

Technical Explanation

SEMiX[®] Press-Fit



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1. Introduction.....	2
2. Type Designation System	3
3. Laser Marking	3
4. Transport Package.....	4
5. Temperature Sensor	5
6. Transient Thermal Impedance.....	6

1. Introduction

The SEMiX 3p package combines the proven SEMiX platform with Press-Fit technology for a quick and easy assembly process of gate driver connections.

The concept of SEMiX is a baseplate-module with 17mm height and separated AC and DC screw terminals, which allows for a gate driver mounted directly on top of the module.

SEMiX 3p is available as IGBT modules, with latest dies sourced from various suppliers, as well as matching rectifier types.

Figure 1: SEMiX 3p



The product family features several voltage classes with a broad current range in various topologies. This supports supply chain safety and comparable modules with solder pins can be replaced as well.

Select half-bridge types have a built-in shunt resistor for measuring the AC current. This allows the footprint and main connections to remain identical to the standard module, while eliminating the need for external current sensors. Integrating the current monitoring into the power module reduces inverter volume and decreases system costs. Additionally, reducing components in the inverter enhances the FIT rate.

The dedicated SKYPER 12 PF gate driver is electrically robust and has 30% fewer components than available plug & play solutions. By this it achieves an MTBF rate of 7.5 million hours at full load. Module and driver together are a cost attractive bundle.

A further option is to purchase Thermal Interface Material applied to the baseplate. Print patterns are optimized for the specific module variant for best performance.

Figure 2: SKYPER 12 PF and Thermal Interface Material



2. Type Designation System

Example: SEMiX703GB12M7HDp

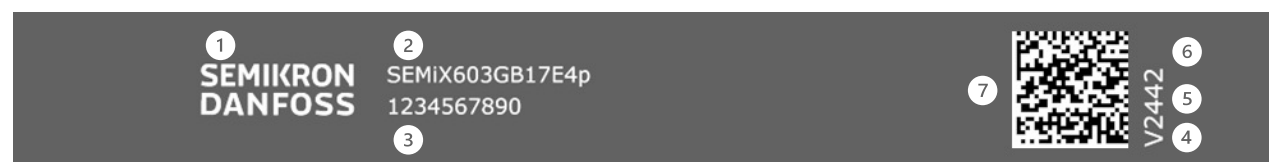
SEMiX	70.....	3.....	GB.....	12.....	M7.....	HD.....	p.....	
a)	b)	c)	d)	e)	f)	g)	h)	i)

- a) Product group
- b) Nominal output current /10A
- c) Housing size 3 (other sizes within extended SEMiX group)
- d) Topology
 - GB = IGBT half bridge
 - GAL = IGBT boost chopper
 - GAR = IGBT buck chopper
 - GM = IGBT common emitter
 - KD = Diode rectifier half bridge
 - KE = Single diode rectifier
 - KH = Half controlled rectifier half bridge
 - KT = Controlled rectifier half bridge
 - KQ = Anti-parallel controlled rectifier half bridge
- e) Voltage class
 - 12 = 1200 V
 - 16 = 1600 V
 - 17 = 1700 V
 - 22 = 2200 V
- f) IGBT technology
 - E4 = IGBT 4
 - E7 = Gen. 7 IGBT
 - M7 = Gen. 7 IGBT (from another supplier)
- g) Diode technology or shunt resistance (optional)
 - not specified = CAL4 F
 - D = CAL4 F with $I_{f\ nom} > I_{c\ nom}$
 - HD = CAL4 HD
 - SiC = Silicon Carbide
 - Ixx = Shunt resistance with value xx*0.01mΩ
- h) Press-fit pins as auxiliary contacts (other contact types within extended SEMiX group)
- i) Appendix (optional)
 - V1, V2, ... = deviation from type without appendix

3. Laser Marking

Every SEMiX 3p module has a label with a laser marking. The typical elements are shown in the following figure and explained below.

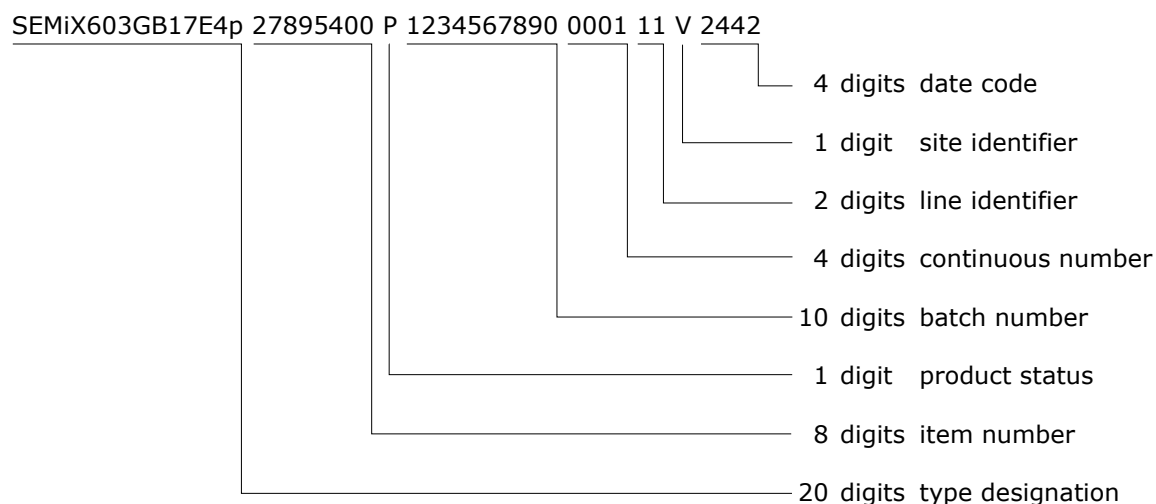
Figure 3: Typical laser marking



- 1 Company logo
- 2 Type designation (see chapter 2)
- 3 Batch number
- 4 Site identifier (V = Vrbové, Slovakia)

- 5 Date Code with 4 digits (YYWW = YearYearWeekWeek)
- 6 Product status: "E" in case of sample will be displayed, "P" for series type will not be printed
- 7 Data Matrix Code (symbol size 26 x 26)

Example of encoded information:



Not needed digits are filled with blanks

4. Transport Package

SEMiX 3p is packed in a transparent ESD tray inside a cardboard box. Dimensions of the cardboard box are 347mm x 270mm x 45mm (L x W x H). The tray is made from APET that is in accordance with ESD standard IEC 61340-5-1.

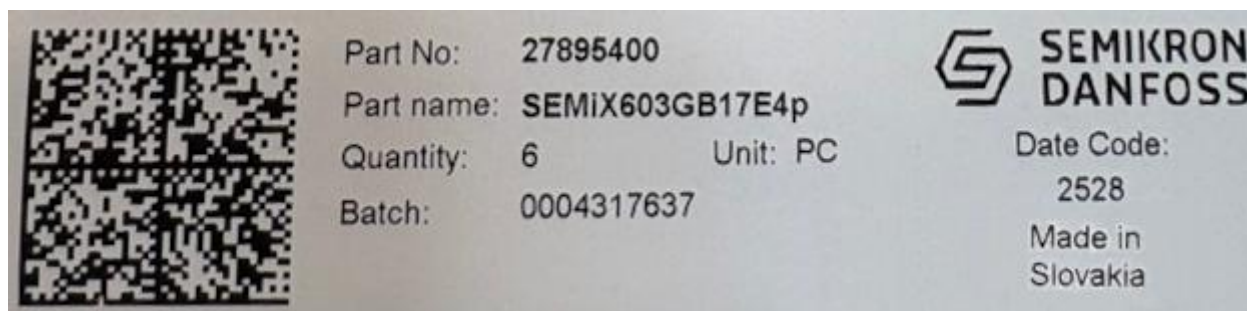
Standard packing unit is 6 pieces per box and maximum weight is 2.4kg then.

Figure 4: Cardboard box with modules in transparent ESD tray



Each box is labelled with a sticker (see Figure 5) that describes the content in plain text. Additionally, the information is also provided in the Data Matrix Code.

Figure 5: Sticker on cardboard box



Example of Data Matrix content:

[>@06@1P27895400@1T0004317637@Q6@3QPC@41PSEMIX603GB17E4p@10LSlovakia@42PSEMikron_DANFOSS@16D2528@30P@2T@4T@18D@19D@14D@K@P@@

Identifier	Information	Example
@1P	Part number	27895400
@1T	Lot number	0004317637
@Q	Quantity	6
@3Q	Unit	PC (=pieces)
@41P	Part name	SEMIX903GB17E7pV2
@10L	Country of origin	Slovakia
@42P	Producer	SEMikron_DANFOSS
@16D	Date Code	2528

5. Temperature Sensor

All SEMiX 3p types feature a temperature sensor that reflects the case temperature. The sensor is a resistor with negative temperature coefficient (NTC). Its characteristic is shown in Figure 6 and more detailed in Figure 7.

Figure 6: Typical characteristic of NTC temperature sensor

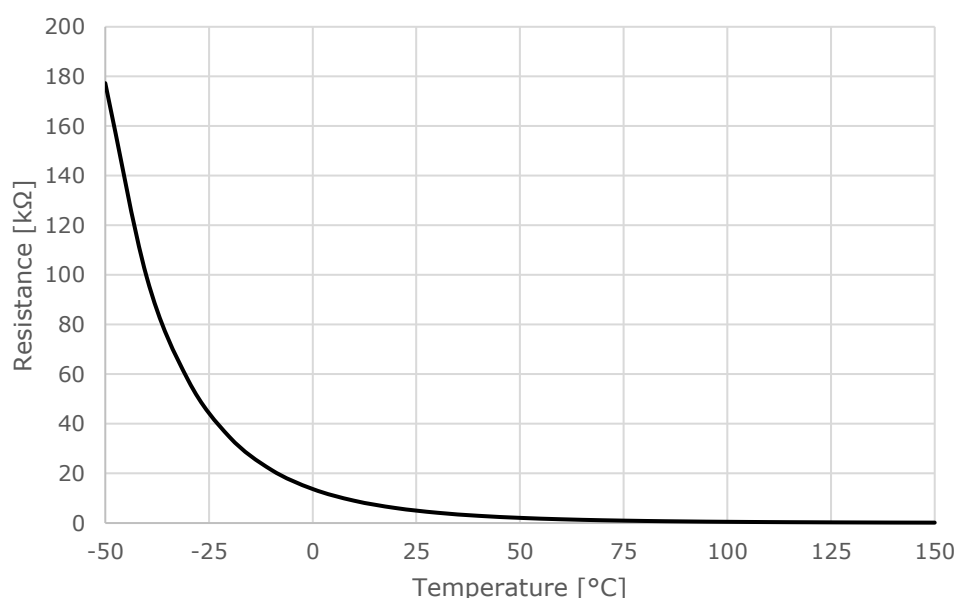
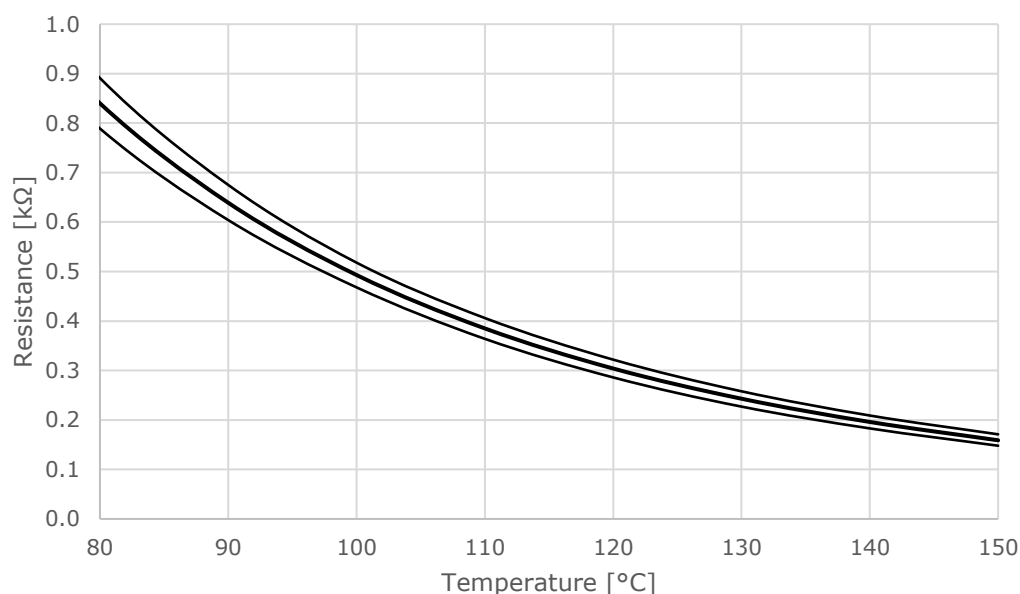


Figure 7: Characteristic of NTC temperature sensor including tolerances


Temperature [°C]	Resistance [kΩ]			Tolerance [%]
	minimum	typical	maximum	
-50	148.183	177.265	211.525	20.2
-40	83.924	99.034	116.572	18.5
-30	49.348	57.508	66.850	16.2
-20	30.019	34.582	39.738	14.9
-10	18.832	21.465	24.404	13.7
0	12.151	13.713	15.438	12.6
10	8.044	8.995	10.034	11.6
20	5.452	6.045	6.685	10.6
30	3.776	4.153	4.557	9.7
40	2.668	2.913	3.172	8.9
50	1.920	2.082	2.251	8.1
60	1.406	1.514	1.626	7.4
70	1.046	1.119	1.195	6.8
80	0.789	0.840	0.891	6.1
90	0.604	0.639	0.675	5.6
100	0.468	0.493	0.518	5.0
110	0.364	0.385	0.406	5.5
120	0.286	0.304	0.322	6.0
130	0.227	0.243	0.258	6.5
140	0.183	0.196	0.209	7.0
150	0.148	0.159	0.171	7.4

6. Transient Thermal Impedance

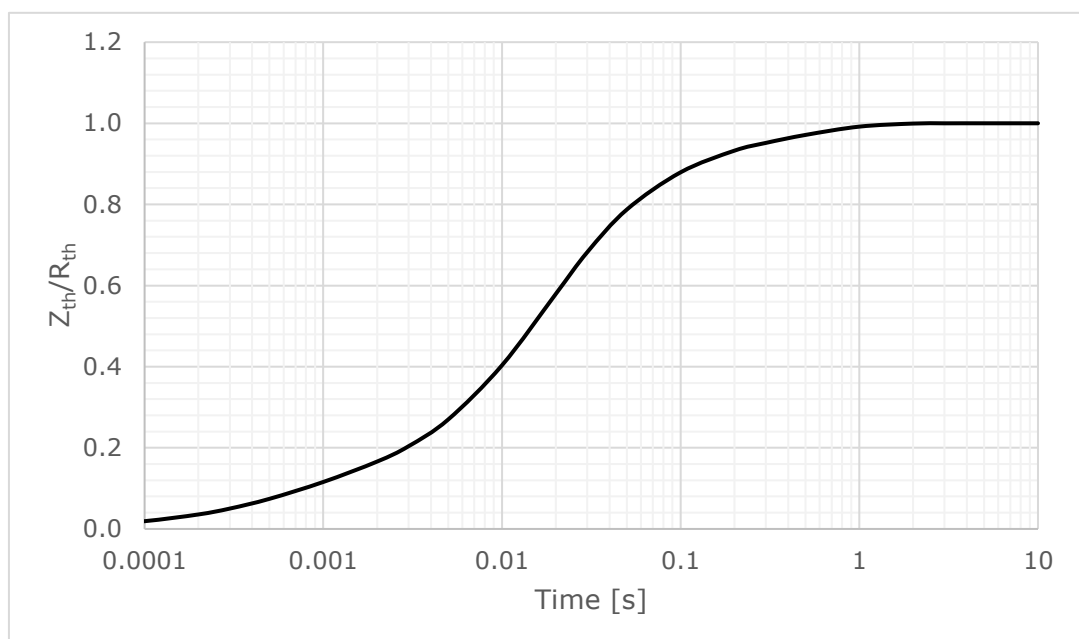
Data sheets of SEMiX 3p contain one figure showing the transient thermal impedance Z_{th} . Curves are calculated with the following equation:

$$Z_{th(j-c)}(t) = R_1 \times \left(1 - \exp\left(-\frac{t}{\tau_1}\right)\right) + R_2 \times \left(1 - \exp\left(-\frac{t}{\tau_2}\right)\right) + R_3 \times \left(1 - \exp\left(-\frac{t}{\tau_3}\right)\right) + R_4 \times \left(1 - \exp\left(-\frac{t}{\tau_4}\right)\right)$$

Coefficients:

$$\begin{aligned} R_1 &= 0.10 \times R_{th(j-c)} & \tau_1 &= 0.40000s \\ R_2 &= 0.26 \times R_{th(j-c)} & \tau_2 &= 0.05500s \\ R_3 &= 0.55 \times R_{th(j-c)} & \tau_3 &= 0.01500s \\ R_4 &= 0.09 \times R_{th(j-c)} & \tau_4 &= 0.00055s \end{aligned}$$

Figure 8: Relative transient thermal impedance



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