

DS1780

CPU Peripheral Monitor

Description

The DS1780 is a highly integrated system instrumentation monitor that is ideal for use in personal computers or any microprocessor-based system. It monitors temperature ($\pm 2^{\circ}\text{C}$ accuracy from -25°C to $+100^{\circ}\text{C}$), six power supply voltages, and the speed of two fans. Fan speed can also be controlled using the DS1780's internal 8-bit DAC. All measurements are internally converted to a digital format for easy processing by the CPU.

The DS1780 can be reset to its default power-up state through a remote reset function that has internal debounce and delay. The DS1780 also features an interrupt function that can be programmed to become active should any of the monitored parameters fall out of spec. For board-level testability, an internal NAND TREE function simplifies system design, and a chassis intrusion input enhances system security.

Programming and data readout are accessed through a simple 2-wire interface with 2-bit addressability. The DS1780 power supply range of 2.8V to 5.75V allows parameter monitoring for 3V or 5V systems. The DS1780 is assembled in a 24-pin 173mil TSSOP package (DS1780E).

Key Features

- $\pm 2^{\circ}\text{C}$ accuracy (from -25°C to $+100^{\circ}\text{C}$) 9-bit digital thermometer
- Six 8-bit ADC channels for monitoring PC power supplies
- Two tachometer inputs
- 8-bit DAC for fan speed control
- Maskable system interrupt for all measured parameters (temperature, voltage, fan speed, intrusion detect)
- Limit settings are user-programmable
- Data is transferred over 2-wire/SMBus interface
- Two address inputs allow up to four DS1780 to operate on a single bus
- 2.8V to 5.75V operating range
- 24-pin 173mil TSSOP package (DS1780E)

Applications/Uses

[Computer Graphics Systems](#)
[Industrial Instruments](#)
[Notebook Computers](#)
[Portable Terminals](#)
[Storage Area Networks \(SANs\)](#)

Key Specifications: Temperature Sensors

Part Number	Sensor Type	Functions	Interface	Accuracy ($\pm^{\circ}\text{C}$)	Parasite Power	Temperature Threshold	Temperature Resolution (Bits)	Multi-Droppable	
DS1780	Local	<ul style="list-style-type: none">Fan ControllerVoltage Monitor	2-Wire/ SMBus	2	No	Programmable	9	Yes	

[See All Temperature Sensors \(99\)](#)

Notes:

**This pricing is BUDGETARY, for comparing similar parts. Prices are in U.S. dollars and subject to change. Quantity pricing may vary substantially and international prices may differ due to local duties, taxes, fees, and exchange rates. For volume-specific prices and delivery, please see the [price and availability page](#) or contact an authorized distributor.

Application Notes

[Application Note 3930: Package Thermal Resistance Values \(Theta JA, Theta JC\) for Dallas Semiconductor Temperature Sensors - DS1780](#)

Evaluation Kits

none

Design Guides

[Temp Sensors \(PDF\)](#)

Reliability Reports

[Reliability Report: DS1780.pdf](#)

Software/Models

none

Ordering Information

Notes:

1. Other options and links for purchasing parts are listed at:
2. [Didn't Find What You Need?](#) Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
3. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: See [Full Data Sheet](#) or [Part Naming Conventions](#).
4. * Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses. Note that "+", "#", "-" in the part number suffix describes RoHS status. Package drawings may show a different suffix character.

Devices: 1-3 of 3

DS1780	Free Sample	Buy	Package: TYPE PINS FOOTPRINT DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
DS1780E			TSSOP; 24 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U24-2*	-20°C to +85°C	RoHS/Lead-Free: No Materials Analysis
DS1780E+			TSSOP; 24 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U24+1*	-20°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis
DS1780E+T&R			TSSOP; 24 pin; Dwg: 21-0066 (PDF) Use pkgcode/variation: U24+1*	-20°C to +85°C	RoHS/Lead-Free: Lead Free Materials Analysis

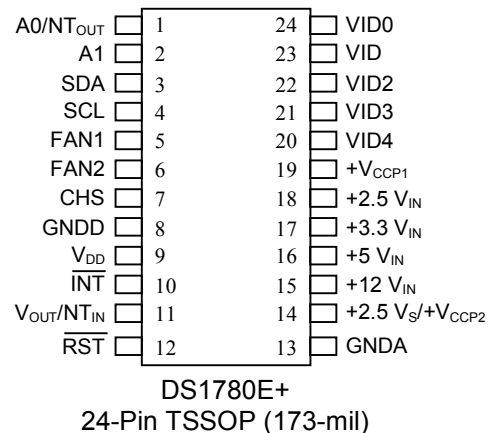
More Information

[Temperature Family by Product Type](#)

FEATURES

- Direct-to-digital temperature sensor requires no external components or user calibration
- Two fan speed sensors
- Monitors 6 power supply voltages
- 8-bit DAC for fan speed control
- Intrusion detect for security (detects when chassis lid has been removed, even if power is off)
- Remote system reset
- System interrupt availability on all monitored functions (temperature, voltages, fan speed, chassis intrusion)
- 2-wire interface with 2-bit addressability
- Integrated NAND TREE for board level testability
- Wide power supply range ($2.8V \leq V_{DD} \leq 5.75V$)
- High integration in a small 24-pin 173-mil TSSOP
- Applications include monitoring of personal computers or any microprocessor-based system

PIN ASSIGNMENT



PIN DESCRIPTION

A0/NT _{OUT}	- Address Input / NAND
TREE	Output
A1	- Address Input
SDA	- 2-Wire Serial Data
	Input/Output
SCL	- 2-Wire Serial Clock
FAN _x	- Tachometer Inputs
CHS	- Chassis Intrusion Detector
	Input
GNDD	- Digital Ground
V _{DD}	- Power Supply Voltage (2.8V to 5.75V)
$\overline{\text{INT}}$	- Hardware Interrupt output
V _{OUT} /NT _{IN}	- DAC output / NAND TREE
	Input
$\overline{\text{RST}}$	- Remote System Reset
GNDA	- Analog Ground
+xxV _{IN}	- Positive Voltage Inputs
+2.5V _S /+V _{CCP2}	- Positive/negative Voltage
	Input
VID _x	- Processor Voltage Supply
	Readout Inputs

See Table 11 on page 27 for Ordering Information

DESCRIPTION

The DS1780 is a highly integrated system instrumentation monitor ideal for use in personal computers, or any microprocessor-based system. It monitors ambient temperature, six power supply voltages, and the speed of two fans. Fan speed can also be controlled with the use of an internal 8-bit DAC. All measurements are internally converted to a digital format for easy processing by the CPU.

The DS1780 can be reset to its default power-up state via a remote reset function with internal debounce and delay. It features an interrupt that can be programmed to become active should any of the functions the DS1780 is monitoring fall out of spec.

For board-level testability, an internal NAND TREE function simplifies the system design. A chassis intrusion input is featured to enhance system security.

Programming and data readout are accessed via a simple 2-wire interface with 2-bit addressability. The DS1780 power supply range of 2.8V to 5.75V allows for monitoring of parameters for 3V or 5V systems. The DS1780 is assembled in a compact 173-mil TSSOP package.

Detailed Pin Description Table 1

PIN	SIGNAL	DIRECTION	DESCRIPTION
1	A0/NT _{OUT}	Digital I/O	The lowest order programmable bit of the 2-wire bus address. This pin functions as an output when doing a NAND TREE test.
2	A1	Digital Input	The highest order programmable bit of the 2-wire bus address.
3	SDA	Digital I/O	2-wire bus bi-directional data. Open-drain output.
4	SCL	Digital Input	2-wire bus synchronous clock.
5	FAN1	Digital Input	0 to V _{DD} amplitude fan tachometer input.
6	FAN2	Digital Input	0 to V _{DD} amplitude fan tachometer input.
7	CHS	Digital I/O	An active high input from an external circuit, which latches a Chassis Intrusion event. This line can go high without any clamping action regardless of the powered state of the DS1780. The DS1780 provides an internal open drain on this line, controlled by Bit 6 of Configuration Register, to provide a minimum 20 ms reset of this signal.
8	GNDD	GROUND	Internally connected to all digital circuitry.
9	V _{DD}	POWER	+3.3V or +5V V _{DD} power. Bypass with the parallel combination of 10 μF (Electrolytic or Tantalum) and 0.1 μF (ceramic) bypass capacitors.
10	$\overline{\text{INT}}$	Digital Output	Active-low Programmable interrupt output. The output is enabled when Bit 1 of the Configuration Register is set to 1. The default state is disabled.
11	V _{OUT} /NT _{IN}	Digital Input/ Analog Output	An active-high input that enables NAND Tree board-level connectivity testing. Refer to “NAND Tree Testing” Section. Used as DAC output when NAND Tree is not selected.
12	$\overline{\text{RST}}$	Digital I/O	Master Reset, 5 mA open drain driver, active low output with at least a 20 ms minimum pulse width. Available when enabled via Bit 4 in Configuration Register. This is a bi-directional I/O pin. It acts as power on RESET input.
13	GNDA	GROUND	Internally connected to all analog circuitry. The ground reference for all analog inputs.
14	+2.5V _S /+V _{CCP2}	Analog Input	Analog input for monitoring -12V or +V _{CCP2} . DS1780 will measure voltages on this pin from 0V to 3.6V. An external resistor ladder is required for monitoring a -12V supply (see Figure 1).
15-19	+xxV _{IN}	Analog Inputs	A/D inputs for 5 positive voltages.
20-24	VID _x	Digital Inputs	Voltage supply readouts from the processor. These values are read in the VID and VID4 Status Registers.

4. This register will latch an 8-bit value into an R-2R D/A to provide a range of 0-1.25 volts; accuracy can be $\pm 5\%$ or more.
5. This location will contain the company identification number which will be used by software to determine analog voltage curves; this register is read only.
6. This location will contain the stepping number of the part; this register is read only.

ABSOLUTE MAXIMUM RATINGS*

Voltage on V_{DD}	(GNDD-0.3V) to +6.5V
Voltage on any other pin (except Analog Inputs)	(GNDD-0.3V) to ($V_{DD} + 0.3V$)
Voltage at +12V _{IN} pin	(GNDD-0.3V) to 18V
Voltage at other Analog input pins	(GNDD-0.3V) to 7.0V
Ground Difference (GNDD-GNDA)	$\pm 0.3V$
Input Current at any Pin (Note 2)	± 5 mA
Package Input Current (Note 2)	± 20 mA
Operating Temperature	-40°C to +125°C
Storage Temperature	-65°C to +150°C
ESD Susceptibility (Human Body Model)	2kV
Soldering Temperature (Note 3)	215°C for 60 seconds (Vapor Phase) 220°C for 15 seconds (IR)

* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

The Dallas Semiconductor DS1780 is built to the highest quality standards and manufactured for long term reliability. All Dallas Semiconductor devices are made using the same quality materials and manufacturing methods. However, the DS1780 is not exposed to environmental stresses, such as burn-in, that some industrial applications require. For specific reliability information on this product, please contact the factory in Dallas at (972) 371-4448.

RECOMMENDED DC OPERATING CONDITIONS

(-40°C to +125°C, $2.8V \leq V_{DD} \leq 5.75V$)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	V_{DD}		2.8		5.75	V	
Ground Difference	ΔGND	IGNDD-GNDAI			0.1	V	
Digital Input Voltage	V_{IND}		-0.05		$V_{DD}+0.05$	V	

DC ELECTRICAL CHARACTERISTICS**Power Supply**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Supply Current	I _{DD}	Active ADC and DAC, Interface Inactive		0.7	1.0	mA	4, 5
		ADC, DAC and Interface Inactive		125		μA	
		Inactive ADC and Interface, DAC Active		250	500	μA	

DC ELECTRICAL CHARACTERISTICS:**Temperature-to-Digital Converter**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Thermometer Error	T _{ERR}	-40°C ≤ T _A ≤ 125°C			±3	°C	
		-25°C ≤ T _A ≤ 100°C			±2		
Resolution			0.5			°C	

DC ELECTRICAL CHARACTERISTICS:**Voltage-to-Digital Converter**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
ADC Resolution					8	bits	
Voltage to Digital Conversion Resolution (See Voltage A/D Section)		+2.5V _{IN} Input		13.0		mV	
		+3.3V _{IN} Input		17.2			
		+5V _{IN} Input		26.0			
		+12V _{IN} Input		62.5			
		+V _{CCP1,2} Inputs		14.1			
		+2.5V _S Input		64.0			
Total Adjusted Error	TUE	0°C ≤ T _A ≤ 100°C			±1.5	%	6
		-40°C ≤ T _A ≤ +125°C			±2		
Differential Nonlinearity	DNL				±1	LSb	
Power Supply Sensitivity	PSS			±1		%/V	
Monitoring Cycle	t _C			0.5	1.0	s	7
Input Resistance	R _{IN}		500k	750k		Ω	

DC ELECTRICAL CHARACTERISTICS:**Fan RPM-to-Digital Converter**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Accuracy		0°C ≤ TA ≤ 100°C			±6	%	
		-40°C ≤ TA ≤ +125°C			±12		
Full scale count					255	decimal	
FAN1 & FAN2 Normal Input RPM		Divisor=1; Fan Count=153		8800		RPM	8
		Divisor=2; Fan Count=153		4400			
		Divisor=4; Fan Count=153		2200			
		Divisor=8; Fan Count=153		1100			
Internal Oscillator Frequency		+25°C ≤ TA ≤ +75°C	21.15	22.5	23.85	kHz	

DC ELECTRICAL CHARACTERISTICS:**Analog Output V_{OUT}**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
DAC Resolution					8	bits	
Voltage Range			0		1.25	V	
Error	DAC _{ERR}				±5	% of FSR	
Output Current	I _{OUT}				2.0	mA	
Load Capacitance	C _{LOAD}				100	pF	

DC ELECTRICAL CHARACTERISTICS:**Digital Outputs: A0NT_{OUT}**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical “1” Output Voltage	V _{OUT(1)}	I _{OUT} =±5 mA at V _{DD} =4.25V	2.4			V	
		I _{OUT} =±3 mA at V _{DD} =2.85V					
Logical “0” Output Voltage	V _{OUT(0)}	I _{OUT} =±5 mA at V _{DD} =5.75V			0.4	V	
		I _{OUT} =±3 mA at V _{DD} =3.45V					

DC ELECTRICAL CHARACTERISTICS:**Open-drain Digital Outputs: $\overline{\text{RST}}$, CHS , $\overline{\text{INT}}$** (-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical 0 Output Voltage	V _{OUT(0)}	I _{OUT} =±5 mA at V _{DD} =5.75V	0.4			V	
		I _{OUT} =±3 mA at V _{DD} =3.45V					
High Level Output Current	I _{OH}	V _{OUT} =V _{DD}		0.1	100	μA	
Active Pulse Width		$\overline{\text{RST}}$ and CHS	20	45		ms	

DC ELECTRICAL CHARACTERISTICS:**Open-drain 2-Wire Bus Output: SDA**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical 0 Output Voltage	V _{OUT(0)}	I _{OUT} =±5 mA at V _{DD} =5.75V	0.4			V	
		I _{OUT} =±3 mA at V _{DD} =3.45V					
High Level Output Current	I _{OH}	V _{OUT} =V _{DD}		0.1	100	μA	

DC ELECTRICAL CHARACTERISTICS:**2-Wire Bus Digital Inputs: SDA, SCL**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical 1 Input Voltage	V _{IN(1)}		0.7V _{DD}			V	
Logical 0 Input Voltage	V _{IN(0)}				0.3V _{DD}	V	

DC ELECTRICAL CHARACTERISTICS:**Digital Inputs: A0/NT_{OUT}, A1, CHS, VID0-4, FAN1, FAN2**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

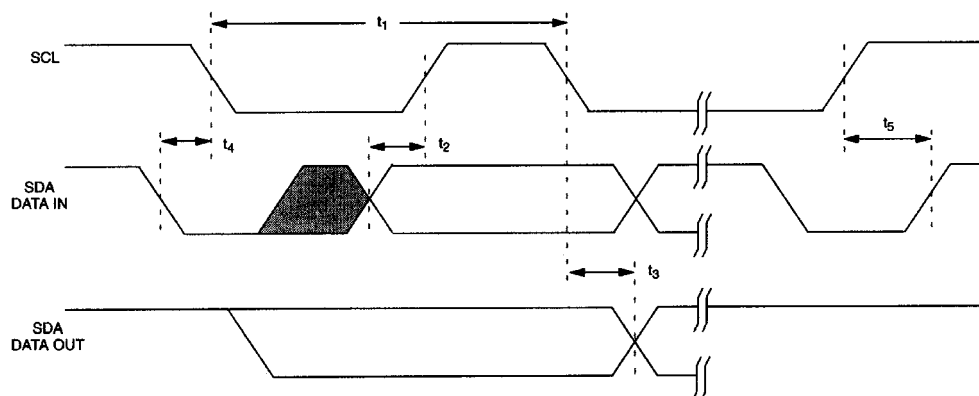
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical 1 Input Voltage	V _{IN(1)}	V _{DD} =5.0V	2.4			V	
Logical 0 Input Voltage	V _{IN(0)}	V _{DD} =5.0V			0.8	V	
Logical 1 Input Voltage	V _{IN(1)}	V _{DD} =3.3V	2.0			V	
Logical 0 Input Voltage	V _{IN(0)}	V _{DD} =3.3V			0.4	V	

DC ELECTRICAL CHARACTERISTICS:**All Digital Inputs**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Logical 1 Input Current	I _{IN(1)}	V _{IN} =V _{DD}	-1	-0.005		μA	
Logical 0 Input Current	I _{IN(0)}	V _{IN} =0V		0.005	1	μA	
Input Capacitance	C _{IN}			20		pF	

AC ELECTRICAL CHARACTERISTICS:**2-Wire Interface**(-40°C to +125°C, 2.8V ≤ V_{DD} ≤ 5.75V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
SCL Clock Period	t ₁		2.5			μs	
Data In Setup Time to SCL High	t ₂		100			ns	
Data Out Stable after SCL Low	t ₃		0			ns	
SDA Low Setup Time to SCL Low (START)	t ₄		100			ns	
SDA High Hold Time after SCL High (STOP)	t ₅		100			ns	

2-WIRE BUS TIMING DIAGRAM Figure 8**NOTES:**

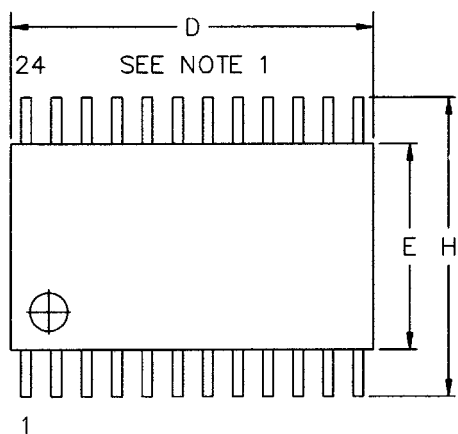
- All voltages are referenced to ground, unless otherwise specified. When the input voltage (V_{IN}) at any pin exceeds the power supplies ($V_{IN} < (GND \text{ or } GND_A)$ or $V_{IN} > V_{DD}$, except for analog voltage inputs), the current at that pin should be limited to 5 mA. The 20 mA maximum package input current rating limits the number of pins that can safely exceed the power supplies with an input current of 5 mA to four.
- Solder according to IPC standards.
- I_{DD} specified with open-drain output pin open.
- I_{DD} specified with V_{CC} at 5.0V and SDA, SCL = 5.0V.
- TUE (Total Unadjusted Error) includes Offset, Gain and Linearity errors of the ADC.
- Monitoring Cycle Time includes temperature conversion, voltage conversions, and fan speed readings.
- The total fan count is based on 2 pulses per revolution of the fan tachometer output.
- Limits (Min and Max specs) are defined for the full temperature range $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ and voltage range $2.8\text{V} \leq V_{DD} \leq 5.75\text{V}$, unless otherwise stated as a condition. Typical values represent parametric norms at $T_A = 25^{\circ}\text{C}$ at $4.5\text{V} \leq V_{DD} \leq 5.5\text{V}$, unless otherwise stated as a condition.

ORDERING INFORMATION Table 11

ORDERING NUMBER	PACKAGE MARKING	DESCRIPTION
DS1780E+	DS1780 (See Note)	DS1780 in Lead-Free 24-pin TSSOP
DS1780E+T&R	DS1780 (See Note)	DS1780 in Lead-Free 24-pin TSSOP, 1000 Piece Tape-and-Reel
DS1780E	DS1780	DS1780 in 24-pin TSSOP
DS1780E/T&R	DS1780	DS1780 in 24-pin TSSOP, 1000 Piece Tape-and-Reel

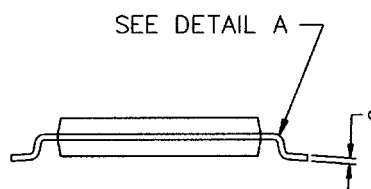
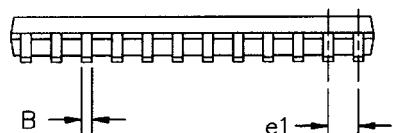
Note: A "+" symbol will also be marked on the package near the Pin 1 indicator

DS1780 24 LD. TSSOP

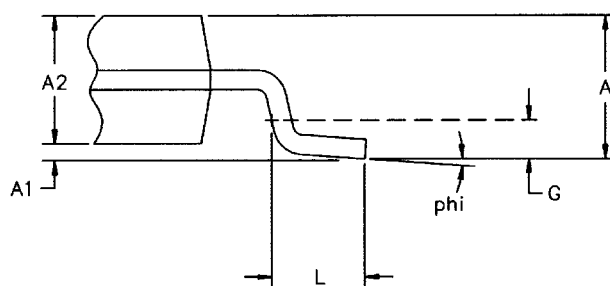


NOTES:

1. DIMENSION "D" INCLUDES MOLD MISMATCH, FLASH, AND PROTRUSIONS.



DIM	MIN	MAX
A	-	1.10
A1	0.05	-
A2	0.75	1.05
c	0.09	0.18
phi	0°	8°
L	0.50	0.70
e1	0.65 BSC	
B	0.18	0.30
D	7.55	8.00
E	4.40 NOM	
G	0.25 REF	
H	6.25	6.55



DETAIL A