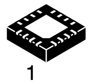
NCS37005

Product Preview

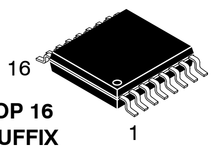
Ground Fault Interrupter (GFI)

ON Semiconductor®

http://onsemi.com



QFN 16
MN SUFFIX
CASE 485G



TSSOP 16
DA SUFFIX
CASE 948F

Description

The NCS37005 is a signal processor for GFI applications. The device integrates a flexible power supply (including both shunt and LDO regulators), and differential fault detection circuits. The proprietary fault processing circuitry offers high performance with low turns ratio ferrite current transformers. The device also includes a specialized DSP controller that offers best in class immunity to nuisance loads without the need for external analog filters.

Features

- 6.0 – 18 Volt Operation (120 − 480 V AC Mains with the Appropriate Series Impedance)
- −40 to 85°C
- Very Low Power Consumption: <5 mW @ 5 V
- 16 Pin QFN Package
- Low Cost/Turns Ratio Ferrite Current Transformer (CT) Detection of Differential
- Self Syncing Internal Oscillator Adjusts to AC Mains Frequency to Guarantee Full Resolution on 50 and 60 Hz Distribution Systems
- Optimized Solenoid Deployment (coil is not energized near the AC mains zero crossings)
- Randomized Testing Sequence to Minimize Noise and Potential Interactions on the AC Mains
- >5 mA SCR Driver for Additional Immunity to Supply Noise/Interference
- Superior Immunity to Nuisance Loads/Noise (up to 10 A) without Loss of Detection Capability or CT Saturation
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

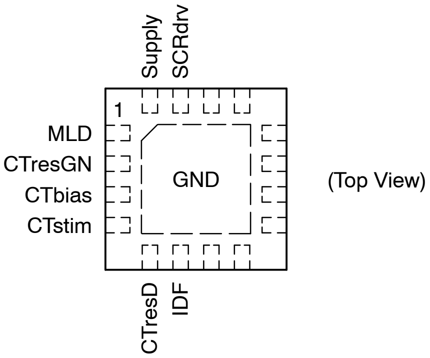
- Load Panel GFI/RCD Breakers
- GFI Receptacles
- In−line GFI Circuits (power cords)

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

MARKING DIAGRAM

XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
G or ▪ = Pb−Free Package
CCCCC = Country of Origin

PIN CONNECTIONS



ORDERING INFORMATION

Device	Package	Shipping†
NCS37005MNTWG	QFN16	Tape & Reel
NCS37005MNG	QFN16	Tube
NCS37005DARG	TSSOP20	Tape & Reel
NCS37005DAG	TSSOP20	Tube

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

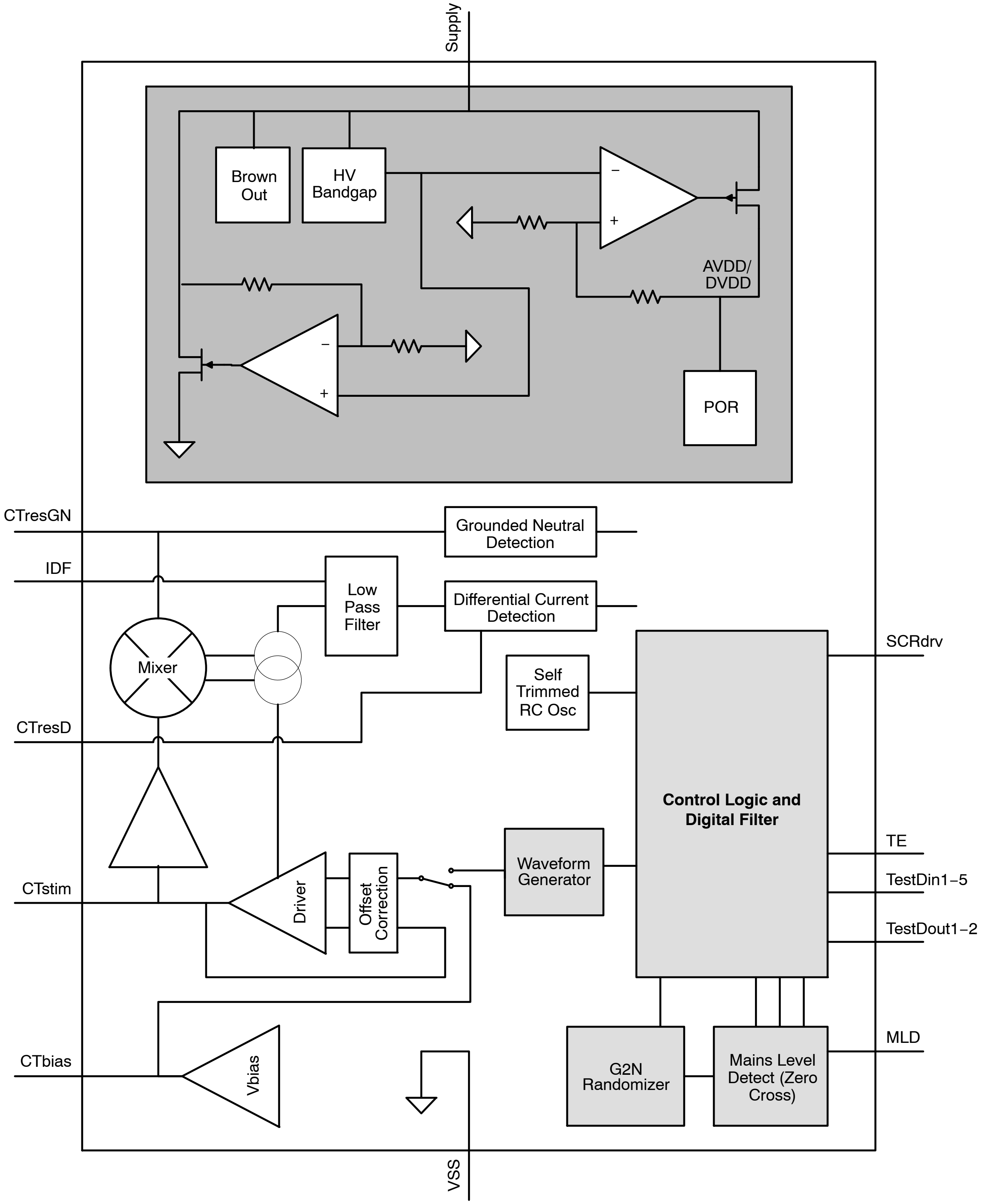


Figure 1. Simplified Block Diagram

Table 1. PIN FUNCTION DESCRIPTION – QFN

Pin #	Name	Pad Description
0	Ground	QFN center slug
1	MLD	Mains Level Detect (Zero Cross)
2	CTtest	Test port (Must be tied to CTbias in functional mode).
3	CTbias	2 V reference that is connected to the external CT sensor
4	CTstim	Differential current measurement port for external CT
5	CTresD	Determines IV converter gain for detection threshold / matched to CT turns ratio (Differential Current)
6	IDF	Front end noise filter capacitor
7	NC	Tie to Ground or leave floating
8	NC	Tie to Ground or leave floating
9	NC	Tie to Ground or leave floating
10	NC	Tie to Ground or leave floating
11	NC	Tie to Ground or leave floating
12	NC	Tie to Ground or leave floating
13	NC	Float
14	NC	Float
15	SCRdrv	Used to trigger the solenoid at a fault detection
16	Supply	Power supply

Table 2. PIN FUNCTION DESCRIPTION – TSSOP

Pin #	Name	Pad Description
1	CTstim	Differential current measurement port for external CT
2	Ground	Main ground connection for IC.
3	CTresD	Determines IV converter gain for detection threshold / matched to CT turns ratio (Differential Current)
4	IDF	Front end noise filter capacitor
5	TE	Test enable
6	NC	Tie to Ground or leave floating
7	NC	Tie to Ground or leave floating
8	NC	Tie to Ground or leave floating
9	NC	Tie to Ground or leave floating
10	NC	Tie to Ground or leave floating
11	NC	Float
12	NC	Float
13	SCRdrv	Used to trigger the solenoid at a fault detection
14	Supply	Power supply
15	MLD	Mains Level Detect (Zero Cross)
16	CTbias	2 V reference that is connected to the external CT sensor

Table 3. ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage Range	Vs	6.0 to 19 V	V
Input Voltage Range (Note 1)	V_{in}	−0.3 to 6.0	V
Output Voltage Range	V_{out}	−0.3 to 6.0 V or (V_{in} + 0.3), whichever is lower	V
Maximum Junction Temperature	$T_{J(max)}$	140	°C
Storage Temperature Range	TSTG	−65 to 150	°C
ESD Capability, Human Body Model (Note 2)	ESDHBM	2	kV
ESD Capability, Machine Model (Note 2)	ESDMM	200	V
Lead Temperature Soldering Reflow (SMD Styles Only), Pb−Free Versions (Note 3)	T_{SLD}	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. This device series incorporates ESD protection and is tested by the following methods:
   ESD Human Body Model tested per AEC−Q100−002 (EIA/JESD22−A114)
   ESD Machine Model tested per AEC−Q100−003 (EIA/JESD22−A115)
   Latchup Current Maximum Rating: ≤ 150 mA per JEDEC standard: JESD78
3. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D

Table 4. THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Characteristics, QFN16, 3x3.3 mm (Note 4) Thermal Resistance, Junction−to−Air (Note 5) Thermal Reference, Junction−to−Lead2 (Note 5)	$R_{\theta JA}$ $R_{\psi JL}$	64	°C/W
Thermal Characteristics, TSOP−5 (Note 4) Thermal Resistance, Junction−to−Air (Note 5)	$R_{\theta JA}$		°C/W

4. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
5. Values based on copper area of 645 mm^2 (or 1 in^2) of 1 oz copper thickness and FR4 PCB substrate.

Table 5. OPERATING RANGES (Note 6)

Parameter	Conditions	Min	Typ	Max	Units
Operating Temperature		−40		85	C
IDD			2		mA
SCR Trigger Current				8	mA
SCR Trigger output voltage	With 5 V supply	4.5		5	V
Fault Current Sensitivity	Ground Fault with ±1% resistor for RctresD	4.5	5	5.5	mA
Ground Fault Response Time	5−20 mA			150	ms
Ground Fault Response Time	20−100 mA			75	ms
Ground Fault Response Time	>100 mA			25	ms
CT Turns Ratio		100		300	
Internal Oscillator Frequency			2		MHz
CT Driver Closed Loop BW				500	KHz

6. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.

APPLICATIONS INFORMATION

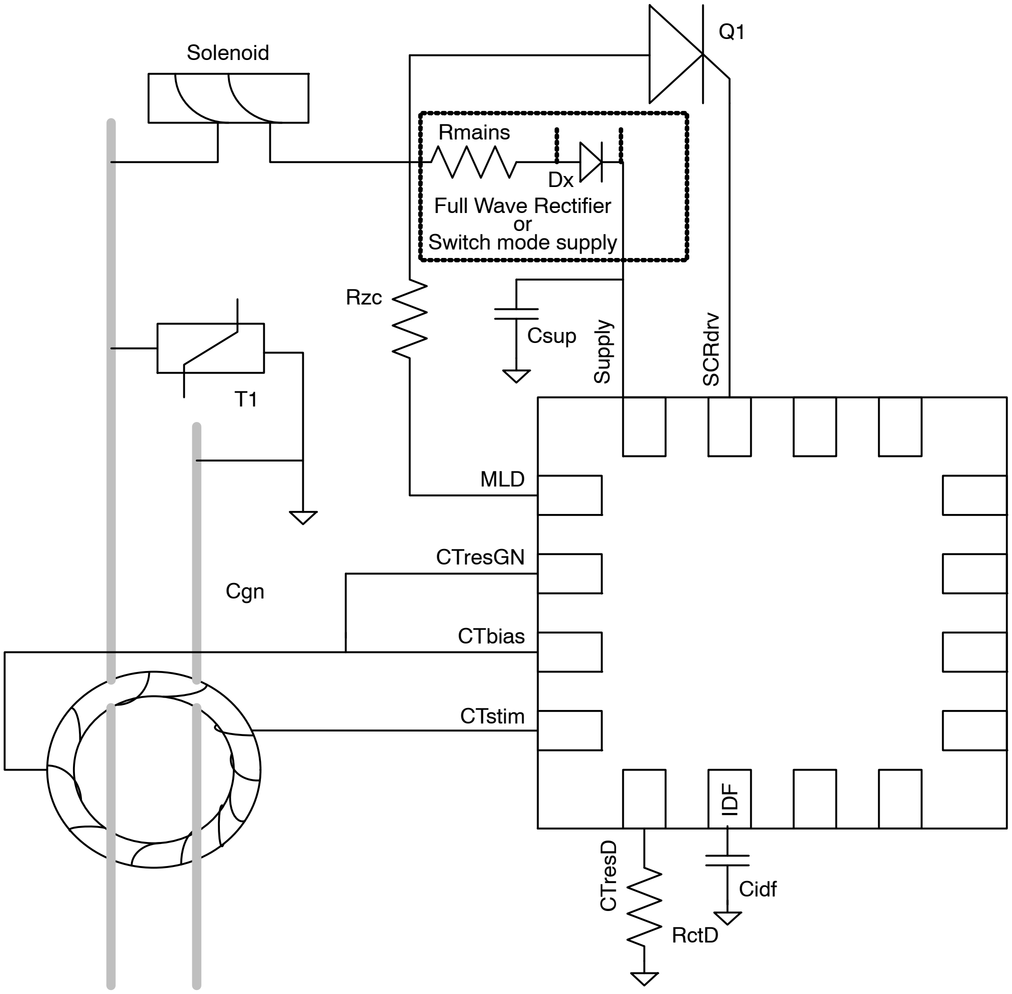


Figure 2. Typical Application Schematic

RECOMMENDED EXTERNAL COMPONENTS:

Component Type	Instance	Value	Note
SCR	Q1	–	ON−MCR08
Diode	Dx	–	ON−1N4007
Capacitor	Csup	1 – 4.7 μF	For a full bridge rectifier
Capacitor	Cidf	180 – 220 nF	Differential current filtering
Resistor	RctD	20 – 70 K	Matched to current transformer
Resistor	Rzc	400 – 800 K	Zero cross detection resistor. Value limits current
Resistor	Rmains	10 – 45 K	For a full bridge rectifier
TVS	T1	–	~250 – 400 V

Filtering

The analog signal capture portion of the IC includes a single pole filter that can be set externally with Cidf. This provides an additional layer of protection against false tripping under steady state noise conditions. High frequency steady state noise is common with pumps, motors or other cyclic noise generators.

Cidf = 220 nF = 1 KHz low pass.

Setting Trip Sensitivity

The CTresD resistor sets the threshold for the differential current fault levels. Increasing CTresD causes the fault levels to trip at lower differential currents. CT efficiency at 60 Hz must be considered.

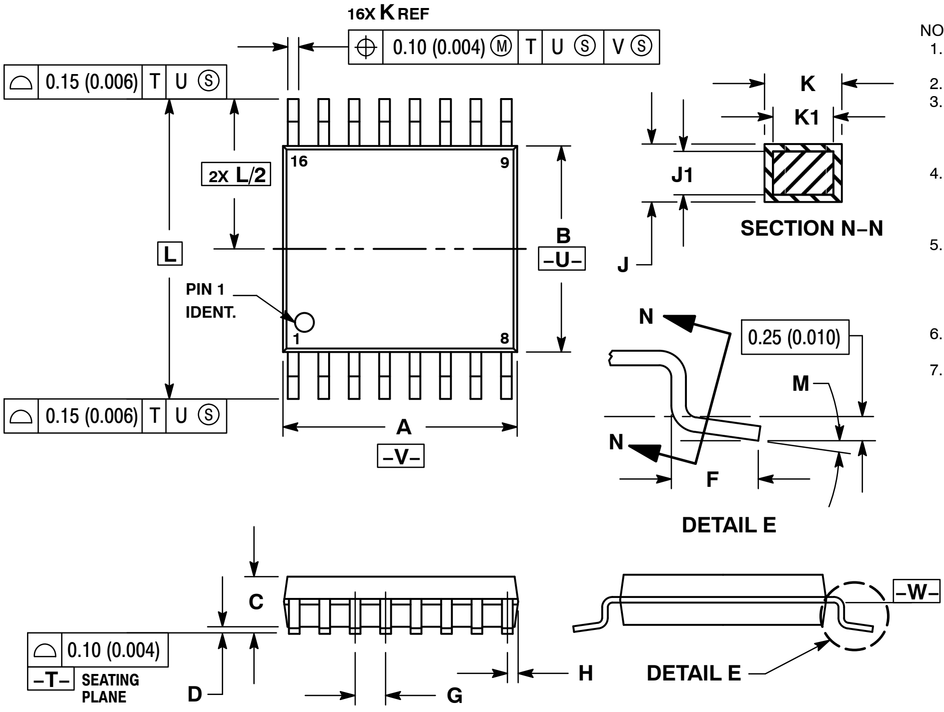
. CTresD= 400*#Turns – Subject to CT efficiency at 60 Hz

PACKAGE DIMENSIONS

TSSOP−16

CASE 948F−01

ISSUE B

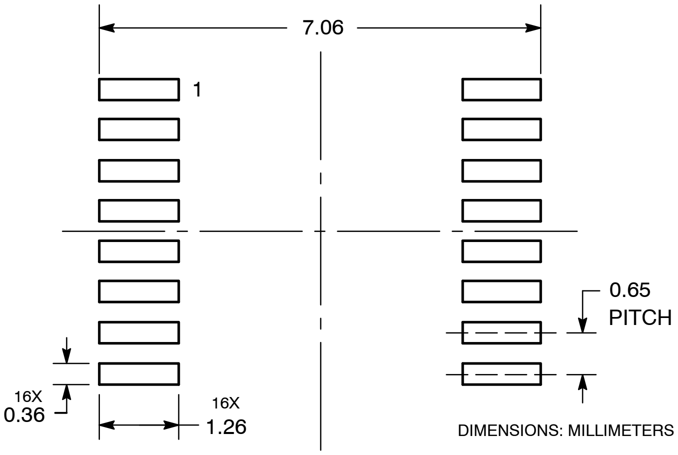


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

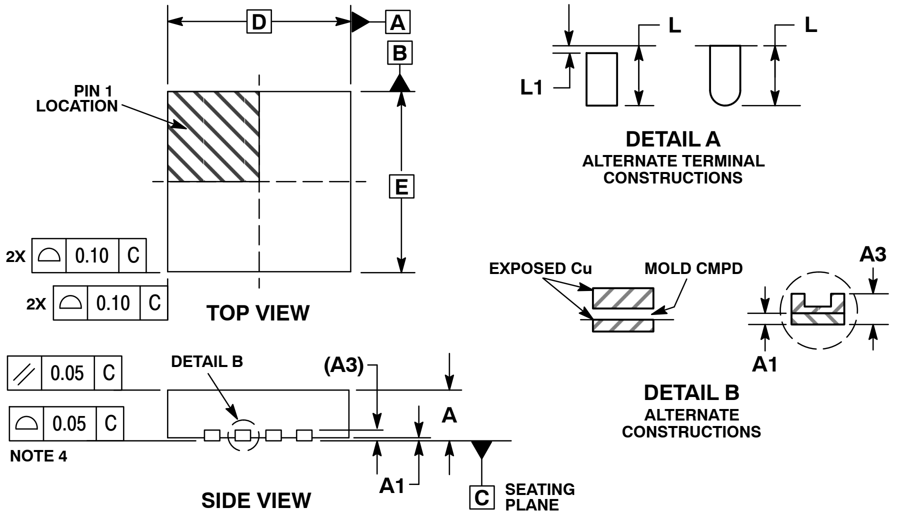
SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

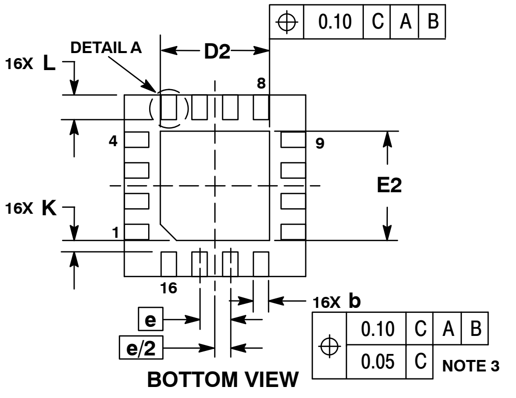
PACKAGE DIMENSIONS

QFN16 3x3, 0.5P
CASE 485G−01
ISSUE F

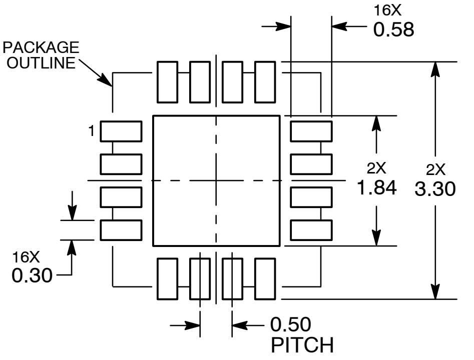


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS		
DIM	**MIN**	**NOM**	**MAX**
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3	0.20 REF		
b	0.18	0.24	0.30
D	3.00 BSC		
D2	1.65	1.75	1.85
E	3.00 BSC		
E2	1.65	1.75	1.85
e	0.50 BSC		
K	0.18 TYP		
L	0.30	0.40	0.50
L1	0.00	0.08	0.15



RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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

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