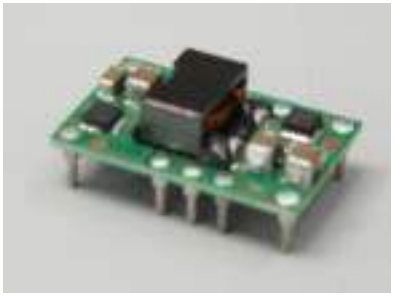
DC-DC Converter Application Manual

MPDTH03060Y**

10-A, 3.3-V Input Non-Isolated DDR/QDR Memory Bus Termination Module



NOMINAL SIZE = 25.27 mm x 15.75 mm

Features

- VTT Bus Termination Output (Output Track the System Vref)
- 10-A Output Current
- 3.3-V Input Voltage
- DDR and QDR Compatible
- Efficiencies up to 91 %
- 57 W/in^3 Power Density
- On/Off Inhibit(for Vtt Standby)
- Under-Voltage Lockout
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- Operating Temp: -40 to +85 °C
- Point-of-Load Alliance Compatible

Description

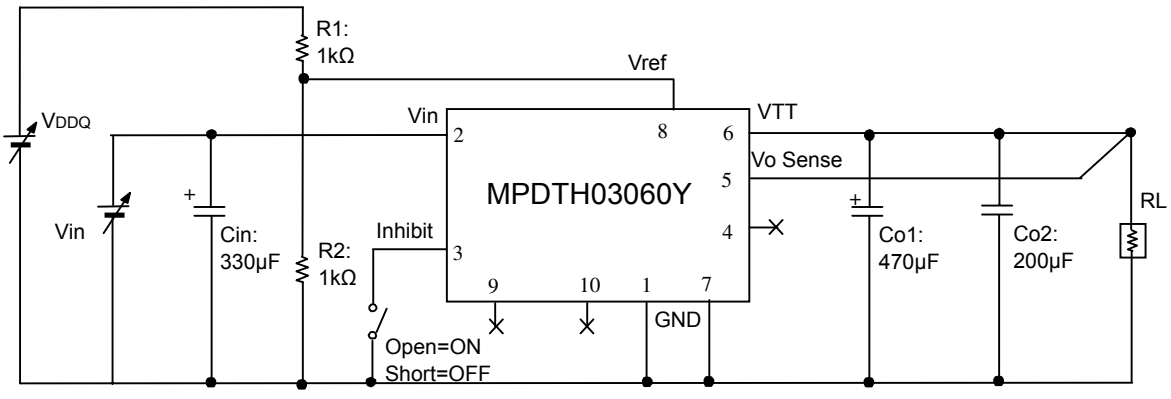
The MPDTH03060Y are a series of ready-to-use switching regulator modules from Murata designed specifically for bus termination in DDR and QDR memory applications. Operating 3.3-V input, the module generates a VTT output that will source or sink up to 10 A of current to accurately track their Vref input. VTT is the required bus termination supply voltage, and Vref is the reference voltage for the memory and chipset bus receiver comparators. Vref is usually set to half the VDDQ power supply voltage.
The MPDTH03060Y employs an actively switched synchronous rectifier output to provide state-of-the-art stepdown switching conversion.

The products are small in size (25.4mm × 15.75mm), and are an ideal choice where space, performance, and high efficiency are desired, along with the convenience of a ready-to-use module.
Operating features include an on/off inhibit and output over-current protection (source mode only). The on/off inhibit feature allows the VTT bus to be turned off to save power in a standby mode of operation. To ensure tight
load regulation, an output remote sense is also provided. Package options include both throughhole and surface mount configurations.

Pin Configuration

Pin	Function
1	GND
2	Vin
3	Inhibit
4	No Connect
5	Vo Sense
6	VTT
7	GND
8	Vref
9	No Connect
10	No Connect

Standard Application



Cin : Required 330μF, Capacitor
Co1 : Required 470μF, Low-ESR Electrolytic Capacitor
Co2 : Ceramic Capacitor for Optimum response, 200μF

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10-A, 3.3-V Input Non-Isolated DDR/QDR Memory Bus Termination Module

Ordering Information

Output Voltage (MPDTH03060□xx)

Code	Voltage
Y	0.55V-1.8V(Adjustable)

Package Options (MPDTH03060x□□)

Code	Description
AH	Horiz. T/H
AS	SMD(*1)

Notes (1) Pb free (Sn-Ag-Cu) pin solder material.

Pin Description

Vin: The positive input voltage power node to the module, which is referenced to common *GND*.

VTT: This is the regulated power output from the module with respect to the *GND* node, and the tracking termination supply for the application data and address buses. It is precisely regulated to the voltage applied to the module's *Vref* input, and is active about 20 ms after a valid input source is applied to the module.
Once active it will track the voltage applied at Vref.

GND: This is the common ground connection for the *VIN* and *VTT* power connections. It is also the 0 VDC reference for the control inputs.

Inhibit: The Inhibit pin is an open-collector/drain negative logic input that is referenced to *GND*. Applying a low-level ground signal to this input turns off the output voltage, *VTT*. Although the module is inhibited, a voltage, VDDQ will be present at the output terminals, fed through the DDR memory. When the Inhibit is active, the input current drawn by the regulator is significantly reduced. If the Inhibit pin is left open circuit, the module will produce an output whenever a valid input source is applied. See the Typical DDR Application Diagram in the Application Information section for reference.

Vref: The module senses the voltage at this input to regulate the output voltage, *VTT*. The voltage at *Vref* is also the reference voltage for the system bus receiver comparators. It is normally set to precisely half the bus *Vref* 8 driver supply voltage (VDDQ÷ 2), using a resistor divider. The Thevenin impedance of the network driving the *Vref* pin should not exceed 500 Ω. See the Typical DDR Application Diagram in the Application Information section for reference.

Vo Sense: The sense input allows the regulation circuit to compensate for voltage drop between the module and the load. For optimal voltage accuracy *Vo Sense* should be connected to *VTT*.

No Connect: No connection.

10-A, 3.3-V Input Non-Isolated DDR/QDR
Memory Bus Termination Module

Environmental & Absolute Maximum Ratings (Voltages are with respect to GND)

Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Control Input Voltage	Vref		-0.3	-	Vin+0.3	V
Operating Temperature Range	Ta	Over Vin Range	-40*(i)*	-	85	°C
Strage Temperature	Ts	-	-40		125	°C
Solder Reflow Temperature	Treflow	Surface temperature of module body or pins			245*(ii)*	°C

Notes: *(i) For operation below 0 °C the external capacitors must have stable characteristics. Use either a low ESR tantalum, Os-Con, or ceramic capacitor.*
(ii) During reflow of SMD package version do not elevate peak temperature of the module, pins or internal components above the stated maximum

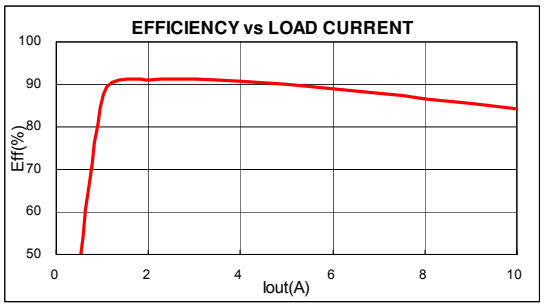
Electrical Specifications

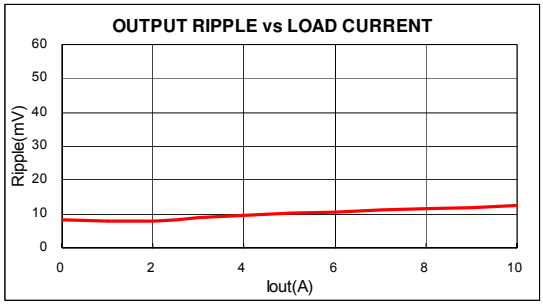
(Unless otherwise stated, Ta =25°C, Vin =3.3 V, Vref =1.25 V, Cin =330µF, Co1 =470µF, Co2 =200µF, and Io =Iomax)

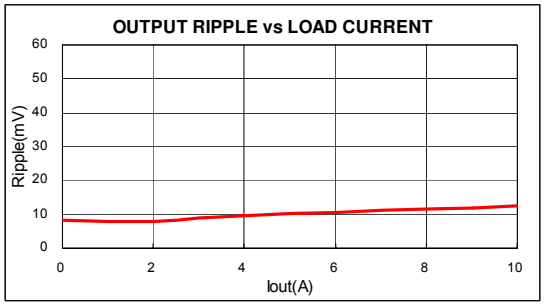
Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Output Current	Io	Over ∆Vref Range	0	-	±10(1)	A
Input Voltage Range	Vin	Over Io Range	2.95(2)	-	3.65	V
Tracking range for Vref	∆Vref		0.55	-	1.8	V
Tracking tolerance to Vref	|VTT-Vref|	Over line, load and temperature Io=0A	-10	-	10	mV
Efficiency	η	Io=8A	-	86	-	%
Vo Ripple (pk-pk)	Vr	20 MHz bandwidth	-	20	-	mVpp
Short Circuit Protection	Io trip	Reset, Followed by Auto-Recovery	-	20		A
Load transient response		15 A/µs load step, from –1. 5A to 1.5A				
	ttr	Recovery Time	-	30	-	µsec
	∆Vtr	Vo Deviation	-	25	40	mV
Rising UVLO Threshold	UVLOr	Vin Increasing	-	2.45	2.8	V
Falling UVLO Threshold	UVLOf	Vin Decreasing	1.9	2.1	-	V
Inhibit Control (pin4)		Referenced to GND				
Input High Voltage	VIH		Vin-0.5	-	Open(2)	V
Input Low Voltage	VIL		-0.2	-	0.6	
Input Low Current	IILinhibit	Pin to GND	-	130	-	µA
Input Standby Current	Iin inh	Inhibit (pin 3) to GND,	-	10	-	mA
Switching Frequency	Frq	Over Vin and Io Ranges	-	300	-	kHz
External Input Capacitance	Cin		330(3)	-	-	µF
External Output Capacitance	Cout	Capacitance Non-Ceramic(ESR≧4mΩ)	470(4)	-	5500(5)	µF
		-	-	200(4)	300	
MTBF	MTBF	Per Bellcore TR-332 50 % stress, Ta =40°C, Ground Benign	6	-	-	10^6 Hrs

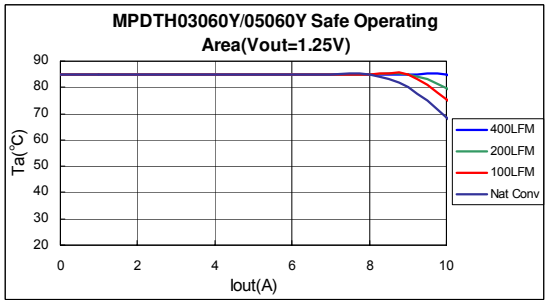
Notes: *(1) Rating is conditional on the module being directly soldered to a 4-layer PCB with 1 oz. copper. See the SOA curves or contact the factory for appropriate derating.*
(2) This control pin has an internal pull-up to the input voltage VIN. If it is left open-circuit the module will operate when input power isapplied. A small low-leakage (<100 nA) MOSFET is recommended for control. For further information, consult the related application note.
(3) An input capacitor is required for proper operation. The capacitor must be rated for a minimum a minimum of 300 mA rms of ripple current.
(4) The minimum value of external output capacitance value ensures that VTT meets the specified transient performance requirements forthe memory bus terminations. Lower values of capacitance may be possible when the measured peak change in output current is consistently less than 3 A.
(5) This is the calculated maximum. The minimum ESR limitation will often result in a lower value. Consult the application notes for further guidance

10-A, 3.3-V Input Non-Isolated DDR/QDR Memory Bus Termination Module

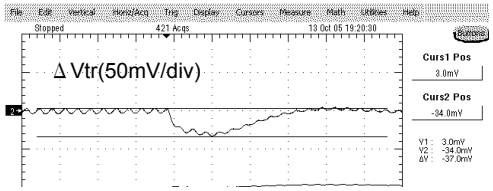








Transient Performance for Δ3A Load Change



Io(1A/div) 100μs/div

Δ Vtr(50mV/div)

Io(1A/div) 100μs/div

(1): The electrical characteristic data has been developed from actual products tested at 25°C. This data is considered typical for the converter. Applies to Figure 1, Figure 2, and Figure 3.

(2):The temperature derating curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures. Derating limits apply to modules soldered directly to a 4 in x 4 in double-sided PCB with 1 oz. copper. For surface mount packages (AS suffix), multiple vias (plated through holes) are required to add thermal paths around the power pins. Please refer to the mechanical specification for more information. Applies to Figure 4.

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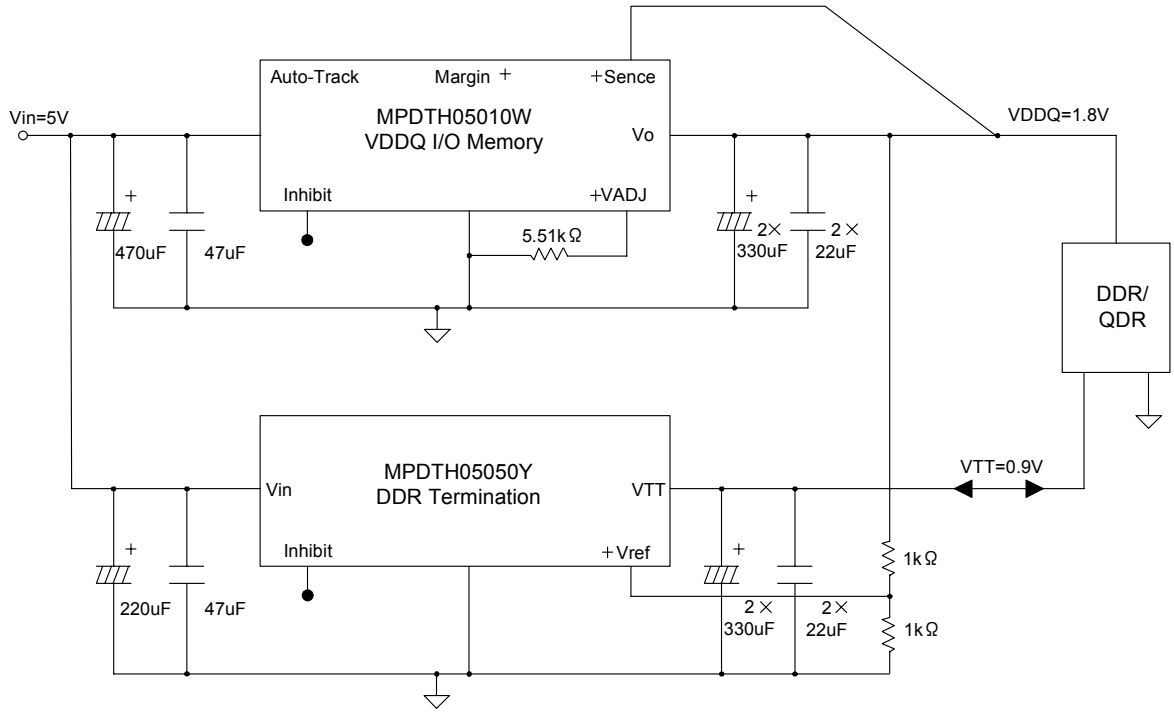
Typical DDR Application Diagram



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Capacitor Recommendations for the MPDTH03060Y DDR Power Module

Input Capacitor

The recommended input capacitor(s) is determined by the 330µF minimum capacitance and 300 mArms minimum ripple current rating.
Ripple current, less than 160 mΩ equivalent series resistance (ESR), and temperature are the major considerations when selecting input capacitors. Unlike polymer tantalum, regular tantalum capacitors have a recommended minimum voltage rating of 2×(maximum DC voltage + AC ripple).
This is standard practice to ensure reliability.
For improved ripple reduction on the input bus, ceramic capacitors may be used to complement electrolytic types and achieve the minimum required capacitance.

Output Capacitors

For applications with load transients (sudden changes in load current), regulator response will benefit from an external output capacitance. The recommended output capacitance of 470µF will allow the module to meet its transient response specification (see Electrical Specifications table). For most applications, high quality computer-grade aluminum electrolytic capacitors are adequate. These capacitors provide decoupling over the frequency range, 2 kHz to 150 kHz, and are suitable when ambient temperatures above 0 °C. Below 0 °C tantalum, ceramic or Os-Con type capacitors are recommended. When using one or more non-ceramic capacitors, the calculated equivalent ESR should not be lower than 4 mΩ (7 mΩ using the manufacturer's maximum ESR for a single capacitor).
A list of preferred low-ESR type capacitors are listed on Table 1-1.

Ceramic Capacitors

Above 150 kHz the performance of aluminum electrolytic capacitors becomes less effective. To further improve the reflected input ripple current or the output transient response, multilayer ceramic capacitors can be added. Ceramic capacitors have very low ESR and their resonant frequency is higher than the bandwidth of the regulator. When used on the output their combined ESR is not critical as long as the total value of ceramic capacitance does not exceed 300µF. Also, to prevent the formation of local resonance, do not place more than five identical ceramic capacitors in parallel with values of 10µF or greater.

Tantalum Capacitors

Tantalum type capacitors can be used at both the input and output, and are recommended for applications where the ambient operating temperature can be less than 0 °C.
The AVX TPS, Sprague 593D/594/595 and Kemet T495/T510 capacitor series are recommended over many other tantalum types due to their higher rated surge, power dissipation, and ripple current capability. As a caution many general purpose tantalum capacitors have considerably higher ESR, reduced power dissipation and lower ripple current capability. These capacitors are also less reliable as they have reduced power dissipation and surge current ratings. Tantalum capacitors that do not have a stated ESR or surge current rating are not recommended for power applications.
When specifying Os-Con and polymer tantalum capacitors for the output, the minimum ESR limit is encountered before the maximum capacitance value is reached.

Capacitor Table

Table 1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The recommended number of capacitors required at both the input and output buses is identified for each capacitor type.
This is not an extensive capacitor list. Capacitors from other vendors are available with comparable specifications. Those listed are for your reference. The RMS ripple current rating and ESR (at 100kHz) are critical parameters necessary to insure both optimum regulator performance and long capacitor life.

Designing for Very Fast Load Transients

The transient response of the DC/DCConverter has been characterized using a load transient with a di/dt of 1A/µs. The typical voltage deviation for this load transient is given in the data sheet specification table using the optional value of output capacitance. As the di/dt of a transient is increased, the response of a converter's regulation circuit ultimately depends on its output capacitor decoupling network. This is an inherent limitation with any DC/DC Converter once the speed of the transient exceeds its bandwidth capability. If the target application specifies a higher di/dt or lower voltage deviation, the requirement can only be met with additional output capacitor decoupling. In these cases special attention must be paid to the type, value and ESR of the capacitors selected.
If the transient performance requirements exceed that specified in the data sheet, or the total amount of load capacitance is above 5,500µuF, the selection of output capacitors becomes more important.

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Table 1-1; Input / Output Capacitors

Capacitor Vendor, Type Series (Style)	Capacitor Characteristics					Quantity		
	Working Voltage	Value (uF)	MAX.(ESR) at 100kHz	Max.Ripple at 85°C Current(Irms)	Physical Size(mm)	Input Bus	Output Bus	Vendor Number
Panasonic, Aluminum S/SE (SMD)	6.3V	180	0.005Ω	4000 mA	7.3×4.3×4.2	2	N/R(2)	EEFSE0J181R
Sanyo								
SEPC, Os-con(Radial)	16V	470	0.010Ω	6100 mA	10×13	1	≦1	16SEPC470M
SVP, (SMD)	6.3V	470	0.015Ω	4210 mA	8×11.9	1	≦2	6SVP470M
TPE Poscap (SMD)	6.3V	330	0.025Ω	2400 mA	7.3×4.3	1	≦3	6TPE330ML
AVX, Tantalum								
TPS Series III	10V	470	0.045Ω	1915 mA	7.3L×5.7W	1	≦5	TPSE447M010R0045
S/SE, (SMD)	10V	470	0.100Ω	1432 mA	×4.1H	1	≦5	TPSV447M010R0100
Kermet								
T520, (SMD)	10V	330	0.040Ω	1800 mA	4.3W×7.3L	1	1	T520X337M010AS
T530, (SMD)	10V	330	0.010Ω	>5200 mA	×4.0H	1	≦1	T530X337M010 ASE010
Vishay-Sprague								
595D, Tantalum (SMD)	10	330	0.100	1040 mA		1	≦5	595D377X0010D2T
595D, Tantalum (SMD)	10	330	0.045	2360 mA	7.2L×6W×4.1H	1	≦5	595D377X0016R2T
94SA, Poly-Alum (SMD)	6.3	330	0.025	3500 mA	10×10.5	1	≦3	94SA337X06R3FBP
94SVP, Poly-Alum (SMD)	6.3	470	0.017	3960 mA	8.3×12	1	≦2	94SVP447X06R3E12
Kermet, Ceramic	16V	10	0.002Ω	-	3225mm	1	≦5	C1210C106M4PAC
X5R(SMD)	6.3V	47	0.002Ω		3225mm	1	≦5	C1210C476K9PAC
Murata, Ceramic	6.3V	100	0.002Ω	-	3225mm	1[3]	≦3	GRM32ER60J107M
X5R(SMD)	6.3V	47			3225mm	1[3]	≦5	GRM32ER60J476M
	16V	22				1[3]	≦5	GRM32ER61C226K
	16V	10				1[3]	≦5	GRM32DR61C106K
TDK, Ceramic X5R(SMD)	6.3V	100	0.002Ω	-	3225mm	1[3]	≦3	C3225X5R0J107MT
	6.3V	47			3225mm	1[3]	≦5	C3225X5R0J476MT
	16V	22				1[3]	≦5	C3225X5R1C226MT
	16V	10				1[3]	≦5	C3225X5R1C106MT

(1) ***Capacitor Supplier Verification***

Please verify availability of capacitors identified in this table. Capacitor suppliers may recommend alternative part numbers because of limited availability or obsolete products. In some instances, the capacitor product life cycle may be in decline and have short-term consideration for obsolescence.

RoHS, Lead-free and Material Details

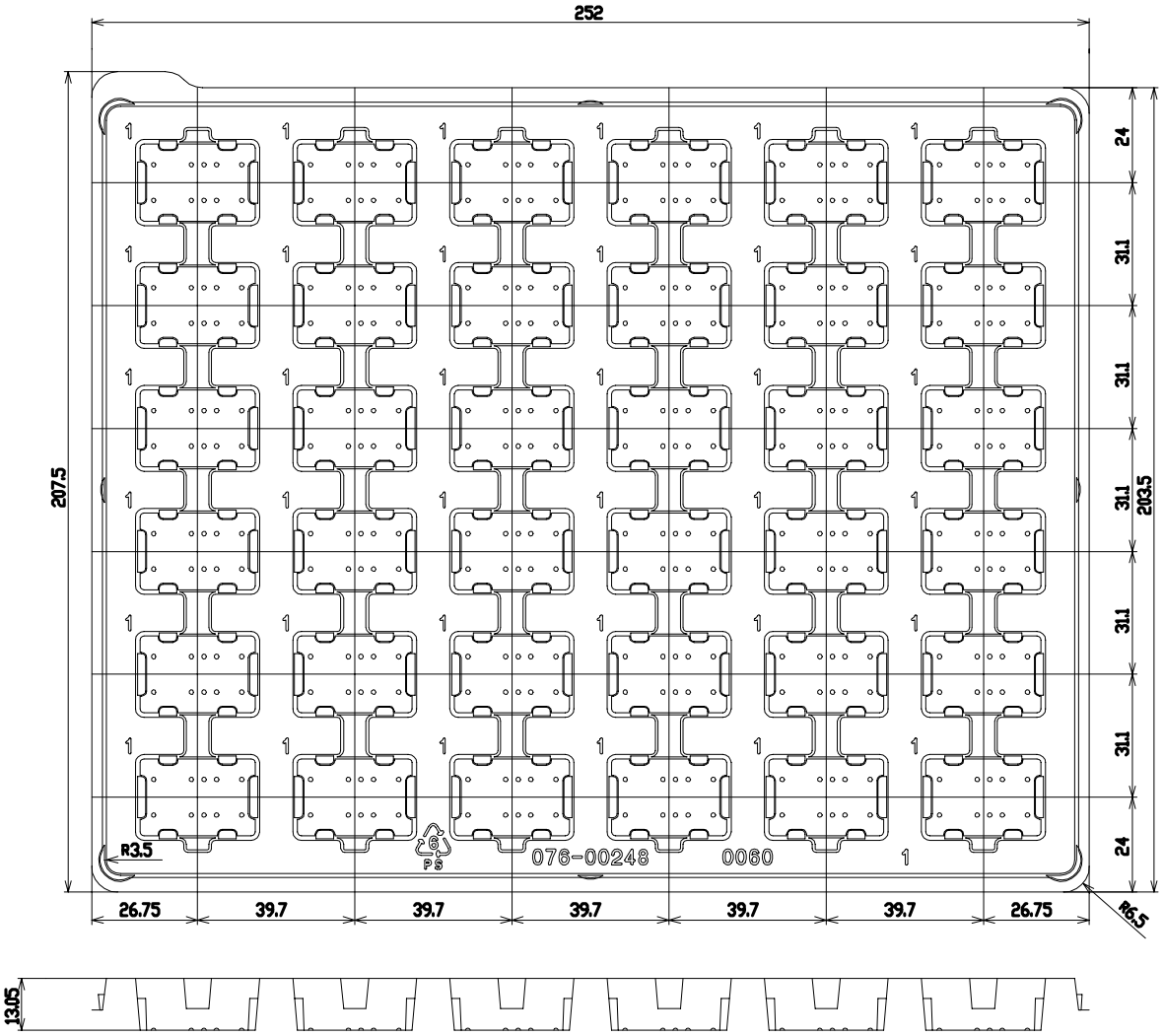
Please consult capacitor suppliers regarding material composition, RoHS status, lead-free status, and manufacturing process requirements. Component designators or part number deviations can occur when material composition or soldering requirements are updated

(2) A total capacitance of 540 µF is acceptable based on the combined ripple current rating.

(3) N/R –Not recommended. The capacitor voltage rating does not meet the minimum derated operating limits.

(4) A ceramic capacitor may be used to compliment electrolytic types at the input to further reduce high-frequency ripple current.

MPDTH03060W & MPDTH05060W



Maximum Pieces per a Tray 36 pcs/(tray)

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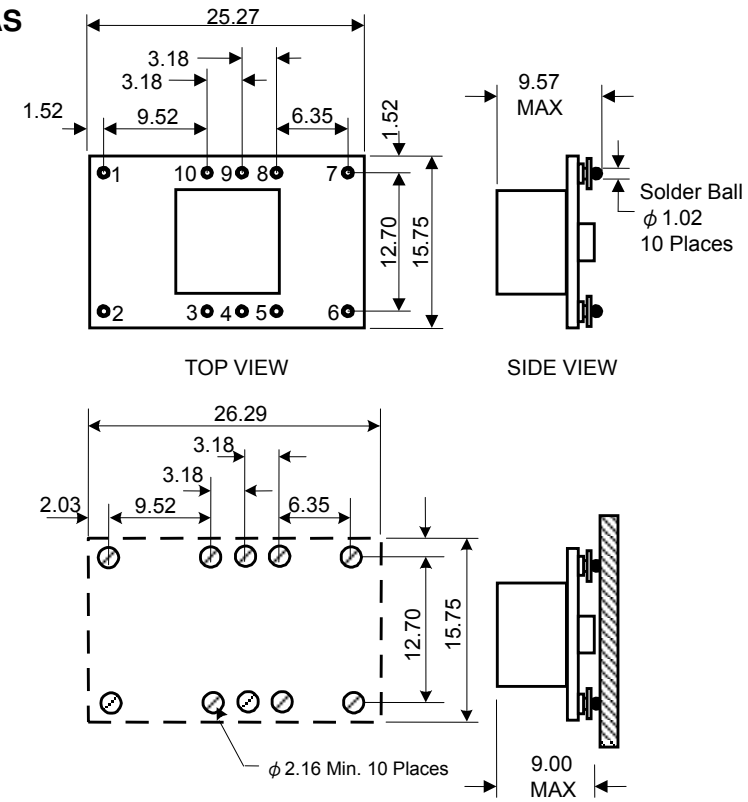
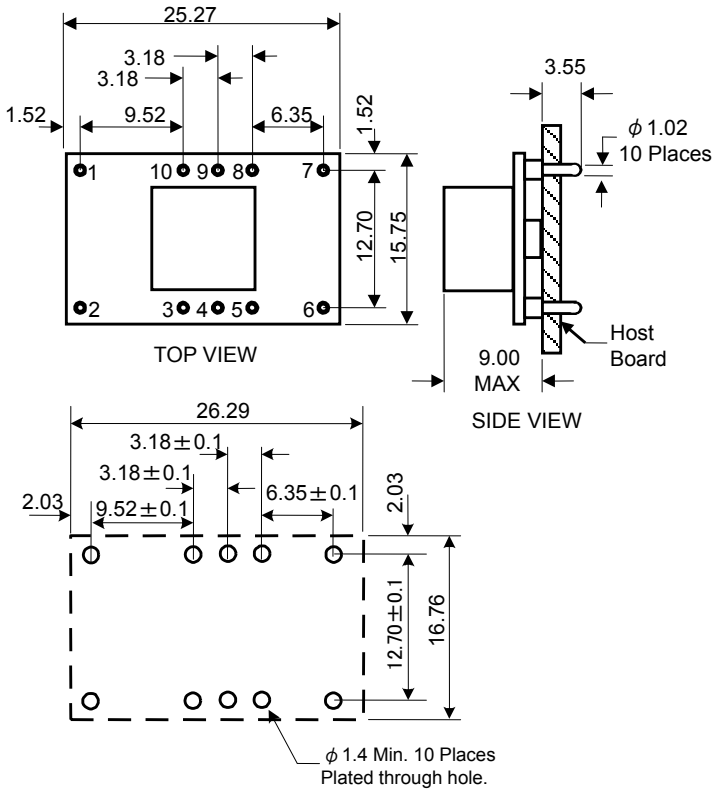
YAS



YAH



Tolerance ±0.25mm

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