

## FEATURES

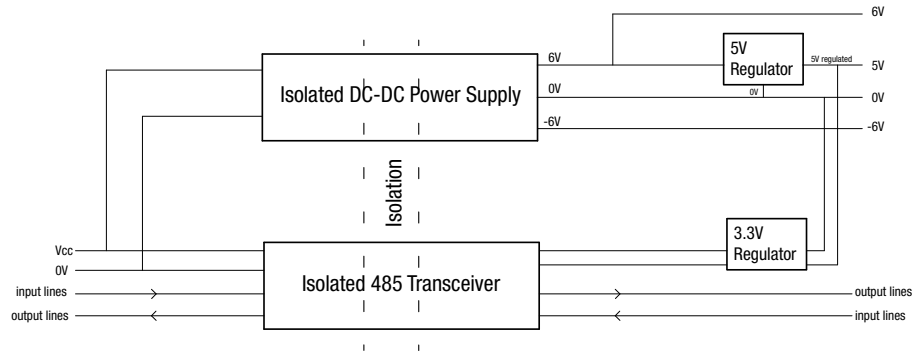
- Patent pending
- ANSI/AAMI ES60601-1, 2 MOPP/1 MOPP recognised
- UL60950 recognised for 250Vrms reinforced insulation
- SMD compatible
- +6V, -6V unregulated and +5V regulated isolated outputs
- Differential driver and receiver
- 500kbps data rate
- Complies with ANSI TIA/EIA RS-485-A-1998 and ISO 8482: 1987(E)
- Industrial temperature range -40°C to +85°C
- Tested at 3000Vac rms 'Hi Pot Test'

## PRODUCT OVERVIEW

The NM485D6S5MC is a low power electrically isolated differential driver and receiver designed for bi-directional data communication or multipoint bus transmission. The device combines a tri-state differential line driver and a differential input line receiver. The driver and receiver have active high and active low enables, respectively, which can be connected together to function as direction control. No external components are needed as a single 5V supply powers all functions either side of the isolation boundary. NM485D6S5MC also provides a regulated 5V, unregulated 6V and -6V isolated supply's for system use.

# NM485D6S5MC

## Isolated RS485 Driver DC-DC



## SELECTION GUIDE

<b>To be discontinued</b>	
Order Code <sup>1</sup>	<b>NM485D6S5MC</b>

## MODULE CHARACTERISTICS

### DRIVER

Parameter	Test conditions	Min.	Typ.	Max.	Units	Symbol
Differential Output Voltages	Loaded $R_L = 100\Omega$ (RS-422), See Figure 1	2.0		3.6	V	$V_{OD}$
	Loaded $R_L = 54\Omega$ (RS-485)	1.5		3.6		
Short Circuit Output Current				250	mA	$I_{OS}$
Complementary Output States	$R_L = 54\Omega$ or $100\Omega$ , see figure 1			0.2	V	$\Delta IV_{OD}$
Common-mode Output Voltages	$R_L = 54\Omega$ or $100\Omega$ , see figure 1			3.0	V	$V_{OC}$
Complementary Output States	$R_L = 54\Omega$ or $100\Omega$ , see figure 1			0.2	V	$\Delta IV_{OC}$
Input Threshold Low		$0.25 \times V_{CC}$			V	$V_{IL}$
Input Threshold High				$0.7 \times V_{CC}$	V	$V_{IH}$
Input Current		-10	+0.01	+10	$\mu A$	$I_I$

### RECEIVER<sup>2</sup>

Parameter	Test conditions	Min.	Typ.	Max.	Units	Symbol
Differential Input Threshold Voltages	$-7V < V_{CM} < +12V$	-200	-125	-30	mV	$V_{TH}$
Input Voltages Hysteresis	$V_{OC} = 0V$		15		mV	$V_{HYS}$
Input Current (A, B)		-100		+125	$\mu A$	$I_I$
Line Input Resistance	$-7V < V_{CM} < +12V$	96			k $\Omega$	$R_{IN}$
Tristate Leakage Current				$\pm 1$	$\mu A$	$I_{OZR}$
Output Voltage Low			0.2	0.4	V	$V_{OLRXD}$
Output Voltage High		$V_{CC} - 0.3$	$V_{CC} - 0.2$		V	$V_{OHRXD}$
Short-Circuit Current				100	mA	
Common-Mode Transient Immunity	$V_{CM} = 1 kV$ , transient magnitude = 800V	25			KV/ $\mu S$	



For full details go to <https://www.murata.com/en-global/products/power/rohs>

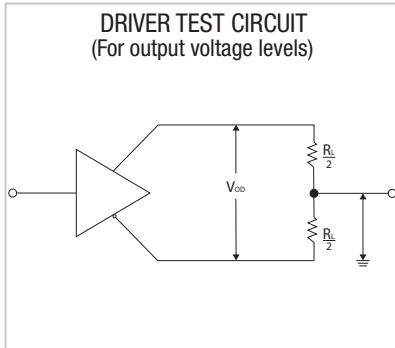


1. Components are supplied in tape and reel packaging, please refer to tape and reel specification section. Orderable part numbers are NM485D6S5MC-R7 (80 pieces per reel), or NM485D6S5MC-R13 (350 pieces per reel).  
 2.  $V_{CM}$  is the common-mode potential difference between the logic and bus sides. The transient magnitude is the range over which the common mode is slewed. The common-mode voltage slew rates apply to both rising and falling common-mode voltage edges.  
 All specifications typical at  $T_A = 25^\circ C$ , nominal input voltage and rated output current unless otherwise specified.

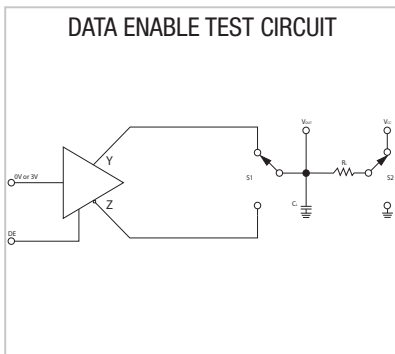
TIMING SPECIFICATIONS						
Parameter	Test conditions	Min.	Typ.	Max.	Units	Symbol
<b>Driver</b>						
Propagation Delay	$R_L = 54\Omega, C_{L1} = C_{L2} = 100\text{ pF}$ see figure 2 & 6	250		700	ns	$t_{DPLH}, t_{DPLH}$
Differential Driver Output Skew	$R_L = 54\Omega, C_{L1} = C_{L2} = 100\text{ pF}$ see figure 2 & 6			100	ns	$T_{DSKEW}$
Rise Time/Fall Time	$R_L = 54\Omega, C_{L1} = C_{L2} = 100\text{ pF}$ see figure 2 & 6	200	450	1100	ns	$T_{DR}, T_{DF}$
Enable Time	$R_L = 110\Omega, C_{L1} = 50\text{ pF}$ see figure 4 & 7			1.5	$\mu\text{s}$	$T_{ZL}, T_{ZH}$
Disable Time	$R_L = 110\Omega, C_{L1} = 50\text{ pF}$ see figure 4 & 7			200	ns	$T_{LZ}, T_{HZ}$
<b>Receiver</b>						
Propagation Delay	$C_{L1} = 15\text{ pF}$ see figure 3 & 8			200	ns	$T_{PLH}, T_{PHL}$
Pulse Width Distortion	$C_{L1} = 15\text{ pF}$ see figure 3 & 8			30	ns	$T_{PWD}$
Enable Time	$R_L = 1\text{ k}\Omega, C_{L1} = 15\text{ pF}$ see figure 5 & 9			13	ns	$T_{ZL}, T_{ZH}$
Disable Time	$R_L = 1\text{ k}\Omega, C_{L1} = 15\text{ pF}$ see figure 5 & 9			13	ns	$T_{LZ}, T_{HZ}$

ABSOLUTE MAXIMUM RATINGS	
Supply voltage $V_{CC}$ with respect to pin 11	6V
Bus Terminal Voltages	-9V to +14V
Logic Terminal Voltage	-0.5V to $V_{CC} + 0.5\text{V}$
Data transmission rate	500Kbps

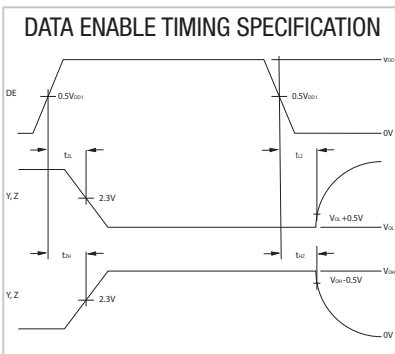
**FIGURE 1**



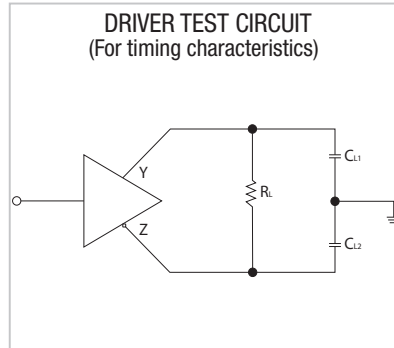
**FIGURE 4**



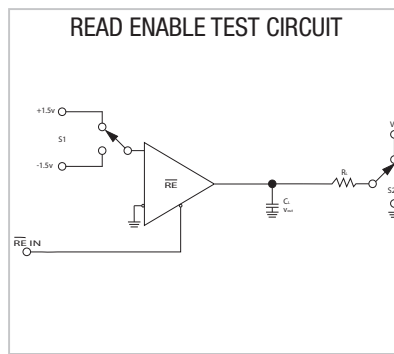
**FIGURE 7**



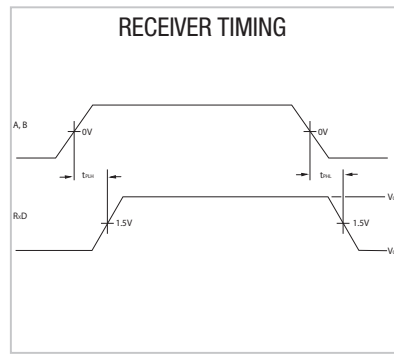
**FIGURE 2**



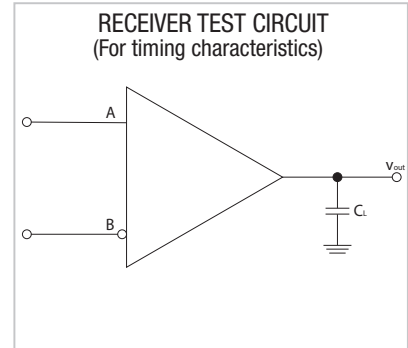
**FIGURE 5**



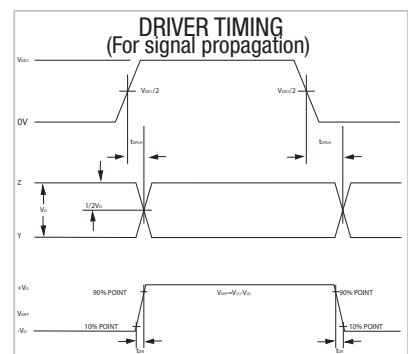
**FIGURE 8**



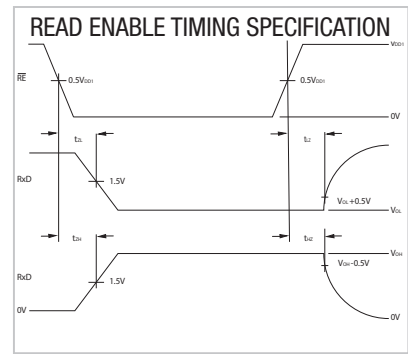
**FIGURE 3**



**FIGURE 6**



**FIGURE 9**



### DC-DC CHARACTERISTICS

#### INPUT CHARACTERISTICS

Parameter	Test conditions	Min.	Typ.	Max.	Units
Voltage range	Continuous operation	4.5	5	5.5	V
Input reflected ripple current	5V Input		6		mA pk-pk

#### OUTPUT CHARACTERISTICS

Parameter	Test conditions	Min.	Typ.	Max.	Units
Output voltage spec (The maximum current share across all outputs is 160mA.)	5V Output regulated (0mA to 80mA)	4.92	5	5.08	V
	+6V Unregulated (16mA to 160mA)	5.4	6	6.6	
	-6V Unregulated (16mA to 160mA)	-6.6	-6	-5.4	
Line regulation			1.1	1.2	%%
Load regulation			5	8	%
Ripple and noise			25	50	mV
Power	5V Regulated			0.4	W
	Total available power across all outputs			0.8	

#### TEMPERATURE CHARACTERISTICS

Parameter	Test conditions	Min.	Typ.	Max.	Units
Operation	See derating graph	-40		85	°C
Storage		-50		125	
Product temperature rise above ambient	Measured in the isolation barrier		20	30	

#### ISOLATION CHARACTERISTICS

Parameter	Test conditions	Min.	Typ.	Max.	Units
Isolation test voltage	Production tested for 1 Second	3000			VACrms
	Qualification tested for 1 minute	3000			VACrms
Isolation capacitance			5		pF
Resistance	Viso = 1kVDC	10			GΩ

#### GENERAL CHARACTERISTICS

Parameter	Test conditions	Min.	Typ.	Max.	Units
MTTF - nominal input voltage at full load	MIL-HDBK-217 FN2		800		kHrs
	Telcordia SR-332		10000		kHrs
Switching frequency			95		kHz

**TECHNICAL NOTES**

**ISOLATION VOLTAGE**

'Hi Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' & 'Isolation Test Voltage' are all terms that relate to the same thing, a test voltage, applied for a specified time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NM485D6S5MC is 100% production tested at 3kVAC rms for 1 second and have been qualification tested at 3kVAC rms for 1 minute.

The NM485D6S5MC has been recognised by Underwriters Laboratory to 250Vrms reinforced insulation.

**REPEATED HIGH-VOLTAGE ISOLATION TESTING**

It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The NM485D6S5MC has toroidal isolation transformers, with no additional insulation between primary and secondary windings of enamelled wire. While parts can be expected to withstand several times the stated test voltage, the isolation capability does depend on the wire insulation. Any material, including this enamel (typically polyurethane) is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. This consideration equally applies to agency recognised parts rated for better than functional isolation where the wire enamel insulation is always supplemented by a further insulation system of physical spacing or barriers.

**SAFETY APPROVAL**

**ANSI/AAMI ES60601-1**

The NM485D6S5MC has been recognised to ANSI/AAMI ES60601-1 and provides 1 MOPP (Means Of Patient Protection) and 2 MOOP (Means Of Operator Protection) based upon a working voltage of 250Vrms max, between Primary and Secondary.

**UL 60950**

The NM485D6S5MC has been recognised by Underwriters Laboratory (UL) to UL 60950 for reinforced insulation to a working voltage of 250Vrms.

Creepage is 5mm and clearance is 4mm.

**FUSING**

The NM485D6S5MC is not internally fused so to meet the requirements of UL an anti-surge input line fuse should always be used with ratings as defined below.

NM485D6S5MC - 1A

All fuses should be UL recognised and rated to at least the maximum allowable DC input voltage.

**RoHS COMPLIANCE, MSL AND PSL INFORMATION**



The NM485D6S5MC is compatible with Pb-Free soldering systems and is also backward compatible with Sn/Pb soldering systems. The NM485D6S5MC has a process, moisture, and reflow sensitivity classification of MSL2 PSL R7F as defined in J-STD-020 and J-STD-075. This translates to: MSL2 = 1 year floor life, PSL R7F = Peak reflow temperature 245°C with a limitation on the time above liquidus (217°C) which for this series is 90sec max. Please refer to [application notes](#) for further information. The pin termination finish on this product series is Gold with Nickel Pre-plate.

**APPLICATION NOTES**

The increased use of balanced data transmission lines, (distributing data to several system components and peripherals over relatively long lines) has brought about the need for multiple driver/receiver combinations on a single twisted pair line. This resulted in an upgraded version of EIA RS-422, named EIA-485. EIA-485 takes into account EIA RS-422 requirements for balanced line data transmission, and allows for multiple drivers and receivers.

The NM485D6S5MC is a low power isolated differential interface providing EIA-485 compatibility. The use of a differential communications interface such as the NM485D6S5MC allows data transmission at high rates and over long distances to be accomplished. This is because effects of external noise sources and cross talk are much less pronounced on the data signal. Any external noise source coupling onto the differential lines will appear as an extra common mode voltage which the receiver is insensitive to. The difference between the signal levels on the two lines will therefore remain the same. Similarly a change in the local ground potential at one end of the line will appear as just another change in the common mode voltage level of the signals. Twisted pair cable is commonly used for differential communications since its twisted nature tends to cause cancellation of the magnetic fields generated by the current flowing through each wire, thus reducing the effective inductance of the pair.

Computer and industrial serial interfacing are areas where noise can seriously affect the integrity of data transfer, and a proven route to improve noise performance for any interface system is galvanic isolation. Galvanic isolation removes the ground loop currents from data lines and hence the impressed noise voltage which affects the signal is also eliminated. The isolation feature of the NM485D6S5MC also means that common mode noise effects are removed and many forms of radiated noise are reduced to negligible limits.

Truth table for NM485 functionality				
DE	RE	RxD	Y	Z
0	0	≈A	Hi Z	Hi Z
0	1	Hi Z	Hi Z	Hi Z
1	0	≈A	≈Txd	≈Txd
1	1	Hi Z	≈Txd	≈Txd

Hi Z = High impedance tri state

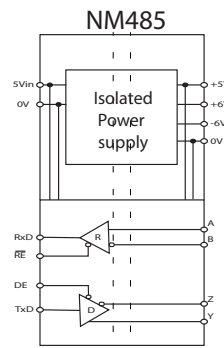
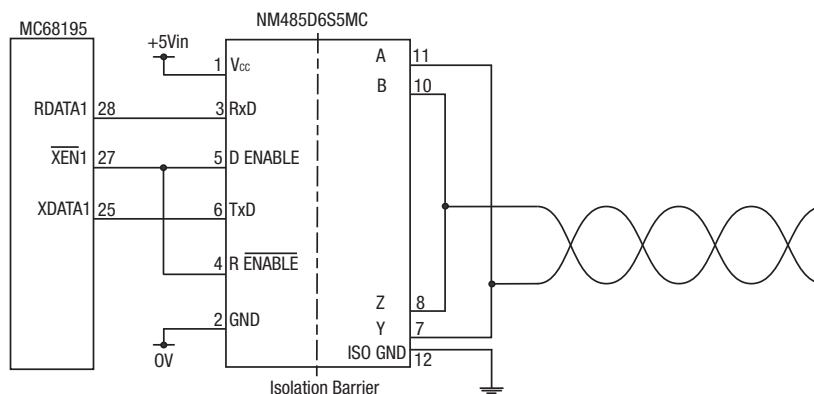


Figure 10 demonstrates how the differential lines of the NM485D6S5MC can be connected to form a transceiver. Data direction is controlled by the driver enable and receiver enable pins. This means the device can receive when the receiver enable is low and transmit when the driver enable is high. As the driver is active high, to reduce the power dissipation even further, it is advisable to disable the driver when not transmitting data.

**Configuring the NM485D6S5MC as a transceiver**

The NM485D6S5MC is configured as a transceiver simply by connecting B to Z, A to Y and D ENABLE to R ENABLE. The system then writes data to the bus when XEN1 is high ( with read disabled) and reads data from bus when XEN1 is low ( with write disabled).

**FIGURE 10**



**Minimum load**

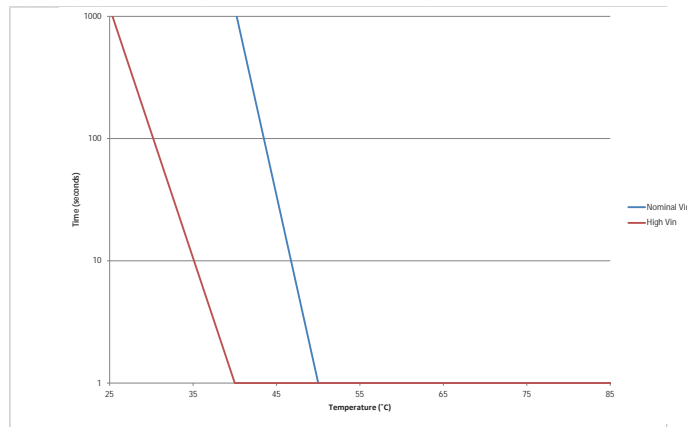
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

**APPLICATION NOTES (Continued)**

**Short Circuit Performance**

The NM485D6S5MC offers short circuit protection at low ambient temperatures from -40°C to the temperatures shown in the below graph, when the output power lines are shorted together or to GND.

For datalines the device has current-limiting and thermal shutdown features to protect against output short circuits and situations where bus contention causes excessive power dissipation.

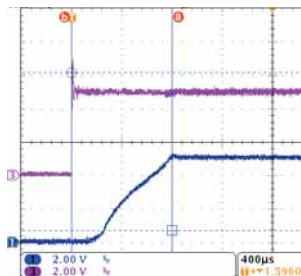


**Capacitive Loading & Start Up**

Typical start up times for this series, with a typical input voltage rise time of 2.2µs and output capacitance of 10µF, are shown in the table below. The product series will start into a capacitance of 47µF with an increased start time of 4.6ms

	Start-up time ms
NM485D6S5MC	1.6

Typical Start-Up Wave Form



**APPLICATION NOTES (Continued)**

**Typical applications**

Figure 11 and Figure 12 show typical applications of half-duplex and full-duplex RS-485 network configurations. Up to 256 transceivers can be connected to the RS-485 bus. To minimize reflections, the line must be terminated at the receiving end in its characteristic impedance and stub lengths off the main line must be kept as short as possible. For half-duplex operation, this means that both ends of the line must be terminated as either end can be the receiving end. The NM485D6S5MC series offers a triple supply (+5V, +6V, -6V) which can be used to power system circuitry.

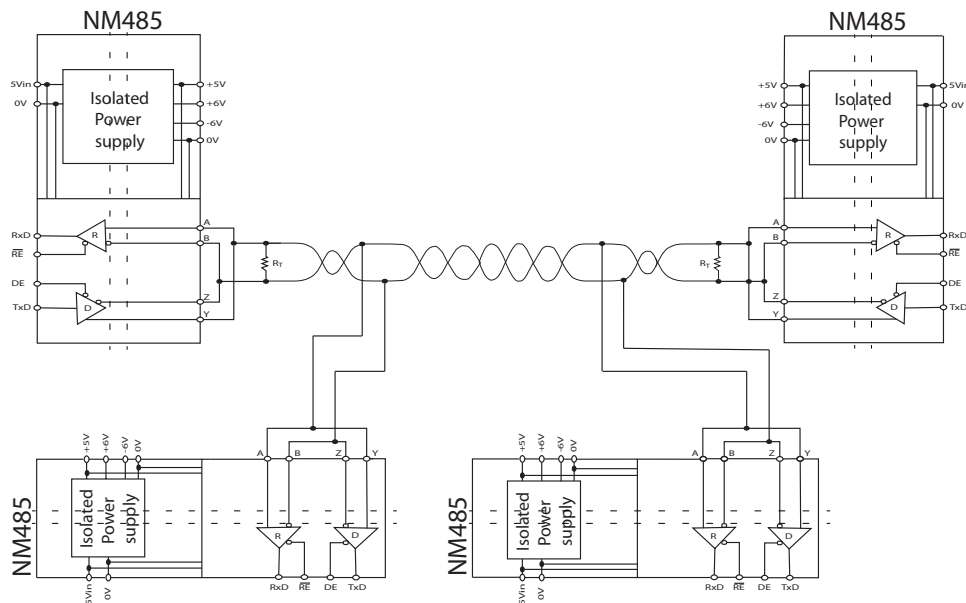


Figure 11. Typical Half-Duplex RS-485 Network

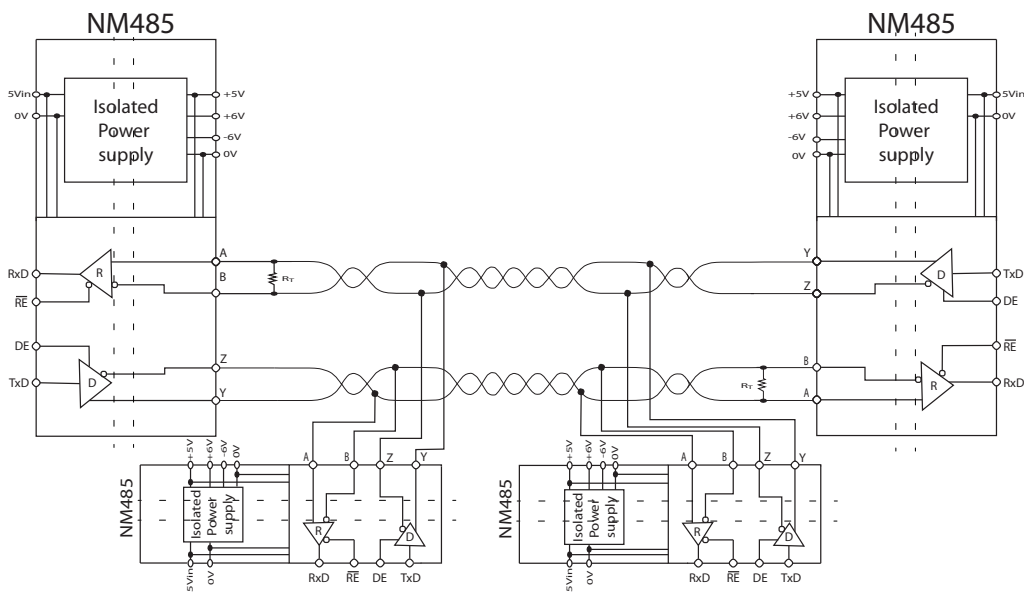
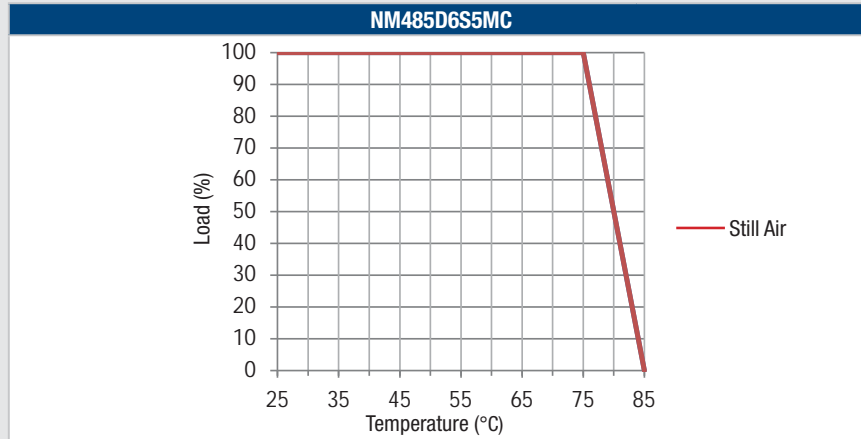


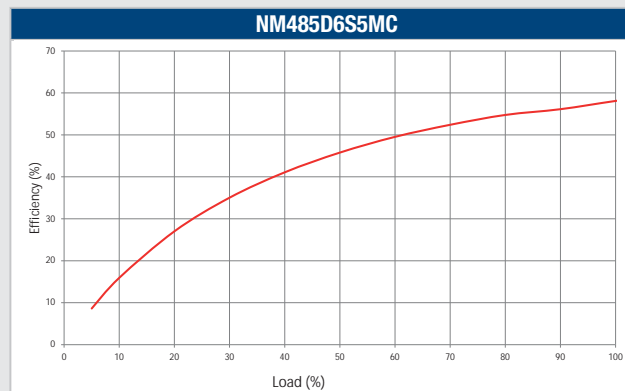
Figure 12. Typical Full-Duplex RS-485 Network



## DERATING GRAPHS

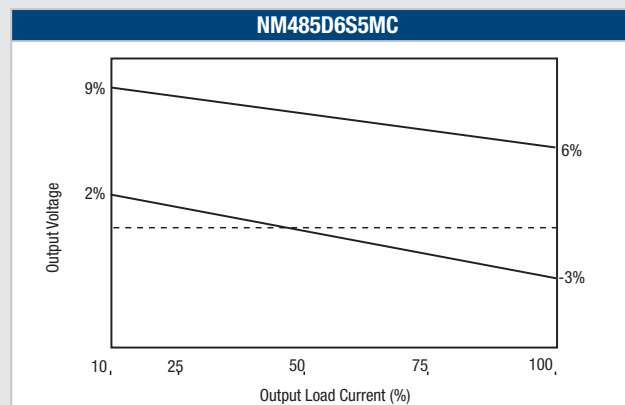


## EFFICIENCY VS LOAD GRAPH



## TOLERANCE ENVELOPE

The voltage tolerance envelope show typical load regulation characteristics for the NM485D6S5MC. The tolerance envelope is the maximum output voltage variation due to changes in output loading and set point accuracy.

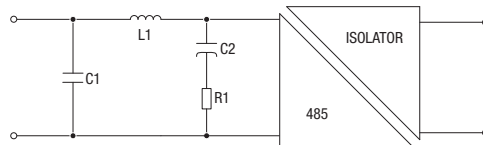


**EMC FILTERING AND SPECTRA**

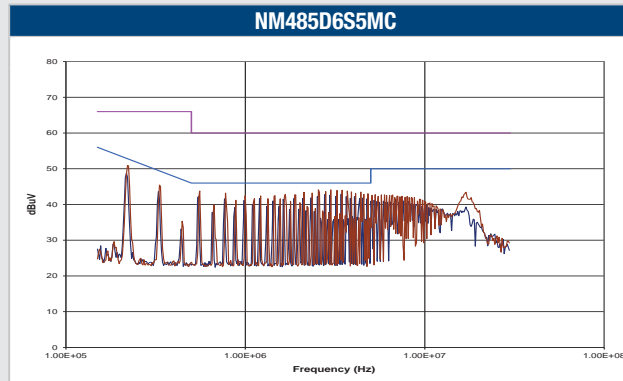
**FILTERING**

The following filter circuit and table shows the input capacitor and input inductor typically required to meet EN55022 Curve A and B, Quasi-Peak EMC limit, as shown in the following plot. The following plot shows positive and negative quasi peak and CISPR22 Average Limit A (pink line) and CISPR22 Average Limit B (blue line) adherence limits.

**C1** 63V Polycarbonate capacitor

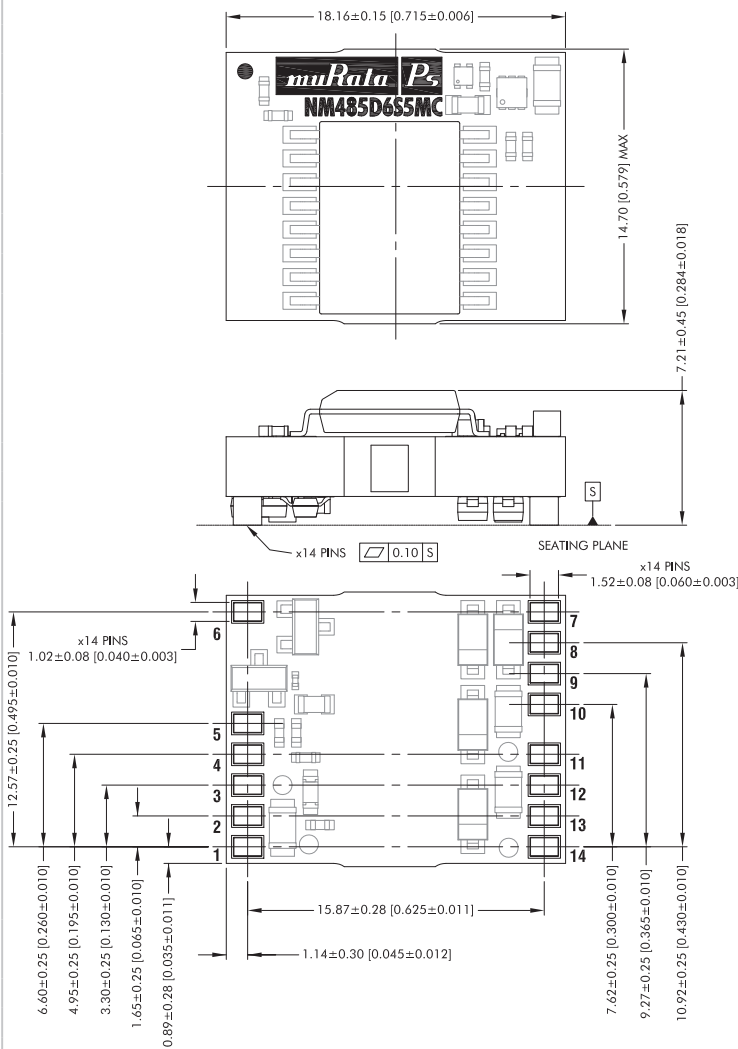


Part Number	Inductor		Capacitor
	L1	Murata Part Number	C1
NM485D6S5MC	22μH	23220C	2.2μF



**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**



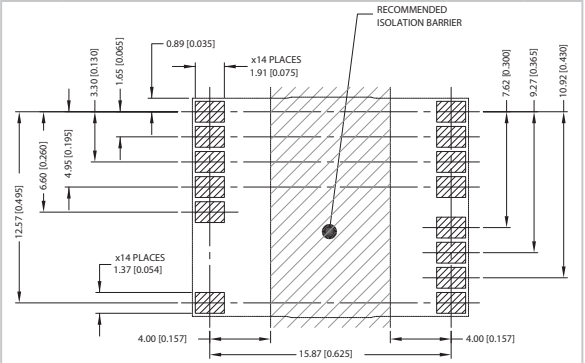
All dimensions in mm (inches), Controlling dimensions is mm.  
Component layout is shown for reference only.

Weight: 2.88g

**PIN CONNECTIONS**

Pin	Function
1	5VIN
2	GND
3	RXD
4	RE
5	DE
6	TXD
7	Y
8	Z
9	-6V
10	B
11	A
12	GND
13	+6V
14	5V REG

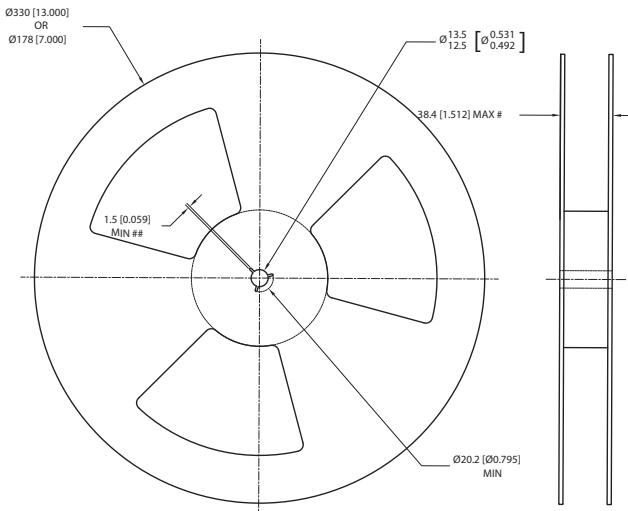
**RECOMMENDED FOOTPRINT DETAILS**



All dimensions in mm (inches), Controlling dimensions is mm.

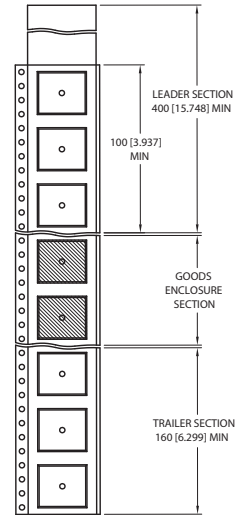
**TAPE & REEL SPECIFICATIONS**

**REEL OUTLINE DIMENSIONS**



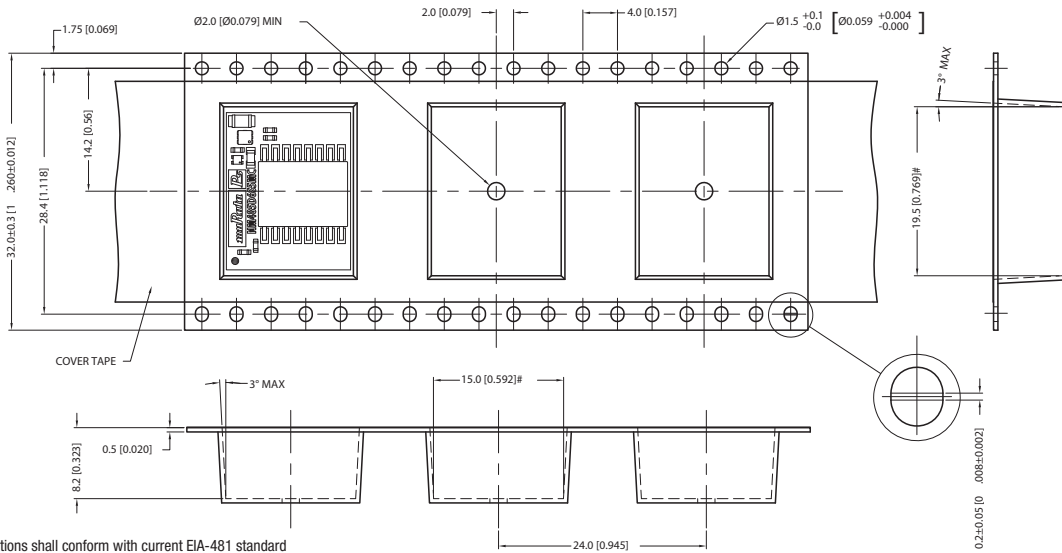
Tape & Reel specifications shall conform with current EIA-481 standard  
 Unless otherwise stated all dimensions in mm(inches)  
 Controlling dimension is mm  
 # Measured at hub  
 ## Six equi-spaced slots on 180mm/7" reel

**REEL PACKAGING DETAILS**



Carrier tape pockets shown are illustrative only - Refer to carrier tape diagram for actual pocket details.  
 Reel Quantity: 7" - 80 or 13" - 350

**TAPE OUTLINE DIMENSIONS**



Tape & Reel specifications shall conform with current EIA-481 standard  
 Unless otherwise stated all dimensions in mm(inches) ±0.1mm (±0.004 inches)  
 Controlling dimension is mm  
 Components shall be orientated within the carrier tape as indicated  
 # Measured on a plane 0.3mm above the bottom pocket

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- Power plant control equipment
- Medical equipment
- Transportation equipment ( automobiles, trains, ships, etc.)
- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Data Processing equipment

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