.50	16.90
A2	0.00	0.35	0.60
A3	12.85	13.35	13.85
b	1.15	1.20	1.25
b1	0.59	0.64	0.69
D	56.40	56.70	57.00
D1	4.40	4.50	4.60
D2	50.85	51.00	51.15
E	47.70	48.00	48.30
E1	42.35	42.50	42.65
E2	52.90	53.00	53.10
E3	62.30	62.80	63.30
E4	4.90	5.00	5.10
P	2.20	2.30	2.40

**GENERIC MARKING DIAGRAM\***



FRONTSIDE MARKING



BACKSIDE MARKING

XXXXX = Specific Device Code  
 AT = Assembly & Test Site Code  
 YYWW = Year and Work Week 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.

<b>DOCUMENT NUMBER:</b>	<b>98AON57392H</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>PIM34 56.70x42.50x12.00</b>	<b>PAGE 1 OF 2</b>

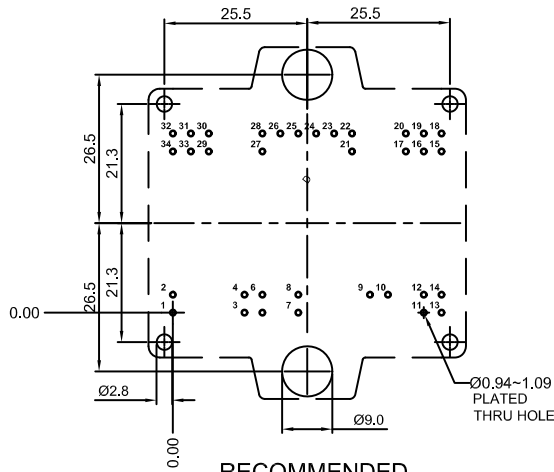
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**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**



**PIM34 56.70x42.50x11.50**  
**CASE 180HU**  
**ISSUE A**

DATE 07 FEB 2024



**RECOMMENDED MOUNTING PATTERN**

\* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

Note2:

Pin	X	Y	Pin	X	Y
1	0	0	18	48	32
2	0	3.2	19	44.8	32
3	12.8	0	20	41.6	32
4	12.8	3.2	21	32	28.8
5	16	0	22	32	32
6	16	3.2	23	28.8	32
7	22.4	0	24	25.6	32
8	22.4	3.2	25	22.4	32
9	35.2	3.2	26	19.2	32
10	38.4	3.2	27	16	28.8
11	44.8	0	28	16	32
12	44.8	3.2	29	6.4	28.8
13	48	0	30	6.4	32
14	48	3.2	31	3.2	32
15	48	28.8	32	0	32
16	44.8	28.8	33	3.2	28.8
17	41.6	28.8	34	0	28.8

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