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April 2017

FTCO3V455A1
3-Phase Inverter Automotive Power Module

General Description

The FTCO3V455A1 is a 40V low Rds(on) automotive qualified power module featuring a 3-phase MOSFET inverter optimized for 12V battery systems. It includes a precision shunt resistor for current sensing an NTC for temperature sensing and an RC snubber circuit.

The module utilizes Fairchild's trench MOSFET technology and it is designed to provide a very compact and high performance variable speed motor drive for applications like electric power steering, electro-hydraulic power steering, electric water pumps, electric oil pumps. The power module is 100% lead free, RoHS and UL compliant.

Benefits

- Low junction-sink thermal resistance
- Low inverter electrical resistance
- High current handling
- Compact motor design
- Highly integrated compact design
- Better EMC and electrical isolation
- Easy and reliable installation
- Improved overall system reliability

Applications

- Electric and Electro-Hydraulic Power Steering
- Electric Water Pump
- Electric Oil Pump
- Electric Fan

Features

- 40V-150A 3-phase trench MOSFET inverter bridge
- 1% precision shunt current sensing
- Temperature sensing
- DBC substrate
- 100% lead free and RoHS compliant 2000/53/C directive.
- UL94V-0 compliant
- Isolation rating of 2500Vrms/min
- Mounting through screws
- Automotive qualified

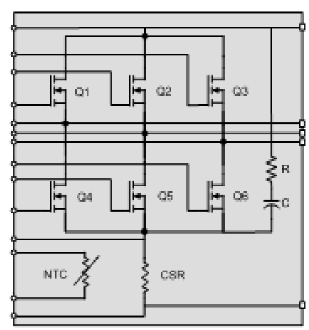

Figure 1.schematic

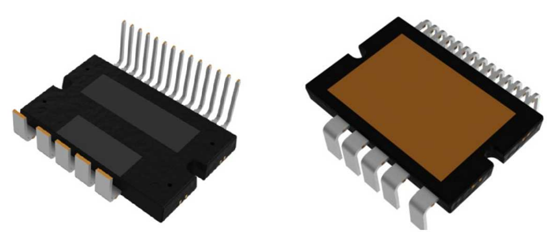

Figure 2. package

Absolute Maximum Ratings (T_J = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Rating	Unit
V_{DS}(Q1~Q6)	Drain to Source Voltage	40	V
V_{GS}(Q1~Q6)	Gate to Source Voltage	±20	V
I_D(Q1~Q6)	Drain Current Continuous(T_C = 25°C, V_{GS} = 10V)	150	A
E_{AS}(Q1~Q6)	Single Pulse Avalanche Energy (*Note 1)	947	mJ
P_D	Power dissipation	115	W
T_J	Maximum Junction Temperature	175	°C
T_{STG}	Storage Temperature	125	°C

Pin Configuration

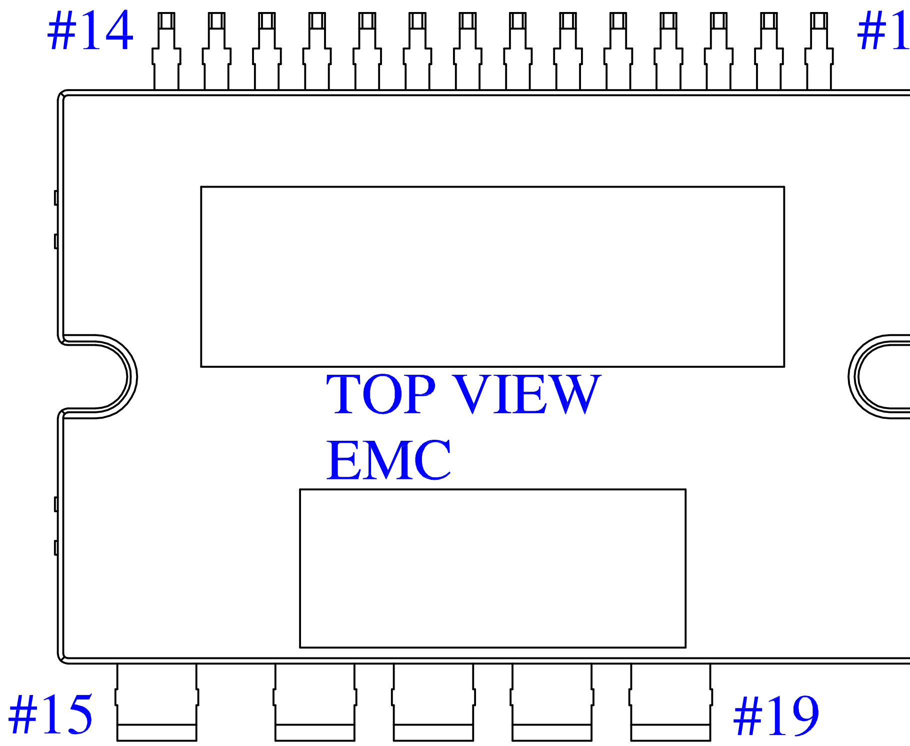

Figure 3.

Pin Description

Pin Number	Pin Name	Pin Descriptions
1	TEMP 1	NTC Thermistor Terminal 1
2	TEMP 2	NTC Thermistor Terminal 2
3	PHASE W SENSE	Source of HS W and Drain of LS W
4	GATE HS W	Gate of HS phase W MOSFET
5	GATE LS W	Gate of LS phase W MOSFET
6	PHASE V SENSE	Source of HS V and Drain of LS V
7	GATE HS V	Gate of HS phase V MOSFET
8	GATE LS V	Gate of LS phase V MOSFET
9	PHASE U SENSE	Source of HS U and Drain of LS U
10	GATE HS U	Gate of HS phase U MOSFET
11	VBAT SENSE	Drain of HS U, V and W MOSFET
12	GATE LS U	Gate of LS phase U MOSFET
13	SHUNT P	Source of LS U, V W MOSFETS / Shunt +
14	SHUNT N	Negative shunt terminal (shunt -)
15	VBAT	Positive battery terminal
16	GND	Negative battery terminal
17	PHASE U	Motor phase U
18	PHASE V	Motor phase V
19	PHASE W	Motor phase W

Internal Equivalent Circuit

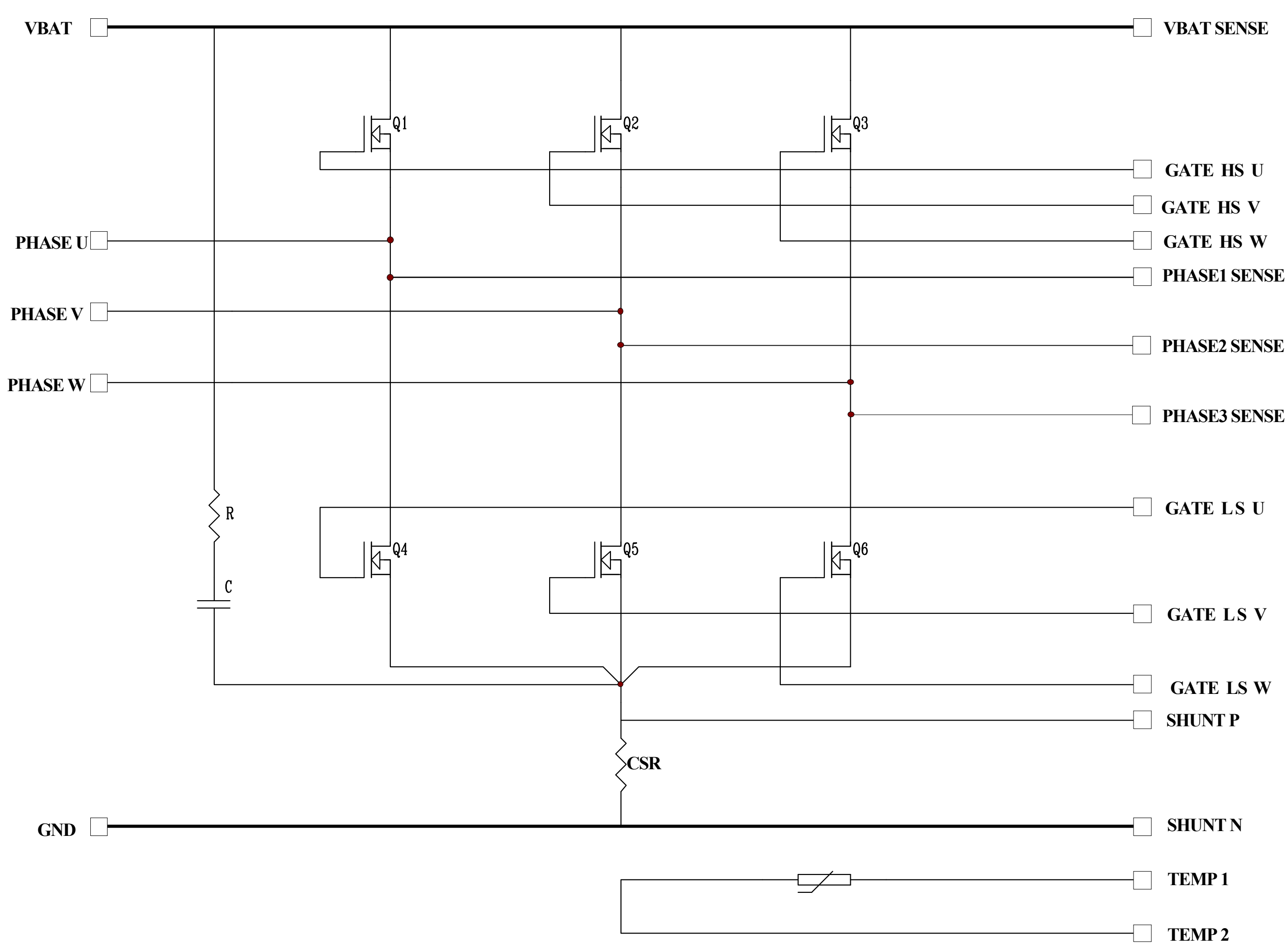

Figure 4.

Flammability Information

All materials present in the power module meet UL flammability rating class 94V-0 or higher.

Solder

Solder used is a lead free SnAgCu alloy.

Compliance to RoHS

The Power Module is 100% lead free and RoHS compiant with the 2000/53/C directive.

Absolute Maximum Ratings (T_J = 25°C, Unless Otherwise Specified)

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P_D	Power dissipation	115	W
T_J	Maximum Junction Temperature	175	°C
T_{STG}	Storage Temperature	125	°C

Thermal Resistance

Symbol	Parameter	Min.	Typ.	Max.	Unit
Rthjc Thermal Resistance Junction to case, Single Inverter FET, chip center (*Note 2)	Q1 Thermal Resistance J -C	-	0.8	1.1	°C/W
	Q2 Thermal Resistance J -C	-	0.8	1.1	°C/W
	Q3 Thermal Resistance J -C	-	0.8	1.1	°C/W
	Q4 Thermal Resistance J -C	-	0.8	1.1	°C/W
	Q5 Thermal Resistance J -C	-	0.8	1.1	°C/W
	Q6 Thermal Resistance J -C	-	0.8	1.1	°C/W
T_J	Maximum Junction Temperature	-		175	°C
T_S	Operating Sink Temperature	-40		120	°C
T_{STG}	Storage Temperature	-40		125	°C

Notes:
.* Note 1 - Starting Tj=25°C,Vds=20V,Ias=64A,L= 480uH.
* Note 2 -These values are based on Thermal simulations and PV level measurements.
These values assume a single MOSFET is on, and the test condition for referenced temperature is “Chip Center”.
This means that the DT is measured between the Tj of each MOSFET and the temperature of the case located immediately under the center of the chip.

Electrical Characteristics (T_J = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{DSS}	D-S Breakdown Voltage (Inverter MOSFETs)	V_{GS}=0, I_D=250uA	40	-	-	V
V_{GS}	Gate to Source Voltage (Inverter MOSFETs)	-	-20	-	20	V
V_{TH}	Threshold Voltage (Inverter MOSFETs)	V_{GS}=V_{DS}, I_D=250uA, T_j=25°C	2.0	2.8	4.0	V
V_{SD}	MOSFET Body Diode Forward Voltage	V_{GS}=0V, I_S=80A, T_j=25°C		0.8	1.28	V
$R_{DS(ON)Q1}$	Inverter High Side MOSFETs Q1 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.15	1.66	mΩ
$R_{DS(ON)Q2}$	Inverter High Side MOSFETs Q2 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.22	1.73	mΩ
$R_{DS(ON)Q3}$	Inverter High Side MOSFETs Q3 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.31	1.82	mΩ
$R_{DS(ON)Q4}$	Inverter Low Side MOSFETs Q4 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.36	1.87	mΩ
$R_{DS(ON)Q5}$	Inverter Low Side MOSFETs Q5 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.57	2.08	mΩ
$R_{DS(ON)Q6}$	Inverter Low Side MOSFETs Q6 (See *Note3)	V_{GS}=10V, I_D=80A, T_j=25°C	-	1.86	2.32	mΩ
I_{DSS}	Inverter MOSFETs (UH,UL,VH,VL,WH,WL)	V_{GS}=0V, V_{DS}=32V, T_j=25°C	-	-	1.0	uA
I_{GSS}	Inverter MOSFETs Gate to Source Leakage Current	V_{GS}=±20V	-	-	±100	nA
Total loop resistance VLINK(+) - V0 (-)		V_{GS}=10V,I_D=80A,T_j=25°C	-	4.69	5.5	mΩ

* Note 3 - All Mosfets have same die size and Rdson. The different Rdson values listed in the datasheet are due to the different access points available inside the module for Rdson measurement. While the high side MOSFETs (Q1, Q2, Q3) have source sense wire bonds, the low side mosfets (Q4, Q5, Q6) do not have source sense wire bonds, thus resulting in higher Rdson values.

Temperature Sense (NTC Thermistor)

Symbol	Test Conditions	Test Time	Min	Typ	Max	Units
Voltage	Current=1mA, Temperature=25°C	T=0.5ms	7.5	-	12	V

Current Sense Resistor

Symbol	Test Conditions	Test Time	Min	Typ	Max	Units
Resistance	Current Senset resistor current = 80A	T=0.5ms	0.46	-	0.53	mΩ

Typical Characteristics (Generated using MOSFETs assembled in a TO263 package, for reference purposes only)

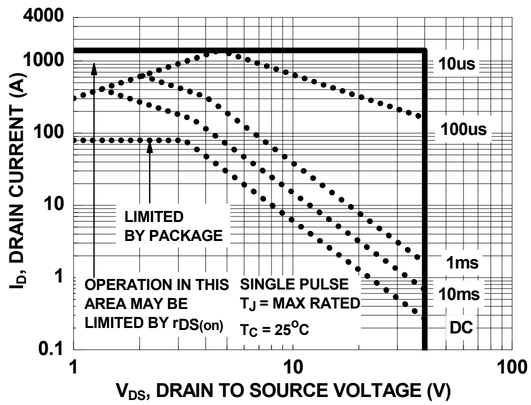
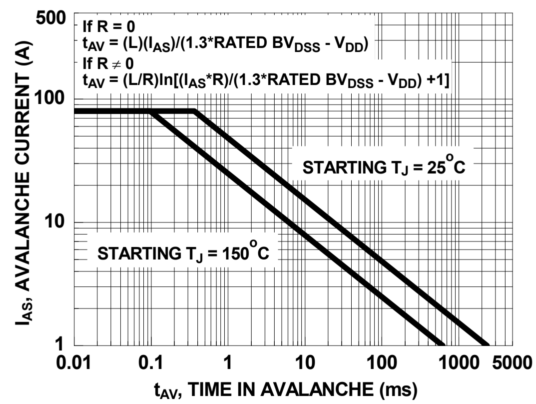


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to Fairchild Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

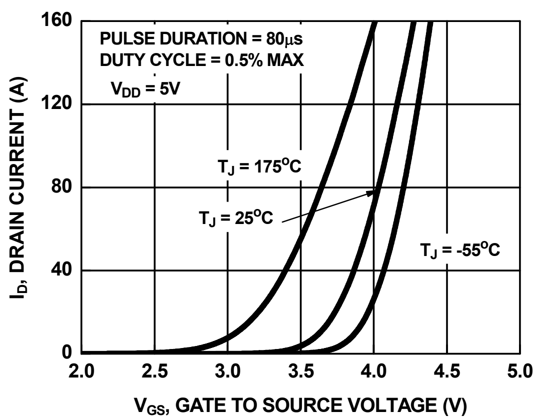


Figure 7. Transfer Characteristics

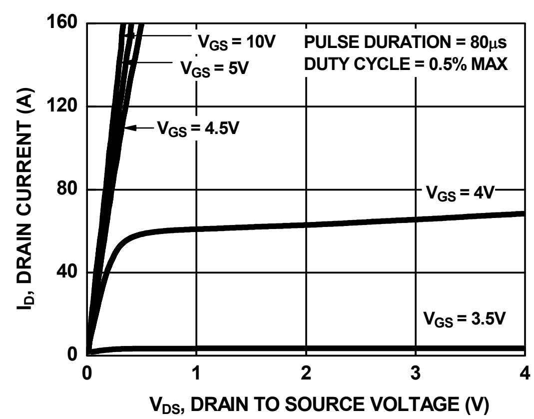


Figure 8. Saturation Characteristics

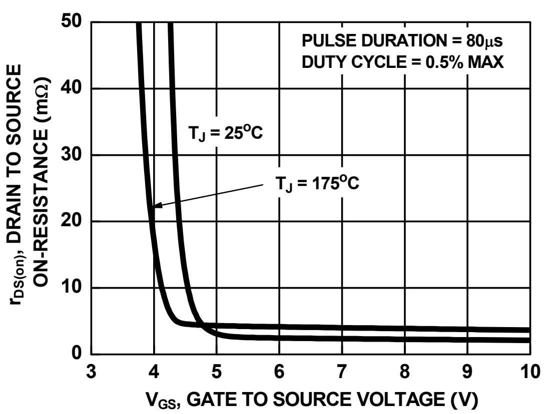


Figure 9. Drain to Source On-Resistance Variation vs Gate to Source Voltage

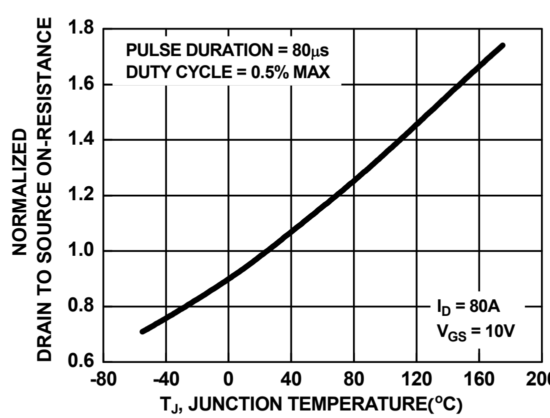


Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

Typical Characteristics (Generated using MOSFETs assembled in a TO263 package, for reference purposes only)

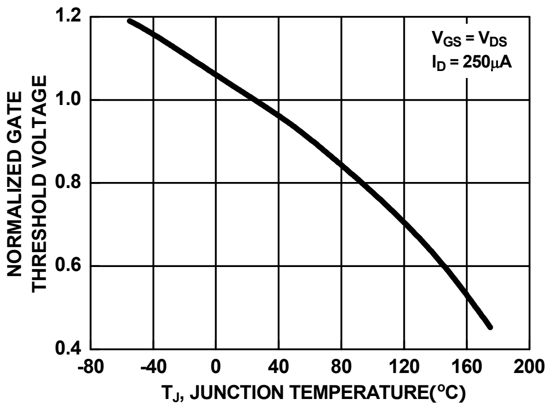


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature

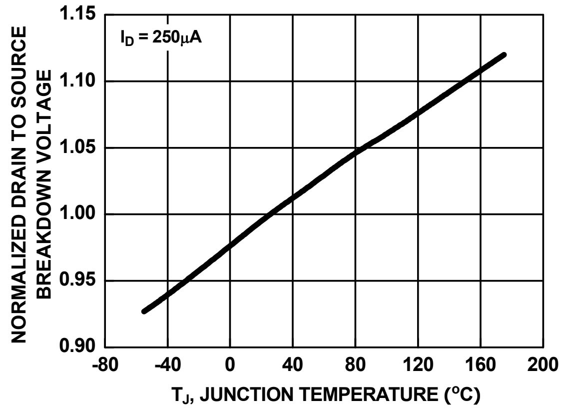


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

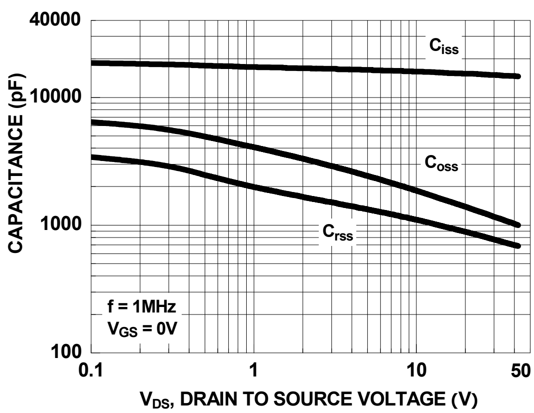


Figure 13. Capacitance vs Drain to Source Voltage

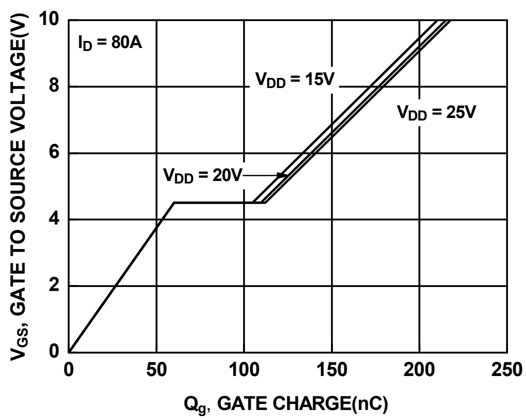


Figure 14. Gate Charge vs Gate to Source Voltage

Mechanical Characteristics and Ratings

Parameter	Condition	Limits			Unit
		Min.	Typ.	Max.	
Device Flatness	Note Fig.15	0	-	+200	um
Mounting Torque	Mounting Screw: - M3, Recommended 0.7N.m	0.6	0.7	0.8	N.m
Weight		-	20	-	g

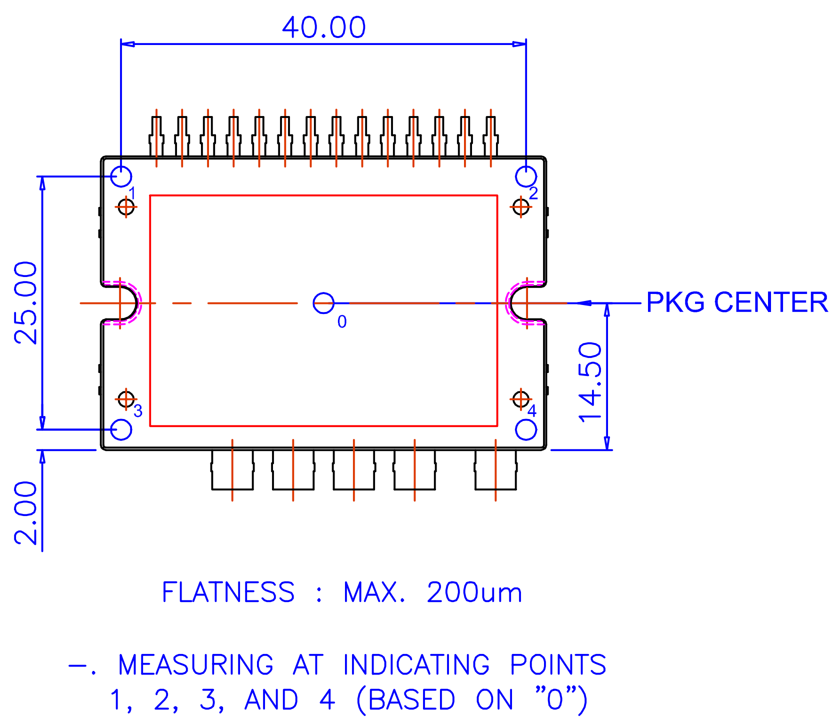


Fig. 15. Flatness Measurement Position

Package Marking and Ordering Information

Device Marking	MOSFET	Packing Type	Quantity
FTCO3V455A1	PCF33478	Tube	11

Detailed Package Outline Drawings

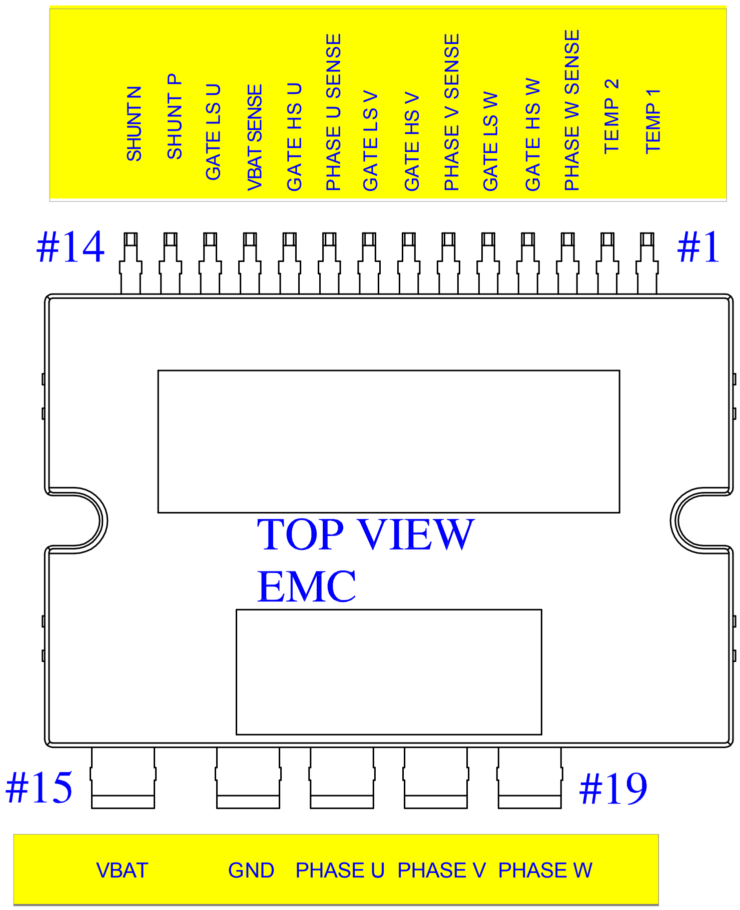
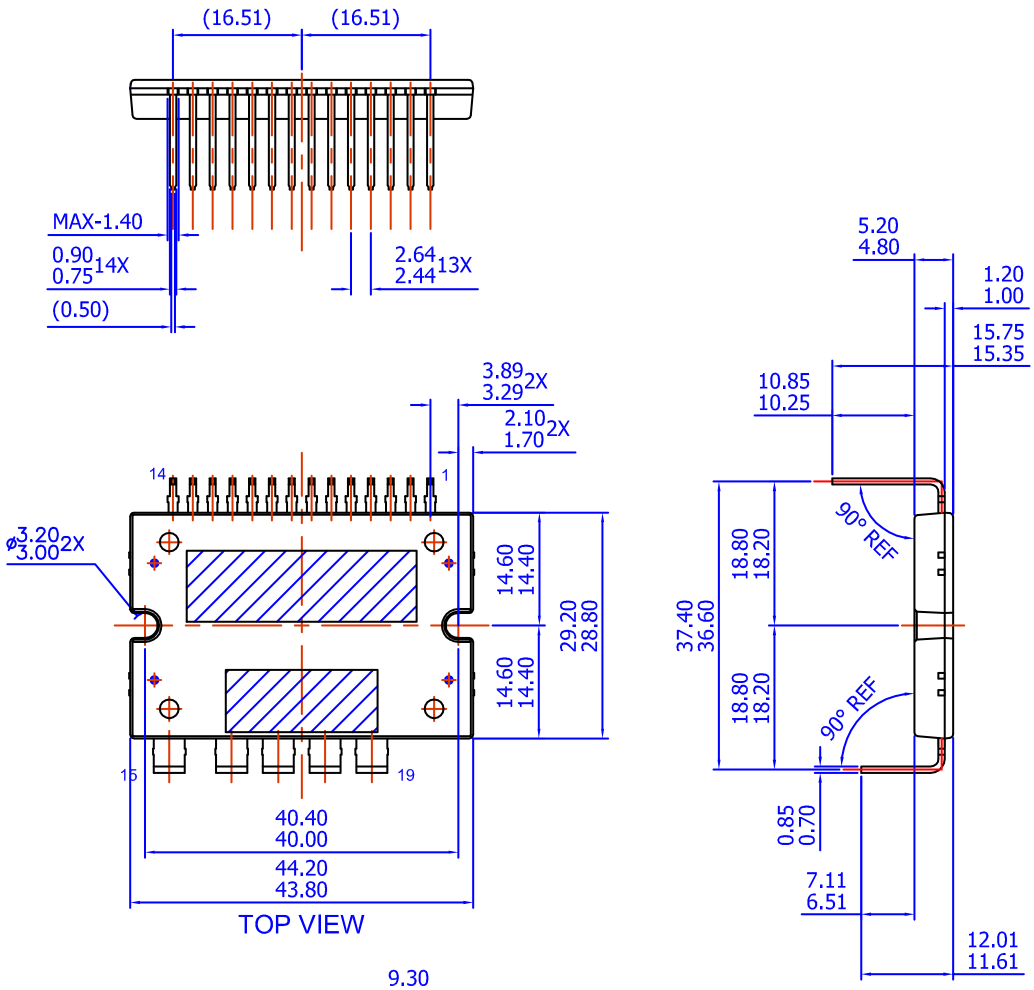


Figure 16.

Detailed Package Outline Drawings



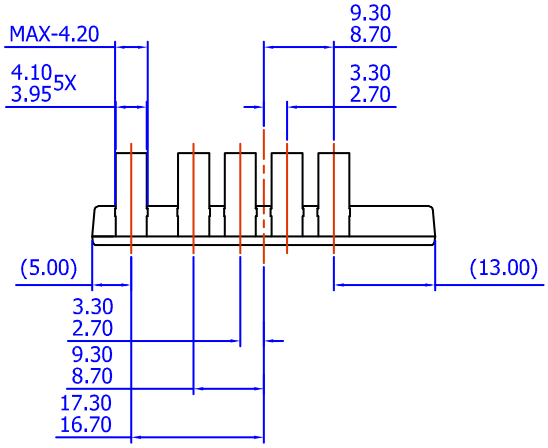


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Figure 17.

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