Control integrated Power System (CiPoS™)

IKCS12F60AA
IKCS12F60AB

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Power Management & Drives

Never stop thinking.

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Table of Contents

CiPoS™
Control integrated Power System

Single In-Line Intelligent Power Module

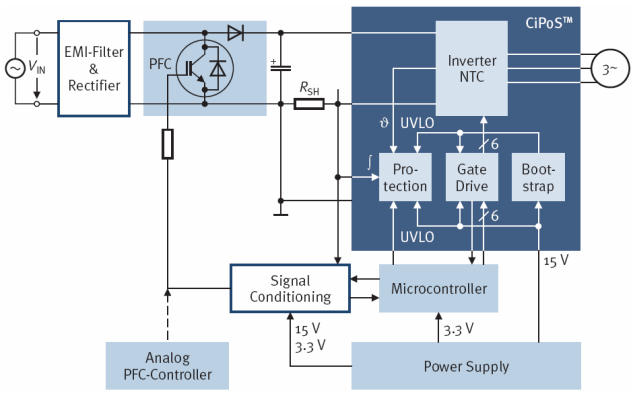
3Φ-bridge 600V / 12A @ 25°C

Features

- Fully isolated Single In-Line molded module
- Infineon TrenchStop® IGBTs with lowest $V_{CE(sat)}$
- Optimal adapted EmCon™ diode for low EMI
- SOI gate driver with bootstrap diode and capacitor
- Rugged SOI gate driver technology with stability against transient and negative voltage
- Temperature monitor and over temperature shutdown
- Overcurrent shutdown
- Undervoltage lockout at all channels
- Matched propagation delay for all channels
- Low side emitter pins accessible for all phase current monitoring
- Cross-conduction prevention
- Green mold compound, lead-free pins

Typical Applications

- Washing machines
- Air conditioners
- AC 3 phase motor drive



Description

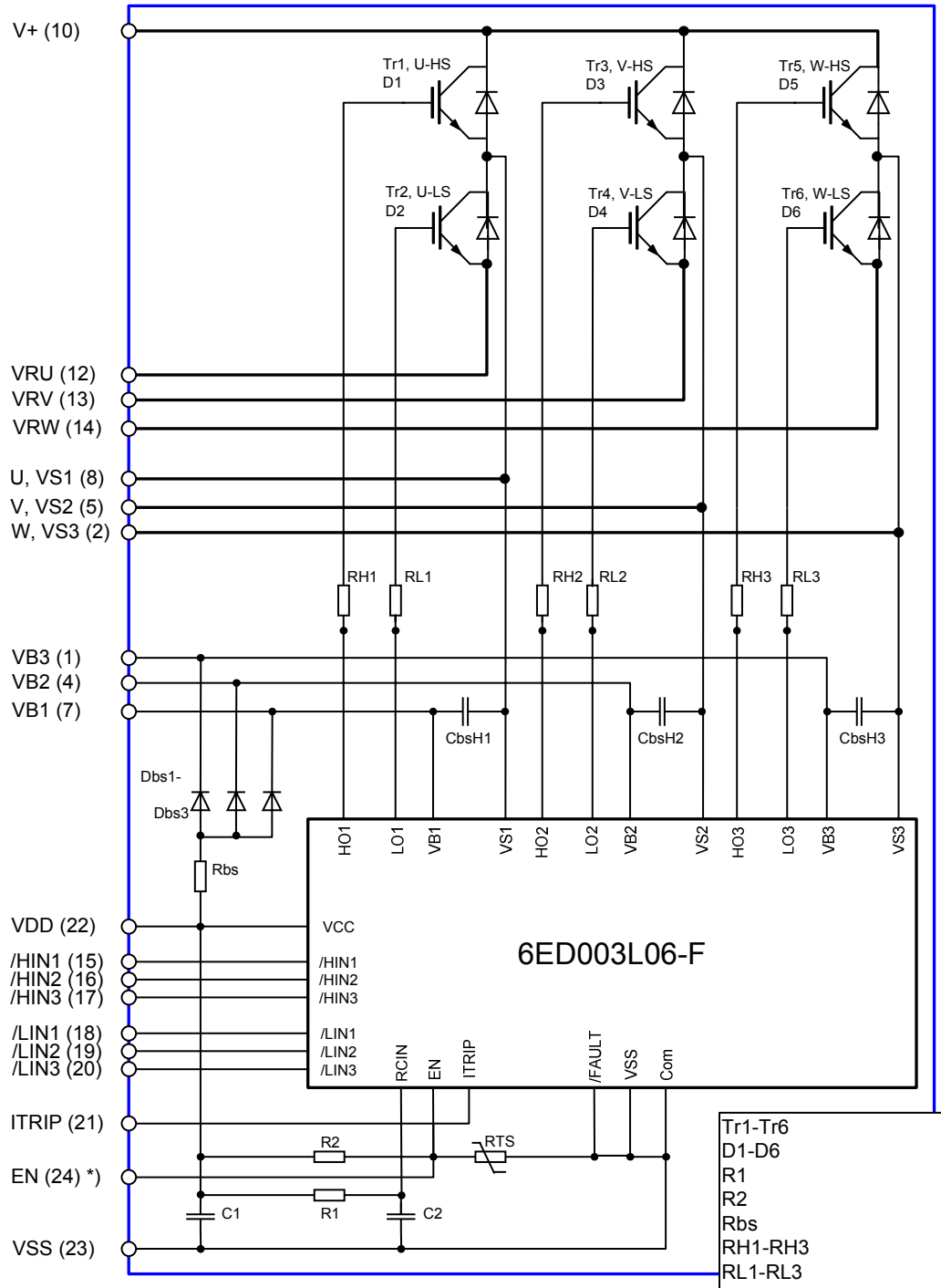
The CiPoS™ module family offers the chance for integrating various power and control components to increase reliability, optimize PCB size and system costs.

This SIL-IPM is designed to control AC motors in variable speed drives for applications like air conditioning, compressors and washing machines. The package concept is specially adapted to power applications, which need extremely good thermal conduction and electrical isolation, but also EMI-save control and overload protection. The features of Infineon TrenchStop® IGBTs and EmCon™ diodes are combined with a new optimized Infineon SOI gate driver for excellent electrical performance.

System Configuration

- 3 halfbridges with TrenchStop® IGBT & FW-EmCon™ diodes
- 3Φ SOI gate driver
- Bootstrap diodes for high side supply
- Integrated 100nF bootstrap capacitance
- Temperature sensor, passive components for adaptions
- Isolated heatsink
- Creepage distance 2.8mm

Internal Electrical Schematic



Tr1-Tr6	12 A @ 25°C/ 600 V
D1-D6	12 A @ 25°C/ 600 V
R1	91 kΩ
R2	24 kΩ
Rbs	10 Ω
RH1-RH3	30 Ω
RL1-RL3	30 Ω
RTS	100 kΩ, B25 = 4250 K
C1	100 nF/ 25 V
C2	100 nF/ 25 V
CbsH1-CbsH3	100 nF/ 25 V
Dbs1-Dbs3	0.5 A/ 600 V

*) not available at IKCS12F60AB

Pin Assignment

Pin Number	Pin Name	Pin Description
1	VB3	high side floating IC supply voltage
2	W,VS3	motor output W, high side floating IC supply offset voltage
3	na	none
4	VB2	high side floating IC supply voltage
5	V,VS2	motor output V, high side floating IC supply offset voltage
6	na	none
7	VB1	high side floating IC supply voltage
8	U,VS1	motor output U, high side floating IC supply offset voltage
9	na	none
10	V+	positive bus input voltage
11	na	none
12	VRU	low side emitter
13	VRV	low side emitter
14	VRW	low side emitter
15	/HIN1	input gate driver high side 1/U
16	/HIN2	input gate driver high side 2/V
17	/HIN3	input gate driver high side 3/W
18	/LIN1	input gate driver low side 1/U
19	/LIN2	input gate driver low side 2/V
20	/LIN3	input gate driver low side 3/W
21	ITRIP	input overcurrent shutdown
22	VDD	IC main supply +15V
23	VSS	IC negative supply
24*	EN*	input logic enable, output temperature monitoring *) not available at IKCS12F60AB

Absolute Maximum Ratings

(T_c = 25°C, if not stated otherwise)

Module Section

Description	Condition	Symbol	Value			Unit
			min	typ	max	
Storage temperature range		T_{stg}	-40	-	125	°C
Operating temperature control PCB[1]		T_{PCB}	-	125	-	°C
Solder temperature	Wave soldering, 1.6mm (0.063in.) from case for 10s	T_{sol}	-	260	-	°C
Insulation test voltage	RMS, f = 50Hz, t = 1min	V_{ISOL}	-	2500	-	V
Mounting torque	M3 screw, using a washer	M_S	-	0.5	0.6	Nm
Mounting pressure on surface	Package flat on mounting surface	N_{MC}	-	-	150	N/mm²
Weight		m_P	-	17	-	g
Creepage distance		d_S	2.8	-	-	mm

IGBT and Diode Section

Description	Condition	Symbol	Value			Unit
			min	typ	max	
Collector-Emitter breakdown voltage[2]	V_{GE} = 0V, I_C = 0.25mA t_p < 250ns	$V_{(BR)CES}$	600	-	-	V
DC output current	T_c = 25°C, T_{vJ} < 150°C T_c = 80°C, T_{vJ} < 150°C	I_u, I_v, I_w	-12 -6	-	12 6	A
Repetitive peak collector current	T_p limited by T_{vJmax}	I_u, I_v, I_w	-18	-	18	A
Short circuit withstand time[3]	V_{CC} = 15V, $V_{DC} \leq$ 400V, $T_j \leq$ 150°C	t_{sc}	-	5	-	µs
Power dissipation per IGBT	T_c = 25°C	P_{tot}	-	35	-	W
Operating junction temperature range	IGBT Diode	T_{vjI} T_{vjD}	-40 -40	- -	150 150	°C

[1] Monitored by pin 24
[2] For static operation with biased High-Side VS is reduced by 50V.
[3] Allowed number of short circuits: <1000; time between short circuits: >1s.

Description	Condition	Symbol	Value			Unit
			min	typ	max	
Single IGBT thermal resistance, junction-case		R_{thJC}	-	3.6	-	K/W
Single diode thermal resistance, junction-case		R_{thJCD}	-	4.9	-	

Control Section

Description	Condition	Symbol	Value		Unit
			min	max	
Module supply voltage		V_{DD}	-1	20	V
High side floating supply voltage (VB vs. VS)		V_{BS}	-1	20	
High side floating IC supply offset voltage	T_p < 250ns t_p < 500ns t_p ≥ 500ns	$V_{S1,2,3}$	- VDD-VBS-50 VDD-VBS-6	600 - 550	V
Input voltage	LIN, HIN, EN, ITRIP	V_{in}	-1	10	V
Operating junction temperature[1]		$T_{J,IC}$	-	125	
Max. switching frequency		f_{PWM}	-	20	kHz

Recommended Operation Conditions

All voltages are absolute voltages referenced to V_{SS} -Potential unless otherwise specified.

Description	Symbol	Value		Unit
		min	max	
High side floating supply offset voltage	V_S	-3	500	V
High side floating supply voltage (V_B vs. V_S)	V_{BS}	12.5	17.5	
High side output voltage (V_{HO} vs. V_S)	V_{HO}	0	V_{BS}	
Low side power supply	V_{DD}	12.5	17.5	
Logic input voltages LIN,HIN,EN,ITRIP	V_{IN}	0	5	

[1] Monitored by pin 24

Static Parameters

(T_c = 25°C, if not stated otherwise)

Description	Condition	Symbol	Value			Unit
			min	typ	max	
Collector-Emitter saturation voltage	V_{DD} = 15V, I_{out} = +/- 6A 25°C 150°C	$V_{CE(sat)}$	 - -	 1.6 1.85	 2.15	V
Diode forward voltage	V_{GE} = 0V, I_{out} = +/- 6A 25°C 150°C	V_F	 - -	 1.55 1.5	 2.05	V
Zero gate voltage collector current[1]	V_{CE} = 600V, VGE = 0V t_p < 250ns T_j = 25°C T_j = 150°C	I_{CES}	 - -	 - -	 40 1000	µA
Short circuit collector current[1]	V_{DD} = 15V, t_{SC} ≤ 5µs V_{CC} = 400V, T_j ≤ 150°C	$I_{C(SC)}$	-	55	-	A
Logic "0" input voltage (LIN,HIN)		V_{IH}	1.7	2.1	2.4	V
Logic "1" input voltage (LIN,HIN)		V_{IL}	0.7	0.9	1.1	V
EN positive going threshold		$V_{EN,TH+}$	1.9	2.1	2.3	V
EN negative going threshold		$V_{EN,TH-}$	1.1	1.32	1.5	V
ITRIP positive going threshold		$V_{IT,TH+}$	360	450	540	mV
ITRIP input hysteresis		$V_{IT,HYS}$	60	85	-	mV
V_{DD} and V_{BS} supply undervoltage positive going threshold		V_{DDUV+} V_{BSUV+}	11.0	12.0	12.8	V
V_{DD} and V_{BS} supply undervoltage negative going threshold		V_{DDUV-} V_{BSUV-}	9.5	10.3	11.0	V
V_{CC} and V_{BS} supply undervoltage lockout hysteresis		V_{DDUVH} V_{BSUVH}	1.2	1.6	-	V
Input clamp voltage (/HIN, /LIN, EN, ITRIP)		$V_{INCLAMP}$	9.0	10.1	13.0	V
Quiescent VB_x supply current (VB_x only)	V_{IN} = low	I_{QB}	-	300	550	µA
Quiescent VDD supply current (VDD only)	V_{IN} = float	I_{QDD}	-	2.1	3.0	mA
Input bias current	V_{IN} = 5V	I_{IN+}	-	43	100	µA
Input bias current	V_{IN} = 0V	I_{IN-}	-	100	200	µA
ITRIP Input bias current	V_{ITRIP} = 5V	I_{ITRIP+}	-	62	120	µA
EN Input bias current	V_{EN} = 5V	I_{EN+}	-	62	120	µA
Leakage current of high side	V_S = 600V, $T_{j,IC}$ = 125°C	I_{LVS}	-	30	-	µA

[1] Allowed number of short circuits: <1000; time between short circuits: >1s.

Dynamic Parameters

(T_c = 25°C, if not stated otherwise)

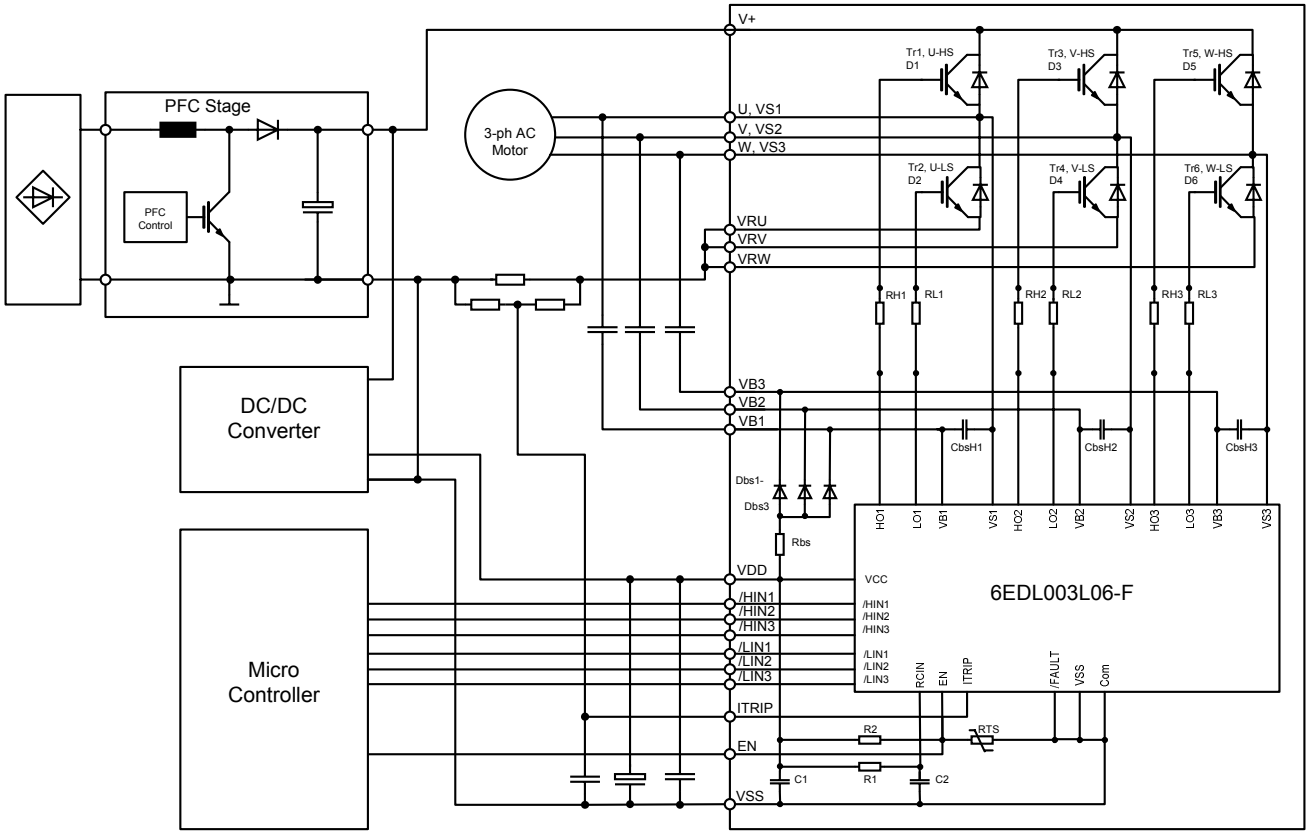
Description	Condition	Symbol	Value			Unit
			min	typ	max	
Turn-on propagation delay	$V_{LIN,HIN}$ = 0V	$t_{d(on)}$	-	1684	-	ns
Turn-on rise time	I_{out} = 6A, V_{DC} = 400V $V_{LIN,HIN}$ = 5V	t_f	-	102	-	ns
Turn-off propagation delay	$V_{LIN,HIN}$ = 5V	$t_{d(off)}$	-	1217	-	ns
Turn-on fall time	I_{out} = 6A, V_{DC} = 400V $V_{LIN,HIN}$ = 0V	t_r	-	18	-	ns
Shutdown propagation delay ENABLE	V_{EN} = 0V	t_{EN}	-	700	1000	ns
Shutdown propagation delay ITRIP	V_{ITRIP} = 1V	t_{ITRIP}	-	690	1000	ns
Input filter time ITRIP	V_{ITRIP} = 1V	$t_{ITRIPmin}$	155	225	380	ns
Input filter time at LIN for turn on and off and input filter time at HIN for turn on only	$V_{LIN,HIN}$ = 0 V & 5V	t_{FILIN}	120	270	-	ns
Input filter time at HIN for turn off	V_{HIN} = 5V	t_{FILIN1}	-	200	-	ns
Input filter time at HIN for turn off	V_{HIN} = 5 V	t_{FILIN2}	-	350	-	ns
Input filter time EN		t_{FILEN}	300	430	-	ns
Fault clear time at RCIN after ITRIP-fault	$V_{LIN,HIN}$ = 0 V & 5V V_{ITRIP} = 0 V	t_{FLTCLR}	-	5	-	ms
Min. deadtime between low side and high side		DT_{min}	1.5	-	-	µs
IGBT Turn-on Energy	I_{out} = 6A, V_{DC} = 400V T_{vj} = 25°C T_{vj} = 150°C	E_{on}	 - -	 tbd 0.27	 - -	mJ
IGBT Turn-off Energy	I_{out} = 6A, V_{DC} = 400V T_{vj} = 25°C T_{vj} = 150°C	E_{off}	 - -	 tbd 0.2	 - -	mJ
Diode recovery Energy	I_{out} = 6A, V_{DC} = 400V T_{vj} = 25°C T_{vj} = 150°C	E_{rec}	 - -	 tbd 0.12	 - -	mJ

Integrated Components

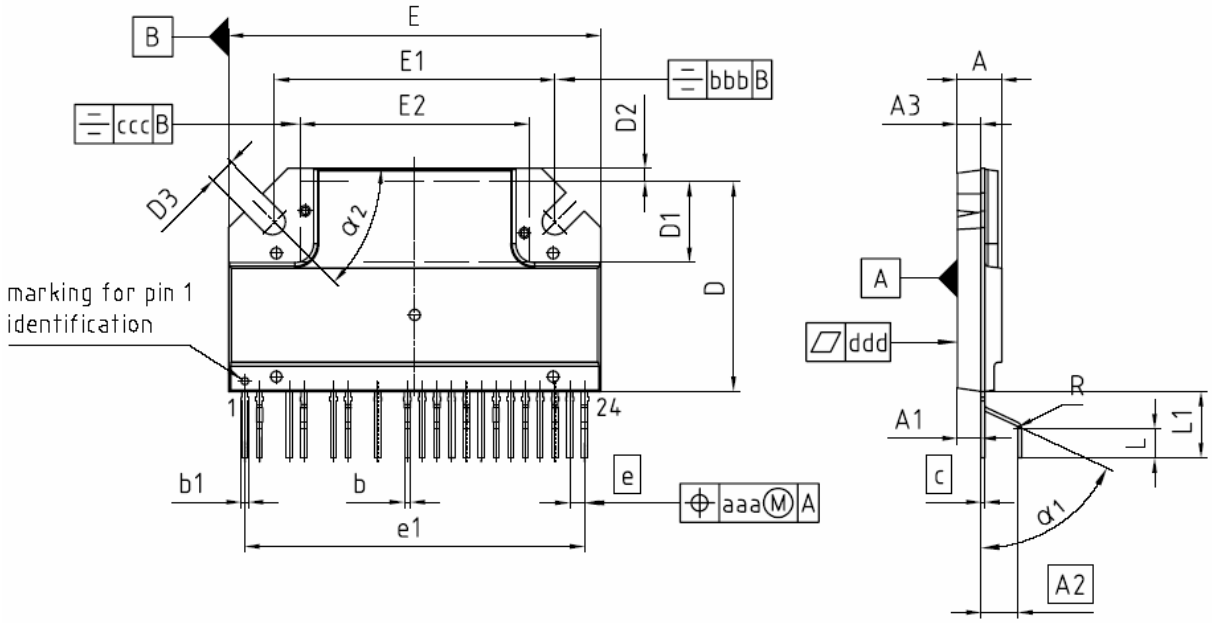
Description	Condition	Symbol	Value			Unit
			min	typ	max	
Integrated Resistor		R1	-	91	-	kΩ
Integrated Resistor		R2	-	24	-	
Integrated Resistor		Rbs	-	10	-	Ω
Integrated Resistor	T_{NTC} = 25°C	RTS	-	100	-	kΩ
Bootstrap diode forward voltage	I_{FDbs} = 100mA	V_{FDbs}	-	1.9	2.05	V
B-Constant of NTC (Negative Temperature Coefficient)	T_{NTC} = 25°C	B25	-	4250	-	K
Integrated Capacitor		C1, C2	-	100	-	nF
Integrated Bootstrap Capacitor		$CbsH_x$	-	100	-	
Integrated Gate Resistor		RL_x	-	30	-	Ω

Circuit of a Typical Application

(here: IKCS12F60AA)



Package Outline IKCS12F60AA



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	5.900	6.100	0.232	0.240
A1	3.200		0.126	
A2	5.000		0.197	
A3	3.100	3.300	0.122	0.130
b	0.760	0.880	0.030	0.035
b1	-	1.120	-	0.044
c	0.460	0.580	0.018	0.023
D	30.100	30.300	1.185	1.193
D1	10.600	11.200	0.417	0.441
D2	1.300	2.300	0.051	0.091
D3	3.400	3.600	0.134	0.142
E	50.300	50.500	1.980	1.988
E1	37.900	38.100	1.492	1.500
E2	30.700	31.300	1.209	1.232
e	2.000		0.079	
e1	46.000		1.811	
N	20		20	
L	3.630	4.230	0.143	0.167
L1	8.700	9.300	0.343	0.366
R	0.300	0.900	0.012	0.035
aaa	0.250		0.010	
bbb	0.250		0.010	
ccc	0.500		0.020	
ddd	0.150		0.006	
α1	64.000	66.000	64.000	66.000
α2	44.000	46.000	44.000	46.000

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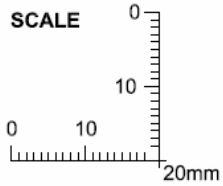
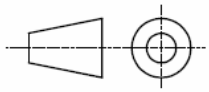
SCALE 
EUROPEAN PROJECTION 
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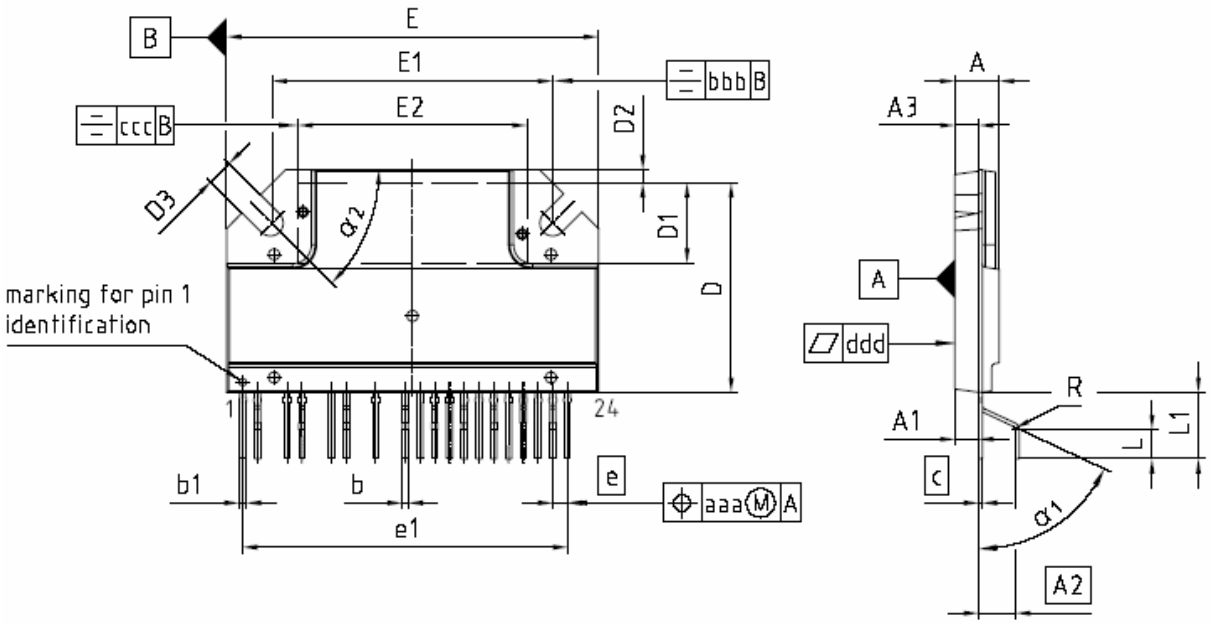

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	5,900	6,100	0,232	0,240
A1	3.200		0.126	
A2	5,000		0,197	
A3	3.100	3.300	0.122	0.130
b	0.760	0.880	0.030	0.035
b1	-	1.120	-	0.044
c	0.460	0.580	0.018	0.023
D	30,100	30,300	1,185	1,193
D1	10.600	11.200	0.417	0.441
D2	1.300	2.300	0.051	0.091
D3	3,400	3,600	0,134	0,142
E	50.300	50.500	1.980	1.988
E1	37.900	38.100	1.492	1.500
E2	30.700	31.300	1.209	1.232
e	2.000		0.079	
e1	44,000		1,732	
N	19		19	
L	3,630	4,230	0,143	0,167
L1	8.700	9.300	0.343	0.366
R	0.300	0.900	0.012	0.035
aaa	0,250		0,010	
bbb	0.250		0.010	
ccc	0.500		0.020	
ddd	0.150		0.006	
α1	64,000	66,000	64,000	66,000
α2	44,000	46,000	44,000	46,000

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