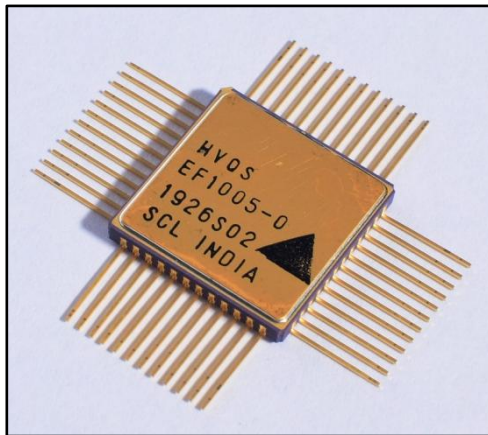


HIGH VOLTAGE SOLID STATE SWITCH

(INPUT: 27V – 42V, LOAD 1A)

(EF1005-0)



DATA SHEET

Version 3.0 MARCH 2020



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HIGH VOLTAGE SOLID STATE SWITCH (EF1005-0)

PRODUCT DESCRIPTION

The device has four switches in a single ASIC. It can switch 1A load at 42V. This switch transistor is controlled through a control circuit. The control circuit operates from input voltage. When the control input is high (5V), the switch conducts and provides the load current (1A). Otherwise this switch remains off. The input voltage may be as low as 3.5V to be considered as High (>3.5V) which can turn on transistor.

FEATURES:

- **Raw bus voltage: 27 V to 42 V**
- **Full load current: 1 A**
- **Control voltage: 3.5 V to 5.5 V**
- **Output drop (V_{SD}): 650 mV at 1 A**
- **Input (leakage) current: 0.19mA**
- **Quiescent current (I_{GND}): 40nA**
- **AMS's 0.35 μ m high voltage process H35B4D3**
- **ASIC functionally equivalent to HMC 112SS**

DEVICE SUMMARY:

Table 1: Device Summary

| DEVICE | *DIE SIZE | PACKAGE | PINS | DESCRIPTION | TEMPERATURE RANGE |
|----------|--------------------|----------------------------|---------|-------------------|-------------------|
| EF1005-0 | 6.75mm X 6.94mm | Chip on Board (COB) | 32 pins | Evaluation Model | -55°C to +125°C |
| | | Ceramic Flat Package (CFP) | 48 Lead | Engineering Model | |

POWER ON SEQUENCE:

1. RAW BUS VOLTAGE (RB)
2. CONTROL INPUT VOLTAGE (IN)



BLOCK DIAGRAM:

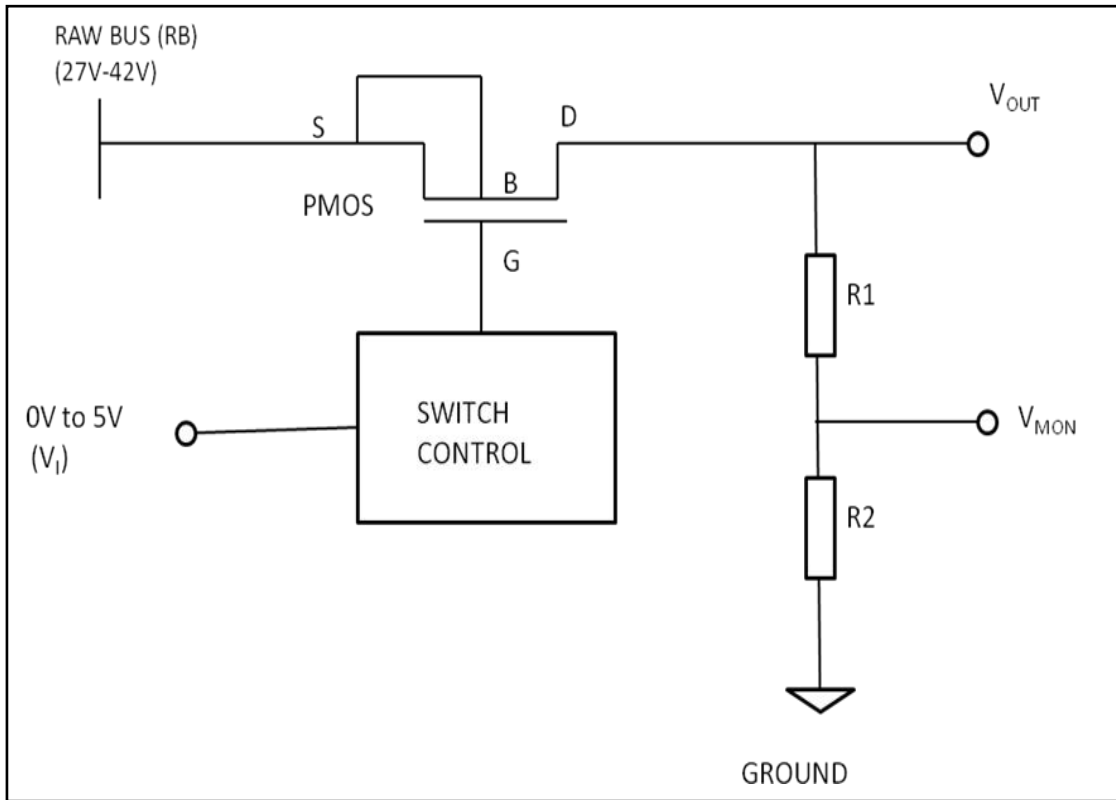


Figure 1: Block Diagram

PIN CONFIGURATION:

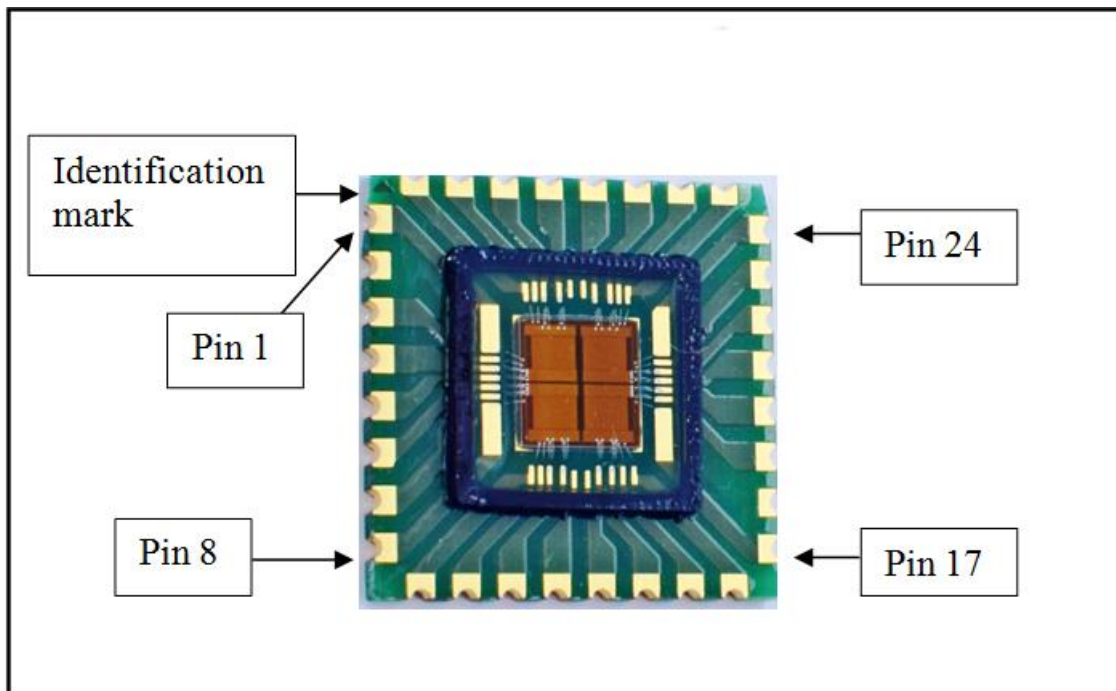


Figure 2: Pin Diagram of COB package

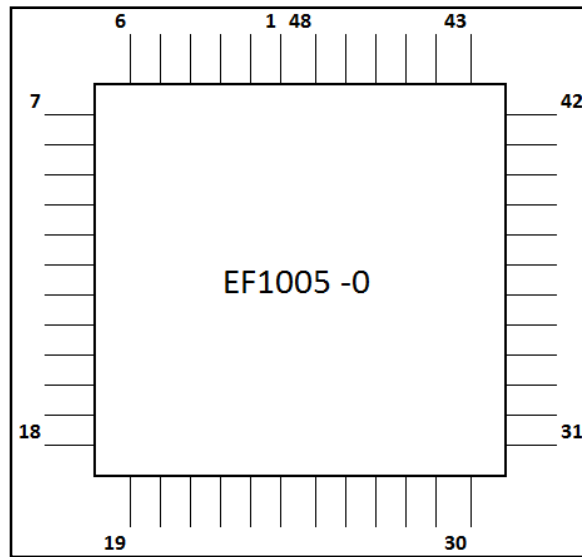


Figure 3: Pin Diagram of CFP package

PIN DESCRIPTION (COB Package):

Pin description for the leadless COB is given in the below table.
Control input = 0V => Switch off, Control input = 5V => Switch on.

Table 2: Pin description for COB

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|---|
| 1 | MON1 | Monitor voltage for switch - 1 |
| 2 | NC | -- |
| 3 | DG12 | Common ground for switch- 1 and 2 |
| 4 | OUT1 | Output pin for switch - 1 |
| 5 | OUT1_1 | Output pin for switch - 1 |
| 6 | OUT2 | Output pin for switch - 2 |
| 7 | OUT2_1 | Output pin for switch - 2 |
| 8 | MON2 | Monitor voltage for switch - 2 |
| 9 | IN2 | Control input for switch - 2 |
| 10 | RET2 | Return for switch - 2 |
| 11 | RB2 | Raw bus voltage (27V- 42V) for switch - 2 |
| 12 | RB2_1 | Raw bus voltage (27V- 42V) for switch - 2 |
| 13 | RB3 | Raw bus voltage (27V- 42V) for switch - 3 |



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| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|---|
| 14 | RB3_1 | Raw bus voltage (27V- 42V) for switch - 3 |
| 15 | RET3 | Return for switch - 3 |
| 16 | IN3 | Control input for switch - 3 |
| 17 | MON3 | Monitor voltage for switch - 3 |
| 18 | NC | -- |
| 19 | OUT3 | Output pin for switch - 3 |
| 20 | OUT3_1 | Output pin for switch - 3 |
| 21 | OUT4 | Output pin for switch - 4 |
| 22 | OUT4_1 | Output pin for switch - 4 |
| 23 | DG34 | Common I ground for switch - 3 and 4 |
| 24 | MON4 | Monitor voltage for switch - 4 |
| 25 | IN4 | Control input for switch - 4 |
| 26 | RET4 | Return signal for switch - 4 |
| 27 | RB4_1 | Raw bus voltage (27V- 42V) for switch - 4 |
| 28 | RB4 | Raw bus voltage (27V- 42V) for switch - 4 |
| 29 | RB1_1 | Raw bus voltage (27V- 42V) for switch - 1 |
| 30 | RB1 | Raw bus voltage (27V- 42V) for switch - 1 |
| 31 | RET1 | Return for switch - 1 |
| 32 | IN1 | Control input for switch - 1 |

PIN DESCRIPTION (Ceramic Flat Package):

Pin description for the 48 pin CFP is given in the below table.

Table 3: Pin description for package

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|---|
| 1 | --- | NC |
| 2 | RB1_1 | Raw bus voltage (27V- 42V) for switch - 1 |
| 3 | RB1 | Raw bus voltage (27V- 42V) for switch - 1 |
| 4 | RET1 | Return for switch - 1 |
| 5 | IN1 | Control input for switch - 1 |



HIGH VOLTAGE SOLID STATE SWITCH (EF1005-0)

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|---|
| 6 | --- | NC |
| 7 | --- | NC |
| 8 | --- | NC |
| 9 | MON1 | Monitor voltage for switch - 1 |
| 10 | DG12 | Common ground for switch - 1 and 2 |
| 11 | OUT1 | Output pin for switch - 1 |
| 12 | OUT1_1 | Output pin for switch - 1 |
| 13 | OUT2 | Output pin for switch - 2 |
| 14 | OUT2_1 | Output pin for switch - 2 |
| 15 | MON2 | Monitor voltage for switch - 2 |
| 16 | --- | NC |
| 17 | --- | NC |
| 18 | --- | NC |
| 19 | --- | NC |
| 20 | IN2 | Control input for switch – 2 |
| 21 | RET2 | Return for switch - 2 |
| 22 | RB2 | Raw bus voltage (27V- 42V) for switch - 2 |
| 23 | RB2_1 | Raw bus voltage (27V- 42V) for switch - 2 |
| 24 | --- | NC |
| 25 | --- | NC |
| 26 | RB3 | Raw bus voltage (27V- 42V) for switch - 3 |
| 27 | RB3_1 | Raw bus voltage (27V- 42V) for switch - 3 |
| 28 | RET3 | Return for switch - 3 |
| 29 | IN3 | Control input for switch - 3 |
| 30 | --- | NC |
| 31 | --- | NC |
| 32 | --- | NC |
| 33 | --- | NC |
| 34 | MON3 | Monitor voltage for switch - 3 |
| 35 | OUT3 | Output pin for switch - 3 |
| 36 | OUT3_1 | Output pin for switch - 3 |
| 37 | OUT4 | Output pin for switch - 4 |



HIGH VOLTAGE SOLID STATE SWITCH (EF1005-0)

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|----------|---|
| 38 | OUT4_1 | Output pin for switch - 4 |
| 39 | DG34 | Common ground for switch - 3 and 4 |
| 40 | MON4 | Monitor voltage for switch - 4 |
| 41 | --- | NC |
| 42 | --- | NC |
| 43 | --- | NC |
| 44 | IN4 | Control input for switch - 4 |
| 45 | RET4 | Return signal for switch - 4 |
| 46 | RB4_1 | Raw bus voltage (27V- 42V) for switch - 4 |
| 47 | RB4 | Raw bus voltage (27V- 42V) for switch - 4 |
| 48 | --- | NC |

ABSOLUTE MAXIMUM RATING ⁽¹⁾: Over operating free-air temperature range (unless otherwise stated).

Table 4: Absolute maximum rating

| PARAMETER | MIN. | MAX. | UNIT |
|---------------------------|------|------|------|
| VGS | - | 5.5 | V |
| VSD | - | 120 | V |
| Ambient Temperature Range | -55 | 125 | °C |

⁽¹⁾Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS:

Table 5: Recommended Operating Condition

| SYMBOL | PARAMETER | MIN. | TYP. | MAX. | UNIT |
|-------------------------|---------------------------|------|------|------|------|
| RB | Raw Bus | 27 | 37 | 42 | V |
| I_{LOAD} | Output drive current | 0 | - | 1 | A |
| T_A | Ambient temperature range | -55 | - | +125 | °C |



HIGH VOLTAGE SOLID STATE SWITCH (EF1005-0)

ELECTRICAL SPECIFICATIONS

Test condition: All these tests are conducted at $R_B = 42V$, Load = 1A, $-55^{\circ}C \leq T_A \leq 125^{\circ}C$, No C_{IN} and C_{OUT} are used in testing, unless otherwise specified. The 4 – Wire measurement method has been employed in the test setup.

Table 6: Electrical specifications in Temperature Range

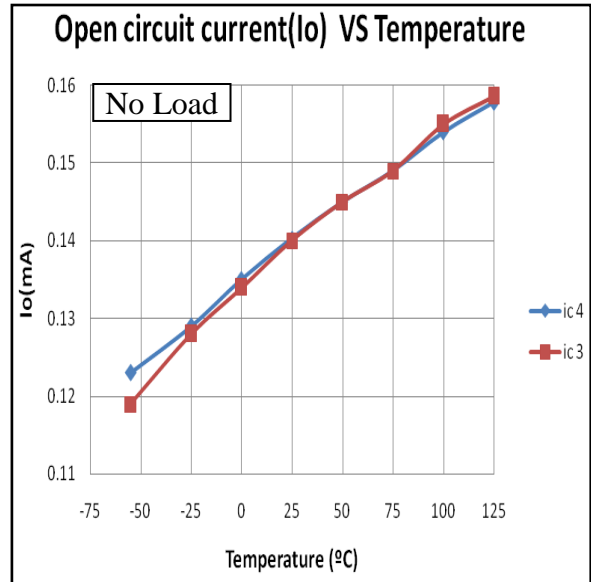
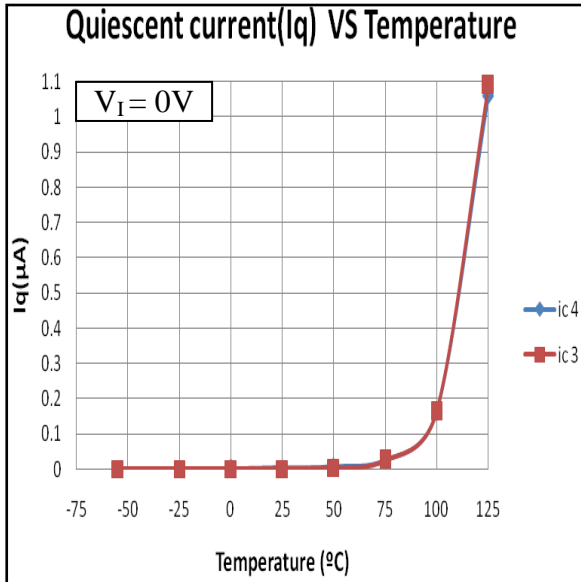
| PARAMETER | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|----------------------------|----------------------------|-------|-------|-------|---------|
| Supply R_B | $V_I = 5V$ | 27 | - | 42 | V |
| Control Voltage – V_I | Load=1A | 3.5 | 5 | 5.5 | V |
| Input Current – I_{IH} | $V_I = 5V$ | - | 0.186 | 0.5 | mA |
| Output drop – V_{SD} | $V_I = 5V$ | 0.35 | 0.62 | 0.85 | V |
| Output current – I_O | Load = No load, $V_I = 5V$ | - | 0.14 | 0.8 | mA |
| Output Voltage – V_{OUT} | $V_I = 5V$ | 41.15 | 41.38 | 41.65 | V |
| Monitor Voltage- V_{MON} | $V_I = 5V$ | 6.7 | 7.07 | 7.8 | V |
| Quiescent Current | Load= No load, $V_I = 0V$ | - | 0.003 | 20 | μA |
| Switch Delay On* | Load = 1mA | 2.0 | 2.96 | 5.0 | μs |
| Switch Delay Off* | Load = 1mA | 0.4 | 0.63 | 0.85 | ms |

Note: * marked parameters are tested on sample basis at lab temperature (T_A) = $23^{\circ}C \pm 2^{\circ}C$

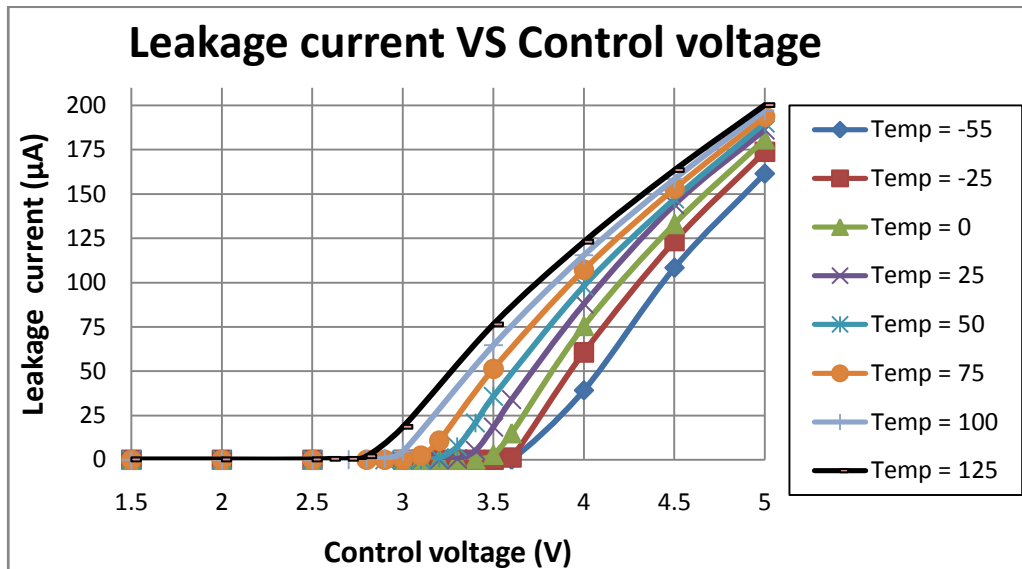


TYPICAL CHARACTERISTICS

All these tests are conducted: $R_B = 42V$, $V_I = 5V$, $-55^{\circ}C \leq T_A \leq 125^{\circ}C$, No C_{IN} and C_{OUT} are used in testing, unless otherwise specified. The 4 –Wire Kelvin Bridge method has been employed to carry out these tests.

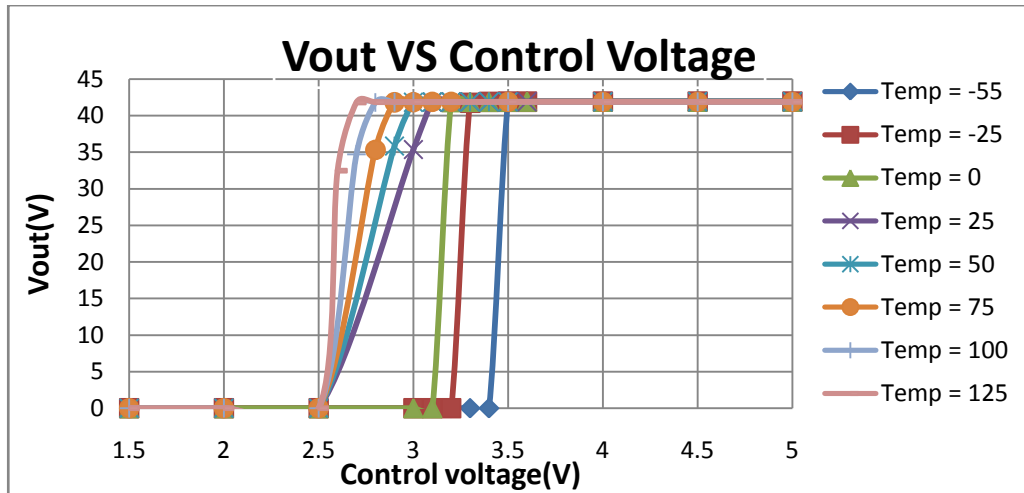


All these tests are conducted: $R_B = 42V$, $V_I = 5V$, Load = 0.1A, $-55^{\circ}C \leq T_A \leq 125^{\circ}C$, No C_{IN} and C_{OUT} are used in testing, unless otherwise specified.

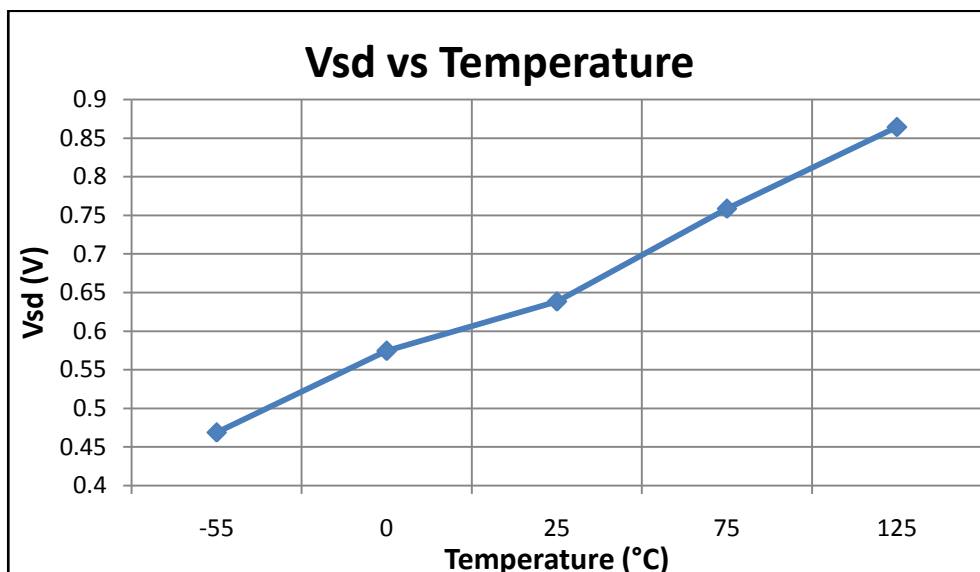
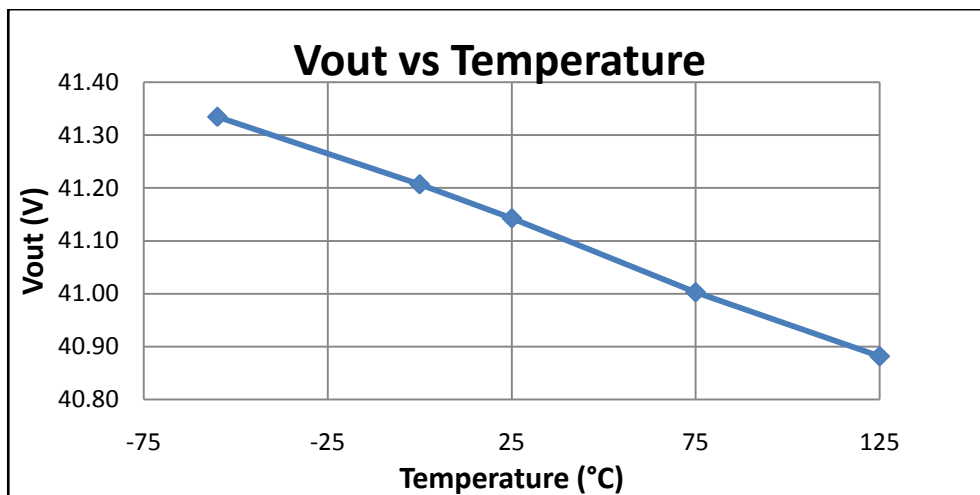


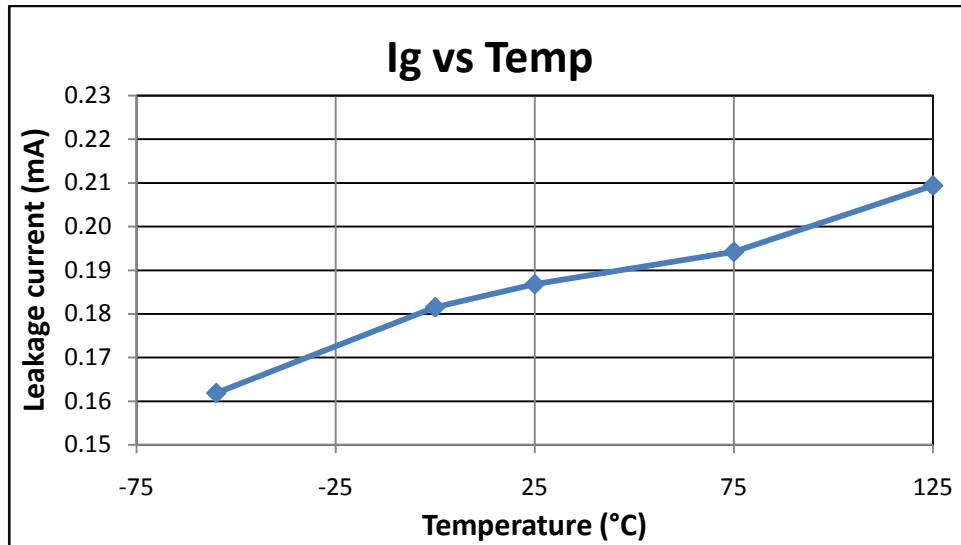


HIGH VOLTAGE SOLID STATE SWITCH (EF1005-0)



All these tests are conducted: $R_B = 42V$, $V_I = 5V$, Load = 1A, $-55^{\circ}C \leq T_A \leq 125^{\circ}C$, No C_{IN} and C_{OUT} are used in testing, unless otherwise specified.





KEY TERMS:

- 1. Control Voltage (V_I):** The voltage applied to turn on/off the circuit. It is applied at the switch control circuit connected to the PMOS gate.
- 2. Input Current (I_I):** The leakage current of the control circuit.
- 3. Supply Voltage (RB):** The raw bus voltage which acts as supply to the PMOS switch.
- 4. Output Voltage (V_{OUT}):** The voltage obtained at the output terminal when the switch is on.
- 5. Output drop (V_{SD}):** The voltage drop across the PMOS due to its effective resistance R_{ON} .

$$V_{SD} = RB - V_{OUT}$$

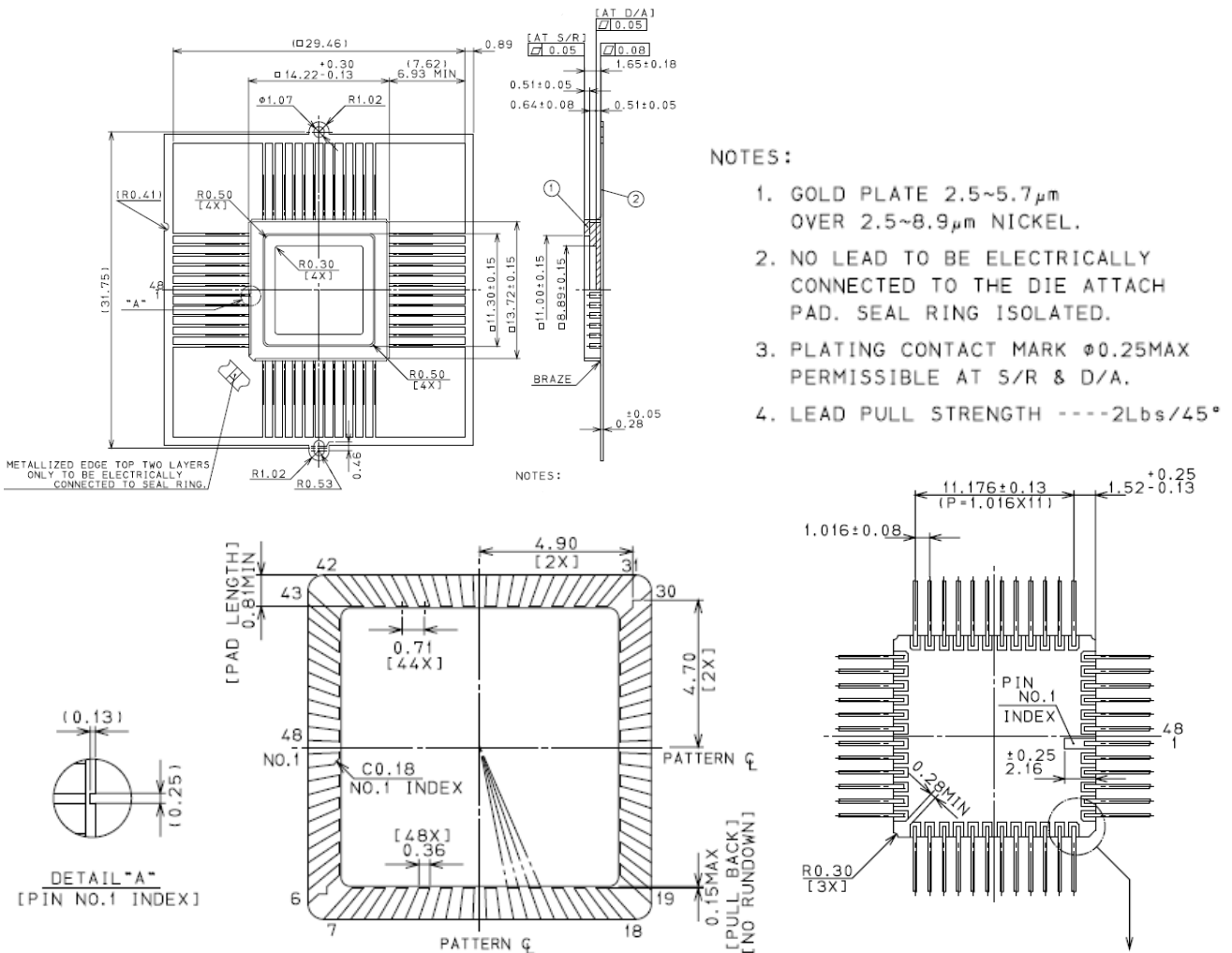
- 6. Monitoring Voltage (V_{MON}):** It is the output voltage across a register divider network to provide 5-9 V voltage for monitoring the operation of switch.



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7. **Output current (I_O):** The open circuit current passing through resistor divider network when no load is applied.
8. **Quiescent Current:** Total bias current (different from load current) consumed by different blocks of the device for their operation.
9. **R_{ON} :** R_{ON} is the total resistance between the drain and source in a MOSFET when it is on which accounts for voltage drop V_{SD} .
10. **Output Noise:** Unwanted disturbance in the electrical signal at the output terminal of the device.

PACKAGE DRAWING (CFP PACKAGE)





CHIP ON BOARD LAYOUT CONSIDERATIONS

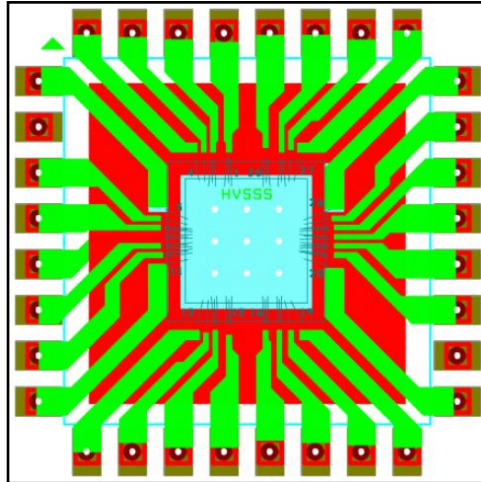


Figure 4: COB Evaluation Package

Remarks: COB Pin 2 and Pin 18 are NC (NO COB tracks are connected)

REVISION HISTORY

| Doc. name | Release Date | Data sheet status | Version |
|--------------------|--------------|-------------------|---------|
| Product Data Sheet | July - 2019 | Development | Ver1.0 |
| Product Data Sheet | Sept - 2019 | Development | Ver2.0 |
| Product Data Sheet | March - 2020 | Development | Ver3.0 |

Table 7: Revision History

IMPORTANT NOTICE

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